Design Document: Altitude of bedrock surface map—Revision and use in the groundwater-flow model

By J.R. Bartolino, USGS

Design document description and purpose

The U.S. Geological Survey (USGS), in collaboration with the Idaho Department of Water Resources (IDWR) is constructing a MODFLOW numerical groundwater-flow model of the Wood River Valley aquifer system in order to simulate potential anthropogenic and climatic effects on groundwater and surface-water resources. This model will serve as a tool for water-rights administration and water-resource management and planning. The study will be conducted over a 3-year period from late 2012 until model and report completion in 2015.

One of the goals of the modeling study is to develop the model in an open and transparent manner. To this end, a Technical Advisory Committee was formed to provide for transparency in model development and to serve as a vehicle for stakeholder input. Technical representation was solicited by the IDWR and includes such interested parties as water-user groups and current USGS cooperating organizations in the Wood River Valley.

The design, construction, and calibration of a groundwater-flow model requires a number of decisions such as the number of layers, model cell size, or methodologies used to represent processes such as evapotranspiration or pumpage. While these decisions will be documented in a final USGS report, intermediate decision documents will be prepared in order to facilitate technical discussion and ease preparation of the report. These decision documents should be considered preliminary status reports and not final products.

Background

Plate 1 in Bartolino and Adkins (2012), "Estimated altitude of pre-Quaternary surface and top of Quaternary basalt, Wood River Valley aquifer system," was generated by GIS interpolation of manually drawn contours with a 100-ft contour interval. This method was used because the primary data source was lithologic information from drillers' logs that may contain imprecise information on well location and lithology and depth of geologic contacts. In areas with tightly spaced wells with conflicting information hand contouring allows for weighting of data points based on evaluation of the log's accuracy.

The GIS datasets of the bedrock-altitude map and DEM elevation were used as a starting point for creating layers in the groundwater-flow model. Initial attempts to create model layers using processing routines in the R programming language (to be described separately) revealed areas in the Wood River Valley where the generalized bedrock-altitude map: (1) represented the bedrock surface in a manner that caused either horizontal or vertical disconnects between model cells, (2) resulted in model cells that were too thin and thus tended to go dry in simulations, or (3) was incorrect. The areas of most concern were the Ketchum area, lower Croy Canyon, and the southeastern Bellevue fan; however other areas were also problematic.

Design decision

A revised bedrock-altitude map was generated to correct errors and specify a minimum sediment thickness of 2 meters. The methodology used for the revised map is slightly different in that the interpolation used modified 100-ft contours as the primary data source and included point data from wells that penetrate bedrock and HVSR survey locations.

In Arcmap 10 the 100-ft contour lines were manually redrawn in several locations to more closely mimic the land surface in areas with no or conflicting bedrock-depth data or to better honor well data. The new bedrock-surface map was then generated using the following steps in Arcmap:

- "Topo to Raster" tool to produce an interpolated bedrock-surface raster in ft: *TopoToR_WRV_13*
  - Input features: 100-ft bedrock contours, well bedrock-altitude points, HVSR bedrock-altitude points
  - Output cell size: 10
  - Margin in cells: 20
  - Drainage enforcement: ENFORCE
  - Primary type of input data: CONTOUR

    - Maximum number of iterations: 45
    - Roughness penalty: 0.5
    - Discretization error factor: 2
    - Vertical standard error: 0
    - Tolerance 1:1
- "Raster calculator" tool to covert the raster to m:
    - Divide *TopoToR_WRV_13* by 0.3048 to generate *rastercalc_WRV_13*
- "Raster calculator" tool to produce a sediment thickness raster:
    - Subtract *rastercalc_WRV_13* from the 2009 DEM *NED_2009_WRV* to generate *rastercalc_WRV_13a*
- "Raster calculator" tool to set the minimum sediment thickness to 2 m in *rastercalc_WRV_13b*:
    - CON(*rastercalc_WRV_13a < 2, 2, rastercalc_WRV_13a)*
- "Raster calculator" tool to produce an adjusted bedrock-surface raster:
    - Subtract *rastercalc_WRV_13b* from *NED_2009_WRV* to generate *rastercalc_WRV_13c*
- "Clip" tool to trim *rastercalc_WRV_13b* and *rastercalc_WRV_13c* to the aquifer extent
- Export the geodatabases *rastercalc_WRV_13b_clip* and *rastercalc_WRV_13c_clip* to .tif format: *WRVsedthk_13.tif* and *WRVbedrockAlt_13.tif*

The revised bedrock-altitude map described here will be used in the groundwater-flow model of the Wood River Valley aquifer system. The revised map will be described in the USGS report documenting the model and the GIS dataset with metadata will be made available online upon completion of the model.

Summary

Plate 1 in Bartolino and Adkins (2012), "Estimated altitude of pre-Quaternary surface and top of Quaternary basalt, Wood River Valley aquifer system," was revised to better represent the bedrock surface and correct errors. The revised GIS dataset will be used in the construction of the groundwater-flow model and will be made available online upon completion of the model.

References Cited

Bartolino, J.R., and Adkins, C.B., 2012, Hydrogeologic framework of the Wood River Valley aquifer system, south-central Idaho: U.S. Geological Survey Scientific Investigations Report 2012–5053, 46 p., 1 plate in pocket, accessed October 23, 2012, at *http://pubs.usgs.gov/sir/2012/5053/*

http://www.uidaho.edu/~/media/Files/orgs/Research%20and%20Economic%20Development/IWRRI/publications/200805.ashx

U.S. Geological Survey, 2009, National Elevation Dataset (NED), 2nd ed.: U.S. Geological Survey raster digital data, 1/3 arc-second (approx. 10 meters) resolution, downloaded June 25, 2013 from *http://nationalmap.gov*