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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
OREGON OPERATIONS OFFICE
811 S.W. 6th Avenue
Portland, Oregon 97204

October 1, 2004

Mr. Jim McKenna
Port of Portland & Co-Chairman, Lower Willamette Group
121 NW Everett
Portland, Oregon 97209

Mr. Robert Wyatt
Northwest Natural & Co-Chairman, Lower Willamette Group
220 Northwest Second Avenue
Portland, Oregon 97209

Re: Portland Harbor Superfund Site; Administrative Order on Consent for Remedial Investigation and Feasibility Study; Docket No. CERCLA-10-2001-0240
Ecological Risk Assessment Technical Memorandum: Evaluating Steady-State Aquatic Food Web Models for the Portland Harbor Superfund Site.

Dear Messrs. Wyatt and McKenna:

EPA has reviewed the Draft Ecological Risk Assessment Technical Memorandum: Evaluating Steady-State Aquatic Food Web Models for the Portland Harbor Superfund Site (Food Web Model TM) dated July 28, 2004. EPA Comments are attached.

As discussed during our August 17, 2004 meeting, EPA does not believe that further revision of the Food Web Model TM is necessary. Rather, EPA believes it would be more productive to incorporate our comments into a subsequent modeling effort using data collected during Round 2 of the Portland Harbor RI/FS. The results of this modeling effort should be presented in the Food Web Modeling Report. The Food Web Model Report is due to EPA 90 days following completion of the Round 2 surface sediment and fall 2004 surface water sampling and analysis.

If you have any questions, please call Chip Humphrey at (503) 326-2678 or Eric Blischke (503) 326-4006. All legal inquiries should be directed to Lori Cora at (206) 553-1115.

Sincerely,

Chip Humphrey
Eric Blischke
Remedial Project Managers

USEPA SF
1210068

cc: John Crellin, ATSDR
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Valerie Lee, Environment International
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EPA Comments on Draft Technical Memorandum: Evaluating Steady State Food Web Models for the Portland Harbor Superfund Site
October 1, 2004

General Comments:

The Technical Memorandum: Evaluating Steady State Food Web Models for the Portland Harbor Superfund Site – Draft – July, 28, 2004 (Food Web Model TM) describes the Lower Willamette Group's exploratory efforts to work with and evaluate a number of candidate food web models. Overall, the Food Web Model TM describes an encouraging first attempt to apply food web modeling to predict contaminant concentrations in fish species from Portland Harbor. Many model run outputs were sufficiently close to measured contaminant concentrations that it is worthwhile to continue modeling efforts.

As discussed during our meeting on August 17, 2004, because of the exploratory nature of the Food Web Model TM, EPA does not believe that document requires revision. Rather, EPA believes it would be more productive to incorporate our comments into a subsequent modeling effort that focuses on the Trophic Trace and Arnot and Gobas models using data collected during Round 2 of the Portland Harbor RI/FS. The results of this modeling effort should be presented in the Food Web Modeling Report.

Objectives:

Objectives of the food web modeling effort at the Portland Harbor site should be clearly stated. Currently, the only objective presented in the Food Web Model TM is to "develop a predictive relationship between chemical concentrations in sediment, water and tissue." This objective should be further refined. Defining the objectives or uses of the food web modeling is a necessary step before substantial resources are expended on additional model runs. EPA believes that the primary uses of the food web modeling effort are to 1) back calculate sediment and water preliminary remedial goals from fish tissue contaminant levels protective of human health and the environment and 2) predict benthic invertebrate and/or fish tissue contaminant levels in species or at locations within Portland Harbor where little data exists or will not be collected. In addition, the modeling effort should be flexible enough to accommodate other uses that may be identified in the future. By defining the uses of food web models in the context of the overall Portland Harbor RI/FS, it should become clearer what data gaps need to be filled to ensure that the modeling effort will meet the overall project objectives.

Benthic Tissue BSAFs

It appears that the BSAF approach predicted tissue residues in sculpin reasonably well, but not as well for crayfish. This is likely a result of the scavenging food habits of crayfish, meaning that a portion of the crayfish diet may be of species not associated with the sediment. Subsequent food web modeling efforts should include a more specific discussion of how the benthic component of the food web will be parameterized. It is clear that the existing crayfish and clam data are inadequate to derive BSAFs and that further discussion between EPA and the LWG is required to determine how site specific BSAFs will be developed. Items for discussion include the

number of samples to analyze, which compounds to consider, how steady state conditions will be estimated, which surrogate species to use and how many benthic groups are required or can be adequately characterized. Elements of a site specific BSAF approach should include lab-based bioaccumulation tests or other methods such as field sampling of co-located sediment, benthic invertebrates, and possibly benthic fish species to generate the analytical data needed to calculate site-specific BSAFs.

