California Sportfishing Protection Alliance
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19 August 2011

Ms. Marily Woodhouse, Director
The Battle Creek Alliance
Marily Woodhouse <marily-lobo@hotmail.com>

VIA: Electronic Submission
Hardcopy if Requested

Dear Marily,

The California Sportfishing Protection Alliance (CSPA) received your letter and data requesting technical assistance in reviewing in stream sampling data assessing the potential impacts of forest clear-cutting operations and the maze of logging roads within the Battle Creek watershed.

In response to your request we assigned Mr. Steven Bond and Mr. Richard McHenry to review the data and assess the potential water quality impacts. Mr. Bond is a Professional Geologist, and Certified Hydro-geologist and Engineering Geologist with more than 30 years of experience in pollutant fate and transport in groundwater and surface water. He has worked for the U.S. Geological Survey, U.S. Army Corps of Engineers, Central Valley Regional Water Quality Control Board and as a private consultant. Mr. McHenry is a Professional Civil Engineer with 25 years of experience. He was Senior Supervisor of the Central Valley Regional Water Quality Control Board's NPDES permitting unit for the Sacramento Valley for over a decade and retired as the Senior Engineer in the State Water Board's Office of Enforcement.

CSPA has reviewed the data from the Battle Creek Alliance monitoring program (Four-Creeks) and find evidence of adverse changes in water quality conditions attributable to clear-cutting activities, and numerous and continuous exceedances of the turbidity Water Quality Standards in the Regional Water Quality Control Plan (Basin Plan). See Attachment 1.

Monitoring Program

The Four Creeks monitoring program is a 20-month effort by a community volunteer organization to sample and record the water quality of four tributaries of the North Fork of Battle Creek between December 2009 and July 2011. The region is an area of 85 square miles located southeast of Redding, California, between 3000 feet and 5000 feet elevation on the western slopes of Mount Lassen. The program includes 11 monitoring stations on Bailey Creek, Rock Creek, Canyon Creek, and Digger Creek. There is an additional station on the south fork of Battle Creek. The objective of the program is to establish a record of water quality in order to assess the potential impacts from the recent forest clear-cutting activities in the region of the four creeks.

Photo Imagery Assessment

Historical aerial photo imagery reveal that 35% of the region's 85 square miles (29 square miles) have been clear-cut within the past 9 -12 years. The photo imagery shows that these relatively recent logging/clear-cutting operations are the dominant activities in the region. The potential for water quality impacts from these clear-cutting operations is the subject of the Four-Creeks Monitoring Program.

Data Analysis

For this review CSPA looked for comparable data from unaffected streams and we looked for comparable turbidity data from the same watershed. We found no published data for these four creeks at any time. We did find published data and references to miscellaneous data for the period 1955 through 2002 for Battle Creek and some other tributaries. Most of the historical data is collected more than 10 miles downstream of the Four-Creek project. A single, 18 month daily record of turbidity was data collected and published by U.S Fish and Wildlife Service (FWS)[1] at the Coleman fish hatchery on Battle Creek (see Attachment 2). The FWS covers the period from September 1999 to February 2001. While the two data sets represent the same approximate duration (≈ 1.5 years) the FWS data set consists of daily measurements in contrast to the Four-Creek data set that consists a 10% sampling of the time span.

Pre-Clear-Cut vs. Post-Clear-Cut data

The FWS, pre-clear-cutting data set shows typical low turbidity with a mean average of four NTU's with less than 7% of the data exceeding 5 NTU's. In contrast, the four-creek monitoring data shows that the upstream, post-clear-cut mean average is 5 NTU's and on average exceeds 5 NTU's 37% of the time. The difference is that the post-clear-cut, Four-Creek data shows greater increases in turbidity compared to the pre-clear-cut FWS data.

- Canyon Creek has a mean average turbidity of more than 11 NTU's and on average, exceeds 5 NTU's 76% of the time. Canyon Creek, represented by CCC, this station is in the heart of the clear-cut area. Canyon Creek is tributary to Rock Creek.
- Rock Creek is represented by RC, and RCP, has a mean average turbidity of more than 5 NTU's and on average, exceeds 5 NTU's 43% of the time.
- Digger Creek, which is south of Rock Creek, is represented by DC, FMC, and DCH. It has a mean average turbidity of 3 NTU's and on average, exceeds 5 NTU's 16% of the time.
- Bailey Creek, which is north of Rock Creek, is represented by BCT and BCP. It has a mean average turbidity of less than 3 NTU's and on average, exceeds 5 NTU's 18% of the time.
- NFB: Below the confluence of Bailey Creek, Rock Creek with the north fork of Battle Creek is station NFB. NFB has a mean average turbidity of less than 4 NTU's and on average, exceeds 5 NTU's 29% of the time.
- SFB: The South Fork Battle Creek station, SFB, has a mean average turbidity of a little less than 5 NTU's and on average, exceeds 5 NTU's 26% of the time.

