

MEMORANDUM

To: Scott King P.E., SPF Water Engineering

From: Chuck Brendecke P.E., Sophia Sigstedt

Subject: Evaporation from Magic Springs Deliveries to Rangen Hatchery

Date: December 2, 2014

This memorandum summarizes calculations by AMEC to determine the potential evaporation of Magic Springs water delivered to the Rangen hatchery facility on Billingsley Creek and the offsetting reach gains to Billingsley Creek and the Snake River from other mitigation activities undertaken by the Idaho Groundwater Appropriators (IGWA). The calculations demonstrate that evaporation of Magic Springs water in Billingsley Creek is more than offset by gains to Billingsley Creek and the Snake River resulting from other IGWA mitigation activities.

Methodology

Evaporation of Magic Springs water in Billingsley Creek was calculated from ET Idaho 2012 Open Water-Shallow Systems (ponds, streams) Precipitation deficit and from estimates of creek length and width derived from aerial imagery. Total evaporation from the surface of Billingsley Creek was then calculated as the product of net evaporation and creek surface area, calculated as creek length times average creek width.

Evaporation of Magic Springs water in Billingsley Creek was then calculated as the product of total evaporation and the proportion of Billingsley Creek flow represented by Magic Springs water. This proportion was taken as the amount of Magic Springs water delivered to Rangen divided by the sum of Magic Springs deliveries and gaged flows of Billingsley Creek near Hagerman. Details of all of the foregoing calculations are shown in Table 1 at the back of this memo.

Reach gains resulting from IGWA's historical and ongoing mitigation activities in Water District 130 were derived from ESPAM2.1 model runs done by the Idaho Department of Water Resources (IDWR) for the Amended Final Order approving IGWA's first mitigation plan, dated May 16, 2014. These model runs are described in Finding of Fact 7 of the Amended Final Order. Model files associated with the runs are available on the IDWR website at:

http://www.idwr.idaho.gov/browse/legal/rangen/Data_Accomp_4_11_14_Order/.

IGWA mitigation activities contributing to gains in springs discharges below Milner include CREP, voluntary dry-ups, conversions, and recharge undertaken by IGWA and SWID. Some of these activities, have been underway since 2005. The IDWR modeling represented the effects of these historical activities for a five-year period starting with 2014. Current gains can reasonably be expected to be slightly larger in magnitude, since these activities are ongoing.

The gains from these IGWA mitigation activities to selected springs were contained in the IDWR model files. The files did not include post-processed output for all modeled springs, so the picture drawn from the files is conservative in that it underestimates the gains from IGWA mitigation activities. The only Billingsley Creek spring outputs contained in the IDWR model files were those for the Rangen model cell and the cell representing Three Springs. There are five additional drain cells in the model that discharge to Billingsley Creek. These include cells representing Potter, Big Springs, and Florence springs, among others. Time did not permit the extraction of these additional gains outputs, but it is reasonable to assume that in total they exceed those of Three Springs.

The post-processed gains that were contained in the IDWR files were summarized for three sets of springs: 1) Three Springs (a surrogate for all the non-Rangen springs discharging to Billingsley Creek), 2) springs represented in the model as serving the Thousand Springs and Malad hydropower facilities, and 3) other large springs entering the Snake River below Milner. Gains from all three groups of springs enter the Snake River above Swan Falls and are thus offsetting the evaporation of Magic Springs water in Billingsley Creek relative to the minimum flows at Swan Falls. Table 2 at the back of this memo summarizes the gains for these groups of springs.

Conclusions

Comparison of evaporation calculated in Table 1 and gains shown in Table 2 indicate that the non-Rangen gains from IGWA mitigation activities dwarf the evaporation of Magic Springs water in Billingsley Creek. In fact, any individual group of spring gains is more than adequate to offset the evaporation. Accordingly, we conclude that there can be no adverse effect on Swan Falls minimum flows from the evaporation of Magic Springs water introduced into Billingsley Creek.

Table 1

Billingsley Creek Surface Water Evaporation Calculation												
ET Idaho 2012 Hagerman 2 SW (NWS-103932)												
Open Water-Shallow Systems (ponds, streams)	Precipitation Deficit (in/month)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
		0.00	0.30	1.88	3.24	4.53	5.60	6.61	5.80	4.64	2.79	0.25
												Dec
												0.00
												annual (in/yr)
												35.64
												annual (ft/yr)
												2.97
Billingsley Creek Length (km)												
13												
Billingsley Creek Width (ft)												
25												
Billingsley Creek surface area (ft ²)												
1,068,273												
Potential Billingsley Creek Evaporation (ft ³ /yr)												
3,166,532												
Potential Billingsley Creek Evaporation (af/yr)												
72.69												
Potential Billingsley Creek Evaporation (cfs)												
0.10												
13134600 Billingsley Creek nr Hagerman, ID ³												
Discharge measurements Water October 2011 to September 2012 (cfs)												
3/6/2012												
Discharge												
15.70												
Magic Springs Transfer (cfs)												
10												
Magic Springs Transfer portion of Billingsley Crk Flow												
39%												
Potential Magic Springs Transfer Evaporation (af/yr)												
28.3												
Potential Magic Springs Transfer Evaporation (cfs)												
0.039												
³ http://data.kimberly.idaho.edu/ETIdaho/cvwrstats.py?station=103932&cover=55&stats=Deficit												
³ http://wdr.water.usgs.gov/wy2012/pdfs/13134600.2012.pdf												

Table 2

	Year 1 (4/2014- 3/2015)	Year 2 (4/2015- 3/2016)	Year 3 (4/2016- 3/2017)	Year 4 (4/2017- 3/2018)	Year 5 (4/2018- 3/2019)
<i>ESPAM 2.1 Predicted Mitigation Benefit to Spring Cell(s) ¹ (cfs)</i>					
Three Springs	1.37	1.48	1.57	1.63	1.68
Malad & Thousand Springs	9.17	9.92	10.51	10.95	11.30
Box Canyon Springs	7.49	8.10	8.57	8.92	9.20
Crystal Springs	5.17	5.60	5.92	6.17	6.36
Clear Lake Springs	4.54	4.91	5.19	5.40	5.57
Blue Lake Springs	3.69	3.94	4.13	4.27	4.37

¹http://www.idwr.idaho.gov/browse/legal/rangen/Data_Accomp_4_11_14_Order/ "2005_2013Transient.xlsx"