6. MODEL CALIBRATION

6.1 General

As discussed in Section 4.2, Loeb et al. (1987) noted that there were no pronounced seasonal fluctuations in the flow gradient between groundwater and the lake; this "made a steady-state model more credible". Additionally, the availability of transient groundwater elevation data was deemed inadequate for a transient calibration study. Therefore, the groundwater model was calibrated as steady-state. Under steady-state conditions, stresses, flow rates, and water levels are assumed to be constant in time.

The conceptual distribution of hydraulic conductivity zones were provided by USACE Sacramento District, and were not subject to major adjustment during the calibration process. Model calibration focused on adjustment of boundary conditions presented in Section 5. Model calibration requires data on groundwater levels, stream flows, lake level, recharge, and pumping. From data analysis, it was determined that the measurements taken in fall 1996 and spring 2002 provided the most complete representation of site conditions.

6.2 Numerical Solution

The MODFLOW Strongly Implicit Procedure (SIP) (McDonald and Harbaugh, 1988), and the Preconditioned Conjugate Gradient (PCG2) (Hill, 1990) numerical solution algorithms were used in concert to attain starting head conditions, and solution convergence. The MODFLOW PCG2 algorithm was used for the final numerical simulations. Head closure criterion was set to 0.001 ft. The final numerical simulation attained a mass balance error of 0.13 % or less for all calibration runs.

6.3 Calibration to Fall 1996 Conditions

Specified boundary conditions for the fall 1996 calibration included lake elevation, pumping rates, and recharge to aquifer. The measured lake elevation was specified as 6226.5 ft MSL, the pumping rates at all wells were specified equal to the average pumping rates for 3 months prior to the calibration date. Recharge to the aquifer was assumed to be negligible. Calibration targets included 26 groundwater elevation measurements taken in fall 1996 (Rowe and Allandar, 1996), and stream flow data from fall 1996 seepage measurements along Trout Creek and the Upper Truckee River (Rowe and Allandar, 1996).

Calibration consisted primarily of adjusting the constant head boundaries along the mountain front to match measured groundwater levels at adjacent wells. Constant head boundaries were further adjusted to simulate measured seepage along Trout Creek and the Upper Truckee River. A good match between measured and simulated water levels was attained. The mean difference between measured and simulated water levels was less than 1 ft. The measured flow of Trout Creek at Highway 50 was 1,990,000 ft^3/day. The simulated flow was 2,000,000 ft^3/day. The measured flow of the Upper Truckee

River at Highway 50 was 968,000 ft^3/day. The simulated flow was 972,000 ft^3/day. Total simulated discharge to lake was 159,000 ft^3/day.

6.4 Calibration to Spring 2002 Conditions

Specified boundary conditions for the spring 1996 calibration included lake elevation, pumping rates, and recharge to aquifer. The measured lake elevation was specified as 6223.1 ft MSL, the pumping rates at all wells were specified equal to the average pumping rates for 3 months prior to the calibration date. Recharge to the aquifer was set equal to 0.004 ft/day, the equivalent of 17.5 in/yr.

Calibration targets included 14 groundwater elevation measurements taken in March 2002 by the South Tahoe Public Utilities District, and stream flow data from 2 gages along Trout Creek and 1 gage along Upper Truckee River.

As with the fall 1996 calibration study, the spring 2002 calibration consisted primarily of adjusting the constant head boundaries along the mountain front to match measured groundwater levels at adjacent wells. Constant head boundaries were further adjusted to simulate measured flows in Trout Creek and the Upper Truckee River. Through model calibration, a good match between measured and simulated water levels was attained. The mean difference between measured and simulated water levels was less than 1 ft. The measured flow of Trout Creek at Martin Avenue was 1,395,000 ft^3/day. The simulated flow was 1,400,000 ft^3/day. The measured flow of the Upper Truckee River at Highway 50 was 5,065,000 ft^3/day. The simulated flow was 5,050,000 ft^3/day. Total simulated discharge to lake was 318,000 ft^3/day.

7. MODEL APPLICATION

7.1 General

As illustrated by Figure 11, the lakeshore was discretized into 4 regions: Region 1 (the west), Region 2 (Tahoe Keys), Region 3 (South Lake Tahoe), and Region 4 (Stateline). The shoreline length of Region 1 is approximately 9200 ft. The shoreline length of Region 2 is approximately 6000 ft. The shoreline length of Region 3 is approximately 9700 ft. The shoreline length of Region 4 is approximately 8600 ft. The total length of the lakeshore in the model domain is approximately 33,500 ft. The model consists of 5 layers at the shoreline. This allowed for the plan- and side-view discretization of water exchange between the lake and groundwater. The model was applied under varying hydrologic conditions.

7.2 Simulation of Lake-Groundwater Interaction

As discussed in Section 6, the model was calibrated to fall 1996 and spring 2002 conditions. The lake level in fall 1996 was 6226.5 ft MSL. The lake level in spring 2002 was 6223.1. Thus, it can be inferred that the increased discharge to the lake during spring