Management of the Iao and Waihee Aquifer Areas with the Aid of a 3-D Numerical SUTRA Model, Maui, Hawaii

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ABSTRACT

A ground-water flow model of central and west Maui, including the heavily utilized Iao and Waihee aquifers in central Maui, has been developed using the US Geological Survey's recently enhanced three-dimensional solute transport (3-D SUTRA) computer code. The code is capable of simulating variable-density ground-water flow and solute transport in heterogeneous, anisotropic aquifers. The ground-water model for Maui simulates freshwater and the underlying brackish-water transition zone and incorporates hydrogeologic features such as valley-fill barriers and the sediments that form a caprock and a barrier between the lavas of West Maui and Haleakala Volcanoes (figure 1). New estimates of recharge during 1926–2004, historical distributions of monthly pumpage, and the position of mean sea level at monthly intervals were used as input to the model.

The resulting freshwater-lens size and position were simulated for the period 1926–2006. Estimated recharge for central and west Maui declined 44 percent between 1979 and 2004 because of decreased agricultural land use, more efficient irrigation, and recent periods of low rainfall. In some parts of the Iao and Waihee areas, simulations show that water levels declined as much as 20 feet and the transition zone moved upward about 200 feet, as withdrawal from these areas began in 1948 and increased to as much as 22 million gallons per day by 2006. These results matched historic water-level and salinity data for these areas. Figure 2 shows the simulated water-table contours in 2006, at the end of the simulation period.

The ground-water flow model is useful as a tool to forecast the effects of future ground-water withdrawal and changes in recharge distributions. The relative benefits of redistributing ground-water withdrawal using existing infrastructure or adding more wells to spread pumping out are compared using different model scenarios. The effects of changes in recharge caused by drought conditions, changing land use, or increased streamflow above the aquifers are also simulated. The results of these scenarios are available to water-system managers so that they can most effectively manage the ground-water resource.

