SECTION 5.6.1 MAIN STEM CARMEL RIVER WATER QUALITY

Since 1991, the MPWMD has collected surface water quality data at two locations on the Carmel River (**Appendix 5.6**). Sampling stations are located below Los Padres Dam and below San Clemente Dam. Specific locations and descriptions of sampling stations can be found in **Appendix 5.6**. Data were collected for the following chemical and physical parameters: temperature (°F), dissolved oxygen (mg/L), carbon dioxide (mg/L), pH, specific conductance (uS/cm), and turbidity (NTU). The emphasis for this suite of parameters is on the suitability for rearing juvenile steelhead.

Favorable water quality conditions for rainbow trout/steelhead culture are listed in **Table 5.6.1-A** (Piper et al., 1982). Also listed below is the Central Coast Basin Plan water quality objectives set by the California State Water Resources Control Board (SWRCB).

Table 5.6.1-A. Suggested chemical criteria for trout hatchery water supply and Central Coast Basin Plan water quality criteria for cold freshwater habitat.

Parameter	***Hatchery water supply****	***Central coast basin plan *****
Temperature range	33-78°F	never 5°F above natural receiving water temp.
Optimum temperature range	50-60°F	N/A
Dissolved oxygen	5 mg/l -saturation	not less than 7.0 mg/L
pH	6.5-8.0	7.0-8.5
Carbon dioxide	0-10 mg/l	N/A

* Piper et al. 1982
** SWRCB, 1994

WATER TEMPERATURE

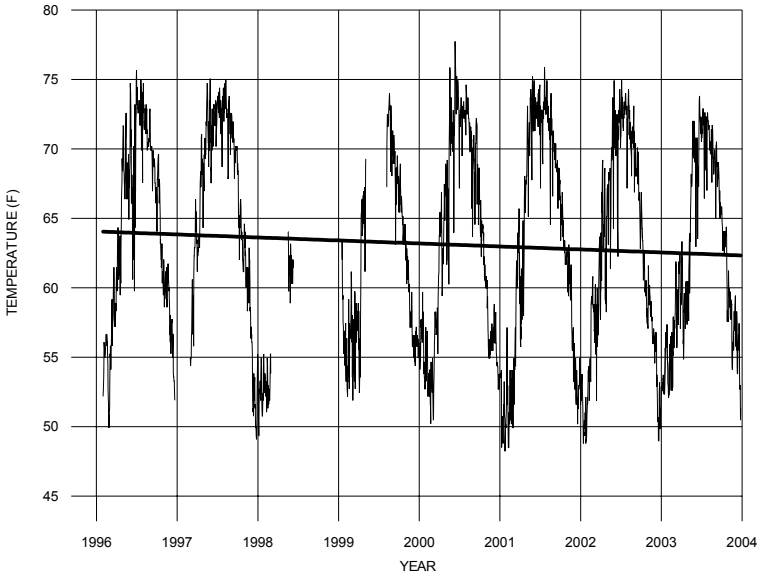
Water temperature has been measured at a total of 11 locations including the Lagoon (two sites), the Narrows, Garland Park, Sleepy Hollow weir, San Clemente Reservoir (three sites), San Clemente Creek, and Los Padres Reservoir (two sites). One of the Lagoon sites has been discontinued due to vandalism.

Water temperature in the main stem Carmel River (excluding the Lagoon and two main stem reservoirs) has been monitored at six different locations, since 1996. For a complete record of sampling dates, and locations refer to **Appendix 5.6**. Generally, water temperatures in the main stem Carmel River are satisfactory for aquatic life during the winter and spring months. Typically this is the period when there is adequate flow and cooler air temperatures. However, water temperatures reach threatening levels for aquatic life during the summer and fall months. This is due to the reduction of flow and warmer air temperatures. Maximum daily water temperature commonly exceeds 70°F during the summer and fall months. Linear trend analysis of data from the eight-year period between 1996 and 2004 at the Garland Park station (see **Figure 5.6.1-A)**, where water temperature annually exceeds 70°F, shows a slight downward trend in maximum daily water temperature.

