Lahontan Regional Water Quality Control Board

INTERNAL MEMO

To: Bud Amorfini, Engineering Geologist

From: Thomas Suk, Senior Environmental Scientist

Date: June 29, 2014

Subject: **HEAVENLY VALLEY CREEK—ANALYSIS OF RESULTS FROM A DECADE OF BIOASSESSMENT MONITORING (2001-2011), AND RECOMMENDATIONS FOR FUTURE MONITORING**

This memo replies to your request for bioassessment site scores for Heavenly Valley Creek for 2010 and 2011, and includes an analysis of the available bioassessment data for the past decade, with recommendations for the future.

Background

Total Maximum Daily Loads (TMDLs) were adopted by the Regional Water Board in January 2001, and approved by the USEPA in September 2002. The adopted "desired condition" for Heavenly Valley Creek is:

> **"Improving trends in benthic invertebrate community metrics over time, approaching conditions in Hidden Valley Creek"**

The adopted TMDLs (in part) required Water Board staff to work with the U.S. Forest Service (USFS) to design a bioassessment monitoring plan that is capable of tracking progress toward the desired condition. That plan was completed by the USFS and submitted to the Water Board in March 2003 (*see* USFS 2003). The plan called for bioassessment sampling at five sites at a frequency of "two years on, two years off" (i.e., sampling to be conducted 2002-03, 2006-07, 2010-11, 2014-15, etc., at least until attainment of the desired condition is documented).

It was subsequently proposed by the USFS, and agreed by Water Board staff, that one of the five sites (i.e., Upper Hidden Valley Creek, elevation 9,030 feet) would be dropped from the study design, due to its ephemeral flow conditions (which limited the value of the results) and difficult access (which imposed significant costs).

The remaining four sites include three "test" sites along Heavenly Valley Creek—i.e., Sky Meadows (at 8,540 feet elevation), Below Patsy's (at 7,921 ft.), and USFS Property Line (at 6,614 ft.)—and one "control" site at Hidden Valley Creek (6,642 ft.). The control site at Hidden Valley Creek is also known as "Lower" Hidden Valley Creek.

From 2001-2011, benthic macroinvertebrate (BMI) samples were collected by four different entities (using a variety of different methods), as summarized in Table 1, below:

Table 1. Bioassessment sampling events at four locations near Heavenly ski resort, including sampling entity and site codes.

Sample Year	Sample Date	**HVC-1 Heavenly Valley Cr "Sky Meadows"** R5BIO-016 (USFS)	**HVC-2 Heavenly Valley Cr "Below Patsy's"** R5BIO-018 (USFS)	**HVC-3 Heavenly Valley Cr "Property Line"** R5BIO-017 (USFS) 634HEV001 (SNARL)	**LHC-1 (Lower) Hidden Valley Cr** (control site) R5BIO-019 (USFS) 634HID001 (SNARL)
2001	Jul-01	USFS	USFS	USFS	USFS
2001	Jul-01			UCSB-SNARL	UCSB-SNARL
2002	Jul-02			UCSB-SNARL	UCSB-SNARL
2002	Jul-02	USFS	USFS	USFS	USFS
2003	Jul-03	USFS	USFS	USFS	USFS
2006	Sep-06	Heavenly	Heavenly	Heavenly	Heavenly
2007	Aug-07	Heavenly	Heavenly	Heavenly	Heavenly
2010	Aug-10	Heavenly	Heavenly	Heavenly	Heavenly
2011	Aug-11	Heavenly	Heavenly	Heavenly	Heavenly
2011	Oct-11				DFW-ABL

Methods

The bioassessment data (from multiple sources and dates, as summarized in Table 1) were compiled, formatted, scored, and analyzed for trends. Drs. Andrew Rehn and Peter Ode of the Dept. of Fish & Wildlife's Aquatic Bioassessment Laboratory (DFW-ABL) graciously agreed to assist us in compiling, formatting, scoring, and assessing the data.

It took several months (during 2013) and a lot of effort (by Andy, Pete, and me) just to obtain all of the data from the various sources. This initial step took longer than expected. In particular, some of the decade-old data were difficult and time-consuming to locate. I want to specifically acknowledge Dr. Joseph Furnish of the USFS, who provided substantial assistance in locating the "missing" data.

Once we had obtained and compiled all of the data, Dr. Rehn then formatted the data and calculated site scores for all sites/dates, using both the Eastern Sierra Index of Biological Integrity ("ESIBI," Herbst and Silldorff 2009), and the California Stream Condition Index (CSCI) which is currently being prepared for publication by DFW-ABL in collaboration with co-authors at the Southern California Coastal Water Research Project (*see* Mazor and others, in preparation).

