



## Frequently Asked Questions

### What is the U.S. Geological Survey and why was it asked to create a groundwater model for northern Arizona?

The U.S Geological Survey (USGS) is a non-regulatory Federal science agency that provides impartial information on the Nation's natural resources. The science conducted by the USGS benefits the public by providing information for making resource-management decisions.

After securing project funding in 1999, the Arizona Department of Water Resources (ADWR) asked the USGS to develop a regional groundwater-flow model for the north-central part of the State. In making this request, "the Department was fully aware of the capability of the USGS to develop an unbiased model that would improve understanding of the groundwater system and ultimately management of the region's water resources," according to Thomas G. Whitmer, ADWR's Manager of Statewide Water Planning.

### What is the Northern Arizona Regional Groundwater-Flow Model?

The Northern Arizona Regional Groundwater-Flow Model, or NARGFM, is a computer model of the interconnected aquifers in central and northern Arizona that simulates how natural recharge from precipitation and snowmelt as well as human-caused recharge move through the region's aquifers and eventually provide water to rivers, streams, springs, and wells.

### How can the model be used?

NARGFM was developed to help communities and resource managers assess the adequacy of the regional groundwater supply and potential effects of increased groundwater use on water levels, streamflow, and riparian vegetation. The model also can be used to evaluate impacts of artificial recharge and climate change. Appropriate applications of the model include a variety of questions involving one or more wells or recharge facilities in a sub-basin; however, the use of the model for site-scale investigations may require additional data to better define the local hydrogeology. An important potential use of the model is to help focus future data-collection efforts and investigations to better understand groundwater resources in the region.

### How was the model created?

NARGFM builds on three previous studies completed by the USGS that focus on groundwater resources in northern and central Arizona undertaken as part of ADWR's

Rural Watershed Initiative. USGS hydrologists with Arizona Water Science Center compiled available data on a range of characteristics (geologic units, water levels, groundwater flow to streams and springs, among others) to develop a conceptual groundwater-flow model. MODFLOW, a computer program developed by the USGS to model groundwater, was used to simulate the groundwater-flow system of the region on the basis of how the system was understood to work (that is, the conceptual groundwater-flow model). The model was then adjusted to ensure the simulated results reasonably approximated measured data for the period of groundwater development that generally began in 1938. The simulation includes changes that occurred to the system through 2005.

Additionally, the USGS worked with the Arizona Department of Water Resources and local stakeholders during the development processes to gather needed information and secure local input. This process was designed to ensure the model reasonably represents the groundwater-flow system and meets the needs of resource managers.

Finally, the model and report were subjected to independent peer review, whereby experts in the field evaluated the appropriateness of the assumptions and data used to create the model.

### What are the model's limitations?

The accuracy of a groundwater-flow model is dependent on the quantity and quality of available data and how complete the flow system is understood. NARGFM was developed using information collected by previous investigations and ongoing data-collection activities. Because data were lacking or the understanding of the groundwater-flow system in some areas was incomplete, the model uses several simplifications or approximations of the system, as do all groundwater models. NARGFM can be improved with additional data collection and investigation. Critical information needed to improve the model includes long-term repeated measurements of groundwater levels and streamflow; these measurements document the response of the groundwater system to changes in pumping and recharge. Use of the model for site-scale investigations may require additional data to better define the local hydrogeology

### What training or expertise is needed to use the model?

Use of the model requires understanding of groundwater hydrology and computer modeling.

### What is the study area considered by the model?

The study area primarily covers northern and central Arizona, but includes adjacent parts of western New Mexico and southern Utah. In Arizona, the study area encompasses Apache, Coconino, Gila, Mohave, Navajo, and Yavapai Counties. The study includes the watersheds of the Verde, Salt, Little Colorado, and Colorado Rivers.

## Why is groundwater important?

Groundwater is the predominant source of water for the study area's estimated 550,000 residents in Arizona.

## Does the model change Arizona water law?

Like many previous groundwater models developed for portions of Arizona, NARGFM is a tool that helps communities and resource managers examine the hydrologic effects of various groundwater development and climate variation scenarios. These models do not change existing laws and regulations.

## What are predicted effects of proposed pumping on streams, springs, and rivers?

Predicted effects of proposed pumping were not part of the original model development. The purpose of the model report is to document the model construction and simulation of the system up through 2005 and to allow general availability of the model to help answer such questions. Some of the effects of past groundwater pumping were simulated including reductions in groundwater levels and discharge to Del Rio Springs near Prescott and to Chevelon Creek near Winslow, Arizona. The model also simulates variations in spring discharge and stream baseflow resulting from dryer and wetter than normal periods in the 20<sup>th</sup> century. The model also was used to study, in a general sense, how pumping locations in the Verde Valley, Arizona, might affect streamflow for different periods of pumping. Results of that investigation can be found at web site <http://pubs.usgs.gov/fs/2010/3108/fs2010-3108.pdf>.

## How can I get additional information about the model?

If you would like additional or updated information about the Northern Arizona Regional Groundwater-Flow Model, please visit the USGS Arizona Water Science Center Web site at <http://az.water.usgs.gov/>.

A copy of the report can be downloaded at <http://pubs.usgs.gov/sir/2010/5180/>

If you have additional questions, please contact:

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