This may be due to the recovery of the riparian zone upstream and the shade it provides along the river. However, maximum water temperatures remain within the stressful range during the summer and fall months. The optimum water temperature range for steelhead growth is 50-60°F (Piper et al. 1982). During the summer and fall period, average daily water temperature commonly exceeds the range for optimum growth (**Figure 5.6.1-B**).

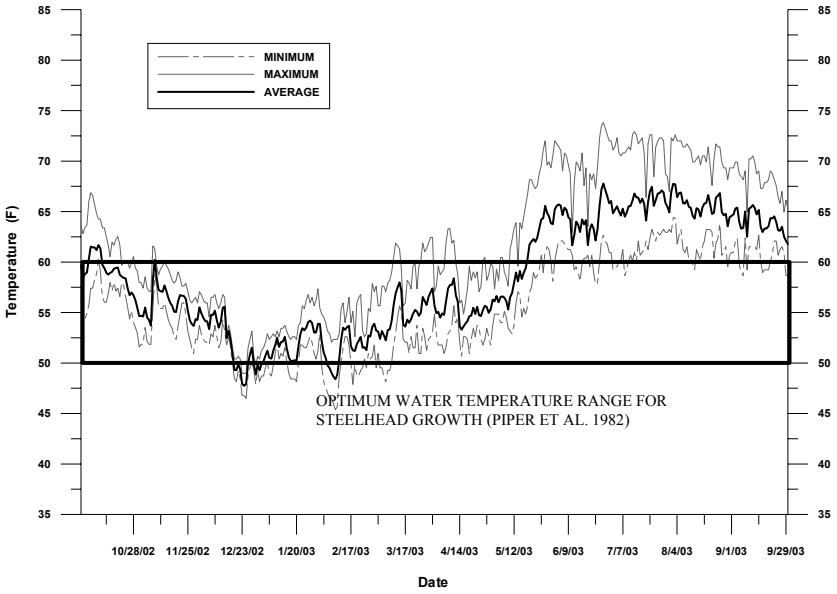
All six main stem monitoring stations exhibit stressful temperature conditions during the summer and fall months. Potential factors affecting water temperature in the main stem Carmel River include rainfall, air temperature, reservoir water temperatures, reservoir flow releases, tributary inflow, water diversions, canopy cover, and septic effluent.

Figure 5.6.1-A. Maximum daily water temperature at Garland Park Station during CY 1996-2003.



Note: Data for 1998 and 1999 years are incomplete

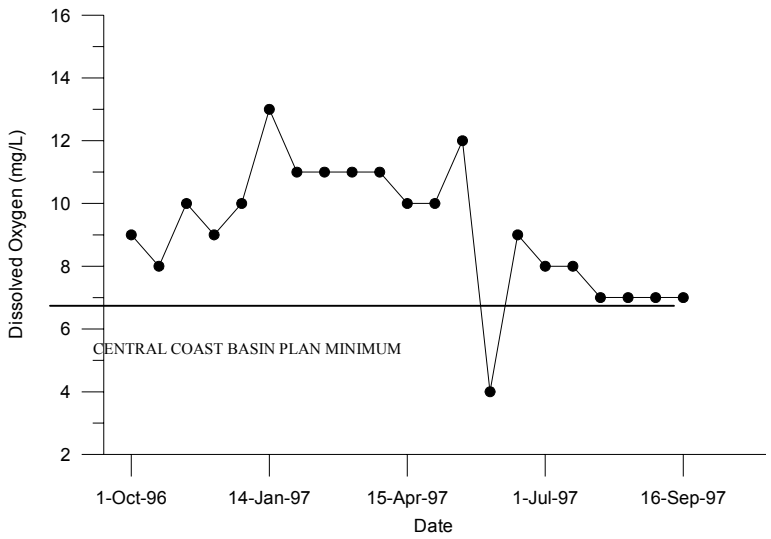
Figure 5.6.1-B. Daily water temperature at Garland Park station during WY 2003.



DISSOLVED OXYGEN

Generally, dissolved oxygen levels observed by MPWMD between 1991 and 2004 have met the Central Coast Basin Plan objectives of 7 mg/L or higher. There has been one recorded violation of this objective, which occurred below the Los Padres Dam on June 3, 1997 (**Figure 5.6.1-C**). During the spring and summer months the reservoir stratifies, creating a bottom layer of cold, low-oxygenated water and a top layer of warmer and more oxygenated water. At the time, the reservoir was nearly full and releases were being made primarily from the lower outlet. Under these stratified conditions, the dissolved oxygen in the lower outlet release can fall below the saturation level. This is believed to be the reason for the observed violation of the objective. This is further evidenced by the fact that an additional measurement made approximately 200 ft downstream showed that the dissolved oxygen level was at or near saturation level.

