Climate and Groundwater Supply in the Santa Ana River Watershed

SAWPA

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Key Findings

- Groundwater currently provides approximately 54% of total water supply in an average year, and groundwater use is projected to increase over the next 20 years.
- Projected decreases in precipitation and increases in temperature will decrease natural recharge throughout the basin.
- Management actions such as reducing municipal and industrial water demands or increasing trans-basin water imports will be required in order to maintain current groundwater levels.
- A basin-scale groundwater screening tool was developed to facilitate analysis of basin-scale effects of conservation, increasing imported supply, changing agricultural land use, and other factors on basin-scale groundwater conditions.

Additional Considerations

- Basin-scale groundwater conditions are an important consideration in basin management; however, local-scale groundwater conditions must be considered in evaluating individual projects.
- The groundwater screening tool does not reflect physical constraints on groundwater use, including the usable amount of groundwater available and decreases in pumping as groundwater levels decline.

Results

Will climate change reduce groundwater availability in the Santa Ana watershed?

Future groundwater availability in the Santa Ana watershed will depend on future recharge from precipitation, stream seepage, and managed infiltration facilities, as well as future groundwater withdrawals to for municipal, industrial, and agricultural uses. A groundwater screening tool was developed to evaluate changes in basin-scale groundwater conditions under climate change. Projected increases in temperature and decreases in precipitation will result in increased water demands and decreased groundwater recharge, respectively. Management actions will be required to protect groundwater resources under projected future climate conditions.

Figure 1 illustrates the observed range of basin-averaged groundwater levels in the Orange County groundwater basin for 1990-2009, along with simulated groundwater levels under projected climate conditions. In the absence of groundwater management actions, groundwater levels are projected to decline significantly over the 21st century. It should be noted that projected declines are not constrained by the physical limits of the aquifer—i.e., projected declines may exceed the actual amount of usable groundwater in the basin.

The groundwater screening tool can be used to evaluate potential deficiencies in future supplies and to develop sustainable management alternatives. As an example, potential actions to avoid projected water level declines in Orange County are listed below. Each of the alternatives listed will protect against groundwater declines through 2060. The groundwater screening tool can be used to develop and compare additional management alternatives.

Projected Impacts of Climate Change on Orange County

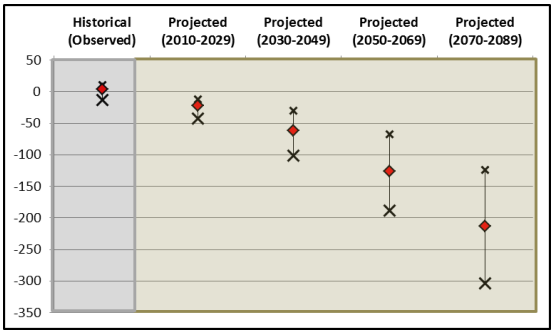

Figure 1 - Range of observed and simulated basin-averaged groundwater elevations for 1990-2009 and projected groundwater elevations for future periods assuming no management action to avoid groundwater deficits

Groundwater Management Alternatives to Offset Projected Impacts of Orange County Groundwater

- **Reduce M&I demand**
  Gradual reduction of approx. 15% by 2020 (i.e., reduce per capita use from ~175 gpd in 2010 to ~150 gpd by 2020)
- **Increase imports from Colorado River and SWP**
  Gradual increase in water imports from Colorado River and SWP from ~30,000 AF/yr to ~105,000 AF/yr by 2020 (this may not be feasible due to cost, greenhouse gas emissions, or availability)
- **Increase local water supplies**
  Increase local water supplies by ~75,000 AF/yr through increasing recycled water treatment capacity, development of seawater desalination capacity, and increase storm water capture efficiency

Methods

A basin-scale groundwater screening tool was developed to facilitate evaluation of basin-averaged groundwater elevations under projected future climate conditions. The tool uses a multiple regression approach to estimate fluctuations in basin-averaged groundwater elevations in response to natural and anthropogenic drivers, including climate and hydrologic conditions, agricultural land use, municipal water demand, and trans-basin water imports. The tool allows users to quickly calibrate a regression model for a basin of interest, estimate basin-scale groundwater conditions under future scenarios, and compare management alternatives to protect groundwater resources under climate change.

Link to full technical report—http://www.usbr.gov/lc/socal/basinstudies/OWOW.html