Delineation of Capture Zones for Springs in Southern Great Basin Based on Modeling Results and Geochemical Data

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The protection zones or capture zones of springs in a desert environment can be hard to identify, but they are critically important for spring protection. Most springs fed by regional aquifers are susceptible to contamination and groundwater development. The U.S. Environmental Protection Agency (EPA) has established hydrogeologic mapping methods to delineate protection zones around springs. It is often difficult to determine a regional aquifer system's flow patterns, due to the uncertainties associated with the hydrogeologic framework (geological formations and structures), with hydrogeologic mapping methods alone. The use of such methods is not conducive to efficient management of groundwater. Particle tracking analysis using a well-conceptualized and calibrated numerical model of the 3-D groundwater flow domain feeding a given group of springs facilitates the identification of spring capture zone boundaries. In this study, a multifaceted approach was implemented to define capture zones for the springs at Furnace Creek, Ash Meadows and the Muddy River. First, capture zones were delineated from inverse particle tracking and HU12 watersheds. Second, the captures zones were adjusted based on water budgets, geology, and hydrologically significant faults. Third, geochemical analysis of the groundwater chemistry and isotopic data available for each capture zone was conducted to verify the extent of each zone. This approach adds confidence to the delineated capture zones. The approach presented in this paper should be considered in the future development of sustainable management policies for the protection of springs, water resources, and aquatic environments.

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