HYDROGEOLOGICAL CHARACTERIZATION OF THE PALOUSE BASIN BASALT AQUIFER SYSTEM, WASHINGTON AND IDAHO

Abstract

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Ground-water management in the bi-state Pullman-Moscow area is facing an impending problem—the continuous, steady decline in water levels in the Palouse Basin basalt aquifers, which is the sole water supply source serving more than 50,000 people. Discovered in 1884, this aquifer system comprises an upper Wanapum aquifer and a lower Grande Ronde aquifer.

A pressing problem is that all previous studies existed as a variety of reports in different media, archived in different ways—a pervasive problem across the nation and the region, particularly in bi-state basins where jurisdiction is dispersed. Lack of systematic, digital archiving of relevant previous studies has become a major impediment to efficient access to existing data and collaboration among researchers.

The purpose of this study was to set a foundation for the development of long-term strategies for sustainable management of the ground-water resources in the Palouse Basin. Specific objectives were to (1) develop a hydrogeology Geographic Information Systems (GIS) database for the Palouse Basin to improve data accessibility, data processing and analysis efficiency, and (2) better characterize the hydrogeology of the basalt aquifer system based on newly available spatial and temporal data.

The study domain was defined by referring to relevant literature, particularly the two modeling studies conducted by the U.S. Geological Survey, to encompass the area bounded by the Snake River on the west, the North Fork of the Palouse River on the north, and, the crystalline uplands on the east and south. Major wells (up to 800) within the study domain were digitized and included in the hydrogeology GIS database, with important attributes compiled from existing literature. Long-term ground-water hydrographs were developed and the relationships between ground-water level, annual precipitation and pumpage were evaluated. Structural maps for the two basalt aquifers were constructed using their top altitude data, and potentiometric surface contour maps for different times were created using corresponding water-level data. Additionally, hydrogeological cross-sections were developed to elucidate ground-water flow regime and hydraulic connections within and between the two basalt aquifers.

Results indicate that each basalt aquifer has a distinct pattern of water-level fluctuations, related to pumping, climate, and recharge. Two cones of depression have formed in the Grande Ronde aquifer as a result of heavy pumping in Pullman and Moscow. Lateral ground-water movement in both Wanapum and Grande Ronde is to the northwest.

Previously developed ground-water models for this region have assumed simplified, "layer-cake" type of basalt system, and uniform aquifer hydraulic properties. The comprehensive hydrogeological information compiled and analyzed in this study suggested that the Palouse Basin ground-water system is largely governed by highly complex geological structures and spatially varying recharge and discharge mechanisms, aquifer geometric configurations and hydraulic properties. This information is important for future development of an improved, process-based model that can be used for ground-water resource management in the Palouse Basin.