

**Attachment B**  
**PG&E's Recommended Use of the Sullivan Report**

**CVRWQCB CITED  
REPORT:**

Sullivan, K., D. J. Martin, R. D. Cardwell, J. E. Toll, and S. Duke. 2000. *An analysis of the effects of temperature on salmonids of the Pacific Northwest with implications for selecting temperature criteria*. Sustainable Ecosystems Institute. Portland, OR. 192 pp.

**REPORT TOPIC:**

Water Temperature

**SWRCB & CVRWQCB  
STAFF APPLICATION:**

The State Water Resources Control Board (SWRCB) and the Central Valley Regional Water Quality Control Board (CVRWQCB) state that the Sullivan report should be used as an evaluation guideline for water temperature for California surface waters in the factsheets used to determine listing or delisting of water segments under the Clean Water Act Section 303(d). However, the SWRCB's use of binomial distributions to determine listing status with this guideline (in the SWRCB's Water Quality Control Policy or Listing Policy) implies that the report is being used as an objective rather than an evaluation guideline.

**PG&E'S RECOMMENDED  
APPLICATION:**

Appropriate use of the Sullivan report would be to use it strictly as an evaluation guideline (i.e., screening tool) in conjunction with available biological data or other lines of evidence to determine the health of California surface waters. Binomial distributions do not apply to guidelines and are meant for use with objectives. In addition, there are a number of technical issues associated with the Sullivan report, which reinforce that it should be used strictly as an evaluation guideline or screening tool.

**PG&E'S RESPONSE:**

The objective of the Water Quality Control Policy (adopted September 2004) is to establish a standardized approach for developing California's section 303(d) list (SWRCB 2004). This approach is to achieve the overall goal of maintaining water quality standards and beneficial uses in all of California's surface waters.

In order to achieve this goal, the SWRCB and the CVRWQCB supported use of a water temperature guideline from Sullivan et al. (2000). The report calculated the Annual Maximum (instantaneous maximum observed during the summer) upper threshold criterion for steelhead trout as 21°C. The risk assessment approach used by Sullivan et al. (2000) suggests that an upper threshold for the Annual Maximum of 21°C for steelhead will reduce average growth 10% from optimum.

There are many technical issues associated with the Sullivan et al. (2000) report and a number are discussed below.

1. **The criteria were developed to protect a specific species, Pacific Northwest salmonids.**

The steelhead occurring in Sierra streams are significantly different populations that exhibit different life history strategies and growth dynamics than Northwest populations. Northern steelhead are generally acclimated to colder stream temperatures. Consequently, they spend relatively longer time in their native streams, grow slower to out-migrant size, and return at an older age to spawn than their southern counterparts. Adopting “Annual Maximum upper threshold criteria” from these northern species (based on the Sullivan et al. report) and applying them to southern Sierra populations, without some field validation efforts is problematic.

2. **Most California or Sierra streams do not meet the Sullivan guideline under natural conditions.**

Historic data does not support the use of a 21°C annual maximum water temperature because water temperatures in the 1940-1963 period were likely comparable to, if not warmer than, the current water temperatures in the North Fork Feather River (NFFR) and other California streams based upon historic PG&E data. In addition, water temperature data collected in 1985 and 2001 by PG&E indicates that release water temperatures from the present intake structure of Lake Almanor for the NFFR ranged from 20-22°C (daily mean) for July and August. The lake water surface levels in these two years were comparable to the peak water surface levels during the period 1940-1963. Ms. Sullivan also stated that many streams and rivers in California are probably not going to be able to achieve the suggested 21°C guideline water temperature naturally, and trying to would be difficult (SWRCB hearing transcript, *Consideration of a Resolution to Approve the 2002 Federal Clean Water Act Section 303(d) list of Water Quality Limited Segments*, dated February 4, 2003, on page 141 (lines 22-25). Therefore, the Sullivan guideline should be used as guidance or as a screening tool that should be used to indicate whether additional review of biological data or other lines of evidence are necessary to determine if the water segment is impaired.