The results were evaluated to assess the biotic condition of sites, and to assess trends at individual sites over time.

Results

The site scores are presented in Table 2, below:

Table 2. Bioassessment scores for sampling events at four stream locations near Heavenly ski resort (2001-11), calculated using the Eastern Sierra IBI (ESIBI) and the California Stream Condition Index (CSCI). (Blue cells indicate USFS samples with low BMI counts, yellow cells indicate SNARL samples.)

Sample Year	Sample Date	HVC-1 Heavenly Valley Cr "Sky Meadows"		HVC-2 Heavenly Valley Cr "Below Patsy's"		HVC-3 Heavenly Valley Cr "Property Line"		LHC-1 (Lower) Hidden Valley Cr (control)	
		ESIBI	CSCI	ESIBI	CSCI	ESIBI	CSCI	ESIBI	CSCI
2001 - USFS	Jul-01	35.6	0.56	49.4	0.74	53.9	0.77	75.2	0.92
2001 - SNARL	Jul-01	-	-	-	-	84.2	1.08	93	0.95
2002 - SNARL	Jul-02	-	-	-	-	75.3	0.87	96.8	1.15
2002 - USFS	Jul-02	37.9	0.69	53.9	0.91	51.1	0.72	75.2	1.08
2003	Jul-03	49.6	0.84	56.6	0.85	48.7	0.93	78.2	1.06
2006	Sep-06	55.3	0.92	52.2	0.95	69.1	1.02	80.6	1.15
2007	Aug-07	23.6	0.44	67	0.98	74.7	1.1	93.3	1.04
2010	Aug-10	36.8	0.74	55.2	0.99	80.7	0.9	94.6	1.08
2011	Aug-11	49.8	0.69	75	0.86	83.5	1.02	87.8	0.86
2011	Oct-11	-	-	-	-	-	-	87.8	0.99

The Eastern Sierra IBI was developed by Drs. David Herbst and Erik Silldorff of the University of California's Sierra Nevada Aquatic Research Laboratory (SNARL). The thresholds applicable to the Eastern Sierra IBI (ESIBI) are presented below in Table 3 (reprinted from Herbst and Silldorff 2009).

Table 3. Thresholds applicable to Eastern Sierra IBI (from Herbst and Silldorff 2009)

Supporting (Unimpaired)			Impaired	
Acceptable		Intermediate supporting but uncertain	Partially-supporting	Not supporting
>89.7	89.7–80.4	80.4 – 63.2	63.2 – 42.2	<42.2
A	B	C	D	F
Very good	Good	Fair	Poor	Very poor
Good		Fair	Poor	

The thresholds applicable to the CSCI are not yet published. Our interpretation of the CSCI results was guided by Drs. Andrew Rehn and Peter Ode of DFW-ABL, who are co-authors of the pending CSCI manuscript (*see* Table 4, from: Mazor and others, in preparation).

Table 4. Thresholds used to define condition classes for the CSCI. Pending publication of the CSCI, the values shown below were used for this assessment. (Values in parentheses reflect the probability that scores in the condition class are within the reference distribution.)

Index	Very likely intact (≥0.50)	Likely intact (0.30 to 0.50)	Possibly altered (0.10 to 0.30)	Likely altered (0.01 to 0.10)	Very likely altered (<0.01)
CSCI	>1.00	1.00 – 0.92	0.91 – 0.79	0.78 – 0.63	0.62 – 0.00

Using the thresholds discussed above, biotic condition at site HVC-1 ("Sky Meadows") is consistently poor according to the ESIBI, and mostly poor according to the CSCI. Biotic condition at site HVC-2 ("Patsy's") is generally poor according to the IBI, and generally good according to the CSCI. Biotic condition at site HVC-3 ("Property Line") is variable (from poor to good, depending on the year) according to the ESIBI, and generally good according to the CSCI. Biotic condition at site LHC-1 (Hidden Valley Creek control site) is always good to very good according to both the IBI and the CSCI.

Discussion

There are several potentially confounding factors that make definitive interpretation of the current dataset difficult. Issues that we considered include: differences in field collection equipment (i.e., net mesh size), differences in area sampled, differences in collection methods (i.e., targeted-riffle methods vs. multi-habitat methods), and differences in field personnel that collected the samples (including poorly documented or undocumented expertise, training, and quality assurance procedures).

