Lower Willamette Group

Co-Chairperson: Jim McKenna, Port of Portland
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November 4, 2005

Mr. Chip Humphrey
Mr. Eric Blischke
Remediation Project Manager
U.S. Environmental Protection Agency, Region 10
Oregon Operations Office
811 SW 6th Avenue
Portland, OR 97204

Re: **Portland Harbor Superfund Site: Administrative Order on Consent for Remedial Investigation and Feasibility Study; Docket No. CERCLA-102001-0240; LWG *Food Web Modeling Report: Evaluating TrophicTrace and the Arnot and Gobas Models for Application to the Portland Harbor Superfund Site***

Dear Mr. Humphrey and Mr. Blischke:

Please find enclosed the *Food Web Modeling Report: Evaluating TrophicTrace and the Arnot and Gobas Models for Application to the Portland Harbor Superfund Site*. For your convenience we have also enclosed copies of the model runs themselves, along with a brief guide to using them. We were pleased with the model's performance and expect it will be a useful tool for the Portland Harbor RI/FS process.

The primary use envisioned by LWG for food web modeling is as tool to help develop preliminary remediation goals (PRGs) for some organic hydrophobic chemicals and as a tool to help evaluate alternative remediation scenarios for the feasibility study (FS). This differs some from goals EPA has expressed including that the model(s) could be used to evaluate when and where fish are safe to eat. The model can be used to address EPA's question on some level, but the model is a bioaccumulation model only and does not itself address chemical fate and transport. The spatial limitations of the models evaluated must also be considered and explored, which is one of the objectives of the current memo. The use of the model to address water versus sediment contribution to tissue burden and options for chemicals for which the model is not well suited are also discussed.

We look forward to further dialogue on the application of the models presented in this TM as well as refining expectations about the use of the food web model in the risk assessment process.

Sincerely,

Bob Wyatt
Jim McKenna
Co-Chairs

Enclosure

cc: LWG Executive Committee
LWG Records

PORTLAND HARBOR SUPERFUND SITE

FOOD WEB MODELING REPORT: EVALUATING TROPHICTRACE AND THE ARNOT AND GOBAS MODELS FOR APPLICATION TO THE PORTLAND HARBOR SUPERFUND SITE

DRAFT

November 4, 2005

DRAFT DOCUMENT: DO NOT QUOTE OR CITE

This document is currently under review by US EPA and its federal, state, and tribal partners, and is subject to change in whole or in part.

Prepared For:
The Lower Willamette Group

Prepared By:

WE-05-0009

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

See separate Table of Contents for Tables

LIST OF ACRONYMS

AWA	area-weighted average
BCF	bioconcentration factor
BMPTC	base model predicted tissue concentration
BSAF	biota-sediment accumulation factor
COPC	chemical of potential concern
DL	detection limit
DO	dissolved oxygen
DOC	dissolved organic carbon
Dw	dry weight
EPA	US Environmental Protection Agency
EPI	Estimated Program Interface
ERA	ecological risk assessment
GIS	geographic information system
HOC	hydrophobic organic chemical
IDW	inverse distance weighting
ISA	initial study area
K_{OC}	organic carbon-water partition coefficient
K_{OW}	octanol-water partition coefficient
LASAR	laboratory analytical storage and retrieval (database)
LWG	Lower Willamette Group
LWR	Lower Willamette River
MLLW	mean lower low water
MPAF	model predictive accuracy factor
ND	not detected
NLOC	non-lipid organic carbon
NPTC	new predicted tissue concentration
OC	organic carbon
ODEQ	Oregon Department of Environmental Quality
ORNL	Oak Ridge National Laboratory
PCB	polychlorinated biphenyl
POC	particulate organic carbon
POP	persistent organic pollutant
RI/FS	remedial investigation/feasibility study
ROC	receptor of concern
RPD	relative percent difference
SOC	sediment organic carbon

SPAF	species predictive accuracy factor
SPD	species percent difference
SPMD	semi-permeable membrane device
TOC	total organic carbon
TSS	total suspended solids
USACE	US Army Corps of Engineers
USGS	US Geological Survey
ww	wet weight

EXECUTIVE SUMMARY

Understanding of the relationship between chemical concentrations in sediment and water and in the tissue of aquatic species at the Portland Harbor Superfund Site (the Site) would be useful in making decisions about possible remediation options. One method for evaluating this relationship is through the application of a food web model. Windward Environmental LLC (Windward) has previously evaluated several food web models and one modeling alternative (biota-sediment accumulation factor) for application to the Site (Windward 2004). Based on the results of this preliminary analysis, and following discussion with EPA and its partners, two models were selected for further evaluation, the Arnot and Gobas model (Arnot and Gobas 2004) and the US Army Corps of Engineers' TrophicTrace model (USACE 2003).

The primary goal of food web modeling for the remedial investigation/feasibility study is to develop a predictive relationship between chemical concentrations in sediment, water, and tissue that can be used to derive preliminary sediment cleanup goals for chemicals that are present in fish tissue at concentrations associated with unacceptable risk. In addition, there are several specific objectives for this report, including the assessment of multiple chemicals, modeling at different spatial scales, and the selection of a single model for future modeling iterations. To address these objectives, the Arnot and Gobas and the TrophicTrace models were run at a large scale (River Mile [RM] 2 to RM 11) and small scale (Swan Island Lagoon). In addition, sensitivity and uncertainty analyses were conducted on model input parameters to characterize uncertainty and identify key data gaps. The modeled variables were total PCB and 4,4′-DDE concentrations in organism tissue. PCBs were modeled in the food web model technical memorandum (Windward 2004) using data available at that time and are modeled again in this report using additional site-specific data.

There were several steps in the modeling process. First, input values for biological, environmental, and chemical parameters were selected. Next, the models were run with different scenarios to select a best-performing parameterization. Then, they were assessed for sensitivity to specific parameters, and finally, their uncertainty was evaluated. The results of the model runs were used to compare the models, identify data gaps, and evaluate model performance at the two different spatial scales for PCBs and 4,4′-DDE.

Overall, the Arnot and Gobas model outperformed the TrophicTrace model, providing best estimates of tissue concentrations that were, on average, within a factor of 4 of average measured values for PCBs for RM 2 to RM 11. Best model predictions were within a factor of 10 for PCBs at the smaller spatial scale and within a factor of 6 for 4,4′-DDE for both spatial scales. Several biological, environmental, and chemical data gaps were identified, some of which are being addressed through ongoing data collection efforts. Additional resources or data that will be available for future modeling include new tools for summarizing sediment chemistry data, additional water chemistry data, a chemical analysis of invertebrates, and further literature research on DDT metabolism.

Future applications of the food web model for Portland Harbor will focus on its use as a tool for helping develop preliminary remediation goals and its use in the feasibility study to explore impacts of different remedial options. Model refinements will be directed toward increasing model capacity for these applications. Based on an assessment of the model results and considerations of applicability for the Portland Harbor Site, the Arnot and Gobas model is recommended for future model iterations. In addition to better model performance, the Arnot and Gobas model has other desirable model features, including built-in consideration of metabolism of chemicals and a more mechanistic modeling approach. In future iterations, the Arnot and Gobas model will be run to predict total PCBs and 4,4′-DDE tissue concentrations using new water chemistry, advances in sediment data analysis, and additional metabolism research (for 4,4′-DDE). Two other areas proposed for future model runs include an investigation of spatial scale constraints for understanding the consequences of remediation or natural attenuation and the use of model output for time-to-recovery estimates. These further modeling efforts will improve the usability of this tool for decision-making related to contaminated sediment and water at the Site.

1.0 INTRODUCTION

As part of the Portland Harbor Remedial Investigation/Feasibility Study (RI/FS), the nature and extent of chemical contamination in sediment, water, and aquatic species tissue is being characterized. These data will be used to characterize risk from exposure to these chemicals in the ecological and human health risk assessments. Based on these risk estimates, decisions will be made on the need for cleanup of contaminated sediments and/or control of upland chemical sources. One likely objective of sediment cleanup will be to reduce chemical concentrations in fish, thereby reducing risks to fish, as well as to people and animals that eat contaminated fish. Cleanup decisions associated with unacceptable risks from chemicals in fish must consider the relationship between chemical concentrations in sediment, water, and fish. One method to evaluate such a relationship is through a food web model. Several types of models have been developed to predict relationships between chemical concentrations in sediment and fish tissue.

Windward Environmental LLC (Windward) evaluated several food web models and one modeling alternative (biota-sediment accumulation factor [BSAF]) for application to the Portland Harbor Superfund Site (the Site) (Windward 2004). As part of this evaluation, preliminary model runs were conducted using existing site-specific data and data from a preliminary review of the scientific literature. Based on the results of this preliminary analysis, and following discussion with the US Environmental Protection Agency (EPA) and its partners, two models were selected for further evaluation, the Arnot and Gobas model (Arnot and Gobas 2004) and the US Army Corps of Engineers' TrophicTrace model (USACE 2003). The evaluation and selection of the appropriate food web model for the Portland Harbor RI/FS will continue to be an iterative process. The modeling and analysis described in this report, which is a second step in that iterative process, is based on a second round of modeling runs using the first set of site-specific water data and all sediment and tissue data available from Round 1 and Round 2 data collection activities. The objectives of the current iteration are described below (Section 1.1). Model performance in these model runs and the models' ability to address the model goal and specifications (Section 1.2) were used to develop future applications of the model(s) which are described in the final section of this report.

1.1 REPORT OBJECTIVES

The following objectives have been established for this report:

1. Evaluate the ability of the two candidate food web models to predict total PCB and 4,4′-DDE concentrations in select resident Lower Willamette River (LWR) fish and invertebrate species based on site sediment and water chemical concentrations

2. Evaluate the ability of the models to predict fish tissue chemical concentrations at two spatial scales: site-wide (large scale), and a subarea (small scale)
3. Identify key data gaps that limit model performance
4. Present a recommendation on which of the candidate models should be applied to the Site to facilitate moving forward with the calibration of a preferred model

To address these objectives, the Arnot and Gobas and the TrophicTrace models were run at for a large scale (River Mile [RM] 2 to RM 11) and small scale (Swan Island Lagoon). Model runs incorporated recent water (Round 2, Event 1) and sediment (Round 1 and Round 2) data, improved information about fish diets, and an expanded benthic component. In addition, sensitivity and uncertainty analyses were conducted on model input parameters to characterize uncertainty and identify key data gaps.

For this report, the modeled outputs are total PCB and 4,4′-DDE concentrations in aquatic organism tissue. PCBs were modeled in the previous food web model technical memorandum (Windward 2004) using data available at that time and are modeled again in this report using the additional site-specific data that are currently available. In addition, 4,4′-DDE, which is an environmentally persistent hydrophobic organic compound, was selected to investigate the ability of the models to predict concentrations of a single chemical. Evaluation of a single chemical may make it possible to more narrowly define some chemical attributes in the model since the attributes are specific to that particular chemical (e.g., BSAFs). 4,4′-DDE was selected because it is present throughout the site with a few areas of high concentration, and it is the DDT metabolite most commonly detected in tissue. The technical approach used to evaluate the steady-state models described in this report relies on available site-specific data for PCB and 4,4′-DDE concentrations in sediment, water, and tissue. Additional site-specific data (e.g., multiplate water column invertebrate sampling) that is relevant to the development of a food web model for the Site is being obtained and, once available, will facilitate more informed, future iterations of the model(s).

1.2 MODELING GOAL AND SPECIFICATIONS

The primary goal of food web modeling for the RI/FS is to develop a predictive relationship between chemical concentrations in sediment, water, and tissue that can be used to derive preliminary sediment cleanup goals for chemicals that are present in fish tissue at concentrations associated with unacceptable risk. If the relationship cannot be established, then alternate methods for developing sediment cleanup goals will be required. The Lower Willamette Group (LWG) and EPA and their partners have convened several meetings to expand on this goal.

Many of the issues raised by EPA at these meetings related to using the model to predict when and where fish would be safe to eat. EPA also provided expectations regarding the use of the models, which are presented as model specifications (or model selection criteria). These specifications will aid LWG and EPA in assessing the suitability of the two models (i.e., the Arnot and Gobas and TrophicTrace models) to meet the modeling goal and thereby meet the specific needs of the Portland Harbor RI/FS. The ability of each model to satisfy the following model specifications will be discussed in the remaining sections of this report. This evaluation is necessarily general since multiple models and applications are being evaluated in this report and the degree to which these specifications can be met depends on which model is used for which chemicals and for what spatial scale. Identified model specifications include:

- Model can represent a reasonable simplification of what is known about the Site food web and the likely pathways of chemical transfer among trophic levels
- Model can be used to model hydrophobic organic compounds other than total PCBs
- Model can be used to model metals
- Model can be used to determine the relative importance of water vs. sediment to chemical concentrations in fish
- Model can evaluate the effects of remedial actions at various spatial scales
- Model can predict tissue concentrations in areas where there is sufficient sediment and water data
- Model can incorporate output data from a transport and fate model
- Model output (i.e., chemical concentrations in fish) can be used in a separate model to characterize the transfer of chemicals from fish to birds to eggs
- Model is fully documented, including all equations, code, and assumptions for input parameters

2.0 BIOACCUMULATION MODELS

Bioaccumulation models predict the transfer of chemicals through ecosystems. Because ecosystems are complex and dynamic environments, many simplifying assumptions are required when selecting and parameterizing a food web model. Simpler models focus on parameters and processes that contribute to the most significant movement of a given chemical among different media in an ecosystem (water, sediment, and tissue). The modeling process is necessarily iterative because numerous assumptions and estimates are required in modeling. For the model to be used as an effective tool, these assumptions and estimates must be clearly articulated to and accepted by all participating parties. This section describes bioaccumulation models and provides an introduction to the simplifying assumptions required to successfully model chemical concentrations in key species in order to meet the RI/FS objectives.

In general, bioaccumulation models include those species, abiotic media, and pathways assumed to play important roles in the transfer and bioaccumulation of chemicals at a site. The transfer of chemicals can be via abiotic, dietary, or respiratory routes. However, the pathways and processes included in a general bioaccumulation model are not necessarily those modeled in each of the food web models evaluated in this report. For example, the TrophicTrace model does not incorporate the ventilation of porewater by biota as an uptake pathway, although it may be implicit in some of its assumptions (e.g., use of BSAF to define the transfer between sediment and biota). The input parameters and processes included in each model are described in Sections 3.0 and 4.0, which also indicate which species, abiotic media, and pathways are assumed to be most important in the transfer and accumulation of chemicals at the Site.

2.1 BIOTIC AND ABIOTIC COMPARTMENTS

Biotic and abiotic media are included in the bioaccumulation model. Species of interest for the Site consist of phytoplankton, zooplankton, representative benthic invertebrate species, and selected fish species. Although sediment and surface water do include detritus and the bacteria and fungi associated with it, they are categorized here as abiotic media.

2.1.1 Species

The target species presented in the bioaccumulation model are either receptors of concern (ROCs) for the Portland Harbor ecological and/or human health risk assessments (Integral et al. 2004b) or serve as key prey for the selected ROCs. Figure 2-1 presents dietary pathways for the Portland Harbor Site used in the models evaluated in this report. Nine fish species from three feeding guilds are included in the conceptual model.

- **Omnivores/herbivores:** largescale sucker (*Catostomus macrocheilus*), common carp (*Cyprinus carpio*), and brown bullhead (*Ameiurus nebulosus*)
- **Invertivores:** sculpin (*Cottus* spp.), peamouth (*Mylocheilus caurinus*), and juvenile chinook salmon (*Oncorhynchus tshawytscha*)
- **Piscivores:** smallmouth bass (*Micropterus dolomieui*), northern pikeminnow (*Ptychocheilus oregonensis*), and black crappie (*Pomoxis nigromaculatus*)

All of the fish species above, except for juvenile chinook salmon, are resident species.

The other biotic compartments include phytoplankton, zooplankton, and five benthic invertebrate groups: amphipods, clams, crayfish, aquatic insect larvae, and oligochaetes. These biotic compartments were included in the model based on available diet information for the fish species modeled as compiled from site-specific studies or the general literature.

Bryozoans, which were used as a prey item in the preliminary model runs (Windward 2004), were not included in the bioaccumulation model after additional literature research concluded that resident fish likely consume only bryozoan statoblasts (reproductive structures), which are produced only once or twice a year (Wood 2004) and do not likely contribute significantly to the chemical transfer.

2.1.2 Abiotic Media

Two major abiotic media are included in the bioaccumulation model: sediment and surface water. Chemicals in both the surface water and sediment, however, are partitioned between those fractions that are freely dissolved, adsorbed onto dissolved organic carbon (DOC), and adsorbed onto particulate organic carbon (POC). However, as will be discussed further in Section 4.0, the measured chemical concentrations for both sediment and surface water used to parameterize the two food web models are from bulk samples that include all three fractions. To varying degrees, the two food web models calculated the partitioning into separate fractions for sediment and surface water. Section 4.2 provides details on how each model estimated these fractions.

2.2 PATHWAYS

Chemical transfer pathways in the bioaccumulation model fall into three categories: dietary uptake, respiratory transfer, and physical processes.

2.2.1 Dietary Uptake

Diets of fish and invertebrates are likely to be variable due to opportunistic feeding behavior and seasonal and spatial variations in prey availability. A description of the diet composition scenarios selected for the two food web models is presented in Section 4.2.

2.2.2 Aqueous Uptake

In addition to direct dietary uptake of chemicals from prey items, freely dissolved fractions of chemicals can be transferred to organisms via aqueous exposure. The primary site of uptake is the respiratory surface of the organism, which varies from the cell membrane for phytoplankton to gills for fish and some invertebrates (Arnot and Gobas 2004; Gobas et al. 1989; McCarthy 1983; McCarthy and Jimenez 1985; Morrison et al. 1996; Morrison et al. 1997; USACE 2003). Dissolved chemicals in the water column also feed into all organisms as they are exposed to or ventilate water column water. Because aqueous uptake occurs from the freely dissolved fraction, chemicals freely dissolved in porewater can be transferred to organisms living on or near the sediment surface because a portion of the water they ventilate is likely to be porewater. However, the methods used to account for aqueous uptake are not the same in the two food web models evaluated in this analysis. TrophicTrace does not include ventilation of porewater for fish. Porewater exposure is included implicitly for invertebrates in the BSAF since the data used to calculate BSAFs are a mixture or dietary and respiratory exposure.

2.2.3 Physical Processes

The physical processes included in the bioaccumulation model primarily relate to equilibrium partitioning between the chemical phases in surface water and sediment. The diffusion of dissolved chemicals across a chemical concentration gradient between the water column water and sediment and the settling and resuspension of particulates are also included in the bioaccumulation model, but neither of those processes are included in the two food web models evaluated in this report.

3.0 DESCRIPTION OF GOBAS-TYPE MODELS

This section presents a brief discussion of the two mechanistic steady-state food web models that will be further evaluated for application at the Site. In addition, at the request of EPA, this section also includes a discussion of another model, the ECOFATE model (Gobas et al. 1998), which is a time-dependent food web model linked to an environmental fate model, rather than a steady-state model.

The precursor to all three models discussed in this section is the Gobas model (Gobas 1993), which is a four-compartment, steady-state, mass-balance bioaccumulation model. This model forms the basis for many subsequent updates and iterations of Gobas-type models, including refinements (Arnot and Gobas 2004; Morrison et al. 1996; Morrison et al. 1997) and simplifications such as TrophicTrace(USACE 2003). Models based on the original Gobas (1993) approach have been used in a broad range of environments (i.e., lakes, rivers, and estuaries) as described in the 2004 memo (Windward 2004). The most widely used versions of the Gobas model at Superfund sites have been those that use a mechanistic approach for modeling invertebrates, as in the Arnot and Gobas version, rather than a BSAF, as used by TrophicTrace. Gobas-type models that use mechanistic invertebrate modeling have been applied at the Hudson River, Fox River, and Sheboygan River sites.

The technical framework of three of these models (Arnot and Gobas, TrophicTrace, and ECOFATE) and their ability to address the model specifications described in Section 1.3 are summarized below.

3.1 Arnot and Gobas (2004)

Arnot and Gobas (2004) incorporates several significant new elements relative to the previous versions of the Gobas model including: 1) a new model for partitioning chemicals into organisms; 2) kinetic models for predicting chemical concentrations in algae, phytoplankton, and zooplankton; 3) new allometric relationships for predicting gill ventilation rates in a wide range of aquatic species; and 4) the inclusion of a mechanistic model for predicting gastrointestinal magnification of organic chemicals in a range of species.

This version of the Gobas model can be used without significant modification to address all of the specifications presented in Section 1.3. The Arnot and Gobas model performed well in the preliminary model runs (Windward 2004) and, based on that performance, was selected for further assessment in this report. The following approaches are used in this model to estimate tissue concentrations in biota.

- Chemical concentrations in phytoplankton are calculated assuming aqueous uptake and loss via the respiratory surface, and loss via growth dilution.
- Chemical concentrations in zooplankton, invertebrates, and fish are calculated assuming uptake from water via the respiratory surface

and uptake from the diet. Losses include metabolism, growth dilution, loss to water via the respiratory surface, and fecal egestion.

- Chemical concentrations in filter-feeding invertebrates are calculated assuming uptake via ingestion of plankton and suspended solids, and uptake from water via the respiratory surface. Filter-feeders are linked to sediments via ingestion of suspended sediments.

Equations for the Arnot and Gobas model are provided in Table 3-1.

3.2 TrophicTrace 3.1 (USACE 2003)

TrophicTrace was developed for USACE for use in the management of dredge materials (von Stackelberg and Burmistrova 2003). Among other models (i.e., human health and ecological risk models and a bioaccumulation model for metals), TrophicTrace includes a mechanistic bioaccumulation model for hydrophobic organic chemicals based on Gobas (1993) and Gobas et al. (1995). TrophicTrace is an Excel® spreadsheet model that estimates concentrations in invertebrates and fish for a user-specified food web. TrophicTrace was the best-performing model in the preliminary model runs (Gobas et al. 1998) and thus was selected for further assessment in this report. The TrophicTrace model may be used to meet all the specifications in Section 1.3 in some way without significant modification.

This model uses equilibrium partitioning to predict invertebrate tissue concentrations in filter-feeders and plankton but differs from the Gobas (1993) model in that it relies on user-supplied BSAFs to predict tissue chemical concentrations in deposit-feeding benthic invertebrates. The following approaches are used in this model to estimate tissue concentrations.

- Chemical concentrations in specific invertebrate prey species are assumed to be derived either entirely from sediment or entirely from water, depending on whether the user designates the invertebrate species as a deposit-feeder or filter-feeder, respectively.
- Chemical concentrations in deposit-feeders are calculated using a user-specified BSAF for each chemical, while concentrations in filter-feeders and phytoplankton are calculated using user-specified octanol-water partition coefficients (Log K_{OW}, hereafter referred to as K_{OW}) for each chemical.
- Chemical concentrations in fish tissue are calculated using a steady-state model based on the approach of Gobas (1993) and Gobas et al. (1995). Values for the rate constants are calculated using equations from several sources (Burkhard 1998, Gobas 1993, Gobas et al. 1995).

Equations for the TrophicTrace model are provided in Table 3-2.

TrophicTrace has built-in probabilistic capabilities. TrophicTrace allows users to characterize uncertainty using trapezoidal fuzzy numbers, with uncertainties propagated throughout the analysis using fuzzy arithmetic principles. A trapezoidal fuzzy number consists of 4 numerical values (e.g., a minimum, a high and low for a range of likeliest values, and a maximum) that represent the range of plausible values for a parameter (Morrison et al. 1997). To simplify the comparability of the results from this model to the results from the Arnot and Gobas model, which does not currently have probabilistic capabilities, the trapezoidal fuzzy number capabilities of this model were not applied during the model runs described in this report.

An updated version of the TrophicTrace model (Version 4) is currently available on the USACE Web site. The updated version, however, was released on August 29, 2005, which was too late for inclusion in this evaluation. The new version is a stand-alone executable application rather than an Excel® add-in, but none of the calculations or features of the actual model have changed from the version used in this evaluation.

3.3 ECOFATE (Gobas et al. 1998)

ECOFATE is a set of linked models that includes an environmental fate model, a food web bioaccumulation model, a human health risk assessment model, and a toxicological hazard assessment model. The food web bioaccumulation model is a time-dependent, multimedia, mass-balance simulation model of the environmental distribution and food-chain accumulation of organic contaminants in aquatic ecosystems (ECOFATE) (Gobas et al. 1998). It has been applied to the Fraser River in British Columbia, where the modeled chemical groups were dioxins and furans.

The model is available for download from the Simon Fraser University, School of Resource and Environmental Management, Environmental Toxicology Research Group, Web site (Gobas 2005). The version of ECOFATE applied to the Fraser River included Morrison (Windward 2005b) updates; however, the downloadable version does not. It relies on the original Gobas model (Gobas 1993). The downloadable model includes a time-dependent bioaccumulation model that has different age classes for fish and spawning times. This model is tied to an environmental fate model.

Pursuant to a request by EPA and their partners, ECOFATE was reviewed for potential use at Portland Harbor. This model could potentially address all of the model specifications described in Section 1.3, with the exception of the ability to model metals. As with the other two models being considered in this report, evaluation of chemical transfer to bird eggs would require the use of an additional model. ECOFATE could not be evaluated in this report because the loadings data required for the fate and transport module do not exist for the site. In addition, the aquatic ecosystem data necessary to parameterize the time-dependent bioaccumulation model do not exist for Portland Harbor. Parameterizing the time-dependent model would require additional data collection or acceptance of the limitations in using literature-based data for key fish species. Furthermore, it is not possible at this time, without reprogramming, to unlink the fate and transport and bioaccumulation models. Finally, the steady-state bioaccumulation model (Gobas 1993) was evaluated in an earlier report (Windward 2005b), and it was eliminated from the list of candidate models due to poor performance. Thus, the ECOFATE model was eliminated from further consideration.

4.0 METHODS

The TrophicTrace and Arnot and Gobas models were used to estimate total PCB and 4,4′-DDE concentrations in tissue for two spatial scales at the Site. This section describes the methods used to develop and execute the model runs. The overall process is summarized in the steps listed below; details are provided in the subsections that follow (except for Step 2). Model parameterizations and runs followed these steps:

- Step 1 – Determine chemicals to be modeled (Section 4.1.1)
- Step 2 – Determine fish and invertebrate species to be modeled (Section 2.1.1)
- Step 3 – Determine spatial scales to be modeled (Section 4.1.2)
- Step 4a – Compile existing model input data required for Arnot and Gobas from site-specific and literature sources (Section 4.2.1)
- Step 4b – Compile existing model input data required for TrophicTrace from site-specific and literature sources (Section 4.2.2)
- Step 5 – Develop multiple model scenarios based on combinations of input data and food webs (Section 4.4)
- Step 6 – Run each model scenario and compare to chemical concentrations for Round 1 fish samples (Section 4.4)
- Step 7 – Conduct sensitivity and uncertainty analyses (Section 4.5)

4.1 MODEL SETUP

Prior to model parameterization, the chemicals and species to be modeled and spatial scales were determined. The fish and invertebrate species selected for modeling were described in Section 2.1.1. This section describes how the chemicals modeled and spatial scales were selected.

4.1.1 Chemicals to be Modeled

A single chemical (4,4′-DDE) and a group of chemicals (total PCBs) were selected and modeled. PCBs and DDTs were identified as initial chemicals of potential concern (COPCs) for ecological receptor groups, including fish, in the Ecological Preliminary Risk Evaluation (PRE) (Windward 2005b). These chemicals also are consistently detected in sediment, water, and fish tissue, making them better candidates than chemicals for which environmental concentrations are not as well-characterized due to non-detect concentrations. The environmental persistence of these chemicals is also well-suited for the two steady-state models. The use of a single chemical and chemical mixture allowed the exploration of model capabilities for both.

4.1.2 Spatial Scales to be Modeled

The candidate models were run for two spatial scales. One scale was bounded to include the entire Site. For the purposes of this report, the spatial boundaries for the Site used for the candidate models were from RM 2 to RM 11, which is consistent with the area considered in the PRE (Windward 2005b). The Site encompasses the initial study area (ISA), defined in the Statement of Work as extending from RM 3.5 to RM .2. The final boundaries of the Site will be defined by EPA in the Record of Decision as a result of the RI/FS process.

Swan Island Lagoon (Figure 4-1) was selected to represent a smaller spatial scale based on the availability of site-specific environmental data (i.e., water temperature, dissolved oxygen [DO], TSS, and total organic carbon [TOC]). In addition, it is a unique environment in terms of flow and residence time. Furthermore, Swan Island Lagoon has elevated PCB concentrations compared to the rest of the Site (most sediment concentrations are >200 µg/kg dw).

The main objective for modeling a smaller spatial scale is to evaluate the impacts of local site remediation on tissue chemical concentrations, which is one of the information needs identified in Section 1.2. Evaluation of model performance after initial model runs will indicate whether either model has the ability to accurately predict tissue concentrations in Swan Island Lagoon. These results may also indicate the general resolution of these steady-state models. For example, fish species with small home ranges that occupy areas with elevated PCB concentrations, such as Swan Island Lagoon, may have elevated tissue concentrations. The ultimate application of modeling a smaller scale is to assess the impact of potential future remediation on tissue concentrations at the smaller scale.

Currently, the Arnot and Gobas model is not programmed to allow partial site use, which would be necessary for modeling species with large home ranges at a smaller spatial scale. Thus, at smaller spatial scales, the Arnot and Gobas model will likely have poor predictability for tissue concentrations of wide-ranging species. The model will be better able to assess the impacts of local-scale remediation on species with large home ranges through the use of area-weighted average sediment concentrations across the entire Site applied in site-wide models. TrophicTrace does allow users to define a site-use fraction for modeled species. Chemical input from outside the defined site is then assumed to be zero.

4.2 PARAMETERIZATION

Existing biological parameters, environmental parameters, and chemical concentration data collected during Round 1 and Round 2 for the Portland Harbor RI/FS and from additional sources were compiled to parameterize the Arnot and Gobas and TrophicTrace models. Sections 4.2.1 and 4.2.2 describe in detail the biological, chemical, and environmental parameters used in the Arnot and Gobas and

TrophicTrace models, respectively, and their sources. The parameters are also presented in Tables 4-1 through 4-7.

Identical values were used for variables common to both models. The sources and data reduction methods for developing or determining input data and model scenarios are described in the following sections. Input parameters for Arnot and Gobas and TrophicTrace are presented in separate tables, although some information is redundant between the two models.

Resident species were assumed to be most appropriate for use in the food web models because both models assume that a steady-state condition exists between the chemical concentrations in the Site sediment and concentrations in the tissue. This assumption is more likely to be true for resident species than for anadromous and wide-ranging fish with relatively short residence times in Portland Harbor, especially adult fish. Juvenile salmonids may or may not remain in the harbor long enough to reach a near-steady-state condition. Juvenile salmonids were modeled, at the request of EPA to investigate whether juvenile salmon might reach a steady state and chemical concentrations could reasonably be predicted by the model. However, their inclusion was not fully integrated into the models. They were not included as prey items for the eight resident fish species, although they are expected to be prey for some of these species, such as pikeminnow. Instead, young fish as prey are represented by the juvenile fish compartment, which includes several different species (peamouth, sculpin, black crappie, and juvenile chinook salmon).

Site-specific biological and environmental parameters were derived from Round 1 and Round 2 data, where appropriate data were available. For environmental parameters where data were not available, data were compiled from the Oregon Department of Environmental Quality (ODEQ) laboratory analytical storage and retrieval (LASAR) database (ODEQ 2005). For biological parameters, data were compiled from other literature sources. Site-specific chemistry data for surface water, surface sediment, and tissue from Round 1 and Round 2 data collection were used either as input to the candidate models or to evaluate the predictive performance of the model (tissue chemistry data).

Round 1 sampling events in the Portland Harbor ISA were conducted in the summer and fall of 2002 and included the collection of surface sediment and whole-body tissue from selected fish and invertebrate species (Integral 2005b). Round 2 sampling events that generated data relevant to the models included sampling of surface sediment in the summer and fall of 2004 (Integral et al. 2004a) and the first sampling of surface water, which was completed in December 2004 (Windward 2005b).

4.2.1 Arnot and Gobas

The equations used in the Arnot and Gobas model are presented in Table 3-1. The input parameters required by the model were derived from site-specific data where possible. When data were not available, literature-derived values were used.

The Arnot and Gobas model was altered slightly from the version used for the 2004 model runs (Windward 2004). Specifically, a small correction was made to the model template for the diet of one fish (one prey item reference cell for one piscivorous fish was incorrect in the 2004 version). The model was also altered to accept species-specific porewater ventilation rates in order to make the model more biologically relevant. Finally, non-lipid organic matter (NLOM) was a directly entered model input in 2004 applications but was calculated by the model in 2005 applications (see Section 4.2.1.1). Percent moisture was calculated by the model in 2004 but was a directly entered input value in 2005. These latter two changes reflect the availability of measured data for these parameters in 2005.

4.2.1.1 Biological Parameters

The Arnot and Gobas model requires biological parameters that characterize tissue composition of species (e.g., organism wet weight [ww]), represent a biological process (e.g., dietary absorption efficiency), or characterize species behavior/exposure (e.g., diet or fraction of porewater ventilated). The complete suite of biological input parameters required for the Arnot and Gobas model are presented in Tables 4-1 and 4-2. Table 4-1 lists those parameters where site-specific data were available to parameterize the model; Table 4-2 lists those parameters where literature-derived data were used. The biological parameter values specific for each species are listed in Table 4-3.

Dietary compositions for fish and invertebrates were compiled primarily from studies in the LWR (ODFW 2005) and general qualitative observations of fish stomach contents collected during Round 1 sampling, as reported in Attachment B8 of Appendix B of the RI/FS Programmatic Work Plan (Integral et al. 2004b; Zimmerman 1999). LWR stomach content results were augmented with data from the general literature when necessary. For example, if no site-specific studies were available, studies from similar environments (e.g., riverine freshwater habitat) were chosen. Professional judgment and local knowledge was used to fill data gaps from the literature. Dietary studies were important in determining which invertebrate species to model. Not all prey species identified in the studies were modeled because doing so would compound estimation error to an unacceptable level. Therefore, similar prey items, in terms of life history, diets, habitat, and size, were grouped and represented by a typical surrogate organism.

Dietary compositions were based on the same sources as the dietary compositions used in the PRE (Windward 2005b) (see Figure 2-1); however, the actual assigned portions of prey were slightly different from those reported in the PRE. The Arnot and Gobas model is able to model specific benthic and water column invertebrate species, as well as other prey items (e.g., phytoplankton), whereas the dietary estimates used in the PRE to determine exposure concentrations in the diet were based on general groups of prey (e.g., all benthic organisms, all water column organisms) and were less specific. In addition, dietary items for some species differed from those in the RI/FS Programmatic Work Plan (see Figure 2-2 Appendix B)

(Integral et al. 2004b). This is because food web model dietary estimates need to be ecologically relevant for the purpose of generating accurate predictions of tissue chemical concentrations instead of conservative estimates for the purpose of risk calculation.

Due to high uncertainty in dietary estimates, two dietary scenarios were created for each organism to reflect a range of potential exposure scenarios. Diet 1 assumed a higher ingested fraction of fish and sediment and a lower ingested fraction of plankton in the diet as compared to Diet 2. Table 4-3 presents dietary assumptions for modeled species and their sources. Neither cannibalism nor predation of lower trophic-level species on higher trophic-level species (supra-trophic consumption) was represented in either model because of the constraints of the model structures. In order to allow such interactions in both models, additional size classes would need be added. A juvenile fish compartment representing many fish species was created to address this issue. The juvenile fish compartment was created by combining biological data from Round 1 tissue data for peamouth, sculpin, black crappie, and juvenile chinook salmon (Table 4-3). The specimens for the eight resident fish species captured during Round 1 data collection activities were representative of adult fish tissue and thus were not realistic prey items for similarly sized piscivores. Smallmouth bass, northern pikeminnow, and black crappie are piscivores that as adults consume a wide range of species, most commonly in the juvenile life stage (Mackintosh et al. 2004; Skoglund and Swackhamer 1999).

The biological parameters derived from site-specific Round 1 data included body weight (in wet weight), lipid content, NLOM content, and percent moisture of clams, crayfish, and fish species. Arnot and Gobas also required an estimate of the fraction of water ventilated that is porewater and the fraction that is overlying water, where overlying water is equal to 1 minus the fraction of porewater ventilated. Benthic fish are likely to ventilate more porewater than pelagic fish. Values for this parameter were estimated using best professional judgment based on the lifestyle and feeding habits of each species.

In the Arnot and Gobas model, the NLOM of the organism is calculated using the following equation:

$$NLOM = 1 - (F_{Mo} + F_L) \qquad \textbf{Equation 4-1}$$

Where:

NLOM	=	fraction of non-lipid organic matter
F_{Mo}	=	fraction of percent moisture
F_L	=	fraction of lipid content

The partitioning of organic chemicals into biological organisms is believed to occur into lipids, NLOM, and water (Arnot and Gobas 2004). A general ranking of sorptive capacity of biological matrices for non-ionic hydrophobic chemicals is lipids, organic carbon, organic matter, and water (Seth et al. 1999). Proximate composition studies of fish and invertebrates report compositions as lipids, water, carbohydrate, protein and ash (Payne et al. 1999, as cited in Arnot and Gobas, 2004). NLOM is the combined carbohydrate and protein fractions of the organism. For the purpose of this report NLOM is estimated using the equation above and thus will include some ash. The nonionic organic chemical sorption affinity of NLOM is approximately 3.5% that of octanol (Gobas et al. 1999). This may seem small, however, for organisms with low lipid contents such as phytoplankton, algae and some invertebrates, the NLOM portion can accumulate significant amounts hydrophobic organic chemicals (on a mass basis) due to a much greater mass of NLOM than lipids.

The NLOM fraction of gut contents is also calculated in the Arnot and Gobas model (Table 3-1). To calculate this value, the dietary absorption efficiency of NLOM is multiplied by the overall NLOM content of the diet and divided by the overall gut content (water, lipid, and NLOM).

Because site-specific values for several biological parameters were not available, values from the literature were assigned for the parameters listed in Table 4-2. Literature values for dietary absorption efficiencies, scavenging efficiencies, and other constants relating to the uptake by primary producers were generally provided in the Arnot and Gobas model framework and used in this analysis.

Measured site-specific data were not available for several species being modeled, including phytoplankton, zooplankton, oligochaetes, insect larvae, and amphipods. These organisms were not collected during Round 1 sampling but may be collected during the ongoing Round 2 sampling of aquatic and benthic species. Thus, input data for weight, lipid content, NLOM, non-lipid organic carbon (NLOC) for phytoplankton, percent moisture, and fraction of porewater ventilated were based on literature-derived values. Percent moisture for phytoplankton was then calculated summing the NLOC and lipid content of phytoplankton and subtracting the resulting sum from 1. For zooplankton, percent moisture was a literature-derived value. For oligochaetes, insect larvae, and amphipods, species-specific literature data were not available for percent moisture, so percent moisture in these organisms was assumed to be 80% (Integral 2005a). Percent NLOM for each species was calculated using Equation 4-1.

NLOC is used for phytoplankton instead of NLOM because it has a greater affinity for hydrophobic organics, is the most important site of storage in phytoplankton ((Mackintosh et al. 2004; Skoglund and Swackhamer 1999), and is readily available from the literature. It is becoming more common that studies include a measurement of organic carbon as well as lipids in phytoplankton bioaccumulation studies (Mackintosh et al. 2004).

4.2.1.2 Environmental Parameters

The environmental input parameters required for the Arnot and Gobas model establish the surface water and sediment chemistry environment in the spatial scales modeled. Chemical concentration and organic carbon (OC) in sediment and chemical concentration, DO concentration, water temperature, suspended solids, DOC, and POC concentrations in the water column are all required.

Total PCB and 4,4′-DDE concentrations in surface sediment (0 to 30 cm) and surface water were derived from site-specific data sets. Surface sediment chemistry data and percent sediment organic carbon (SOC) content were derived from Round 1 and Round 2 sampling events (MDEQ 2004). Surface water chemistry data for total PCBs and 4,4′-DDE were based on samples collected during the first sampling event of Round 2, which was conducted in November and December 2004 (ATSDR 2003). Additional water chemistry data, including TOC, DO,[1] total suspended solids (TSS), and temperature were derived from the ODEQ LASAR database (ODEQ 2005).

Sediment chemistry

For each spatial scale, a representative value of percent SOC content and sediment concentrations of total PCBs and 4,4′-DDE was calculated. Total PCBs were calculated for each sample as the sum of all detected Aroclors. PCBs totals were based on Aroclors primarily because more samples were analyzed for Aroclors than for PCB congeners. Where no Aroclors were detected, the highest reporting limit was used to represent the total PCB concentration. All Round 1 and Round 2 surface sediment samples analyzed for total PCBs from within the study area (from RM 2 to RM 11; n=615) were included in the data set.

Total PCBs (as Aroclors) and 4,4′-DDE concentrations were calculated for each sampling location. These data were then analyzed in the geographic information system (GIS) to generate an area-weighted average (AWA) concentration using the inverse distance weighting (IDW) method. IDW interpolation is a spatial calculation that predicts values for locations where chemical concentrations were not measured. IDW interpolation is based on the assumption that sediment concentrations from locations that are close to one another are more alike than those that are farther apart. Therefore, a location without a known sediment concentration can be estimated by weighting the nearby sediment concentrations according to their distance from the location without a known sediment concentration and then calculating an IDW interpolation. Estimates of sediment concentration used in the model are presented in Tables 4-1 and 4-4. Maps with interpolated surface sediment concentrations for total PCBs and 4,4′-DDE are presented as Figures 4-2 and 4-3, respectively.

[1] DO data were derived from the ODEQ database; however, the Arnot and Gobas model used an equation to calculate DO. The data were used to validate the equation. Future model runs may use the measured data instead of the equation.

Water chemistry

Chemical concentrations of total PCBs and 4,4′-DDE were generated from the three integrated transect XAD™ samples collected at the Site as part of the first sampling event of Round 2 (Figure 4-1). Total PCBs were calculated for each transect sample as the sum of all detected congeners. Where no congeners were detected, the highest reporting limit was used to represent the total PCB concentration. Total PCBs were estimated using PCB congener data rather than PCB Aroclor data because the laboratory experienced significant interferences during the initial PCB Aroclor analysis on the XAD extracts, and these data were rejected by the data validator.

For PCBs and 4,4′-DDE, average, maximum, and minimum surface water concentrations were calculated for each of the three XAD samples.[2] These concentrations were used for both spatial scales due to a lack of integrated samples from Swan Island Lagoon (Tables 4-1 and 4-4). These surface water chemistry data may not be representative of surface water chemistry during different seasons at the Site because they represent the chemical concentrations collected during one sampling event. Additional surface water data from three subsequent sampling events (conducted in March, July, and November 2005) will be incorporated into future modeling efforts, which will be more representative of the seasonal and water flow variations throughout the year. The samples selected for inclusion were integrated both vertically and horizontally in the water column and therefore accurately represent the chemical water concentration at these locations.

DO, temperature, TSS, and TOC data were extracted from the LASAR database (ODEQ 2005). Data were collected between 1995 and 2005 at the SP&S railroad bridge monitoring station 10332 (Figure 4-1). Summary statistics, including mean, minimum, and maximum values, were calculated for DO, temperature, and TSS (Tables 4-1 and 4-4). The data were collected seasonally at the monitoring station; although for 2005, only one measurement existed at the time that this report was being written. DO concentrations were calculated from 71 measurements, temperature values from 67 measurements, TSS from 65 measurements, and TOC from 43 measurements. Field duplicates were not included in the calculations.

For Swan Island Lagoon, ODEQ data for DO, temperature, and TSS were exported from the LASAR database for the Swan Island Lagoon channel midpoint station 10801 (Figure 4-1). The Swan Island Lagoon monitoring station is within Swan Island Lagoon. Summary statistics, including maximum, minimum, and average values, were calculated for each parameter. DO concentrations were calculated from 20 measurements, temperature from 103 values, TOC from 63 values, and TSS from 76 values.[3] Data were extracted from the ODEQ database for years 1995-2005 to

[2] Surface water XAD results were based on the sum of concentrations from the XAD filter and water column.

[3] DO concentrations were calculated from 20 measurements (including field duplicates) temperature from 103 values (including field duplicates); TOC from 63 values (no field duplicates); and TSS from 76 values (no field duplicates).

capture temporal and seasonal variation within the RM 2 to RM 11 and Swan Island Lagoon subareas.

4.2.1.3 Chemical Parameters

Two chemical-specific input parameters are required for the Arnot and Gobas model: the K_{OW} and metabolic breakdown rate.

Several parameters associated with total PCBs were derived from the technical literature. A K_{OW} of 6.3 was estimated using EPA's Estimated Program Interface (EPI Suite™) software (EPA 2003). EPI Suite is a Windows®-based suite of physical and chemical property and environmental fate estimation models developed by EPA's Office of Pollution Prevention Toxics and the Syracuse Research Corporation. For 4,4′-DDE, a K_{OW} of 6.76 was selected from the literature (ATSDR 2003). These values are presented in Tables 4-2 and 4-5.

One of the chemical loss mechanisms for the Arnot and Gobas model is metabolism. Metabolism loss is considered insignificant for PCBs and has not been included in recent Gobas model applications (Evans-White et al. 2001). Metabolism of PCBs in preliminary model runs was considered to be zero. This simplifying assumption was also made in the original Arnot and Gobas model (2004), which modeled individual PCB congeners within a factor of 2 of most empirical data. The dynamics of metabolism for DDT and its metabolites can have a significant effect on the resulting body burdens of exposed organisms. Uptake of 4,4′-DDE by organisms can occur via the water or the diet. Another source of 4,4′-DDE is 4,4′-DDT, its parent compound. A significant portion of 4,4′-DDT may be metabolized to 4,4′-DDE upon uptake. In addition, 4,4′-DDE may itself be further metabolized. These processes do not occur readily, however, as demonstrated by the persistence of the parent compound and its metabolites in environmental matrices. An initial literature search identified few studies of 4,4′ DDT metabolism with relevant species (Windward 2005b) and no articles on 4,4′-DDE metabolism. For these reasons, the metabolism of 4,4′-DDE in preliminary model runs was assumed to be zero. Although this assumption is incorrect, the metabolism of 4,4′-DDE is partially balanced by the conversion of 4,4′-DDT into 4,4′-DDE.

4.2.2 TrophicTrace

The equations used in the TrophicTrace model are presented in Table 3-2. This model requires many of the same input parameters as the Arnot and Gobas model. The same values were used for parameters included in both models.

4.2.2.1 Biological Parameters

The biological input parameters required by TrophicTrace were also required by the Arnot and Gobas model; fish diet composition and weight and lipid content of all species modeled. The same site-specific or literature values used and described for Arnot and Gobas in the previous section were used to parameterize TrophicTrace (Tables 4-4 and 4-5). Values for two chemical transport rate constants that are embedded in the calculations of TrophicTrace were derived from the literature by the authors of TrophicTrace (Table 4-5).

In addition to using the biological input parameters listed in Section 4.2.1.1, TrophicTrace also requires the user to designate the dietary exposure pathway for each invertebrate species as either via water or sediment (Figure 2-1). No actual diet was designated for each species as was done in Arnot and Gobas because more simplified equations were used to calculate invertebrate tissue concentrations in TrophicTrace (Table 3-2). The following dietary exposure pathways were designated for each invertebrate modeled throughout this analysis:

- Water-pathway invertebrates: phytoplankton, zooplankton, crayfish, and insect larvae
- Sediment-pathway invertebrates: oligochaetes, clams, and amphipods

The designation as a water-pathway or sediment-pathway organism was determined based on foraging habits and life history presented in the literature and on best professional judgment. The clam diets used in the Arnot and Gobas model were either 80% or 50% sediment (Table 4-3), so they were modeled through the sediment pathway in TrophicTrace to best correspond to the Arnot and Gobas model. Crayfish are opportunistic feeders (Windward 2005b) and, therefore, likely feed from both the sediment and water pathways at the Site. The sediment pathway, however, was not selected for crayfish because tissue concentrations from crayfish collected during Round 1 did not correlate well with co-located sediment concentrations (Windward 2005b).

Sediment ingestion is included as a diet component for several of the fish species modeled (Table 4-3; Figure 2-1). However, there is currently no direct mechanism to include sediment ingestion into the diets of fish provided in TrophicTrace. In order to model the effect of sediment ingestion on fish tissue chemistry in TrophicTrace, sediment was included as a potential prey item. TrophicTrace requires the input of lipid content for each prey item, therefore for sediment as a “prey item,” it was assumed that the lipid content was equal to the OC content (i.e., this assumes that all OC in the sediment was composed of lipids). This approach likely overestimates the effect of sediment ingestion on tissue concentrations because TrophicTrace calculates the sediment as prey concentration by multiplying the user-defined sediment concentration (ng/g dw) by the user-defined BSAF for each chemical.

4.2.2.2 Environmental Parameters

The environmental input parameters required by TrophicTrace were DOC, POC, TOC, chemical concentrations in the water column and sediment, and water temperature. Each of these parameters was also required for Arnot and Gobas and the same site-specific values calculated for Arnot and Gobas also were used in TrophicTrace (Table 4-4).

One literature-derived environmental parameter value was used in TrophicTrace. A value for the density of OC in the water column was embedded in the calculations by the authors of the model (Table 4-5).

4.2.2.3 Chemical Parameters

Two chemical-specific input parameters are required by TrophicTrace: K_{OW} and BSAF. The K_{OW} values that were derived from the literature for use in the Arnot and Gobas model were used in TrophicTrace (Table 4-5). Both models calculate the K_{OC} internally based on the user-defined K_{OW}, but they use different equations from the literature, which results in different K_{OC}s for the same K_{OW} (Tables 3-1 and 3-2). TrophicTrace, however, allows the user to designate a K_{OC} rather than rely on the internally calculated value.

The BSAF is required to calculate benthic invertebrate tissue concentrations in designated deposit-feeders. Three composite clam tissue samples co-located with surface sediment samples were collected from the Site during Round 1 sampling, but the sample-specific BSAFs for 4,4′-DDE and total PCB BSAFs ranged over three orders of magnitude. Similarly, BSAFs calculated from co-located crayfish tissue and sediment samples collected from the Site during Round 1 sampling ranged over two orders of magnitude. The statistical analysis conducted for co-located crayfish tissue and sediment samples (see Appendix C of the PRE) (Windward 2005b) found no significant positive rank correlation for total PCB and 4,4′-DDE concentrations (ORNL 1998). Therefore, a reliable site-specific benthic invertebrate BSAF could not be estimated for these chemicals, and literature-based BSAFs were used instead.

BSAFs for benthic invertebrates were compiled for a number of chemicals, including 4,4′-DDE and total PCBs, in the PRE (Windward 2005b). The same sources, including the ORNL compilation (Arnot 2005) and the USACE BSAF database (USACE 2004) were used to develop BSAFs for use in TrophicTrace. The BSAFs used in the PRE were not the same BSAFs used in TrophicTrace because the BSAFs developed for the PRE were based on the 90th percentile BSAF reported in the reviewed literature and were intended to be conservative factors for use in estimating risk. Instead, the average BSAF reported in appropriate invertebrates was used in TrophicTrace. For PCBs, 45 BSAF values for 14 marine and freshwater invertebrate species from 8 guilds were identified (Table 4-6). The guild weighted mean of these (3.7) was used as the primary estimate of the PCB BSAF for TrophicTrace. For 4,4′-DDE, far fewer studies of BSAFs were identified. Eight BSAFs for two marine species from two guilds were found (Table 4-7). In this case, the primary BSAF used for TrophicTrace was the average (6.2) of all reported BSAFs.

