RIVER *MONITORING* Dennis Jackson & Associates

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August 17, 1998

Edward Anton
Chief, Division of Water Rights
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000

re: 363:RF:262.0(23-10-03)

Dear Mr. Anton:

I would like to offer comments on the document entitled, *Report of Investigation on the Navarro River Watershed Complaint in Mendocino County, July 1998.* The Complaint Unit of the Division of Water Rights prepared the document.

I was the Hydrologist for the Mendocino County Water Agency from May 1989 to November 1994. I have a Masters in Physical Science with emphasis on Hydrology. I am familiar with the Navarro River watershed. I have worked with your staff on various aspects of water resource questions in the Navarro River watershed.

Declining Annual Minimum Streamflows

In May of 1991 I sent a letter to you (attached) describing a simple regression model I constructed using data from the USGS gage. The regression model used *total annual runoff* in feet (Total Annual Acre-feet divided by watershed area in acres = feet) and the *year* to predict the annual minimum streamflow. The model explained 67% of the variance in the data. Both the variables had statistically significant t-test values. The *year* variable had a negative coefficient, indicating that the annual minimum streamflow was declining with time.

This simple model indicates that minimum annual streamflow may have been declining during the period between the 1951 and 1988. Since the model includes an index to precipitation, it is unlikely that the significant statistical relationship between time and annual minimum streamflow is due to changes in precipitation over the period. Further study should be directed towards investigating the declining annual minimum streamflow during the study period. If the decline in annual minimum streamflow can be further substantiated it would support the hypothesis that there is a measurable impact associated with increased summertime pumping in the watershed. The pattern of declining annual minimum streamflow has not been observed on the Garcia, Noyo or Ten Mile Rivers

Effect of Flow on Temperature

The discussion of the effect of flow on temperature in the SWRCB July 1998 report is flawed. The report focuses on the observed decline in water temperature over the summer. The report offers the theory that the proportion of flow from ground water is increasing from early summer to fall and that the ground

water is cooling the water. The report demonstrates the decline in temperature with time by doing a regression using the *Number of Days Since the Temperature Peak to* predict the *Temperature*. The report correctly observes that, *"The existence of a significant statistical relationship between temperature and flow does not establish that a cause and effect relationship exists"*.

The observation of declining water temperature from June to October can be better explained by simple astronomical facts. The summer solstice occurs on June 21-22. The solstice is the day the sun reaches its maximum northerly latitude in its daily transit across the horizon. Since the sun reaches its zenith on the solstice, the intensity of sunlight, measured in Watts per square meter, striking the surface of the Earth is greatest, in the Northern Hemisphere, on the summer solstice. Sunlight is at maximum intensity when the sun is directly overhead. In the Northern Hemisphere the sun is never directly overhead. The summer solstice is the day that the sun comes closest to being directly overhead. The day-length also reaches its maximum on the summer solstice. Each day following the solstice, the sun crosses the sky on a progressively lower arc. The lower arc means that both day-length and light intensity are decreasing.

Water temperature is effected air temperature, as mentioned in the SWRCB report. However, water temperature is also strongly effected by direct solar radiation. As described above, the energy supplied by direct solar radiation begins to decline after the summer solstice. The sun's progressively lower arc across the sky effects water temperature by:

- decreasing the energy per square meter of the sunlight
- decreasing day-length
- increasing topographic shading

The SWRCB report does not discuss the large diurnal variation in water temperature. The range in diurnal variation, in some cases, is almost as great as the seasonal change.

The report also speculates that the proportion of streamflow coming from ground water reservoirs increases over the course of the summer. The report offers no credible evidence for this hypothesis. In my opinion, it is likely that the streamflow is 100% ground water by the end of June. Tracking flow and conductivity measurements from March to October would be a reasonable way of determining when the flow is primarily supplied by ground water. As the proportion of ground water increases the conductivity should increase. Furthermore, the hydrograph could be used to estimate the beginning of the period when flow was completely derived from ground water sources since periods with no surface water flow can be adequately modeled with an exponential decay function (Chow and others).

The discussion in the SWRCB report offers nothing to refute the postulate in the complaint that decreased summer flows are associated with higher temperatures and that increased summer flows would result in lower water temperatures. Paired watershed studies or continued monitoring of temperature and flow over a number of years would be better approaches to studying the relationship between temperature and flow. For example, the water temperatures in Elder Creek could be compared to water temperatures in different tributaries of the Navarro. Elder Creek is a national *Benchmark* watershed. Elder Creek is not effect by diversions. Elder Creek is located on Nature Conservancy property near Laytonville. Elder Creek may represent the best obtainable water temperature regime in Mendocino County.

The attached preliminary report I prepared in 1994 discusses water temperatures measured by the U.S. Geological Survey in Elder Creek, the Garcia, Noyo and the Navarro Rivers. The monthly average maximum water temperature occur in July on all four of these streams. The July monthly average maximum water temperature in the Navarro River was 4° F higher than in either the Garcia or the Noyo Rivers and was 7° F higher than in Elder Creek. The Noyo River is a coastal watershed that lies to the north of the Navarro. The Garcia River is a coastal watershed to the south of the Navarro. Both the Garcia and Noyo Rivers have are predominately timberland upstream of the USGS stream gage with only a few water diversions. The Navarro River has many more water diversions upstream of its stream gage than either the Noyo or the Garcia Rivers. The observed difference in water temperature between the Navarro

River and the Garcia and Noyo Rivers supports the contention that water diversions effect water temperature.