Figure 5.6.1-C. Dissolved oxygen measurements recorded below Los Padres during WY 1997.



pH

The pH measurements observed at the sampling stations in the Carmel River always were within the Central Coast Basin Plan recommended range of 7-8.5. For example, **Figure 5.6.1-E** shows the pH measurements recorded at the Los Padres sampling station for the past thirteen years.

CARBON DIOXIDE

Carbon dioxide levels ranging from 0-10 mg/L are recommended for salmonid hatchery water sources (Piper et al. 1982). Carbon dioxide in excess of 20 mg/L may be harmful to fish (Piper et al. 1982). The most detrimental influence of carbon dioxide results when concentrations increase during periods of critically low dissolved oxygen. Dissolved oxygen concentrations at the sampling stations never fell below 7.0 mg/L at times when the carbon dioxide concentrations were above 10 mg/L. For example, carbon dioxide measurements recorded below Los Padres during the last thirteen years are shown in **Figure 5.6.1-F**.

Figure 5.6.1-E. The pH measurements recorded at below Los Padres sampling station from WY 1991-2003.

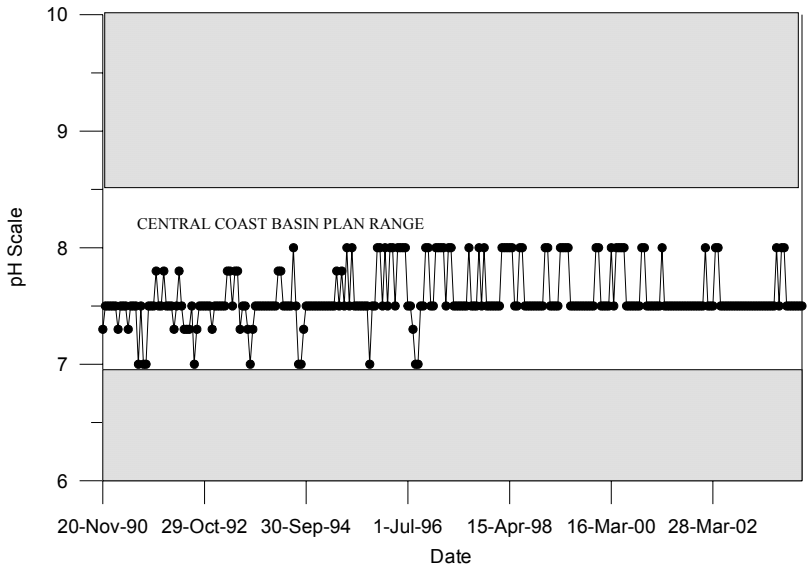
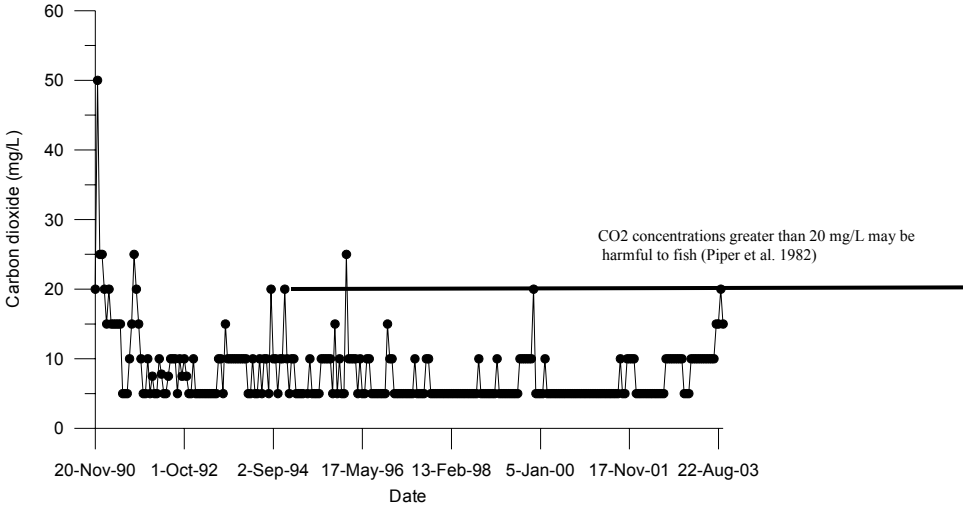


Figure 5.6.1-F. Carbon dioxide measurements recorded below Los Padres during WY 1991-2003.



