VERDE INTEGRATED GROUNDWATER AND SURFACE WATER MODEL

ABOUT THE MODEL

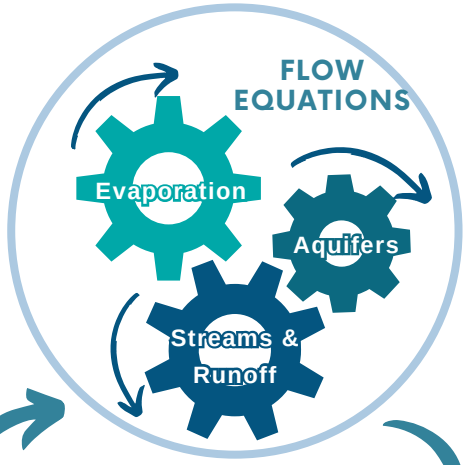
THE BASICS

Hydrologic models help us understand what we can't see - like aquifers - and can test the effects of different stresses on the natural system. Models can show simplified scenarios of the future.

In contrast to widely used but much simpler groundwater models, this MIKE SHE model crunches large amounts of observed real-time data, including weather, data from nearly 2,000 wells, and new information about geologic layers. MIKE SHE permits simultaneous and interactive simulations of climate-driven surface flows, infiltration and groundwater recharge, groundwater flow, groundwater-surface water interactions, vegetative water use (transpiration), and evaporation from moist soils, open water, and snowpack.

NUMERICAL MODEL

Data is entered into the model ("input") and it runs through "flow equations" that simulate natural processes like evaporation and aquifer recharge. The "output" contains results that can be used to inform management decisions.



INPUT

Observed weather
Stream flow
Pumping
Diversion rules
Vegetation
Aquifer properties
Topography
Soils

OUTPUT

Predicted groundwater levels
Stream flow
Evaporative consumption
Water balance

STORY OF THE MODEL

The Yavapai-Apache Nation (YAN) and The Nature Conservancy (TNC) have successfully concluded a collaborative effort to run simulations with innovative new modeling tools, which shed light on balancing water demand with a healthy, flowing Verde River. Funded through an Applied Science Grant from the U.S. Bureau of Reclamation, this participatory process brought together diverse Verde Valley stakeholders through a series of 5 workshops to ensure that the resulting tools are scientifically robust, widely accepted, and aligned with the needs of local communities.

MANAGEMENT IMPLICATIONS

Models can help us understand things we can't see and test the effects of different stresses. These simulations used dramatic but isolated stresses for demonstration purposes, but in real life, different stresses will overlap and compound. We don't know exactly how things will change in the future, but starting to plan now will increase resiliency. This section highlights the modeling results that could impact water management priorities.

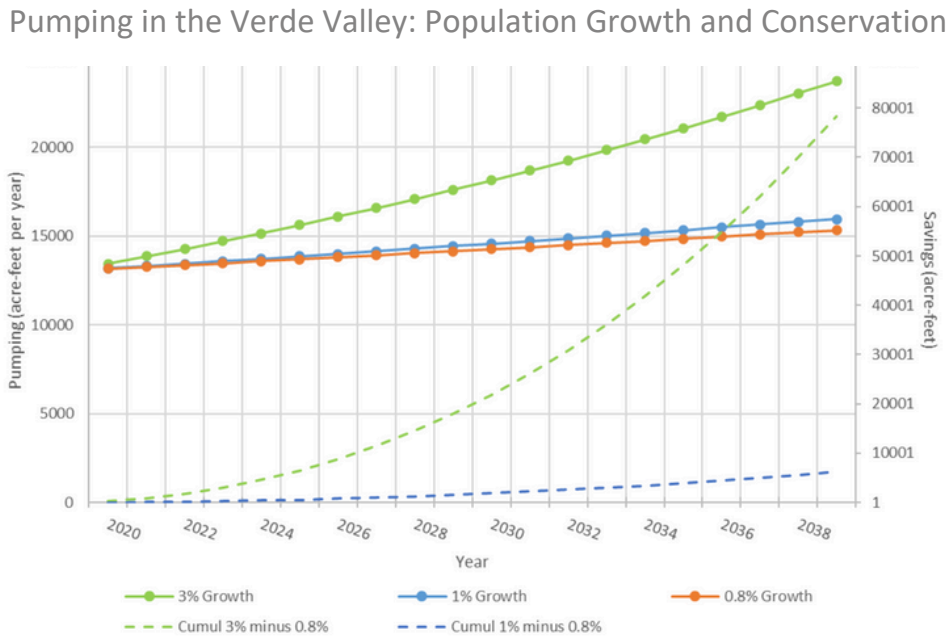
IMPORTANCE OF TRIBUTARIES

When the Verde River is low, flows are supported by Oak Creek and other tributaries. This highlights the importance of protecting all streams from pumping impacts to ensure streams continue to provide this benefit.