4.3 MODEL EVALUATION METHODS

4.3.1 Measured Tissue Concentrations

In order to evaluate the predictive power of the candidate models, the predicted tissue concentrations were compared to measured tissue concentrations. Composite samples of whole-body fish species, clam, and crayfish were collected in Round 1 sampling and analyzed for various chemicals, including PCBs and 4,4′-DDE. No site-specific tissue chemistry data for phytoplankton, zooplankton, amphipods, insect larvae, or oligochaetes were available because these organisms were not collected during Round 1 sampling. Round 2 sampling of aquatic and benthic species is currently on-going, and data are not yet available.

Summary statistics for total PCB Aroclors and 4,4′-DDE concentrations in whole-body tissue, including arithmetic mean, geometric mean, and maximum, were calculated for each spatial scale for each of the modeled species based on Round 1 data (Table 4-8). The number of composite samples for RM 2 to RM 11 varied by species, ranging from 3 to 27. Fewer samples were available for Swan Island Lagoon. Organisms collected in Swan Island Lagoon or in trawls that included Swan Island Lagoon were included in Swan Island Lagoon summary data.. No clam or juevenile salmon samples for Swan Island Lagoon were available. In addition, geomeans were not developed for species with only one sample from Swan Island Lagoon (peamouth, northern pikeminnow, largescale sucker). Thus, no comparisons of model predictions to geomean were made for these species for the small spatial scale. Collection locations for each species are shown in Figure 4-1.

4.3.2 Performance Evaluation Metrics

Four primary metrics were used for the comparison of model performance for scenario and uncertainty model runs. The first three metrics could only be generated for species with measured tissue chemical concentration data.

4.3.2.1 Species Predictive Accuracy Factor

The species predictive accuracy factor (SPAF) is the maximum of predicted tissue concentration and measured tissue concentration divided by minimum of predicted tissue concentration and measured tissue concentration. This equation calculates a factor difference between predicted and measured tissue concentrations that is always greater than 1. The “measured” concentration may be the arithmetic mean or geometric mean measured concentration (this is always specified in the results tables). Because the arithmetic mean can be greatly skewed for a small sample size with outliers, the SPAFs generated were based on comparisons to both the mean and geometric mean of measured tissue concentrations.

SPAF = measured mean or geomean/predicted concentration for particular species

if the predicted concentration < measured concentration

Or

SPAF = predicted/measured mean or geomean concentration for particular species

if the predicted concentration > measured concentration

The SPAF allows for equal weighting of overpredictions and underpredictions when comparing and averaging factor differences. For example, if one prediction is two times greater than measured values (greater by a factor of 2) while the other prediction is two times less than measured values (less by a factor of 2), the number representing them both will be 2 and not 2 and 0.5. For RM 2 to RM 11, measured chemical concentration data were available for eleven species. For Swan Island Lagoon, data were available for only nine species (no clam or juvenile salmon) (Table 4-8). Thus, there are eleven SPAFs for RM 2 to RM 11 and only nine for the Swam Island Lagoon model results.

4.3.2.2 Model Predictive Accuracy Factor

Model predictive accuracy factor (MPAF) is the average of all SPAFs. The factor difference provides a measure of the true average factor difference between predicted and measured tissue concentrations without considering overpredictions or underpredictions. Thus, this metric provides a measure of the average prediction error, taking into account all values rather than having some values cancel out. Since SPAFs were based on both comparisons to measured means and geometric means, MPAFs likewise reflect comparisons by species to means and geometric means. The number of species included was slightly less for Swan Island Lagoon than for RM 2 to RM 11 based on the availability of measured data (Table 4-8).

4.3.2.3 Model Bias

Model bias is the average of all the SPAFs, once negative signs have been applied to species being underpredicted. Negatives are assigned to the SPAFs to indicate underpredicting and overpredicting both at a species and model (all species) level. The predictive accuracy factor made the comparisons numerically equivalent (i.e., 2 and 2, instead of 2 and 0.5), thus making overpredictions and underpredictions equally weighted. The negative signs lead to overpredictions and underpredictions canceling out, thus the metric “model bias” tracks the central tendency of the model (all species) to predict chemical concentrations. As with the SPAFs, model bias was based on comparison to both measured species mean and geometric mean to reduce the influence of outliers in small sample sets. Again, because there were fewer data available, the mean model bias for RM 2 to RM 11 reflects eleven species comparisons, and the model bias for Swan Island Lagoon reflects nine species comparisons.

4.3.2.4 Percentage Change

For the sensitivity analysis, model output from a baseline model parameterization was compared to model output from that same parameterization with just one parameter adjusted. The species percent difference (SPD) metric represents the percent difference between adjusted and base model tissue concentrations for a given species (Equation 4-2). Changes that increase the species predicted concentration will be positive, and those that decrease the species predicted concentration will be negative.

$$\text{SPD} = \frac{\text{NPTC - BMPTC}}{\text{BMPTC}} \times 100 \qquad \textbf{Equation 4-2}$$

Where:

SPD	=	species percent difference
NPTC	=	new predicted tissue concentration
BMPTC	=	base model predicted tissue concentration

This allows a specific change in a specific parameter to be assessed for its influence on model predictions. For example, assuming a 50% increase in biota lipids for all species may result in an average 30% increase in predicted PCB concentrations for all species.

4.4 MODEL SCENARIOS

Model scenarios were developed from unique combinations of parameter values for parameters with high uncertainty or high potential variability. The purpose of running scenarios is to determine early in the process, if possible, which combination of different values for uncertain parameters performs the best. The relative performance of scenario runs may help determine "best values" for parameters. In contrast, if all scenarios for a given chemical at a given spatial scale perform poorly, this process may help reveal additional uncertainties that need investigation. Organism diets are highly uncertain and variable; thus, two food webs were tested in the scenarios. K_{OW} is highly uncertain for DDE, so three K_{OW} values were tested in the scenarios. For the Arnot and Gobas model, the fraction of porewater ventilated was tested in the scenarios. For TrophicTrace, several BSAFs for benthic invertebrates were tested in the scenarios. Tables 4-9 through 4-12 summarize the model scenarios.

Results of the model scenarios were compared to measured results. The MPAF and model bias for the measured mean and geometric mean were first evaluated. The number of species with predicted concentrations within a factor of 2 and 5 of the measured mean concentration was considered in some cases.

4.4.1 Arnot and Gobas

Scenarios for the Arnot and Gobas model are presented in Tables 4-9 and 4-10. The model scenarios represented different combinations of complex feeding relationships among organisms of different trophic guilds and habitats (food webs), the range of hydrophobicity of the chemical (K_{OW}), and the exchange of chemicals between organisms and sediment (porewater ventilation).

4.4.1.1 Total PCBs

For total PCBs, six scenarios were run for each spatial scale. The scenarios consisted of combinations of the two diets and the mean, minimum, or maximum fraction of porewater ventilated for each organism (Table 4-9).

4.4.1.2 4,4′-DDE

For 4,4′-DDE, 18 scenarios were run for each spatial scale. The DDE model runs consisted of combinations of the two diets, three K_{OW} values, and the mean, minimum, or maximum fraction of porewater ventilated for each organism (Table 4-10).

4.4.2 TrophicTrace

Scenarios for the TrophicTrace model are presented in Tables 4-11 and 4-12. The model scenarios represented different combinations of complex feeding relationships among trophic guilds and habitats (food webs), the range of hydrophobicity of the chemical (K_{OW}), and the exchange of chemicals between organisms and sediment (BSAF).

4.4.2.1 Total PCBs

For total PCBs, eight scenarios were run for each spatial scale. All scenarios consisted of combinations of the two diets and one of four estimates of BSAF (Table 4-11).

4.4.2.2 4,4′-DDE

For 4,4′-DDE, 18 scenarios were run for each spatial scale. The DDE model runs consisted of combinations of the two diets, three K_{OW} values, and three estimates of BSAF (Table 4-12).

4.5 SENSITIVITY ANALYSIS / UNCERTAINTY ANALYSIS

4.5.1 Sensitivity Analysis

Sensitivity analysis involves an investigation of how a fixed percent change in an input parameter (or set of input parameters) affects model output. It is a first step in evaluating the influence of error or variability in the model's parameters on the model outcome (Arnot 2005). Highly sensitive parameters will result in a large change in the model output, whereas less-sensitive parameters will produce a smaller change in model output. The sensitivity analysis identifies parameters that most influence model predictions. Sensitive parameters merit relatively close scrutiny; thus, a sensitivity analysis provides the basis for selecting parameters to be evaluated in the uncertainty analysis as well as contributes to the decision to focus on particular parameters for calibration.

A sensitivity analysis was applied to the base model (parameterization of the model selected after scenario runs). Parameter selection for the sensitivity analysis was based on previous runs of the Arnot and Gobas and TrophicTrace models (SRC 2001) as well as on advice from the creator of the Arnot and Gobas model (Mackay et al. 1992). To assess the influence of these parameters, selected parameters were decreased by 50% (while all other parameters were unchanged) to determine the model's response to that specific parameter change. Species-specific parameters such as lipids, weights, percent moisture, dietary absorption efficiencies, and fraction of porewater ventilated were changed for all species in one model run.

To assess the influence of these parameter changes, the new predicted tissue concentrations are compared to the base model predicted tissue concentrations. The SPD metric represents the percent difference between adjusted and base model tissue concentrations for a given species (Section 4.3.2.4).

The purpose of the sensitivity analysis is to examine how each candidate model responds to changes in key input parameters, both physical and biotic. The level of response from the model is determined both by the structure of the coding (mechanisms) as well as the unique parameterization used for the base model. Models will respond differently to parameters depending on the K_{OW}, sediment and water chemical concentrations, SOC content, and the lipid levels of the organisms. Swan Island Lagoon has unique sediment, water, and tissue characteristics and therefore was run separately from RM 2 to RM 11 for the sensitivity analysis.

Both candidate models are highly sensitive to K_{OW}. The K_{OW} influences the relative sensitivity of different parameters. K_{OW} values for the 209 PCB congeners ranged from 4.5 to 9.1 (MDEQ 2004). Reported values for 4,4′-DDE ranged from 5.7 (Arnot and Gobas 2004) to 6.76 (Addison and Zinck 1977; Addison et al. 1976; Sodergren and Svensson 1973). For both candidate models, the primary parameter that distinguishes 4,4′-DDE from PCBs is the K_{OW}.[4] Thus, to test the models' differential sensitivity to PCBs and DDE, three sensitivity runs were conducted using three K_{OW}s (5.5, 6.5, and 7.5) to represent the range of hydrophobicity for PCB congeners and the range of reported K_{OW}s for 4,4′-DDE.

For both spatial scales, a total of 16 parameters (11 parameters for TrophicTrace and 14 for Arnot and Gobas, with some of them overlapping) were altered in the sensitivity analysis at three K_{OW} values. Changes in biotic parameters are presented in Tables 4-13 and 4-14, dietary absorption efficiencies are in Table 4-15, and physical factors are in Tables 4-16 through 4-25 (Tables 4-16 through 4-25 also include the resultant output). All parameters were decreased by 50%, except the K_{OW}, which was increased and decreased by 50% in separate sensitivity runs. Physical parameters that

[4] Other chemical-specific parameters are K_{OC} (both models) and BSAF (TrophicTrace). Both models calculate K_{OC} from the K_{OW}. BSAFs for PCBs and DDE are quite different, with average values of 3.7 and 6.2, respectively; however, the impact of BSAFs on the sensitivity of the TrophicTrace model was not investigated. One BSAF (3.2) was selected to represent an average for PCBs.

changed in both models were water temperature, DOC and POC (combined and separately), PCB sediment concentration, PCB water concentration, and SOC. In TrophicTrace, BSAFs were also decreased by 50%, and the K_{OC} was also increased and decreased by 50%, independent of K_{OW}. Biotic factors that changed in Arnot and Gobas included percent lipids, biota weight, dietary absorption efficiencies, fraction of porewater ventilated, and percent moisture of organism. The only biotic factors that could be changed in TrophicTrace were percent lipids and biota weight.

4.5.2 Uncertainty Analysis

4.5.2.1 Total PCBs

Model performance is evaluated by the uncertainty analysis and includes the testing of sensitive parameters, as determined through the sensitivity analysis. The objective of the uncertainty analysis is to use a range of plausible input data for sensitive parameters to define the range the model may overpredict or underpredict as compared to measured data. The uncertainty analysis differs from the sensitivity analysis, in which parameters were varied by a specified amount, regardless of whether the new values were realistic. The performance of the uncertainty runs was evaluated by comparing model predictions to the observed data as described in Section 4.3. MPAF and model bias (as compared to measured data) were calculated and compared to determine the most and least uncertain parameters.

Uncertainty analyses were run for each spatial scale. Parameters included K_{OW}, PCB sediment concentration, PCB water concentration, water temperature, DO, SOC, DOC, biota weight, biota lipids, and percent moisture (Table 4-26). For PCBs at both spatial scales, uncertainty scenarios of mean, upper estimate, and lower estimate were run to test the possible range of the model response to the sensitive variables (as identified by the sensitivity analysis). For example, the upper estimate run used the maximum values of water temperature, SOC, TSS, POC, DOC, and the minimum concentration for DO. Simultaneously, biota weight, lipids, percent moisture, and dietary absorption efficiencies were increased by 5%. When available, site-specific data were used for RM 2 to RM 11 and the Swan Island Lagoon subarea. In the TrophicTrace PCB uncertainty runs, BSAF values generated for the scenario runs were determined to not represent the true upper range of values, and thus a new maximum (upper bound) estimate of BSAF for total PCBs (21.8) was generated as the 90th percentile of infaunal BSAFs.

4.5.2.2 4,4′-DDE

For the PCB uncertainty analysis, the standard approach of bracketing the range of predicted tissue concentration estimates using a range of input parameters was employed. For 4,4′-DDE a different approach was used. Both the Arnot and Gobas and the TrophicTrace models are designed for chemicals that are either minimally metabolized or, in the case of Arnot and Gobas, chemicals for which metabolism is well-characterized. In the initial scenario runs, it was assumed that metabolism was zero for both PCBs and 4,4′-DDE. For PCBs, this is a standard assumption that has been made for many previous modeling efforts (ATSDR 2003).

As described in Section 4.2.1.3, metabolism of 4,4′-DDE was not addressed in the scenario modeling. The contribution of metabolized 4,4′-DDT to 4,4′-DDE tissue concentrations was also not included. Preliminary scenario runs for 4,4′-DDE indicated that the models were significantly underestimating 4,4′-DDE in fish tissue. This suggests that consideration of an additional source of 4,4′-DDE, such as 4,4′-DDT metabolism, was warranted. Metabolism estimates, interpreted from literature sources (Windward 2004) ranged from 20 to 50 percent. The species studied ranged from aquatic invertebrates to brook trout. In the Arnot and Gobas model, a different metabolism rate may be selected for each species, but for most species in the model, appropriate data are completely lacking. It would not be possible to simultaneously account for both 4,4′-DDE and 4,4′-DDT contributions to 4,4′-DDE without significant reprogramming of the Arnot and Gobas model because the model is designed to deal with chemicals independently. In addition, no estimates of 4,4′-DDE metabolism by aquatic species were available.

In an effort to address the contribution of 4,4′-DDT in some way, model inputs were adjusted to account for both 4,4′-DDT and 4,4′-DDE in water and sediment. To do this, it was assumed that 20, 50, or 100% of 4,4′-DDT in water and sediment was converted to 4,4′-DDE. For water data, 4,4′-DDT concentrations were available, multiplied by one of the metabolic conversion factors (20, 50, or 100%) and added to the complementary 4,4′-DDE concentration to obtain a “metabolism-adjusted” 4,4′-DDE value. To account for the differences in chemical behavior of 4,4′-DDE and 4,4′-DDT, the K_{OW} was adjusted to reflect the proportion of each constituent in the metabolism-adjusted 4,4′-DDE water concentrations. Thus, a different K_{OW} was derived for each metabolism assumption at each spatial scale. A K_{OW} of 6.91 for 4,4′-DDT (ORNL 1998; USACE 2004) was used in these adjustments (Table 4-27).

For sediment samples, the situation was more complex because the 4,4′-DDE concentrations used were the result of IDW interpolations. Because this was an exploratory exercise, the ratio of the geometric means of 4,4′-DDE to 4,4′-DDT in measured samples was used to estimate a 4,4′-DDE to 4,4′-DDT ratio for sediment. This ratio was applied to the IDW estimate for 4,4′-DDE to obtain a crude estimate of 4,4′-DDT. The DDT estimate was then multiplied by a metabolism factor (20, 50, or 100%) and added to the original 4,4′-DDE sediment value (Table 4-27). Only 4,4′-DDE water and sediment concentrations and 4,4′-DDE K_{OW} were adjusted in the DDE uncertainty runs.

5.0 RESULTS AND DISCUSSION

Scenario, sensitivity, and uncertainty analyses were performed using both models as described in Sections 4.4 and 4.5. These exercises address Objectives 1 and 2 of this report (Section 1.1). The results and discussion for all model runs are presented along with a summary of model uncertainties and assumptions. Each model is discussed separately. This is followed by a model and data limitations section (Section 5.3), which highlights key data gaps (i.e., Objective 3). The results and insights gained through model application were used for model comparisons (Section 5.4) that are used for model selection (Objective 4, Section 6.1). References to MPAFs and SPAFS refer to those compared to mean measured tissue concentrations (not geometric mean), unless otherwise indicated. Summary results are presented in tables, and species-specific model results are presented in the appendices as specified in each subsection. Measured concentrations for individual species are provided in Appendix A; species specific model output data are presented in Appendices B and C.

5.1 ARNOT AND GOBAS

5.1.1 Scenario Results and Discussion

Summary scenario results as compared to measured concentrations are presented in Table 5-1, and species-specific model output data and comparisons to measured concentrations are presented in Appendices B1.1 to B1.4. Sections 5.1.1.1 to 5.1.1.4 provide details of model runs for the two chemicals at both spatial scales. These are summarized in Section 5.1.1.5.

5.1.1.1 Total PCBs – RM 2 to RM 11

Results

For PCBs at the large spatial scale (RM 2 to RM 11), Diet 1 (MPAF 3.2) performed slightly better than Diet 2 (MPAF 3.4). For all scenarios, there were overpredictions and underpredictions for species. Model biases for Scenarios 1a to 1c (Table 5-1) ranged from 0.3 to 0.4, while Diet 2 had a model bias of -1.1 for all porewater fractions. For Diet 1 (across all porewater fractions), the model performed poorest for black crappie (SPAF 8.6 to 8.7) and carp (SPAF -5.5), while performing very well for pikeminnow (SPAF 1.0 to 1.1), smallmouth bass (SPAF 1.4), peamouth (SPAF 1.5), and sculpin (SPAF -1.6) (Table 5-1). For Diet 2 (across all porewater fractions), the model performed poorest for carp (SPAF -6.6 to -6.7) and black crappie (SPAF 5.7 to 5.8) and most closely predicted concentrations for peamouth (SPAF 1.2), smallmouth bass (SPAF -1.4), and crayfish (SPAF -1.9) (Table 5-1). Diet 1 predicted nine species (out of eleven) within a factor of 5 and four species within a factor of 2.

Scenario 1c (Diet 1 and maximum porewater fraction) performed marginally better than Scenarios 1b and 1a but not enough to distinguish between the various porewater ventilation assumptions.

For comparisons of predicted tissue concentrations to the geometric mean of measured tissue concentrations, Diet 2 (MPAF 3.2, model bias 0.4) performed better than Diet 1 (MPAF 3.4 to 3.5, model bias 2).

Discussion
Diet 1 generally outperformed Diet 2. This was true for most modeled species, including carp and largescale sucker. The black crappie overpredictions may be related to a poor understanding of crappie diet. In the first food web model runs (Windward 2004), crappie was assumed to be a piscivore. Per EPA recommendations, their diet was adjusted to include more insects. Although black crappie are primarily invertivores as juveniles, as adults they are primarily piscivorous (ODFW 2005; Turner 1966) These feeding changes make generation of an "average" diet for this species particularly difficult. The size category captured during Round 1 tissue sampling was larger than those captured in the ODFW study. The ODFW study sampled for 1 year, capturing 11 black crappie >9 cm. Even though the crappie were of smaller size than the Round 1 crappie, the ODFW study still found them to be eating approximately 60% fish by biomass (ODFW 2005). Diet 1 designates higher proportions of fish in their diet, while Diet 2 designates more zooplankton and benthic invertebrates. Diet 2 may be a better compromise between piscivore and invertivore. Model performance for species higher on the food chain was better than for black crappie.

The maximum porewater ventilation assumption performed the best for all scenarios with Diet 1. This assumption would tend to estimate higher PCB exposure from porewater than lower porewater ventilation fractions. The difference was marginal and not enough to make a decision on optimal fraction porewater ventilation.

5.1.1.2 Total PCBs – Swan Island Lagoon

Results
For PCBs at the small spatial scale (Swan Island Lagoon), all scenarios overpredicted for all species. Diet 2 performed better with an MPAF (and model bias) of 7.7 (Table 5-1) compared to Diet 1 with an MPAF of 11.6. Changes in porewater ventilation rates did not appreciably affect model output. In Diet 2, brown bullhead (SPAF 1.3) and smallmouth bass (SPAF 1.8) were the best performers, and the poorest performer was black crappie (SPAF 34.9). Diet 2 predicted six species (out of nine with measured tissue concentration data for Swan Island Lagoon) within a factor of 5 and two species within a factor of 2. Relative scenario performance was the same for comparisons of predicted tissue concentrations to the geometric mean of measured tissue concentrations.

Discussion
The overprediction for Swan Island Lagoon may be party explained by the fact that the model assumed 100% site use. Also, some of the fish samples were from trawls that included Swan Island Lagoon as well as other portions of the river. Many of the fish species have home ranges much larger than Swan Island Lagoon, which has high

concentrations of PCBs. The small spatial scale would have been expected to produce the most accurate predictions for small-home-range fish such as sculpin. Sculpin SPAF was much better than the MPAF (Appendix B1.2), which supports this expectation.

Water data from RM 2 to RM 11 were used for Swan Island Lagoon model runs because there were no XAD integrated transect water samples from Swan Island Lagoon. An XAD "near bottom" sample was available but not considered representative of the entire lagoon. There were other non-XAD water samples for Swan Island Lagoon, but the analytical methods used for these samples were not as sensitive as for the XAD samples and results were dominated by non-detect PCB Arcolor data. This might seriously compromise the model's ability to predict waterborne organism concentrations such as phytoplankton/algae and zooplankton, which make up a significant portion of the diets of carp (phytoplankton), peamouth (phytoplankton and zooplankton), and largescale sucker (phytoplankton and zooplankton).

5.1.1.3 4,4′-DDE – RM 2 to RM 11

Results

For 4,4′-DDE at the large spatial scale (RM 2 to RM 11), the model consistently underpredicted as compared to measured concentrations across two dietary scenarios and three K_{OW} values. Scenario 1b (Diet 1, K_{OW} 6.76, and minimum porewater ventilation) performed the best (MPAF 5.9, model bias -5.4) (Table 5-1). Diet 1 and K_{OW} 6.76 had the best predictions and demonstrated significant effects on model output. Porewater ventilation had an insignificant effect on model output. The worst-performing species within Scenario 1b were carp (SPAF -8.7) and peamouth (SPAF -8.0), while the best-performing species were smallmouth bass (SPAF -1.1) crayfish (SPAF -1.3), and black crappie (SPAF 1.4). The worst performing scenario (2i) had an MPAF of 43 (model bias -43), combining Diet 2 with the lowest K_{OW} value (5.7).

Relative scenario performance was the same for comparisons of predicted tissue concentrations to the geometric mean of measured tissue concentrations.

Discussion

The issue of the conversion of 4,4′-DDT into 4,4′-DDE, as discussed in Section 4.4.2.2, may explain some of the underprediction of 4,4′-DDE in tissue. Similar to the scenario results for PCBs (RM 2 to RM 11), Diet 1 outperformed Diet 2 overall. K_{OW} 6.67 (the highest) performed the best, however, high K_{OW} values lead to higher tissue concentration estimates. This may compensate some for underprediction due to the lack of consideration of 4,4′-DDT metabolism (conversion to 4,4′-DDE). Model performance overall for 4,4′-DDE was not as good as that for PCBs, and all scenario runs tended to underpredict. Porewater ventilation did not significantly impact model results.

5.1.1.4 4,4′-DDE – Swan Island Lagoon

Results

For 4,4′-DDE at the small spatial scale (Swan Island Lagoon), model output for all 18 scenarios underpredicted measured tissue concentrations for 56% of species or greater. Scenario 1b performed the best (Diet 1, K_{OW} 6.76, and minimum porewater ventilation), with an MPAF of 3.7 and a model bias of -2.2 (Table 5-1). Diet 1 had the best predictions. There was little difference between the model output for K_{OW} 6.76 and K_{OW} 6.51 (a 44% change in the K_{OW}). There was little difference in output between scenarios with different porewater fractions. Scenario 1b predicted four species under a factor of 2 and six under a factor of 5. The best-performing species within scenario 1b were northern pikeminnow (SPAF -1.1), black crappie (SPAF 1.4), sculpin (SPAF 1.4), and smallmouth bass (SPAF 1.8); model performance for largescale sucker (SPAF 8.6), carp (SPAF 7.6), and peamouth (SPAF 6.9) was worse.

For comparisons of predicted tissue concentration to the geometric mean of measured tissue concentrations, Diet 2 and K_{OW} 6.76 had a slightly lower MPAF (2.7) than Diet 1 and K_{OW} 6.76 (MPAF 2.8). Model bias for Diet 2 and K_{OW} 6.76 (2.2) was lower than model bias for Diet 1 and K_{OW} 6.76 (4.0).

Discussion

As with the RM 2 to RM 11, runs for 4,4′-DDE, these model runs underpredicted tissue concentrations overall. The overall performance for RM 2 to RM 11 was greatly affected by very poor prediction of clam tissue concentration. There were no measured clam data for Swan Island Lagoon, and thus, no comparisons for this species, which may have contributed to the appearance of overall better model performance. The range of species overpredicted and underpredicted across trophic levels may be due to several factors. It is possible that metabolism is unaccounted for and likely different across species, the food web is poorly characterized, site-specific chemistry data (especially water) are inadequate, and/or site-use assumptions (100%) are too inaccurate to create a reasonable model at this scale.

5.1.1.5 Summary of Selected Base Parameterization

Dietary Scenarios

MPAFs determined by comparison to mean measured concentrations were better for Diet 1 for 4,4′-DDE at both spatial scales and PCBs at the RM 2 to RM 11 scale. MPAFs determined by comparison to the geometric mean of measured concentrations were better for Diet 1 for 4,4′-DDE at the RM 2 to RM 11 spatial scale. Most differences were small (differences in MPAFs <2).

MPAFs determined by comparison to mean measured concentrations were better for Diet 2 for PCBs at the Swan Island Lagoon scale. MPAFs determined by comparison to the geometric mean of measured concentrations were better for Diet 2 for PCBs at both spatial scales and 4,4′-DDE for Swan Island Lagoon. Most differences were small (differences in MPAFs <1), except those for PCBs at the Swan Island Lagoon spatial scale, where MPAF differences were between 4 and 5.

Thus, when comparison to the mean and geometric mean were considered for all scenario runs, neither dietary scenario performed better. As discussed in Section 5.2.1.5, Diet 1 performed better for most scenarios for TrophicTrace.

For black crappie, Diet 2 greatly outperformed Diet 1 for Arnot and Gobas model scenarios, but there was little difference in performance between the two diets in TrophicTrace. As discussed in Section 5.1.1.1, black crappie diets are uncertain. Diet 2 has greater fractions of invertebrates and lower fractions of fish. Black crappie may eat even more invertebrates than are represented in Diet 2.

Diet 1 was selected for use in further model runs with the exception of black crappie. Because black crappie was consistently overpredicted for the Arnot and Gobas model, Diet 2 was selected for further model runs for this species.

4,4′-DDE K_{OW}

For DDE at both spatial scales, K_{OW} was also assessed and led to significant differences in model performance. The best-performing runs used the highest K_{OW} (6.76). However, as mentioned above, the model's tendency to underpredict 4,4′-DDE concentrations may be partly caused by the exclusion of the process of converting 4,4′-DDT to 4,4′-DDE. If exclusion of this process were the leading cause, then higher K_{OW}s would compensate for this by increasing uptake of 4,4′-DDE. Further analysis is required before the final selection of a K_{OW} for 4,4′-DDE.

Porewater Ventilation

Performance for various porewater ventilation assumptions was similar for a particular diet and/or K_{OW} for PCBs and 4,4′-DDE, indicating no clear preference between porewater ventilation assumptions. Since neither the upper or lower bound values for porewater ventilation performed significantly better than the mean value, the mean value was selected for further model runs.

As discussed in Section 4.5.1, the model was parameterized for PCBs for the sensitivity runs but spanned a range of K_{OW}s overlapping with K_{OW} estimates for 4,4′-DDE. Thus, the base parameterization carried through into the sensitivity analysis was Diet 1 for all species except black crappie (Diet 2), and mean porewater ventilation for all species. All other parameter values used in further model runs (base parameterization) were average values as presented in Tables 4-1 through 4-3.

5.1.2 Sensitivity Analysis Results and Discussion

One purpose of the sensitivity analysis is to determine which parameters will be included in the uncertainty analysis and for calibration. Parameters were designated a level of sensitivity based on the maximum change in predicted concentration of all species to 50% changes in the parameter value. Strictly speaking, the model is sensitive or insensitive to a particular parameter rather than the parameter itself being sensitive or insensitive. For convenience, however, the parameters will be designated in this report according to their effect on the model (e.g. highly sensitive, moderately sensitive, or insensitive). Parameters were designated as highly sensitive (response greater than 50%), moderately sensitive (10 to 50% response), or insensitive (<10% response). Parameters identified as moderately to highly sensitive were included in the uncertainty analysis. All 16 parameters examined, except DOC and fraction of porewater ventilated, were found to be highly or moderately sensitive for at least one K_{OW} at one spatial scale. Details of these results are presented in Section 5.1.2.1. Species-specific model output data for sensitivity analysis are presented in Appendix B.2.

5.1.2.1 Highly Sensitive Parameters

K_{OW} (50% increase)

K_{OW} was a highly sensitive parameter at K_{OW} 5.5 for RM 2 to RM 11, where the mean model response was a 66.1% change in model predictions (Table 4-16). However, at K_{OW}s 6.5 and 7.5, the parameter was moderately sensitive, producing a model response of 15.7% and -23.9%, respectively. Smallmouth bass exhibited the greatest response at K_{OW}s 5.5 and 7.5, while juvenile chinook salmon exhibited the highest sensitivity at K_{OW} 6.5.

For the Swan Island Lagoon subarea, a 50% increase of K_{OW} produced a moderate response in K_{OW}s 5.5 and 7.5 of 40.4% and -20.1%, respectively, while the parameter is completely insensitive at K_{OW} 6.5 (Tables 4-19, 4-21, and 4-20, respectively).

K_{OW} is the primary driver of chemical uptake from both the water and diet. In the Arnot and Gobas model, K_{OC} is calculated from the K_{OW} and thus affects partitioning from sediment into porewater, which affects porewater ventilation exposure. Increasing the K_{OW} also leads to decreased porewater concentrations, which leads to less exposure via this route. The K_{OW} also affects dietary chemical transfer efficiency and respiratory surface chemical uptake efficiency, decreasing both of these with increasing K_{OW}. The magnitude of this influence is most significant at low K_{OW}s.

K_{OW} (50% decrease)

The results from a decrease in K_{OW} followed the same trend as an increase in K_{OW}. This parameter was only highly sensitive at RM 2 to RM 11, K_{OW} 5.5 (-55.2%), while moderately sensitive at K_{OW}s 6.5 (-32.5%) and 7.5 (39.8%) (Tables 4-16, 4-17, and 4-18, respectively). The maximum change in predicted concentrations was for smallmouth bass at K_{OW}s 5.5 and 7.5, while juvenile chinook salmon (-46.0%) generated the greatest change at K_{OW} 6.5 for RM 2 to RM 11.

For the Swan Island Lagoon subarea, a moderate change from predicted concentrations was shown at K_{OW}s 5.5 and 7.5, while predicted concentrations were insensitive to the 50% decrease at K_{OW} 6.5 (Tables 4-19, 4-21, and 4-20, respectively). All levels of K_{OW} generated the maximum percent change from predicted concentrations for different species. At K_{OW} 5.5, the largest change was seen for smallmouth bass (-66.4%), while at K_{OW} 6.5, the greatest change was for zooplankton (-34.9%). Black crappie responded the most at K_{OW} 7.5 (79.6%). At the three K_{OW}s (5.5, 6.5, and 7.5) the lowest change was reflected in insect larvae (-0.2%), clam and insect larvae (0.0%), and insect larvae (0.0%), respectively.

Similar to the effects from K_{OW} increases, the model is highly sensitive to decreases in K_{OW}. Again the model was most sensitive to decreases in K_{OW} at the lowest K_{OW} (5.5).

Dietary Absorption Efficiencies (lipid, non-lipid organic matter, water) (50% decrease)
Dietary absorption efficiency was a highly sensitive parameter at all scales and all K_{OW}s, except for RM 2 to RM 11, K_{OW} 5.5, where it exhibited a moderate response (-28.4%) to a 50% decrease. Table 4-14 details the changes made to these parameters. For RM 2 to RM 11, K_{OW} 6.5, the mean percent change in predicted concentrations was -54.3%; while at K_{OW} 7.5, the mean percent change was -54.2% (Tables 4-17 and 4-18, respectively). For the Swan Island Lagoon subarea, the mean percent change was highest at K_{OW} 6.5 (-64.4%) and lowest at K_{OW} 5.5 (-53.7%). In addition, across all scales and K_{OW} levels, smallmouth bass produced the maximum response greater than 80%, while phytoplankton did not respond at all (0.0% all runs, all scales) (Tables 4-16 through 4-21).

These parameters affect the percent absorption of lipids, NLOM, and water in the digestive tract. Reducing the amount of lipids absorbed into the organism will result in a lower concentration of chemical in the lipids of the chyme (partially digested food in the gut) and thus a lower concentration gradient from the gut contents to the organism, leading to less chemical uptake. As expected, these parameters exert a strong influence on predictions across K_{OW}s and spatial scales.

Percent Moisture (50% decrease) (near-inverse effect on non-lipid organic matter)
Percent moisture was a highly sensitive parameter for RM 2 to RM 11, K_{OW} 5.5, and a mean percent change in predicted concentration of 56.8% (Table 4-16), with a maximum response from crayfish (136.4%). At the two other K_{OW} levels, it exhibited a moderately sensitive response to the 50% decrease in percent moisture. At K_{OW} 6.5, crayfish (98.2%) again generated the maximum response; while at K_{OW} 7.5, tissue concentrations in amphipods were 73.1% higher than the predicted tissue concentrations (Tables 4-17 and 4-18, respectively). Phytoplankton did not respond to a 50% decrease in percent moisture at any K_{OW} (0.0%).

The Swan Island Lagoon subarea followed the same trend as RM 2 to RM 11, where percent moisture was highly sensitive at the lowest K_{OW} (72.6%) and moderately sensitive at all other K_{OW}s (32.8% and 34.6%) (Tables 4-19 through 4-21, respectively). Crayfish generated the greatest response at K_{OW}s 5.5 and 6.5 (170.7% and 106.6%, respectively); while at K_{OW} 7.5, clam responded with an 87.8% change from predicted values. Phytoplankton exhibited no change from predicted values in response to a decrease in percent moisture at any K_{OW}.

Chemical uptake from the diet is partially determined by the proportions of prey organisms that are water, NLOM, and lipids, with the chemical contribution from each increasing respectively. The way the Arnot and Gobas model is programmed, if percent moisture is decreased, NLOM increases (NLOM = 1 - % lipids - % moisture). NLOM has a greater capacity to store hydrophobic organic chemicals (HOCs) than water. Therefore, decreasing water content leads to an increase in NLOM content and increases an organism's ability to absorb and store HOCs. The impacts of this were most dramatic at the lowest K_{OW}.

5.1.2.2 Moderately Sensitive Parameters

Moderately sensitive parameters in the Arnot and Gobas model include biota lipids, DO, PCB sediment concentration, PCB water concentration, and water temperature. Biota weight was a moderately sensitive parameter at K_{OW} (5.5) for the Swan Island Lagoon spatial scale. Several physical parameters (DOC and POC combined, SOC, POC, and TSS) ranged from the low end of moderately sensitive (under 26%) to insensitive at different spatial scale, and K_{OW}s.

Biota lipids were moderately sensitive across all K_{OW}s for RM 2 to RM 11, with a 50% decrease in biota lipids resulting in a decrease in predicted tissue concentrations. Smallmouth bass exhibited the largest change in predicted values, while phytoplankton did not respond at all over all K_{OW}s for RM 2 to RM 11 (Tables 4-16 through 4-18). Biota lipids were moderately sensitive for RM 2 to RM 11. For Swan Island Lagoon, they were highly sensitive at K_{OW}s 5.5 and 6.5 but moderately sensitive at 7.5. Reduced biota lipids reduced predicted tissue concentrations at the Swan Island Lagoon spatial scale (Table 4-19 through 4-21). Lipids are the primary storage site of HOCs in organisms. Decreasing lipids decreases the ability of organisms to take up and store HOCs.

DO was a moderate to insensitive parameter across all K_{OW} and spatial scales. For RM 2 to RM 11, a 50% decrease in DO resulted in an overall decrease in predicted concentrations in fish tissue. DO was moderately sensitive across all K_{OW}s for the Swan Island Lagoon spatial scale. The predicted concentrations decreased with increasing K_{OW}. For the Arnot and Gobas model, decreases in DO cause increases in gill ventilation rates, which leads to higher feeding rates for filter-feeders. An increase in gill ventilation rates for other invertebrates and fish leads to an increase in k_1 (aqueous uptake rate constant).

A decrease in PCB sediment concentrations caused a decrease in predicted concentrations for RM 2 to RM 11 and in Swan Island Lagoon. In Swan Island Lagoon, insect larvae and clam exhibited the greatest change in tissue concentrations, while phytoplankton and zooplankton were insensitive to a 50% decrease in PCB sediment concentrations (Tables 4-19 through 4-21).

PCB water concentration is a moderately sensitive parameter across all K_{OW}s for RM 2 to RM 11. This parameter was insensitive for the Swan Island Lagoon spatial scale. Change in predicted tissue concentration decreased with increasing K_{OW} for RM 2 to RM 11.

Water temperature was a moderately sensitive parameter across all spatial scales and K_{OW}s. For RM 2 to RM 11, mean predicted concentrations decrease moderately (18.8% to 24.6%). Smallmouth bass responded most to the decreased in water temperature, while phytoplankton were insensitive. For the Swan Island Lagoon spatial scale, water temperature was a moderately sensitive parameter. Smallmouth bass and black crappie exhibited the maximum change in predicted concentrations, while clam, insect larvae, and phytoplankton were insensitive to water temperature at all K_{OW}s. Decreases in temperature led to decreases in feeding rate, excretion, and growth rate. The net effect of these was a decrease in PCB tissue concentrations with decreases in temperature.

Biota weight was moderately sensitive in Swan Island Lagoon K_{OW} 5.5 (-10.2%) and insensitive at all other scales and all other K_{OW}s. Feeding rate and gill ventilation rate decreased with biota weight, leading to decreased exposure. Since the body burden was for a smaller mass, however, reductions were slightly offset.

Changes in several physical parameters had low to moderate effects, not exceeding 26% for any scenario and dropping below 10% (insensitive) for many scenarios. For RM 2 to RM 11, POC was moderately sensitive at K_{OW} 7.5 (25.4%) but insensitive for RM 2 to RM 11 at K_{OW}s 5.5 and 6.5 and for Swan Island Lagoon at all K_{OW}s. DOC and POC (combined) was moderately sensitive for RM 2 to RM 11 at K_{OW} 7.5 and for Swan Island Lagoon at K_{OW} 7.5 but insensitive for both spatial scales at other K_{OW}s. For RM 2 to RM 11, SOC (19.7% at K_{OW} 6.5 and 26.2% at K_{OW} 7.5) and TSS (-10.7% at K_{OW} 6.5 and -10.2% at K_{OW} 7.5) were moderately sensitive at K_{OW} 6.5 and 7.5 but were insensitive at K_{OW} 5.5 for RM 2 to RM 11 (Table 4-16 through 4-18). For Swan Island Lagoon at all K_{OW}s, SOC and TSS were insensitive. These parameters all affect bioavailability and therefore uptake of PCBs.

5.1.2.3 Insensitive Parameters

Those parameters that exhibited a mean response of less than 10% were considered insensitive in the performance of the model. DOC and fraction of porewater ventilated were insensitive across all K_{OW}s for both spatial scales.

5.1.3 Uncertainty Analysis Results

As described in Section 4.5.2, uncertainty estimates for Arnot and Gobas model predictions were defined by running the model with average (average run) and upper- and lower-range parameter values and comparing those modeled tissue concentrations with results from running the model with average parameter values. Model results were compared to measured values using the metrics described in Section 4.2.

For total PCBs, only those parameters determined to be highly or moderately sensitive in the sensitivity analysis were changed for the uncertainty analysis (Table 4-26). For DDE, only those parameters relevant to the inclusion of DDT uptake and metabolism to DDE were changed in the uncertainty analysis (Table 4-27). Uncertainty analysis summary results for the Arnot and Gobas model are presented in Table 5-2. Details of these results are presented in Sections 5.1.3.1 to 5.1.3.4 and summarized in Section 5.1.3.5. Complete species-specific model output is presented in Appendix B.3.

5.1.3.1 Total PCBs – RM 2 to RM 11

The model bias for the average run was 0.5. Model bias for the maximum run increased to 32.7, while it decreased to -14.3 for the minimum run. Modeled tissue concentrations from 5 of the 11 species were underpredicted in the average run with SPAFs ranging from 1.1 for northern pikeminnow to 9.0 for black crappie. Modeled tissue concentrations from all of the 11 species were overpredicted in the maximum run. SPAFs ranged from 1.6 for carp to 37.3 smallmouth bass, with black crappie as an outlier at 189.7. All 11 modeled tissue concentrations were underpredicted in the minimum run. SPAFs ranged from -1.5 for black crappie to -35.8 for carp (Appendix B.3.1).

5.1.3.2 Total PCBs – Swan Island Lagoon

The model bias for Arnot and Gobas using average parameter values was 9.6. It increased to 73.0 using maximum parameter values and decreased to -3.0 using minimum parameter values. Measured tissue concentrations were not available for clams or juvenile chinook salmon for Swan Island Lagoon. Therefore, SPAFs were only calculated for nine species in Swan Island Lagoon. Modeled tissue concentrations were overpredicted for all of the nine species in the average run. SPAFs ranged from 1.6 for carp to 43.1 for black crappie. Modeled tissue concentrations from all of the nine species were overpredicted in the maximum run. The minimum SPAF was 7.6 for carp, and the maximum was 394.0 for black crappie. Seven of the nine modeled tissue concentrations were underpredicted in the minimum run. SPAFs ranged from -1.1 for crayfish to -7.5 for brown bullhead. The two overpredicted species in the minimum run were peamouth (1.1) and black crappie (2.5) (Appendix B.3.2).

5.1.3.3 4,4′-DDE Metabolism Adjusted – RM 2 to RM 11

Only those input parameters specific to the chemical being modeled were changed in the DDE uncertainty analysis. In Arnot and Gobas, those parameters were the K_{OW} and the concentration of DDE in water and sediment. The parameter values (Table 4-27) were calculated to approximate 50, 100, and 20% metabolism of DDT in sediment and water to DDE in tissue. All other parameters were kept at the average values used in other model runs. Because only the uncertainty of the DDT contribution was tested with these uncertainty runs, the range of model bias and predictive accuracy factors were significantly lower for DDE than they were for total PCBs.

The model bias for Arnot and Gobas, assuming 50% metabolism of DDT, was -4.1. It improved slightly to -2.8 for 100% metabolism and decreased to -5.6 for 20% metabolism (Table 5-2). Modeled tissue concentrations were overpredicted in all 11 species in all three runs. Juvenile chinook salmon consistently had the best SPAFs, ranging from 1.0 to 1.6. Clams consistently had the worst SPAFs, ranging from 11.6 to 18.5.

5.1.3.4 4,4′-DDE Metabolism Adjusted – Swan Island Lagoon

Arnot and Gobas model predictions for Swan Island Lagoon were slightly better than those for RM 2 to RM 11. The model bias for Arnot and Gobas in Swan Island Lagoon assuming 50% metabolism of DDT was 0.9, and it ranged from 2.8 assuming 100% metabolism to -0.5 assuming 20% metabolism. Modeled tissue concentrations were overpredicted in five of nine species in 20% metabolism and 50% metabolism runs, while they were overpredicted in six of nine species in the 100% metabolism uncertainty run. No measured clam data were available for Swan Island Lagoon, so the best SPAFs were for brown bullhead, and they ranged from -1.7 to 1.5. Smallmouth bass had the worst SPAFs, ranging from 2.7 to 6.7 (Appendix B.3.3).

5.1.3.5 Uncertainty results Summary

The results from the PCB uncertainty analyses provided upper and lower boundaries on model predictions using a realistic range of parameter values likely in the Site. The average estimates for PCBs for RM 2 to RM 11 were quite close to mean measured values, with some tendency for overprediction; the model bias was 0.5, and the MPAF was 3.2. For RM 2 to RM 11, minimum PCB estimates, the mean model bias was -14.3 compared to the measured mean, with all species underpredicted (Appendix B.3). For the maximum, the mean model bias was 32.7, with all species overpredicted. This suggests that the known variability in the parameters that are included in Arnot and Gobas is sufficient to account to bracket mean PCB fish tissue concentrations for RM 2 to RM 11.

For Swan Island Lagoon, model overprediction was greater as compared to RM 2 to RM 11. Mean estimates overpredicted by almost tenfold. Performance for the minimum run for Swan Island Lagoon PCBs was similar to the RM 2 to RM 11 mean performance. Comparisions to measured data indicate that model performance is better on the larger spatial scale, with the uncertainty for those runs bounding a range of overprediction and underprediction. Results from the Swan Island Lagoon uncertainty analysis indicate a need for improved parameterization at smaller spatial scales. Some of the overestimation may be due to the fact that the model assumes fish spend all their time in the defined exposure area. Since the home range of many of the fish is larger than the Site, this assumption is even more erroneous for a small scale such as Swan Island Lagoon. As would be expected, predicted concentrations for larger-home-range species such as crappie, pikeminnow, and peamouth were greatly overpredicted (Appendix B.3). Performance for sculpin, the fish species with the smallest home range, ranged from underprediction for the minimum estimates to overprediction for the maximum parameter estimates. The Swan Island Lagoon results indicate the model is not performing well at the smaller spatial scale and may require additional parameterization, including possible adjustment for site use and/or exclusion of some species with larger home ranges.

Unlike the PCB uncertainty runs, the 4,4′-DDE uncertainty runs were not intended to bound estimates using known variability of input parameters. Since 4,4′-DDE was consistently underpredicted (particularly for TrophicTrace), these uncertainty runs were designed to try to account for an additional source of 4,4′-DDE (i.e., the parent compound 4,4′-DDT) using a range of adjusted tissue and sediment concentrations and an average, maximum, or minimum estimate for relevant input parameters. For RM 2 to RM 11, all uncertainty runs still tended to underestimate 4,4′-DDE concentrations. Results for Swan Island Lagoon spanned the range of underestimation to overestimation of 4,4′-DDE concentration based on comparison to the mean. In comparison to the geometric mean, the model tended to overpredict using mean concentrations. On the larger scale, accounting for DDT metabolism improved model bias, but further parameterization or accounting for DDE metabolism may be necessary. Overall the model performed better for Swan Island Lagoon than for RM 2 to RM 11. However, as discussed for PCBs, the 100% site use assumption of Arnot and Gobas tended to overestimate exposure for Swan Island Lagoon for fish with large home ranges. The worst-performing species (carp, largescale sucker, and peamouth) were those with larger home ranges and tended to be underestimated. Since, Swan Island Lagoon has moderate 4,4′-DDE sediment concentrations, this error tended to be less common for 4,4′-DDE than for PCBs (for which Swan Island Lagoon has elevated concentrations). These results indicate the potential for model improvement with further refinement of 4,4′-DDE source assumptions and metabolism.

5.1.4 Model Uncertainties and Assumptions

There are several areas of uncertainty specific to Arnot and Gobas. As discussed in Section 4.1.2, there is no built-in mechanism for consideration of site use. However, a difficulty with such assumptions is that focusing on site use would still require consideration of chemical input from other sources to parameterize the model using measured data. Another limitation of Arnot and Gobas is that it cannot readily account for several sources of one chemical, such as 4,4′-DDE. It would be possible to run the model for 4,4′-DDT and 4,4′-DDE separately to predict 4,4′-DDE tissue concentrations. Each model could also account for further metabolism to DDD and other metabolites, and the results could be summed. However, the validity of such estimates is uncertain, and there are no published applications of the model in this way. Limited information on metabolism for relevant species would also restrict this approach. Overall, the Arnot and Gobas model is a flexible tool, allowing the user to provide species, chemical, and site-specific data for most parameters. Availability of appropriate data for the model may therefore be a greater limitation than the model structure itself.

5.2 TROPHICTRACE MODEL

5.2.1 Scenario Results

Summary results for TrophicTrace scenario runs are presented in Table 5-3. Species-specific model output is presented in Appendix C.1. Sections 5.1.1.1 to 5.1.1.4 provide details of model runs for the two chemicals at both spatial scales. These are summarized in Section 5.1.1.5.

5.2.1.1 Total PCBs – RM 2 to RM 11

Results

As discussed previously, two different diet combinations were combined with four different BSAF values for total PCBs for RM 2 to RM 11 (Section 4.2.2, Table 4-26). As in the Arnot and Gobas model, Diet 1 performed better than Diet 2 for all BSAFs in TrophicTrace. Model bias ranged from -7.9 to -20.2 for Diet 1 and from -8.5 to -23.0 for Diet 2 (Table 5-3).

Model bias was smallest in the scenarios that used the highest BSAF. All scenarios underpredicted tissue concentrations for at least 10 of the 11 species for which measured values were available. Therefore, the MPAF was not notably different from the model bias. Clams were the only species where PCB concentrations were not consistently underpredicted, and those measured data are highly uncertain because they are based on only three composite samples.

Scenario 1a outperformed all other scenarios with the lowest model bias and had the most species within factors of 10 and 2 of the measured values. Predicted concentrations for juvenile chinook salmon, peamouth, and black crappie were all within a factor of 2 of measured concentrations. Predicted concentrations for smallmouth bass, pikeminnow, and carp were consistently among the most underpredicted concentrations in all scenarios. Carp concentrations were especially sensitive to the BSAF.