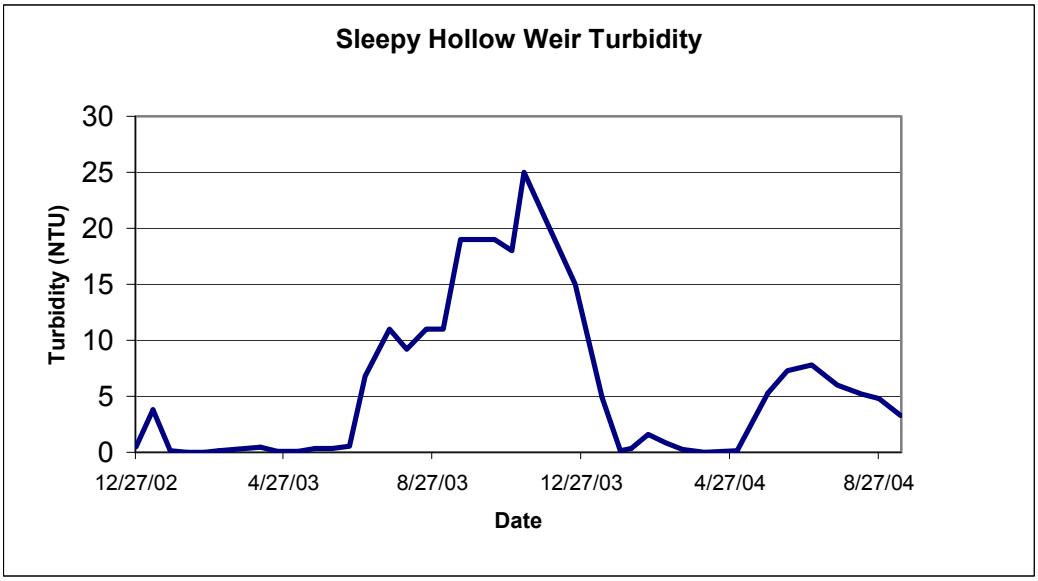
SPECIFIC CONDUCTANCE

Specific conductance at the sampling stations ranged from 129-550 umhos. The average specific conductance over the thirteen-year monitoring period is 267 umhos.

TURBIDITY

Turbidity in the main stem is normally low, except during winter when storm runoff events can elevate turbidity for several days during and after a storm event. Very wet years, such as in 1998, can cause extensive landslides and bank erosion, which can increase turbidity in the main stem for up to several months. In June 2003, Cal-Am was ordered by the State of California's Department of Water Resources, Division of Dam Safety to lower the water elevation of San Clemente Reservoir for safety precautions. The lowering caused a large amount of sediment that was historically trapped behind the dam to move downstream. The turbidity below the San Clemente Dam during this process increased to 25 NTU as shown in **Figure 5.6.1-G**. Sigler et al. (1984) found that turbidity levels of 25 NTU caused a reduction in growth of steelhead. Other effects of elevated turbidity levels on steelhead include disruptions in physiological functions, emigration, decreased foraging ability, damage to redds, reduction in spawning and benthic macro-invertebrate habitat. The Central Coast Basin Plan objectives for turbidity state that levels should not exceed 20% or 10 units above natural levels. Based on the limited amount of data available, it appears that turbidity levels have increased above background levels since the draw down of San Clemente Dam was initiated.

Figure 5.6.1-G. Turbidity measured at the Sleepy Hollow Weir from December 2002 to September 2004.



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Sigler, J.W., T.C. Bjornn, and F. H. Everest. 1984. *Effects of chronic turbidity on density and growth of steelheads and coho salmon.* Transactions of the American Fisheries Society 113: 142-150.

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