MANAGEMENT IMPLICATIONS

WATER CONSERVATION

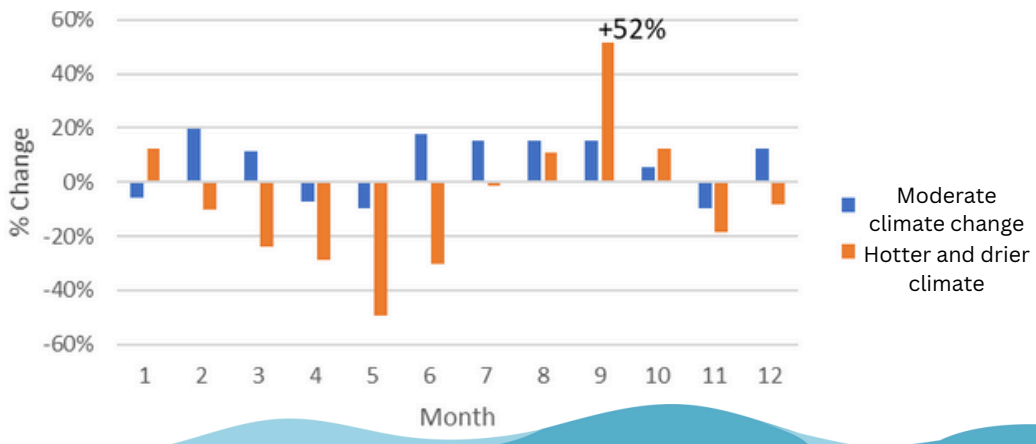
Higher levels of growth could have large impacts on the aquifer. However, high levels of conservation can reduce this impact. These benefits accumulate over time.



Left: Annual pumping rates for different levels of population growth (3%, 1% and 0.8%) are shown with solid lines. The dashed lines represent potential groundwater savings over time that could be achieved by reducing pumping rates with 3% and 1% population growth through water conservation efforts.

FLOODING AND CLIMATE EXTREMES

Even in a hotter and drier climate scenario, flooding and erosion risk is high. Runoff increased in the wettest months like September because of more concentrated storms and more deep recharge in the high country with less frozen soils. Dry months are also drier than normal.



MANAGEMENT STRATEGIES

PROTECT & ENHANCE FLOWS

- Conserve the Big Chino Aquifer
- Secure strategic conservation easements in the watershed
- Protect tributaries from pumping
- Overcome barriers to enhancing flows with reclaimed water

STORMWATER & FLOOD CONTROL

- Build green stormwater infrastructure to passively slow and collect runoff
- Collaborate on regional flood control projects

HIGH DENSITY DEVELOPMENT

- Coordinate on water adequacy model
- Prioritize water conservation ordinances and codes
- Educate the public about the benefits of high density development on water use

INFORMED WATER MANAGEMENT

NEW IDEAS FOR A RESILIENT WATERSHED

Municipal and non-government stakeholders generated these regional and local water management strategies at a workshop and in subsequent discussions. Their discussions were informed by model results.

WATER CONSERVATION INCENTIVES

- Research water rates that incentivize water conservation
- Participate in regional partnerships & efforts
- Coordinate water conservation messaging

GROUNDWATER RECHARGE

- Identify aquifer recharge locations to increase storage, benefit riparian areas, and offset pumping
- Identify data gaps to better track groundwater levels

RECLAIMED WATER

- Prioritize shared systems to increase collection and production
- Aquifer recharge and potable reuse

This informational handout was prepared by Southwest Decision Resources. The model was created and run by Lacher Hydrological Consulting and Integrated Hydrological Systems. The Nature Conservancy and Yavapai-Apache Nation co-own the model and co-convened the project.