February 26th, 2013

To: Technical Review Committee

From: Don Yee

Re: **Preproposal: Margins Contaminant Characterization**

Margins contaminant characterization pilot pre-proposal

One hypothesis for the lack of an apparent decreasing trend in biota (e.g., fish tissue) concentrations of PCBs (and other persistent bioaccumulative contaminants), despite apparent decreasing trends in much of the open Bay, is the contribution of higher concentrations and more persistent contamination in shallow water Bay margins. There are known hot spots in the margins associated with Superfund sites and other legacy sources, but what remains unknown is the prevalence of less- but still moderately- or highly- contaminated sites in the Bay margins, due to the RMP's historical focus on deep water locations, and even after the 2002 redesign, the limiting of sampling to areas accessible by a moderately large boat (~3 foot draft).

Within the RMP, There have been some efforts to collect sediment samples for mercury in margin areas where small fish sampling occurred, but site selection for that study was intentionally biased to characterize areas of known sources (e.g., mines and contaminated watersheds). The median mercury concentration for samples collected in 2008 for the small fish study was 0.39 mg/kg (avg±sd 0.46±0.25), as compared to the median for RMP S&T sampling for that year of 0.28 mg/kg (avg±sd 0.27±0.08). Thus concentrations for the sampled margin areas appear significantly higher, but may be primarily due to the targeted inclusion of contaminated areas for the former (small fish) study. Although there are characteristics of some of those targeted contaminated areas included in the small fish study that may make them preferable habitat for biota (sheltered water, vegetation, nutrient loading associated with tributary discharge locations), better characterization of untargeted areas though an unbiased sampling scheme is also needed to better estimate regional risk, as biota are unlikely to constrain themselves to these sampled known contaminated areas.

Thus as a first step, a more widespread characterization of surficial sediment contamination and habitat ancillary characteristics in shallow water and intertidal areas for dioxins as well as other sediment-associated contaminants (PCBs, mercury, other trace metals and organics) is suggested. These data are critical to any efforts to characterize or model contaminant fate and risk in the Bay margins. Otherwise, any models and risk assessments of the margins would have to be estimated or extrapolated using data from deeper subtidal open water areas of the Bay, or data in the margins biased largely to cleanup hotspots. Given the unrepresentativeness of hotspots and open water site data for most locations the margins, extrapolations based on either those data

sets would be ill-advised other than for exploratory sensitivity testing. Collection of representative margin data is the only real solution for testing of assumptions (e.g., that margins are generally more contaminated than adjacent open-water Bay segments) and for population and calibration of empirical or mechanistic models. Ideally margins sampling would be included as an ongoing part of the RMP sediment S&T, as it is characterizing a relevant, evolving, and presumed critical portion of the ecosystem, which should have been continuously included in the sampling frame of the RMP S&T program but for logistical considerations.

A margins sampling plan would include areas excluded from the sampling frame in the RMP redesign process: areas shallower than 1 foot at MLLW, and all the intertidal areas surrounding the Bay up to some limit to be determined: e.g., MTL, MHW, or MHHW. Perhaps also areas theoretically included in the RMP sampling frame – 1 foot or deeper at MLLW – but skipped due to logistical reasons- e.g., having to pass through shallower water to access, having a deeper draft boat in a particular year- would be picked up in the margins sampling effort. Sites within that sampling frame would be picked via a GRTS method (similar to the selection for RMP S&T).

The management questions to be addressed are the same as those of the overall RMP S&T effort, localized to the margins, namely:

1) Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely?
2) What are the concentrations and masses of contaminants in the Estuary and its segments?
3) What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary?
4) Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased?
5) What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary?

None of these questions can be adequately addressed for margins using only data from open water areas of the Bay or a biased selection of hot spots. Similar to the need for data for open water sites provided in the current RMP S&T, no amount of modeling and other extrapolation methods can substitute for having representative data; it is the representative data itself that provides the basis and justification for even being able to extrapolate or model ecosystem characteristics in the first place. As a first cut, the margins should be sampled at a spatial density and temporal frequency at least proportional to their area relative to the rest of the Bay. In the short term, given their relative lack of representative data, margins likely should be sampled more than the rest of the Bay. Even in the longer term, if these areas are more productive and highly utilized by biota of interest (humans or wildlife), then they should be characterized even more intensely than other areas of the Bay. Some hypothetical sampling schemes are provided in the Appendix to scope the possible extent and cost of such efforts.

