MEMORANDUM

Date: May 17, 2011

To: Andrew Burns, SNWA

From: James Thomas, DRI

Subject: Answer to questions about potential interbasin flows

Following is my response to five questions asked of me by Andrew Burns at SNWA about potential interbasin flows in the White River Flow System:

1. Discuss the potential flow from southern Butte Valley to Jakes Valley in the northern part of the White River Flow System (WRFS).

Response: Recharge to Butte Valley has similar isotopic values (deuterium ranges from -126.0 to -118.9 permil with an average value of -121.8 permil and oxygen-18 ranges from -16.40 to -15.36 permil with an average value of -15.93 permil, for nine recharge area samples) as that of recharge to Long Valley (-122.4 permil in deuterium and -15.96 permil in oxygen-18) and Jakes Valley (-119.8 permil in deuterium and -15.71 permil in oxygen-18) and as the regional warm springs in northern White River Valley (-123.1 permil in deuterium and -15.97 permil in oxygen-18) (Thomas and Mihevc, 2007; 2011). Thus, stable isotopic data would support groundwater flow from southern Butte Valley to Jakes Valley in the WRFS and also to the regional warm springs in northern White River Valley.

2. Discuss the potential source(s) of water supplying the Muddy River warm springs in Upper Moapa Valley.

Response: The isotopic composition of groundwater discharging from the Muddy River springs area in Upper Moapa Valley (deuterium values ranging from -99.0 to -96.5 permil, with a discharge weighted average value of -97.8 permil and oxygen-18 values ranging from -13.05 to -12.45 permil, with a discharge weighted average value of -12.92 permil; Thomas and Mihevc, 2007) is: (1) more negative than local recharge to Coyote Springs Valley (-90.8 and -12.53 permil; Thomas and Mihevc, 2007) and Kane Springs Valley (-88.8 and -12.20 permil; Thomas and Mihevc, 2007), and potential inflow from Lower Meadow Valley Wash (-91.3 and -12.35 permil; Thomas and Mihevc, 2007, model 3 with SNWA and BARCAS recharge and ET values); (2) similar to the isotopic composition of groundwater flowing out of Delamar Valley into northern Coyote Springs Valley (-97.6 and -12.95 permil; Thomas and Mihevc, 20011); and (3) more positive than water in the Pahranagat Valley area of the WRFS that flows south toward Muddy River Springs (-108.9 and -14.25 permil, discharge weighted average values from

Thomas and Mihevc, 2007, model 3 with SNWA and BARCAS recharge and ET values). Given the hydrogeology of the area, the isotopic composition of the Muddy River area warm springs and previous studies (Kirk and Campana, 1990; Thomas et al., 1996; 2001; and Thomas and Mihevc, 2007) it is clear that there is not one main source or water supplying the warm springs, rather it has to be a mixture of the isotopically more positive and more negative waters to obtain the observed isotopic composition of Muddy River warm springs. The isotopic, recharge and discharge, and interbasin flow data show that some of the water from Pahranagat Valley continues south in the WRFS to the Muddy River Springs area and mixes with inflow from Delamar Valley, local recharge to Coyote Springs and Kane Springs valleys, and probably also groundwater from Lower Meadow Valley Wash to produce the observed flow and isotopic composition of the Muddy River springs.

3. What is the source of groundwater in Hidden and Garnet valleys?

Response: Deuterium and oxygen-18 data for groundwater in carbonate wells in Hidden and Garnet Valleys (deuterium values ranging from –97.5 to –96.0 permil and oxygen-18 values ranging from -13.70 to –12.75 permil) are significantly more negative than the isotopic composition of local recharge water to the Sheep Range (average deuterium and oxygen-18 values of -92.7 and -12.83 permil) and Delamar Range (average deuterium and oxygen-18 values of -88.9 and -12.22 permil) the two main recharge areas near Hidden and Garnet valleys (Thomas and Mihevc, 2007, 2011). Furthermore, the isotopic composition of these groundwaters is similar to that of groundwater in Coyote Springs Valley and the Muddy River Springs area (discharge weighted average deuterium and oxygen-18 values of -97.8 and -12.92 permil). Thus, the most likely source of this groundwater is groundwater in the carbonate-rock aquifers of the WRFS from the Coyote Springs Valley and Upper Moapa Valley areas.

4. Carbonate well water in California Wash is lighter (more negative) than the Muddy River Springs water and carbonate well water in Upper Moapa Valley, so could lighter water from Hidden and Garnet valleys cause this difference?

Response: The two carbonate well waters in California Wash have deuterium and oxygen-18 values of -99.0 and -13.50 and -99.0 and -13.40 permil, and since Upper Moapa Valley carbonate aquifer groundwater has deuterium values that range from -99.0 to -96.5 permil and oxygen-18 values that range from -13.05 to -12.45 permil (Thomas and Mihevc, 2007), the isotopic differences between the groundwaters in these two areas is not different enough (analytical uncertainty for deuterium is +/- 1.0 permil and for oxygen-18 is +/- 0.1 permil) that these waters would be from different sources. The more negative oxygen-18 values of the California Wash waters than the Upper Moapa Valley waters may indicate slightly less evaporation of these waters during recharge than the Upper Moapa Valley groundwater. Furthermore, the groundwater in Hidden and Garnet valleys is isotopically similar to Upper Moapa Valley groundwater so these two potentially different sources cannot be differentiated on the basis of deuterium and oxygen-18 data.

5. What is the potential for some groundwater flow out of Pahranagat to southern Tikaboo Valley along the Pahranagat Shear Zone?

Response: This potential groundwater flow out of the WRFS has been proposed by Winograd and Friedman (1972), Kirk and Campana (1988; 1990), and Thomas et al. (1996). This proposed groundwater outflow is possible based on the isotopic composition of Ash Meadows springs, but research on the Devils Hole vein calcite Winograd et al. (1992; 2006) makes groundwater flow from Pahranagat Valley to Ash Meadows less probable.

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