3. **The report uses risk-based methods applicable to evaluation of contaminants but unproven as a management tool for the development of water temperature criteria.**

The method modifies an approach taken from laboratory studies that estimate the length of time it takes to observe 50% mortality in a population exposed to a given temperature (LT50); it then proposes (with little documentation and no field testing) that an LT10 curve (the temperature where 10% mortality is observed) is more ecologically relevant. Natural variability in a sample can be well above 10% of the mean.

The report stated that the data from the U. S. Environmental Protection Agency (USEPA), used to document the relationship between LT50 and LT10, did not provide sufficient data to statistically test differences in the two curves. Nonetheless, Sullivan et al. (2000) used Chinook salmon data to develop a conversion factor from LT50 and LT10, and then applied that to steelhead without any field or laboratory validation. Using the acute temperature analogy (LT10 curves), the report then applied the same 10% criteria to “Reduction In Maximum Growth” (RMG) to obtain the threshold water temperatures for “Sub-lethal” effects. Sullivan et al. (2000) even stated that, “The criteria above assume 10% growth loss as the acceptable level of risk. There is uncertainty associated with this number, since there are relatively few quantitative data to base it on. Further research could help confirm acceptable risk levels.”

4. **Using a 10% reduction in growth as a guideline is arbitrary.**

It should also be noted that Ms. Sullivan states that a 10% growth loss from the optimal conditions was arbitrarily chosen. She further states that this 10% condition is a very good condition and a very safe number. Ms. Sullivan states that in her evaluation she found that no stream had optimal temperatures all of the time for the fish from the time they emerge from the gravels to the time they meet the winter months. The best stream she noted had a 5% growth reduction. She concludes that the 10% limit is, in fact, a very good number for fish and it would be difficult to actually ascertain that there is impairment at this level (SWRCB Hearing Transcript, page 140, lines 9-25).

Finally, Ms. Sullivan states on page 141, lines 6-13 in the above transcript, that while growth is an important aspect of the life of the fish it is not clear from scientific research how to pick the threshold number that would indicate impairment. There is no scientific research at this time that would indicate that 10%, 12%, 13%, or 14% is the ideal number and there is no scientific evidence that would allow one to pick with confidence one of these threshold numbers. In conclusion, Ms. Sullivan states that you could easily pick a number at 20% reduction in maximum growth with a great deal of confidence.

5. **Ms. Sullivan’s testimony supports the concept that USEPA’s target of a 20% reduction in maximum growth provides adequate protection from impairment.**

Consequently, the Sullivan et al. (2000) report makes reference to a USEPA document from 1977, which also supports the selection of a higher threshold number (24.0°C) for the protection of steelhead trout with an associated reduction in growth of 20%. PG&E believes that both the Sullivan and USEPA threshold numbers should be used as guidelines for comparison to temperatures as part of a screening process to evaluate

stream temperatures and to determine whether additional assessment of biological data or other lines of evidence is needed. These are not lethal temperatures and an Annual Maximum of 24°C was reported as acceptable to the USEPA in their 1977 report and is also supported by Ms. Sullivan's testimony statements from the February 4, 2003 hearing.

6. **Application of a single water temperature guideline to waters in a highly variable environmental setting is problematic.**

According to research conducted by Don Essig of the Idaho Division of Environmental Quality, Water Quality Assessment and Standards Bureau in November 1998, use of a fixed or single water temperature criterion applied uniformly (all places, all times, or pre-defined time periods) does not reflect the range in stream temperatures one would expect, based on climatic variability. In addition, single value criteria do not account for environmental preference or tolerance differences between species, or within species throughout its range (Essig 1998). One must account for a number of variables in the application of surface water temperature criteria. These include natural spatial and temporal climate variation (i.e., elevation differences), types of species or organisms present in the system (including species of concern) and their response to water temperature. The behavioral response of aquatic organisms needs to be accounted for in water temperature metrics and criteria and in how stream water temperatures are assessed (Essig 1998).

