Design Document: Assigning pumping to model layers

By Allan Wylie, IDWR

Design document description and purpose

The U.S. Geological Survey (USGS), in collaboration with the Idaho Department of Water Resources (IDWR) is constructing a 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.

Problem statement

Bartolino and Adkins (2012) define the “Wood River Valley aquifer system” as consisting of a single unconfined aquifer and an underlying confined aquifer present south of Baseline Road and underlying igneous, sedimentary, or metamorphic rocks where they are hydraulically connected and used for water supply. Thus, the southern portion of the ground water model will include three layers, an upper unconfined aquifer (layer 1), a confining layer (layer 2), and a lower confined aquifer (layer 3), and simulated pumping in the model will need to be assigned to the correct layer. Driller’s logs (IDWR,

2013) contain information that can be used to assist in assigning pumping to the proper model layer such as well construction information and the geologic material encounter during the drilling process. However, the driller's log database is less complete prior to 1987, so earlier logs are often not on file. Wells drilled prior to the advent of modern GPS technology can occasionally be difficult to correlate with water right point of diversion (POD) because drillers were not always able to precisely locate the well on maps and thus submitted the log with an incorrect location. Because ownership of wells and water rights can change, owner names listed on drillers logs are often inconsistent with owner names listed on water rights, especially for older wells. Within the southern portion of the model area, approximately 57% of the groundwater PODs were correlated with driller's logs. There were very few irrigation well logs that could not be matched to water right PODs.

Options considered

The options considered to assist in assigning ground water pumping to the correct layer are:

1) Where driller's logs and ground water PODs can be correlated, assign well pumping to the layer or layers adjacent to the open interval identified in the driller's log. Where driller's logs are not available, assign well pumping to layer 1.
2) Where driller's logs and groundwater PODs can be correlated, assign well pumping to the layer or layers adjacent to the open interval identified in the driller's log. Where driller's logs are not available, assume wells are completed in the same layer(s) as the nearest ground water POD with a correlated driller's log.

Assign orphaned water-rights to layer 1

Farmers irrigating crops in the arid west know that they need to provide some deep percolation of irrigation water to rinse salt deposits left by evaporating water from the root zone to keep the soil from becoming sterile. In the Wood River Valley, this deep percolation returns to the shallow aquifer occupying layer 1 in the Wood River Valley Aquifer Model. The deep percolation mitigates part of the pumping impact if the pumping is from layer 1. If the pumping is from layer 3, the deep percolation represents incidental recharge to layer 1 and the total pumping represents depletions to the confined aquifer occupying layer 3.

Effect

The effect of assigning the pumping from all orphaned water-rights to layer 1 is that the pumping impact for layer 1 will likely be overestimated and the pumping impact on layer 3 will likely be underestimated.

Assigning orphaned water-rights similar to nearest neighbor

This technique assumes that the local geology does not change rapidly, thus hydrogeologic conditions that favor a well construction scheme at one well likely will persist and favor a similar well construction scheme for a neighboring well. Support for this scheme comes from the fact that drillers frequently use logs from neighboring wells to help plan drilling and well completion strategies when they are drilling in an unfamiliar area.

Effect

The effect of assigning the pumping from orphaned water-rights to the same layer as the nearest neighbor is likely to be in balance with the total assignment in both layers 1 and 3, and will result in the most appropriate approximation of pumpage from layers 1 & 3.

Design decision

The recommended design decision is to assign pumping for the orphaned ground water-rights based on the construction of the nearest well with a correlated driller's log. This design decision is favored because it likely results in the least negative impact on the model. There is no need to correlate ground water points of diversion and wells north of Hailey, Idaho, because the model will only have one layer in this area.

The shape file located in WRV_POD_WMIS_WellLogs.zip contains both the water-rights PODs and the correlated driller logs. Figure 1 contains a map showing the location of the ground-water points of diversion, the blue ground-water points of diversion have associated driller logs while the yellow ground-water points of diversion do not.