PCB Aroclor vs. Congeners:

All of the modeling in the report is done on an Aroclor basis. Modeling of chemical mixtures leads to greater uncertainty in the model outcome because average properties and conditions are used to represent the mixture and because mixture components differ between sediment, water, and biota phases. Models such as the Gobas model are very sensitive to the values chosen for log Kow. Aroclor mixtures have numerous individual PCB congeners, each with their own log Kow value, so a single Kow chosen for an Aroclor will not accurately represent PCB partitioning for all congeners in the environment. Combined with the differential transport, partitioning, metabolic transformation and environmental fate of the individual PCB congeners, it is not surprising that differences were found among the different models and model runs using a central tendency value for log Kow for Aroclors. Measured PCB concentrations in tissues of aquatic species rarely correspond to the patterns observed in commercial Aroclor mixtures, which can add substantial uncertainty to model predictions based on Aroclor concentrations. The true differences between the models should become more apparent if individual congeners (or a single chemical such as DDE) are modeled instead of Aroclor mixtures. Identification of these differences will help determine which model is best suited for continued use at Portland Harbor. Since PCB congener data are already available for some fish species, future modeling efforts should be performed on a congener basis to develop more accurate model predictions.

Single Chemical Evaluation:

The Food Web Model TM only presents data for total PCBs, which is only one of numerous contaminants of potential concern in Portland Harbor. It should be noted that the Gobas-class models have been tested much more extensively on PCBs than anything else and have usually performed worse on other contaminants. While Gobas may be reliable for PCBs, how it will work for other organics is unknown. The modeling effort could benefit from evaluation of other hydrophobic chemicals.

As we discussed during our meeting on August 17, 2004, it may be useful to repeat the best performing model scenarios using DDE (a single chemical) instead of Aroclor mixtures. This should clarify differences among the predictive ability of the various models remaining under consideration. As log Kow and the lipid content of aquatic biota are often the two parameters most critical for obtaining acceptable model performance, running the model on a single compound with a well typified log Kow value may be a better test of the predictive ability of a model than is testing the model with a mixture. This effort should also be used to evaluate spatial variation in sediment, surface water and tissue concentrations.

Refine Modeling Assumptions:

Refinement of the assumptions used in the modeling effort is required prior to further modeling efforts to avoid selecting a model based upon an unrepresentative food web (who eats whom and how much).

Review of the fisheries literature will likely identify studies that better and more accurately define the food habits and dietary preferences of the fish species being modeled. This effort should result in more accurate model predictions. One example of where this could quickly result in improved model accuracy is with black crappie. Based in information in Scott and Crossman (1973) and Carlander (1977), most size and age classes of black crappie are primarily invertivores, not piscivores as modeled by Windward. This is a likely cause of the consistent over prediction of crappie tissue residues by modeled scenarios. Crappies tend to feed lower in the food web than do smallmouth bass, and should not be in combined compartments with smallmouth bass in future model runs. To a lesser extent, this may also account for the over prediction of PCB residues in peamouth, which may be more of a zooplankton feeder than a benthic invertebrate feeder, as discussed on page 27 of the Food Web Model TM.

All of the model predictions were made using predicted growth rates based upon the size of the organisms. Obtaining actual growth rates for the organisms should improve model predictions. In addition, it should be recognized that the food habits of most fish species change as the fish grow and mature. Many species feed lower in the food web during their earlier life stages than they do during their adult life stages. For chemicals such as PCBs and DDT, which are long lived in the environment and poorly metabolized and depurated by most fish species, adjusting the modeled dietary preferences throughout their life (or alternatively, modeling different age classes of the same fish species using age specific dietary preferences) should result in model predictions closer to the tissue concentrations observed in field collected animals.

References that may be useful for refining the modeling assumptions include:

Zimmerman, M.P. 1999. Food habits of smallmouth bass, walleyes, and northern pikeminnow in the lower Columbia River basin during out migration of juvenile salmonids. Transactions of the American Fisheries Society 128:1036-1054.