Discussion

The fish species with high SPAFs (e.g., carp, smallmouth bass, and northern pikeminnow) represent fish species that feed from all components of the food web. The same is true for those species with relatively low SPAFs: juvenile chinook salmon, peamouth, and black crappie. Carp and peamouth diets are more closely linked to the sediment pathway, while smallmouth bass and black crappie are more closely linked to the water pathway. Therefore, there do not appear to be any systematic problems in TrophicTrace modeling either of the possible exposure pathways.

5.2.1.2 Total PCBs – Swan Island Lagoon

Results

Similarly, Diet 1 performed better than Diet 2 for total PCBs in Swan Island Lagoon, as did the highest BSAF (Table 5-3). The mean model bias, however, was lower for

Swan Island Lagoon than it was for RM 2 to RM 11, ranging from -3.9 to -13.7 for all scenarios. The MPAFs were 5.2 and 4.8 in the best-performing scenarios (Scenarios 1 and 2a, respectively). Scenario 1a had the lowest model bias, but Scenario 2a had the greatest number of species within a factor of 2 of the mean measured concentrations.

Overall, the predicted concentrations for 8 of the 9 species with measured values were within a factor of 10 of the mean measured tissue concentrations for the two best performing scenarios. TrophicTrace underpredicted smallmouth bass mean tissue concentrations by more than a factor of 15 in all scenarios.

Discussion
Model performance appears to be better for PCBs for Swan Island Lagoon than for RM 2 to RM 11, with much lower overall underprediction. The mean measured sediment PCB concentration in Swan Island Lagoon was higher than the mean measured sediment concentration for RM 2 to RM 11 (Table 4-4). The higher sediment concentration resulted in higher modeled tissue concentrations in deposit-feeding invertebrates and fish. TrophicTrace also assumes that fish spend 100% of their time in Swan Island Lagoon, which is unlikely for most species modeled. Model performance metrics include comparisons to measured tissue chemistry from fish that only spend a portion their time in Swan Island Lagoon. Therefore, the model would be expected to perform worst for large-home-range species and best for small-home-range species. Despite this, SPAFs were the worst for fish such as sculpin and smallmouth bass, which are likely to spend the most time in Swan Island Lagoon (Appendix C.1.2).

5.2.1.3 4,4′-DDE – RM 2 to RM 11

Results
TrophicTrace underpredicted tissue DDE concentrations for all 11 species in all 18 scenarios tested from RM 2 to RM 11. The model bias ranged from -20.5 to -124, which was not different from the MPAF. Diet 1 performed slightly better than Diet 2, and the highest BSAF and K_{OW} performed better than their lower test values. Therefore, the overall best-performing scenario was 1b (Table 5-3).

In Scenario 1b, clams had the only predicted DDE tissue concentrations within a factor of 5 of the mean measured tissue concentrations. Predicted sculpin, smallmouth bass, and northern pikeminnow tissue concentrations performed the worst and were below mean measured tissue concentrations by factors of 24.7, 32.5, and 75.4, respectively. All other predicted tissue concentrations were within a factor of 20 of the mean measured tissue concentrations.

Discussion
As discussed above, modeling DDE concentrations without considering DDT and DDD is problematic because metabolism of DDT into DDE is not accounted for. DDT may be taken up from sediment or the water column and converted to DDE by fish or invertebrates. Therefore, a large potential source of DDE was not modeled in

these scenarios and could account for the large underprediction of tissue DDE concentrations at the Site.

5.2.1.4 4,4′-DDE – Swan Island Lagoon

Results

Predicted tissue DDE concentrations for Swan Island Lagoon were only slightly better than those predicted for RM 2 to RM 11. Tissue DDE concentrations were underpredicted for all 9 species in all 18 scenarios, and model bias ranged from -20.0 to -124.9 (Table 5-3). The MPAF did not differ from the model bias. Scenario 1b, which had the highest BSAF and K_{OW} and used Diet 1 (1b), was also the best-performing scenario.

In Swan Island Lagoon, crayfish had the only predicted DDE tissue concentration within a factor of 5 of the mean measured tissue concentrations. The absolute factor difference from mean measured values was greater than 20 for more species in Swan Island Lagoon. While only 3 of the 11 species were underpredicted by a factor of greater than 20 for the RM 2 to RM 11best performing scenario, 5 species were underpredicted by a factor of greater than 20 for the Swan Island Lagoon the best performing scenario. In addition, no fish species were within a factor of 10 of the mean measured concentrations in Swan Island Lagoon.

Discussion

Although the average model bias for DDE in Swan Island Lagoon was similar to the model bias for RM 2 to RM 11, TrophicTrace did worse at predicting DDE tissue concentrations for more species for Swan Island Lagoon than it did for RM 2 to RM 11. In addition, predicted crayfish concentrations were relatively close to measured concentrations because mean measured crayfish DDE concentrations for Swan Island Lagoon were below those measured for RM 2 to RM 11, even though sediment PCB concentrations were higher in Swan Island Lagoon. Therefore, as discussed in Section 5.2.1.2, modeled concentrations in Swan Island Lagoon may reasonably approximate measured concentrations but may not be biologically defensible.

5.2.1.5 Summary of Selected Base Parameterization

The scenarios that performed the best in TrophicTrace were those that used the highest BSAFs for both total PCBs and DDE, used Diet 1 (for most species), and used the highest K_{OW} for DDE.

For parameters used by both models (dietary scenarios and K_{OW}), the process of selecting parameter values for further model runs considered results of scenarios from both models. If a particular parameter value performed better for one model but had little impact on another model, the value was selected, even though it would only benefit one model.

Dietary Scenarios

TrophicTrace Diet 1 performed the best for both PCBs and 4,4′-DDE. As discussed in Section 5.1.1.5, for the Arnot and Gobas model, both diets performed equally well, except for black crappie, for which Diet 2 greatly outperformed Diet 1.

Diet 1 was selected for use in further model runs with the exception of black crappie. Performance in both models (TrophicTrace and Arnot and Gobas) was considered in selection of base parameterization. Because black crappie was consistently overpredicted in Arnot and Gobas model runs, Diet 2 was selected for this species for both models.

4,4′-DDE K_{OW}

The scenarios that performed the best in TrophicTrace were those that used the highest K_{OW} for 4,4′-DDE. However, as discussed in Section 5.1.1.5, the model's tendency to underpredict 4,4′-DDE tissue concentrations, and therefore favor a higher K_{OW}, may be partly caused by a lack of consideration of the 4,4′-DDT conversion to 4,4′-DDE process. This issue complicates selection of an appropriate K_{OW}.

BSAF

The scenarios that performed the best in TrophicTrace were those that used the highest BSAFs for both total PCBs and 4,4′-DDE. BSAFs produced definitive differences in model performance across scenario runs, which simplified parameter value selection. TrophicTrace underpredicted tissue concentrations for most species for both total PCBs and 4,4′-DDE, and therefore it is not surprising that the highest BSAF performed the best. The highest BSAF values for PCBs (3.7) and 4,4′-DDE (6.2) were selected for use in further model runs.

As discussed in Section 4.5.1, the model was parameterized for PCBs for the sensitivity runs but spanned a range of K_{OW}s that overlapped with K_{OW} estimates for 4,4′-DDE. Thus, the base parameterization carried through into the sensitivity analysis was Diet 1 for all species except black crappie (Diet 2) and highest BSAF values for PCBs. All other parameter values used in further model runs (base parameterization) were average values as presented in Tables 4-3 to 4-7.

During the evaluation of scenario results, it was discovered that K_{OC} is calculated from the K_{OW} using different formulas in each of the models (Tables 3-1 and 3-2). Because TrophicTrace consistently underpredicted tissue concentrations for both chemicals to a greater extent than the Arnot and Gobas model, the method used to calculate K_{OC} in Arnot and Gobas was used to parameterize TrophicTrace in further model runs.

5.2.2 Sensitivity Analysis Results and Discussion

As described in Section 4.4.1, the sensitivity of TrophicTrace to variations in 12 physical and biotic parameters was evaluated in the sensitivity analysis. The complete set of parameters was run at three different K_{OW}s (5.5, 6.5, and 7.5) that cover the expected range of K_{OW} s for both total PCBs and 4,4′-DDE. Tables 4-22 through 4-25 present the sensitivity results for TrophicTrace from RM 2 to RM 11 and Swan Island Lagoon. Sections 5.2.2.1 to 5.2.2.3 provide detailed descriptions of those parameters to which TrophicTrace is insensitive, moderately sensitive, and highly sensitive. Species-specific model output for sensitivity model runs may be found in Appendix C.2. All 12 parameters assessed, with the exception of POC concentration, were found to be highly or moderately sensitive for at least one K_{OW} for one spatial scale.

Unlike Arnot and Gobas, the sensitivity of TrophicTrace in Swan Island Lagoon to the 12 parameters was only evaluated at one K_{OW}. Sensitivity runs across the two spatial scales led to similar results for the Arnot and Gobas model, with the majority of parameters assessed meeting the criteria of highly or moderately sensitive. The sensitivity assessment was streamlined for TrophicTrace to include the three K_{OW}s for RM 2 to RM 11 but only one K_{OW} for Swan Island Lagoon. The latter was intended to verify that the patterns of sensitivity in Swan Island Lagoon are the same as those for RM 2 to RM 11. Since results were consistent, additional runs for the other two K_{OW}s at Swan Island Lagoon were not deemed necessary.

5.2.2.1 Highly Sensitive Parameters

Biota Lipids (50% decrease)

Both fish and invertebrate lipid contents were reduced by 50% in this sensitivity analysis. Modeled invertebrate tissue concentrations in both deposit- and filter-feeders decreased by 50% with the same magnitude decrease in lipid content. Modeled fish tissue concentrations were slightly more variable than modeled invertebrate concentrations but also decreased on average by approximately 50% at all three K_{OW}s and in both spatial scales (Tables 4-22 through 4-25). TrophicTrace was slightly more sensitive to biota lipids at lower K_{OW}s. At a K_{OW} of 5.5, largescale sucker tissue concentration decreased by only 39.6% given a 50% decrease in lipid content, the smallest decline among all species. Juvenile chinook salmon was the most sensitive to lipid content with modeled concentrations declining by 66% at the lowest K_{OW} (see Appendix C2.2).

Because PCBs are organic compounds that tend to partition into fat tissue, decreasing lipid content of invertebrates and fish should decrease overall tissue concentrations in both. In TrophicTrace, invertebrate tissue concentration is modeled by relatively simple linear equations for both deposit-feeders and filter-feeders (Table 3-2); and the 50% decline in lipid content, therefore, led to a 50% decline in modeled invertebrate tissue concentration. The decline in invertebrate tissue concentrations drives the modeled fish tissue concentrations down because invertebrates are a major component of most modeled fish species diets. The intake of organic chemicals is not affected by the lipid content of fish, but they are partitioned into fat tissue prior to elimination or excretion. Therefore, lipid content is included in the respiratory elimination component (k_2) in TrophicTrace. When lipid content decreases, organic compounds taken in via the aqueous pathway partitioning into the fish tissue declines.

Therefore, the respiratory elimination of those compounds increases. Based on the TrophicTrace equations in Table 3-2, as fish lipid content decreases, the value of k_2 increases, which leads to further decreases in the modeled fish tissue concentrations.

Water Temperature (50% decrease)
Modeled invertebrate tissue concentration was not affected by water temperature in any of the TrophicTrace sensitivity analyses. Modeled fish tissue concentrations were, however, highly sensitive to a 50% decrease in water temperature, especially at increasing K_{OW}s (Tables 4-22 through 4-25). There did not appear to be any notable difference in sensitivity in Swan Island Lagoon from RM 2 to RM 11. Sensitivity to water temperature differed widely for different fish species, however. Modeled juvenile chinook salmon and brown bullhead tissue concentrations increased by less than 1%, while modeled smallmouth bass tissue concentrations increased by more than 60% at the lowest K_{OW}. At the highest K_{OW}, modeled fish tissue concentrations increased from 125 to 540% when water temperature was decreased by 50%. Smallmouth bass was consistently the most sensitive species to a decrease in water temperature.

Water temperature affects tissue concentrations via several mechanisms modeled in TrophicTrace. Feeding rates are assumed to decrease as the water temperature decreases, and fecal excretion rates are determined, in part, by the feeding rate. These are modeled as the dietary uptake rate (k_D) and the fecal excretion rate (k_E) constants in Table 3-2. As the feeding rate declines, the fecal excretion rate also declines. These changes offset each other to some degree in TrophicTrace, but modeled fish tissue concentrations would be expected to increase when water temperature increases because the dietary uptake rate constant increases at a greater rate with increasing temperatures than the excretion rate constant. However, because water temperature affects feeding rate, it also affects growth rate. Although growth rate is a function of the weight of the fish in TrophicTrace, greater overall growth rates are assumed to occur at temperatures above 10°C (Table 3-2). Greater growth results in relative dilution of the chemical concentration in tissue. Therefore, modeled fish tissue concentrations increased when water temperature were decreased from 13.4°C to 6.7°C because TrophicTrace applies a slower growth rate at temperatures below 10°C.

Sediment TOC (50% decrease)
Modeled fish and some invertebrate tissue concentrations were highly sensitive to a 50% decrease in sediment TOC concentrations. Filter-feeding invertebrates and phytoplankton tissue concentrations were not affected by the change in TOC, but modeled deposit-feeding invertebrate tissue concentrations all increased by 100% at all K_{OW}s (Tables 4-22 through 4-25). Modeled fish tissue concentrations were slightly more sensitive to the decrease in TOC as the K_{OW} value decreased, but fish tissue concentrations consistently increased when TOC concentrations were decreased. The most sensitive fish species at K_{OW} of 5.5 was brown bullhead, and the least sensitive was largescale sucker (see Appendix C2.2).

When sediment TOC is decreased while the chemical concentration in the sediment remains the same, the OC normalized chemical concentration of the sediment increases. This results in organic compounds partitioning into deposit-feeding invertebrate tissue to a greater extent when sediment TOC concentrations decline (see Table 3-2). Fish tissue concentrations are not directly related to sediment TOC concentrations, but their tissue concentrations are directly impacted by increases in invertebrate prey tissue concentrations.

5.2.2.2 Moderately Sensitive Parameters

TrophicTrace was moderately sensitive to 8 of the 12 parameters tested in this sensitivity analysis: biota weight, K_{OW}, K_{OC}, DOC concentration, combination of DOC and POC, sediment PCB concentration, water PCB concentration, and BSAF. The sensitivity to some parameters depended on the initial K_{OW} value. For example, modeled fish tissue concentrations were only sensitive to fish weight when K_{OW} was relatively low, while they were only sensitive to changes in DOC concentration (alone or in combination with changes in POC concentration) and K_{OC} when K_{OW} was relatively high.

Decreases in biota weight, sediment PCB concentration, water PCB concentration, BSAF, and an increase in K_{OC} all led to decreases in modeled tissue concentrations. Decreases in DOC concentration (alone or in combination with decreases in POC concentration) and K_{OC} led to increases in modeled tissue concentrations. The response of modeled fish tissue concentrations to changes in K_{OW}, however, depended upon the initial K_{OW} value. Modeled tissue concentrations for filter-feeding invertebrates always increased when K_{OW} was increased and decreased when K_{OW} was decreased. At the lowest K_{OW}, fish tissue concentrations responded in the same direction as the invertebrate concentrations; they increased when K_{OW} was increased and decreased when K_{OW} was decreased. However, at the highest K_{OW}, modeled fish tissue concentrations did not follow the same pattern as invertebrate tissue concentrations. Modeled fish tissue concentrations decreased when K_{OW} increased by 50% and increased when K_{OW} decreased by 50% (see Appendix C.2).

Because separate invertebrate exposure pathways can be designated by the user in TrophicTrace, parameters manipulated in this sensitivity analysis frequently affected some invertebrate species groups without affecting others. For example, a 50% decrease in the sediment PCB concentration led to a 50% decrease in deposit-feeding invertebrate tissue concentrations (e.g., clams, oligochaetes, and amphipods) but did not affect tissue concentrations in the other invertebrates. Changes in the DOC concentration, water PCB concentration, K_{OW}, and K_{OC} affected only filter-feeding invertebrate and phytoplankton tissue concentrations, while changes in sediment PCB concentration and BSAFs affected only deposit-feeding invertebrate tissue concentrations. Finally, TrophicTrace does not require data on invertebrate weight. Therefore, invertebrate tissue concentrations were not affected by biota weight because only fish weights were altered in this analysis.

5.2.2.3 Insensitive Parameters

TrophicTrace was completely insensitive to changes in POC concentration. Modeled tissue concentrations for invertebrates and fish did not change given a 50% decrease in POC concentration.

5.2.3 Uncertainty Analysis Results

As described in Section 4.5.2, uncertainty of TrophicTrace model predictions was bounded by running the model with upper and lower range parameter values and comparing those modeled tissue concentrations with results from running the model with average parameter values. For total PCBs, parameters determined to be moderately or highly sensitive in the sensitivity analysis were changed for the uncertainty analysis (Table 4-26). For DDE, only those parameters relevant to the inclusion of DDT uptake and metabolism to DDE were changed in the uncertainty analysis (Table 4-27). Summary results for comparisons of uncertainty model output to measured data are presented in Table 5-4 and described in detail in Sections 5.2.3.1 to 5.2.3.4. The results are summarized in Section 5.2.3.5. Species-specific model output is presented in Appendix C.3.

5.2.3.1 Total PCBs – RM 2 to RM 11

The average parameter value model run (hereafter referred to as the average run) produced results very similar to those from the preferred scenario run. However, the black crappie diet and K_{OC} calculation methods were changed following the scenario runs, so the results for the average parameter value run were slightly improved from the Scenario 1a results (see Appendix C.3.1).

The model bias for the average run was -7.6 (Table 5-4). Model bias for the maximum run increased by a factor of 3 to 14.0, while it decreased by a factor of 6 to -43.4 for the minimum run. Modeled tissue concentrations from 10 of the 11 species were underpredicted in the average run with SPAFs ranging from 1.3 for juvenile chinook salmon to 17.8 for sculpin and smallmouth bass. Modeled tissue concentrations from 10 of the 11 species, however, were overpredicted in the maximum run; only modeled crayfish concentrations did not exceed mean measured concentrations. SPAFs ranged from 2.0 for sculpin to 30.6 for juvenile chinook salmon. All 11 modeled tissue concentrations were underpredicted in the minimum run. SPAFs ranged from 5.0 for juvenile chinook salmon to 109 for carp.

5.2.3.2 Total PCBs – Swan Island Lagoon

The model bias for TrophicTrace using average parameter values was -4.6 (Table 5-4). It increased to 17.1 using maximum parameter values and decreased to -30.1 using minimum parameter values. Measured tissue concentrations were not available for clams or juvenile chinook salmon for Swan Island Lagoon. Therefore, SPAFs were only calculated for nine species for Swan Island Lagoon. Modeled tissue concentrations were underpredicted for six of the nine species in the average run. SPAFs ranged from 1.1 for largescale sucker to 19.0 for smallmouth bass. Modeled tissue concentrations from eight of the nine species were overpredicted in the maximum run; only modeled crayfish concentrations did not exceed mean measured concentrations. For the maximum run, the minimum SPAF was 2.3 for smallmouth bass, and the maximum was 60.4 for peamouth. All nine modeled tissue concentrations were underpredicted in the minimum run. SPAFs ranged from 4.0 for peamouth to 85.9 for smallmouth bass.

5.2.3.3 4,4′-DDE Metabolism Adjusted – RM 2 to RM 11

Only those parameters that would be affected by attempting to account for some amount of DDT uptake and metabolism to DDE were changed in the DDE uncertainty analysis. In TrophicTrace, those parameters were K_{OW} and K_{OC} and the concentration of DDE in the water and sediment. The parameter values (Table 5-4) were calculated to approximate 50%, 100%, and 20% metabolism of DDT in sediment and water to DDE in tissue. All other parameters were kept at the average values used in other model runs. Therefore, the range of model bias and predictive accuracy factors was significantly lower for DDE than it was for total PCBs.

The model bias for TrophicTrace assuming 50% metabolism of DDT was -14.9. It improved slightly to -11.8 for 100% metabolism and decreased to -17.9 for 20% metabolism (Table 5-4). Modeled tissue concentrations were underpredicted in all 11 species in all three runs. Clams consistently had the best SPAFs, ranging from 1.8 to 2.7. Northern pikeminnow consistently had the worst SPAFs, ranging from 42.9 to 65.2.

5.2.3.4 4,4′-DDE Metabolism Adjusted – Swan Island Lagoon

TrophicTrace model predictions for Swan Island Lagoon were better than those for RM 2 to RM 11, but the patterns were similar in both areas. The model bias for TrophicTrace for Swan Island Lagoon, assuming 50% metabolism of DDT, was -8.3, and it ranged from -5.4 assuming 100% metabolism to -12.5 assuming 20% metabolism (Table 5-4). Modeled tissue concentrations were underpredicted in all 9 species in all three runs. No measured clam data were available in Swan Island Lagoon, so the best SPAFs were for crayfish, and they ranged from 2.1 to 3.6. Largescale sucker had the worst SPAFs with 13.7 and 21.2 assuming 50% and 20% metabolism, respectively. Assuming 100% metabolism, northern pikeminnow had the worst SPAF (8.8).

5.2.3.5 Uncertainty Results Summary

The results from the PCB uncertainty analyses provide upper and lower boundaries on model predictions using a realistic range of parameter values likely from the Site. The results for RM 2 to RM 11 are similar to those for Swan Island Lagoon. Model bias in both areas suggests that TrophicTrace tends to underpredict tissue concentrations. However, maximum runs greatly overpredicted and minimum runs greatly underpredicted tissue concentrations, which suggests that TrophicTrace is not providing unreasonable tissue concentration predictions. When compared to the maximum measured tissue concentrations, the model bias for the maximum run for RM 2 to RM 11 drops to 5.5, while the model bias for the minimum run when compared to the minimum measured concentration was -8.9. This suggests that the known variability of the parameters that are included in TrophicTrace is sufficient to account for the measured variability in fish tissue concentrations from the Site.

The DDE uncertainty results are not analogous to those for total PCBs and do not provide an estimated range of DDE concentrations in aquatic organisms based on the known variability of model parameters. The minimum and maximum DDE uncertainty runs provide minimum and maximum likely contributions of 4,4′-DDT and 4,4′-DDE to fish and invertebrate tissue concentrations of 4,4′-DDE in the Site. Tissue DDE concentrations were still underpredicted in all species even if 100% of DDT was assumed to be readily metabolized to DDE at both spatial scales. Therefore, accounting for DDT metabolism in TrophicTrace improved its model bias but still does not account for the underpredictions of tissue concentrations in all species.

These results led to the following hypotheses:

- Another source/exposure route of DDE is still not accounted for.
- There is some error in the parameterization of TrophicTrace.
- TrophicTrace model structure (mechanisms and assumptions) is not able to accurately predict tissue concentrations of DDE in the Site.

5.2.4 Model Uncertainties and Assumptions

There are several areas of uncertainty specific to TrophicTrace. As discussed in Section 4.2.2.1, there is no mechanism for including sediment ingestion in fish diets in TrophicTrace, and the methods used in this analysis likely resulted in an overestimate of ingested sediment concentrations. Invertebrate tissue concentrations are modeled very simplistically with all deriving their concentration from either sediment or water. It is not possible to incorporate the effects of both sediment- and water-derived chemical concentrations on individual invertebrate species. The BSAFs for specific chemicals vary by species, but TrophicTrace does not allow the user to specify species-specific BSAFs. Finally, TrophicTrace is highly sensitive to water temperature (Section 5.2.2.1), which varies seasonally. The use of 10°C to delineate between fast or slow growth rates is uncertain and creates large changes in modeled tissue concentrations with a small change in water temperature.

5.3 MODEL AND DATA LIMITATIONS

Identifying data gaps is one of the primary objectives of the modeling exercises presented in this report (Section 1.1). Several data gaps that affect both models have been discussed at various points in this document. There are no measured tissue data for phytoplankton, zooplankton, oligochaetes, insect larvae, amphipods, and juvenile fish for evaluating model performance. Plankton and benthic invertebrate tissue chemistry affect fish tissue chemistry through dietary uptake. Both models predict plankton and benthic invertebrate tissue concentrations; however, species without measured data cannot be calibrated. In addition, lack of measured tissue data for some species reduces the ability to evaluate model bias and parameter uncertainty for both models.

An important aspect of the model's predictive ability is the extent to which sediment concentrations represent the exposure of the fish collected and analyzed. Both models assume that fish within each modeled area spend 100% of their time within that area. However, most of the fish species modeled have home ranges that exceed RM 2 to RM 11 of the lower Willamette River. This assumption has an even greater effect on the models run specifically for Swan Island Lagoon. Fish caught within Swan Island Lagoon are likely to spend a large percentage of their time in other parts of the river. Therefore, the measured tissue chemistry of fish caught within the lagoon are not just a product of their exposure within the lagoon as the models assume.

TrophicTrace can account for fish not spending 100% of their time within the area modeled because the fish tissue concentration calculation includes a site-use factor (see Table 3-2). The calculated concentration is multiplied by the fraction of time fish spend in that area. In a large river such as the LWR, this is problematic because it assumes that there is no other exposure from outside the area modeled. For the purpose of consistency between models, however, the site-use factor was not used in TrophicTrace for this analysis.

TrophicTrace does not model ventilation of porewater by fish. Porewater ventilation accounts for the exposure of fish to water with higher chemical concentrations than those present in water column water at the sediment surface. This may underestimate the exposure of fish to chemicals. Exposure to porewater is modeled indirectly for benthic invertebrates with sediment exposure pathway designations, by way of the BSAF.

Evaluation of the models' performance is limited by the quantity and quality of measured tissue data available for comparison. This includes the number of species collected (11 for RM 2 to RM 11) and the number of composite samples (as few as 3). There were even fewer measured biological data available from Swan Island Lagoon. There are no measured tissue chemistry data available for clams and juvenile chinook from Swan Island Lagoon; and the data available for largescale sucker, peamouth, and northern pikeminnow are based on one sample each. In addition, the samples used for comparison to Swan Island modeling results for black crappie, carp, and brown bullhead were composited over 3 river miles and include fish that were caught both inside and outside of Swan Island Lagoon. This makes parameterization of Swan Island Lagoon difficult. Since the models use "average" sediment and water data, they tend to predict average tissue concentration (assuming 100% exposure). Thus, because there are more samples for RM 2 to RM 11, the average and geomean for the measured data are more robust. For Swan Island Lagoon, one composite sample or none was available for some species.

Availability of appropriate sediment and water data was also a limitation. For sediment chemistry used in the model, the concentrations in samples from the top 30 centimeters were used. Most organisms modeled would only be exposed to sediment or porewater in the top few centimeters. The stratification of PCBs and 4,4'-DDE concentrations in the top 30 centimeters has not been well characterized. Thus, this represents an assumption contributing to model uncertainty. As discussed previously (Section 4.2.1.2), water PCB totals were based on congeners rather than Aroclors, due to the large number of non-detects in water samples analyzed for Aroclors. Since tissue and sediment total PCB data from the Site were based on Aroclors, this presents an inconsistency contributing to model uncertainty. In addition, the surface water data used to parameterize the Swan Island Lagoon models were collected from outside the lagoon because no appropriate samples from the lagoon were available.

Diet composition is a large determinant of tissue concentration. Although the diet scenarios were based on the best site-specific data available, fish diets are seasonally and spatially variable. Neither model is capable of allowing organisms to consume within their own compartment (cannibalism) or to consume from compartments above them (higher trophic levels). In order to overcome this limitation size and/or age classes or organisms can be created. As descried in Section 3.1.1, because of the limited tissue data for juvenile fish in the LWR (juvenile chinook salmon only) a juvenile compartment was created by combining biological data from Round 1 tissue data for peamouth, sculpin, black crappie, and juvenile chinook salmon. The creation of a juvenile fish compartment results in less estimation uncertainty but more approximation uncertainty than would exist if a greater number of compartments were used. Therefore, diets are a large source of uncertainty in both models.

Finally, seasonal variations in surface water chemistry data were not included in the current assessment because water chemistry data from Round 2, Events 2 and 3 (and perhaps other additional) surface water sampling were not available in time for this analysis. These data, when obtained, are not expected to reflect high flow or storm water events, presenting another further model limitation. In the current assessment, a single average water temperature was assumed. Since both models are steady state models, they are not capable of evaluating episodic events, temporally or spatially.

5.4 COMPARISON OF CANDIDATE MODEL PERFORMANCES

Overall the models performed well. Inasmuch as two different models were being assessed, the ability to calibrate was limited because the different models and different spatial scales sometimes required different adjustments to improve performance. Thus, selection of one model, and the ability to focus on and calibrate that model, is key to improving model performance. To facilitate this comparison, both models were assessed with several criteria.

5.4.1 Model Suitability to the Site

The selected model should be appropriate for the site of concern. There are attributes of each model that make it both well-suited and poorly suited for the Site. These are presented here to facilitate model comparison and selection.

5.4.1.1 Arnot and Gobas

The Arnot and Gobas model assumes 100% site use for all species modeled. Thus, when large-home-range species are modeled in subareas (e.g., pikeminnow for Swan Island Lagoon), exposure and therefore tissue concentrations may not be well-characterized. The Arnot and Gobas model contains many fewer assumptions than does TrophicTrace. Consequently, more data and user-selected assumptions are required to run the model.

Unlike, TrophicTrace, Arnot and Gobas uses a mechanistic approach to calculate invertebrate tissue concentrations. This results in a more site-specific calculation. The Arnot and Gobas model also allows for the consideration of sediment consumption, without defining sediment as species (as in TrophicTrace).

5.4.1.2 TrophicTrace

TrophicTrace's greatest attribute is that it is a relatively simple model with a user-friendly interface. The model allows users to define a site-use factor for different species. This allows for a focus on site-related exposure but ignores exposure from areas outside the site. The model's general simplicity means fewer data are required to run the model and fewer assumptions must be made for the inevitable data gaps. This also means that the model carries built-in assumptions, without flexibility for the user. These built-in assumptions are the least-desirable attributes for application at the Site.

Although it incorporates many Gobas equations, TrophicTrace relies on a K_{OW} or BSAF, rather than a mechanistic approach, to calculate invertebrate tissue concentrations. Because site-specific data (clam data) are insufficient to develop a reasonable BSAF, literature values were used, based primarily on species different than those found at the Site. Furthermore, TrophicTrace uses one BSAF value for all invertebrates.

TrophicTrace is also limited in that there is not an easy way to incorporate the consumption of sediment. Many fish and benthic invertebrates are expected to consume some sediment incidentally, which could be a significant exposure route. To account for this in TrophicTrace, sediment was included as a prey item analogous to invertebrates and phytoplankton so it could be consumed by other species. This created an internal dichotomy in the model because the predicted wet weight concentration for the "prey" sediment was different than the measured dry weight sediment concentration. The wet weight concentration was actually greater than the dry weight, indicating a problem with this approach.

5.4.2 Fit between Predicted and Observed Values (Model Predictive Accuracy Factor)

Model performance is a key factor in model selection. The Arnot and Gobas model performed better at both spatial scales for 4,4′-DDE. However, at the RM 2 to RM 11 scale, MPAFs for the measured mean exceeded 5 for all scenarios. The MPAF and model bias were less for Swan Island Lagoon, but perhaps for the wrong reasons, since many of the best-performing species (pikeminnow, smallmouth bass, black crappie) were species with home ranges that are much larger than Swan Island Lagoon. For TrophicTrace at RM 2 to RM 11, all species were underpredicted with an MPAF of 20.5 for the measured mean for the best-performing scenario. Predictions were similar for Swan Island Lagoon (minimum MPAF for mean of 19.3). As discussed previously, inadequate consideration of metabolism and 4,4′-DDT as an additional source were likely major issues that affected model performance (Section 4.4.2.2).

Overall, both models performed better for PCBs than for 4,4′-DDE at the RM 2 to RM 11 scale. The Arnot and Gobas model predicted particularly well, with all scenarios under an MPAF of 3.4 as compared to the mean. The lowest MPAF, as compared to the mean for TrophicTrace, for PCBs for RM 2 to RM 11 was 8.7, with all scenarios tending to underpredict. For Swan Island Lagoon, TrophicTrace had lower MPAFs than did Arnot and Gobas. However, Arnot and Gobas tended to perform better for sculpin, which have a small home range, and worse for crappie and pikeminnow, which have home ranges that are much larger than Swan Island Lagoon. In contrast, TrophicTrace performed better for pikeminnow and crappie and worse for sculpin. Thus, although TrophicTrace had lower MPAFs, these results indicate that the model does not describe the system well.

Results of the uncertainty analysis also indicated superior performance of the Arnot and Gobas model. For Arnot and Gobas PCBs for RM 2 to RM 11, the best-performing model, the uncertainty runs bounded the measured mean values quite well. All species were underpredicted for the minimum run and overpredicted for the maximum run. This indicates that the measured data fall within the model's predictive range and provides further evidence that the model is an appropriate tool to describe PCBs for the system.

5.4.3 Data Requirements

With the exception of benthic invertebrate-related data, the data requirements for the use of the two models for the current assessments were similar. Because TrophicTrace is a simpler model, it inherently has fewer data requirements. TrophicTrace uses a single BSAF and species-specific weights to calculate concentrations of benthic invertebrates, thus limited biological information is required. However, a BSAF that can be applied across all benthic invertebrates is required. Invertebrate weight is also not required for TrophicTrace. Arnot and Gobas requires biological information for all these species, including species-specific ingestion and porewater ventilation rates.

TrophicTrace can also model equilibrium partitioning by diffusion between the sediment and surface water if surface water chemistry data are not available for parameterization, but this process is not necessary if site-specific surface water data are used. The Arnot and Gobas model only includes the equilibrium partitioning processes within the surface water compartment and within the sediment compartment. TrophicTrace only includes the equilibrium partitioning processes within the surface water compartment.

5.4.4 Acceptability of Assumptions and Uncertainty

Because both of the models are based on the original Gobas model (Gobas 1993), many of their assumptions are the same. The least acceptable assumption, the use of a BSAF, is only included in TrophicTrace. One BSAF is used for all benthic invertebrates, a major simplification and generalization. However, site-specific data for the mechanistic modeling of benthic invertebrates in Arnot and Gobas are not available. TrophicTrace actually performed slightly better for the prediction of clam data, but performance for most benthic invertebrates could not be compared because measured data were not available. The TrophicTrace model structure does not include metabolism. This complicates future applications of the model for chemicals such as 4,4′-DDE, which may be produced through metabolism and which themselves are metabolized. As discussed in Section 5.3, TrophicTrace does not model ventilation of porewater by fish. Porewater ventilation accounts for the exposure of fish to water with higher chemical concentrations than those present in water column water at the sediment surface. This may underestimate exposure of fish to chemicals.

5.4.5 Ease of Model Construction and Implementation

Although TrophicTrace is an easier model to use, more manipulation was required to meet modeling needs. The inclusion of sediment as an invertebrate required special consideration, as discussed in Section 5.4.1.2. This resulted in two sediment concentrations: one was predicted by the model for sediment as an invertebrate; the other was the entered sediment concentration.

Aside from this adjustment, no other special manipulations were made to the models other than entering the required data. The Arnot and Gobas model does not include a built-in site-use factor as does TrophicTrace. This option may be useful in predicting body burden from particular sites but is of limited use for parameterizing the model because measured data reflect total tissue concentrations, and the fractions of these attributable to outside areas are unknown. Because more data are required for the Arnot and Gobas model, parameterizing the model is slightly more onerous.

5.4.6 Summary

Overall, the Arnot and Gobas model performed better than the TrophicTrace model for RM 2 to RM 11 for PCBs and for both spatial scales for 4,4′-DDE. Mean predictive ability for TrophicTrace was only better for one chemical at one spatial scale (PCBs at Swan Island Lagoon). However, when examined on a species level, the TrophicTrace results are biologically inconsistent. The Arnot and Gobas model includes mechanistic consideration of bioaccumulation for benthic invertebrates rather than a simple BSAF, as used by TrophicTrace. Although slightly more complicated to use, the Arnot and Gobas model provides more accurate and biologically defensible predictions.

6.0 RECOMMENDATIONS

Report Objectives 1 to 3 (Section 1.1) were addressed by running the food web models and evaluating their results. This section presents the single model that has been selected for future runs (Objective 4), discusses approaches to address data gaps, and proposes future applications for the food web model.

6.1 MODEL SELECTION

The Arnot and Gobas model is recommended for future model iterations. Overall, the Arnot and Gobas model outperformed the TrophicTrace model, has built-in consideration of metabolism, and provides mechanistic estimates of benthic invertebrates. One impediment to model parameterization in the runs described in this report was the conflict of trying to maintain consistency between two models. In some cases, the performance of one model could be improved by adjusting a particular parameter, but that adjustment had little effect on the other model (e.g., the use of Diet 2 for black crappie improved Arnot and Gobas performance and had little effect on TrophicTrace performance). In other cases, an adjustment that improved one model made the other model perform worse. Thus, simultaneously running two models made it more difficult to improve either. Future modeling using only the Arnot and Gobas model will facilitate the improved parameterization and performance of the model.

6.2 FILLING DATA GAPS

For future iterations of the model, new data will be collected to reduce model uncertainties. Some of these address data needs presented in Section 5.3. The new data will include new tools for summarizing sediment chemistry data, more water chemistry data, chemical analysis of invertebrates, and further research on DDT metabolism.

In model runs, primarily one approach was used for estimation of sediment chemical concentrations. The IDW approach provides an estimate of sediment concentration for areas where no data are available. However, as currently applied, there was no prediction accuracy assessment of the interpolation model. This will be improved in future iterations. Using Geostatistical Analyst, the data will split into training and testing data sets for accuracy assessment. This will allow optimization of the interpolation of input parameters such as size of search radius and weighting factor for samples within the search radius and reduce uncertainty for the estimation of sediment chemistry data.

More invertebrate PCB and 4,4′-DDE concentrations will be available in the coming months. Invertebrate samples from multiplates, deployed throughout the Site, will soon be analyzed (Windward 2005a). These data will be particularly valuable because invertebrates are an important prey in the food web model. Since data are not currently available, it has not been possible to evaluate model performance for invertebrates other than clams or crayfish. These new data will facilitate model calibration and should help improve the food web model from the bottom up.

The model runs presented in this report used only Round 2, Event 1, water chemistry data. In future iterations of the model, data from two or three more seasonal water sampling events will be available. The new water data will provide greater insight on the potential seasonal variation in chemical concentrations in the water column. Several options for inclusion of the new data will be considered, including possible use of a time weighted average.

In the model runs presented here, characterization of 4,4′-DDE tissue concentrations were limited by lack of consideration of metabolism. This issue was addressed in a preliminary manner in the uncertainty analysis and enhanced model performance. A more thorough literature search should improve the quantitative description of metabolism for the model and perhaps provide some species- or guild-specific metabolism information. The Arnot and Gobas model allows users to input different metabolism constants for different species. Since future model iterations might involve separate model runs for 4,4′-DDT and 4,4′-DDE (both used separately to predict 4,4′-DDE concentrations and summed), metabolism for both chemicals will be researched using library databases (e.g., BIOSIS).

6.3 FUTURE ACTIONS

Future applications of the food web model for Portland Harbor will focus on its use as a tool for helping develop preliminary remediation goals and its use in the feasibility study to explore impacts of different remedial options. Model refinements will be directed toward increasing model capacity for these applications. In future iterations, the Arnot and Gobas model will be run to predict total PCB and 4,4′-DDE tissue concentrations using new water chemistry, advances in sediment data analysis approaches, and additional metabolism research (for 4,4′-DDE). In addition, invertebrate chemistry data will allow for more comprehensive evaluations of model performance. Focusing on one model will facilitate model calibration and is expected to further refine predictive capabilities. The recognition and filling of data gaps directly addresses the overall modeling goal of developing a predictive relationship between chemical concentrations in sediment, water, and tissue (Section 1.2). Other areas proposed for future model runs include investigating spatial scale constraints in order to understand the consequences of remediation or natural attenuation, using model output for time-to-recovery estimates, modeling other chemicals, and assessing the relative importance of water versus sediment contributions to biota tissue chemical concentrations. These address other aspects of the overall modeling goal (Section 1.2) and model specifications (Section 1.3) and are discussed below.

6.3.1 Predicting Fish Tissue Concentrations at Refined Spatial Scales

Refining spatial scale of the model is critical for predicting fish contaminant concentrations for specific areas given assumptions of remedial activities and natural attenuation. This issue relates to the primary modeling question regarding where fish will be safe to eat in the future (Section 1.2). In the current model applications, the performance of the Arnot and Gobas model was much better for the large scale (RM 2 to RM 11), than for the small scale, or subarea (Swan Island Lagoon), for PCBs. Reasons for the performance difference include availability of fewer input and calibration data for the subarea and the fact that the home range of many fish species exceeds the modeled subarea. Very little calibration was performed for the modeling effort in this report due in part to the complexity of trying to maintain consistency across two models. Advanced calibration techniques, including the refinement of parameter selection based on findings from sensitivity and uncertainty analyses, will be employed to improve model performance.

Since many remediation and attenuation options may occur at small areas of the Site, it is important to refine the resolution of the model at smaller spatial scales. Upcoming model iterations may include assessing additional areas and running the model with assumed changes in sediment concentration. Additional techniques for generating a central tendency estimate for sediment chemical concentration, such as kriging, may also be considered. An inherent limitation of smaller spatial scales is that predictions of fish with home ranges much larger than the modeled sub area would be expected to be poor, since the model assumes that spatial scale selected is the home range of all modeled species. Most of the fish have home ranges of several kilometers (Table 4-3). The large home range fish may be of greater concern for human exposures via fish ingestion than less mobile species, like benthic invertebrates and sculpin. Thus, calibration activities may focus on the large spatial scale (RM 2 to RM 11), with best estimates for many parameters for the large scale applied to smaller spatial scales.

In order to provide predictive estimates of future tissue concentrations, predictions of future sediment and water concentrations will be needed. The Arnot and Gobas model is capable of accepting input data (sediment and water chemistry data) for the area to be modeled from any source, empirical or modeled.. The potential use of ECOFATE has also been discussed (Section 3.3). Lacking information on chemical loading, the use of ECOFATE is not feasible at this time. In addition, ECOFATE uses an older version of the Gobas model, which lacks many of the updates in the Arnot and Gobas version (Section 3.1).

6.3.2 Estimating Time to Recovery and When Fish May Be Safe to Eat

Time to recovery, or understanding when fish may be safe to eat given the assumptions of remedial action and/or natural attenuation, is another question that has been raised related to food web modeling (Section 1.2). This requires a more complex approach than the steady-state modeling that has been used in this report. Options to address this question include using output from a steady-state model, such as Arnot and Gobas, to evaluate simple decay and the use of a time-varying model.

In a steady-state model, relationships between variables in model compartments are constant. In a time-varying model, these relationships are allowed to vary over time. Deciding whether to use a steady-state or time-varying model depends on several factors, the most important of which is the temporal variability of the parameters being modeled. Often, the temporal variability of variables is unknown. New water data should enhance understanding of seasonal water chemistry variation, however all other site-specific data (tissue data, sediment data, etc.) have been collected at single time points. Using a time-varying model in the absence of relevant temporal data would increase model uncertainty because so many assumptions would have to be made for parameters where data are lacking.

As an alternative to the use of a time-varying model, output from the Arnot and Gobas model could be used to estimate time to recovery. There are several levels of complexity at which such modeling could be conducted. The most basic level would be to assume no further input of chemicals into the system. A simple estimate of environmental decay could then be used to calculate the time it would take for tissue concentrations to reach a specific target (e.g., risk-based tissue concentration goal or concentration in tissue predicted with the Arnot and Gobas model based on assumption of future water and sediment concentrations). The size and lipid content of organisms and the hydrophobicity of the chemicals considered are factors that might affect their time to recovery. In this simple approach contributions to tissue concentrations from continued exposure through time would not be included, which may lead to underestimation of time to recovery.

The next level of consideration, would involve consideration of changes in sediment concentration over time and would be significantly more complex to develop. In determining the most appropriate approach, these uncertainties would need to be weighed against the level of effort required and the quality of information obtained for decision-making at the Site.

6.3.3 Modeling other chemicals

The models here were applied for 4,4'-DDE and total PCBs. Other chemicals may also be of human health and/or ecological risk concern at the Portland Harbor site, including other organics and metals. The Arnot and Gobas model is recommended for other hydrophobic organic chemicals, particularly those sharing properties with PCBs, such as dioxins and furans. This is supported by the fact that the Arnot and Gobas model has been previously applied to dozens of PCB congeners with K_{OW}s ranging between 1 and 9, and the majority of predictions for were within a factor of two of empirical data (Arnot and Gobas 2004). For modeling these chemicals, the same base model parameterization may be used as for PCBs, but the K_{OW} of the new compound, as well as sediment and water concentrations will be needed. In addition, model output should be compared to measured tissue data for these chemicals to ensure the model is predicting reasonably before it is applied for hypothetical situations, such as remediation scenarios. Confidence in modeling additional hydrophobic organics will depend in part on the availability and quality of input data (e.g., sediment and water chemistry data).

For metals and PAHs, options other than the Arnot and Gobas model are recommended. Many of these chemicals involve important biotransformations that are not sufficiently well characterized for inclusion in the Arnot and Gobas model (e.g. metabolism rates for different species are unknown). For these chemicals, available options to predict tissue concentrations from sediment and/or water concentrations include:

- BSAFs – sediment to tissue estimation
- bioconcentration factors (BCFs) – water to tissue estimation
- bioaccumulation factor water (BAFs) – water to tissue (where food/prey is in equilibrium with water)
- TrophicTrace model for metals – primarily uses BCFs

These options are not mechanistically based and require far less data than the Arnot and Gobas model. However, a complicated model is not warranted because the processes involved are not well understood. Thus, a simpler approach, such as one of those listed above, is recommended. In applying these approaches, it is important that the uncertainty of resulting predictions be considered. Since these processes are less understood, results are expected to be far more uncertain than for those chemicals recommended for the Arnot and Gobas model. Another consideration for these approaches is the availability of detected chemical data for water, sediment, and tissue. If the majority of samples are non-detects, establishing relationships between media may not be possible.

6.3.4 Estimating the relative importance of water versus sediment contribution to tissue

Another future application for the food web model is to estimate the relative contribution of sediment versus water to tissue concentrations. This will be addressed after the incorporation of new water data. The approach will be fairly simplistic and involve entering zero water chemical concentration in the model. The resulting output will then be compared to model predictions in which both sediment and water were included. This approach is dependent on the quality of the water and sediment data used; sediment chemical concentrations are much better characterized than water concentrations. The results of this evaluation will not provide information on the source of chemicals in water or sediment, but will provide perspective on the potential impact of remediation options, which generally focus on sediment, investigated in the FS.

