

MEMORANDUM

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

From: Chuck Brendecke P.E., Sophia Sigstedt

Subject: Follow-up to December 2nd Memo Re: Evaporation from Magic Springs Deliveries to Rangen Hatchery

Date: December 12, 2014

This memo is a follow-up to AMEC's December 2nd, 2014 memo Re: Evaporation from Magic Springs Deliveries to Rangen Hatchery. The December 2nd memo summarized 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).

It was noted in the December 2nd memo that the offsetting reach gains to Billingsley Creek and the Snake River were only summarized for selected springs for which IDWR had post-processed the model output and that time did not permit the extraction of these additional gains outputs. The purpose of this follow-up memo is to summarize the expanded analysis for offsetting reach gains to Billingsley Creek and the Snake River from all modeled springs and the tributary underflow to the Snake River through General Head Boundaries (GHBs). The expanded analysis further supports the conclusions drawn in the December 2nd memo that 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

AMEC's calculation of evaporation of Magic Springs water in Billingsley Creek is unchanged and for methodology the reader should refer to the original documentation in the December 2nd memo. For convenience Table 1 summarizing the evaporation calculation in the December 2nd memo is reproduced as 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_Accmp_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, only the Class A&B springs were included in their post-processed spreadsheet "2005_2013Transient.xlsx" associated with their model runs. In the December 2nd memo 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. These gains were summarized in Table 2 of the December 2nd memo and for convenience is reproduced as Table 2 at the back of this memo.

Table 3 is an expanded version of Table 2 from our memo of December 2nd. The spring gain extractions that were contained in Table 2 were extended to all springs between Kimberly and King Hill. These extractions represent the increased flows from the ESPA resulting from IGWA mitigation activities exclusive of Sandy Pond recharge.

Springs that discharge to surface flows are represented by drain cells in ESPAM2.1. Those springs that were used as calibration targets are classified as either A, B or C, depending on the flow data collection methods used. Class A and B springs have systematic measurement by the USGS and water users, respectively. Class C springs have only spot or sporadic measurements. Subsurface flows from the ESPA directly into the Snake River are represented by General Head Boundary (GHB) cells in the groundwater model.

Most of the springs listed in Table 3 discharge directly to the Snake River through powerplants or fish hatcheries, which are non-consumptive uses. For these there is very little if any opportunity for subsequent re-diversion to consumptive use. Of the listed springs, only those serving the National Fish Hatchery and those discharging to Billingsley Creek present significant potential for re-diversion. Minor re-diversion is possible at Blue Lakes and Clear Lakes. Increased flows from GHB cells occur directly in the river and present no opportunity for re-diversion.

Conclusions

From the comparison of evaporation calculated in Table 1 and gains shown in Table 3, we would conclude that ongoing increases in spring discharges to the Snake River above Murphy from ongoing IGWA mitigation activities substantially exceed the potential consumption of water added to Billingsley Creek from the Magic Springs transfer. Accordingly, the transfer does not present risk to the minimum flows called for in the Swan Falls agreement.

Table 1

<i>Billingsley Creek Surface Water Evaporation Calculation</i>												
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)												
			1,066,273									
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 ¹												
Discharge measurements Water October 2011 to September 2012 (cfs)												
		Date	Discharge									
		3/6/2012	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									

¹<http://data.kimberly.udaaho.edu/ETidaho/scvstats.py?station=103932&cover=55&stats=Deficit>

³<http://wdr/water/usgs/govwy/2012/pdfs/13134600.2012.pdf>

Table 2

<i>ESPAM 2.1 Predicted Mitigation Benefit to Spring Cell(s) ¹ (cfs)</i>	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)
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_Accmp_4_11_14_Order/ "2005_2013Transient.xlsx"

Table 3

<i>ESPAM 2.1 Predicted Mitigation Benefit to Spring Cell(s) & GHBs Tributary to Snake River¹ (cfs)</i>		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)
Three Springs (tributary to Billingsley Creek)		1.37	1.48	1.57	1.63	1.68
Thousand Springs		5.30	5.73	6.06	6.31	6.50
Malad		3.87	4.20	4.45	4.64	4.80
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
Niagara Springs		3.51	3.79	4.01	4.18	4.31
Sands Springs		2.00	2.16	2.29	2.38	2.46
Devils C Springs		1.68	1.77	1.84	1.90	1.94
Devils WB Springs		1.30	1.37	1.43	1.47	1.50
NFBatchery Springs		1.20	1.30	1.37	1.43	1.47
Briggs Springs		0.12	0.13	0.14	0.15	0.15
Rangen Cell (Talus Slope Springs)		0.70	0.76	0.82	0.82	0.88
Total AB Springs (not including Rangen Curren Tunnel)		41.95	45.23	47.78	49.66	51.18
Class C Springs Tributary to Billingsley Creek		0.96	1.03	1.09	1.14	1.13
Class C Springs Kimberly to King Hill		2.22	2.33	2.42	2.40	2.26
General Head Boundaries (GHBs) Kimberly to King Hill		3.49	3.49	3.49	3.49	3.49
Total Snake River Gains below Milner		48.61	52.09	54.78	56.70	58.06

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