Appendix: Example sampling schemes logistics and costs

As a necessity, margins sampling would need to be conducted from much shallower draft vessels (small outboard motor vessels, duckboats, kayaks, airboats, or accessed from shore, or some combination of these, e.g., motorboat to near the site, paddlecraft to beach near the site, and wading out to the site). Because of the slow transit speed of most of these access methods, rather than annually selecting sites Baywide from the margins sampling frame to include, there might be some benefit in sampling areas in close proximity within a more limited geographical area- e.g., Lower South Bay one year, east shore South Bay the next, west shore South Bay after that, etc, would be sampled in sequential years.

The number of sites to be included each year is up for discussion, but the number of sites dropped in RMP S&T sampling by going to alternating dry (47 site) and wet (27 site) season sampling (20 sites fewer every two sampling years) would be a start: 10 samples per year. These 10 sites could either be allocated all to a single segment or area in a given year, or distributed among segments. If sampled one segment at a time, we would revisit a Bay segment after ~5 to 10 years, at which time one or more of the previously sampled sites could be revisited to examine long term trends. Collection of field replicates at revisit sites would help establish the contribution of site patchiness to apparent interannual variation. If rotating areas are being sampled, annual revisits of some sites would not be possible, and even if ~10 sites were distributed through the Bay, using one of those sites each year as a revisited site, even if rotated among segments each year, should be a low priority. Annual revisits would be better associated with studies of specific loading sources of interest, e.g., the near field deposition around the mouth of a tributary being monitored for loads in different wet and dry years.

Some limitations may be placed on the time of year that sampling can occur due to the use of the margins as breeding habitat by some species of concern, e.g., clapper rail, so sampling may always have to occur in late summer or fall to avoid interfering with breeding. We thus likely may not be able to capture many wet versus dry year impacts, as the sampling will occur only after loads have had a good amount of time to redistribute. However, given the low frequency of station revisits, this is probably not a great loss, and the interannual source variations might be best captured in targeted sampling, e.g., at mouths of tributaries with sequential years of loading data in the same period (some of which may have areas without habitat for populations of species of concern).

Analytical costs for specific analytes will be the same as for the S&T sediment sampling, but overall likely cost less as collection and processing for some of the samples will not be feasible/practical for access via land or small outboard vessels, e.g., benthic samples, sed/water interface toxicity, and thus fewer analyses will be possible. However, this is likely offset by increased sampling time and thus cost (50-100% higher?) per site due to difficulty of access for many of the sites (boat launch and landing, long transit from the nearest marina at a very slow rate of travel, small craft warnings in high afternoon winds limiting available sampling times).

Estimates for sampling 8-10 sites per segment range around $20-35k per segment per year (~$135k for all segments), with the differences in estimated cost among segments driven by shoreline and boat launch accessibility to potential sampling locations (Central Bay costing the least due to extensive shore access, and Lower South Bay the most due to limited access). Analytical costs for the RMP S&T in 2011, the last year with 47 sites, were $170k for sediment chemistry ($50k for sediment toxicity, and $60k for benthos) so total costs for 8-10 margin sites per segment (40-50 sites baywide) will be similar depending on what analyses are included. There are small incremental costs ($3-4000 per year) when sampling and analyses are not conducted in times where there is not already sediment sampling.

For Baywide assessment of impairment in the margins, all the RMP S&T sediment elements are likely needed ($135k sampling + $170k chemistry + $50k toxicity + $60k benthos = $415k), since impairment in the Bay's sediment is not driven exclusively by bioaccumulation of contaminants. Characterizing the Bay margins a segment at a time will require 5 years, and cost around $9-12k in extra mobilization costs over doing all segments at once (because 3 of those years might not already have RMP S&T sediment sampling), but may be easier to fit in the RMP budget, staffing, and contract laboratory capacity without moving around other program elements. A compromise alternative between those would be to 2 or 3 segments in consecutive years, with an added cost of $3-4k for mobilizing in the year without RMP S&T sediment sampling. Another compromise would be to sample 2 or 3 segments in non-consecutive (RMP S&T) years, saving the additional mobilization costs but taking 3 years instead of 2 to get a first round of complete coverage of the Bay. For input data for bioaccumulative contaminant fate modeling, the alternatives present similar opportunities and costs, although only the sediment chemistry component, and perhaps the benthos (for food web characterization) would be needed for that.