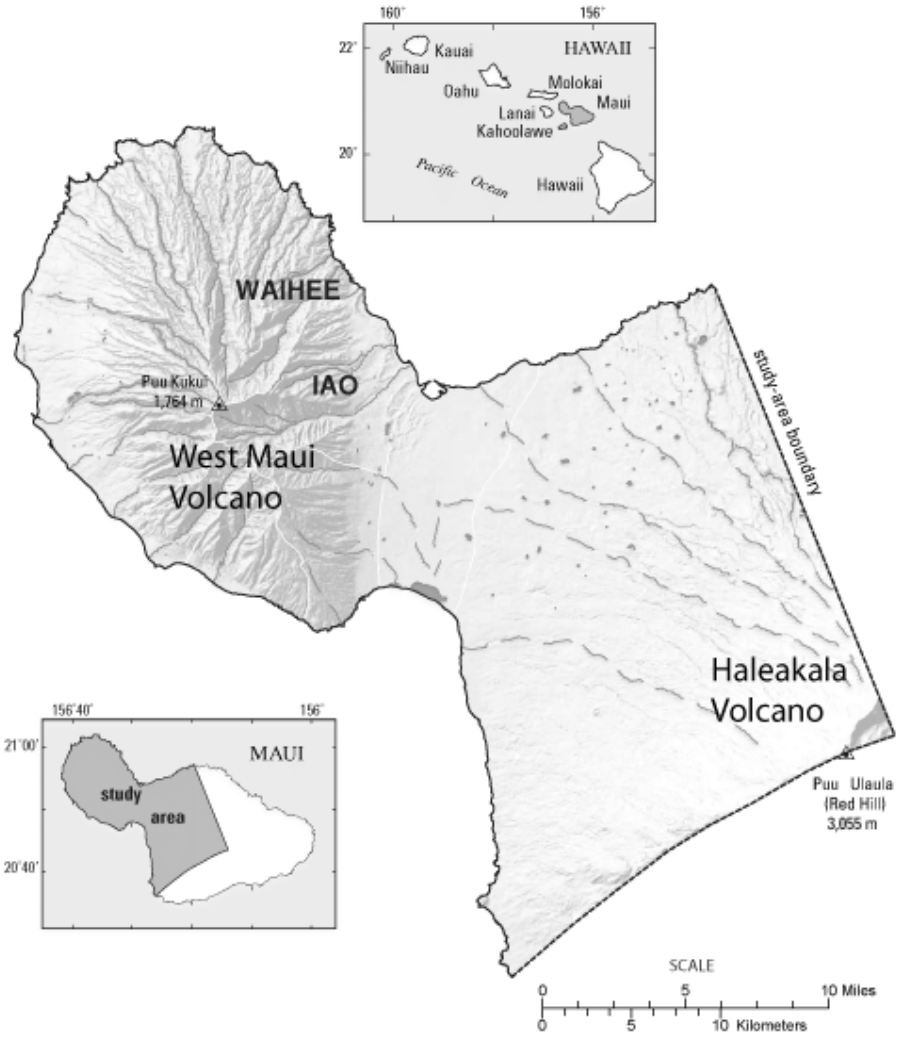

Figure 1. Study area and location of Iao and Waihee aquifer areas, Maui Hawaii, USA.

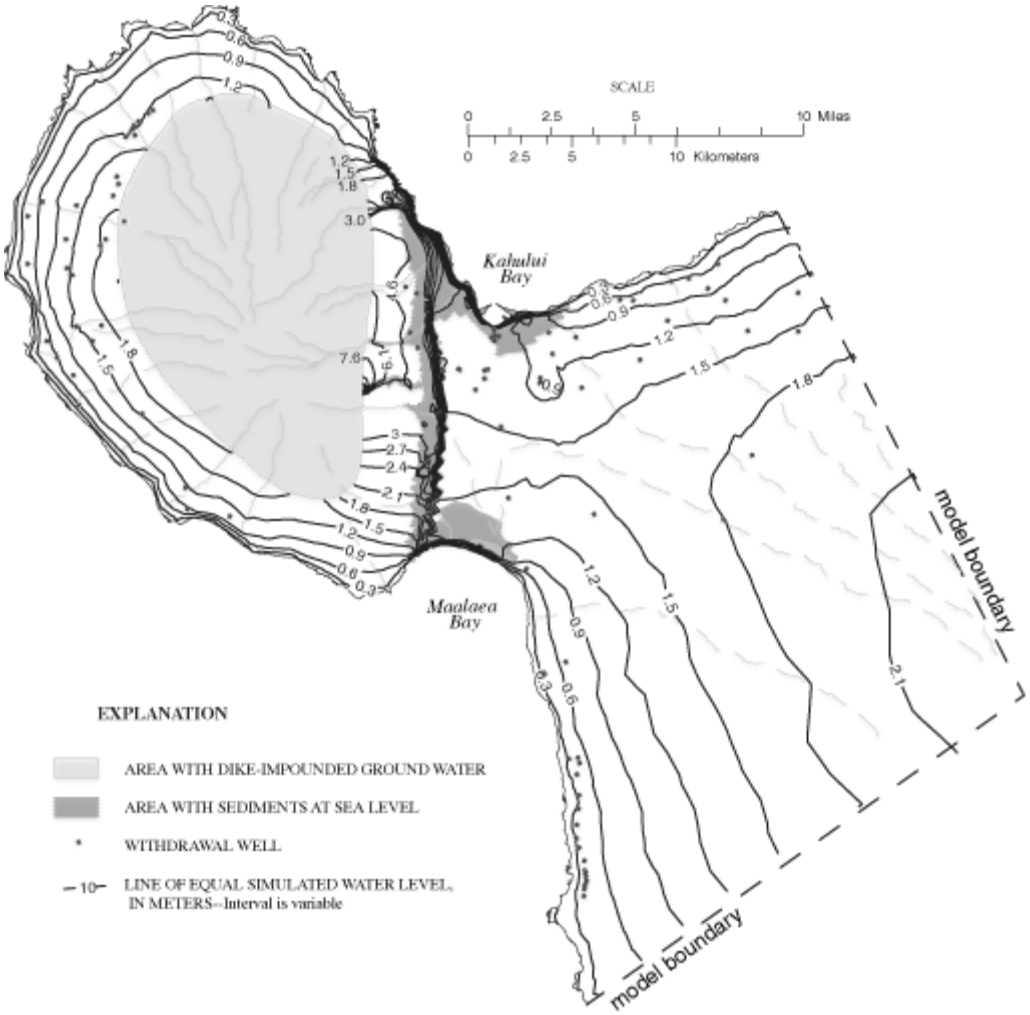

Figure 2. Simulated water-table contours in 2005, Maui Hawaii, USA.

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