5.0 ANALYSIS OF WATER REPLACEMENT

As discussed in Section 4.2, decreases in inflow to the river alluvium due to pumping of the lower aquifer are predicted for the base and sensitivity cases. These predicted decreases in inflow were calculated using the zone budget feature in MODFLOW to estimate the inflow under the pumping and non-pumping scenarios and comparing these two values. Subsequently, model runs were used to evaluate the potential for replacement of the decreases in inflow to the river alluvium by both subsurface injection of water and augmentation of surface water.

The steady state base case of the model was used to test the potential locations for either injection of water into the groundwater system or augmentation of the surface water flows in the system. Several model simulations were performed including the assessment of the injection of water at:

- the location of monitor well OW1,
- the location of monitor well OW8,
- the southern end of the Banegas Ranch, and
- at all three of the above locations.

The model simulations performed indicated that injected water in the areas of wells OW1 and OW8 using small volumes of water could offset the predicted drawdowns upstream of the marsh. As these simulations were developed, the location near the southern end of the Banegas Ranch was incorporated to attempt to offset the drawdowns in the southern end of the Big Sandy Basin. Subsequent runs were performed at varying injection rates, which indicated that the marsh (simulated as a general head boundary) was the principal area of water loss in the Big Sandy River alluvium due to pumping from the lower aquifer. Further analyses of the zone budget from the marsh area indicated that the principal reduction in outflow from the basin was the result of reduction of evapotranspiration and evaporation from the marsh and the translation of this reduction into drawdown.

As a result of the realization that the marsh is the principal mechanism for the reduction in outflow of water from the Big Sandy River alluvium, subsequent model runs focused on the potential for balancing the decreased losses by evapotranspiration and evaporation (and thus the drawdowns) with augmentation of water into the marsh area. To simulate this potential offset, the general head boundary within the model was redefined as a series of wells. The simulation of

the marsh as a series of wells allows fluxes from the marsh to be specified. The specified flux initially simulated was determined by total flow out of the marsh during the non-pumping scenario. To this value, the predicted amount of decrease in inflow to the river alluvium was added in a time-varying fashion, thus providing a method of simulating the augmentation to the marsh.

Several model runs were performed that simulated variations on the water augmentation scenario. These model runs indicated that the predicted drawdowns are very sensitive to the total flux value out of the marsh. Eventually, simulations were achieved that resulted in both a drawdown of less than 0.5 feet and a mounding of less than 0.5 feet. These simulations were achieved with a change in flux of less than 60 gallons per minute (gpm). Both the mounding and the drawdown simulations indicate that the offset program via augmentation to the marsh is viable, and provides a mechanism and location where decreases in inflow and head in the river alluvium due to pumping may be entirely offset.

If water is placed into the marsh over the lifetime of the project, it is likely that this will act to reduce the reduction in flow from the middle aquifer to the upper aquifer, thus reducing both the quantity and time period over which the water flow to the marsh will be necessary to compensate for the effects of the groundwater drawdown.

Observed heads in the volcanic and middle aquifers during pumping will demonstrate which of the predicted cases best represents reality, and the corresponding likely water replacement volumes required for mitigation of pumping effects.