Based on prior bioassessment "methods comparison" studies (Rehn and others 2007, Gerth and Herlihy 2006, Herbst and Silldorff 2006 & 2004), we concluded that the effects of most of the methodological differences are relatively minor (e.g., targeted-riffle composite method vs. multi-habitat reachwide benthos method, area sampled, 250um mesh vs. 500um mesh), but three issues stand out:

1. Several USFS samples had very low benthic macroinvertebrate (BMI) counts, making them not good candidates for scoring with either the ESIBI or the CSCI. Both protocols expect at least 450- to 500-count samples, whereas these USFS data points had very low (i.e., <200) counts. Since SNARL samples from these same sites collected in the same time frame had large BMI counts, and SNARL has both more experience and better QA documentation, it seems likely that this discrepancy may reflect problems with the USFS's sample collection and/or processing techniques during that era. For these reasons, we recommend ignoring the data from three USFS samples with very low BMI counts (HVC-3 in 2001 and 2002, and LHC-1 in 2001).

2. The 2001 and 2002 SNARL samples stand out as having considerably higher scores than other data from the same sites in the 2001-2002 time period. Dr. Rehn observed that SNARL's taxa lists frequently had a higher frequency of taxa identified to genus level, whereas USFS identifications were more often left at the family level for a number of groups. This may have contributed to the difference. But whatever the cause, because SNARL has both more experience and better QA documentation than the USFS crews of that era, we trust the SNARL results.

3. Even when the USFS samples for 2001-03 had sufficient BMI counts, differences between USFS's and other crews' scores persisted. (See LHC-1 in 2002-03.) For example, we cannot definitively explain why the USFS crews consistently obtained lower IBI scores at the control site (LHC-1) than the other three crews (SNARL, Heavenly's consultants, and ABL).

Another key issue is that—given the variability in scores—there simply are not enough samples to permit a valid statistical comparison to demonstrate "improving trends over time" (as called for by the TMDLs). Even if we ignored the three issues above, statistical tests of early vs. later years would not demonstrate definitive trends because of the high variance in individual observations. While some (or all) of the HVC sites may be on an "upward" trend since the implementation of post-TMDL sediment control measures, we cannot conclude with a high degree of confidence whether any such trend is underway. At best, more data are needed to document any trend(s). At worst, the management measures installed to date may be insufficient to achieve the desired condition. Continued monitoring is needed to answer these questions.

If we exclude the questionable results, as discussed above, several generalizations about site condition can be made. Table 5, below, summarizes the results in narrative terms. The ESIBI and CSCI assessments generally agree for three of the four sites. We cannot explain why the assessments differ at the fourth site, HVC-2 (Heavenly Valley Creek below Patsy's), where the ESIBI scores indicated generally poor biotic condition, and the CSCI scores indicated generally good condition. That difference may be due, in whole or in part, to methods, sampling error, and/or the low number of samples. Additional sampling may shed light on this question.

Table 5. Narrative summary of biological condition scores
(excluding questionable samples; see discussion)

Site	CSCI	ESIBI
HVC-1 Sky Meadows	Biological scores generally poor (except 2003 & 2006 were fair to good)	Biological scores always poor
HVC-2 Below Patsy's	Biological scores generally good (except 2001 was fair)	Biological scores generally poor (except 2007 & 2011 were "fair")
HVC-3 Property Line	Biological scores generally good	Biological scores mixed ➢ poor in 2003 ➢ fair in 2002, 2006-07 ➢ borderline fair-good in 2010 ➢ good in 2001, 2011
LHC-1 Lower Hidden	Biological scores always good to very good	Biological scores always good to very good

Conclusions & Recommendations

In the decade since TMDLs were adopted for Heavenly Valley Creek (i.e., from 2001-2011), bioassessment monitoring was conducted at three sites along the Creek, and at a nearby "control" site (Hidden Valley Creek). Taken as a whole, the results indicate that the instream biotic condition of site HVC-1 ("Sky Meadows") is poor, and the biotic condition of sites HVC-2 ("Patsy's") and HVC-3 ("Property Line") is generally fair to good (but not yet *"approaching conditions in Hidden Valley Creek"* as called for in the TMDLs).

While nascent signs of recovery may be emerging, there is insufficient data at this time to determine whether biotic condition is improving significantly at any of the sites since the TMDLs were adopted.

Given the above findings, bioassessment monitoring should be continued (using SWAMP's Reachwide Benthos protocols and the existing 2-years-on, 2-years off schedule), at least until an improving trend can be definitively documented (i.e., conduct sampling in 2014-15, 2018-19, 2022-23, etc.).

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