Buchanan, D.V., R.M. Hooten, and J.R. Moring. 1981. Northern squawfish (Ptychocheilus oregonensis) predation on juvenile salmonids in sections of the Willamette River basin, Oregon. North American Journal of Fisheries Management 38:360-364.

Dietary preference data collected within Portland Harbor by the Oregon Department of Fish and Wildlife.

Supporting Information:

Input files for the various models should be forwarded to EPA to facilitate evaluation of the modeling results and/or to quickly vary one or two parameters, such as the dietary preference of black crappie, to see if an improvement in model predictions could be obtained. In addition, the

calculations used to develop the BSAFs presented in the Food Web Model TM should also be submitted to EPA.

Spatial and Temporal Changes:

The modeling results presented in the Food Web Model TM are not dynamic or capable of forecasting time to recovery under variable conditions and cannot be linked to other relevant environmental phenomenon such as hydrodynamics and sediment transport. More information needs to be developed concerning how the spatial and temporal elements of exposure will be modeled. Data should be assembled and analyzed concerning movement patterns of the receptors (fish), habitat usage, foraging and home ranges, etc. The tissue data currently in hand should be probed to provide insight into the extent to which spatial signatures from sub-areas within the harbor are evident. From this collection of data and analysis hypotheses can be developed or sensible approaches for dealing with the spatial/temporal elements can be formulated.

Calibration and Validation

EPA guidance states that all modeling studies must contain the following components: Model calibration, validation, and sensitivity and uncertainty analyses. In the PH RI/FS Deliverable Table (Table 9-2 of the Programmatic RI/FS Work Plan), it states that the TM is to include the objectives for use of the model and is to describe how model calibration and validation will be done. Page 2 of the TM states that "Calibration and validation **may** also be conducted as part of the additional model runs." The follow-up report should discuss in specific terms a strategy for calibrating and validating the models that will be used to characterize exposure through the food chain. This strategy should include discussion of additional data collection needs to accomplish calibration and validation.

Uncertainty Analysis:

The follow-up report should discuss how uncertainty would be addressed and quantified in the modeling. This discussion should include how parameterization will be conducted to ensure that the modeling results lend themselves to reaching protective conclusions about risk. In addition, the modeling should allow for describing the range of probable outcomes given the uncertainty and variability associated with the parameter inputs. Whether this would involve interval-based methods, Monte Carlo techniques, or some other approach should be discussed.

The effect of BSAFs on model predictions should be further explored. In several of the models, BSAF is a calculated parameter, not a parameter specified before the run of the model. In Trophic Trace, where the BSAF can be specified, it doesn't appear as though the default Trophic Trace BSAF of 1.7 was utilized. Assessment of the uncertainty in the various models can be achieved by varying model inputs to see how they affected the outcome of the model BSAF calculations for sculpin. Sculpin BSAFs and their range of variability are known from field sampling at Portland Harbor. This is a standard method for evaluating food web model outputs.

In the assessment of the various models, it should be noted that the Trophic Trace model has a straightforward treatment of uncertainty.

It does not appear that during the sensitivity analysis, parameter values were varied by more than 10% for any given parameter. This does not seem like a very large change to perform during sensitivity analyses; variations greater than 10% should be included in future evaluation of model sensitivity.

Sediment Data

The sediment concentration used in the model was an area weighted average concentration based upon an inverse weighting method. Further discussion will be required to determine if this is the most appropriate method to use for calculating the sediment concentration once the Round 2 sediment data has been received.

Specific Comments:

The following comments relate to the submitted document. These comments should also be incorporated into subsequent modeling efforts.

Page 2, Section 1.1: Additional objectives of the food web model include evaluation of impact of various sediment remedial alternatives on fish tissue concentrations, and temporal modeling of fish tissue concentrations. Other risk drivers, such as DDT isomers and other bioaccumlative contaminants should also be assessed using various models prior to finalizing model selection.

Page 2, Section 1.2: Additional modeling efforts should consider spatial and temporal changes. The Food Web Model TM states "the potential utility of a dynamic food web model will be discussed with the USEPA and its partners once they have reviewed this memorandum." The consequences of running a steady-state model in a dynamic system should be discussed further with EPA.

