# Determination of Groundwater Fluxes and Evaluation of Water-Level Data to Characterize Effectiveness of Low-Permeability Valley-Fill Deposits in the Pearl Harbor Aquifer Area

## Introduction

The Pearl Harbor Aquifer is the most important aquifer on the island of Oahu and currently supplies about 100 mgd of fresh groundwater mainly for public use (Rotzoll et al., 2010). Decisions related to future infrastructure development and alternate sources of freshwater, including desalinization, will depend on the long-term sustainability of the groundwater resources in the Pearl Harbor Aquifer.

For proper resource management it is critically important to have an accurate understanding of the groundwater flow through the Pearl Harbor Aquifer. That is: (1) quantification of groundwater fluxes to the Pearl Harbor Aquifer from adjacent groundwater areas, and (2) evaluation of the effects of local hydrogeologic features, in particular low-permeability valley-fill barriers.

Stream valleys filled with alluvium below the water table act as hydrologic barriers to cross-valley groundwater flow because the deposits have a lower permeability than the adjacent basalt. Weathered basalt underneath the streambed contributes to the permeability contrast under the valley fill with respect to the otherwise high-permeability basalt aquifer. Water levels that differ by several feet on opposite sides of a valley-fill indicate an effective barrier. The effectiveness of a valley fill to impede horizontal groundwater flow depends on the geometry and hydrologic parameters of the deposits (Oki, 2005; Rotzoll and El-Kadi, 2007).

## Problem and Research Objectives

The scope of work includes (1) developing a regional numerical groundwater model that quantifies groundwater fluxes to the Pearl Harbor Aquifer from adjacent areas, and (2) analyzing groundwater-level data to evaluate the hydrologic effectiveness of valley-fill barriers, including those associated with Waimano, Waimalu, and Kalauao Streams.

## Methodology

Groundwater fluxes to the Pearl Harbor freshwater-lens aquifer include surficial recharge and underflow from adjacent high-level water bodies (Schofield Plateau and dike-impounded water from the rift zones of the Koolau and Waianae Volcano). A three-dimensional island-wide MODFLOW model (Harbaugh et al., 2000) of Oahu with the focus on groundwater areas adjacent to the Pearl Harbor Aquifer will be developed. The numerical model is capable of simulating groundwater flow and the freshwater-saltwater interface using the Saltwater-Intrusion (SWI) package (Bakker and Schaars, 2005).

The model developed as part of this work will incorporate the latest available groundwater-recharge estimates developed by the USGS, recent groundwater withdrawal rates, and aquifer parameters that are based on previously published values. The steady-state model of the recent hydrologic conditions is calibrated using observed groundwater levels, vertical salinity profiles, and estimated base flows of streams. Upon successful calibration, groundwater fluxes into the Pearl Harbor Aquifer can be determined for recent conditions. The effects of predevelopment conditions on the location of the groundwater divide between leeward and Pearl Harbor side in the Koolau high-level water area can be tested.

Recent synoptic water-level surveys in the Pearl Harbor Aquifer by the USGS and water levels measured on opposite sides of valley-fills will be used to characterize the effectiveness of the alluvium as a hydrologic barrier. Moreover, continuously measured water levels will be analyzed to evaluate the cross-boundary effects of groundwater withdrawals. After removing environmental stresses that influence water levels other than groundwater withdrawals (e.g., barometric pressure, recharge events), the water-level time series can be investigated for signs of drawdown and recovery across valley fills.

## Principal Findings and Significance

Study is ongoing.

## Publications Cited in Synopsis


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