Tracking the water temperature and flow at a site over a two-year period does not demonstrate the effect of an increase or decrease in summertime streamflow at the site. The argument advanced by the SWRCB report can not assess the impact on water temperature due to an increase or decrease in streamflow.

Effect of Winter Water Diversions on Summer Streamflow

There are three possible interactions between a stream reach and an adjacent aquifer.

- a stream reach can receive water from ground water reservoirs (gaining stream)
- a stream reach can contribute water to ground water reservoirs (losing stream)
- or there may be no ground water/surface water interaction

The relationship between surface water and ground water can change from reach to reach. The ground water/surface water interaction in the same stream reach can also change seasonally and between wet years and dry years.

Therefore, it is within the realm of possibility that, winter diversions could reduce the amount of ground water recharge. Reduced ground water recharge could result in lower summer time stream flows which, in turn, could result in higher summer water temperatures. Evaluation of this mechanism of effecting summer streamflow requires extensive fieldwork. The SWRCB report does not mention this mechanism. Serious consideration needs to be given to this issue since Coho are an endangered species.

Flow Needs for Fishery

The Division has proposed a method for estimating bypass flows in the Russian River watershed. The Division may use this methodology for water diversion applications in the Navarro. The proposed methodology sets the bypass flow for the April 1 to December 14 period at 30% of the annual average flow rate. On the Navarro this translates into a flow of 150 cfs. The report observes that the flow record for the Navarro does not meet the proposed April 1 to December 14 bypass flow. The report then concludes that:

> Low flows in the summer under natural conditions may have been a limiting factor in the anadromous fish population.

A factor could be a limiting condition for a fish population prior to the settlement of the watershed. In this sense, the factor played a key role in checking the size of the fish population, when compared to the pre-settlement potential population size. The same factor could be impacted by water diversions and other land use practices to such an extent as to reduce the post-settlement potential population size relative to the pre-settlement potential population size.

In my opinion, the proposed methodology is faulty. It generates a bypass flow that is an order of magnitude higher than the observed summer time flow for the period of record. The proposed methodology is based on the *Tennant Method* also know as the *Montana Method*. A method that was developed for a snow-dominated system is inappropriate for a system dominated by winter rains.

The California streams most similar to Montana stream are the snow-dominated streams on the east side of the Sierras. Snowmelt streams on the east side of the Sierras typically experience their maximum streamflow in late June or early August. The minimum streamflow typically occurs in January or February for east-side Sierra streams. The maximum flow in the Navarro typically occurs in December to February. The minimum flow in the Navarro occurs in September or October.

The flashy nature of northern coastal California watersheds and the typically limited ground water storage results in summer flows typically in the range of 10 to 20 cfs. The Division's report points out that, "However the frequency of low flows is more meaningful from a fishery standpoint than the average

flows". Therefore, the Division should forsake the use of a percentage of mean annual flow to set the summer bypass flow. I suggest that the Division investigate the use of a declining bypass flow for the April 1 to December 14 period. A declining bypass flow would better simulate the flow regime of the Navarro than a fixed value.

Separate reviews of the Division's attempt to apply the Tennant method to the Russian River were made by Dr. Robert Curry and by McBain and Trush. Both reviews were extremely critical of the Tennant method. The Division of Water Rights has not presented adequate justification to apply the Tennant method to Northern Californian coastal stream. Furthermore, The Division has not developed appropriate modifications to the Tennant method that would make it more applicable to systems such as the Navarro.

Public Trust Action

The report claims that,

> However, the cause of the anadromous fish decline may be principally due to factors other than flow, and there is not enough information available regarding the needs of the fishery in the summer. Consequently, the Division recommends that a public trust action should not be initiated at this time.

The report fails to demonstrate that water diversions are not a significant factor in the decline of anadromous fish in the Navarro watershed. The Division should increase its efforts to determine if existing diversions, both legal and illegal, are significantly depressing summer flows. The long term flow record at the USGS gage indicates that there may be a statistically significant decline in annual minimum streamflow with time.

The Division should continue to study the effect of decreased streamflow on water temperature. The high water temperatures observed in the Navarro may be caused by water diversions decreasing the volume of streamflow in the summer time.

The State Water Resources Control Board is responsible for any adverse impacts, caused by water diversions, to endangered fish populations. The mere observation that other factors, besides water diversions, are impacting endangered fish populations does not relieve the SWRCB of its responsibility. The SWRCB should initiate a public trust action in the Navarro watershed.

The Division's claim that water diversions are not a significant factor in the decline of anadromous fisheries in the Navarro River watershed is not scientifically supported. Therefore, I request that the State Water Resources Control Board override the Division of Water Rights' recommendation and initiate a Public Trust action in the Navarro River system. The SWRCB should also declare the Navarro River and its tributaries fully appropriated for the April 1 - December 14 period.

Thank you for the opportunity to comment on the Division's report.

Sincerely,

Dennis Jackson
Hydrologist

Attachments:

cc: Jim Bybee, NMFS
Brian Hunter, DFG
Robert Klamt, RWQCB
Diane Paget, Friends of the Navarro