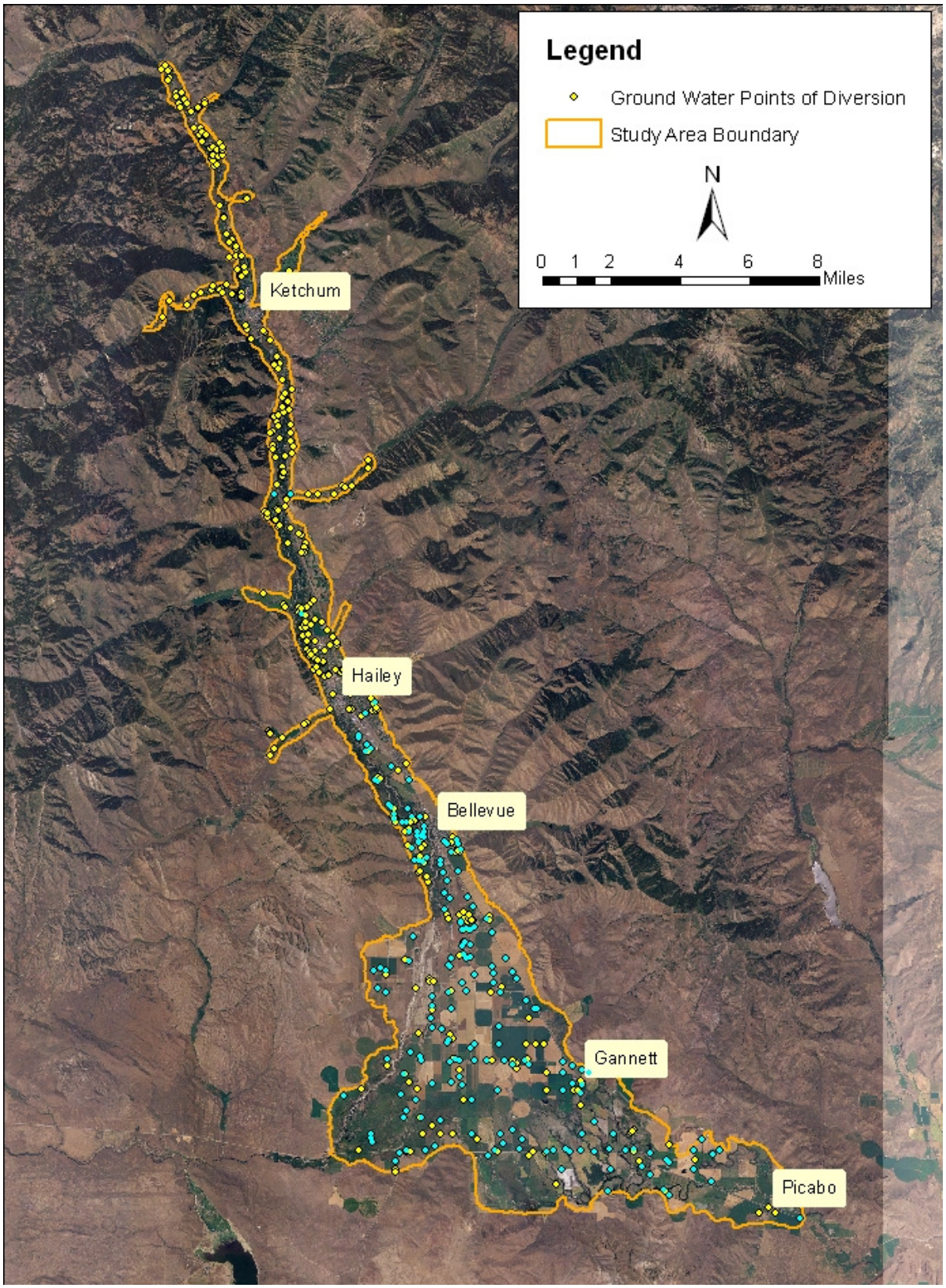

Figure 1. Map showing the location of the ground water points of diversion within the Wood River Study Area. The blue points of diversion have correlated driller logs, the yellow points of diversion do not.

References

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.

IDWR http://www.idwr.idaho.gov/WaterManagement/WellInformation/DrillerReports/dr_default.htm