MEMORANDUM

TO: Candice McHugh, Randy Budge
FROM: Chuck Brendecke
SUBJECT: Temperature Gain Analysis
DATE: March 19, 2009

In the technical review discussion held on March 17th questions were raised about the potential for water temperature gain in the delivery pipeline proposed in the Ground Water District's over-the-rim mitigation plan. This memo addresses this concern.

A preliminary steady-state heat transfer analysis was conducted to determine the expected water temperature change in the pipeline transporting water from the seven wells to the Snake River Farm. The alternative route shown on Exhibit 2 "Over the Rim Delivery Plan Schematic" was assumed. The pipeline was analyzed in sections based on well locations. Flow rates, pipe sizes, pipe lengths, and materials of construction were based on the same assumptions used for reconnaissance level cost estimates submitted with the mitigation plan. The heat transfer computations considered factors such as:

- Burial depth;
- Flow rates;
- Pipe size, length, materials of construction and associated properties;
- Soil type, moisture content, and associated properties;
- Soil temperature; and
- Well water temperature.

ARS personnel in Kimberly suggested that soil temperatures in the area at a depth of 3 ft could range from a low of 30 degrees F in the winter to a high of 65 degrees F in summer. The heat transfer analysis assumed that soil temperature would be at the peak summer level year-around.

Observation well 08S 15E 33ABB1 is the nearest upgradient observation well to the mitigation wells. In 2004, the last year observed, the water temperature in this well was 14.7 degrees Centigrade (58.5 degrees F). Thus for most periods of the year when soil temperatures are less than 58.5 degrees F the pipeline will likely cool the well water rather than heat it.

Nevertheless, the heat transfer analysis showed that, based on a 3 foot burial depth, a well water temperature of 14.7 °C, and a year-around soil temperature of 65 °F, the water

delivered to Snake River Farm would be approximately 14.9 °C. Thus, a 0.2 °C temperature rise could be expected in delivered water under worst-case conditions.

Considering the dilution afforded by mixing the 2 cfs of delivered mitigation water with the roughly 90 cfs of spring discharge, it is not likely that hatchery influent temperatures will be measurably increased by mitigation water delivery.