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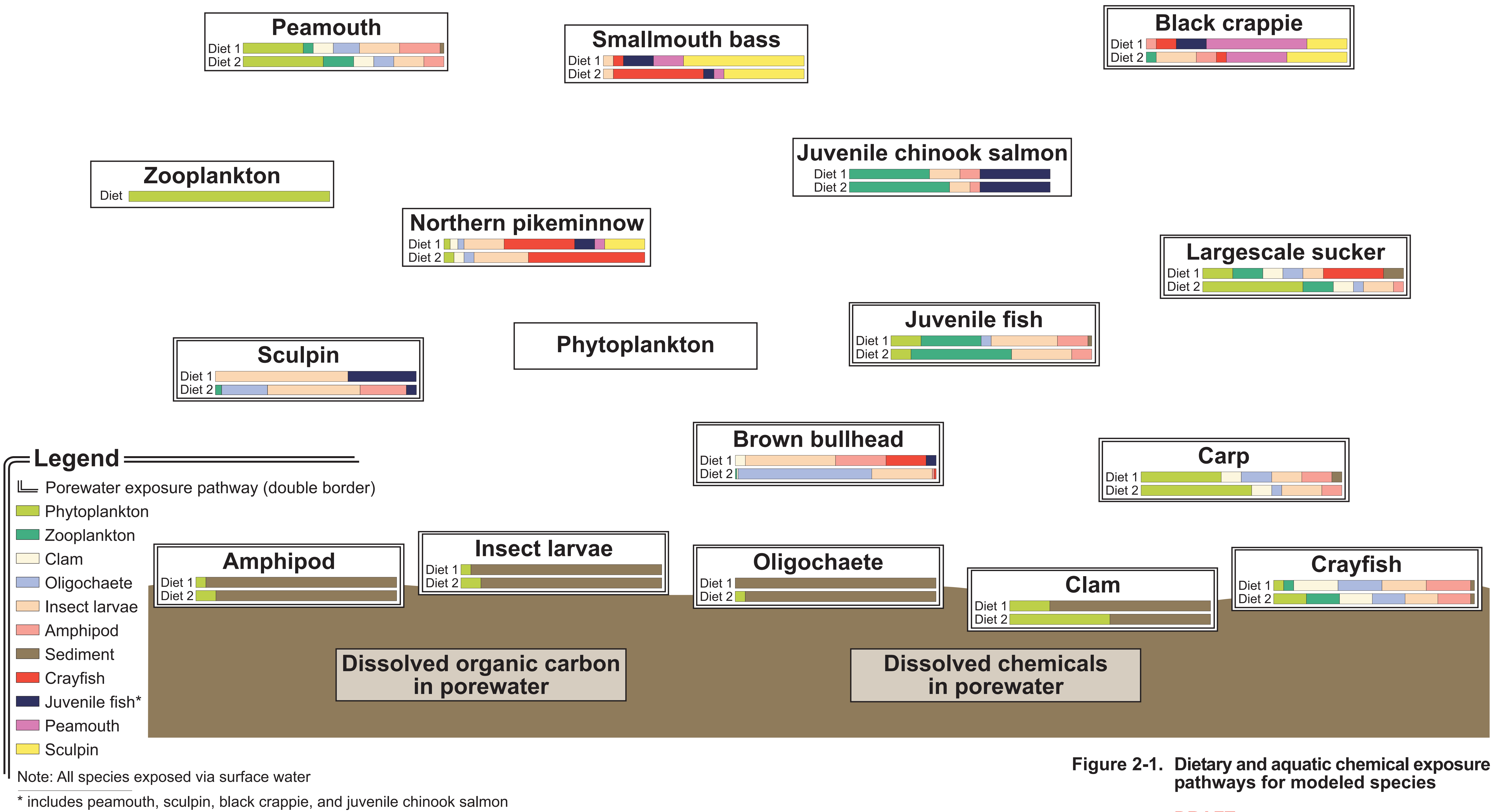

Figure 2-1. Dietary and aquatic chemical exposure pathways for modeled species

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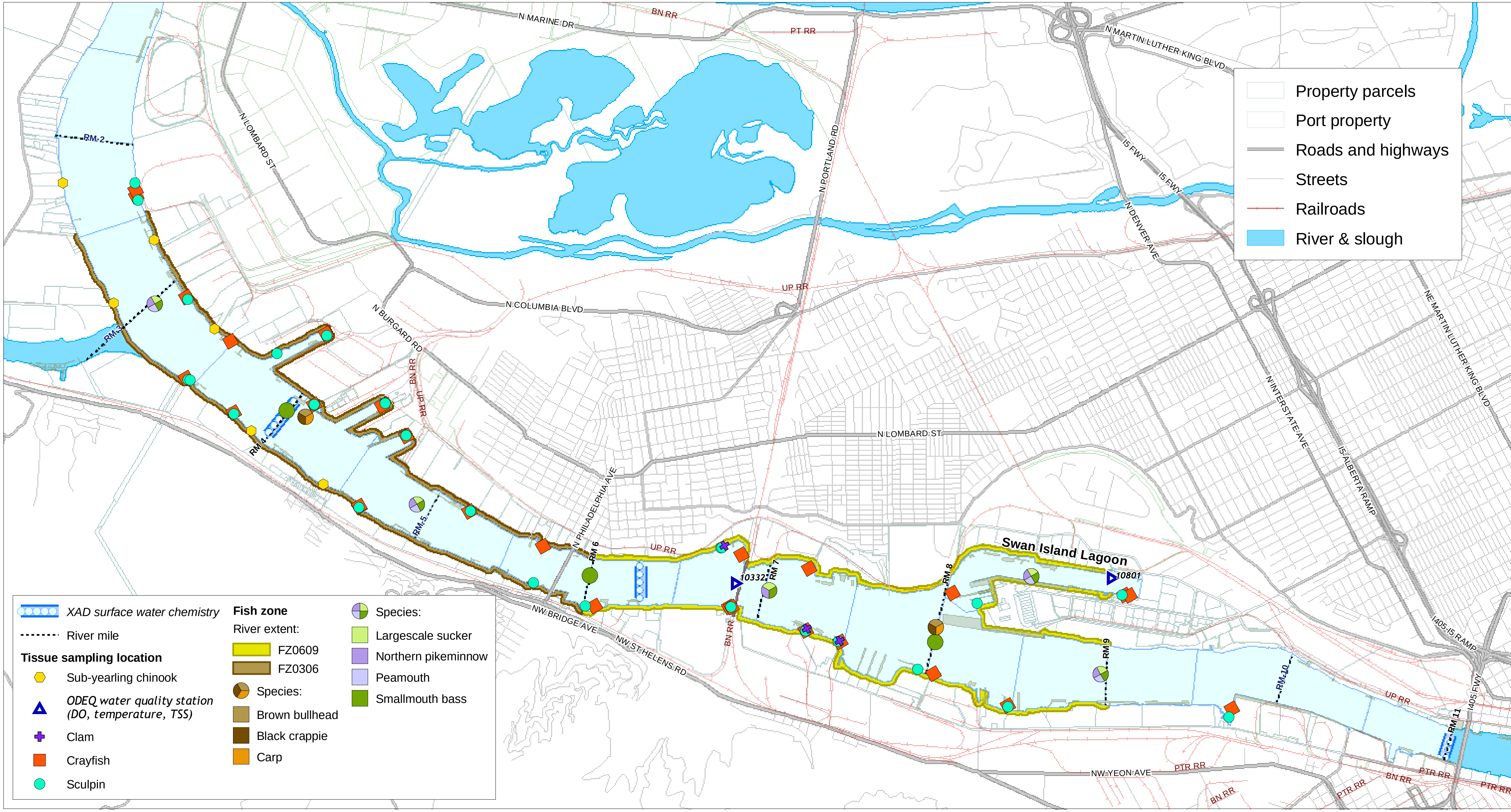

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Figure 4-1. Portland Harbor whole-body tissue sampling and surface water quality sampling

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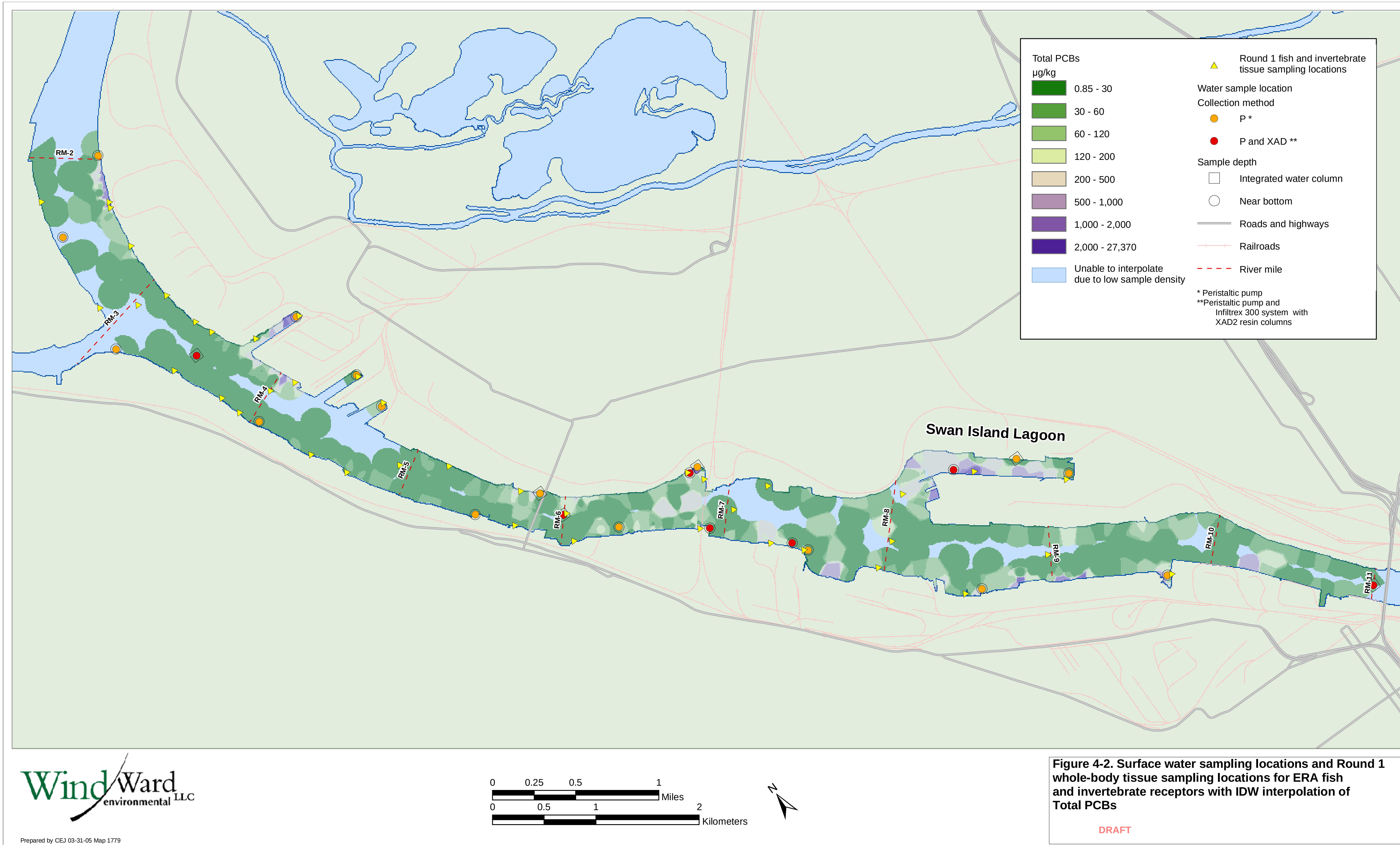

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Figure 4-2. Surface water sampling locations and Round 1 whole-body tissue sampling locations for ERA fish and invertebrate receptors with IDW interpolation of Total PCBs

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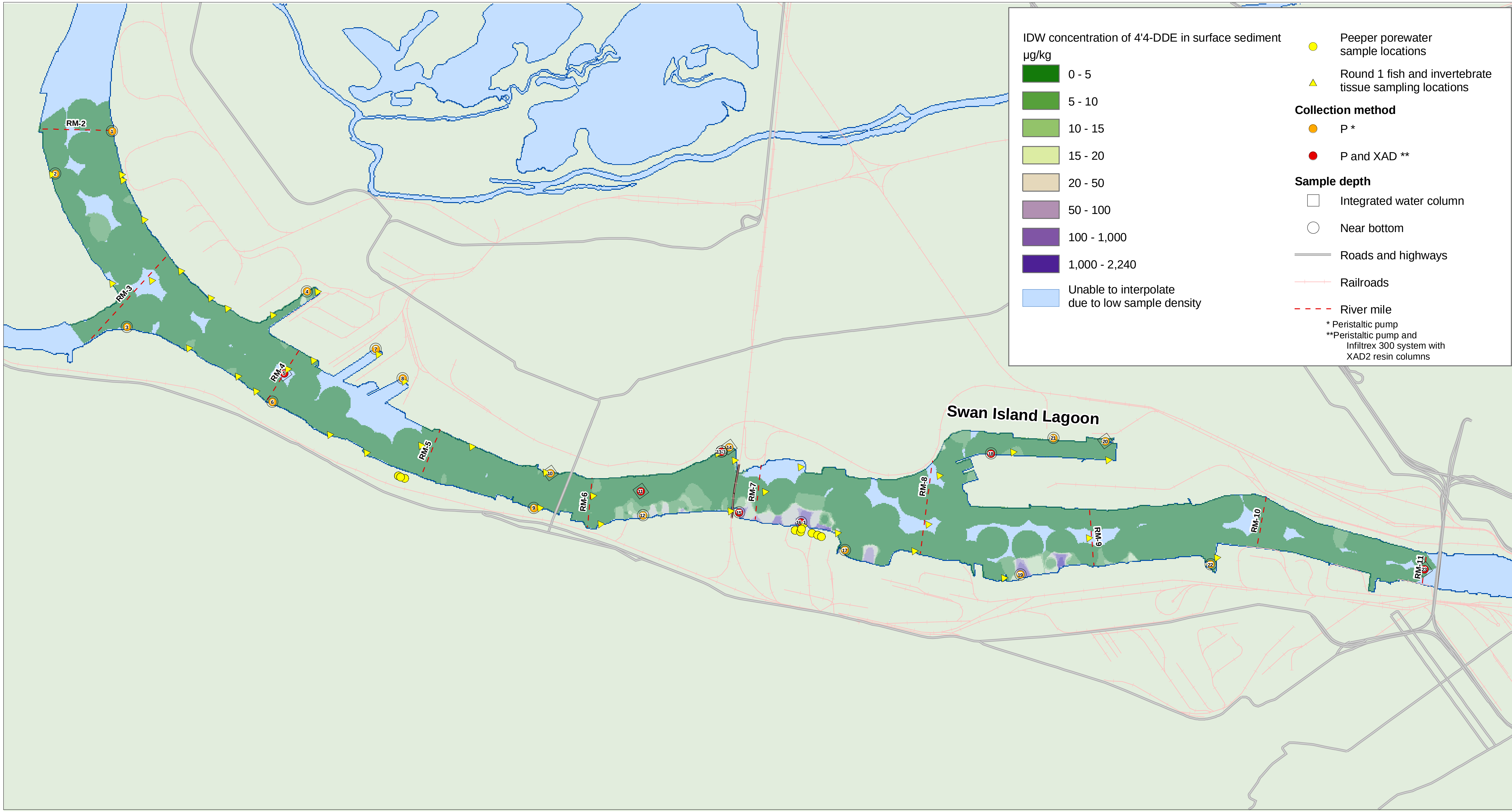

Wind Ward environmental LLC

Prepared by CEJ 05-17-05 Map 1777

0 0.25 0.5 1 Miles
0 0.5 1 2 Kilometers

N

Figure 4-3. Surface water sampling locations and Round 1 whole-body tissue sampling locations for ERA fish and invertebrate receptors with IDW interpolation of 4,4'-DDE

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PORTLAND HARBOR SUPERFUND SITE

FOOD WEB MODELING REPORT: EVALUATING TROPHICTRACE AND THE ARNOT AND GOBAS MODELS FOR APPLICATION TO THE PORTLAND HARBOR SUPERFUND SITE: TABLES

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November 4, 2005

DRAFT DOCUMENT: DO NOT QUOTE OR CITE
This document is currently under review by US EPA and its federal, state, and tribal partners, and is subject to change in whole or in part.

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WE-05-0009

TABLE OF CONTENTS

Table 3-1. Arnot and Gobas model: Equations

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
Biological						
Chemical concentration in the organism	C_B	µg/kg ww	$C_B = \{k_1 \times (m_O \times C_{WD} + m_P \times C_{WD,P}) + k_D \times \sum P_i \times C_{D,i}\}/(k_2 + k_E + k_G + k_M)$	species-specific model output	See Table 4-8 for tissue chemistry data to be used to evaluate model performance.	Arnot and Gobas (2004)
Chemical concentration in prey item i	$C_{D,i}$	µg/kg ww	same as above	species-specific model output	See Table 4-8 for tissue chemistry data to be used to evaluate model performance.	Arnot and Gobas (2004)
Rate constant for aqueous uptake (fish, invertebrates and zooplankton)	k_1	L/kg/day	$k_1 = E_W \times G_V/W_B$	calculated in model by equation at left	for chemical uptake via the respiratory area (i.e., gills)	Gobas (1993) Gobas and Mackay (1987)
Rate constant for aqueous uptake (algae, phytoplankton and aquatic macrophytes)	k_1	L/kg/day	$k_1 = (A+(B/K_{OW}))^{-1}$	calculated in model by equation at left	for chemical uptake via the respiratory area (i.e., cell wall)	Arnot and Gobas (2004)
Rate constant for chemical elimination via the respiratory area	k_2	day^{-1}	$k_2 = k_1/K_{BW}$	calculated in model by equation at left	loss through respiratory surface (gills or cell membrane/wall)	Gobas (1993) Arnot and Gobas (2004)
Rate constant for chemical uptake via ingestion and digestion of food and water	k_D	kg food/kg organism/day	$k_D = E_D \times G_D/W_B$	calculated in model by equation at left	For phytoplankton/algae k_D is zero.	Gobas (1993)
Rate constant for chemical elimination via excretion into egested feces	k_E	day^{-1}	$k_E = G_F \times E_D \times K_{GB}/W_B$	calculated in model by equation at left	For phytoplankton/algae k_E is zero.	Gobas et al. (1993)
Rate constant for growth of aquatic organisms	k_G	day^{-1}	$k_G = 0.0005 \times W_B^{-0.2}$	calculated in model by equation at left		Thomann et al. (1992)

Table 3-1. Arnot and Gobas model: Equations

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
Rate constant for metabolic transformation of the chemical	k_M	day^{-1}	No equation given in paper ($k_M = 0$)	0	Assume k_M to be zero for all PCBs. Arnot and Gobas (2003), Van der Linde et al.(2001), and Fisk et al. (2000) identify ways to calculate k_M.	best professional judgment Arnot and Gobas (2004)
Dietary chemical transfer efficiency	E_D	unitless	$E_D = (3.0 \times 10^{-7} \times K_{OW} + 2.0)^{-1}$	calculated in model by equation at left	Transfer of chemical across gut can be characterized by K_{OW} relationship.	SETAC Supplemental Data Archive S.3 as cited in Arnot and Gobas (2004)
Respiratory surface chemical uptake efficiency	E_W	unitless	$E_W = (1.85 + (155/K_{OW}))^{-1}$	calculated in model by equation at left	Transfer of chemical across respiratory surface can be characterized by K_{OW} relationship.	Gobas et al. (1998)
Feeding rate – filter-feeders	G_D	kg/d	$G_D = G_V \times C_S \times \sigma$	calculated in model by equation at left		Morrison et al. (1996) as cited in Arnot and Gobas (2004)
Feeding rate – other species	G_D	kg/d	$G_D = 0.022 \times W_B^{0.85} \times e^{(0.06 \times T)}$	calculated from weight of biota	feeding rates in coldwater fish (can be used for zooplankton and aquatic invertebrate species)	Weininger (1978); SETAC Supplemental Data Archive S.1 as cited in Arnot and Gobas (2004)
Fecal egestion rate	G_F	kg/d	$G_F = \{ (1-\varepsilon_L) \times V_{LD}) + (1-\varepsilon_N) \times V_{ND} + (1-\varepsilon_W) \times V_{WD}\} \times G_D$	calculated in model by equation at left		Arnot and Gobas (2004)

Table 3-1. Arnot and Gobas model: Equations

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
Gill ventilation rate	G_V	L/d	$G_V = 1400 \times W_B^{0.65}/C_{OX}$	calculated in model by equation at left	Gill ventilation or a related measure, oxygen consumption rate, can be obtained from literature sources. Good databases exist for fish (Thurston and Gehrke 1990); however, similar data are less accessible for invertebrates.	SETAC Supplemental Data Archive S.1 as cited in Arnot and Gobas (2004)
Organism-water partition coefficient on a wet weight basis	K_{BW}	unitless	. $K_{BW} = \tilde{k}_1/k_2 = v_{LB} \times K_{OW} + v_{NB} \times \beta \times K_{OW} + v_{WB}$	calculated in model by equation at left		Arnot and Gobas (2004)
Phytoplankton-water partition coefficient on a wet weight basis	K_{PW}	unitless	$K_{PW} = v_{LP} \times K_{OW} + v_{NP} \times 0.35 \times K_{OW} + v_{WP}$	calculated in model by equation at left		Arnot and Gobas (2004)
Partition coefficient of the chemical between the contents of the gastrointestinal tract and the organism	K_{GB}	unitless	$K_{GB} = (v_{LG} \times K_{ow} + v_{NG} \times \beta \times K_{ow} + v_{WG}) / (v_{LB} \times K_{ow} + v_{NB} \times \beta \times K_{ow} + v_{WB})$	calculated in model by equation at left		Arnot and Gobas (2004)
Lipid fraction of gut contents	v_{LG}	kg lipid/kg digesta ww	$v_{LG} = (1-\varepsilon_L) \times v_{LD} / [(1-\varepsilon_L) \times v_{LD} + (1-\varepsilon_N) \times v_{ND} + (1-\varepsilon_W) \times v_{WD}]$	calculated in model by equation at left		Arnot and Gobas (2004)
NLOM fraction of gut contents	v_{NG}	kg NLOM/kg digesta ww	$v_{NG} = (1-\varepsilon_L) \times v_{ND} / [(1-\varepsilon_L) \times v_{LD} + (1-\varepsilon_N) \times v_{ND} + (1-\varepsilon_W) \times v_{WD}]$	calculated in model by equation at left		Arnot and Gobas (2004)
Water fraction of gut contents	v_{WG}	kg water/kg digesta ww	$v_{LG} = (1-\varepsilon_L) \times v_{WD} / [(1-\varepsilon_L) \times v_{LD} + (1-\varepsilon_N) \times v_{ND} + (1-\varepsilon_W) \times v_{WD}]$	calculated in model by equation at left		Arnot and Gobas (2004)
Overall lipid content of the diet	v_{LD}	kg lipid/kg food ww	$v_{LD} = \Sigma P_i \times v_{LB,i}$	calculated in model by equation at left		Arnot and Gobas (2004)

Table 3-1. Arnot and Gobas model: Equations

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
Overall NLOM content of the diet	v_{ND}	kg NLOM/kg food ww	$v_{ND} = \Sigma P_i \times v_{NB,I}$	calculated in model by equation at left		Arnot and Gobas (2004)
Overall water content of the diet	v_{WD}	kg water/kg food ww	$v_{WD} = \Sigma P_i \times v_{WB,i}$	calculated in model by equation at left		Arnot and Gobas (2004)
Environmental						
Freely dissolved chemical concentration in the porewater	$C_{WD,P}$	ng/L	$C_{WD,P} = C_{S,OC} \times \delta_{OCS}/K_{OC}$	calculated in model using equation at left	This parameter will be calculated for each spatial scale evaluated, using sediment data appropriate for that spatial scale.	
Chemical concentration in the sediment, organic carbon normalized	$C_{S,OC}$	µg/kg dw OC	$C_{S,OC} = C_S/OC_{sed}$	calculated in model using equation at left	This parameter will be calculated for each spatial scale evaluated, using sediment data appropriate for that spatial scale.	calculated using Phase 1 and Phase 2 sediment data
Freely dissolved chemical concentration in the water (total PCBs as congeners and 4,4′-DDE)	C_{WD}	ng/L	$C_{WD} = C_{WT} \times \phi$	calculated in model by equation at left	Simulates sequestering of chemical by DOC and POC in the water.	Gobas et al. (1989) McCarthy (1983) McCarthy and Jimenez (1985)
Bioavailable solute fraction	ϕ	unitless	$\phi = 1/(1+\chi_{POC} \times D_{POC} \times \alpha_{POC} \times K_{OW} + \chi_{DOC} \times D_{DOC} \times \alpha_{DOC} \times K_{OW})$	calculated in model by equation at left	Simulates sequestering of chemical by DOC and POC in the water.	Gobas et al. (1989) McCarthy (1983) McCarthy and Jimenez (1985)
Dissolved oxygen concentration of water (RM 2 to RM 11)	C_{OX}	mg O_2/L	$C_{OX} = (-0.24 \times T + 14.04) \times 0.9$	9.74 (value calculated by the model)	Equation was used for scenario and sensitivity runs.	Benson and Krause (1980) as cited in Arnot and Gobas (2004)
Dissolved oxygen concentration of water (Swan Island)	C_{OX}	mg O_2/L	$C_{OX} = (-0.24 \times T + 14.04) \times 0.9$	9.68 (value calculated by the model)	Equation was used for scenario and sensitivity runs.	Benson and Krause (1980) as cited in Arnot and Gobas (2004)

Table 3-1. Arnot and Gobas model: Equations

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
Organic carbon-water partition coefficient (total PCBs as Aroclors and 4,4′-DDE)	$\text{Log } K_{OC}$	unitless	$\text{Log } K_{OC} = \text{Log}_{10}(0.35 * 10^{\text{Log Kow}})$	calculated in model from equation at left		Seth et al. (1999)

Table 3-2. TrophicTrace model: Equations

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	NOTES	SOURCE
Biological					
Chemical concentration in the organism (fish)	C_F	µg/kg ww	C_F = SUF x {(k_1 x C_{WD} + k_D x C_{DIET})/(k_2 + k_E + k_G)}		Modified from Gobas (1993)
Concentration in the diet	C_{DIET}	µg/kg/day	$C_{DIET} = \Sigma P_{\boldsymbol{i}} C_{D,\boldsymbol{i}}$		Gobas (1993); Gobas et al. (1995)
Rate constant for aqueous uptake	k_1	L/kg/day	$k_1 = 1/((V_F/Q_W) + (V_F/Q_L)/K_{OW})$	for chemical uptake via the respiratory area (i.e., gills)	Gobas (1993); Gobas et al. (1995)
Rate constant for chemical elimination via the respiratory area	k_2	day^{-1}	$k_2 = k_1/(L_F \times K_{OW})$	loss through respiratory surface (gills or cell membrane/wall)	von Stackelberg and Burmistrova (2003)
Rate constant for chemical uptake via ingestion and digestion of food and water	k_D	kg food/kg organism/day	$k_D = E_D \times F_D/V_F$	For phytoplankton/algae, k_D is zero.	Gobas (1993)
Gill/dietary uptake efficiency	E_D	unitless	$E_D = 1/(A \times K_{OW} + B)$		Gobas (1993)
Feeding rate	F_D	kg/day	$F_D = .022 \times (V_F)^{.085} \times \exp(.06 \times T_W)$		Gobas (1993); Gobas et al. (1995)
Rate constant for chemical elimination via excretion into egested feces	k_E	day^{-1}	$k_E = 0.2 \times k_D$	For phytoplankton/algae, k_E is zero.	Modified from Gobas et al. (1995)
Rate constant for growth of aquatic organisms **above 10°C**	k_G	day^{-1}	$k_G = 0.01 \times V_F^{-0.2}$		von Stackelberg and Burmistrova (2003)[a]
Rate constant for growth of aquatic organisms **below 10°C**	k_G	day^{-1}	$k_G = 0.002 \times V_F^{-0.2}$		von Stackelberg and Burmistrova (2003)[a]
Aqueous phase gill uptake transfer rate	Q_W	L/day	$Q_W = 88.3 \times V_F^{0.6}$		Gobas (1993); Gobas et al. (1995)
Lipid phase gill uptake transfer rate	Q_L	L/day	$Q_L = Q_W/100$		Gobas (1993); Gobas et al. (1995)
Chemical concentration in phytoplankton	C_P	µg/kg ww	$C_P = C_{WD}/1000 \times L_P \times K_{OW}$		Gobas et al. (1995)

Table 3-2. TrophicTrace model: Equations

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	NOTES	SOURCE
Chemical concentration in zooplankton	C_Z	µg/kg ww	$C_Z = C_{WD}/1000 \times L_Z \times K_{OW}$		Gobas et al. (1995)
Concentration of contaminant in benthic invertebrates (sediment pathway)	$C_{B(sed)}$	µg/kg ww	$C_{B(sed)} = C_S \times (L_B/F_{OC}) \times BSAF$		von Stackelberg and Burmistrova (2003)
Chemical concentration in benthic invertebrates (water pathway)	$C_{B(wat)}$	µg/kg ww	$C_{B(wat)} = C_{WD}/1000 \times L_B \times K_{OW}$		Gobas et al. (1995)
Environmental					
Concentration of chemical freely dissolved in water	C_{WD}	ng/L	$C_{WD} = C_{WW}/(1+DE_{OC} \times P_{OC} + D_{OC} \times K_{OC})$		Modified from Gobas (1993), Gobas et al. (1995)[a]
Chemical					
Organic carbon/water partitioning coefficient (log)	$\text{Log } K_{OC}$	L/kg OC	$\text{Log } K_{OC} = 0.00028 + 0.983 \times \text{Log}K_{OW}$	This is the default equation used in TrophicTrace. However, the equation used in the Arnot and Gobas model to calculate K_{OC} was used in the sensitivity and uncertainty analysis of TrophicTrace.	Connell and Hawker (1988)

[a] Model equation was taken from TrophicTrace software; the ultimate source of the equation is unclear.

Table 4-1. Arnot and Gobas model: Parameter values from site-specific data

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
Fraction of the diet consisting of prey item *i*	P_i	fraction (add up to 1)	not applicable	species-specific	see Table 4-3	see Table 4-3
Weight of the organism (fish, clams, and crayfish)	W_B	kg ww	not applicable	species-specific	see Table 4-3	see Table 4-3
Lipid fraction of the organism (fish, clams, and crayfish)	v_{LB}	kg lipid/kg organism ww	not applicable	species-specific	see Table 4-3	see Table 4-3
NLOM fraction of the organism (fish, clams, and crayfish)	v_{NB}	kg NLOM/kg organism ww	not applicable	species-specific	See Table 4-3; NLOM is a secondary site of PCB accumulation.	see Table 4-3
Water fraction of the organism (fish, clams, and crayfish)	v_{WB}	kg water/kg organism ww	not applicable	species-specific	See Table 4-3; water is not a significant contributor to the storage capacity of PCBs but is the third phase of storage in the body.	see Table 4-3
Environmental/Sediment						
Total PCB (as Aroclors) concentration in sediment (RM 2 to RM 11)	C_S	µg/kg dw	Spatially weighted average concentration calculated using inverse distance weighted (IDW) method.	95.4	arithmetic summary statistics: 170.2 (mean) 23.7 (geomean) (from 615 samples)	Round 1 and Round 2 sediment data
Total PCB (as Aroclors) concentration in sediment (Swan Island Lagoon)	C_S	µg/kg dw	Spatially weighted average concentration calculated using inverse distance weighted (IDW) method.	365.4	arithmetic summary statistics: 296.7 (mean) 90.13 (geomean)	Round 1 and Round 2 sediment data
4,4′-DDE concentration in the sediment (RM 2 to RM 11)	C_S	µg/kg dw	Spatially weighted average concentration calculated using inverse distance weighted (IDW) method.	3.48		Round 1 and Round 2 sediment data

Table 4-1. Arnot and Gobas model: Parameter values from site-specific data

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
4,4′-DDE adjusted to include 4,4′-DDT (RM 2 to RM 11)	C_S	µg/kg dw	see notes	4.72 (3.97-5.95)	Multiplied ratio of geomeans of all DDE and DDT sediment samples (0.71) by AWA for 4,4′-DDE for RM to RM 11. Multiplied result by 0.5 (average), 0.2, or 1 (min and max) to obtain estimate of 4,4′-DDT contribution (metabolic conversion of 4,4′-DDT to 4,4′-DDE). Added this result to 4,4′-DDE concentration.	
4,4′-DDE concentration in the sediment (Swan Island Lagoon)	C_S	µg/kg dw	Spatially weighted average concentration calculated using inverse distance weighted (IDW) method.	2.62		Round 1 and Round 2 sediment data
4,4′-DDE adjusted to include 4,4′-DDT (Swan Island Lagoon)	C_S	µg/kg dw	see notes	6.76 (4.28-10.9)	Multiplied ratio of geomeans of all DDE and DDT sediment samples (3.16) by AWA for 4,4′-DDE for Swan Island Lagoon. Multiplied result by 0.5 (average), 0.2, or 1 (min and max) to obtain estimate of 4,4′-DDT contribution (metabolic conversion of 4,4′-DDT to 4,4′-DDE). Added this results to 4,4′-DDE concentration.	
Sediment organic carbon content (RM 2 to RM 11)	OC_{sed}	% dw	spatially weighted average concentration calculated using inverse distance weighted (IDW) method	1.84 (0.03-12)	arithmetic summary statistics: 1.88 (mean) 1.37 (geomean)	calculated using Round 1 and Round 2 sediment data

Table 4-1. Arnot and Gobas model: Parameter values from site-specific data

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
Sediment organic carbon content (Swan Island Lagoon)	OC_{sed}	% dw	spatially weighted average concentration calculated using inverse distance weighted (IDW) method	2.02	arithmetic summary statistics: 1.86 (mean) 1.42 (geomean)	calculated using Round 1 and Round 2 sediment data
Environmental/Water						
Total chemical concentration in the water column (total PCBs as congeners)	C_{WT}	ng/L	site-specific data	0.409 (0.229-0.609)	Integrated transects only, XAD filter plus column data	Round 2, Event 1 XAD data. Water sample locations 5, 11, and 23.
Total chemical concentration in the water column (4,4′-DDE)	C_{WT}	ng/L	site-specific data	0.023 (0.016-0.029)	Integrated transects only, XAD filter plus column data	Round 2, Event 1 XAD data Water samples,
4,4′-DDE adjusted for 4,4′-DDT contribution	C_{WT}	ng/L	site-specific data	0.03 (0.026-0.036)	Integrated transects only, XAD filter plus column data. Assume 4,4′-DDE conc. in water + metabolism fraction * 4,4′-DDT conc. in water. This is to account for contribution of 4,4′-DDT to 4,4′-DDE using assumptions of 0.5 (average), 0.2 (min) or 1 (max) metabolic conversion to 4,4′-DDE.	Round 2, Event 1 XAD data Water samples
Concentration of total organic carbon (TOC) in the water (RM 2 to RM 11)	χ_{TOC}	kg/L	site-specific data	0.000002 (0.000001–0.000006)	Parameter calculated from ODEQ data collected 1995-2005. Not input into model, used for calculating χ_{DOC} and χ_{POC} below.	ODEQ (2005) SP&S bridge

Table 4-1. Arnot and Gobas model: Parameter values from site-specific data

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
Concentration of total organic carbon (TOC) in the water (Swan Island Lagoon)	χ_{TOC}	kg/L	Site-specific data	2.1 E-6 (0.000 001 – 0.000 004)	Parameter calculated from ODEQ data collected 1995-2005. Not input into model, used for calculating χ_{DOC} and χ_{POC} below.	ODEQ (2005) Swan Island Lagoon channel midpoint station 10801
Concentration of dissolved organic carbon (DOC) in the water (RM 2 to RM 11)	χ_{DOC}	kg/L	Site-specific data	1.6 E-6 (8.0 E-7 – 4.8 E-6)	Used to derive a "freely dissolved water concentration" (C_{WD}).	Derived from TOC value (ODEQ 2005) and χ_{DOC} /χ_{POC} ratio from the Great Lakes (DOC = 80% of TOC) (Arnot and Gobas 2004)
Concentration of dissolved organic carbon (DOC) in the water (Swan Island Lagoon)	χ_{DOC}	kg/L	Site-specific data	1.7 E-6 (0.000 0008 – 0.000 0032)	Used to derive a "freely dissolved water concentration" (C_{WD}).	Derived from TOC value (ODEQ 2005) and χ_{DOC} /χ_{POC} ratio from the Great Lakes (DOC = 80% of TOC) (Arnot and Gobas 2004)
Concentration of particulate organic carbon (POC) in the water (RM 2 to RM 11)	χ_{POC}	kg/L	Site-specific data	4.0 E-7 (1.2 E-6– 2.0 E-7)	Used to derive a "freely dissolved water concentration" (C_{WD}).	Derived from TOC value (ODEQ 2005) and χ_{DOC}/χ_{POC} ratio from the Great Lakes (POC = 20% of TOC) (Arnot and Gobas 2004)

Table 4-1. Arnot and Gobas model: Parameter values from site-specific data

MODEL COMPONENT	SYMBOL	UNIT	EQUATION	VALUE	NOTES	SOURCE
Concentration of particulate organic carbon (POC) in the water (Swan Island Lagoon)	χ_{POC}	kg/L	site-specific data	0.42 E-6 (0.000 0002 – 0.000 0008)	Used to derive a "freely dissolved water concentration" (C_{WD})	Derived from TOC value (ODEQ 2005) and χDOC/χPOC ratio from the Great Lakes (POC = 20% of TOC) (Arnot and Gobas 2004)
Mean water temperature in water column (RM 2 to RM 11)	T	^{o}C	site-specific data	13.4 (5.3 – 24.5)	parameter calculated from ODEQ data collected 1995-2005	ODEQ (2005) (SP&S bridge)
Mean water temperature in water column (Swan Island Lagoon)	T	^{o}C	site-specific data	13.7 (5.00 – 25.1)	parameter calculated from ODEQ data	ODEQ (2005), Swan Island Lagoon channel midpoint station 10801
Dissolved oxygen concentration of water column (RM 2 to RM 11)	C_{OX}	mg O_2/L	site-specific data	10.8 (6.9 – 14.2)	These values were explored during uncertainty analysis	ODEQ (2005), SP&S bridge data collected 1995-2005
Dissolved oxygen concentration of water column (Swan Island Lagoon)	C_{OX}	mg O_2/L	site-specific data	8.9 (6.2 – 11.0)	These values were explored during the uncertainty analysis.	ODEQ (2005), Swan Island Lagoon channel midpoint, station 10801
Concentration of suspended solids in water column (RM 2 to RM 11)	C_{SS}	kg/L	site-specific data	0.0000114 (0.000002 – 0.00011)		ODEQ (2005), SP&S bridge
Concentration of suspended solids in water column (Swan Island Lagoon)	C_{SS}	kg/L	site-specific data	0.078 (0.034 – 0.230)		ODEQ (2005), Swan Island Lagoon channel midpoint, station 10801

Table 4-2. Arnot and Gobas model: Parameter values from literature data

MODEL COMPONENT	SYMBOL	UNIT	VALUE	NOTES	SOURCE
Biological					
Fraction of the diet consisting of prey item *i*	P_i	fraction (add up to 1)	species-specific	see Table 4-3	see Table 4-3
Weight of the organism (zooplankton, oligochaete, amphipod, and insect larvae)	W_B	kg ww	species-specific	see Table 4-3	see Table 4-3
Lipid fraction of the organism (zooplankton, oligochaete, amphipod, and insect larvae)	v_{LB}	kg lipid/kg organism ww	species-specific	see Table 4-3	see Table 4-2
Lipid fraction of phytoplankton	v_{LP}	kg lipid/kg phytoplankton ww	species-specific	see Table 4-3	see Table 4-3
NLOM fraction of the organism (zooplankton, oligochaete, amphipod, and insect larvae)	v_{NB}	kg NLOM/kg organism ww	species-specific	see Table 4-3; NLOM is a secondary site of PCB accumulation	see Table 4-3
Non-lipid organic carbon (NLOC) fraction of phytoplankton	v_{NP}	kg NLOC/kg phytoplankton ww	species-specific	see Table 4-3; NLOC is secondary site of PCB accumulation, for phytoplankton	see Table 4-3
Water fraction of the organism	v_{WB}	kg water/kg organism ww	species-specific	see Table 4-2; water is not a significant contributor to the storage capacity of PCBs, but they are the third phase of storage in the body	see Table 4-3
Fraction of overlying water ventilated	m_O	fraction (add up to 1)	species-specific	$m_O = 1 - m_P$ see Table 4-3	see Table 4-3
Fraction of porewater ventilated	m_P	fraction (add up to 1)	species-specific	see Table 4-3	see Table 4-3

Table 4-2. Arnot and Gobas model: Parameter values from literature data

MODEL COMPONENT	SYMBOL	UNIT	VALUE	NOTES	SOURCE
Scavenging efficiency of particles absorbed from the water	σ	%	100	used to calculate feeding rate for filter feeders	Morrison et al. (1996) as cited in Arnot and Gobas (2004); Reeders et al. (1989); Ten Winkel and Davids (1982)
Algae, phytoplankton and aquatic macrophytes -resistance to chemical uptake through aqueous phase	A	day^{-1}	6×10^{-5}	Derived from phytoplankton bioconcentration factor data from the Great Lakes	Gobas and McLean (2003); Swackhamer and Skoglund (1993) as cited in Arnot and Gobas (2004)
Algae, phytoplankton and aquatic macrophytes -resistance to chemical uptake through organic phase	B	day^{-1}	5.5		Arnot and Gobas (2004) (Great Lakes phytoplankton)
Proportionality constant expressing the sorption capacity of non-lipid organic matter (NLOM) to that of octanol	β	unitless	0.035		Gobas et al. (1999)
Dietary absorption efficiencies of lipid—fish	ε_L	fraction (%/100)	0.92		Gobas et al. (1999)
Dietary absorption efficiencies of lipid – invertebrates	ε_L	fraction (%/100)	0.75		Roditi and Fisher (1999); Berge and Brevik (1996); Gordon (1966); Parkerton (1993) as cited in Arnot and Gobas (2004)
Dietary absorption efficiencies of lipid – zooplankton	ε_L	fraction (%/100)	0.72		Conover (1966) as cited in Arnot and Gobas (2004)
Dietary absorption efficiencies of NLOM – fish	ε_N	fraction (%/100)	0.55	value in model template	Nichols et al. (2001) as cited in Arnot and Gobas (2004)
Dietary absorption efficiencies of NLOM – invertebrates	ε_N	fraction (%/100)	0.75		Roditi and Fisher (1999); Berge and Brevik (1996); Gordon (1966); Parkerton (1993); all as cited in Arnot and Gobas (2004)

Table 4-2. Arnot and Gobas model: Parameter values from literature data

MODEL COMPONENT	SYMBOL	UNIT	VALUE	NOTES	SOURCE
Dietary absorption efficiencies of NLOM – zooplankton	ε_N	fraction (%/100)	0.72		Conover (1966)as cited in Arnot and Gobas (2004)
Dietary absorption efficiencies of water – all aquatic animal species	ε_W	fraction (%/100)	0.25		Arnot and Gobas (2004)
Environmental					
Density of the organic carbon in sediment	δ_{OCS}	kg/L	0.9	Great Lakes value	Arnot and Gobas (2004)
Disequilibrium factor for DOC partitioning	D_{DOC}	unitless	1	assumes chemicals in the water column are in equilibrium with DOC	Arnot and Gobas (2004)
Disequilibrium factor for POC partitioning	D_{POC}	unitless	1	assumes chemicals in the water column are in equilibrium with POC	Arnot and Gobas (2004)
Proportionality constant describing similarity in phase partitioning of DOC in relation to that of octanol	α_{DOC}	unitless	0.028 (0.01-0.07)	Burkhard determined that the α_{DOC} is 8% of α_{POC} (± a factor of 2.5) (e.g., $\alpha_{DOC} = 0.08\times\ \alpha_{POC} = 0.08\times0.35 = 0.028$) 0.035 is the value that the Arnot and Gobas model framework is currently using as programmed. Per communication with Jon Arnot, the 0.028 value is correct and will be used in future applications of the model.	Burkhard (2003)
Proportionality constant describing similarity in phase partitioning of POC in relation to that of octanol	α_{POC}	unitless	0.35 (0.14-0.87)		Seth et al. (1999) as cited in Arnot and Gobas (2004)
Chemical					
Octanol-water partition coefficient (total PCBs as Aroclors)	Log K_{OW}	unitless	6.3	Concentration-weighted average of Aroclors 1242 (K_{OW}=5.6), 1254 (K_{OW}=6.5), and 1260 (K_{OW}=6.8). Other K_{OW}s may also be evaluated	Phase 1 and 2 sediment data; EPA's Estimated Program Interface software (EPA 2003)
Henry's Law constant (total PCBs as Aroclors)	H	Pa-m^3/mol	43.3	31.4 Pa-m^3/mol = geomean (alternate)	Mackay et al. (1992) as cited in Arnot and Gobas (2004); average of 28 congeners available in this source

Table 4-2. Arnot and Gobas model: Parameter values from literature data

MODEL COMPONENT	SYMBOL	UNIT	VALUE	NOTES	SOURCE
Octanol-water partition coefficient of the chemical (4,4′-DDE)	Log K_{OW}	unitless	6.76 (6.51)	6.51 is an alternate value	MDEQ (2004) (6.76); ATSDR (2003) (6.51); Mackay et al. (1992)(5.7)
Henry’s Law constant (4,4′-DDE)	H	Pa-m^3/mol	2.13		MDEQ (2004); ATSDR (2003)

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Phytoplankton				
Lipid content (%)	0.123 (0.08 – 0.2)	False Creek, Burrard Inlet, Vancouver, BC	Tissue analyzed was a combination of phytoplankton and zooplankton (236 μm plankton tow net). Aggregate lipid values from green algae, brown algae, and phytoplankton.	Mackintosh et al. (2004)
Non-lipid organic carbon (NLOC) content (%)	4.33 (0.6 – 6.3)	False Creek, Burrard Inlet, Vancouver, BC	Plankton carbon is an important organic chemical storage phase due to low lipid concentrations. Carbon rather than "matter" is used for phytoplankton because it is a better predictor of organic chemical content (Arnot and Gobas 2004). Aggregate organic carbon values from green algae, brown algae, and phytoplankton.	Mackintosh et al. (2004)
Moisture content (%)	95.5 (93.5 – 99.3)	False Creek, Burrard Inlet, Vancouver, BC	= 100% – % lipid – % carbon not a true measure of moisture content because there are constituents other than lipid and carbon	
Fraction of porewater ventilated	0	na	Phytoplankton live in water column and are not exposed to porewater.	best professional judgment
Exposure area	RM 2 to RM 11	LWR	Phytoplankton are exposed to entire ISA as they flush through the system with currents and tidal fluctuations.	best professional judgment
Zooplankton				
Weight (kg)	1.4E-07 (3.3E-08 – 2.3E-07)	Puget Sound (Budd inlet)	Converted average dry weight mass of zooplankton assuming 90% moisture.	Giles and Cordell (1998)

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Lipid content (%)	1.0 (0.9 – 1.1)	Norway	Converted from dry weight assuming 90% moisture.	Evjemo and Olsen {, 1997 #9427}
Moisture content (%)	90	Japan	Species not specified.	Kuroshima et al. (1987)as cited in Delbare et al. (1996)
Fraction of porewater ventilated	0	NA	Zooplankton live in water column and are not exposed to porewater.	best professional judgment
Exposure area	RM 2 to RM 11	LWR	Zooplankton are exposed to entire RM 2 to RM 11 as they flush through the system with currents and tidal fluctuations.	best professional judgment
Diet 1				
Phytoplankton	100	NA	It is assumed that the portion of carnivorous zooplankton in the LWR is insignificant as compared to planktivores.	best professional judgment
Amphipod *Corophium volutator*				
Weight (kg) (all spatial scales)	6E-06			Leon (1980)
Lipid content (%) (all spatial scales)	0.8			Kraaij et al. (2001)
Moisture content (%) (all spatial scales)	80			
Fraction of porewater ventilated	0.05 (0.01-0.10)		Primarily live on sediment surface, feeding style facilitates porewater exposure, best estimate is 0.30.	best professional judgment
Exposure area (km)	0.080		Assumed <1.0 mi^2 as some species are tube-dwelling, and others are in water column. Can move up to 0.080 km with tidal fluctuations.	best professional judgment

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Diet 1			Suspension and deposit feeders	best professional judgment, Pechenik (1991); Zaranko et al. (1997)
Phytoplankton	5			
Sediment	95			
Diet 2			Suspension and deposit feeders	best professional judgment, Pechenik (1991); Zaranko et al. (1997)
Phytoplankton	10			
Sediment	90			
Clam				
Weight (kg) (RM 2 to RM 11)	0.0005 (0.0005 – 0.006)		*Corbicula fluminea*	Round 1 data
Lipid content (%) (RM 2 to RM 11)	1.18 (0.837 – 1.7)			Round 1 data
Lipid content (%) (Swan Island Lagoon)				
Moisture content (%) (RM 2 to RM 11)	88.0 (87.2 – 89.0)			Round 1 data
Moisture content (%) (Swan Island Lagoon)				
Fraction of porewater ventilated	0.05 (0.01-0.10)	NA	Clams live in the sediment, and ventilate using short siphon water from just above the sediment surface, best estimate is 0.30.	Winsor et al. (1990) as cited in Arnot and Gobas (2004); best professional judgment
Exposure area (km)	0.001		Clams are sessile organisms, range is for *Corbicula* sp.	best professional judgment

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Diet 1			Filter feeders living in the sediment	best professional judgment, Pechenik (1991); Kraaij et al. (2001); Zaranko et al. (1997)
Phytoplankton	20			
Sediment	80			
Diet 2				best professional judgment Pechenik (1991); Zaranko et al. (1997)
Phytoplankton	50			
Sediment	50			
Crayfish				
Weight (kg) (RM 2 to RM 11)	0.043 (0.034 – 0.048)		*Pacifastacus* sp.	Round 1 data
Weight (kg) (Swan Island Lagoon)	0.0414 (0.0395 – 0.0449)			
Lipid content (%) (RM 2 to RM 11)	0.781 (0.160 – 1.30)			
Lipid content (%) (Swan Island Lagoon)	0.74 (0.51 – 1)			
Moisture content (%) (RM 2 to RM 11)	73.5 (69.3 – 77.1)			
Moisture content (%) (Swan Island Lagoon)	73.6 (71.4 – 76.4)			
Fraction of porewater ventilated/ all exposure areas	0.02 (0-0.04)		Crayfish live in open burrows in the sediment, best estimate is 0.30	best professional judgment
Exposure area	1 mile			best professional judgment
Diet 1				

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Phytoplankton	5		Highly uncertain, crayfish expected to feed non-selectively	Pechenik (1991); Evans-White et al. (2001); best professional judgment
Zooplankton	5			
Clam	22			
Oligochaete	22			
Insect larvae	22			
Amphipod	22			
Sediment	2			
Diet 2				
Phytoplankton	16.4		Highly uncertain, crayfish expected to feed non-selectively	Pechenik (1991); Evans-White et al. (2001); best professional judgment
Zooplankton	16.4			
Clam	16.3			
Oligochaete	16.3			
Insect larvae	16.3			
Amphipod	16.3			
Sediment	2			
Insect Larvae				
Weight (kg) (all spatial scales)	5.33E-06		*Chironomus riparius*	Bervoets et al. (2003)
Lipid content (%) (all spatial scales)	1.20		*Chironomus* spp.	Lyytikäinen et al. (2003)
Moisture content (%) (all spatial scales)	80			best professional judgment

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Fraction of porewater ventilated	0.05 (0.01-0.10)		0.50 (0.10-0.80) range for *Chironomus* spp., which primarily borrow in the sediment to dragon fly larvae which live on the surface.	best professional judgment
Exposure area (km)	<0.0005 for *Chironomous* 0.001 for dragonfly			best professional judgment
Diet 1				
Phytoplankton	5		*Chironomus* spp. (our representative organism) are filter feeders. Insect larvae species in Portland have a wide range of feeding groups from detritivores to carnivores, but *Chironomus* are the dominant species.	best professional judgment; Pechenik (1991); Zaranko et al. (1997)
Sediment	95			
Diet 2				
Phytoplankton	10		*Chironomus* spp. (our representative organism) are filter feeders. Insect larvae species in Portland have a wide range of feeding groups from detritivores to carnivores, but *Chironomus* are the dominant species.	best professional judgment, Pechenik (1991) Zaranko et al. (1997)
Sediment	90			
Oligochaete				
Weight (kg) (all spatial scales)	1.4 E-06		*Limnodrilus hoffmeisteri*	Millward et al. (2001)
Lipid content (%) (all spatial scales)	1		Nereis vexillosa	Weston et al. (2002)
Moisture content (%) (all spatial scales)	80			best professional judgment

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Fraction of porewater ventilated	0.05 (0.01-0.10)		Primarily dwell beneath sediment surface, best estimate is 0.80.	best professional judgment
Exposure area (km)	<0.0005 laterally 0.001 depth			best professional judgment,
Diet 1				
Sediment	100		Mostly eat sediment, also eat many organisms and parts of organisms that fall from above ("riverine snow"), this "snow" has been somewhat characterized by the organic carbon content of the sediment.	best professional judgment, Pechenik (1991), Zaranko et al. (1997)
Diet 2				
Phytoplankton	5		Mostly eat sediment, also eat many organisms and parts of organisms that fall from above ("riverine snow"), this "snow" has been somewhat characterized by the organic carbon content of the sediment.	best professional judgment, Pechenik (1991), Zaranko et al. (1997)
Sediment	95			
Bass, Smallmouth				
Weight (kg) (RM 2 to RM 11)	0.462 (0.264 – 1.23)			Round 1 data
Weight (kg) (Swan Island Lagoon)	0.289 (0.264 – 0.314)			
Lipid content (%) (RM 2 to RM 11)	5.43 (1.50 – 7.20)			
Lipid content (%) (Swan Island Lagoon)	5.7 (5 – 6.6)			

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Moisture content (%) (RM 2 to RM 11)	70.2 (68.0 – 78.5)			
Moisture content (%) (Swan Island Lagoon)	69.6 (68.5 – 70.4)			
Fraction of porewater ventilated	0		Primarily swim and feed in water column.	best professional judgment
Exposure area (km)	0.8		Most were tracked within <0.80 km using radio tags.	North et al. (2001)
Diet 1				
Insect larvae	5	Lower Willamette RM 0 to RM 26		ODFW (2005), Zimmerman (1999)
Crayfish	5			
Juvenile fish	15			
Peamouth	15			
Sculpin	60			
Diet 2				ODFW (2005), best professional judgment to fill “fish” (36%), and “other” (2%)
Insect larvae	5	Lower Willamette RM 0 to RM 26		
Crayfish	45			
Juvenile fish	5			
Peamouth	5			
Sculpin	40			

Table 4-3. Characteristics of species to be modeled

Model Component	**Value – Mean (range)**	**Locale of Data Collection**	**Notes**	**Source**
Bullhead, Brown				
Weight (kg) (RM 2 to RM 11)	0.243 (0.217 – 0.256)			Round 1 data
Weight (kg) (Swan Island Lagoon)	0.248 (0.242 – .0254)			
Lipid content (%) (RM 2 to RM 11)	2.43 (1.50 – 3.80)			
Lipid content (%) (Swan Island Lagoon)	2.63 (1.5 – 3.8)			
Moisture content (%) (RM 2 to RM 11)	76.1 (74.9 – 76.7)			
Moisture content (%) (Swan Island Lagoon)	75.9 (74.9 – 76.5)			
Exposure area	RM 2 to RM 11		Yellow bullhead likely move in and out of RM 2 to RM 11.	Scott and Crossman (1973)
Fraction of porewater ventilated	0.005 (0-0.01)		Primarily swim and feed in water column.	best professional judgment
Diet 1				
Clam	5	Sacramento-San Joaquin delta		Turner (1966), best professional judgment
Insect larvae	45			
Amphipod	25			
Crayfish	20			
Juvenile fish	5			