Although the before and after conditions can only be inferred from the differences in the

[1] http://www.fws.gov/redbluff/PDF/Battle%20Creek%20Juvenile%20Salmonid%20Monitoring%2002-03.pdf

locations of the data and the periods of time represented (i.e., downstream pre-clear-cut daily data, and upstream post-clear-cut 10% sampling), we can make certain conclusions from the information in the preceding paragraph. Typically, upstream reaches are characterized by turbulent flows, steep gradients, cold water temperatures, coarse substrates, and well-oxygenated water, whereas lowland reaches are typically characterized by warmer water temperatures, gentle gradients, turbidity, sediment deposition, fine substrates, and smaller concentrations of dissolved oxygen. If we use this general characterization, we can infer that given equal conditions, the Four-Creeks water quality should have lower turbidity than the downstream data. But, the data shows the opposite, strongly suggesting changed conditions for the upstream environment. This points directly at the likely impacts from the clear-cutting in the Four-Creeks watershed.

Basin Plan Turbidity Water Quality Standard Exceedances

We also reviewed the Four-Creeks data in terms of turbidity changes within occurring on the same day. For that, we compared the following pairs of stations: BCT > BCP, CCC > CC2, CC2 > CC, RC > RCP, DC > FMC, FMC > DCH. Certain pairs where omitted because they represented water quality changes owing to different water sources. For example: BCP to NFP compares the water from Bailey Creek to the North Fork of Battle Creek mixed with Bailey Creek, and CC to RC compares Canyon Creek to Rock Creek and its tributaries mixed with Canyon Creek.

- Bailey Creek (BCT > BCP), turbidity increased in 56% of the sampling events and 20% of the sampling events registered (8) exceedances of the Basin Plan water Quality Standard for turbidity.
- Canyon Creek (CCC > CC2) turbidity increased in 40% of the sampling events and 37% of the sampling events registered (13) exceedances of Basin Plan Turbidity Water Quality Standard. Also on Canyon Creek (CC2 > CC) turbidity increased in 85% of the sampling events and 76% of the sampling events registered (39) exceedances of Basin Plan Water Quality Standard.
- Rock Creek (RC > RCP) turbidity increased in 83% of the sampling events and 61% of the sampling events registered (30) exceedances of Basin Plan Water Quality Standard.
- Digger Creek (DC > FMC) turbidity increased in 20% of the sampling events and 20% of the sampling events registered (2) exceedances of Basin Plan Water Quality standard. Also on Digger Creek (FMC > DCH) turbidity increased in 75% of the sampling events and 40% of the sampling events registered (8) exceedances of Basin Plan Water Quality Standard.

Based on our review of the submitted data and sampling procedures, we can reasonably conclude that it is unlikely that the grab sampling activities would have captured peak turbidity flows within the watershed. Ideally, instream sampling devices would have been installed with frequent interval sampling that could have captured a more comprehensive assessment of turbidity increases related to stormwater events. The limited resources of the Battle Creek Alliance volunteer organization likely prohibit this level of sampling. A more robust sampling program is highly recommended to further quantify the water quality impacts of forest clear-cutting operations and the maze of logging roads within the Battle Creek watershed

However, the Battle Creek Alliance's Four-Creeks monitoring program documents at least 100

exceedances of the Basin Plan Water Quality Standard for turbidity. While some of the preceding station pairs used for this determination are widely spaced, all, with the exception of NFB and DCH, are within the 85 square mile region of clear-cutting activities. And, because clear-cutting operations are or appear to be the dominant influence on turbidity within the region, the changes in turbidity can likely be attributed to variations in the clear-cutting effects from different areas. Consequently, we may reasonably conclude that the exceedances of the Basin Plan Water Quality Standard owing to increases in turbidity are attributable to the timber harvest activities in the watersheds.

Summary

- Historical aerial photo imagery that in the last 10 years 35%, 29 square miles of forested land has been clear-cut by timber harvesting operations.
- The timber harvest activities of the past decade are the dominant activity in the watersheds with pollution producing potential.
- The Four-Creeks post-clear-cut water quality has higher turbidity than the downstream FWS pre-clear-cut water quality data, indicating changed conditions in the upstream environment.
- Canyon Creek and Rock Creek are the most impacted streams and show the greatest occurrence of high turbidity registering 81 exceedances of the Basin Plan Water Quality Standard for turbidity.
- The Four Creeks monitoring program has registered at least 100 exceedances of the Basin Plan Water Quality Standard for turbidity.
- Based on our review of the submitted data we feel confident that it is reasonable to conclude that the turbidity exceedances of the Basin Plan water Quality Standard are attributable to the timber harvest activities in the Battle Creek watershed(s).

We hope that CSPA's evaluation of the data is of value to you and the Battle Creek Alliance. Please contact me at (209) 464-5067 if we can be of further assistance or answer any questions regarding our review and assessment of the data.

Sincerely,

Bill Jennings, Executive Director
California Sportfishing Protection Alliance

Attachment 1: Battle Creek Monitoring Data Set.
Attachment 2: Area Map.