SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT
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Mr David Barker
Regional Water Quality Control Board
9771 Clairemont Mesa Blvd., Suite A
San Diego, CA 92124

Dear David,

Enclosed is my peer review response relating to the use of sediment cleanup levels at San Diego Bay shipyards. Thank you for your patience in awaiting my response and please call should you need clarification regarding my comments.

Sincerely,

Z/

Steven Bay
Principal Scientist

I have examined the supporting documents provided by the Regional Board and have determined that there are significant scientific concerns regarding the application of the Campbell Shipyard Apparent Effects Threshold (AET) values to other shipyard sites. I do not recommend the application of the Campbell Shipyard AETs to cleanup activities at the NASSCO and the Southwest Marine Shipyards in the manner prescribed by Resolutions Nos. 99-12 and 99-20.

My recommendation is based on two concerns. First, contamination patterns differ among the shipyard sites, which indicate that the relationship between adverse biological impacts and indicator chemicals (the foundation of the AETs) may differ between sites. Second, insufficient data are available to support the assumption that the Campbell Shipyard AETs are sufficiently reliable to allow their application at other locations. Due to these concerns, considerable uncertainty exists as to whether the Campbell Shipyard AETs will provide the desired level of protection for benthic organisms at other shipyard sites. An explanation of the scientific basis for these concerns follows.

1. Similarity of contamination among sites.

AETs and many other sediment quality guidelines use a correlational approach to establish chemical concentrations associated with biological effects. Although guidelines are specified for individual chemicals, the effects measures used to develop the values are influenced by the joint effect of all contaminants in the sample. Toxicant exposure is influenced by the types, relative composition, and bioavailability (the portion of the chemical in a biologically accessible form) of the contaminants present, which in turn determines the apparent effects relationship between concentration of a specific contaminant and biological effects. If exposure conditions are substantially different between sites, then AETs may be under- or overprotective.

The types and composition of potentially toxic contaminants present at the NASSCO and Southwest Marine sites differ substantially from those at Campbell Shipyard. Determination of the types of potentially toxic contaminants present at each site was based on comparisons of maximum sediment concentrations at each site to NOAA effects range-median (ERM) screening values. Compared to the Campbell Shipyard data used to derive AETs, NASSCO sediments differ in containing relatively low (below ERM) concentrations of lead and PCBs. Maximum tributyltin (TBT) and PCT concentrations were also less than 5% of those at the other two sites. Relatively high concentrations of some PAHs (e.g., fluoranthene and phenanthrene) were present at NASSCO but not at Campbell or Southwest Marine. Contaminant types were similar between Southwest Marine and Campbell Shipyard. Relative contaminant composition was evaluated by normalizing the average concentration to that of copper. Contaminant composition varied among the shipyards, as illustrated in the examples shown in the following table.

	Ratio to Copper (Constituent/Copper)		
Constituent	Campbell	NASSCO	SWM
Lead	0.3	0.07	0.2
TBT	3.3	0.002	0.6
PCB	0.5	0.03	0.7
PCT	1.1	0.03	2.0
Benzo(a)Pyrene	2.0	0.3	2.3
Fluoranthene	2.0	2.0	1.2

These differences in relative composition are most striking for NASSCO and indicate that that overall exposure of benthic animals to potentially toxic contaminants may be different between sites. These comparisons of contaminants between the sites used selected data (1997 NPDES data for NASSCO and Southwest Marine and a subset of the Campbell bioeffects dataset) in order to illustrate trends and are not intended to represent definitive analyses.

The presence of different mixtures of contaminants at potentially biologically significant levels among the shipyards produces uncertainty as to whether the concentration-effects relationships used to derive the Campbell AETs will be accurate for NASSCO and Southwest Marine. This uncertainty cannot be resolved using the available data since no biological tests have been conducted at NASSCO or Southwest Marine to verify the accuracy of the AET values and the resolutions establishing interim cleanup levels for the shipyards do not include a provision to confirm the biological effectiveness of the cleanup levels.

2. Reliability of Campbell Shipyard AETs.

The Regional Board's intent to rely solely upon concentration-based cleanup levels assumes that these levels will always produce the desired level of protection at each site. This assumption cannot be supported by the available data for two reasons.

First, the Campbell Shipyard AETs are based on too small of a data set to satisfy concerns about their effectiveness at other sites. A minimum of fifty data points is recommended for the development of AET values, whereas only 14 samples from a relatively small area (one shipyard) were used for Campbell Shipyard. In reality, the AETs for Campbell Shipyard were determined by the data for only three stations (those stations showing the required effects-concentration pattern). Biological and chemical measurements typically vary by 10-30% among replicates and occasional outliers occur. In addition, several of the organic analyses for the Campbell study had excessive variability or poor recovery. The strength of guidelines such as the AET is that they integrate a large number of data points to compensate for measurement variability and our incomplete understanding of how multiple contaminants interact with sediments to produce toxicity. The use of such a small data set increases the probability that the AET values are biased by measurement variability or unusual sediment characteristics. While the differences evident between the Campbell Shipyard AETs and other AET values may

reflect important differences in contaminant bioavailability at the shipyard, they may also represent false differences from the use of such a small set of data.

Second, there have been no studies that demonstrate that the Campbell AETs will protect benthic organisms or other components of the marine ecosystem, either at Campbell or other shipyard sites. While the Campbell Shipyard AETs *should* provide a level of protection, verification of their effectiveness is an essential step that should be taken before they can be applied to other locations. Follow-up biological testing of sediments meeting the cleanup levels at Campbell and other shipyards is needed to demonstrate that these values work as intended. Without these studies, the Regional Board will not be able to effectively answer criticisms that the cleanup levels are underprotective.

My review has also identified a related issue of concern regarding the development of sediment cleanup levels for San Diego Bay: whether the AET is the appropriate tool to guide cleanup activities. The establishment of cleanup levels in San Diego Bay appears to assume that sediment contamination below the AET will not produce significant impacts to benthic organisms and other aspects of the marine ecosystem of San Diego Bay. This assumption has been challenged by resource agencies and environmental groups and needs additional evaluation/justification.

The AET represents the sediment contaminant concentration above which adverse impacts are always observed. Use of the AET is therefore expected to result in cleanup actions that are highly cost effective, because all sediments exceeding the AET should be of poor quality. The application of AETs has a downside, however. Because the AET represents the concentration associated with *consistent* adverse effects, their use will not protect against all incidences of benthic effects. Variations in contaminant composition and sediment characteristics will produce toxicity at concentrations below the AET (false negative). An evaluation of the frequency of these "false negatives" for San Diego Bay and whether the use of AETs will adequately protect beneficial uses is not available. This concern can be moderated by the application of other sediment quality guidelines, such as the NOAA ERM or ERL, which are lower than corresponding AETs and should be more protective of biological resources. The consequence of applying lower cleanup levels will be higher costs for an uncertain benefit, however. In addition none of the commonly used sediment quality guidelines are designed to be protective of impacts related to bioaccumulation of organics in higher trophic level organisms (fish, birds, humans).

The establishment of sediment cleanup levels is a complex task because we still have an incomplete understanding of how biological systems respond to complex mixtures of chemicals. Determination of the appropriate level of protection to be attained is ultimately a policy decision that should weigh the degree of benefit against the costs. Controversy over the establishment of sediment cleanup levels for San Diego Bay shipyards is evidence that this issue needs to be resolved using a process that will promote a higher level of consensus among the stakeholders of San Diego Bay.