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Diet 2				
Zooplankton	0.5	West Virginia		Klarberg and Benson (1975), best professional judgment
Clam	0.5			
Oligochaete	67			
Insect larvae	30			
Amphipod	1			
Crayfish	1			
Carp, Common				
Weight (kg) (RM 2 to RM 11)	2.33 (2.15 – 2.79)			Round 1 data
Weight (kg) (Swan Island Lagoon)	2.221 (2.145 – 2.304)			
Lipid content (%) (RM 2 to RM 11)	7.88 (5.60 – 13.0)			
Lipid content (%) (Swan Island Lagoon)	8.43 (5.6 – 13)			
Moisture content (%) (RM 2 to RM 11)	70.5 (66.5 – 72.0)			
Moisture content (%) (Swan Island Lagoon)	69.8 (66.5 – 71.6)			
Exposure area	RM 2 to RM 11		Likely moves in and out of RM 2 to RM 11.	best professional judgment
Fraction of porewater ventilated	0.08 (0.05-0.10)		Some bottom feeding in sediment.	best professional judgment

Table 4-3. Characteristics of species to be modeled

Model Component	Value – Mean (range)	Locale of Data Collection	Notes	Source
Diet 1				
Phytoplankton/algae	40	Hanford Reach, Mid-Columbia River		Gray and Dauble (2001), FishBase (2004), best professional judgment
Clam	10			
Oligochaete	15			
Insect larvae	15			
Amphipod	15			
Sediment	5			
Diet 2				
Phytoplankton/algae	55			best professional judgment
Clam	10			
Oligochaete	5			
Insect larvae	20			
Amphipod	10			
Crappie, Black				
Weight (kg) (RM 2 to RM 11)	0.218 (0.176 – 0.254)			Round 1 tissue data
Weight (kg) (Swan Island Lagoon)	0.253 (0.251 – 0.254)			
Lipid content (%) (RM 2 to RM 11)	5.26 (3.33 – 7.50)			
Lipid content (%) (Swan Island Lagoon)	7 (6.5 – 7.5)			

Table 4-3. Characteristics of species to be modeled

Model Component	Value – Mean (range)	Locale of Data Collection	Notes	Source
Moisture content (%) (RM 2 to RM 11)	72.4 (70.5 – 74.2)			
Moisture content (%) (Swan Island Lagoon)	71.2 (70.5 – 71.8)			
Exposure area (km)	11.3		Data from work plan (Integral et al. 2004)	Ward et al. (1991)
Fraction of porewater ventilated	0.005 (0-0.01)		Primarily swim and feed in water column	best professional judgment
Diet 1				
Amphipod	5	Lower Willamette RM 0 to RM 26		ODFW (2005) best professional judgment
Crayfish	10			
Juvenile fish	15			
Peamouth	50			
Sculpin	20			
Diet 2				
Zooplankton	5			best professional judgment
Insect larvae	20			
Amphipod	10			
Crayfish	5			
Peamouth	30			
Sculpin	30			
Peamouth				
Weight (kg) (RM 2 to RM 11)	0.105 (0.080 – 0.159)			Round 1 tissue data

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Weight (kg) (Swan Island Lagoon)	.0799			
Lipid content (%) (RM 2 to RM 11)	8.93 (6.93 – 10.7)			
Lipid content (%) (Swan Island Lagoon)	10.2			
Moisture content (%) (RM 2 to RM 11)	70.2 (69.3 – 71.2)			
Moisture content (%) (Swan Island Lagoon)	69.7			
Exposure area	RM 2 to RM 11		Species likely to move in and out of the ISA.	Integral et al. (2004)
Fraction of porewater ventilated	0		Primarily swim and feed in water column.	best professional judgment
Diet 1				
Phytoplankton/algae	30	Hanford Reach, Mid-Columbia River		best professional judgment based on Gray and Dauble (2001)
Zooplankton	5			
Clam	10			
Oligochaete	13			
Insect larvae	20			
Amphipod	20			
Sediment	2			

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Diet 2				
Phytoplankton/algae	40			best professional judgment based on Gray and Dauble (2001)
Zooplankton	15			
Clam	10			
Oligochaete	10			
Insect larvae	15			
Amphipod	10			
Pikeminnow, Northern				
Weight (kg) (RM 2 to RM 11)	0.557 (0.440 – 0.719)			Round 1 tissue data
Weight (kg) (Swan Island Lagoon)	0.453			
Lipid content (%) (RM 2 to RM 11)	5.25 (2.30 – 8.10)			
Lipid content (%) (Swan Island Logoon)	5.8			
Moisture content (%) (RM 2 to RM 11)	71.9 (68.4 – 74.4)			
Moisture content (%) (Swan Island Lagoon)	68.4			
Exposure area (km)	21.7		Most recaptured <0.81km.	North et al.(2001)); Integral et al. (2004)
Fraction of porewater ventilated	0		Primarily swim and feed in water column.	best professional judgment

Table 4-3. Characteristics of species to be modeled

Model Component	Value – Mean (range)	Locale of Data Collection	Notes	Source
Diet 1				
Phytoplankton/algae	3	Lower Willamette RM 0 to RM 26		best professional judgment Gray and Dauble (2001) Buchanan et al. (1981) Zimmerman (1999)
Clam	4			
Oligochaete	3			
Insect larvae	20			
Crayfish	35			
Juvenile fish	10		ODFW study indicated that juvenile salmon were a major part of Pikeminnow (~346 mm) their diet. However, EPA recommended not using juvenile chinook salmon as prey.	
Peamouth	5			
Sculpin	20			
Diet 2				
Phytoplankton/algae	5	Lower Willamette RM 0 to RM 26		ODFW (2005), best professional judgment to fill out ODFW's "other" (42%) which comprised all but crayfish
Clam	5			
Oligochaete	5			
Insect larvae	27			
Crayfish	58			
Salmon, Chinook (juvenile)				
Weight (kg) (RM 2 to RM 11)	0.012 (0.011-0.014)			Round 1 tissue data
Weight (kg) (Swan Island Lagoon)				

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Weight (kg) (Swan Island Lagoon)				
Weight (kg) (Swan Island Lagoon)				
Lipid content (%) (RM 2 to RM 11)	2.90 (2.20 – 3.60)			
Lipid content (%) (Swan Island Lagoon)				
Moisture content (%) (RM 2 to RM 11)	78.3 (77.6 – 79.4)			
Moisture content (%) (Swan Island Lagoon)				
Exposure area	NA		Anadromous fish, likely move in and out of the study area. Exposure area not determined in this literature review.	
Fraction of porewater ventilated	0		Do not ingest sediment. Forage in nearshore areas.	Integral et al. (2004), best professional judgment
Diet 1				
Zooplankton	40			ODFW (2005)
Insect larvae	15			
Amphipod	10			
Juvenile fish	35			
Diet 2				
Zooplankton	50		PRE and ODFW study	ODFW (2005), Windward

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Insect larvae	10		PRE and ODFW study (portion of "benthic invertebrates")	(2005)
Amphipod	5		PRE and ODFW study (portion of "benthic invertebrates")	
Juvenile fish	35		PRE and ODFW study	
Sculpin				
Weight (kg) (RM 2 to RM 11)	0.019 (0.014 – 0.030)			Round 1 tissue data
Weight (kg) (Swan Island Lagoon)	0.0189 (0.0176 – 0.0202)			
Lipid content (%) (RM 2 to RM 11)	4.20 (2.20 – 6.00)			
Lipid content (%) (Swan Island Lagoon)	3.5			
Moisture content (%) (RM 2 to RM 11)	74.8 (72.8 – 78.7)			
Moisture content (%) (Swan Island Lagoon)	75.0 (74.8 – 75.1)			
Exposure area (km)	1.61		Usually <1.61 km.	Integral et al. (2004)
Fraction of porewater ventilated	0.02 (0.01-0.03)		Some sediment surface feeding.	best professional judgment
Diet 1				
Insect larvae	66			Brown et al. (1995)
Juvenile fish	34			

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Diet 2				
Zooplankton	3			best professional judgment
Oligochaete	23			
Insect larvae	46			
Amphipod	23			
Juvenile fish	5			
Sucker, Largescale				
Weight (kg) (RM 2 to RM 11)	0.790 (0.748 – 0.864)			Round 1 tissue data
Weight (kg) (Swan Island Lagoon)	0.788			
Lipid content (%) (RM 2 to RM 11)	7.56 (5.4 – 8.7)			
Lipid content (%) (Swan Island Lagoon)	7.5			
Moisture content (%) (RM 2 to RM 11)	71.2 (69.7 – 73.4)			
Moisture content (%) (Swan Island Lagoon)	72			
Exposure area (km)	59.5		Most recaptured <0.81 km, although majority population considered to be transient.	Dauble (1986); Integral et al. (2004)
Fraction of porewater ventilated	0.08 (0.05-0.10)		Primarily rest on surfaces below water column.	best professional judgment

Table 4-3. Characteristics of species to be modeled

MODEL COMPONENT	VALUE – MEAN (range)	LOCALE OF DATA COLLECTION	NOTES	SOURCE
Diet 1				
Phytoplankton/algae	15			Jorgensen (1979), stomach contents (Integral et al. 2004, Attachment B8), best professional judgment
Zooplankton	15			
Clam	10			
Oligochaete	10			
Insect larvae	10			
Crayfish	30			
Sediment	10			
Diet 2				
Phytoplankton/algae	50			Jorgensen (1979), stomach contents (Integral et al. 2004, Attachment B8), best professional judgment
Zooplankton	15			
Clam	10			
Oligochaete	5			
Insect larvae	15			
Amphipod	5			
Juvenile Fish				
Weight (kg)	0.079			mean peamouth, sculpin, crappie, and chinook weights, minus 20%; best professional judgment

Table 4-3. Characteristics of species to be modeled

Model Component	**Value – Mean (range)**	**Locale of Data Collection**	**Notes**	**Source**
Lipid content (%)	4.79 (min = 2.2) min = min for juvenile chinook salmon		A lower number should be explored during uncertainty analysis (e.g., juvenile chinook salmon have 2.9% lipids).	mean of % lipids for peamouth, sculpin, crappie, and juvenile chinook salmon minus 10%; best professional judgment
Moisture content (%)	74			mean of % moisture for peamouth, sculpin, crappie, and juvenile chinook salmon; best professional judgment
Exposure area (km)	0.5			
Fraction of porewater ventilated	0.01 (0.0 – 0.02)			
Diet 1				
Phytoplankton/algae	15			best professional judgment
Zooplankton	30			
Oligochaete	5			
Insect larvae	33			
Amphipod	15			
Sediment	2			
Diet 2				
Phytoplankton/algae	10			best professional judgment
Zooplankton	50			
Insect larvae	30			

Table 4-3. Characteristics of species to be modeled

Model Component	**Value – Mean (range)**	**Locale of Data Collection**	**Notes**	**Source**
Amphipod	10			

Table 4-4. TrophicTrace model: Parameter values from site-specific data

MODEL COMPONENT	SYMBOL	UNIT	VALUE	NOTES	SOURCE
Biological					
Lipid content of phytoplankton	L_P	kg lipid/ kg ww	Table 4-3		Gobas et al. (1995)
Lipid content of zooplankton	L_Z	kg lipid/kg ww	Table 4-3		Gobas et al. (1995)
Lipid content of benthic invertebrates	L_B	kg lipid/kg ww	Table 4-3		Gobas et al. (1995)
Lipid content of fish	L_F	kg lipid/kg fish	Table 4-3	Entered as percent in model input, but converted to fraction in model equations.	Gobas (1993); Gobas et al. (1995)
Weight of the fish	V_F	kg ww	Table 4-3	Entered as grams in model input, but converted to kg in model equations.	Gobas (1993); Gobas et al. (1995)
Concentration in individual prey species	$C_{D,i}$	µg/kg ww			Gobas (1993); Gobas et al. (1995)
Fraction of the diet consisting of prey item *i*	P_i	fraction (add up to 1)	Table 4-3	Entered as percent in model input, but converted to fraction in model equations.	Gobas (1993); Gobas et al. (1995)
Environmental					
Dissolved organic carbon concentration in the water column (RM 2 to RM 11)	D_{OC}	mg/L	1.6 (0.8 – 4.8)	Entered as mg/L in model input, but converted in ng/L in most model equations. Derived from TOC value (ODEQ 2005) and $\chi DOC/\chi POC$ ratio from the Great Lakes (DOC = 80% of TOC) (Arnot and Gobas 2004).	TrophicTrace model framework – von Stackelberg and Burmistrova (2003)
Dissolved organic carbon concentration in the water column (Swan Island)	D_{OC}	mg/L	1.7 (0.8 – 3.2)	Entered as mg/L in model input, but converted in ng/L in most model equations. Derived from TOC value (ODEQ 2005) and $\chi DOC/\chi POC$ ratio from the Great Lakes (DOC = 80% of TOC) (Arnot and Gobas 2004).	TrophicTrace model framework – von Stackelberg and Burmistrova (2003)
Particulate organic carbon concentration in the water column (RM 2 to RM 11)	P_{OC}	mg/L	0.4 (0.2 – 1.2)	Entered as mg/L in model input, but converted in ng/L in most model equations. Derived from TOC value (ODEQ 2005) and $\chi DOC/\chi POC$ ratio from the Great Lakes (DOC = 80% of TOC) (Arnot and Gobas 2004).	TrophicTrace model framework – von Stackelberg and Burmistrova (2003)

Table 4-4. TrophicTrace model: Parameter values from site-specific data

Model Component	Symbol	Unit	Value	Notes	Source
Particulate organic carbon concentration in the water column (Swan Island)	P_{OC}	mg/L	0.42 (0.2 – 0.8)	Entered as mg/L in model input, but converted in ng/L in most model equations. Derived from TOC value (ODEQ 2005) and $\chi DOC/\chi POC$ ratio from the Great Lakes (DOC = 80% of TOC) (Arnot and Gobas 2004).	TrophicTrace model framework – von Stackelberg and Burmistrova (2003)
Total chemical concentration in the water column (total PCBs as congeners)	C_{WW}	ng/L	0.409 (0.229-0.609)	Integrated transects only, XAD filter plus column data, Round 2, Event 1, XAD data.	TrophicTrace model framework– von Stackelberg and Burmistrova (2003)
Total chemical concentration in the water column (4,4′-DDE)	C_{WW}	ng/L	0.023 (0.016-0.029)	Integrated transects only, XAD filter plus column data, Round 2, Event 1, XAD data. Water sample locations 5, 11, and 23.	TrophicTrace model framework – von Stackelberg and Burmistrova (2003)
4,4′-DDE adjusted for 4,4′-DDT contribution	C_{WW}	ng/L	0.03	Integrated transects only, XAD filter plus column data. Assume 4,4′-DDE conc. in water + metabolism fraction * 4,4′-DDT conc in water. This is to account for contribution of 4,4′-DDT to 4,4′-DDE using assumptions of 0.5 (average), 0.2 (min) or 1 (max) metabolic conversion to 4,4′-DDE.	TrophicTrace model framework – von Stackelberg and Burmistrova (2003)
Temperature of water column (RM 2 to RM 11)	T_W	°C	13.4 (5.3 – 24.5)	Parameter calculated from ODEQ data collected 1995-2005.	ODEQ (2005) SP&S bridge
Temperature of water column (Swan Island)	T_W	°C	13.7 (5.00 – 25.1)	Parameter calculated from ODEQ data.	ODEQ (2005) Swan Island Lagoon channel midpoint station 10801
Concentration of Total PCB (as Aroclors) in sediment (RM 2 to RM 11)	C_S	mg/kg dw	95.4	Spatially weighted average concentration calculated using inverse distance weighted (IDW) method. Arithmetic summary statistics: 170.2 (mean); 23.7 (geomean) (from 615 samples).	Round 1 and Round 2 sediment data
Concentration of Total PCB (as Aroclors) in sediment (Swan Island)	C_S	mg/kg dw	365.4	Spatially weighted average concentration calculated using inverse distance weighted (IDW) method. Arithmetic summary statistics: 296.7 (mean); 90.13 (geomean).	Round 1 and Round 2 sediment data
Concentration of 4,4′-DDE in sediment (RM 2 to RM 11)	C_S	mg/kg dw	3.48	Spatially weighted average concentration calculated using inverse distance weighted (IDW) method.	
Concentration of 4,4′-DDE (adjusted to include 4,4′-DDT) in	C_S	mg/kg dw	4.72	Multiplied ratio of geomeans of all DDE and DDT sediment samples (0.71) by AWA for 4,4′-DDE for	

Table 4-4. TrophicTrace model: Parameter values from site-specific data

MODEL COMPONENT	SYMBOL	UNIT	VALUE	NOTES	SOURCE
sediment (RM 2 to RM 11)				RM2-11. Multiplied result by 0.5 (average), 0.2, or 1 (min and max) to obtain estimate of 4,4′-DDT contribution (metabolic conversion of 4,4′-DDT to 4,4′-DDE). Added this result to 4,4′-DDE concentration.	
Concentration of 4,4′-DDE in sediment (Swan Island)	C_S	mg/kg dw	2.62		
Concentration of 4,4′-DDE (adjusted to include 4,4′-DDT) in sediment (Swan Island)	C_S	mg/kg dw	6.76	Multiplied ratio of geomeans of all DDE and DDT sediment samples (3.16) by AWA for 4,4′-DDE for Swan Island Lagoon. Multiplied result by 0.5 (average), 0.2, or 1 (min and max) to obtain estimate of 4,4′-DDT contribution (metabolic conversion of 4,4′-DDT to 4,4′-DDE). Added this results to 4,4′-DDE concentration.	
Fraction organic carbon in the sediment (RM 2 to RM 11)	F_{OC}	kg OC/ kg dw	1.84 (0.03-12)	Spatially weighted average concentration calculated using inverse distance weighted (IDW) method. Arithmetic summary statistics: 1.88 (mean); 1.37 (geomean).	TrophicTrace model framework – von Stackelberg and Burmistrova (2003)
Fraction organic carbon in the sediment (Swan Island Lagoon)	F_{OC}	kg OC/ kg dw	2.02 (0-4 %)	Spatially weighted average concentration calculated using inverse distance weighted (IDW) method. Arithmetic summary statistics: 1.86 (mean); 1.42 (geomean).	

Table 4-5. TrophicTrace model: Parameter values from literature data

MODEL COMPONENT	SYMBOL	UNIT	VALUE	NOTES	SOURCE
Biological					
Constant related to transport rate of the chemical in aqueous and lipid phases	A	unitless	5.3×10^{-8}		Gobas (1993)
Constant related to transport rate of the chemical in aqueous and lipid phases	B	unitless	2.3		Gobas (1993)
Environmental					
Density of organic carbon	DE_{OC}	mg/mg	0.41		TrophicTrace model, different from value in von Stackelberg and Burmistrova (2003)
Site use factor for fish	SUF	unitless	1.0	All fish modeled were assumed to be resident fish spending 100% of their time in the study area.	
Chemical					
Octanol-water partition coefficient (total PCBs as Aroclors)	Log K_{OW}	unitless	6.3	Concentration-weighted average of Aroclors 1242 (K_{OW}=5.6), 1254 (K_{OW}=6.5), and 1260 (K_{OW}=6.8). Other K_{OW}s may also be evaluated.	Phase 1 and 2 sediment data; EPA's Estimated Program Interface software (EPA 2003)
Octanol-water partition coefficient of the chemical (4,4′-DDE)	Log K_{OW}	unitless	6.76 (6.51)	6.51 is an alternate value.	MDEQ (2004) (6.76); ATSDR (2003) (6.51); Mackay et al. (1992)(5.7)
Biota Sediment Accumulation Factor (total PCBs)	BSAF	unitless	3.7 (0.9, 1.6, 1.9)	Guild weighted mean (raw geometric mean, guild weighted geometric mean, raw average).	USACE BSAF database (USACE 2004) and ORNL BSAF compilation (ORNL 1998)
Biota Sediment Accumulation Factor (DDE)	BSAF	unitless	6.2 (1.3, 2.2)	Raw average (average *Macoma* sp., raw geometric mean).	USACE BSAF database (USACE 2004)

Table 4-6. Invertebrate BSAFs for total PCBs

Guild	Freshwater or Marine	Average BSAF	Number of Values	BSAF Source
Crustacean	freshwater	8.17	3	USACE (2004)
Modeled infauna	freshwater	9.02	1	ORNL (1998)
Mollusc	marine	1.83	13	USACE (2004)
Nemertean	marine	0.12	1	USACE (2004)
Oligochaete	freshwater	0.86	21	USACE (2004)
Polychaete	marine	0.14	3	USACE (2004)
Zooplankton	freshwater	4.96	1	USACE (2004)
Worms	freshwater	4.46	1	USACE (2004)
Guild average		**3.70**		

Table 4-7. Invertebrate BSAFs for 4,4′-DDE

Organism	Guild	BSAF	BSAF Source
Macoma	mollusc	2.8	USACE (2004)
Macoma	mollusc	0.72	USACE (2004)
Macoma	mollusc	1.26	USACE (2004)
Macoma	mollusc	1.06	USACE (2004)
Macoma	mollusc	0.65	USACE (2004)
Macoma	mollusc	1.08	USACE (2004)
Burrowing crab	crustacean	10	USACE (2004)
Burrowing crab	crustacean	32	USACE (2004)
Raw average		**6.20**	

Table 4-8. Chemical concentrations in fish and invertebrate species to be used to evaluate model output

Chemical (spatial scale)	Tissue Concentration (µg/kg ww)		No. of Composite Samples	Notes
	Arithmetic Mean, Geometric Mean	Range		
Clam				
Total PCBs (RM 2 to RM 11)	86.3, 83.0	62 – 120	3	Round 1 data
4,4′-DDE (RM 2 to RM 11)	42.7, 26.4	7.5 – 94.5	3	Round 1 data
Crayfish				
Total PCBs (RM 2 to RM 11)	30, 8.1	1.7 – 280	27	Round 1 data
4, 4′-DDE (RM 2 to RM 11)	6.3, 4.4	1.6 – 51	27	Round 1 data
Total PCBs (Swan Island Lagoon)	46, 45.9	43 – 49	3	Round 1 data
4, 4′-DDE (Swan Island Lagoon)	2.3, 2.2	1.6 – 3.4	3	Round 1 data
Bass, Smallmouth				
Total PCBs (RM 2 to RM 11)	1,113, 714	90 – 4,500	14	Round 1 data
4, 4′-DDE (RM 2 to RM 11)	132, 124	53 – 220	14	Round 1 data
Total PCBs (Swan Island Lagoon)	2,933, 2,458	1,000 – 4,500	3	Round 1 data
4, 4′-DDE (Swan Island Lagoon)	75.7, 73.7	53 – 92.5	3	Round 1 data
Bullhead, Brown				
Total PCBs (RM 2 to RM 11)	404, 193	67 – 1,700	6	Round 1 data
4, 4′-DDE (RM 2 to RM 11)	47, 45	30 – 70	6	Round 1 data
Total PCBs (Swan Island Lagoon)	715, 411	130 – 1,700	3	Round 1 data
4, 4′-DDE (Swan Island Lagoon)	46.8, 44.9	29.5 – 58	3	Round 1 data
Carp, Common				
Total PCBs (RM 2 to RM 11)	1638, 837	230 – 6,500	6	Round 1 data
4, 4′-DDE (RM 2 to RM 11)	135, 125	81 – 260	6	Round 1 data
Total PCBs (Swan Island Lagoon)	933, 915	690 – 1,100	3	Round 1 data
4, 4′-DDE (Swan Island Lagoon)	122, 120	91.5 – 145	3	Round 1 data

Table 4-8. Chemical concentrations in fish and invertebrate species to be used to evaluate model output

CHEMICAL (spatial scale)	TISSUE CONCENTRATION (µg/kg ww)		NO. OF COMPOSITE SAMPLES	NOTES
	ARITHMETIC MEAN, GEOMETRIC MEAN	RANGE		
Crappie, Black				
Total PCBs (RM 2 to RM 11)	134, 120	85 – 250	4	Round 1 data
4,4′-DDE (RM 2 to RM 11)	56, 53	37 – 81	4	Round 1 data
Total PCBs (Swan Island Lagoon)	180, 165	109 – 250	2	Round 1 data
4,4′-DDE (Swan Island Lagoon)	73.8, 73.4	67 – 80.5	2	Round 1 data
Peamouth				
Total PCBs (RM 2 to RM 11)	187, 179	138 – 290	4	Round 1 data
4, 4′-DDE (RM 2 to RM 11)	132, 129	109 – 185	4	Round 1 data
Total PCBs (Swan Island Lagoon)	138, NA	NA	1	Round 1 data
4, 4′-DDE (Swan Island Lagoon)	125, NA	NA	1	Round 1 data
Pikeminnow, Northern				
Total PCBs (RM 2 to RM 11)	833, 721	370 – 1,800	6	Round 1 data
4, 4′-DDE (RM 2 to RM 11)	252, 213	82 – 545	6	Round 1 data
Total PCBs (Swan Island Lagoon)	670, NA	NA	1	Round 1 data
4, 4′-DDE (Swan Island Lagoon)	82, NA	NA	1	Round 1 data
Salmon, Chinook (juvenile)				
Total PCBs (RM 2 to RM 11)	56, 51	30 – 100	6	Round 1 data
4, 4′-DDE (RM 2 to RM 11)	21, 21	19 – 24	6	Round 1 data
Sculpin				
Total PCBs (RM 2 to RM 11)	562, 318	62 – 3,360	26	Round 1 data
4, 4′-DDE (RM 2 to RM 11)	56, 24	11 – 630	26	Round 1 data
Total PCBs (Swan Island Lagoon)	495, 495	480 – 510	2	Round 1 data
4, 4′-DDE (Swan Island Lagoon)	21, 20.8	18 – 24	2	Round 1 data

Table 4-8. Chemical concentrations in fish and invertebrate species to be used to evaluate model output

CHEMICAL (spatial scale)	TISSUE CONCENTRATION (µg/kg ww)		NO. OF COMPOSITE SAMPLES	NOTES
	ARITHMETIC MEAN, GEOMETRIC MEAN	RANGE		
Sucker, Largescale				
Total PCBs (RM 2 to RM 11)	819, 529	95 – 2,020	6	Round 1 data
4, 4′-DDE (RM 2 to RM 11)	121, 116	79 – 185	6	Round 1 data
Total PCBs (Swan Island Lagoon)	320, NA	NA	1	Round 1 data
4, 4′-DDE (Swan Island Lagoon)	185, NA	NA	1	Round 1 data

NA– not available

Table 4-9. Arnot and Gobas model scenarios: Total PCBs

RUN NAME	DIET	FRACTION OF POREWATER VENTILATED
AG-RM2-11-PCB-1a AG-SI-PCB-1a	1	mean
AG-RM2-11-PCB-1b AG-SI-PCB-1b	1	minimum
AG-RM2-11-PCB-1c AG-SI-PCB-1c	1	maximum
AG-RM2-11-PCB-2a AG-SI-PCB-2a	2	mean
AG-RM2-11-PCB-2b AG-SI-PCB-2b	2	minimum
AG-RM2-11-PCB-2c AG-SI-PCB-2c	2	maximum

AG – Arnot and Gobas
RM2-11 – RM 2 to RM 11
SI – Swan Island
PCB – chemical modeled
alphanumeric code – scenario run

Table 4-10. Arnot and Gobas model scenarios: 4,4′-DDE

Run Name	Diet	LOG_{10} K_{OW}	Fraction of Porewater Ventilated
AG-RM2-11-DDE-1a AG-SI-DDE-1a	1	6.76	mean
AG-RM2-11-DDE-1b AG-SI-DDE-1b	1	6.76	minimum
AG-RM2-11-DDE-1c AG-SI-DDE-1c	1	6.76	maximum
AG-RM2-11-DDE-1d AG-SI-DDE-1d	1	6.51	mean
AG-RM2-11-DDE-1e AG-SI-DDE-1e	1	6.51	minimum
AG-RM2-11-DDE-1f AG-SI-DDE-1f	1	6.51	maximum
AG-RM2-11-DDE-1g AG-SI-DDE-1g	1	5.7	mean
AG-RM2-11-DDE-1h AG-SI-DDE-1h	1	5.7	minimum
AG-RM2-11-DDE-1i AG-SI-DDE-1i	1	5.7	maximum
AG-RM2-11-DDE-2a AG-SI-DDE-2a	2	6.76	mean
AG-RM2-11-DDE-2b AG-SI-DDE-2b	2	6.76	minimum
AG-RM2-11-DDE-2c AG-SI-DDE-2c	2	6.76	maximum
AG-RM2-11-DDE-2d AG-SI-DDE-2d	2	6.51	mean
AG-RM2-11-DDE-2e AG-SI-DDE-2e	2	6.51	minimum
AG-RM2-11-DDE-2f AG-SI-DDE-2f	2	6.51	maximum
AG-RM2-11-DDE-2g AG-SI-DDE-2g	2	5.7	mean
AG-RM2-11-DDE-2h AG-SI-DDE-2h	2	5.7	minimum
AG-RM2-11-DDE-2i AG-SI-DDE-2i	2	5.7	maximum

AG – Arnot and Gobas
RM2-11 – RM 2 to RM 11
SI – Swan Island
DDE (4,4′-DDE) – chemical modeled
alphanumeric code – scenario run.

Table 4-11. TrophicTrace model scenarios: Total PCBs

RUN NAME	DIET	BSAF
TT-RM2-11-PCB-1a TT-SI-PCB-1a	1	3.7 (average, all invertebrates weighted by guild)
TT-RM2-11-PCB-1b TT-SI-PCB-1b	1	1.6 (geomean, all invertebrates weighted by guild)
TT-RM2-11-PCB-1c TT-SI-PCB-1c	1	1.9 (average, all invertebrates NOT weighted by guild)
TT-RM2-11-PCB-1d TT-SI-PCB-1d	1	0.9 (geomean, all invertebrates NOT weighted by guild)
TT-RM2-11-PCB-2a TT-SI-PCB-2a	2	3.7 (average, all invertebrates weighted by guild)
TT-RM2-11-PCB-2b TT-SI-PCB-2b	2	1.6 (geomean, all invertebrates weighted by guild)
TT-RM2-11-PCB-2c TT-SI-PCB-2c	2	1.9 (average, all invertebrates NOT weighted by guild)
TT-RM2-11-PCB-2d TT-SI-PCB-2d	2	0.9 (geomean, all invertebrates NOT weighted by guild)

TT – TrophicTrace
RM 2-11– RM 2 to RM 11
SI – Swan Island
PCB – chemical modeled
alphanumeric code – scenario run

Table 4-12. TrophicTrace model scenarios: 4,4′-DDE

Run Name	Diet	$\log_{10} K_{OW}$	BSAF
TT-RM2-11-DDE-1a TT-SI-DDE-1a	1	6.76	2.2 (geomean, no weighting by species)
TT-RM2-11-DDE-1b TT-SI-DDE-1b	1	6.76	6.2 (average, no weighting by species)
TT-RM2-11-DDE-1c TT-SI-DDE-1c	1	6.76	1.3 (average, *Macoma* sp.)
TT-RM2-11-DDE-1d TT-SI-DDE-1d	1	6.51	2.2 (geomean, no weighting by species)
TT-RM2-11-DDE-1e TT-SI-DDE-1e	1	6.51	6.2 (average, no weighting by species)
TT-RM2-11-DDE-1f TT-SI-DDE-1f	1	6.51	1.3 (average, *Macoma* sp.)
TT-RM2-11-DDE-1g TT-SI-DDE-1g	1	5.7	2.2 (geomean, no weighting by species)
TT-RM2-11-DDE-1h TT-SI-DDE-1h	1	5.7	6.2 (average, no weighting by species)
TT-RM2-11-DDE-1i TT-SI-DDE-1i	1	5.7	1.3 (average, *Macoma* sp.)
TT-RM2-11-DDE-2a TT-SI-DDE-2a	2	6.76	2.2 (geomean no weighting by species)
TT-RM2-11-DDE-2b TT-SI-DDE-2b	2	6.76	6.2 (average, no weighting by species)
TT-RM2-11-DDE-2c TT-SI-DDE-2c	2	6.76	1.3 (average, *Macoma* sp.)
TT-RM2-11-DDE-2d TT-SI-DDE-2d	2	6.51	2.2 (geomean, no weighting by species)
TT-RM2-11-DDE-2e TT-SI-DDE-2	2	6.51	6.2 (average, no weighting by species)
TT-RM2-11-DDE-2f TT-SI-DDE-2f	2	6.51	1.3 (average, *Macoma* sp.)
TT-RM2-11-DDE-2g TT-SI-DDE-2g	2	5.7	2.2 (geomean, no weighting by species)
TT-RM2-11-DDE-2h TT-SI-DDE-2h	2	5.7	6.2 (average, no weighting by species)
TT-RM2-11-DDE-2i TT-SI-DDE-2i	2	5.7	1.3 (average, *Macoma* sp.)

TT – TrophicTrace
RM 2-11 – RM 2 to RM 11
SI – Swan Island
DDE (4,4′-DDE) – chemical modeled
alphanumeric code – scenario run

Table 4-13. Sensitivity run: Biota input, RM 2 to RM 11

Organism	Fraction of Porewater Ventilated		Lipids		% Moisture		Weight (kg)	
	Initial	50% Decrease	Initial	50% Decrease	Initial	50% Decrease	Initial	50% Decrease
Phytoplankton/plants	0	NA	0.00123	0.000615	0.955	0.4775	NA	NA
Zooplankton	0	NA	0.01	0.005	0.9	0.45	0.00000014	0.00000007
Clam	0.05	0.025	0.0118	0.0059	0.88	0.44	0.0005	0.00025
Oligochaete	0.05	0.025	0.01	0.005	0.8	0.4	0.0000014	0.0000007
Insect larvae	0.05	0.025	0.012	0.006	0.8	0.4	0.00000533	0.00000266
Amphipod	0.05	0.025	0.008	0.004	0.8	0.4	0.000006	0.000003
Crayfish	0.02	0.01	0.00781	0.003905	0.735	0.3675	0.043	0.0215
Juvenile fish	0.01	0.005	0.0479	0.02395	0.74	0.37	0.079	0.0395
Carp	0.08	0.04	0.0788	0.0394	0.705	0.3525	2.33	1.165
Sucker, largescale	0.08	0.04	0.0756	0.0378	0.712	0.356	0.79	0.395
Salmon, chinook (juvenile)	0	0	0.029	0.0145	0.783	0.3915	0.012	0.006
Peamouth	0	NA	0.0893	0.04465	0.702	0.351	0.105	0.0525
Sculpin	0.02	0.01	0.042	0.021	0.748	0.374	0.019	0.0095
Bass, smallmouth	0	NA	0.0543	0.02715	0.702	0.351	0.462	0.231
Bullhead, brown	0.005	0.0025	0.0243	0.01215	0.761	0.3805	0.243	0.1215
Crappie, black	0.005	0.0025	0.0526	0.0263	0.724	0.362	0.218	0.109
Pikeminnow, northern	0	NA	0.0525	0.02625	0.719	0.3595	0.557	0.2785

NA – not applicable

Table 4-14. Sensitivity run: Biota input, Swan Island

ORGANISM	LIPIDS		% MOISTURE		WEIGHT (kg)	
	INITIAL	50% DECREASE	INITIAL	50% DECREASE	INITIAL	50% DECREASE
Phytoplankton/plants	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	NA	NA
Zooplankton	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13
Clam	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13
Oligochaete	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13
Insect larvae	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13
Amphipod	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13
Crayfish	0.0074	0.0037	0.736	0.368	0.0414	0.0207
Juvenile fish	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13
Carp	0.0843	0.04215	0.698	0.349	2.22	1.11
Sucker, largescale	0.075	0.0375	0.72	0.36	0.788	0.394
Salmon, chinook (juvenile)	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13	see Table 4-13
Peamouth	0.102	0.051	0.697	0.3485	0.08	0.04
Sculpin	0.035	0.0175	0.75	0.375	0.019	0.0095
Crappie, black	0.07	0.035	0.712	0.356	0.253	0.1265
Bullhead, brown	0.0263	0.01315	0.759	0.3795	0.248	0.124
Bass, smallmouth	0.057	0.0285	0.696	0.348	0.289	0.1445
Pikeminnow, northern	0.058	0.029	0.684	0.342	0.453	0.2265

NA – not applicable

Table 4-15. Dietary absorption efficiency for modeled organisms

Modeled Organism	**Absorption Efficiency**	
	Initial	**50% Decrease**
Fish, lipids	92%	46.0%
Fish, non-lipid organic matter	55%	27.5%
Fish, water	25%	12.5%
Invertebrates, lipids	75%	37.5%
Invertebrates, non-lipid organic matter	75%	37.5%
Invertebrates, water	25%	12.5%
Zooplankton, lipids	72%	36.0%
Zooplankton, non-lipid organic matter	72%	36.0%
Zooplankton, water	25%	12.5%

Table 4-16. Results for sensitivity analysis Arnot and Gobas, K_{OW} 5.5, RM 2 to RM 11

Sensitivity Run (50% decrease unless otherwise indicated)	**Initial Value**	New **Value**	**Mean % Change in Predicted Concentrations**	**Species with Max % Change**	**Max % Change**	**Species with Min % Change**	**Min % Change**
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	Table 4-15	Table 4-15	-28.4%	bass, smallmouth	-68.5%	PH	0%
Biota lipids	Table 4-13	Table 4-13	-44.6%	bass, smallmouth	-69.2%	PH	0%
Log K_{OW} (50% decrease)	5.5	5.20	-55.2%	bass, smallmouth	-74.2%	PH	15.8%
PCB sediment concentration	95.4	47.7	-28.4%	amphipod	-43.6%	PH and Z	0%
% moisture (same as "non-lipid organic matter")	Table 4-13	Table 4-13	56.8%	crayfish	136.4%	PH	0%
Dissolved oxygen	9.74	4.87	-35.1%	bass, smallmouth	-59.5%	PH	0%
Sediment organic carbon	1.84	0.92	4.5%	sucker, largescale	10.9%	PH and Z	0%
Water temperature	13.4	6.70	-18.8%	bass, smallmouth	-34.3%	PH	0%
PCB water concentration	0.409	0.205	-21.6%	PH and Z	-49.9%	amphipod	-6.4%
Log K_{OW} (50% increase)	5.5	5.68	66.1%	bass, smallmouth	118.5%	PH	5.1%
Concentration of suspended solids	1.14 E-05	5.7 E-06	-9.5%	insect larvae	-33.8%	PH, Z, O, and amphipod	0%
Dissolved and particulate organic carbon (combined)	See DOC and POC in this table	See DOC and POC in this table	1.3%	PH and Z	3.0%	amphipod	0.4%
Particulate organic carbon	4.0E-07	2.0E-07	0.9%	PH and Z	2.1%	oligochaete, amphipod	0.3%
Biota weight	Table 4-13	Table 4-13	-9.7%	bass, smallmouth	-17.8%	PH	0%
Dissolved organic carbon	1.60 E-06	8.0 E-07	0.4%	PH and Z	0.8%	oligochaete, amphipod	0.1%
Fraction of porewater ventilated	Table 4-13	Table 4-13	-0.04%	clam	-0.08%	PH and Z	0%

Table 4-17. Results for sensitivity analysis, Arnot and Gobas, K_{OW} 6.5, RM 2 to RM 11

Sensitivity Run (50% decrease unless otherwise indicated)	**Initial Value**	**New Value**	**Mean % Change in Predicted Concentrations**	**Species with Max % Change**	**Max % Change**	**Species with Min % Change**	**Min % Change**
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	Table 4-13	Table 4-13	-54.3%	bass, smallmouth	-91.2%	PH	0%
Biota lipids	Table 4-13	Table 4-13	-44.3%	bass, smallmouth	-68.2%	PH	0%
Log K_{OW} (50% decrease)	6.5	6.20	-32.5%	salmon, chinook (juvenile)	-46.0%	PH	20.2%
PCB sediment concentration	95.4	47.7	-31.9%	amphipod	-44.0%	PH and Z	0%
% moisture (same as "non-lipid organic matter")	Table 4-13	Table 4-13	28.9%	crayfish	98.2%	PH	0%
Dissolved oxygen	9.74	4.87	-24.4%	bass, smallmouth	-41.7%	PH	0%
Sediment organic carbon	1.84	0.92	19.7%	sucker, largescale	36.3%	PH and Z	0%
Water temperature	13.4	6.70	-18.4%	bass, smallmouth	-34.7%	PH	0%
PCB water concentration	0.409	0.205	-18.0%	PH and Z	-49.9%	amphipod	-6.0%
Log K_{OW} (50% increase)	6.5	6.68	15.7%	salmon, chinook (juvenile)	24.3%	carp	8.1%
Concentration of suspended solids	1.14E-05	5.70E-06	-10.7%	insect larvae	-27.6%	PH and Z	0%
Dissolved and particulate organic carbon (combined)	See DOC and POC in this table	see DOC and POC in this table	8.5%	PH and Z	23.7%	amphipod	2.8%
Particulate organic carbon	4.0E-07	2.00E-07	5.7%	PH and Z	15.8%	amphipod	1.9%
Biota weight	Table 4-13	Table 4-13	-5.9%	bass, smallmouth	-10.5%	PH	0%
Dissolved organic carbon	1.60E-06	8.00E-07	2.1%	PH and Z	5.8%	amphipod	0.7%
Fraction of porewater ventilated	Table 4-13	Table 4-13	0.36%	bass, smallmouth	0.65%	PH	0%

PH – phytoplankton
Z – zooplankton

Table 4-18. Results for sensitivity analysis, Arnot and Gobas, K_{OW} 7.5, RM 2 to RM 11

Sensitivity Run (50% decrease unless otherwise indicated)	Initial Value	New Value	Mean % Change in Predicted Concentrations	Species with Max % Change	Max % Change	Species with Min % Change	Min % Change
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	Table 4-13	Table 4-13	-54.2%	bass, smallmouth	-87.2%	PH	0%
Biota lipids	Table 4-13	Table 4-13	-34.1%	bass, smallmouth	-51.5%	PH	0%
Log K_{OW} (50% decrease) (same increase for K_{OC}, calculated from K_{OW})	7.5	7.20	39.8%	bass, smallmouth	89.1%	Z	0.7%
PCB sediment concentration	95.4	47.7	-33.2%	amphipod	-44.7%	PH and Z	0%
% moisture (same as "non-lipid organic matter")	Table 4-13	Table 4-13	21.0%	amphipod	73.1%	PH	0%
Dissolved oxygen	9.74	4.87	-1.5%	clam (*Corbicula*)	22.7%	PH	0%
Sediment organic carbon	1.84	0.92	26.2%	amphipod	44.9%	PH and Z	0%
Water temperature	13.4	6.70	-24.6%	bass, smallmouth	-47.9%	PH	0%
PCB water concentration	0.409	0.205	-16.8%	PH and Z	-49.9%	amphipod	-5.3%
Log K_{OW} (50% increase) (same increase for K_{OC}, calculated from K_{OW})	7.5	7.68	-23.9%	bass, smallmouth	-43.2%	amphipod	-3.9%
Concentration of suspended solids	1.14E-05	5.70E-06	-10.2%	clam (*Corbicula*)	-26.2%	PH and Z	0%
Dissolved and particulate organic carbon (combined)	see DOC and POC in this table	see DOC and POC in this table	25.4%	PH and Z	75.6%	amphipod	8.0%
Particulate organic carbon	4.0E-07	2.00E-07	14.9%	PH and Z	44.4%	amphipod	4.7%
Biota weight	Table 4-13	Table 4-13	-2.2%	bass, smallmouth	-5.2%	PH	0%
Dissolved organic carbon	1.60E-06	8.00E-07	4.7%	PH and Z	14.0%	amphipod	1.5%
Fraction of porewater ventilated	Table 4-13	Table 4-13	0.37%	clam (*Corbicula*)	0.67%	PH and Z	0%

PH – phytoplankton
Z – zooplankton

Table 4-19. Sensitivity for Arnot and Gobas model, K_{OW} 5.5, Swan Island Lagoon

SENSITIVITY RUN (50% decrease unless otherwise indicated)	INITIAL VALUE	NEW VALUE	MEAN % CHANGE IN PREDICTED CONCENTRATIONS	SPECIES WITH MAX % CHANGE	MAX % CHANGE	SPECIES WITH MIN % CHANGE	MIN % CHANGE
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	Table 4-14	Table 4-14	-53.7%	bass, smallmouth	-84.7%	PH	0%
Biota lipids	Table 4-14	Table 4-14	-51.9%	juvenile fish	-84.3%	PH	0%
log K_{OW} (50% decrease)	5.5	5.20	-42.3%	bass, smallmouth	-66.4%	insect larvae	0%
PCB sediment concentration	365.4	182.7	-43.1%	insect larvae	-50.0%	PH, Z	0%
% moisture (same as "non-lipid organic matter")	Table 4-14	Table 4-14	72.6%	crayfish	170.7%	PH	0%
Dissolved oxygen	8.9	4.45	-39.0%	bass, smallmouth	-67.1%	clam (*Corbicula* sp.), insect larvae	0%
Sediment organic carbon	2.02	1.01	69.8%	insect larvae	99.0%	PH, Z	0%
Water temperature	13.7	6.85	-20.2%	bass, smallmouth	-37.9%	clam (*Corbicula* sp.), insect larvae, PH	0%
PCB water concentration	0.409	0.205	-6.9%	PH, Z	-49.9%	insect larvae	0%
Log K_{OW} (50% increase)	5.5	5.68	40.4%	bass, smallmouth	79.1%	clam (*Corbicula* sp.), insect larvae	0%
Concentration of suspended solids	0.078	0.039	-0.2%	clam (*Corbicula* sp.), insect larvae	-0.3%	amphipod, oligochaete	0%
Dissolved and particulate organic carbon (combined)	see DOC and POC in this table	see DOC and POC in this table	0.4%	PH, Z	3.2%	clam (*Corbicula* sp.), insect larvae, bullhead	0%
Particulate organic carbon	4.2E-07	2.10E-07	0.3%	PH, Z	2.2%	clam (*Corbicula* sp.), insect larvae, crayfish, sucker, pikeminnow	0%

Table 4-19. Sensitivity for Arnot and Gobas model, K_{OW} 5.5, Swan Island Lagoon

Sensitivity Run (50% decrease unless otherwise indicated)	**Initial Value**	**New Value**	**Mean % Change in Predicted Concentrations**	**Species with Max % Change**	**Max % Change**	**Species with Min % Change**	**Min % Change**
Biota weight	Table 4-14	Table 4-14	-10.2%	bass, smallmouth	-19.2%	clam (*Corbicula* sp.), insect larvae, PH	0%
Dissolved organic carbon	1.70E-06	8.50E-07	0.1%	PH, Z	0.9%	all other organisms	0%
Fraction of porewater ventilated	Table 4-14	Table 4-14	-0.07%	oligochaete	-0.33%	clam (*Corbicula* sp.), insect larvae, PH, Z	0%

PH – phytoplankton
Z – zooplankton

Table 4-20. Sensitivity for Arnot and Gobas model, K_{OW} 6.5, Swan Island Lagoon

Sensitivity Run (50% decrease unless otherwise indicated)	Initial Value	New Value	Mean % Change in Predicted Concentrations	Species with Max % Change	Max % Change	Species with Min % Change	Min % Change
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	Table 4-14	Table 4-14	-64.4%	bass, smallmouth	-94.3%	PH	0%
Biota lipids	Table 4-14	Table 4-14	-50.3%	juvenile fish	-80.9%	PH	0%
log K_{OW} (50% decrease)	6.5	6.20	-19.0%	Z	-34.9%	clam (*Corbicula* sp.), insect larvae	0%
PCB sediment concentration	365.4	182.7	-42.9%	insect larvae	-50.0%	PH, Z	0%
% moisture (same as "non-lipid organic matter")	Table 4-14	Table 4-14	32.8%	crayfish	106.6%	PH	0%
Dissolved oxygen	8.9	4.45	-26.2%	salmon, chinook (juvenile)	-44.4%	clam (*Corbicula* sp.), insect larvae, PH	0%
Sediment organic carbon	2.02	1.01	71.5%	sucker, largescale	101.8%	PH, Z	0%
Water temperature	13.7	6.85	-18.4%	crappie, black	-34.5%	clam (*Corbicula* sp.), insect larvae, PH	0%
PCB water concentration	0.409	0.205	-7.1%	PH, Z	-49.9%	insect larvae	0%
Log K_{OW} (50% increase)	6.5	6.68	6.6%	Z	21.3%	clam (*Corbicula* sp.), insect larvae	0%
Concentration of suspended solids	0.078	0.039	0.0%	All	0.0%	All	0%
Dissolved and particulate organic carbon (combined)	see DOC and POC in this table	see DOC and POC in this table	3.5%	PH, Z	24.6%	insect larvae	0%
Particulate organic carbon	4.2E-07	2.10E-07	2.3%	PH, Z	16.4%	clam (*Corbicula* sp.), insect larvae	0%
Biota weight	Table 4-14	Table 4-14	-6.1%	salmon, chinook (juvenile)	-10.7%	clam (*Corbicula* sp.), PH	0%
Dissolved organic carbon	1.70E-06	8.50E-07	0.9%	PH, Z	6.0%	clam (*Corbicula* sp.), insect larvae	0%
Fraction of porewater ventilated	Table 4-14	Table 4-14	0.01%	oligochaete	0.04%	clam (*Corbicula* sp.), PH, Z, insect larvae	0%

PH – phytoplankton Z – zooplankton

Table 4-21. Sensitivity for Arnot and Gobas model, K_{OW} 7.5, Swan Island Lagoon

Sensitivity Run (50% decrease unless otherwise indicated)	Initial Value	New Value	Mean % Change in Predicted Concentrations	Species with Max % Change	Max % Change	Species with Min % Change	Min % Change
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	Table 4-14	Table 4-14b	-63.2%	bass, smallmouth	-91.3%	PH	0%
Biota lipids	Table 4-14	Table 4-14	-41.9%	juvenile fish	-69.1%	PH	0%
log K_{OW} (50% decrease) (same increase for K_{OC}, calculated from K_{OW})	7.5	7.20	35.2%	crappie, black	79.6%	insect larvae	0%
PCB sediment concentration	365.4	182.7	-43.0%	clam (*Corbicula* sp.)	-50.0%	PH and Z	0%
% moisture (same as "non-lipid organic matter")	Table 4-14	Table 4-14	34.6%	clam (*Corbicula* sp.)	87.8%	PH	0%
Dissolved oxygen	8.9	4.45	-10.5%	oligochaete	-18.9%	clam (*Corbicula* sp.), insect larvae, and PH	0%
sediment organic carbon	2.02	1.01	71.7%	insect larvae	99.5%	PH and Z	0%
Water temperature	13.7	6.85	-23.7%	bass, smallmouth	-46.5%	clam (*Corbicula* sp.), insect larvae, and PH	0%
PCB water concentration	0.409	0.205	-7.0%	PH and Z	-49.9%	clam (*Corbicula* sp.) and insect larvae	0%
log K_{OW} (50% increase) (same increase for K_{OC}, calculated from K_{OW})	7.5	7.68	-20.1%	bass, smallmouth	-38.4%	clam (*Corbicula* sp.) and insect larvae	0%
Concentration of suspended solids	0.078	0.039	0.0%	all	0.0%	All	0%
dissolved and particulate organic carbon (combined)	see DOC and POC in this table	see DOC and POC in this table	10.8%	PH and Z	76.6%	clam (*Corbicula* sp.) and insect larvae	0%
Particulate organic carbon	4.2E-07	2.10E-07	6.3%	PH and Z	44.6%	clam (*Corbicula* sp.) and insect larvae	0%
Biota weight	Table 4-14	Table 4-14	-3.7%	bass, smallmouth	-6.9%	clam (*Corbicula* sp.) and PH	0%
Dissolved organic carbon	1.70E-06	8.50E-07	2.0%	PH and Z	14.3%	clam (*Corbicula* sp.)	0%
Fraction of porewater ventilated	Table 4-14	Table 4-14	0.02%	oligochaete	0.07%	clam (*Corbicula* sp.), PH, insect larvae, and Z	0%

