Regional Board Modeling Needs Straw-Dog (Richard Looker, Naomi Feger, Barbara Baginska, July 2, 2008)

Table 1. Modeling Needs Summary Matrix. This matrix includes entries on the status and need of various types of models for each of the following pollutants. The entries in each cell should give an indication of the purpose for which this type of model is needed. In some cases, more information about each entry is given in the pollutant specific narrative below.

Pollutant	Conceptual Model	Food Web Model	Box Model	Multi-Box Model	Finer Scale Model, space and time
Mercury	Completed by TetraTech	Maybe need – pending outcome of mercury strategy investigations (see narrative)	Completed	Maybe need, but not imminent need (see narrative)	Maybe need as part of Bay margins (see narrative)
PCBs, including dioxin-like PCBs		completed		Almost Completed	Maybe as part of Bay margins (see narrative)
Legacy Pesticides	Completed by SFEI		Completed as part of conceptual model		
Sediment Quality	Maybe need, can a single CM cover range of issues?				If localized problem, fine scale model may be appropriate (see narrative)
Selenium	Completed by TetraTech	Food web model completed by Presser and Luoma		Salinity Model available based on Uncles-Peterson	
PAHs **Dioxin**	Some work completed Completed by SFEI	Mabe some similarity to PCBs, but we may need to develop model specific to these pollutants.	Both box models completed by SFEI. May be useful to enhance box model and couple to air		

			quality model.		
Pathogens					Need to apply this type of model to shellfish harvesting areas (see narrative)
Nutrients/Ammonia	Need one, synthesize Dugdale data	Maybe need, depends on conceptual model findings		Maybe need, depends on conceptual model findings	
Bay Margins (includes "hot spots")	Needed as first step, but may exist from other efforts – Craig Jones, etc.				Needed, apply to specific inputs. (see narrative)

Pollutant-Specific Information

Mercury: The RMP is currently implementing a mercury strategy to address 1) where mercury is entering the food web, and 2) which sources/pathways/processes exert high leverage in determining food web mercury concentrations. It is probably prudent to await results from these efforts before committing to additional modeling work for this pollutant. We may get some insights to aid modeling from the coring study data. Subject to the outcome of the mercury strategy studies, the next possible modeling needs to be considered are a food web model to refine the TMDL linkage analysis between updated information on sources (of total and bioavailable mercury) to the existing (or possibly refined) targets, a multi-box model to provide an updated assessment on the trajectory of Bay recovery and attaining water quality standards, and possibly a fine-scale modeling application near those areas found to be critical for uptake into the food web (see Bay Margin strategy below). The first two of these possible models are probably not needed within the first five years of implementation, however.

PCBs: The RMP has completed a food web model and a multi-box model for PCBs. At this point, there are no additional model development needs for PCBs, beyond the multi-box model. The one area where modeling development may be recommended is for small spatial scale modeling near sources to the Bay. This is described in more detail in the Bay Margins section below.

Legacy Pesticides: Based on the CM/IA report produced by SFEI, the state of impairment is such that model development specifically for legacy pesticides is not warranted. Concentrations in the Bay have been declining, and the Bay appears to be on its way to recovery. However, monitoring has shown that areas of contamination exist in near-shore locations in the Bay and in localized areas in the watershed. Thus, legacy pesticides may be a candidate for modeling as part of a Bay margin modeling strategy discussed below.

Sediment Quality: The project to develop sediment quality objectives will eventually lead to the identification of sites for which the sediments are not meeting objectives due to some combination of chemical contaminants, toxicity, or impaired benthic community. A conceptual model for sediment quality impairments may be in order and would be the recommended first step of a regulatory process. However, sediment quality has not yet been called out as a priority, and there are no 303(d) listings so the need for such a conceptual model is not urgent. There is ongoing sediment quality data collection that will help clarify the need for model development in this area.