In a letter titled, *Proposed 303(d) Listing for the North Fork Feather River*, from Mr. James Pedri (RWQCB, Redding Branch Office) to Mr. Joe Karkoski (RWQCB, TMDL Unit) dated December 1, 2005; Mr. Pedri acknowledges that use of a single water temperature criteria is not appropriate for listing water segments on the 303(d) list and that additional lines of evidence based on current available data should be assessed to substantiate or disprove impairment. In addition, Mr. Pedri states that exceedence of an instantaneous daily maximum water temperature guideline as basis for listing grossly oversimplifies water temperature and cold water species relationships in California rivers and streams. There are several different metrics that can be used for assessing the implications of temperature to aquatic species. He concludes that understanding water temperature/cold water species relationships and determining 'impairment' in the real world of modified rivers and streams is a very complex process and cannot rely on a single water temperature criterion or single line of evidence, nor can it rely on strictly historical data. Listings must be well founded and substantiated not only in differences from suggested water temperature guidelines, but must also consider all known current available biological data or other lines of evidence when assessing the health or impairment of a water segment.

## PG&E's CONCLUSION

PG&E believes that the Sullivan threshold number (10% growth reduction) should be used as a *guideline* or *screening tool* in conjunction with other available temperature guidance such as the USEPA threshold number (20% growth reduction). In testimony that Ms. Sullivan provided to the SWRCB back in February 2003, she indicated that the 10% growth reduction was an arbitrary number that is actually indicative of a very good number for fish and that it would be difficult to ascertain that there is impairment at this level. In addition, she stated that the associated water temperature of 21°C would likely not be met in many Sierra streams. Finally, she stated that one could easily pick a number at 20% reduction in maximum growth with a great deal of confidence.

These values (Sullivan and USEPA guidelines) should be used to provide a preliminary screening of stream water temperatures which would then indicate whether a closer look at additional current and available data or lines of evidence (biological indicator data and elevation or climatic influences, etc.) would be warranted to determine the overall health of the stream. The exceedance of the guideline provided by Sullivan is not the same as exceeding a water temperature objective included in the Basin Plan and a single criterion does not accurately reflect the dynamic nature of any river system.

Ultimately, if the other lines of evidence such as biological data indicate a healthy stream or lack of impairment, then the water segment should not be listed on the 303(d) list -- even if there are exceedances of either the Sullivan or USEPA guidelines. All of these factors (screening water temperature guidelines and current biological data or other lines of evidence) must be considered to determine validity of listing.

A listing cannot be based solely on one factor such as the Sullivan guideline to determine listing status, and listings cannot rely on outdated historical anecdotal data.

## References

Essig, Don A., 1998. *The Dilemma of Applying Uniform Temperature Criteria in a Diverse Environment: An Issue Analysis*, Idaho Division of Environmental Quality, Water Quality Assessment and Standards Bureau, Boise, Idaho, November 1998.

Regional Water Quality Control Board (RWQCB) 2005. Letter to Mr. Joe Karkoski (RWQCB, TMDL Unit) from James Pedri (RWQCB, Redding Branch Office) titled, *Proposed 303(d) Listing for North Fork Feather River*, December 1, 2005.

State Water Resources Control Board (SWRCB) 2003. *Consideration of a Resolution to Approve the 2002 Federal Clean Water Act Section 303(d) List of Water Quality Limited Segments*, USEPA Hearing Transcript Notes from February 4, 2003, prepared by Capitol Reporters.

SWRCB. 2004. *Water Quality Control Policy (Listing Policy) for Developing California's Clean Water Act Section 303(d) List*. September 2004.

Sullivan, K., D. J. Martin, R. D. Cardwell, J. E. Toll, and S. Duke. 2000. *An Analysis of the Effects of Temperature on Salmonids of the Pacific Northwest with Implications for Selecting Temperature Criteria*. Sustainable Ecosystems Institute. Portland, OR. 192pp.