PH – phytoplankton Z - zooplankton

Table 4-22. Sensitivity for TrophicTrace model, K_{OW} 5.5, RM 2 to RM 11

SENSITIVITY RUN (50% decrease unless otherwise indicated)	INITIAL VALUE	NEW VALUE	MEAN % CHANGE IN PREDICTED CONCENTRATIONS	SPECIES WITH MAX % CHANGE	MAX % CHANGE	SPECIES WITH MIN % CHANGE	MIN % CHANGE
Biota weight	Table 4-14	Table 4-14	-4.9%	smallmouth bass	-11.6%	plankton and inverts	0%
Biota lipids	Table 4-14	Table 4-14	-54.8%	chinook	-66.0%	largescale sucker	-40%
Dissolved organic carbon (mg/L)	1.60E-06	8.00E-07	0.3%	water plankton and inverts	0.9%	sediment inverts (3)	0%
Water temperature	13.4	6.7	18.3%	smallmouth bass	61.3%	plankton and inverts	0%
K_{OW} (50% increase)	5.5	5.676	23.6%	water plankton and inverts	48.7%	sediment inverts (3)	0%
Corresponding K_{OC} (based on Arnot formula)	5.044	5.220					
K_{OW} (50% decrease)	5.5	5.199	-30.8%	water plankton and inverts	-49.6%	sediment inverts (3)	0%
Corresponding K_{OC} (based on Arnot formula)	5.044	4.743					
K_{OC} (50% decrease from K_{OW}=5.5)	5.044	4.743	0.3%	water plankton and inverts	0.9%	sediment inverts (3)	0%
K_{OC} (50% increase from K_{OW}=5.5)	5.044	5.220	-0.3%	water plankton and inverts	-0.9%	sediment inverts (3)	0%
Particulate organic carbon (mg/L)	4.0E-07	2.00E-07	0.0%	water plankton and inverts	0.0%	sediment inverts (3)	0%
Sediment organic carbon (%)	1.84	0.92	61.4%	sediment inverts (3)	100.0%	water plankton and inverts	0%
dissolved and particulate organic carbon (combined)	see DOC and POC in this table	see DOC and POC in this table	0.3%	water plankton and inverts	0.9%	sediment inverts (3)	0%
PCB sediment concentration (ng/L)	95.4	47.7	-34.3%	sediment inverts (3)	-50.0%	water plankton and inverts	0%
PCB water concentration (ng/L)	0.409	0.205	-15.7%	water plankton and inverts	-50.0%	sediment inverts (3)	0%
BSAF	3.5	1.8	-34.3%	sediment inverts (3)	-50.0%	water plankton and inverts	0%

Table 4-23. Sensitivity for TrophicTrace model, K_{OW} 6.5, RM 2 to RM 11

Sensitivity run (50% decrease unless otherwise indicated)	Initial Value	New Value	Mean % Change in Predicted Concentrations	Species with Max % Change	Max % Change	Species with Min % Change	Min % Change
Biota weight	Table 4-13	Table 4-13	-2.0%	smallmouth bass	-5.0%	invertebrates	0%
Biota lipids	Table 4-13	Table 4-13	-47.1%	bullhead	-52.6%	sucker	-30.1%
Dissolved organic carbon (mg/L)	1.60E-06	8.00E-07	3.0%	water plankton and invertebrates (2)	8.1%	sediment invertebrates	0%
Water temperature	13.4	6.7	89.2%	smallmouth bass	323.3%	all invertebrates	0%
K_{OW} (50% increase)	6.5	6.676	12.6%	water plankton and invertebrates (2)	39.5%	sediment invertebrates	0%
Corresponding K_{OC} (based on Arnot formula)	6.044	6.220		carp	-0.7%	—	0%
K_{OW} (50% decrease)	6.5	6.199	-17.4%	water plankton and invertebrates (2)	-45.9%	sediment invertebrates	0%
Corresponding K_{OC} (based on Arnot formula)	6.044	5.743		—	0%	—	0%
K_{OC} (50% decrease from K_{OW}=5.5)	6.044	5.743	3.0%	water plankton and invertebrates (2)	8.1%	sediment invertebrates	0%
K_{OC} (50% increase from K_{OW}=5.5)	6.044	6.220	-2.6%	water plankton and invertebrates (2)	-7.0%	sediment invertebrates	0%
Particulate organic carbon (mg/L)	4.0E-07	2.00E-07	0.0%	—	0%	—	0%
Sediment organic carbon (%)	1.84	0.92	55.8%	sediment invertebrates	100.0%	water invertebrates	0%
Dissolved and particulate organic carbon (combined)	see DOC and POC in this table	see DOC and POC in this table	3.0%	water invertebrates	8.1%	sediment invertebrates	0%
PCB sediment concentration (µg/kg)	95.4	47.7	-31.3%	sediment invertebrates	-50.0%	water invertebrates	0%
PCB water concentration (ng/L)	0.409	0.205	-18.7%	water invertebrates	-50.0%	sediment invertebrates	0%
BSAF	3.5	1.8	-31.3%	sediment invertebrates	-50.0%	water invertebrates	0%

Table 4-24. Sensitivity for TrophicTrace model, K_{OW} 7.5, RM 2 to RM 11

Sensitivity Run (50% decrease unless otherwise indicated)	Initial Value	New Value	Mean % Change in Predicted Concentrations	Species with Max % Change	Max % Change	Species with Min % Change	Min % Change
Biota weight	Table 4-13	Table 4-13	-1.8%	smallmouth bass	-4.9%	all invertebrates	0%
Biota lipids	Table 4-13	Table 4-13	-46.9%	water invertebrates	-50.0%	sucker	-32.70%
Dissolved organic carbon (mg/L)	1.60E-06	8.00E-07	23.8%	water invertebrates	47.0%	sediment invertebrates	0%
Water temperature	13.4	6.7	137.3%	bass	541.1%	all invertebrates	0%
K_{OW} (50% increase)	7.5	7.676	-4.7%	bass	-22.2%	sediment invertebrates	0%
Corresponding K_{OC} (based on Arnot formula)	7.044	7.220		water invertebrates	13.7%	— —	0%
K_{OW} (50% decrease)	7.5	7.199	1.5%	water invertebrates	-26.5%	sediment invertebrates	0%
Corresponding K_{OC} (based on Arnot formula)	7.044	6.743		bass	26.0%	—	0%
K_{OC} (50% decrease from K_{OW}=5.5)	7.044	6.743	23.8%	water invertebrates	47.0%	sediment invertebrates	0%
K_{OC} (50% increase from K_{OW}=5.5)	7.044	7.220	-12.3%	water invertebrates	-24.2%	sediment invertebrates	0%
Particulate organic carbon (mg/L)	4.0E-07	2.00E-07	0.0%	—	0%	—	0%
sediment organic carbon (%)	1.84	0.92	44.4%	sediment invertebrates	100.0%	water invertebrates	0%
dissolved and particulate organic carbon (combined)	see DOC and POC in this table	see DOC and POC in this table	23.8%	water invertebrates	47.0%	sediment invertebrates	0%
PCB sediment concentration (µg/kg)	95.4	47.7	-24.7%	sediment invertebrates	-50.0%	water invertebrates	0%
PCB water concentration (ng/L)	0.409	0.205	-25.3%	water invertebrates	-50.0%	sediment invertebrates	0%
BSAF	3.5	1.8	-24.7%	sediment invertebrates	-50.0%	water invertebrates	0%

Table 4-25. Sensitivity for TrophicTrace model, K_{OW} 6.5, Swan Island Lagoon

Sensitivity Run (50% decrease unless otherwise indicated)	Initial Value	New Value	Mean % Change in Predicted Concentrations	Species with Max % Change	Max % Change	Species with Min % Change	Min % Change
Biota weight	Table 4-14	Table 4-14	-2.60%	bass	-6.70%	invertebrates	0%
Biota lipids	Table 4-14	Table 4-14	-47.70%	bullhead	-53.40%	sucker	-28.20%
Dissolved organic carbon (mg/L)	1.70E-06	8.50E-07	2.46%	water invertebrates	8.60%	sediment invertebrates	0%
Water temperature	13.7	6.9	87.84%	bass	315.17%	invertebrates	0%
K_{OW} (50% increase)	6.5	6.676	10.18%	water invertebrates	38.97%	sediment invertebrates	0%
Corresponding K_{OC} (based on Arnot formula)	6.044	6.220		carp	-1.42%		
K_{OW} (50% decrease)	6.5	6.199	-14.90%	water invertebrates	-45.70%	sediment invertebrates	0%
Corresponding K_{OC} (based on Arnot formula)	6.044	5.743		carp	0.20%		
K_{OC} (50% decrease from K_{OW}=5.5)	6.044	5.743	2.50%	water invertebrates	8.60%	sediment invertebrates	0%
K_{OC} (50% increase from K_{OW}=5.5)	6.044	6.220	-2.10%	water invertebrates	-7.30%	sediment invertebrates	0%
Particulate organic carbon (mg/L)	4.2E-07	2.10E-07	0%	—	0%	—	0%
sediment organic carbon (%)	1.84	0.92	62.90%	sediment invertebrates	100%	water invertebrates	0%
dissolved and particulate organic carbon (combined)	2.1	see DOC and POC in this table	2.50%	water invertebrates	8.60%	sediment invertebrates	0%
PCB sediment concentration (µg/kg)	365.4	182.7	-35.70%	sediment invertebrates	-50%	water invertebrates	0%
PCB water concentration (ng/L)	0.409	0.205	-14.30%	water invertebrates	-50%	sediment invertebrates	0%
BSAF	3.5	1.8	-35.70%	sediment invertebrates	-50%	water invertebrates	0%

Table 4-26. Uncertainty input for PCBs

Parameter	Input Values		
	Average	Upper Estimate	Lower Estimate
RM 2 to RM 11			
Log K_{OW}	6.3	6.3	6.3
PCB sediment concentration	95.4	173.0	23.8
PCB water concentration	0.41	0.61	0.23
Water temperature	13.4	24.5	5.3
Dissolved oxygen	10.8	6.9	14.2
sediment organic carbon	1.84	1.37	1.88
Concentration of suspended solids	1.14E-05	1.10E-04	2.00E-06
Particulate organic carbon	4.00E-07	1.20E-06	2.00E-07
Dissolved organic carbon	1.60E-06	4.80E-06	8.00E-07
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	average	5% change	5% change
Biota weight	average	maximum	minimum
Biota lipids	average	maximum	minimum
% moisture (inverse of “non-lipid organic matter”)	average	minimum	maximum
TrophicTrace additional			
BSAF	3.7	21.8	1.6
K_{OC}	5.844	5.844	5.844
Swan Island Lagoon			
Log K_{OW}	6.3	6.3	6.3
PCB sediment concentration	296.7	365.40	90.13
PCB water concentration	0.409	0.609	0.229
Water temperature	13.7	25.1	5
Dissolved oxygen	8.9	6.2	11
sediment organic carbon	1.86	1.42	2.02
Concentration of suspended solids	7.80E-02	2.30E-01	3.40E-02
Particulate organic carbon	4.20E-07	1.20E-06	2.00E-07
Dissolved organic carbon	1.70E-06	3.20E-06	8.00E-07
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	average	5% change	5% change
Biota weight	average	maximum	minimum
Biota lipids	average	maximum	minimum
% moisture (inverse of “non-lipid organic matter”)	average	minimum	maximum
TrophicTrace additional			
BSAF	3.7	21.8	1.6
K_{OC}	5.8	5.8	5.8

Table 4-27. Uncertainty input for 4,4′-DDE

Parameter	DDT Metabolism (% converted to DDE in the body)		
	50%	100%	20%
	Average	Upper Estimate	Lower Estimate
RM 2 to RM 11			
Log K_{OW}	6.61	6.67	6.56
DDE/DDT sediment concentration	4.72	5.95	3.97
DDE/DDT water concentration	0.03	0.036	0.0256
Water temperature	13.4	average	average
Dissolved oxygen	10.8	average	average
sediment organic carbon	1.84	average	average
Concentration of suspended solids	1.14E-05	average	average
Particulate organic carbon	4.00E-07	average	average
Dissolved organic carbon	1.60E-06	average	average
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	average	average	average
Biota weight	average	average	average
Biota lipids	average	average	average
% moisture (inverse of “non-lipid organic matter”)	average	average	average
TrophicTrace additional			
BSAF	6.2	6.2	6.2
K_{OC}	6.224	6.274	6.154
Swan Island Lagoon			
Log K_{OW}	6.68	6.73	6.61
DDE sediment concentration	6.76	10.9	4.27
DDE water concentration	0.03	0.036	0.026
Water temperature	13.7	average	average
Dissolved oxygen	8.9	average	average
sediment organic carbon	1.84	average	average
Concentration of suspended solids	7.80E-02	average	average
Particulate organic carbon	4.20E-07	average	average
Dissolved organic carbon	1.70E-06	average	average
Dietary absorption efficiencies (lipid, non-lipid organic matter, water)	average	average	average
Biota weight	average	average	average
Biota lipids	average	average	average
% moisture (inverse of “non-lipid organic matter”)	average	average	average
TrophicTrace additional			
BSAF	6.2	6.2	6.2
K_{OC}	6.224	6.274	6.154

Table 5-1. Arnot and Gobas scenario results

RUN NAME	COMPARISON OF PREDICTED MEAN TO MEASURED MEAN			COMPARISON OF PREDICTED MEAN TO MEASURED GEOMEAN		
	MEAN FACTOR (model bias)	MEAN FACTOR (absolute values)	NO. OF SPECIES UNDER FACTOR OF 5	NO. OF SPECIES UNDER FACTOR OF 2	MEAN FACTOR (model bias)	MEAN FACTOR (absolute values)
PCBs, RM 2 to RM 11						
AG-RM2-11-PCB-1a	0.4	3.2	9	4	2.0	3.5
AG-RM2-11-PCB-1b	0.4	3.2	9	4	2.0	3.5
AG-RM2-11-PCB-1c	0.3	3.2	9	4	2.0	3.4
AG-RM2-11-PCB-2a	-1.1	3.4	9	3	0.4	3.2
AG-RM2-11-PCB-2b	-1.1	3.4	9	3	0.4	3.2
AG-RM2-11-PCB-2c	-1.1	3.4	9	3	0.4	3.2
PCBs, Swan Island Lagoon[a]						
AG-SI-PCB-1a	11.6	11.6	4	1	13.6	13.6
AG-SI-PCB-1b	11.6	11.6	4	1	13.6	13.6
AG-SI-PCB-1c	11.6	11.6	4	1	13.6	13.6
AG-SI-PCB-2a	7.7	7.7	6	2	9.1	9.1
AG-SI-PCB-2b	7.7	7.7	6	2	9.1	9.1
AG-SI-PCB-2c	7.7	7.7	6	2	9.1	9.1
4,4′-DDE, RM 2 to RM 11						
AG-RM2-11-DDE-1a	-5.7	5.9	7	4	-4.0	4.7
AG-RM2-11-DDE-1b	-5.4	5.9	7	4	-3.7	4.6
AG-RM2-11-DDE-1c	-5.8	6.0	7	4	-4.0	4.7
AG-RM2-11-DDE-1d	-6.8	7.0	7	4	-5.2	5.4
AG-RM2-11-DDE-1e	-6.7	6.9	7	4	-5.1	5.3
AG-RM2-11-DDE-1f	-6.9	7.1	7	4	-5.2	5.5
AG-RM2-11-DDE-1g	-31.0	31.0	0	0	-24.3	24.3
AG-RM2-11-DDE-1h	-30.8	30.8	0	0	-24.1	24.1
AG-RM2-11-DDE-1i	-31.2	31.2	0	0	-24.5	24.5
AG-RM2-11-DDE-2a	-7.8	7.8	6	3	-6.0	6.2
AG-RM2-11-DDE-2b	-7.5	7.7	6	3	-5.9	6.1
AG-RM2-11-DDE-2c	-8.0	8.0	6	3	-6.1	6.2
AG-RM2-11-DDE-2d	-9.3	9.3	5	3	-7.2	7.2
AG-RM2-11-DDE-2e	-9.2	9.2	5	3	-7.2	7.2
AG-RM2-11-DDE-2f	-9.5	9.5	5	3	-7.4	7.4

Table 5-1. Arnot and Gobas scenario results

Run Name	Comparison of Predicted Mean to Measured Mean			Comparison of Predicted Mean to Measured Geomean		
	Mean Factor (model bias)	Mean Factor (absolute values)	No. of Species under Factor of 5	No. of Species under Factor of 2	Mean Factor (model bias)	Mean Factor (absolute values)
AG-RM2-11-DDE-2g	-42.7	42.7	0	0	-33.7	33.7
AG-RM2-11-DDE-2h	-42.4	42.4	0	0	-33.5	33.5
AG-RM2-11-DDE-2i	-43.0	43.0	0	0	-33.9	33.9
4,4′-DDE, Swan Island Lagoon[a]						
AG-SI-DDE-1a	-2.3	3.7	6	4	-0.5	2.8
AG-SI-DDE-1b	-2.2	3.7	6	4	-0.5	2.8
AG-SI-DDE-1c	-2.3	3.8	6	4	-0.6	2.8
AG-SI-DDE-1d	-2.4	3.8	6	5	-0.7	2.8
AG-SI-DDE-1e	-2.4	3.8	6	5	-0.7	2.8
AG-SI-DDE-1f	-2.5	3.8	6	5	-0.7	2.8
AG-SI-DDE-1g	-8.6	8.6	5	1	-5.4	5.4
AG-SI-DDE-1h	-8.5	8.5	5	1	-5.3	5.3
AG-SI-DDE-1i	-8.6	8.6	5	1	-5.3	5.3
AG-SI-DDE-2a	-4.0	4.4	6	4	-2.1	2.7
AG-SI-DDE-2b	-4.0	4.4	6	4	-2.1	2.7
AG-SI-DDE-2c	-4.0	4.4	6	4	-2.1	2.8
AG-SI-DDE-2d	-4.1	4.5	6	4	-2.2	2.8
AG-SI-DDE-2e	-4.1	4.4	6	4	-2.2	2.8
AG-SI-DDE-2f	-4.1	4.5	6	4	-2.2	2.8
AG-SI-DDE-2g	-10.6	10.6	2	1	-7.0	7.0
AG-SI-DDE-2h	-10.6	10.6	2	1	-6.9	6.9
AG-SI-DDE-2i	-10.6	10.6	2	1	-7.0	7.0

AG – Arnot and Gobas
RM 2-11 – RM 2 to RM 11
SI – Swan Island Lagoon
PCB or DDE (4,4′-DDE) – chemical modeled
alphanumeric code – scenario run
[a]For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker. No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5-2. Arnot and Gobas uncertainty results

Run Name	Comparison of Predicted Mean to Measured Mean				Comparison of Predicted Mean to Measured Geomean	
	Mean Factor (model bias)	Mean Factor (absolute values)	No. of Species under Factor of 5	No. of Species under Factor of 2[a]	Mean Factor (model bias)	Mean Factor (absolute values)
PCBs, RM 2 to RM 11						
AG-RM2-11-PCB-AVG	0.5	3.2	9	5	2.2	3.6
AG-RM2-11-PCB-MAX	32.7	32.7	3	1	43.4	43.4
AG-RM2-11-PCB-MIN	-14.3	14.3	4	2	-9.3	9.3
PCBs, Swan Island Lagoon[b]						
AG-SI-PCB-AVG	9.6	9.8	4	2	11.3	11.3
AG-SI-PCB-MAX	73.0	73.0	0	0	92.5	92.5
AG-SI-PCB-MIN	-3.0	3.8	6	3	-3.1	4.0
4,4′-DDE adjusted, RM 2 to RM 11						
AG-RM2-11-DDE-20	-5.6	5.9	7	4	-3.7	4.6
AG-RM2-11-DDE-50	-4.1	4.9	8	5	-2.6	4.0
AG-RM2-11-DDE-100	-2.8	4.0	9	5[a]	-1.7	3.4
4,4′-DDE adjusted, Swan Island Lagoon[b]						
AG-SI-DDE-20	-0.5	3.1	8	2	0.7	2.8
AG-SI-DDE-50	0.9	3.2	8	1	2.1	3.4
AG-SI-DDE-100	2.8	4.1	5	3	4.3	4.9

AG – Arnot and Gobas
RM 2-11 – RM 2 to RM 11
SI – Swan Island Lagoon
PCB or DDE (4,4′-DDE) – chemical modeled
AVG – average value used in run
MAX – maximum value used in run
MIN – minimum value used in run
20, 50, or 100 – assumed metabolic contribution of DDT to DDE.

[a] Included in count was one species with factor of 2.0.

[b] For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker. No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5-3. TrophicTrace scenario results

Run Name	Comparison of Predicted Mean to Measured Mean				Comparison of Predicted Mean to Measured Geomean	
	Mean Factor (model bias)	Mean Factor (absolute values)	No. of Species under Factor of 5	No. of Species under Factor of 2	Mean Factor (model bias)	Mean Factor (absolute values)
PCBs, RM 2 to RM 11						
TT-RM2-11-PCB-1a	-7.9	8.3	4	3	-4.8	5.3
TT-RM2-11-PCB-1b	-14.2	14.4	4	1	-8.8	9.2
TT-RM2-11-PCB-1c	-12.7	12.9	4	1	-7.8	8.3
TT-RM2-11-PCB-1d	-20.2	20.2	3	1	-12.7	12.9
TT-RM2-11-PCB-2a	-8.5	9.0	5	1	-5.2	5.9
TT-RM2-11-PCB-2b	-15.4	15.6	4	1	-9.8	10.2
TT-RM2-11-PCB-2c	-13.6	13.8	5	1	-8.6	9.0
TT-RM2-11-PCB-2d	-23.0	23.0	3	1	-14.7	14.9
PCBs, Swan Island Lagoon[a]						
TT-SI-PCB-1a	-3.9	5.2	6	3	-5.4	6.1
TT-SI-PCB-1b	-8.9	9.2	4	3	-10.2	10.2
TT-SI-PCB-1c	-7.6	8.2	4	3	-8.7	9.1
TT-SI-PCB-1d	-13.7	13.7	3	2	-14.9	14.9
TT-SI-PCB-2a	-4.0	4.8	6	5	-4.2	5.2
TT-SI-PCB-2b	-8.6	8.6	5	2	-8.8	8.8
TT-SI-PCB-2c	-7.5	7.5	5	2	-7.7	7.7
TT-SI-PCB-2d	-13.4	13.4	2	0	-13.4	13.4
DDE, RM 2 to RM 11						
TT-RM2-11-DDE-1a	-39.4	39.4	0	0	-34.0	34.0
TT-RM2-11-DDE-1b	-20.5	20.5	1	0	-17.2	17.2
TT-RM2-11-DDE-1c	-52.0	52.0	0	0	-45.3	45.3
TT-RM2-11-DDE-1d	-43.0	43.0	0	0	-36.9	36.9
TT-RM2-11-DDE-1e	-21.7	21.7	1	0	-18.1	18.1
TT-RM2-11-DDE-1f	-57.7	57.7	0	0	-49.9	49.9
TT-RM2-11-DDE-1g	-77.6	77.6	0	0	-64.2	64.2
TT-RM2-11-DDE-1h	-38.7	38.7	1	0	-31.0	31.0
TT-RM2-11-DDE-1i	-106.5	106.5	0	0	-89.4	89.4
TT-RM2-11-DDE-2a	-48.3	48.3	0	0	-42.8	42.8
TT-RM2-11-DDE-2b	-24.3	24.3	2	0	-21.4	21.4
TT-RM2-11-DDE-2c	-64.2	64.2	0	0	-56.9	56.9
TT-RM2-11-DDE-2d	-52.9	52.9	0	0	-46.7	46.7
TT-RM2-11-DDE-2e	-25.7	25.7	2	0	-22.5	22.5
TT-RM2-11-DDE-2f	-71.8	71.8	0	0	-63.6	63.6
TT-RM2-11-DDE-2g	-87.4	87.4	0	0	-76.2	76.2
TT-RM2-11-DDE-2h	-41.1	41.1	1	0	-35.3	35.3
TT-RM2-11-DDE-2i	-124.0	124.0	0	0	-108.6	108.6

Table 5-3. TrophicTrace scenario results

Run Name	Comparison of Predicted Mean to Measured Mean				Comparison of Predicted Mean to Measured Geomean	
	Mean Factor (model bias)	Mean Factor (absolute values)	No. of Species under Factor of 5	No. of Species under Factor of 2	Mean Factor (model bias)	Mean Factor (absolute values)
DDE, Swan Island Lagoon[a]						
TT-SI-DDE-1a	-40.4	40.4	1	0	-27.5	27.5
TT-SI-DDE-1b	-20.0	20.0	1	0	-14.3	14.3
TT-SI-DDE-1c	-54.5	54.5	1	0	-36.4	36.4
TT-SI-DDE-1d	-43.2	43.2	0	0	-29.7	29.7
TT-SI-DDE-1e	-20.8	20.8	0	0	-15.1	15.1
TT-SI-DDE-1f	-59.3	59.3	0	0	-39.8	39.8
TT-SI-DDE-1g	-69.2	69.2	0	0	-53.6	53.6
TT-SI-DDE-1h	-32.7	32.7	0	0	-27.8	27.8
TT-SI-DDE-1i	-97.3	97.3	0	0	-72.3	72.3
TT-SI-DDE-2a	-53.9	53.9	1	0	-32.1	32.1
TT-SI-DDE-2b	-26.5	26.5	2	0	-15.4	15.4
TT-SI-DDE-2c	-71.5	71.5	1	0	-43.3	43.3
TT-SI-DDE-2d	-58.0	58.0	0	0	-34.2	34.2
TT-SI-DDE-2e	-27.4	27.4	1	0	-15.9	15.9
TT-SI-DDE-2f	-78.9	78.9	0	0	-47.3	47.3
TT-SI-DDE-2g	-87.2	87.2	0	0	-55.6	55.6
TT-SI-DDE-2h	-38.9	38.9	0	0	-26.3	26.3
TT-SI-DDE-2i	-124.9	124.9	0	0	-78.8	78.8

TT – TrophicTrace
RM 2-11 – RM 2 to RM 11
SI – Swan Island Lagoon
PCB or DDE (4,4′-DDE) – chemical modeled
alphanumeric code – scenario run

[a] For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker. No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5-4. TrophicTrace uncertainty results

Run Name	Comparison of Predicted Mean to Measured Mean				Comparison of Predicted Mean to Measured Geomean	
	Mean Factor (model bias)	Mean Factor (absolute values)	No. of Species under Factor of 5[a]	No. of Species under Factor of 2	Mean Factor (model bias)	Mean Factor (absolute values)
PCBs, RM 2 to RM 11						
TT-RM2-11-PCB-AVG	-7.6	8.1	4	3	-4.7	5.2
TT-RM2-11-PCB-MAX	14.0	14.4	6	0	16.6	16.6
TT-RM2-11-PCB-MIN	-43.4	43.4	1[a]	0	-26.1	26.1
PCBs, Swan Island Lagoon[b]						
TT-SI-PCB-AVG	-4.6	5.7	5	2	-5.8	6.2
TT-SI-PCB-MAX	17.1	18.1	3	0	12.8	14.3
TT-SI-PCB-MIN	-30.1	30.1	2	0	-31.8	31.8
4,4′-DDE adjusted, RM 2 to RM 11						
TT-RM2-11-DDE-20	-17.9	17.9	1	0	-15.1	15.1
TT-RM2-11-DDE-50	-14.9	14.9	1	0	-12.6	12.6
TT-RM2-11-DDE-100	-11.8	11.8	2	1	-9.9	9.9
4,4′-DDE adjusted, Swan Island Lagoon[b]						
TT-SI-DDE-20	-12.5	12.5	1	0	-9.3	9.3
TT-SI-DDE-50	-8.3	8.3	1	0	-6.3	6.3
TT-SI-DDE-100	-5.4	5.4	5	0	-4.2	4.2

TT – TrophicTrace
RM 2-11 – RM 2 to RM 11
SI – Swan Island Lagoon
PCB or DDE (4,4′-DDE) – chemical modeled
AVG – average value used in run
MAX – maximum value used in run
MIN – minimum value used in run
20, 50, and 100 – assumed metabolic contribution of DDT to DDE

[a] Included in count was one species with factor of 5.0

[b] For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker. No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

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Appendix A. Measured Values

Appendix B. Arnot and Gobas Model Run

B.1.1

B.1.2

B.1.3

B.1.4

B.2.1

Appendix C. TrophicTrace Model Run

Appendix A. Measured Values

Table A-1. Total PCBs, RM 2 to RM 1

Chemical - PCB
Spatial Scale - RM2-11
Measured values (µg/kg ww)

Species	Mean	Geomean	Max	Min
Plankton and Primary Producers				
Various Plankton and Algae				
Zooplankton				
Invertebrates				
Clam (Corbicula sp)	86	83	120	62
Oligochaete				
Insect Larvae				
Amphipod				
Crayfish	30	4	280	2
Fish				
Juvenile Fish				
Carp	1630	837	6500	230
Sucker, Largescale	819	529	2020	95
Chinook, Salmon (juv)	56	51	100	30
Peamouth	187	179	290	138
Sculpin	562	318	3360	62
Crappie, Black	134	120	250	85
Bullhead, Brown	404	193	1700	67
Bass, Smallmouth	1113	714	4500	90
Pikeminnow, Northern	833	721	1800	138

Table A-2. Total PCBs, Swan Island Lagoon

Chemical - PCB
Spatial Scale - Swan Island
Measured values (µg/kg ww)

Species	Mean	Geomean	Max	Min
Plankton and Primary Producers				
Various Plankton and Algae				
Zooplankton				
Invertebrates				
Clam (Corbicula sp)				
Oligochaete				
Insect Larvae				
Amphipod				
Crayfish	46	46	49	43
Fish				
Juvenile Fish				
Carp	933	915	1100	690
Sucker, Largescale	320	320	320	320
Chinook, Salmon (juv)				
Peamouth	138	138	138	138
Sculpin	495	495	510	480
Crappie, Black	180	165	250	109
Bullhead, Brown	715	411	1700	130
Bass, Smallmouth	2933.3	2458	4500	1000
Pikeminnow, Northern	670	670	670	670

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table A-3. 4,4′-DDE, RM 2 to RM 11

Chemical - DDE
Spatial Scale - RM2-11
Measured values (µg/kg ww)

Species	Mean	Geomean	Max	Min
Plankton and Primary Producers				
Various Plankton and Algae				
Zooplankton				
Invertebrates				
Clam (Corbicula sp)	42.7	26.4	94.5	7.5
Oligochaete				
Insect Larvae				
Amphipod				
Crayfish	6.3	4.4	51.0	1.6
Fish				
Juvenile Fish				
Carp	135.4	125.0	260.0	81.0
Sucker, Largescale	121.3	115.7	185.0	79.0
Chinook, Salmon (juv)	21.2	21.1	24.0	19.0
Peamouth	132.3	129.0	185.0	109.0
Sculpin	56.3	24.3	630.0	11.0
Crappie, Black	55.6	52.5	80.5	37.0
Bullhead, Brown	47.4	45.2	70.0	29.5
Bass, Smallmouth	131.6	123.7	220.0	53.0
Pikeminnow, Northern	252.0	213.0	545.0	82.0

Table A-4. 4,4′-DDE, Swan Island Lagoon

Chemical - DDE
Spatial Scale - Swan Island
Measured values (µg/kg ww)

Species	Mean	Geomean	Max	Min
Plankton and Primary Producers				
Various Plankton and Algae				
Zooplankton				
Invertebrates				
Clam (Corbicula sp)				
Oligochaete				
Insect Larvae				
Amphipod				
Crayfish	2.3	2.2	3.4	1.6
Fish				
Juvenile Fish				
Carp	122.2	119.9	145.0	91.5
Sucker, Largescale	185.0	185.0	185.0	185.0
Chinook, Salmon (juv)				
Peamouth	125.0	125.0	125.0	125.0
Sculpin	21.0	20.8	24.0	18.0
Crappie, Black	73.8	73.4	80.5	67.0
Bullhead, Brown	46.8	44.9	58.0	29.5
Bass, Smallmouth	75.7	73.7	92.5	53.0
Pikeminnow, Northern	82.0	82.0	82.0	82.0

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Appendix B. Arnot and Gobas Model Run

B.1.1

Table 1 - Arnot-Gobas Model Output for Scenario Runs

Chemical - PCB Spatial Scale - RM2-11

Scenario	AG-RM2-11-PCB-1a	AG-RM2-11-PCB-1b	AG-RM2-11-PCB-1c	AG-RM2-11-PCB-2a	AG-RM2-11-PCB-2b	AG-RM2-11-PCB-2c
Species						
Plankton						
Various Plankton and Algae	4.7	4.7	4.7	4.7	4.7	4.7
Zooplankton	8.7	8.7	8.7	8.7	8.7	8.7
Benthos						
Clam (Corbicula sp)	22.4	22.6	22.1	18.0	18.2	17.7
Oligochaete	39.9	40.1	39.7	38.9	39.1	38.7
Insect Larvae	29.7	30.0	29.4	28.9	29.2	28.6
Amphipod	39.7	39.9	39.5	38.7	38.9	38.5
Crayfish	67.3	67.7	66.8	56.3	56.6	55.8
Fish						
Juvenile Fish	164.0	164.9	162.9	138.1	138.9	137.1
Carp	296.6	298.2	294.9	246.1	247.9	244.0
Sucker, Largescale	345.2	347.1	343.1	195.7	197.2	194.1
Chinook, Salmon (juv)	246.7	248.0	245.2	209.6	210.7	208.3
Peamouth	281.6	283.0	279.9	221.1	222.2	219.7
Sculpin	347.3	349.5	344.6	202.0	203.3	200.4
Crappie, Black	1163.0	1169.2	1155.3	770.8	775.3	765.2
Bullhead, Brown	197.2	198.4	195.6	160.7	161.7	159.6
Bass, Smallmouth	1585.3	1594.8	1573.7	802.9	808.0	796.8
Pikeminnow, Northern	879.0	884.4	872.4	337.1	339.4	334.3

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-PCB-1a	AG-RM2-11-PCB-1b	AG-RM2-11-PCB-1c	AG-RM2-11-PCB-2a	AG-RM2-11-PCB-2b	AG-RM2-11-PCB-2c
Various Plankton and Algae						
Zooplankton						
Benthos						
Clam (Corbicula sp)	-3.9	-3.8	-3.9	-4.8	-4.7	-4.9
Oligochaete						
Insect Larvae						
Amphipod						
Crayfish	2.2	2.3	2.2	1.9	1.9	1.9
Fish						
Juvenile Fish						
Carp	-5.5	-5.5	-5.5	-6.6	-6.6	-6.7
Sucker, Largescale	-2.4	-2.4	-2.4	-4.2	-4.2	-4.2
Chinook, Salmon (juv)	4.4	4.4	4.4	3.7	3.8	3.7
Peamouth	1.5	1.5	1.5	1.2	1.2	1.2
Sculpin	-1.6	-1.6	-1.6	-2.8	-2.8	-2.8
Crappie, Black	8.7	8.7	8.6	5.8	5.8	5.7
Bullhead, Brown	-2.0	-2.0	-2.1	-2.5	-2.5	-2.5
Bass, Smallmouth	1.4	1.4	1.4	-1.4	-1.4	-1.4
Pikeminnow, Northern	1.1	1.1	1.0	-2.5	-2.5	-2.5
MEAN	**0.4**	**0.4**	**0.3**	**-1.1**	**-1.1**	**-1.1**
Max	**8.7**	**8.7**	**8.6**	**5.8**	**5.8**	**5.7**
Min	**-5.5**	**-5.5**	**-5.5**	**-6.6**	**-6.6**	**-6.7**
underpredict count	**5**	**5**	**5**	**7**	**7**	**7**
underpredict percentage	**45%**	**45%**	**45%**	**64%**	**64%**	**64%**

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-PCB-1a	AG-RM2-11-PCB-1b	AG-RM2-11-PCB-1c	AG-RM2-11-PCB-2a	AG-RM2-11-PCB-2b	AG-RM2-11-PCB-2c
Various Plankton and Algae						
Zooplankton						
Benthos						
Clam (Corbicula sp)	-3.9	-3.8	-3.9	-4.8	-4.7	-4.9
Oligochaete						
Insect Larvae						
Amphipod						
Crayfish	2.2	2.3	2.2	1.9	1.9	1.9
Fish						
Juvenile Fish						
Carp	-5.5	-5.5	-5.5	-6.6	-6.6	-6.7
Sucker, Largescale	-2.4	-2.4	-2.4	-4.2	-4.2	-4.2
Chinook, Salmon (juv)	4.4	4.4	4.4	3.7	3.8	3.7
Peamouth	1.5	1.5	1.5	1.2	1.2	1.2
Sculpin	-1.6	-1.6	-1.6	-2.8	-2.8	-2.8
Crappie, Black	8.7	8.7	8.6	5.8	5.8	5.7
Bullhead, Brown	-2.0	-2.0	-2.1	-2.5	-2.5	-2.5
Bass, Smallmouth	1.4	1.4	1.4	-1.4	-1.4	-1.4
Pikeminnow, Northern	1.1	1.1	1.0	-2.5	-2.5	-2.5
MEAN	**0.4**	**0.4**	**0.3**	**-1.1**	**-1.1**	**-1.1**
Max	**8.7**	**8.7**	**8.6**	**5.8**	**5.8**	**5.7**
Min	**-5.5**	**-5.5**	**-5.5**	**-6.6**	**-6.6**	**-6.7**
underpredict count	**5**	**5**	**5**	**7**	**7**	**7**
underpredict percentage	**45%**	**45%**	**45%**	**64%**	**64%**	**64%**

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-PCB-1a	AG-RM2-11-PCB-1b	AG-RM2-11-PCB-1c	AG-RM2-11-PCB-2a	AG-RM2-11-PCB-2b	AG-RM2-11-PCB-2c
Various Plankton and Algae						
Zooplankton						
Benthos						
Clam (Corbicula sp)	-3.7	-3.7	-3.7	-4.6	-4.5	-4.7
Oligochaete						
Insect Larvae						
Amphipod						
Crayfish	8.3	8.4	8.2	6.9	7.0	6.9
Fish						
Juvenile Fish						
Carp	-2.8	-2.8	-2.8	-3.4	-3.4	-3.4
Sucker, Largescale	-1.5	-1.5	-1.5	-2.7	-2.7	-2.7
Chinook, Salmon (juv)	4.8	4.9	4.8	4.1	4.1	4.1
Peamouth	1.6	1.6	1.6	1.2	1.2	1.2
Sculpin	1.1	1.1	1.1	-1.6	-1.6	-1.6
Crappie, Black	9.7	9.7	9.6	6.4	6.5	6.4
Bullhead, Brown	1.0	1.0	1.0	-1.2	-1.2	-1.2
Bass, Smallmouth	2.2	2.2	2.2	1.1	1.1	1.1
Pikeminnow, Northern	1.2	1.2	1.2	-2.1	-2.1	-2.2
MEAN	**2.0**	**2.0**	**2.0**	**0.4**	**0.4**	**0.4**
Max	**9.7**	**9.7**	**9.6**	**6.9**	**7.0**	**6.9**
Min	**-3.7**	**-3.7**	**-3.7**	**-4.6**	**-4.5**	**-4.7**
underpredict count	**3**	**3**	**3**	**6**	**6**	**6**
underpredict percentage	**27%**	**27%**	**27%**	**55%**	**55%**	**55%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-PCB-1a	AG-RM2-11-PCB-1b	AG-RM2-11-PCB-1c	AG-RM2-11-PCB-2a	AG-RM2-11-PCB-2b	AG-RM2-11-PCB-2c
Various Plankton and Algae						
Zooplankton						
Benthos						
Clam (Corbicula sp)	3.9	3.8	3.9	4.8	4.7	4.9
Oligochaete						
Insect Larvae						
Amphipod						
Crayfish	2.2	2.3	2.2	1.9	1.9	1.9
Fish						
Juvenile Fish						
Carp	5.5	5.5	5.5	6.6	6.6	6.7
Sucker, Largescale	2.4	2.4	2.4	4.2	4.2	4.2
Chinook, Salmon (juv)	4.4	4.4	4.4	3.7	3.8	3.7
Peamouth	1.5	1.5	1.5	1.2	1.2	1.2
Sculpin	1.6	1.6	1.6	2.8	2.8	2.8
Crappie, Black	8.7	8.7	8.6	5.8	5.8	5.7
Bullhead, Brown	2.0	2.0	2.1	2.5	2.5	2.5
Bass, Smallmouth	1.4	1.4	1.4	1.4	1.4	1.4
Pikeminnow, Northern	1.1	1.1	1.0	2.5	2.5	2.5
MEAN (MPAF)	**3.2**	**3.2**	**3.2**	**3.4**	**3.4**	**3.4**
Geomean	**2.6**	**2.6**	**2.6**	**3.0**	**3.0**	**3.0**
Max	**8.7**	**8.7**	**8.6**	**6.6**	**6.6**	**6.7**
Min	**1.1**	**1.1**	**1.0**	**1.2**	**1.2**	**1.2**
# under 10	**11**	**11**	**11**	**11**	**11**	**11**
# under 5	**9**	**9**	**9**	**9**	**9**	**9**
# under 2	**4**	**4**	**4**	**3**	**3**	**3**

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-PCB-1a	AG-RM2-11-PCB-1b	AG-RM2-11-PCB-1c	AG-RM2-11-PCB-2a	AG-RM2-11-PCB-2b	AG-RM2-11-PCB-2c
Various Plankton and Algae						
Zooplankton						
Benthos						
Clam (Corbicula sp)	3.7	3.7	3.7	4.6	4.5	4.7
Oligochaete						
Insect Larvae						
Amphipod						
Crayfish	8.3	8.4	8.2	6.9	7.0	6.9
Fish						
Juvenile Fish						
Carp	2.8	2.8	2.8	3.4	3.4	3.4
Sucker, Largescale	1.5	1.5	1.5	2.7	2.7	2.7
Chinook, Salmon (juv)	4.8	4.9	4.8	4.1	4.1	4.1
Peamouth	1.6	1.6	1.6	1.2	1.2	1.2
Sculpin	1.1	1.1	1.1	1.6	1.6	1.6
Crappie, Black	9.7	9.7	9.6	6.4	6.5	6.4
Bullhead, Brown	1.0	1.0	1.0	1.2	1.2	1.2
Bass, Smallmouth	2.2	2.2	2.2	1.1	1.1	1.1
Pikeminnow, Northern	1.2	1.2	1.2	2.1	2.1	2.2
MEAN (MPAF)	**3.5**	**3.5**	**3.4**	**3.2**	**3.2**	**3.2**
Geomean	**2.6**	**2.6**	**2.5**	**2.6**	**2.6**	**2.6**
Max	**9.7**	**9.7**	**9.6**	**6.9**	**7.0**	**6.9**
Min	**1.0**	**1.0**	**1.0**	**1.1**	**1.1**	**1.1**
# under 10	**11**	**11**	**11**	**11**	**11**	**11**
# under 5	**9**	**9**	**9**	**9**	**9**	**9**
# under 2	**5**	**5**	**5**	**4**	**4**	**4**

B.1.2

Table 1 - Arnot-Gobas Model Output for Scenario Runs
Chemical - PCBs Spatial Scale -Swan Island

Scenario	AG-SI-PCB-1a	AG-SI-PCB-1b	AG-SI-PCB-1c	AG-SI-PCB-2a	AG-SI-PCB-2b	AG-SI-PCB-2c
Species						
Plankton						
Various Plankton and Algae	4.6	4.6	4.6	4.6	4.6	4.6
Zooplankton	8.6	8.6	8.6	8.6	8.6	8.6
Benthos						
Clam (Corbicula sp)	320.2	320.2	320.2	314.0	314.0	314.0
Oligochaete	132.6	132.6	132.5	128.6	128.7	128.6
Insect Larvae	383.7	383.7	383.7	383.1	383.1	383.1
Amphipod	134.0	134.0	133.9	130.0	130.1	130.0
Crayfish	434.9	435.0	434.9	345.3	345.4	345.3
Fish						
Juvenile Fish	1092.4	1092.5	1092.3	970.1	970.2	970.1
Carp*	1758.0	1758.2	1757.7	1993.5	1993.6	1993.3
Sucker, Largescale	2022.5	2022.7	2022.2	1410.6	1410.8	1410.5
Chinook, Salmon (juv)	1582.3	1582.4	1582.2	1368.8	1368.8	1368.7
Peamouth	1825.6	1825.8	1825.4	1488.7	1488.8	1488.5
Sculpin	2473.4	2473.5	2473.2	1258.2	1258.3	1258.1
Crappie, Black*	9394.4	9395.1	9393.6	6277.8	6278.3	6277.2
Bullhead, Brown*	1609.3	1609.4	1609.1	954.7	954.9	954.5
Bass, Smallmouth	11422.4	11423.0	11421.6	5237.9	5238.4	5237.3
Pikeminnow, Northern	6777.0	6777.4	6776.5	2657.4	2657.7	2657.2

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-PCB-1a	AG-SI-PCB-1b	AG-SI-PCB-1c	AG-SI-PCB-2a	AG-SI-PCB-2b	AG-SI-PCB-2c
Various Plankton and Algae						
Zooplankton						
Benthos						
Clam (Corbicula sp)						
Oligochaete						
Insect Larvae						
Amphipod						
Crayfish	9.5	9.5	9.5	7.5	7.5	7.5
Fish						
Juvenile Fish						
Carp	1.9	1.9	1.9	2.1	2.1	2.1
Sucker, Largescale	6.3	6.3	6.3	4.4	4.4	4.4
Chinook, Salmon (juv)						
Peamouth	13.2	13.2	13.2	10.8	10.8	10.8
Sculpin	5.0	5.0	5.0	2.5	2.5	2.5
Crappie, Black	52.2	52.2	52.2	34.9	34.9	34.9
Bullhead, Brown	2.3	2.3	2.3	1.3	1.3	1.3
Bass, Smallmouth	3.9	3.9	3.9	1.8	1.8	1.8
Pikeminnow, Northern	10.1	10.1	10.1	4.0	4.0	4.0
MEAN	**11.6**	**11.6**	**11.6**	**7.7**	**7.7**	**7.7**
Max	**52.2**	**52.2**	**52.2**	**34.9**	**34.9**	**34.9**
Min	**1.9**	**1.9**	**1.9**	**1.3**	**1.3**	**1.3**
underpredict count	**0**	**0**	**0**	**0**	**0**	**0**
underpredict percentage	**0**	**0**	**0**	**0**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-PCB-1a	AG-SI-PCB-1b	AG-SI-PCB-1c	AG-SI-PCB-2a	AG-SI-PCB-2b	AG-SI-PCB-2c
Various Plankton and Algae						
Zooplankton						
Benthos						
Clam (Corbicula sp)						
Oligochaete						
Insect Larvae						
Amphipod						
Crayfish	9.5	9.5	9.5	7.5	7.5	7.5
Fish						
Juvenile Fish						
Carp	1.9	1.9	1.9	2.2	2.2	2.2
Sucker, Largescale						
Chinook, Salmon (juv)						
Peamouth						
Sculpin	5.0	5.0	5.0	2.5	2.5	2.5
Crappie, Black	56.9	56.9	56.9	38.0	38.1	38.0
Bullhead, Brown	3.9	3.9	3.9	2.3	2.3	2.3
Bass, Smallmouth	4.6	4.6	4.6	2.1	2.1	2.1
Pikeminnow, Northern						
MEAN	**13.6**	**13.6**	**13.6**	**9.1**	**9.1**	**9.1**
Max	**56.9**	**56.9**	**56.9**	**38.0**	**38.1**	**38.0**
Min	**1.9**	**1.9**	**1.9**	**2.1**	**2.1**	**2.1**
underpredict count	**0**	**0**	**0**	**0**	**0**	**0**
underpredict percentage	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**

Table 4 - SPAF- Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-PCB-1a	AG-SI-PCB-1b	AG-SI-PCB-1c	AG-SI-PCB-2a	AG-SI-PCB-2b	AG-SI-PCB-2c
Various Plankton and Algae						
Zooplankton						
Benthos						
Clam (Corbicula sp)						
Oligochaete						
Insect Larvae						
Amphipod						
Crayfish	9.5	9.5	9.5	7.5	7.5	7.5
Fish						
Juvenile Fish						
Carp	1.9	1.9	1.9	2.1	2.1	2.1
Sucker, Largescale	6.3	6.3	6.3	4.4	4.4	4.4
Chinook, Salmon (juv)						
Peamouth	13.2	13.2	13.2	10.8	10.8	10.8
Sculpin	5.0	5.0	5.0	2.5	2.5	2.5
Crappie, Black	52.2	52.2	52.2	34.9	34.9	34.9
Bullhead, Brown	2.3	2.3	2.3	1.3	1.3	1.3
Bass, Smallmouth	3.9	3.9	3.9	1.8	1.8	1.8
Pikeminnow, Northern		10.1	10.1	4.0	4.0	4.0
MEAN (MPAF)	**11.6**	**11.6**	**11.6**	**7.7**	**7.7**	**7.7**
Geomean	**6.6**	**6.9**	**6.9**	**4.4**	**4.4**	**4.4**
Max	**52.2**	**52.2**	**52.2**	**34.9**	**34.9**	**34.9**
Min	**1.9**	**1.9**	**1.9**	**1.3**	**1.3**	**1.3**
# under 10	**6**	**6**	**6**	**7**	**7**	**7**
# under 5	**4**	**4**	**4**	**6**	**6**	**6**
# under 2	**1**	**1**	**1**	**2**	**2**	**2**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-PCB-1a	AG-SI-PCB-1b	AG-SI-PCB-1c	AG-SI-PCB-2a	AG-SI-PCB-2b	AG-SI-PCB-2c
Various Plankton and Algae						
Zooplankton						
Benthos						
Clam (Corbicula sp)						
Oligochaete						
Insect Larvae						
Amphipod						
Crayfish	9.5	9.5	9.5	7.5	7.5	7.5
Fish						
Juvenile Fish						
Carp	1.9	1.9	1.9	2.2	2.2	2.2
Sucker, Largescale						
Chinook, Salmon (juv)						
Peamouth						
Sculpin	5.0	5.0	5.0	2.5	2.5	2.5
Crappie, Black	56.9	56.9	56.9	38.0	38.1	38.0
Bullhead, Brown	3.9	3.9	3.9	2.3	2.3	2.3
Bass, Smallmouth	4.6	4.6	4.6	2.1	2.1	2.1
Pikeminnow, Northern						
MEAN (MPAF)	**13.6**	**13.6**	**13.6**	**9.1**	**9.1**	**9.1**
Geomean	**6.7**	**6.7**	**6.7**	**4.5**	**4.5**	**4.5**
Max	**56.9**	**56.9**	**56.9**	**38.0**	**38.1**	**38.0**
Min	**1.9**	**1.9**	**1.9**	**2.1**	**2.1**	**2.1**
# under 10	**5**	**5**	**5**	**5**	**5**	**5**
# under 5	**4**	**4**	**4**	**4**	**4**	**4**
# under 2	**1**	**1**	**1**	**0**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