Selenium: The TMDL will rely on two linked models – a transport model adapted from the Uncles and Peterson salinity model and the selenium bioaccumulation model developed by Presser and Luoma. There is no urgent need for additional model development, but the Water Board would encourage SFEI to develop the capacity to maintain and run these two models in the future for adaptation of the selenium TMDL in future years.

Dioxin/PAHs: These contaminants can be grouped together for the purpose of the modeling discussion. Both of these pollutants have a strong nexus to air quality. For both, it is probably the case that historical loads were much greater, there is a substantial legacy component, and atmospheric deposition and subsequent runoff is a main factor in sustaining Bay concentrations. Especially for dioxins, there is little hope for developing a more sophisticated model because the data needs are so pronounced. For both contaminants then, the recommended approach is to pursue observational programs aimed at getting more information to characterize the patterns of impairment and linking this information to the simple box models. There may be a need to develop food web models for TMDL linkage. And, there is possibly a role for linking the Bay box models to air quality models and watershed models as well.

Pathogens: Pathogens are not a widespread problem throughout the Bay. Rather, the impairments are focused at those few areas where shellfish are harvested recreationally or commercially. Further, pathogens may be treated as a constituent in the water column as was demonstrated in Tomales Bay by models developed by researchers from UC Berkeley. In Tomales Bay, the numerical model, Tidal Residual and Intertidal Mudflat (TRIM), was used. This model is a state-of-the-art numerical, three-dimensional hydrodynamic model that simulates a portion of the bay as a network of cells which exchange water and dissolved constituents according to the governing physical equations. For contaminants such as pathogens which are microscopic, non-swimming organisms whose location is determined by the flow of water, this modeling approach is a good approximation for the distribution of that contaminant and may be useful for shellfish harvesting areas in San Francisco Bay. Before such a model is developed, it must be confirmed that it can feasibly be applied to the areas in the Bay on the 303(d) list for pathogens.

Nutrients/Ammonia: The situation for these pollutants in terms of priority is similar to sediment quality. Namely, there are no 303(d) listings for nutrients/ammonia so it is not a high priority right now. Dr. Richard Dugdale has been studying declines in pelagic fishes in the northern SF Estuary (the Delta and Suisun Bay) in relation to the food web. Current studies suggest that high nutrient levels (especially ammonia) may be adversely affecting phytoplankton physiology resulting in low phytoplankton productivity and little chlorophyll of poor food quality for the food web. As yet, there is not unequivocal evidence for impaired beneficial uses due to ammonia. The recommended first step would be development of a conceptual model/impairment assessment that can synthesize the available information and help determine if further modeling is required.

Bay Margins (includes "hot spots"): There are a number of locations in the Bay that are on the 303(d) list due to elevated concentrations of one or more contaminants (PCBs, mercury, sediment quality, PBDEs, others). And, while there may be elevated tissue concentrations throughout the Bay, there are localized zones of high sediment and biota concentrations. The overwhelming majority of these locations are at the Bay margins where sources currently enter the Bay, historical sources once entered the Bay, or historical activity contaminated the site. These regions present questions that may be treated with models. The models developed to date for the Bay through RMP are more concerned with large spatial and temporal scales. The Bay Margin areas require modeling sediment and contaminant transport at much finer temporal and spatial resolution. A high priority for the Water Board is to develop a model that could be generally applied (subject to the availability of suitable inputs) to Bay margin areas rather than one "tuned" to a particular site. The types of questions that a fine-scale model might address are:

- What is the fate of contaminants (mainly contaminanted sediment) that enter the Bay in the vicinity of a particular Bay margin contaminated site and that are already present at the contaminated site? This question involves physical (locating zones of deposition, and modeling transport process), chemical (rates of transformations), and biological (food web uptake) processes in the Bay margin interface.
- What is the effect of certain management interventions at the site (remediation, source control, etc.)?
- What is the trajectory and pace of recovery for the site under various management scenarios?

It is understood that this type of model entails a substantial field observation program. Perhaps such a model can be built in stages of incremental sophistication while, at the same time, confirming with managers and stakeholders the necessity of taking each additional step in model complexity.