# Design Objectives:
# Treasure Valley Aquifer System Groundwater-Flow Model

Prepared with input from the Modeling Technical Advisory Committee by the USGS/IDWR Modeling Team

July 1, 2019

## Background

The Treasure Valley of southwestern Idaho has experienced significant population growth in recent decades. Although the existing water supply has been generally adequate, the population is projected to more than double by 2065 (SPF Water Engineering, 2016). Groundwater development has been identified as an option for satisfying at least a portion of the increased future demand for domestic and municipal water.

The need to better understand the spatial and temporal impacts of groundwater extraction on surface and ground water resources has provided impetus for the development of quantitative tools to facilitate water resource planning and management. The following are among the questions that Idaho water resource managers will likely need to answer:

1. Does the Treasure Valley have an adequate water supply for the foreseeable future?

2. What will be the spatial and temporal impacts of new groundwater development on the Boise River and the Snake River? What will be the impacts on irrigation canals and agricultural drains?

3. What will be the location, timing, and magnitude of aquifer water level changes resulting from new groundwater development and from changes in irrigation practices?

4. Which areas are capable of supporting additional groundwater development? Should groundwater development be restricted in some areas?

5. In general, which aquifers (or aquifer zones) are capable of supporting additional groundwater development? Should groundwater development be restricted in some aquifers?

6. How will urbanization affect water supply and water demand?

7. How will climate variability affect water supply and water demand?

8. Is managed aquifer recharge a viable water management strategy? If so, where might managed aquifer recharge be both practicable and beneficial?

9. What will be the impact of groundwater development on surface and groundwater quality?

## Project description

In 2016, the U.S. Geological Survey (USGS) in partnership with the Idaho Department of Water Resources (IDWR) embarked on a five-year project to construct a transient numerical groundwater-flow model of the Treasure Valley aquifer system (TVAS). Resource managers will use the model for water-supply planning and management. As part of model construction, the hydrogeologic understanding of the aquifer system will be updated with information collected during the last two decades as well as new data collected as part of the study. Funding for the project is being provided by the Idaho Water Resource Board (IWRB) through a special appropriation from the Idaho Legislature for statewide aquifer stabilization and sustainability studies (see Senate Concurrent Resolution 137) with matching funds from the USGS. Collaborative model development is proceeding with input from a Modeling Technical Advisory Committee that is composed of stakeholder representatives.

## Purpose and Objectives

The purpose of this project is to develop a transient numerical groundwater-flow model of the lower Boise River basin (Treasure Valley). The general objective is to provide a tool for the management of surface and groundwater resources. Specific objectives are as follows:

### *1. Compile data*

A primary component of this project is development of a water resource database to facilitate model construction, water budget development, and model calibration. The database will be used to compile and organize aquifer water levels, streamflow and diversion measurements, and geology and well construction information.

### *2. Revise the hydrogeologic conceptual model*

The hydrogeologic conceptual model that was developed during the Treasure Valley Hydrologic Project (Petrich and Urban, 2004) will be updated to include information collected during the last two decades as well as new data collected as part of this study. The revised conceptual model will include a conceptual water budget and a hydrogeologic framework. The revised conceptual model will be documented in a standalone report and serve as the basis for model design.

### *3. Design, construct, and calibrate a transient model of the TVAS*

A primary objective of this project is to develop a model that is capable of making time-dependent predictions of the TVAS response to stress. Model layering and the assignment of

hydrologic boundary conditions will be based on the revised hydrogeologic conceptual model. Grid size and other model design elements will be based on consideration of design objectives, data availability constraints, and input from the Modeling Technical Advisory Committee.

The model will be constructed using the USGS computer program MODFLOW. The water resource database will be used to help develop a transient water budget and automated parameter estimation methods will be used to calibrate the model. A predictive uncertainty analysis will be performed using the calibrated model and documented in a standalone report.

### *4. Improve understanding of groundwater/surface-water interaction*

The model will be used to improve the understanding of groundwater/surface-water interaction at the scale of a river reach. Stream gages will be used to define the river and canal reaches for model calibration.

### *5. Facilitate conjunctive administration*

Conjunctive administration is the combined administration by priority date of water rights for the use of groundwater and surface water. Conjunctive administration recognizes that the use of water from one hydraulically connected resource affects water availability in the other resource.

Previous investigations established that the Boise River is hydraulically connected to the Treasure Valley aquifer system (see, for example, Newton (1991), Petrich and Urban (2004)). With the objective of developing a tool to facilitate conjunctive administration, the Treasure Valley groundwater flow model is being designed to simulate and quantify the effects on flow in the Boise River resulting from: (1) new groundwater withdrawals; (2) pumping curtailment by priority date; (3) groundwater point-of-diversion transfers; and (4) mitigation.

### *6. Provide a tool for water resource planning*

The TVAS groundwater-flow model will be designed to assist the IWRB with water resource planning efforts and should generally be capable of evaluating long-term system responses to changes in aquifer recharge, surface water supply, and surface and groundwater water use. For design purposes, the Board's planning horizon is assumed to be 50 years.

The model should specifically be capable of evaluating whether managed recharge is a viable, long-term water management strategy in the Treasure Valley, and, if so, where it would be both practicable and beneficial.

### *7. Provide a tool for water allocation*

The model should be useful for assessing water supply sufficiency at a regional scale in order to facilitate water allocation decisions by IDWR such as whether to limit groundwater development in certain areas and/or aquifers. However, the model will not be designed to evaluate hydrologic responses to changes in aquifer recharge/discharge at a local scale.

### *8. Identify data gaps and develop recommendations for further study*

Data gaps will be identified during hydrogeologic conceptual model revision, model calibration, and the predictive uncertainty analysis. The data gaps will be used to develop recommendations for further study.

### *9. Develop a tool based on best available science*

USGS and IDWR personnel will develop the model cooperatively with the benefit of input provided by the Modeling Technical Advisory Committee. The calibration dataset will be updated to include hydrologic and water use data that have been collected since completion of the TVHP project, and the model will be calibrated using PEST, a state-of-the-science computer program for model calibration and predictive uncertainty analysis. An open model development process along with state-of-the-science calibration procedures and an extended calibration dataset should result in a predictive tool based on best available science.

### *10. Be accessible and well-documented*

The model will be constructed using a version of the open-source, USGS computer program MODFLOW. The calibrated model will be documented in a peer-reviewed, USGS Scientific Investigations Report. Individual model design components will be documented in technical memoranda. All calibrated model files, documentation, and relevant GIS datasets and metadata will be made available to the public on the project webpage (http://www.idwr.idaho.gov/water-data/projects/treasure-valley/).

## References

Newton, G.D., 1991, Geohydrology of the regional aquifer system, western Snake River plain, southwestern Idaho: U.S. Geological Survey Professional Paper 1408-G, p. G1-G52; 1 plate in pocket. [Also available at http://pubs.er.usgs.gov/usgspubs/pp/pp1408G]

Petrich, C.R., and Urban, S., 2004, Characterization of ground water flow in the lower Boise River basin: Moscow, University of Idaho Water Resources Research Institute, Research Report IWRRI-2004-01, 148 p. [Also available at http://www.idwr.idaho.gov/files/projects/treasure-valley/TVHP-Characterization.pdf.]

SPF Water Engineering, 2016, Treasure Valley DCMI water-demand projections (2015–2065): Boise, SPF Water Engineering, 131 p., 3 appendices. [Also available at http://www.idwr.idaho.gov/files/publications/20160808-OFR-Treasure-Valley-Water-Demand-(2015-2065).pdf.]