B.1.3

Table 1 - Arnot-Gobas Model Output for Scenario Runs
Chemical - DDE Spatial Scale - RM 2-11

Scenario	AG-RM2-11-DDE-1a	AG-RM2-11-DDE-1b	AG-RM2-11-DDE-1c	AG-RM2-11-DDE-1d	AG-RM2-11-DDE-1e	AG-RM2-11-DDE-1f	AG-RM2-11-DDE-1g	AG-RM2-11-DDE-1h	AG-RM2-11-DDE-1i	AG-RM2-11-DDE-2a	AG-RM2-11-DDE-2b	AG-RM2-11-DDE-2c	AG-RM2-11-DDE-2d	AG-RM2-11-DDE-2e	AG-RM2-11-DDE-2f	AG-RM2-11-DDE-2g	AG-RM2-11-DDE-2h	AG-RM2-11-DDE-2i
Species																		
Plankton																		
Various Plankton and Algae	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Zooplankton	0.8	0.8	0.8	0.7	0.7	0.7	0.2	0.2	0.2	0.8	0.8	0.8	0.7	0.7	0.7	0.2	0.2	0.2
Benthos																		
Clam (Corbicula sp)	1.5	1.5	1.4	1.2	1.2	1.2	0.4	0.4	0.3	1.3	1.3	1.2	1.0	1.1	1.0	0.3	0.3	0.3
Oligochaete	2.3	2.3	2.2	1.9	1.9	1.9	0.6	0.7	0.6	2.2	2.2	2.2	1.9	1.9	1.9	0.6	0.6	0.6
Insect Larvae	1.9	2.0	1.9	1.6	1.6	1.6	0.5	0.5	0.5	1.9	1.9	1.9	1.6	1.6	1.5	0.4	0.5	0.4
Amphipod	2.1	2.1	2.1	1.8	1.9	1.8	0.7	0.7	0.7	2.1	2.1	2.1	1.8	1.8	1.8	0.6	0.7	0.6
Crayfish	4.9	4.9	4.8	3.8	3.9	3.8	0.7	0.7	0.7	4.2	4.3	4.2	3.3	3.3	3.3	0.6	0.6	0.6
Fish																		
Juvenile Fish	11.3	11.4	11.2	9.4	9.5	9.3	2.0	2.0	2.0	10.8	10.9	10.7	8.7	8.8	8.7	1.6	1.6	1.5
Carp	15.5	15.7	15.4	14.4	14.5	14.2	5.0	5.1	5.0	14.0	14.1	13.8	13.0	13.2	12.9	4.0	4.0	3.9
Sucker, Largescale	21.4	21.6	21.2	18.3	18.4	18.1	4.8	4.8	4.7	12.1	12.3	12.0	11.1	11.2	10.9	3.1	3.1	3.1
Chinook, Salmon (juv)	20.8	21.0	20.7	16.1	16.2	16.0	1.8	1.8	1.8	20.0	20.1	19.8	15.0	15.1	14.9	1.5	1.5	1.5
Peamouth	16.5	16.6	16.3	14.7	14.9	14.6	3.8	3.8	3.7	13.9	14.0	13.8	12.4	12.5	12.3	3.1	3.1	3.0
Sculpin	27.3	27.5	27.0	21.7	21.9	21.4	2.6	2.7	2.6	15.0	15.2	14.9	12.0	12.1	11.8	1.8	1.8	1.8
Crappie, Black	80.2	80.9	79.3	67.8	68.4	67.1	9.4	9.4	9.3	55.5	56.0	54.9	46.5	46.9	46.0	6.2	6.2	6.2
Bullhead, Brown	14.6	14.8	14.5	11.6	11.7	11.4	1.7	1.7	1.7	10.9	11.0	10.8	8.8	8.9	8.7	1.6	1.6	1.6
Bass, Smallmouth	122.8	123.9	121.4	99.5	100.4	98.4	10.0	10.0	9.9	61.6	62.2	60.9	49.7	50.1	49.1	5.6	5.6	5.6
Pikeminnow, Northern	67.2	67.9	66.5	54.4	54.9	53.8	5.9	5.9	5.8	25.5	25.8	25.2	20.4	20.6	20.2	2.9	2.9	2.9

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-DDE-1a	AG-RM2-11-DDE-1b	AG-RM2-11-DDE-1c	AG-RM2-11-DDE-1d	AG-RM2-11-DDE-1e	AG-RM2-11-DDE-1f	AG-RM2-11-DDE-1g	AG-RM2-11-DDE-1h	AG-RM2-11-DDE-1i	AG-RM2-11-DDE-2a	AG-RM2-11-DDE-2b	AG-RM2-11-DDE-2c	AG-RM2-11-DDE-2d	AG-RM2-11-DDE-2e	AG-RM2-11-DDE-2f	AG-RM2-11-DDE-2g	AG-RM2-11-DDE-2h	AG-RM2-11-DDE-2i
Various Plankton and Algae																		
Zooplankton																		
Benthos																		
Clam (Corbicula sp)	-29.0	-28.6	-29.6	-35.2	-34.7	-35.9	-121.0	-119.9	-122.4	-33.5	-32.9	-34.3	-41.0	-40.3	-42.0	-147.2	-145.6	-149.4
Oligochaete																		
Insect Larvae																		
Amphipod																		
Crayfish	-1.3	-1.3	-1.3	-1.7	-1.6	-1.7	-9.2	-9.2	-9.3	-1.5	-1.5	-1.5	-1.9	-1.9	-1.9	-10.3	-10.2	-10.4
Fish																		
Juvenile Fish																		
Carp	-8.7	-8.6	-8.8	-9.4	-9.3	-9.5	-26.8	-26.7	-26.9	-9.7	-9.5	-9.8	-10.4	-10.3	-10.5	-34.1	-33.9	-34.3
Sucker, Largescale	-5.7	-5.6	-5.7	-6.6	-6.6	-6.7	-25.4	-25.3	-25.5	-10.0	-9.9	-10.1	-10.9	-10.8	-11.1	-39.0	-38.8	-39.2
Chinook, Salmon (juv)	-1.0	1.0	-1.0	-1.3	-1.3	-1.3	-11.9	-11.9	-12.0	-1.1	-1.0	-1.1	-1.4	-1.4	-1.4	-14.4	-14.4	-14.5
Peamouth	-8.0	-7.9	-8.1	-9.0	-8.9	-9.0	-35.2	-35.1	-35.3	-9.5	-9.4	-9.6	-10.6	-10.5	-10.7	-43.2	-43.1	-43.4
Sculpin	-2.1	-2.0	-2.1	-2.6	-2.6	-2.6	-21.2	-21.1	-21.3	-3.7	-3.7	-3.8	-4.7	-4.6	-4.7	-30.8	-30.6	-31.0
Crappie, Black	1.4	1.4	1.4	1.2	1.2	1.2	-6.0	-6.0	-6.0	-1.0	1.0	-1.0	-1.2	-1.2	-1.2	-9.0	-9.0	-9.1
Bullhead, Brown	-3.2	-3.2	-3.3	-4.1	-4.0	-4.1	-28.1	-27.9	-28.3	-4.3	-4.3	-4.3	-5.3	-5.3	-5.4	-29.8	-29.6	-30.0
Bass, Smallmouth	-1.1	-1.1	-1.1	-1.3	-1.3	-1.3	-13.2	-13.2	-13.3	-2.1	-2.1	-2.2	-2.7	-2.6	-2.7	-23.6	-23.5	-23.7
Pikeminnow, Northern	-3.7	-3.7	-3.8	-4.6	-4.6	-4.7	-42.9	-42.7	-43.2	-9.9	-9.8	-10.0	-12.3	-12.2	-12.5	-87.7	-87.2	-88.3
MEAN	**-5.7**	**-5.4**	**-5.8**	**-6.8**	**-6.7**	**-6.9**	**-31.0**	**-30.8**	**-31.2**	**-7.8**	**-7.5**	**-8.0**	**-9.3**	**-9.2**	**-9.5**	**-42.7**	**-42.4**	**-43.0**
Max	**1.4**	**1.4**	**1.4**	**1.2**	**1.2**	**1.2**	**-6.0**	**-6.0**	**-6.0**	**-1.0**	**1.0**	**-1.0**	**-1.2**	**-1.2**	**-1.2**	**-9.0**	**-9.0**	**-9.1**
Min	**-29.0**	**-28.6**	**-29.6**	**-35.2**	**-34.7**	**-35.9**	**-121.0**	**-119.9**	**-122.4**	**-33.5**	**-32.9**	**-34.3**	**-41.0**	**-40.3**	**-42.0**	**-147.2**	**-145.6**	**-149.4**
underpredict count	**10**	**9**	**10**	**10**	**10**	**10**	**11**	**11**	**11**	**11**	**10**	**11**	**11**	**11**	**11**	**11**	**11**	**11**
underpredict percentage	**91%**	**82%**	**91%**	**91%**	**91%**	**91%**	**100%**	**100%**	**100%**	**100%**	**91%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-DDE-1a	AG-RM2-11-DDE-1b	AG-RM2-11-DDE-1c	AG-RM2-11-DDE-1d	AG-RM2-11-DDE-1e	AG-RM2-11-DDE-1f	AG-RM2-11-DDE-1g	AG-RM2-11-DDE-1h	AG-RM2-11-DDE-1i	AG-RM2-11-DDE-2a	AG-RM2-11-DDE-2b	AG-RM2-11-DDE-2c	AG-RM2-11-DDE-2d	AG-RM2-11-DDE-2e	AG-RM2-11-DDE-2f	AG-RM2-11-DDE-2g	AG-RM2-11-DDE-2h	AG-RM2-11-DDE-2i
Various Plankton and Algae																		
Zooplankton																		
Benthos																		
Clam (Corbicula sp)	-17.9	-17.7	-18.3	-21.8	-21.4	-22.2	-74.8	-74.1	-75.7	-20.7	-20.3	-21.2	-25.4	-24.9	-26.0	-91.0	-90.0	-92.4
Oligochaete																		
Insect Larvae																		
Amphipod																		
Crayfish	1.1	1.1	1.1	-1.2	-1.1	-1.2	-6.4	-6.4	-6.5	-1.0	-1.0	-1.1	-1.3	-1.3	-1.3	-7.2	-7.1	-7.2
Fish																		
Juvenile Fish																		
Carp	-8.1	-8.0	-8.1	-8.7	-8.6	-8.8	-24.8	-24.7	-24.9	-8.9	-8.8	-9.1	-9.6	-9.5	-9.7	-31.6	-31.4	-31.8
Sucker, Largescale	-5.4	-5.4	-5.5	-6.4	-6.3	-6.4	-24.3	-24.2	-24.4	-9.6	-9.5	-9.7	-10.5	-10.4	-10.6	-37.4	-37.2	-37.6
Chinook, Salmon (juv)	-1.0	1.0	-1.0	-1.3	-1.3	-1.3	-11.9	-11.9	-12.0	-1.1	-1.0	-1.1	-1.4	-1.4	-1.4	-14.4	-14.4	-14.5
Peamouth	-7.8	-7.8	-7.9	-8.7	-8.7	-8.8	-34.4	-34.3	-34.5	-9.3	-9.2	-9.4	-10.4	-10.3	-10.5	-42.2	-42.1	-42.4
Sculpin	1.1	1.1	1.1	-1.1	-1.1	-1.1	-9.1	-9.0	-9.1	-1.6	-1.6	-1.6	-2.0	-2.0	-2.0	-13.2	-13.1	-13.3
Crappie, Black	1.5	1.5	1.5	1.3	1.3	1.3	-5.7	-5.6	-5.7	1.0	1.1	1.0	-1.1	-1.1	-1.2	-8.5	-8.5	-8.6
Bullhead, Brown	-3.1	-3.0	-3.1	-3.9	-3.9	-3.9	-26.9	-26.7	-27.1	-4.1	-4.1	-4.2	-5.1	-5.0	-5.1	-28.5	-28.4	-28.7
Bass, Smallmouth	-1.0	-1.0	-1.0	-1.2	-1.2	-1.3	-12.4	-12.4	-12.5	-2.0	-2.0	-2.0	-2.5	-2.5	-2.5	-22.2	-22.1	-22.3
Pikeminnow, Northern	-3.2	-3.1	-3.2	-3.9	-3.9	-4.0	-36.3	-36.1	-36.5	-8.3	-8.3	-8.5	-10.4	-10.3	-10.6	-74.2	-73.7	-74.7
MEAN	**-4.0**	**-3.7**	**-4.0**	**-5.2**	**-5.1**	**-5.2**	**-24.3**	**-24.1**	**-24.5**	**-6.0**	**-5.9**	**-6.1**	**-7.2**	**-7.2**	**-7.4**	**-33.7**	**-33.5**	**-33.9**
Max	**1.5**	**1.5**	**1.5**	**1.3**	**1.3**	**1.3**	**-5.7**	**-5.6**	**-5.7**	**1.0**	**1.1**	**1.0**	**-1.1**	**-1.1**	**-1.2**	**-7.2**	**-7.1**	**-7.2**
Min	**-17.9**	**-17.7**	**-18.3**	**-21.8**	**-21.4**	**-22.2**	**-74.8**	**-74.1**	**-75.7**	**-20.7**	**-20.3**	**-21.2**	**-25.4**	**-24.9**	**-26.0**	**-91.0**	**-90.0**	**-92.4**
underpredict count	**8**	**7**	**8**	**10**	**10**	**10**	**11**	**11**	**11**	**10**	**10**	**10**	**11**	**11**	**11**	**11**	**11**	**11**
underpredict percentage	**73%**	**64%**	**73%**	**91%**	**91%**	**91%**	**100%**	**100%**	**100%**	**91%**	**91%**	**91%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-DDE-1a	AG-RM2-11-DDE-1b	AG-RM2-11-DDE-1c	AG-RM2-11-DDE-1d	AG-RM2-11-DDE-1e	AG-RM2-11-DDE-1f	AG-RM2-11-DDE-1g	AG-RM2-11-DDE-1h	AG-RM2-11-DDE-1i	AG-RM2-11-DDE-2a	AG-RM2-11-DDE-2b	AG-RM2-11-DDE-2c	AG-RM2-11-DDE-2d	AG-RM2-11-DDE-2e	AG-RM2-11-DDE-2f	AG-RM2-11-DDE-2g	AG-RM2-11-DDE-2h	AG-RM2-11-DDE-2i
Various Plankton and Algae																		
Zooplankton																		
Benthos																		
Clam (Corbicula sp)	29.0	28.6	29.6	35.2	34.7	35.9	121.0	119.9	122.4	33.5	32.9	34.3	41.0	40.3	42.0	147.2	145.6	149.4
Oligochaete																		
Insect Larvae																		
Amphipod																		
Crayfish	1.3	1.3	1.3	1.7	1.6	1.7	9.2	9.2	9.3	1.5	1.5	1.5	1.9	1.9	1.9	10.3	10.2	10.4
Fish																		
Juvenile Fish																		
Carp	8.7	8.6	8.8	9.4	9.3	9.5	26.8	26.7	26.9	9.7	9.5	9.8	10.4	10.3	10.5	34.1	33.9	34.3
Sucker, Largescale	5.7	5.6	5.7	6.6	6.6	6.7	25.4	25.3	25.5	10.0	9.9	10.1	10.9	10.8	11.1	39.0	38.8	39.2
Chinook, Salmon (juv)	1.0	1.0	1.0	1.3	1.3	1.3	11.9	11.9	12.0	1.1	1.0	1.1	1.4	1.4	1.4	14.4	14.4	14.5
Peamouth	8.0	7.9	8.1	9.0	8.9	9.0	35.2	35.1	35.3	9.5	9.4	9.6	10.6	10.5	10.7	43.2	43.1	43.4
Sculpin	2.1	2.0	2.1	2.6	2.6	2.6	21.2	21.1	21.3	3.7	3.7	3.8	4.7	4.6	4.7	30.8	30.6	31.0
Crappie, Black	1.4	1.4	1.4	1.2	1.2	1.2	6.0	6.0	6.0	1.0	1.0	1.0	1.2	1.2	1.2	9.0	9.0	9.1
Bullhead, Brown	3.2	3.2	3.3	4.1	4.0	4.1	28.1	27.9	28.3	4.3	4.3	4.3	5.3	5.3	5.4	29.8	29.6	30.0
Bass, Smallmouth	1.1	1.1	1.1	1.3	1.3	1.3	13.2	13.2	13.3	2.1	2.1	2.2	2.7	2.6	2.7	23.6	23.5	23.7
Pikeminnow, Northern	3.7	3.7	3.8	4.6	4.6	4.7	42.9	42.7	43.2	9.9	9.8	10.0	12.3	12.2	12.5	87.7	87.2	88.3
MEAN (MPAF)	**5.9**	**5.9**	**6.0**	**7.0**	**6.9**	**7.1**	**31.0**	**30.8**	**31.2**	**7.8**	**7.7**	**8.0**	**9.3**	**9.2**	**9.5**	**42.7**	**42.4**	**43.0**
Geomean	**3.3**	**3.3**	**3.4**	**3.9**	**3.9**	**4.0**	**22.2**	**22.1**	**22.3**	**4.5**	**4.5**	**4.6**	**5.5**	**5.4**	**5.5**	**30.5**	**30.4**	**30.7**
Max	**29.0**	**28.6**	**29.6**	**35.2**	**34.7**	**35.9**	**121.0**	**119.9**	**122.4**	**33.5**	**32.9**	**34.3**	**41.0**	**40.3**	**42.0**	**147.2**	**145.6**	**149.4**
Min	**1.0**	**1.0**	**1.0**	**1.2**	**1.2**	**1.2**	**6.0**	**6.0**	**6.0**	**1.0**	**1.0**	**1.0**	**1.2**	**1.2**	**1.2**	**9.0**	**9.0**	**9.1**
# under 10	**10**	**10**	**10**	**10**	**10**	**10**	**2**	**2**	**2**	**10**	**10**	**9**	**6**	**6**	**6**	**1**	**1**	**1**
# under 5	**7**	**7**	**7**	**7**	**7**	**7**	**0**	**0**	**0**	**6**	**6**	**6**	**5**	**5**	**5**	**0**	**0**	**0**
# under 2	**4**	**4**	**4**	**4**	**4**	**4**	**0**	**0**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**0**	**0**	**0**

Table 5 - SPAF - Comparison to geomean measured value (μg/kg ww) as Factor Difference

Scenario	AG-RM2-11-DDE-1a	AG-RM2-11-DDE-1b	AG-RM2-11-DDE-1c	AG-RM2-11-DDE-1d	AG-RM2-11-DDE-1e	AG-RM2-11-DDE-1f	AG-RM2-11-DDE-1g	AG-RM2-11-DDE-1h	AG-RM2-11-DDE-1i	AG-RM2-11-DDE-2a	AG-RM2-11-DDE-2b	AG-RM2-11-DDE-2c	AG-RM2-11-DDE-2d	AG-RM2-11-DDE-2e	AG-RM2-11-DDE-2f	AG-RM2-11-DDE-2g	AG-RM2-11-DDE-2h	AG-RM2-11-DDE-2i
Various Plankton and Algae																		
Zooplankton																		
Benthos																		
Clam (Corbicula sp)	17.9	17.7	18.3	21.8	21.4	22.2	74.8	74.1	75.7	20.7	20.3	21.2	25.4	24.9	26.0	91.0	90.0	92.4
Oligochaete																		
Insect Larvae																		
Amphipod																		
Crayfish	1.1	1.1	1.1	1.2	1.1	1.2	6.4	6.4	6.5	1.0	1.0	1.1	1.3	1.3	1.3	7.2	7.1	7.2
Fish																		
Juvenile Fish																		
Carp	8.1	8.0	8.1	8.7	8.6	8.8	24.8	24.7	24.9	8.9	8.8	9.1	9.6	9.5	9.7	31.6	31.4	31.8
Sucker, Largescale	5.4	5.4	5.5	6.4	6.3	6.4	24.3	24.2	24.4	9.6	9.5	9.7	10.5	10.4	10.6	37.4	37.2	37.6
Chinook, Salmon (juv)	1.0	1.0	1.0	1.3	1.3	1.3	11.9	11.9	12.0	1.1	1.0	1.1	1.4	1.4	1.4	14.4	14.4	14.5
Peamouth	7.8	7.8	7.9	8.7	8.7	8.8	34.4	34.3	34.5	9.3	9.2	9.4	10.4	10.3	10.5	42.2	42.1	42.4
Sculpin	1.1	1.1	1.1	1.1	1.1	1.1	9.1	9.0	9.1	1.6	1.6	1.6	2.0	2.0	2.0	13.2	13.1	13.3
Crappie, Black	1.5	1.5	1.5	1.3	1.3	1.3	5.7	5.6	5.7	1.0	1.1	1.0	1.1	1.1	1.2	8.5	8.5	8.6
Bullhead, Brown	3.1	3.0	3.1	3.9	3.9	3.9	26.9	26.7	27.1	4.1	4.1	4.2	5.1	5.0	5.1	28.5	28.4	28.7
Bass, Smallmouth	1.0	1.0	1.0	1.2	1.2	1.3	12.4	12.4	12.5	2.0	2.0	2.0	2.5	2.5	2.5	22.2	22.1	22.3
Pikeminnow, Northern	3.2	3.1	3.2	3.9	3.9	4.0	36.3	36.1	36.5	8.3	8.3	8.5	10.4	10.3	10.6	74.2	73.7	74.7
MEAN (MPAF)	**4.7**	**4.6**	**4.7**	**5.4**	**5.3**	**5.5**	**24.3**	**24.1**	**24.5**	**6.2**	**6.1**	**6.2**	**7.2**	**7.2**	**7.4**	**33.7**	**33.5**	**33.9**
Geomean	**2.9**	**2.9**	**2.9**	**3.2**	**3.2**	**3.3**	**18.2**	**18.2**	**18.4**	**3.8**	**3.7**	**3.8**	**4.5**	**4.4**	**4.5**	**25.1**	**25.0**	**25.3**
Max	**17.9**	**17.7**	**18.3**	**21.8**	**21.4**	**22.2**	**74.8**	**74.1**	**75.7**	**20.7**	**20.3**	**21.2**	**25.4**	**24.9**	**26.0**	**91.0**	**90.0**	**92.4**
Min	**1.0**	**1.0**	**1.0**	**1.1**	**1.1**	**1.1**	**5.7**	**5.6**	**5.7**	**1.0**	**1.0**	**1.0**	**1.1**	**1.1**	**1.2**	**7.2**	**7.1**	**7.2**
# under 10	**10**	**10**	**10**	**10**	**10**	**10**	**3**	**3**	**3**	**10**	**10**	**10**	**7**	**7**	**7**	**2**	**2**	**2**
# under 5	**7**	**7**	**7**	**7**	**7**	**7**	**0**	**0**	**0**	**6**	**6**	**6**	**5**	**5**	**5**	**0**	**0**	**0**
# under 2	**5**	**5**	**5**	**5**	**5**	**5**	**0**	**0**	**0**	**4**	**5**	**4**	**3**	**4**	**3**	**0**	**0**	**0**

B.1.4

Table 1 - Arnot-Gobas Model Output for Scenario Runs
Chemical - DDE Spatial Scale - Swan Island

Scenario	**AG-SI-DDE-1a**	**AG-SI-DDE-1b**	**AG-SI-DDE-1c**	**AG-SI-DDE-1d**	**AG-SI-DDE-1e**	**AG-SI-DDE-1f**	**AG-SI-DDE-1g**	**AG-SI-DDE-1h**	**AG-SI-DDE-1i**	**AG-SI-DDE-2a**	**AG-SI-DDE-2b**	**AG-SI-DDE-2c**	**AG-SI-DDE-2d**	**AG-SI-DDE-2e**	**AG-SI-DDE-2f**	**AG-SI-DDE-2g**	**AG-SI-DDE-2h**	**AG-SI-DDE-2i**
Species																		
Plankton																		
Various Plankton and Algae	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Zooplankton	0.8	0.8	0.8	0.6	0.6	0.6	0.2	0.2	0.2	0.8	0.8	0.8	0.6	0.6	0.6	0.2	0.2	0.2
Benthos																		
Clam (Corbicula sp)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5
Oligochaete	1.7	1.7	1.7	1.5	1.5	1.5	0.5	0.5	0.5	1.7	1.7	1.7	1.5	1.5	1.4	0.5	0.5	0.5
Insect Larvae	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Amphipod	1.6	1.6	1.6	1.4	1.4	1.4	0.5	0.5	0.5	1.6	1.6	1.6	1.4	1.4	1.4	0.5	0.5	0.5
Crayfish	5.0	5.0	5.0	4.4	4.4	4.3	1.5	1.5	1.5	4.4	4.5	4.4	3.8	3.9	3.8	1.3	1.3	1.3
Fish																		
Juvenile Fish	12.3	12.4	12.3	11.4	11.4	11.4	4.5	4.5	4.5	12.5	12.5	12.5	11.3	11.3	11.3	4.1	4.1	4.1
Carp	15.9	16.0	15.9	16.1	16.2	16.0	9.0	9.0	8.9	17.5	17.5	17.4	18.5	18.5	18.4	10.5	10.6	10.5
Sucker, Largescale	21.4	21.4	21.3	19.9	19.9	19.8	7.9	7.9	7.9	14.6	14.6	14.6	14.9	14.9	14.8	7.4	7.4	7.4
Chinook, Salmon (juv)	22.7	22.8	22.7	19.4	19.5	19.4	3.8	3.8	3.8	22.8	22.8	22.7	19.0	19.1	19.0	3.3	3.3	3.3
Peamouth	18.0	18.1	17.9	17.8	17.9	17.7	7.9	7.9	7.9	16.3	16.3	16.2	16.2	16.3	16.2	7.0	7.0	7.0
Sculpin	28.5	28.6	28.5	25.6	25.7	25.6	7.2	7.2	7.2	14.8	14.8	14.7	13.1	13.1	13.1	4.1	4.1	4.1
Crappie, Black	102.6	102.8	102.2	97.9	98.1	97.6	25.9	25.9	25.8	72.2	72.4	71.9	68.7	68.9	68.5	18.5	18.5	18.5
Bullhead, Brown	17.3	17.3	17.2	15.5	15.6	15.5	5.3	5.3	5.3	11.1	11.1	11.0	9.8	9.8	9.7	3.3	3.3	3.3
Bass, Smallmouth	134.7	134.9	134.4	122.8	123.0	122.5	24.4	25.3	25.3	65.7	65.9	65.4	58.8	59.0	58.6	12.5	12.5	12.5
Pikeminnow, Northern	77.8	77.9	77.5	71.3	71.4	71.1	16.6	16.6	16.6	30.7	30.8	30.6	27.8	27.9	27.8	8.7	8.7	8.7

Table 2 - Model Bias - Comparison to mean measured value (μg/kg ww) as Factor Difference

Scenario	AG-SI-DDE-1a	AG-SI-DDE-1b	AG-SI-DDE-1c	AG-SI-DDE-1d	AG-SI-DDE-1e	AG-SI-DDE-1f	AG-SI-DDE-1g	AG-SI-DDE-1h	AG-SI-DDE-1i	AG-SI-DDE-2a	AG-SI-DDE-2b	AG-SI-DDE-2c	AG-SI-DDE-2d	AG-SI-DDE-2e	AG-SI-DDE-2f	AG-SI-DDE-2g	AG-SI-DDE-2h	AG-SI-DDE-2i
Various Plankton and Algae																		
Zooplankton																		
Benthos																		
Clam (Corbicula sp)																		
Oligochaete																		
Insect Larvae																		
Amphipod																		
Crayfish	2.2	2.2	2.2	1.9	1.9	1.9	-1.5	-1.5	-1.5	1.9	1.9	1.9	1.7	1.7	1.7	-1.8	-1.8	-1.8
Fish																		
Juvenile Fish																		
Carp	-7.7	-7.6	-7.7	-7.6	-7.5	-7.6	-13.6	-13.6	-13.6	-7.0	-7.0	-7.0	-6.6	-6.6	-6.6	-11.6	-11.5	-11.6
Sucker, Largescale	-8.7	-8.6	-8.7	-9.3	-9.3	-9.3	-23.5	-23.4	-23.5	-12.7	-12.6	-12.7	-12.4	-12.4	-12.5	-25.1	-25.1	-25.2
Chinook, Salmon (juv)																		
Peamouth	-6.9	-6.9	-7.0	-7.0	-7.0	-7.0	-15.8	-15.7	-15.8	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	-17.8	-17.7	-17.8
Sculpin	1.4	1.4	1.4	1.2	1.2	1.2	-2.9	-2.9	-2.9	-1.4	-1.4	-1.4	-1.6	-1.6	-1.6	-5.2	-5.2	-5.2
Crappie, Black	1.4	1.4	1.4	1.3	1.3	1.3	-2.9	-2.9	-2.9	-1.0	-1.0	-1.0	-1.1	-1.1	-1.1	-4.0	-4.0	-4.0
Bullhead, Brown	-2.7	-2.7	-2.7	-3.0	-3.0	-3.0	-8.9	-8.9	-8.9	-4.2	-4.2	-4.3	-4.8	-4.8	-4.8	-14.2	-14.2	-14.3
Bass, Smallmouth	1.8	1.8	1.8	1.6	1.6	1.6	-3.1	-3.0	-3.0	-1.2	-1.1	-1.2	-1.3	-1.3	-1.3	-6.0	-6.0	-6.1
Pikeminnow, Northern	-1.1	-1.1	-1.1	-1.2	-1.1	-1.2	-4.9	-4.9	-4.9	-2.7	-2.7	-2.7	-2.9	-2.9	-3.0	-9.4	-9.4	-9.4
MEAN	**-2.3**	**-2.2**	**-2.3**	**-2.4**	**-2.4**	**-2.5**	**-8.6**	**-8.5**	**-8.6**	**-4.0**	**-4.0**	**-4.0**	**-4.1**	**-4.1**	**-4.1**	**-10.6**	**-10.6**	**-10.6**
Max	**2.2**	**2.2**	**2.2**	**1.9**	**1.9**	**1.9**	**-1.5**	**-1.5**	**-1.5**	**1.9**	**1.9**	**1.9**	**1.7**	**1.7**	**1.7**	**-1.8**	**-1.8**	**-1.8**
Min	**-8.7**	**-8.6**	**-8.7**	**-9.3**	**-9.3**	**-9.3**	**-23.5**	**-23.4**	**-23.5**	**-12.7**	**-12.6**	**-12.7**	**-12.4**	**-12.4**	**-12.5**	**-25.1**	**-25.1**	**-25.2**
underpredict count	**5**	**5**	**5**	**5**	**5**	**5**	**9**	**9**	**9**	**8**	**8**	**8**	**8**	**8**	**8**	**9**	**9**	**9**
underpredict percentage	**56%**	**56%**	**56%**	**56%**	**56%**	**56%**	**100%**	**100%**	**100%**	**89%**	**89%**	**89%**	**89%**	**89%**	**89%**	**100%**	**100%**	**100%**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-DDE-1a	AG-SI-DDE-1b	AG-SI-DDE-1c	AG-SI-DDE-1d	AG-SI-DDE-1e	AG-SI-DDE-1f	AG-SI-DDE-1g	AG-SI-DDE-1h	AG-SI-DDE-1i	AG-SI-DDE-2a	AG-SI-DDE-2b	AG-SI-DDE-2c	AG-SI-DDE-2d	AG-SI-DDE-2e	AG-SI-DDE-2f	AG-SI-DDE-2g	AG-SI-DDE-2h	AG-SI-DDE-2i
Various Plankton and Algae																		
Zooplankton																		
Benthos																		
Clam (Corbicula sp)																		
Oligochaete																		
Insect Larvae																		
Amphipod																		
Crayfish	2.3	2.3	2.3	2.0	2.0	2.0	-1.5	-1.5	-1.5	2.0	2.0	2.0	1.7	1.8	1.7	-1.7	-1.7	-1.7
Fish																		
Juvenile Fish																		
Carp	-7.5	-7.5	-7.6	-7.5	-7.4	-7.5	-13.4	-13.4	-13.4	-6.9	-6.9	-6.9	-6.5	-6.5	-6.5	-11.4	-11.4	-11.4
Sucker, Largescale																		
Chinook, Salmon (juv)																		
Peamouth																		
Sculpin	1.4	1.4	1.4	1.2	1.2	1.2	-2.9	-2.9	-2.9	-1.4	-1.4	-1.4	-1.6	-1.6	-1.6	-5.1	-5.1	-5.1
Crappie, Black	1.4	1.4	1.4	1.3	1.3	1.3	-2.8	-2.8	-2.8	-1.0	-1.0	-1.0	-1.1	-1.1	-1.1	-4.0	-4.0	-4.0
Bullhead, Brown	-2.6	-2.6	-2.6	-2.9	-2.9	-2.9	-8.5	-8.5	-8.5	-4.1	-4.0	-4.1	-4.6	-4.6	-4.6	-13.7	-13.6	-13.7
Bass, Smallmouth	1.8	1.8	1.8	1.7	1.7	1.7	-3.0	-2.9	-2.9	-1.1	-1.1	-1.1	-1.3	-1.2	-1.3	-5.9	-5.9	-5.9
Pikeminnow, Northern																		
MEAN	**-0.5**	**-0.5**	**-0.6**	**-0.7**	**-0.7**	**-0.7**	**-5.4**	**-5.3**	**-5.3**	**-2.1**	**-2.1**	**-2.1**	**-2.2**	**-2.2**	**-2.2**	**-7.0**	**-6.9**	**-7.0**
Max	**2.3**	**2.3**	**2.3**	**2.0**	**2.0**	**2.0**	**-1.5**	**-1.5**	**-1.5**	**2.0**	**2.0**	**2.0**	**1.7**	**1.8**	**1.7**	**-1.7**	**-1.7**	**-1.7**
Min	**-7.5**	**-7.5**	**-7.6**	**-7.5**	**-7.4**	**-7.5**	**-13.4**	**-13.4**	**-13.4**	**-6.9**	**-6.9**	**-6.9**	**-6.5**	**-6.5**	**-6.5**	**-13.7**	**-13.6**	**-13.7**
underpredict count	**2**	**2**	**2**	**2**	**2**	**2**	**6**	**6**	**6**	**5**	**5**	**5**	**5**	**5**	**5**	**6**	**6**	**6**
underpredict percentage	**33%**	**33%**	**33%**	**33%**	**33%**	**33%**	**100%**	**100%**	**100%**	**83%**	**83%**	**83%**	**83%**	**83%**	**83%**	**100%**	**100%**	**100%**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 4 - SPAF - Comparison to **mean** measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-DDE-1a	AG-SI-DDE-1b	AG-SI-DDE-1c	AG-SI-DDE-1d	AG-SI-DDE-1e	AG-SI-DDE-1f	AG-SI-DDE-1g	AG-SI-DDE-1h	AG-SI-DDE-1i	AG-SI-DDE-2a	AG-SI-DDE-2b	AG-SI-DDE-2c	AG-SI-DDE-2d	AG-SI-DDE-2e	AG-SI-DDE-2f	AG-SI-DDE-2g	AG-SI-DDE-2h	AG-SI-DDE-2i
Various Plankton and Algae																		
Zooplankton																		
Benthos																		
Clam (Corbicula sp)																		
Oligochaete																		
Insect Larvae																		
Amphipod																		
Crayfish	2.2	2.2	2.2	1.9	1.9	1.9	1.5	1.5	1.5	1.9	1.9	1.9	1.7	1.7	1.7	1.8	1.8	1.8
Fish																		
Juvenile Fish																		
Carp	7.7	7.6	7.7	7.6	7.5	7.6	13.6	13.6	13.6	7.0	7.0	7.0	6.6	6.6	6.6	11.6	11.5	11.6
Sucker, Largescale	8.7	8.6	8.7	9.3	9.3	9.3	23.5	23.4	23.5	12.7	12.6	12.7	12.4	12.4	12.5	25.1	25.1	25.2
Chinook, Salmon (juv)																		
Peamouth	6.9	6.9	7.0	7.0	7.0	7.0	15.8	15.7	15.8	7.7	7.7	7.7	7.7	7.7	7.7	17.8	17.7	17.8
Sculpin	1.4	1.4	1.4	1.2	1.2	1.2	2.9	2.9	2.9	1.4	1.4	1.4	1.6	1.6	1.6	5.2	5.2	5.2
Crappie, Black	1.4	1.4	1.4	1.3	1.3	1.3	2.9	2.9	2.9	1.0	1.0	1.0	1.1	1.1	1.1	4.0	4.0	4.0
Bullhead, Brown	2.7	2.7	2.7	3.0	3.0	3.0	8.9	8.9	8.9	4.2	4.2	4.3	4.8	4.8	4.8	14.2	14.2	14.3
Bass, Smallmouth	1.8	1.8	1.8	1.6	1.6	1.6	3.1	3.0	3.0	1.2	1.1	1.2	1.3	1.3	1.3	6.0	6.0	6.1
Pikeminnow, Northern	1.1	1.1	1.1	1.2	1.1	1.2	4.9	4.9	4.9	2.7	2.7	2.7	2.9	2.9	3.0	9.4	9.4	9.4
MEAN (MPAF)	**3.7**	**3.7**	**3.8**	**3.8**	**3.8**	**3.8**	**8.6**	**8.5**	**8.6**	**4.4**	**4.4**	**4.4**	**4.5**	**4.4**	**4.5**	**10.6**	**10.6**	**10.6**
Geomean	**2.8**	**2.8**	**2.8**	**2.7**	**2.7**	**2.7**	**5.9**	**5.9**	**5.9**	**3.1**	**3.1**	**3.1**	**3.2**	**3.2**	**3.2**	**8.1**	**8.1**	**8.2**
Max	**8.7**	**8.6**	**8.7**	**9.3**	**9.3**	**9.3**	**23.5**	**23.4**	**23.5**	**12.7**	**12.6**	**12.7**	**12.4**	**12.4**	**12.5**	**25.1**	**25.1**	**25.2**
Min	**1.1**	**1.1**	**1.1**	**1.2**	**1.1**	**1.2**	**1.5**	**1.5**	**1.5**	**1.0**	**1.0**	**1.0**	**1.1**	**1.1**	**1.1**	**1.8**	**1.8**	**1.8**
# under 10	**9**	**9**	**9**	**9**	**9**	**9**	**6**	**6**	**6**	**8**	**8**	**8**	**8**	**8**	**8**	**5**	**5**	**5**
# under 5	**6**	**6**	**6**	**6**	**6**	**6**	**5**	**5**	**5**	**6**	**6**	**6**	**6**	**6**	**6**	**2**	**2**	**2**
# under 2	**4**	**4**	**4**	**5**	**5**	**5**	**1**	**1**	**1**	**4**	**4**	**4**	**4**	**4**	**4**	**1**	**1**	**1**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5 - SPAF - Comparison to **geomean** measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-DDE-1a	AG-SI-DDE-1b	AG-SI-DDE-1c	AG-SI-DDE-1d	AG-SI-DDE-1e	AG-SI-DDE-1f	AG-SI-DDE-1g	AG-SI-DDE-1h	AG-SI-DDE-1i	AG-SI-DDE-2a	AG-SI-DDE-2b	AG-SI-DDE-2c	AG-SI-DDE-2d	AG-SI-DDE-2e	AG-SI-DDE-2f	AG-SI-DDE-2g	AG-SI-DDE-2h	AG-SI-DDE-2i
Various Plankton and Algae																		
Zooplankton																		
Benthos																		
Clam (Corbicula sp)																		
Oligochaete																		
Insect Larvae																		
Amphipod																		
Crayfish	2.3	2.3	2.3	2.0	2.0	2.0	1.5	1.5	1.5	2.0	2.0	2.0	1.7	1.8	1.7	1.7	1.7	1.7
Fish																		
Juvenile Fish																		
Carp	7.5	7.5	7.6	7.5	7.4	7.5	13.4	13.4	13.4	6.9	6.9	6.9	6.5	6.5	6.5	11.4	11.4	11.4
Sucker, Largescale																		
Chinook, Salmon (juv)																		
Peamouth																		
Sculpin	1.4	1.4	1.4	1.2	1.2	1.2	2.9	2.9	2.9	1.4	1.4	1.4	1.6	1.6	1.6	5.1	5.1	5.1
Crappie, Black	1.4	1.4	1.4	1.3	1.3	1.3	2.8	2.8	2.8	1.0	1.0	1.0	1.1	1.1	1.1	4.0	4.0	4.0
Bullhead, Brown	2.6	2.6	2.6	2.9	2.9	2.9	8.5	8.5	8.5	4.1	4.0	4.1	4.6	4.6	4.6	13.7	13.6	13.7
Bass, Smallmouth	1.8	1.8	1.8	1.7	1.7	1.7	3.0	2.9	2.9	1.1	1.1	1.1	1.3	1.2	1.3	5.9	5.9	5.9
Pikeminnow, Northern																		
MEAN (MPAF)	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**5.4**	**5.3**	**5.3**	**2.7**	**2.7**	**2.8**	**2.8**	**2.8**	**2.8**	**7.0**	**6.9**	**7.0**
Geomean	**2.3**	**2.3**	**2.3**	**2.2**	**2.2**	**2.2**	**4.0**	**4.0**	**4.0**	**2.1**	**2.1**	**2.1**	**2.2**	**2.2**	**2.2**	**5.6**	**5.6**	**5.7**
Max	**7.5**	**7.5**	**7.6**	**7.5**	**7.4**	**7.5**	**13.4**	**13.4**	**13.4**	**6.9**	**6.9**	**6.9**	**6.5**	**6.5**	**6.5**	**13.7**	**13.6**	**13.7**
Min	**1.4**	**1.4**	**1.4**	**1.2**	**1.2**	**1.2**	**1.5**	**1.5**	**1.5**	**1.0**	**1.0**	**1.0**	**1.1**	**1.1**	**1.1**	**1.7**	**1.7**	**1.7**
# under 10	**6**	**6**	**6**	**6**	**6**	**6**	**5**	**5**	**5**	**6**	**6**	**6**	**6**	**6**	**6**	**4**	**4**	**4**
# under 5	**5**	**5**	**5**	**5**	**5**	**5**	**4**	**4**	**4**	**5**	**5**	**5**	**5**	**5**	**5**	**2**	**2**	**2**
# under 2	**3**	**3**	**3**	**4**	**4**	**4**	**1**	**1**	**1**	**3**	**3**	**3**	**4**	**4**	**4**	**1**	**1**	**1**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

B.2.1

Table 1 - Arnot Gobas - Initial Predicted Values (µg/kg ww) for Sensiti

Chemical - parameterized for average values "Total PCBs"

Spatial Scale - RM 2-11 Kow - 5.5

Species	Mean
Plankton and Primary Producers	
Various Plankton and Algae	5.0
Zooplankton	1.9
Invertebrates	
Clam (Corbicula sp)	5.5
Oligochaete	11.3
Insect Larvae	7.4
Amphipod	11.9
Crayfish	8.9
Fish	
Juvenile Fish	25.6
Carp	79.0
Sucker, Largescale	76.8
Chinook, Salmon (juv)	17.7
Peamouth	50.7
Sculpin	27.8
Crappie, Black	78.4
Bullhead, Brown	19.5
Bass, Smallmouth	93.5
Pikeminnow, Northern	58.0

Table 2

Chemical - parameterized for average values "Total PCBs"

Spatial Scale - RM 2-11 Kow - 6.5

Species	Mean
Plankton and Primary Producers	
Various Plankton and Algae	4.1
Zooplankton	11.5
Invertebrates	
Clam (Corbicula sp)	28.3
Oligochaete	48.4
Insect Larvae	37.6
Amphipod	47.2
Crayfish	91.3
Fish	
Juvenile Fish	214.4
Carp	349.3
Sucker, Largescale	437.8
Chinook, Salmon (juv)	359.6
Peamouth	350.0
Sculpin	493.2
Crappie, Black	1557.8
Bullhead, Brown	273.7
Bass, Smallmouth	2275.9
Pikeminnow, Northern	1254.1

Table 3
Chemical - Parameterized for average values "Total PCBs"
Spatial Scale - RM2-11 Kow - 7.5

Species	Mean
Plankton and Primary Producers	
Various Plankton and Algae	0.9
Zooplankton	18.7
Invertebrates	
Clam (Corbicula sp)	34.6
Oligochaete	64.6
Insect Larvae	51.9
Amphipod	60.4
Crayfish	115.2
Fish	
Juvenile Fish	183.2
Carp	223.0
Sucker, Largescale	323.0
Chinook, Salmon (juv)	286.3
Peamouth	224.9
Sculpin	365.8
Crappie, Black	810.5
Bullhead, Brown	264.8
Bass, Smallmouth	1185.1
Pikeminnow, Northern	725.1

Table 4
Chemical - parameterized for average values "Total PCBs"
Spatial Scale - Swan Island Kow - 5.5

Species	Mean
Plankton and Primary Producers	
Various Plankton and Algae	5.0
Zooplankton	1.9
Invertebrates	
Clam (Corbicula sp)	319.5
Oligochaete	38.2
Insect Larvae	383.0
Amphipod	41.3
Crayfish	125.8
Fish	
Juvenile Fish	371.9
Carp	786.0
Sucker, Largescale	673.3
Chinook, Salmon (juv)	233.2
Peamouth	638.8
Sculpin	569.8
Crappie, Black	1605.1
Bullhead, Brown	452.2
Bass, Smallmouth	1599.1
Pikeminnow, Northern	1156.4

Table 5
Chemical - parameterized for average values "Total PCBs"
Spatial Scale - Swan Island Kow - 6.5

Species	Mean
Plankton and Primary Producers	
Various Plankton and Algae	4.0
Zooplankton	11.3
Invertebrates	
Clam (Corbicula sp)	320.1
Oligochaete	159.9
Insect Larvae	383.7
Amphipod	158.5
Crayfish	518.8
Fish	
Juvenile Fish	1235.8
Carp	1886.4
Sucker, Largescale	2314.3
Chinook, Salmon (juv)	2002.3
Peamouth	2022.5
Sculpin	2958.7
Crappie, Black	11311.3
Bullhead, Brown	1894.7
Bass, Smallmouth	14033.3
Pikeminnow, Northern	8234.7

Table 6
Chemical - parameterized for average values "Total PCBs"
Spatial Scale - Swan Island Kow - 7.5

Species	Mean
Plankton and Primary Producers	
Various Plankton and Algae	0.9
Zooplankton	17.9
Invertebrates	
Clam (Corbicula sp)	319.5
Oligochaete	212.9
Insect Larvae	383.6
Amphipod	201.9
Crayfish	565.1
Fish	
Juvenile Fish	866.6
Carp	1082.8
Sucker, Largescale	1527.0
Chinook, Salmon (juv)	1285.2
Peamouth	1104.9
Sculpin	1912.1
Crappie, Black	4698.4
Bullhead, Brown	1488.8
Bass, Smallmouth	6247.4
Pikeminnow, Northern	3962.8

B.2.2

Table 1 - Arnot-Gobas Model Output for Sensitivity Runs

Spatial Scale: RM2-11 Kow: 5.5

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Species								
Plankton								
Various Plankton and Algae	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Zooplankton	1.8	1.2	1.9	1.9	4.0	1.9	1.9	1.8
Benthos								
Clam (Corbicula sp)	5.5	3.5	5.5	5.2	10.9	5.6	3.7	5.5
Oligochaete	10.2	8.0	11.3	9.8	20.6	11.3	11.3	9.3
Insect Larvae	7.4	5.1	7.3	6.9	12.8	7.4	4.9	7.3
Amphipod	10.8	8.8	11.9	10.1	23.1	11.9	11.9	9.8
Crayfish	7.8	5.9	8.9	6.5	20.9	8.9	8.2	7.0
Fish								
Juvenile Fish	23.1	13.1	25.6	19.3	34.9	25.7	23.5	20.6
Carp	71.2	42.0	79.0	56.3	81.9	79.2	75.7	62.0
Sucker, Largescale	69.6	40.9	76.8	53.5	89.4	77.0	74.0	61.3
Chinook, Salmon (juv)	15.2	7.2	17.7	10.5	28.1	17.8	16.4	13.0
Peamouth	44.9	25.3	50.6	38.7	63.0	50.8	47.6	39.3
Sculpin	24.4	11.1	27.8	16.3	40.7	27.9	23.8	20.9
Crappie, Black	64.8	26.1	78.4	28.9	101.0	78.7	71.1	52.2
Bullhead, Brown	16.9	9.2	19.5	12.1	35.6	19.5	17.0	14.7
Bass, Smallmouth	76.9	28.8	93.5	29.4	119.6	93.9	83.3	61.4
Pikeminnow, Northern	48.5	20.6	58.0	25.1	81.8	58.2	51.4	39.7

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Species								
Plankton								
Various Plankton and Algae	5.2	4.2	5.0	5.1	5.0	5.1	2.5	5.0
Zooplankton	2.8	0.9	1.7	1.9	1.9	1.9	0.9	1.9
Benthos								
Clam (Corbicula sp)	7.9	3.0	5.6	5.6	5.7	5.6	4.7	3.6
Oligochaete	15.8	6.1	6.9	11.3	11.9	11.3	10.4	6.5
Insect Larvae	10.5	3.9	7.4	7.4	7.7	7.4	6.3	4.7
Amphipod	16.6	6.6	7.2	12.0	12.8	12.0	11.2	6.7
Crayfish	15.1	3.6	5.0	8.9	9.3	9.0	7.4	5.9
Fish								
Juvenile Fish	41.9	11.0	16.0	25.8	26.7	25.9	20.1	18.3
Carp	114.6	40.2	47.9	79.5	85.8	79.7	67.1	51.5
Sucker, Largescale	111.5	41.1	47.6	77.2	85.2	77.3	68.5	46.7
Chinook, Salmon (juv)	35.4	5.6	9.2	17.9	18.3	18.0	13.0	13.7
Peamouth	81.3	22.0	30.2	51.1	52.9	51.3	40.3	35.8
Sculpin	54.5	9.0	15.1	28.1	28.9	28.2	21.2	20.6
Crappie, Black	163.1	21.8	32.9	79.1	81.6	79.5	60.9	56.8
Bullhead, Brown	36.4	6.6	10.4	19.6	20.3	19.7	15.9	13.3
Bass, Smallmouth	204.3	24.1	37.9	94.4	97.1	94.8	71.3	69.0
Pikeminnow, Northern	121.6	16.4	26.1	58.6	60.2	58.8	44.8	42.3