Page 6, Section 2.4.2: Although the Gobas model may have been used in a broad range of environments, it is important to note that the model has not been extensively tested for non-PCBs outside the Great Lakes region.

Page 9, Section 3.1: The "total PCBs" calculation methods for each composite should follow the rules outlined in the approved Technical Memorandum: "Guidelines for Data Reporting, Data Averaging and Treatment of Non-Detected Values for the Round 1 Data Base." Future modeling efforts following collection of the Round 2 sediment data should be based on QA Level 2 data as stated in the Programmatic Work Plan.

Page 9, Section 3.1.2: This section fails to account for sturgeon. Because sturgeon are long-lived and spend a great deal of time in fresh water and the Portland Harbor area, it is advisable to develop a steady state model for them.

Page 10, Section 3.1.2, Total PCB concentrations is sediment: Future modeling efforts should describe and justify the basis for developing sediment concentrations for input into the model (e.g., inverse distance weighting). Results can vary significantly based upon the method of spatial extrapolation utilized. In addition, future modeling efforts should focus on smaller segments of the river.

Page 11, Section 3.1.3, Input Parameters: Crayfish BSAFs should not be used to predict total PCB concentrations in the Trophic Trace model since no relationship between sediment and crayfish tissue concentrations was found (Page 18, Section 4.1). The BSAF of 2.36 calculated for sculpin represents a more reasonable site specific estimate.

Page 12, Section 3.1.4: Feeding preferences can be highly site-specific placing great importance upon using Portland-Harbor-specific information. As a result, Portland Harbor specific data is preferred. However, if this is not possible, a more extensive literature search should be conducted rather than only consulting www.fishbase.org.

Page 14, Section 3.2.1: Efforts should be made to account for known predation upon fish higher in the food chain in the models. This information is important to minimize uncertainty. In addition, utilization of the Arnot and Gobas model should be modified to accommodate more invertebrate groups if possible. If this is not possible, a literature review should be conducted to evaluate the similarity of the invertebrates being combined into single groups. Combining invertebrates into single groups and assuming that they have similar chemical contaminant concentrations adds assumptions and uncertainty, which should be avoided wherever possible.

Page 16, Section 3.2.3: Combining species into aggregate groups and recalculating parameters is not a desirable approach. Attempts should be made to modify the model to account for the needs of the Portland Harbor Superfund Site.

Page 17, Section 3.3: This section states that because of the "small amount of data available for the resident species being modeled, there was a need to compare the results of several types of calculations (i.e., mean, median, geometric mean, and maximum) on the measured data were compared to the predicted concentrations." Further evaluation should consider whether additional fish tissue data is required to support the food web modeling effort.

Page 21, Section 4.3.3: Further justification of the use of a non-lipid organic carbon (NLOC) concentration of 6.8% should be presented.

Page 28, Section 4.6.4: The lack of invertebrate concentration data for Portland Harbor, and the subsequent use of a generic BSAF for invertebrate tissue is a significant data gap. The use of any food web model would benefit from additional data collection in this area.

Page 25, Section 4.5.2: The sensitivity analysis should include BSAFs.

Page 30, Section 5.2: Based upon the models that have been suggested for further consideration, addition field data collection should include, in order of importance, 1) water and sediment data (collected during Round 2); 2) percent lipid and organic carbon contents; and 3) feeding

preferences. In general, data should be site specific when ever possible. However, EPA recognizes that in some cases, literature values may have to suffice.

Table 3-3 to 3-9, Food Web Dietary Preferences: The dietary preferences used in the food web should draw on the data collected for Portland Harbor by Oregon Fish and Wildlife to the extent possible. Daphnia and other organisms may play are more important role in the diet than is recognized here (e.g. juvenile Chinook salmon). The most appropriate diet assumptions should be used in the model. Juvenile Chinook salmon should be removed as a "dietary preference" for many species (e.g. sculpin)

Table 3-13, Lipid Percentages: It is unclear why literature lipid contents were used instead of site-specific lipid contents collected during Round 1. This parameter in particular should be as relevant as possible.

Table 4-1, Site Specific BSAFs calculated for sculpin and crayfish: Given the ranges of BSAFs calculated from the Round 1 data (sculpin 0.67 to 6.68 and crayfish 0.029 to 4.86), it may be relevant to run this model for different parts of the river – matching changes in sediment concentrations and tissue concentrations.