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.00%	0.00%	0.00%	0.00%	0.00%	0.8%	0.0%	0.0%
Zooplankton	-1.8%	-36.6%	0.00%	-0.4%	114.8%	0.8%	0.0%	-3.3%
Benthos								
Clam (Corbicula sp)	0.1%	-36.3%	-0.08%	-5.7%	96.2%	0.3%	-32.3%	-0.1%
Oligochaete	-9.7%	-28.9%	-0.04%	-12.5%	83.4%	0.1%	0.0%	-17.6%
Insect Larvae	0.1%	-31.0%	-0.07%	-6.6%	74.3%	0.2%	-33.8%	-0.1%
Amphipod	-9.8%	-26.1%	-0.03%	-15.1%	93.9%	0.1%	0.0%	-17.9%
Crayfish	-11.8%	-33.6%	-0.05%	-26.2%	136.4%	0.3%	-7.5%	-21.5%
Fish								
Juvenile Fish	-9.8%	-48.9%	-0.03%	-24.7%	36.4%	0.4%	-8.1%	-19.6%
Carp	-9.9%	-46.8%	-0.05%	-28.8%	3.7%	0.3%	-4.3%	-21.6%
Sucker, Largescale	-9.4%	-46.7%	-0.04%	-30.4%	16.4%	0.2%	-3.7%	-20.2%
Chinook, Salmon (juv)	-14.3%	-59.2%	-0.03%	-40.6%	58.5%	0.5%	-7.3%	-26.6%
Peamouth	-11.5%	-50.1%	-0.02%	-23.6%	24.4%	0.3%	-6.0%	-22.4%
Sculpin	-12.4%	-60.1%	-0.05%	-41.5%	46.3%	0.4%	-14.4%	-24.8%
Crappie, Black	-17.4%	-66.7%	-0.04%	-63.1%	28.9%	0.4%	-9.3%	-33.4%
Bullhead, Brown	-13.2%	-52.6%	-0.05%	-38.0%	82.9%	0.3%	-12.8%	-24.3%
Bass, Smallmouth	-17.8%	-69.2%	-0.04%	-68.5%	27.9%	0.4%	-10.9%	-34.3%
Pikeminnow, Northern	-16.3%	-64.5%	-0.04%	-56.8%	41.0%	0.4%	-11.3%	-31.5%
MEAN (with negatives)	**-9.7%**	**-44.6%**	**-0.04%**	**-28.4%**	**56.8%**	**0.4%**	**-9.5%**	**-18.8%**
Median (with negatives)	**-9.9%**	**-46.8%**	**0.0%**	**-26.2%**	**46.3%**	**0.3%**	**-7.5%**	**-21.5%**
Max (with negatives)	**0.1%**	**0.0%**	**0.00%**	**0.0%**	**136.4%**	**0.8%**	**0.0%**	**0.0%**
Min (with negatives)	**-17.8%**	**-69.2%**	**-0.08%**	**-68.5%**	**0.0%**	**0.1%**	**-33.8%**	**-34.3%**
# that decreased	**14**	**16**	**15**	**16**	**0**	**0**	**13**	**16**
percentage that decreased	**82%**	**94%**	**88%**	**94%**	**0%**	**0%**	**76%**	**94%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	5.1%	-15.8%	0.0%	2.1%	0.0%	3.0%	-49.9%	0.0%
Zooplankton	47.8%	-49.5%	-7.0%	2.1%	0.0%	3.0%	-49.9%	0.0%
Benthos								
Clam (Corbicula sp)	43.3%	-46.5%	0.5%	0.7%	3.8%	1.0%	-15.9%	-34.1%
Oligochaete	40.6%	-45.6%	-38.8%	0.3%	5.9%	0.5%	-7.7%	-42.3%
Insect Larvae	43.2%	-46.5%	0.3%	0.6%	4.0%	0.8%	-13.9%	-36.1%
Amphipod	39.2%	-45.0%	-39.7%	0.3%	7.0%	0.4%	-6.4%	-43.6%
Crayfish	70.9%	-59.9%	-43.2%	0.7%	4.7%	1.0%	-16.7%	-33.3%
Fish								
Juvenile Fish	63.7%	-57.1%	-37.7%	0.9%	4.2%	1.3%	-21.6%	-28.4%
Carp	45.0%	-49.2%	-39.3%	0.6%	8.5%	0.9%	-15.1%	-34.8%
Sucker, Largescale	45.1%	-46.5%	-38.0%	0.5%	10.9%	0.7%	-10.8%	-39.2%
Chinook, Salmon (juv)	99.7%	-68.2%	-48.4%	1.1%	3.3%	1.6%	-26.9%	-23.0%
Peamouth	60.5%	-56.6%	-40.4%	0.9%	4.4%	1.2%	-20.5%	-29.4%
Sculpin	96.1%	-67.7%	-45.6%	1.0%	3.8%	1.4%	-23.9%	-26.1%
Crappie, Black	108.0%	-72.2%	-58.0%	1.0%	4.1%	1.3%	-22.3%	-27.6%
Bullhead, Brown	86.8%	-66.1%	-46.3%	0.8%	4.4%	1.1%	-18.5%	-31.4%
Bass, Smallmouth	118.5%	-74.2%	-59.5%	1.0%	3.8%	1.4%	-23.8%	-26.2%
Pikeminnow, Northern	109.6%	-71.7%	-55.1%	1.0%	3.8%	1.4%	-22.8%	-27.1%
MEAN (with negatives)	**66.1%**	**-55.2%**	**-35.1%**	**0.9%**	**4.5%**	**1.3%**	**-21.6%**	**-28.4%**
Median (with negatives)	**60.5%**	**-56.6%**	**-39.7%**	**0.9%**	**4.1%**	**1.2%**	**-20.5%**	**-29.4%**
Max (with negatives)	**118.5%**	**-15.8%**	**0.5%**	**2.1%**	**10.9%**	**3.0%**	**-6.4%**	**0.0%**
Min (with negatives)	**5.1%**	**-74.2%**	**-59.5%**	**0.3%**	**0.0%**	**0.4%**	**-49.9%**	**-43.6%**
# that decreased	**0**	**17**	**14**	**0**	**0**	**0**	**17**	**15**
percentage that decreased	**0%**	**100%**	**82%**	**0%**	**0%**	**0%**	**100%**	**88%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.0%	0.0%	0.00%	0.0%	0.0%	0.84%	0.0%	0.0%
Zooplankton	1.8%	36.6%	0.00%	0.4%	114.8%	0.84%	0.0%	3.3%
Benthos								
Clam (Corbicula sp)	0.1%	36.3%	0.08%	5.7%	96.2%	0.27%	32.3%	0.1%
Oligochaete	9.7%	28.9%	0.04%	12.5%	83.4%	0.13%	0.0%	17.6%
Insect Larvae	0.1%	31.0%	0.07%	6.6%	74.3%	0.23%	33.8%	0.1%
Amphipod	9.8%	26.1%	0.03%	15.1%	93.9%	0.11%	0.0%	17.9%
Crayfish	11.8%	33.6%	0.05%	26.2%	136.4%	0.28%	7.5%	21.5%
Fish								
Juvenile Fish	9.8%	48.9%	0.03%	24.7%	36.4%	0.36%	8.1%	19.6%
Carp	9.9%	46.8%	0.05%	28.8%	3.7%	0.26%	4.3%	21.6%
Sucker, Largescale	9.4%	46.7%	0.04%	30.4%	16.4%	0.18%	3.7%	20.2%
Chinook, Salmon (juv)	14.3%	59.2%	0.03%	40.6%	58.5%	0.45%	7.3%	26.6%
Peamouth	11.5%	50.1%	0.02%	23.6%	24.4%	0.35%	6.0%	22.4%
Sculpin	12.4%	60.1%	0.05%	41.5%	46.3%	0.40%	14.4%	24.8%
Crappie, Black	17.4%	66.7%	0.04%	63.1%	28.9%	0.38%	9.3%	33.4%
Bullhead, Brown	13.2%	52.6%	0.05%	38.0%	82.9%	0.31%	12.8%	24.3%
Bass, Smallmouth	17.8%	69.2%	0.04%	68.5%	27.9%	0.40%	10.9%	34.3%
Pikeminnow, Northern	16.3%	64.5%	0.04%	56.8%	41.0%	0.38%	11.3%	31.5%
MEAN (MPAF) (abs val)	**9.7%**	**44.6%**	**0.04%**	**28.4%**	**56.8%**	**0.36%**	**9.5%**	**18.8%**
Median (absolute values)	**9.9%**	**46.8%**	**0.04%**	**26.2%**	**46.3%**	**0.35%**	**7.5%**	**21.5%**
Max (absolute values)	**17.8%**	**69.2%**	**0.08%**	**68.5%**	**136.4%**	**0.84%**	**33.8%**	**34.3%**
Min (absolute values)	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**0.0%**	**0.11%**	**0.0%**	**0.0%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	5.1%	15.8%	0.0%	2.1%	0.0%	3.0%	49.9%	0.0%
Zooplankton	47.8%	49.5%	7.0%	2.1%	0.0%	3.0%	49.9%	0.0%
Benthos								
Clam (Corbicula sp)	43.3%	46.5%	0.5%	0.7%	3.8%	1.0%	15.9%	34.1%
Oligochaete	40.6%	45.6%	38.8%	0.3%	5.9%	0.5%	7.7%	42.3%
Insect Larvae	43.2%	46.5%	0.3%	0.6%	4.0%	0.8%	13.9%	36.1%
Amphipod	39.2%	45.0%	39.7%	0.3%	7.0%	0.4%	6.4%	43.6%
Crayfish	70.9%	59.9%	43.2%	0.7%	4.7%	1.0%	16.7%	33.3%
Fish								
Juvenile Fish	63.7%	57.1%	37.7%	0.9%	4.2%	1.3%	21.6%	28.4%
Carp	45.0%	49.2%	39.3%	0.6%	8.5%	0.9%	15.1%	34.8%
Sucker, Largescale	45.1%	46.5%	38.0%	0.5%	10.9%	0.7%	10.8%	39.2%
Chinook, Salmon (juv)	99.7%	68.2%	48.4%	1.1%	3.3%	1.6%	26.9%	23.0%
Peamouth	60.5%	56.6%	40.4%	0.9%	4.4%	1.2%	20.5%	29.4%
Sculpin	96.1%	67.7%	45.6%	1.0%	3.8%	1.4%	23.9%	26.1%
Crappie, Black	108.0%	72.2%	58.0%	1.0%	4.1%	1.3%	22.3%	27.6%
Bullhead, Brown	86.8%	66.1%	46.3%	0.8%	4.4%	1.1%	18.5%	31.4%
Bass, Smallmouth	118.5%	74.2%	59.5%	1.0%	3.8%	1.4%	23.8%	26.2%
Pikeminnow, Northern	109.6%	71.7%	55.1%	1.0%	3.8%	1.4%	22.8%	27.1%
MEAN (MPAF) (abs val)	**66.1%**	**55.2%**	**35.2%**	**0.9%**	**4.5%**	**1.3%**	**21.6%**	**28.4%**
Median (absolute values)	**60.5%**	**56.6%**	**39.7%**	**0.9%**	**4.1%**	**1.2%**	**20.5%**	**29.4%**
Max (absolute values)	**118.5%**	**74.2%**	**59.5%**	**2.1%**	**10.9%**	**3.0%**	**49.9%**	**43.6%**
Min (absolute values)	**5.1%**	**15.8%**	**0.0%**	**0.3%**	**0.0%**	**0.4%**	**6.4%**	**0.0%**

B.2.3

Table 1 - Arnot-Gobas Model Output for Sensitivity Runs
Spatial Scale - RM2-11 Kow - 6.5

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Species								
Plankton								
Various Plankton and Algae	4.1	4	4	4	4	4	4	4
Zooplankton	11.4	7	12	11	22	12	12	11
Benthos								
Clam (Corbicula sp)	28.5	18	28	21	52	29	21	28
Oligochaete	46	35	49	30	87	49	48	43
Insect Larvae	37.7	26	38	27	64	38	27	37
Amphipod	45	35	47	28	90	48	47	42
Crayfish	84.8	63	92	35	181	93	82	76
Fish								
Juvenile Fish	202	109	215	93	231	219	190	172
Carp	330	185	351	156	335	354	322	274
Sucker, Largescale	408	216	440	158	530	444	400	337
Chinook, Salmon (juv)	323	140	361	77	339	368	320	256
Peamouth	326	182	351	158	368	355	319	266
Sculpin	452	194	495	111	463	503	418	359
Crappie, Black	1397	534	1564	173	1222	1586	1361	1026
Bullhead, Brown	252	132	275	73	340	278	237	213
Bass, Smallmouth	2037	725	2285	200	1689	2320	1958	1487
Pikeminnow, Northern	1126	438	1259	168	1044	1277	1084	838

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Species								
Plankton								
Various Plankton and Algae	3	5	4	5	4	5	2	4
Zooplankton	14	7	11	13	12	14	6	12
Benthos								
Clam (Corbicula sp)	33	20	29	30	32	30	24	18
Oligochaete	55	36	36	49	61	50	45	28
Insect Larvae	44	26	38	39	43	40	33	24
Amphipod	53	36	35	48	62	49	44	26
Crayfish	111	56	62	95	112	97	80	57
Fish								
Juvenile Fish	251	138	161	226	258	232	177	145
Carp	378	266	275	362	455	368	310	214
Sucker, Largescale	501	297	315	455	597	463	384	272
Chinook, Salmon (juv)	447	194	213	382	427	392	290	249
Peamouth	390	243	260	365	432	372	303	222
Sculpin	601	277	318	520	583	534	408	332
Crappie, Black	1850	888	926	1635	1874	1674	1314	1024
Bullhead, Brown	333	160	181	285	331	291	237	173
Bass, Smallmouth	2745	1247	1326	2397	2711	2458	1893	1522
Pikeminnow, Northern	1512	695	743	1318	1499	1349	1053	829

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.00%	0.00%	0.00%	0.00%	0.00%	5.8%	0.0%	0.0%
Zooplankton	-1.2%	-35.8%	0.00%	-2.7%	89.2%	5.8%	0.0%	-2.9%
Benthos								
Clam (Corbicula sp)	0.7%	-34.7%	0.65%	-24.3%	84.1%	1.8%	-27.2%	-1.1%
Oligochaete	-5.7%	-28.4%	0.32%	-38.6%	80.8%	0.8%	0.0%	-11.5%
Insect Larvae	0.4%	-30.2%	0.58%	-27.3%	70.1%	1.5%	-27.6%	-0.7%
Amphipod	-5.3%	-25.7%	0.26%	-41.7%	89.8%	0.7%	0.0%	-10.9%
Crayfish	-7.2%	-30.5%	0.41%	-62.0%	98.2%	1.4%	-9.8%	-17.0%
Fish								
Juvenile Fish	-5.8%	-49.3%	0.36%	-56.8%	7.9%	2.0%	-11.5%	-19.6%
Carp	-5.4%	-47.0%	0.41%	-55.4%	-4.0%	1.3%	-7.7%	-21.5%
Sucker, Largescale	-6.9%	-50.6%	0.40%	-63.9%	21.0%	1.4%	-8.7%	-23.0%
Chinook, Salmon (juv)	-10.1%	-61.1%	0.34%	-78.5%	-5.7%	2.2%	-11.0%	-28.9%
Peamouth	-6.8%	-48.0%	0.34%	-54.7%	5.2%	1.6%	-9.0%	-24.1%
Sculpin	-8.3%	-60.6%	0.42%	-77.4%	-6.2%	2.0%	-15.2%	-27.1%
Crappie, Black	-10.3%	-65.7%	0.39%	-88.9%	-21.6%	1.8%	-12.7%	-34.2%
Bullhead, Brown	-8.0%	-51.8%	0.42%	-73.2%	24.2%	1.5%	-13.3%	-22.1%
Bass, Smallmouth	-10.5%	-68.2%	0.41%	-91.2%	-25.8%	2.0%	-14.0%	-34.7%
Pikeminnow, Northern	-10.2%	-65.1%	0.41%	-86.6%	-16.7%	1.9%	-13.6%	-33.2%
MEAN (with negatives)	**-5.9%**	**-44.3%**	**0.36%**	**-54.3%**	**28.9%**	**2.1%**	**-10.7%**	**-18.4%**
Median (with negatives)	**-6.8%**	**-48.0%**	**0.4%**	**-56.8%**	**7.9%**	**1.8%**	**-11.0%**	**-21.5%**
Max (with negatives)	**0.7%**	**0.0%**	**0.65%**	**0.0%**	**98.2%**	**5.8%**	**0.0%**	**0.0%**
Min (with negatives)	**-10.5%**	**-68.2%**	**0.00%**	**-91.2%**	**-25.8%**	**0.7%**	**-27.6%**	**-34.7%**
# that decreased	**14**	**16**	**0**	**16**	**6**	**0**	**13**	**16**
percentage that decreased	**82%**	**94%**	**0%**	**94%**	**35%**	**0%**	**76%**	**94%**

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	-15.6%	20.2%	0.0%	15.8%	0.0%	23.7%	-49.9%	0.0%
Zooplankton	21.9%	-35.4%	-4.4%	15.8%	0.0%	23.7%	-49.9%	0.0%
Benthos								
Clam (Corbicula sp)	16.7%	-30.9%	3.8%	4.8%	12.1%	7.2%	-15.2%	-34.7%
Oligochaete	13.6%	-26.6%	-26.3%	2.3%	26.6%	3.4%	-7.2%	-42.7%
Insect Larvae	17.4%	-31.1%	2.3%	4.2%	14.5%	6.3%	-13.3%	-36.7%
Amphipod	12.0%	-24.5%	-25.3%	1.9%	31.4%	2.8%	-6.0%	-44.0%
Crayfish	21.5%	-38.9%	-32.0%	3.8%	22.6%	5.7%	-12.1%	-37.9%
Fish								
Juvenile Fish	16.9%	-35.4%	-24.8%	5.6%	20.2%	8.3%	-17.5%	-32.4%
Carp	8.1%	-24.0%	-21.4%	3.6%	30.4%	5.3%	-11.3%	-38.7%
Sucker, Largescale	14.5%	-32.1%	-28.0%	3.9%	36.3%	5.8%	-12.2%	-37.8%
Chinook, Salmon (juv)	24.3%	-46.0%	-40.9%	6.1%	18.8%	9.1%	-19.3%	-30.7%
Peamouth	11.4%	-30.5%	-25.6%	4.3%	23.3%	6.4%	-13.4%	-36.5%
Sculpin	21.8%	-43.8%	-35.5%	5.5%	18.3%	8.2%	-17.3%	-32.7%
Crappie, Black	18.8%	-43.0%	-40.6%	5.0%	20.3%	7.4%	-15.7%	-34.3%
Bullhead, Brown	21.7%	-41.4%	-33.7%	4.2%	20.8%	6.3%	-13.2%	-36.7%
Bass, Smallmouth	20.6%	-45.2%	-41.7%	5.3%	19.1%	8.0%	-16.8%	-33.1%
Pikeminnow, Northern	20.6%	-44.6%	-40.8%	5.1%	19.5%	7.6%	-16.0%	-33.9%
MEAN (with negatives)	**15.7%**	**-32.5%**	**-24.4%**	**5.7%**	**19.7%**	**8.5%**	**-18.0%**	**-31.9%**
Median (with negatives)	**17.4%**	**-35.4%**	**-26.3%**	**4.8%**	**20.2%**	**7.2%**	**-15.2%**	**-34.7%**
Max (with negatives)	**24.3%**	**20.2%**	**3.8%**	**15.8%**	**36.3%**	**23.7%**	**-6.0%**	**0.0%**
Min (with negatives)	**-15.6%**	**-46.0%**	**-41.7%**	**1.9%**	**0.0%**	**2.8%**	**-49.9%**	**-44.0%**
# that decreased	**1**	**16**	**14**	**0**	**0**	**0**	**17**	**15**
percentage that decreased	**6%**	**94%**	**82%**	**0%**	**0%**	**0%**	**100%**	**88%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.0%	0.0%	0.00%	0.0%	0.0%	5.78%	0.0%	0.0%
Zooplankton	1.2%	35.8%	0.00%	2.7%	89.2%	5.78%	0.0%	2.9%
Benthos								
Clam (Corbicula sp)	0.7%	34.7%	0.65%	24.3%	84.1%	1.76%	27.2%	1.1%
Oligochaete	5.7%	28.4%	0.32%	38.6%	80.8%	0.84%	0.0%	11.5%
Insect Larvae	0.4%	30.2%	0.58%	27.3%	70.1%	1.54%	27.6%	0.7%
Amphipod	5.3%	25.7%	0.26%	41.7%	89.8%	0.69%	0.0%	10.9%
Crayfish	7.2%	30.5%	0.41%	62.0%	98.2%	1.40%	9.8%	17.0%
Fish								
Juvenile Fish	5.8%	49.3%	0.36%	56.8%	7.9%	2.03%	11.5%	19.6%
Carp	5.4%	47.0%	0.41%	55.4%	4.0%	1.30%	7.7%	21.5%
Sucker, Largescale	6.9%	50.6%	0.40%	63.9%	21.0%	1.41%	8.7%	23.0%
Chinook, Salmon (juv)	10.1%	61.1%	0.34%	78.5%	5.7%	2.23%	11.0%	28.9%
Peamouth	6.8%	48.0%	0.34%	54.7%	5.2%	1.56%	9.0%	24.1%
Sculpin	8.3%	60.6%	0.42%	77.4%	6.2%	2.00%	15.2%	27.1%
Crappie, Black	10.3%	65.7%	0.39%	88.9%	21.6%	1.82%	12.7%	34.2%
Bullhead, Brown	8.0%	51.8%	0.42%	73.2%	24.2%	1.53%	13.3%	22.1%
Bass, Smallmouth	10.5%	68.2%	0.41%	91.2%	25.8%	1.95%	14.0%	34.7%
Pikeminnow, Northern	10.2%	65.1%	0.41%	86.6%	16.7%	1.86%	13.6%	33.2%
MEAN (MPAF) (abs val)	**6.1%**	**44.3%**	**0.36%**	**54.3%**	**38.3%**	**2.09%**	**10.7%**	**18.4%**
Median (absolute values)	**6.8%**	**48.0%**	**0.40%**	**56.8%**	**21.6%**	**1.76%**	**11.0%**	**21.5%**
Max (absolute values)	**10.5%**	**68.2%**	**0.65%**	**91.2%**	**98.2%**	**5.78%**	**27.6%**	**34.7%**
Min (absolute values)	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**0.0%**	**0.69%**	**0.0%**	**0.0%**

Scenario	Kow (50% increase)	Kow (50% decrease)	dissolved oxygen	particulate organic carbon	sediment organic carbon	Dissolved and particulate organic carbon	PCB water concentration	PCB sediment concentration
Various Plankton and Algae	15.6%	20.2%	0.0%	15.8%	0.0%	23.7%	49.9%	0.0%
Zooplankton	21.9%	35.4%	4.4%	15.8%	0.0%	23.7%	49.9%	0.0%
Benthos								
Clam (Corbicula sp)	16.7%	30.9%	3.8%	4.8%	12.1%	7.2%	15.2%	34.7%
Oligochaete	13.6%	26.6%	26.3%	2.3%	26.6%	3.4%	7.2%	42.7%
Insect Larvae	17.4%	31.1%	2.3%	4.2%	14.5%	6.3%	13.3%	36.7%
Amphipod	12.0%	24.5%	25.3%	1.9%	31.4%	2.8%	6.0%	44.0%
Crayfish	21.5%	38.9%	32.0%	3.8%	22.6%	5.7%	12.1%	37.9%
Fish								
Juvenile Fish	16.9%	35.4%	24.8%	5.6%	20.2%	8.3%	17.5%	32.4%
Carp	8.1%	24.0%	21.4%	3.6%	30.4%	5.3%	11.3%	38.7%
Sucker, Largescale	14.5%	32.1%	28.0%	3.9%	36.3%	5.8%	12.2%	37.8%
Chinook, Salmon (juv)	24.3%	46.0%	40.9%	6.1%	18.8%	9.1%	19.3%	30.7%
Peamouth	11.4%	30.5%	25.6%	4.3%	23.3%	6.4%	13.4%	36.5%
Sculpin	21.8%	43.8%	35.5%	5.5%	18.3%	8.2%	17.3%	32.7%
Crappie, Black	18.8%	43.0%	40.6%	5.0%	20.3%	7.4%	15.7%	34.3%
Bullhead, Brown	21.7%	41.4%	33.7%	4.2%	20.8%	6.3%	13.2%	36.7%
Bass, Smallmouth	20.6%	45.2%	41.7%	5.3%	19.1%	8.0%	16.8%	33.1%
Pikeminnow, Northern	20.6%	44.6%	40.8%	5.1%	19.5%	7.6%	16.0%	33.9%
MEAN (MPAF) (abs val)	**17.5%**	**34.9%**	**25.1%**	**5.7%**	**19.7%**	**8.5%**	**18.0%**	**31.9%**
Median (absolute values)	**17.4%**	**35.4%**	**26.3%**	**4.8%**	**20.2%**	**7.2%**	**15.2%**	**34.7%**
Max (absolute values)	**24.3%**	**46.0%**	**41.7%**	**15.8%**	**36.3%**	**23.7%**	**49.9%**	**44.0%**
Min (absolute values)	**8.1%**	**20.2%**	**0.0%**	**1.9%**	**0.0%**	**2.8%**	**6.0%**	**0.0%**

B.2.4

Table 1 - Arnot-Gobas Model Output for Sensitivity Runs
Spatial Scale - RM2-11 Kow - 7.5

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Species								
Plankton								
Various Plankton and Algae	0.9	0.9	0.9	0.9	0.9	1.1	0.9	0.9
Zooplankton	19.1	12.9	18.7	17.7	27.3	21.3	18.7	18.2
Benthos								
Clam (Corbicula sp)	36.0	25.4	34.9	24.5	50.1	36.0	25.6	32.8
Oligochaete	62.8	47.8	64.8	34.8	107.1	65.8	64.6	58.1
Insect Larvae	53.2	38.8	52.2	33.8	76.9	53.7	39.3	50.1
Amphipod	58.9	46.1	60.5	31.3	104.6	61.3	60.4	54.7
Crayfish	111.9	88.3	115.7	39.4	184.5	118.6	104.4	90.8
Fish								
Juvenile Fish	179.4	114.7	183.9	84.5	199.0	191.8	163.5	132.1
Carp	216.2	145.2	223.9	107.7	245.2	228.4	205.6	155.1
Sucker, Largescale	311.2	200.7	324.3	125.4	378.8	333.2	295.4	214.7
Chinook, Salmon (juv)	274.1	154.6	287.3	72.6	267.0	301.8	257.6	178.2
Peamouth	217.6	148.4	225.7	109.5	262.7	231.9	205.1	153.2
Sculpin	354.6	201.2	367.5	99.7	353.0	382.0	310.0	232.0
Crappie, Black	769.4	415.6	813.9	125.6	719.7	842.2	707.1	438.6
Bullhead, Brown	256.0	158.0	266.0	73.7	300.4	273.4	231.5	185.1
Bass, Smallmouth	1124.0	575.2	1190.3	151.3	976.0	1236.1	1019.4	618.0
Pikeminnow, Northern	689.8	381.4	728.3	133.6	670.3	753.8	629.7	404.9

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Species								
Plankton								
Various Plankton and Algae	0.7	1.7	0.9	1.4	0.9	1.7	0.5	0.9
Zooplankton	17.6	18.8	20.8	27.0	18.7	32.8	9.4	18.7
Benthos								
Clam (Corbicula sp)	30.4	38.5	42.5	38.9	40.1	41.8	29.9	22.1
Oligochaete	62.0	65.2	56.4	68.3	90.4	70.9	60.4	36.5
Insect Larvae	47.9	54.2	59.3	57.5	63.3	61.4	45.7	32.2
Amphipod	58.0	61.2	53.3	63.2	87.5	65.2	57.2	33.4
Crayfish	96.6	132.7	104.8	126.1	152.9	133.7	102.9	69.9
Fish								
Juvenile Fish	136.8	249.6	183.9	210.3	232.1	229.4	152.8	122.1
Carp	163.2	320.9	217.9	240.1	301.9	252.1	203.8	130.7
Sucker, Largescale	229.2	468.2	306.1	355.5	442.2	378.3	286.4	198.1
Chinook, Salmon (juv)	191.7	440.9	266.0	335.2	356.4	369.6	231.4	198.2
Peamouth	161.0	333.4	221.7	247.0	296.9	262.5	200.2	137.3
Sculpin	243.8	570.3	359.2	417.1	455.1	453.2	308.1	240.7
Crappie, Black	476.8	1493.6	766.7	910.9	1032.5	981.4	697.8	518.3
Bullhead, Brown	196.8	355.5	248.3	291.9	344.4	311.0	234.4	162.9
Bass, Smallmouth	673.5	2240.5	1123.8	1346.5	1487.9	1459.8	1003.9	774.2
Pikeminnow, Northern	440.0	1281.8	681.6	816.0	921.7	879.9	623.0	464.9

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.00%	0.00%	0.00%	0.00%	0.00%	14.0%	0.0%	0.0%
Zooplankton	2.1%	-31.1%	0.00%	-5.4%	46.1%	14.0%	0.0%	-2.7%
Benthos								
Clam (Corbicula sp)	3.8%	-26.6%	0.67%	-29.2%	44.7%	3.9%	-26.2%	-5.2%
Oligochaete	-2.8%	-26.1%	0.32%	-46.1%	65.8%	1.8%	0.0%	-10.1%
Insect Larvae	2.5%	-25.4%	0.59%	-35.0%	48.1%	3.4%	-24.4%	-3.5%
Amphipod	-2.5%	-23.6%	0.26%	-48.2%	73.1%	1.5%	0.0%	-9.4%
Crayfish	-2.8%	-23.3%	0.42%	-65.8%	60.2%	3.0%	-9.3%	-21.1%
Fish								
Juvenile Fish	-2.1%	-37.4%	0.37%	-53.9%	8.6%	4.7%	-10.8%	-27.9%
Carp	-3.0%	-34.9%	0.43%	-51.7%	10.0%	2.4%	-7.8%	-30.4%
Sucker, Largescale	-3.6%	-37.9%	0.41%	-61.2%	17.3%	3.2%	-8.5%	-33.5%
Chinook, Salmon (juv)	-4.3%	-46.0%	0.34%	-74.7%	-6.7%	5.4%	-10.0%	-37.8%
Peamouth	-3.3%	-34.0%	0.36%	-51.3%	16.8%	3.1%	-8.8%	-31.9%
Sculpin	-3.1%	-45.0%	0.45%	-72.8%	-3.5%	4.4%	-15.3%	-36.6%
Crappie, Black	-5.1%	-48.7%	0.42%	-84.5%	-11.2%	3.9%	-12.8%	-45.9%
Bullhead, Brown	-3.3%	-40.3%	0.43%	-72.2%	13.4%	3.2%	-12.6%	-30.1%
Bass, Smallmouth	-5.2%	-51.5%	0.43%	-87.2%	-17.6%	4.3%	-14.0%	-47.9%
Pikeminnow, Northern	-4.9%	-47.4%	0.43%	-81.6%	-7.6%	4.0%	-13.2%	-44.2%
MEAN (with negatives)	**-2.2%**	**-34.1%**	**0.37%**	**-54.2%**	**21.0%**	**4.7%**	**-10.2%**	**-24.6%**
Median (with negatives)	**-3.0%**	**-34.9%**	**0.4%**	**-53.9%**	**13.4%**	**3.9%**	**-10.0%**	**-30.1%**
Max (with negatives)	**3.8%**	**0.0%**	**0.67%**	**0.0%**	**73.1%**	**14.0%**	**0.0%**	**0.0%**
Min (with negatives)	**-5.2%**	**-51.5%**	**0.00%**	**-87.2%**	**-17.6%**	**1.5%**	**-26.2%**	**-47.9%**
# that decreased	**13**	**16**	**0**	**16**	**5**	**0**	**13**	**16**
percentage that decreased	**76%**	**94%**	**0%**	**94%**	**29%**	**0%**	**76%**	**94%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	-30.6%	74.8%	0.0%	44.4%	0.0%	75.6%	-49.9%	0.0%
Zooplankton	-6.0%	0.7%	11.5%	44.4%	0.0%	75.6%	-49.9%	0.0%
Benthos								
Clam (Corbicula sp)	-12.3%	11.1%	22.7%	12.2%	15.8%	20.8%	-13.7%	-36.3%
Oligochaete	-4.0%	0.9%	-12.7%	5.8%	39.9%	9.8%	-6.5%	-43.5%
Insect Larvae	-7.8%	4.3%	14.1%	10.7%	21.9%	18.2%	-12.0%	-37.9%
Amphipod	-3.9%	1.3%	-11.7%	4.7%	44.9%	8.0%	-5.3%	-44.7%
Crayfish	-16.2%	15.2%	-9.0%	9.5%	32.8%	16.1%	-10.6%	-39.3%
Fish								
Juvenile Fish	-25.3%	36.2%	0.4%	14.8%	26.7%	25.2%	-16.6%	-33.3%
Carp	-26.8%	43.9%	-2.3%	7.7%	35.4%	13.0%	-8.6%	-41.4%
Sucker, Largescale	-29.0%	45.0%	-5.2%	10.1%	36.9%	17.1%	-11.3%	-38.7%
Chinook, Salmon (juv)	-33.0%	54.0%	-7.1%	17.1%	24.5%	29.1%	-19.2%	-30.8%
Peamouth	-28.4%	48.2%	-1.4%	9.8%	32.0%	16.7%	-11.0%	-39.0%
Sculpin	-33.3%	55.9%	-1.8%	14.0%	24.4%	23.9%	-15.8%	-34.2%
Crappie, Black	-41.2%	84.3%	-5.4%	12.4%	27.4%	21.1%	-13.9%	-36.1%
Bullhead, Brown	-25.7%	34.2%	-6.2%	10.2%	30.1%	17.4%	-11.5%	-38.5%
Bass, Smallmouth	-43.2%	89.1%	-5.2%	13.6%	25.5%	23.2%	-15.3%	-34.7%
Pikeminnow, Northern	-39.3%	76.8%	-6.0%	12.5%	27.1%	21.3%	-14.1%	-35.9%
MEAN (with negatives)	**-23.9%**	**39.8%**	**-1.5%**	**14.9%**	**26.2%**	**25.4%**	**-16.8%**	**-33.2%**
Median (with negatives)	**-26.8%**	**43.9%**	**-5.2%**	**12.2%**	**27.1%**	**20.8%**	**-13.7%**	**-36.3%**
Max (with negatives)	**-3.9%**	**89.1%**	**22.7%**	**44.4%**	**44.9%**	**75.6%**	**-5.3%**	**0.0%**
Min (with negatives)	**-43.2%**	**0.7%**	**-12.7%**	**4.7%**	**0.0%**	**8.0%**	**-49.9%**	**-44.7%**
# that decreased	**17**	**0**	**12**	**0**	**0**	**0**	**17**	**15**
percentage that decreased	**100%**	**0%**	**71%**	**0%**	**0%**	**0%**	**100%**	**88%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.0%	0.0%	0.00%	0.0%	0.0%	14.03%	0.0%	0.0%
Zooplankton	2.1%	31.1%	0.00%	5.4%	46.1%	14.03%	0.0%	2.7%
Benthos								
Clam (Corbicula sp)	3.8%	26.6%	0.67%	29.2%	44.7%	3.85%	26.2%	5.2%
Oligochaete	2.8%	26.1%	0.32%	46.1%	65.8%	1.82%	0.0%	10.1%
Insect Larvae	2.5%	25.4%	0.59%	35.0%	48.1%	3.38%	24.4%	3.5%
Amphipod	2.5%	23.6%	0.26%	48.2%	73.1%	1.48%	0.0%	9.4%
Crayfish	2.8%	23.3%	0.42%	65.8%	60.2%	2.99%	9.3%	21.1%
Fish								
Juvenile Fish	2.1%	37.4%	0.37%	53.9%	8.6%	4.67%	10.8%	27.9%
Carp	3.0%	34.9%	0.43%	51.7%	10.0%	2.42%	7.8%	30.4%
Sucker, Largescale	3.6%	37.9%	0.41%	61.2%	17.3%	3.18%	8.5%	33.5%
Chinook, Salmon (juv)	4.3%	46.0%	0.34%	74.7%	6.7%	5.39%	10.0%	37.8%
Peamouth	3.3%	34.0%	0.36%	51.3%	16.8%	3.10%	8.8%	31.9%
Sculpin	3.1%	45.0%	0.45%	72.8%	3.5%	4.43%	15.3%	36.6%
Crappie, Black	5.1%	48.7%	0.42%	84.5%	11.2%	3.91%	12.8%	45.9%
Bullhead, Brown	3.3%	40.3%	0.43%	72.2%	13.4%	3.23%	12.6%	30.1%
Bass, Smallmouth	5.2%	51.5%	0.43%	87.2%	17.6%	4.30%	14.0%	47.9%
Pikeminnow, Northern	4.9%	47.4%	0.43%	81.6%	7.6%	3.96%	13.2%	44.2%
MEAN (MPAF) (abs val)	**3.2%**	**34.1%**	**0.37%**	**54.2%**	**26.5%**	**4.72%**	**10.2%**	**24.6%**
Median (absolute values)	**3.1%**	**34.9%**	**0.42%**	**53.9%**	**16.8%**	**3.85%**	**10.0%**	**30.1%**
Max (absolute values)	**5.2%**	**51.5%**	**0.67%**	**87.2%**	**73.1%**	**14.03%**	**26.2%**	**47.9%**
Min (absolute values)	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**0.0%**	**1.48%**	**0.0%**	**0.0%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	30.6%	74.8%	0.0%	44.4%	0.0%	75.6%	49.9%	0.0%
Zooplankton	6.0%	0.7%	11.5%	44.4%	0.0%	75.6%	49.9%	0.0%
Benthos								
Clam (Corbicula sp)	12.3%	11.1%	22.7%	12.2%	15.8%	20.8%	13.7%	36.3%
Oligochaete	4.0%	0.9%	12.7%	5.8%	39.9%	9.8%	6.5%	43.5%
Insect Larvae	7.8%	4.3%	14.1%	10.7%	21.9%	18.2%	12.0%	37.9%
Amphipod	3.9%	1.3%	11.7%	4.7%	44.9%	8.0%	5.3%	44.7%
Crayfish	16.2%	15.2%	9.0%	9.5%	32.8%	16.1%	10.6%	39.3%
Fish								
Juvenile Fish	25.3%	36.2%	0.4%	14.8%	26.7%	25.2%	16.6%	33.3%
Carp	26.8%	43.9%	2.3%	7.7%	35.4%	13.0%	8.6%	41.4%
Sucker, Largescale	29.0%	45.0%	5.2%	10.1%	36.9%	17.1%	11.3%	38.7%
Chinook, Salmon (juv)	33.0%	54.0%	7.1%	17.1%	24.5%	29.1%	19.2%	30.8%
Peamouth	28.4%	48.2%	1.4%	9.8%	32.0%	16.7%	11.0%	39.0%
Sculpin	33.3%	55.9%	1.8%	14.0%	24.4%	23.9%	15.8%	34.2%
Crappie, Black	41.2%	84.3%	5.4%	12.4%	27.4%	21.1%	13.9%	36.1%
Bullhead, Brown	25.7%	34.2%	6.2%	10.2%	30.1%	17.4%	11.5%	38.5%
Bass, Smallmouth	43.2%	89.1%	5.2%	13.6%	25.5%	23.2%	15.3%	34.7%
Pikeminnow, Northern	39.3%	76.8%	6.0%	12.5%	27.1%	21.3%	14.1%	35.9%
MEAN (MPAF) (abs val)	**23.9%**	**39.8%**	**7.2%**	**14.9%**	**26.2%**	**25.4%**	**16.8%**	**33.2%**
Median (absolute values)	**26.8%**	**43.9%**	**6.0%**	**12.2%**	**27.1%**	**20.8%**	**13.7%**	**36.3%**
Max (absolute values)	**43.2%**	**89.1%**	**22.7%**	**44.4%**	**44.9%**	**75.6%**	**49.9%**	**44.7%**
Min (absolute values)	**3.9%**	**0.7%**	**0.0%**	**4.7%**	**0.0%**	**8.0%**	**5.3%**	**0.0%**

B.2.5

Table 1 - Arnot-Gobas Model Output for Sensitivity Runs
Spatial Scale - Swan Island Kow - 5.5

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Species								
Plankton								
Various Plankton and Algae	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Zooplankton	1.8	1.2	1.9	1.9	4.0	1.9	1.9	1.8
Benthos								
Clam (Corbicula sp)	319.5	203.3	319.5	128.1	600.2	319.6	318.5	319.5
Oligochaete	34.0	27.2	38.1	33.0	70.1	38.2	38.2	30.4
Insect Larvae	383.0	263.8	383.0	153.4	663.3	383.0	382.0	383.0
Amphipod	36.8	30.5	41.2	34.5	80.0	41.3	41.3	32.9
Crayfish	111.6	71.6	125.7	47.5	340.6	125.8	125.5	98.5
Fish								
Juvenile Fish	332.0	58.3	371.7	137.9	588.7	372.0	371.0	290.5
Carp	712.0	346.3	785.0	321.9	1002.4	786.2	784.4	618.0
Sucker, Largescale	599.9	290.3	672.4	277.6	1060.5	673.4	671.9	518.3
Chinook, Salmon (juv)	192.8	50.9	233.2	66.3	427.9	233.3	232.7	157.0
Peamouth	568.5	263.7	638.7	258.7	937.8	639.0	637.4	488.8
Sculpin	496.5	188.0	569.6	154.6	1019.1	569.8	568.3	420.0
Crappie, Black	1325.3	439.5	1604.6	282.9	2397.1	1605.4	1601.2	1040.8
Bullhead, Brown	397.7	187.9	452.1	134.7	851.5	452.3	451.1	346.1
Bass, Smallmouth	1292.6	358.1	1598.6	245.2	2526.4	1599.4	1595.2	992.9
Pikeminnow, Northern	964.1	332.5	1156.1	243.7	1878.0	1156.6	1153.5	773.4

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Species								
Plankton								
Various Plankton and Algae	5.2	4.2	5.0	5.1	5.0	5.1	2.5	5.0
Zooplankton	2.7	0.9	1.7	1.9	1.9	1.9	0.9	1.9
Benthos								
Clam (Corbicula sp)	319.9	318.5	319.5	319.6	630.9	319.6	319.0	160.2
Oligochaete	53.5	20.9	21.3	38.2	40.7	38.3	37.3	19.9
Insect Larvae	383.3	382.1	383.0	383.0	762.3	383.0	382.9	191.5
Amphipod	57.2	22.8	23.1	41.3	44.4	41.3	40.5	21.4
Crayfish	176.9	68.0	67.6	125.9	233.5	125.9	124.6	64.1
Fish								
Juvenile Fish	508.4	207.7	206.9	372.1	704.5	372.2	367.1	190.6
Carp	1010.0	478.5	475.1	786.5	1436.1	786.8	774.6	404.2
Sucker, Largescale	918.2	380.5	377.3	673.6	1234.6	673.7	666.0	343.6
Chinook, Salmon (juv)	398.5	90.9	90.9	233.4	440.4	233.5	228.9	120.9
Peamouth	871.7	357.1	356.4	639.3	1175.0	639.5	628.5	329.5
Sculpin	856.2	278.5	274.6	570.0	1112.0	570.0	565.2	289.2
Crappie, Black	2704.2	618.5	607.0	1606.0	3045.8	1606.3	1585.6	821.4
Bullhead, Brown	643.8	239.6	236.5	452.4	869.6	452.4	449.3	228.9
Bass, Smallmouth	2864.5	538.0	525.5	1599.9	3073.9	1600.2	1581.1	816.9
Pikeminnow, Northern	1917.0	472.1	463.8	1157.0	2223.6	1157.2	1144.8	589.4

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.00%	0.00%	0.00%	0.00%	0.00%	0.9%	0.0%	0.0%
Zooplankton	-1.8%	-36.6%	0.00%	-0.4%	114.9%	0.9%	0.0%	-3.4%
Benthos								
Clam (Corbicula sp)	0.0%	-36.4%	0.00%	-59.9%	87.8%	0.0%	-0.3%	0.0%
Oligochaete	-11.0%	-28.9%	-0.33%	-13.6%	83.4%	0.0%	0.0%	-20.4%
Insect Larvae	0.0%	-31.1%	0.00%	-59.9%	73.2%	0.0%	-0.3%	0.0%
Amphipod	-10.9%	-26.1%	-0.27%	-16.3%	94.0%	0.0%	0.0%	-20.2%
Crayfish	-11.3%	-43.1%	-0.06%	-62.2%	170.7%	0.0%	-0.2%	-21.7%
Fish								
Juvenile Fish	-10.7%	-84.3%	-0.04%	-62.9%	58.3%	0.0%	-0.2%	-21.9%
Carp	-9.4%	-55.9%	-0.13%	-59.0%	27.5%	0.0%	-0.2%	-21.4%
Sucker, Largescale	-10.9%	-56.9%	-0.12%	-58.8%	57.5%	0.0%	-0.2%	-23.0%
Chinook, Salmon (juv)	-17.4%	-78.2%	-0.03%	-71.6%	83.5%	0.0%	-0.2%	-32.7%
Peamouth	-11.0%	-58.7%	-0.03%	-59.5%	46.8%	0.0%	-0.2%	-23.5%
Sculpin	-12.9%	-67.0%	-0.03%	-72.9%	78.9%	0.0%	-0.3%	-26.3%
Crappie, Black	-17.4%	-72.6%	-0.03%	-82.4%	49.3%	0.0%	-0.2%	-35.2%
Bullhead, Brown	-12.1%	-58.5%	-0.03%	-70.2%	88.3%	0.0%	-0.3%	-23.5%
Bass, Smallmouth	-19.2%	-77.6%	-0.03%	-84.7%	58.0%	0.0%	-0.2%	-37.9%
Pikeminnow, Northern	-16.6%	-71.2%	-0.03%	-78.9%	62.4%	0.0%	-0.2%	-33.1%
MEAN (with negatives)	**-10.2%**	**-51.9%**	**-0.07%**	**-53.7%**	**72.6%**	**0.1%**	**-0.2%**	**-20.2%**
Median (with negatives)	**-11.0%**	**-56.9%**	**0.0%**	**-59.9%**	**73.2%**	**0.0%**	**-0.2%**	**-21.9%**
Max (with negatives)	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**170.7%**	**0.9%**	**0.0%**	**0.0%**
Min (with negatives)	**-19.2%**	**-84.3%**	**-0.33%**	**-84.7%**	**0.0%**	**0.0%**	**-0.3%**	**-37.9%**
# that decreased	**14**	**16**	**15**	**16**	**0**	**0**	**13**	**16**
percentage that decreased	**82%**	**94%**	**88%**	**94%**	**0%**	**0%**	**76%**	**94%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	5.0%	-15.7%	0.0%	2.2%	0.0%	3.2%	-49.9%	0.0%
Zooplankton	47.6%	-49.4%	-7.1%	2.2%	0.0%	3.2%	-49.9%	0.0%
Benthos								
Clam (Corbicula sp)	0.1%	-0.3%	0.0%	0.0%	97.4%	0.0%	-0.2%	-49.9%
Oligochaete	40.1%	-45.4%	-44.3%	0.1%	6.5%	0.1%	-2.2%	-47.8%
Insect Larvae	0.1%	-0.2%	0.0%	0.0%	99.0%	0.0%	0.0%	-50.0%
Amphipod	38.6%	-44.7%	-44.1%	0.1%	7.7%	0.1%	-1.8%	-48.2%
Crayfish	40.6%	-45.9%	-46.3%	0.0%	85.6%	0.1%	-1.0%	-49.0%
Fish								
Juvenile Fish	36.7%	-44.2%	-44.4%	0.1%	89.5%	0.1%	-1.3%	-48.8%
Carp	28.5%	-39.1%	-39.6%	0.1%	82.7%	0.1%	-1.5%	-48.6%
Sucker, Largescale	36.4%	-43.5%	-44.0%	0.0%	83.4%	0.1%	-1.1%	-49.0%
Chinook, Salmon (juv)	70.9%	-61.0%	-61.0%	0.1%	88.8%	0.1%	-1.9%	-48.2%
Peamouth	36.4%	-44.1%	-44.2%	0.1%	83.9%	0.1%	-1.6%	-48.4%
Sculpin	50.3%	-51.1%	-51.8%	0.0%	95.2%	0.1%	-0.8%	-49.2%
Crappie, Black	68.5%	-61.5%	-62.2%	0.1%	89.8%	0.1%	-1.2%	-48.8%
Bullhead, Brown	42.4%	-47.0%	-47.7%	0.0%	92.3%	0.0%	-0.6%	-49.4%
Bass, Smallmouth	79.1%	-66.4%	-67.1%	0.1%	92.2%	0.1%	-1.1%	-48.9%
Pikeminnow, Northern	65.8%	-59.2%	-59.9%	0.0%	92.3%	0.1%	-1.0%	-49.0%
MEAN (with negatives)	**40.4%**	**-42.3%**	**-39.0%**	**0.3%**	**69.8%**	**0.4%**	**-6.9%**	**-43.1%**
Median (with negatives)	**40.1%**	**-45.4%**	**-44.3%**	**0.1%**	**88.8%**	**0.1%**	**-1.2%**	**-48.8%**
Max (with negatives)	**79.1%**	**-0.2%**	**0.0%**	**2.2%**	**99.0%**	**3.2%**	**0.0%**	**0.0%**
Min (with negatives)	**0.1%**	**-66.4%**	**-67.1%**	**0.0%**	**0.0%**	**0.0%**	**-49.9%**	**-50.0%**
# that decreased	**0**	**17**	**14**	**0**	**0**	**0**	**17**	**15**
percentage that decreased	**0%**	**100%**	**82%**	**0%**	**0%**	**0%**	**100%**	**88%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (μg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.0%	0.0%	0.00%	0.0%	0.0%	0.89%	0.0%	0.0%
Zooplankton	1.8%	36.6%	0.00%	0.4%	114.9%	0.89%	0.0%	3.4%
Benthos								
Clam (Corbicula sp)	0.0%	36.4%	0.00%	59.9%	87.8%	0.00%	0.3%	0.0%
Oligochaete	11.0%	28.9%	0.33%	13.6%	83.4%	0.04%	0.0%	20.4%
Insect Larvae	0.0%	31.1%	0.00%	59.9%	73.2%	0.00%	0.3%	0.0%
Amphipod	10.9%	26.1%	0.27%	16.3%	94.0%	0.03%	0.0%	20.2%
Crayfish	11.3%	43.1%	0.06%	62.2%	170.7%	0.02%	0.2%	21.7%
Fish								
Juvenile Fish	10.7%	84.3%	0.04%	62.9%	58.3%	0.02%	0.2%	21.9%
Carp	9.4%	55.9%	0.13%	59.0%	27.5%	0.03%	0.2%	21.4%
Sucker, Largescale	10.9%	56.9%	0.12%	58.8%	57.5%	0.02%	0.2%	23.0%
Chinook, Salmon (juv)	17.4%	78.2%	0.03%	71.6%	83.5%	0.03%	0.2%	32.7%
Peamouth	11.0%	58.7%	0.03%	59.5%	46.8%	0.03%	0.2%	23.5%
Sculpin	12.9%	67.0%	0.03%	72.9%	78.9%	0.01%	0.3%	26.3%
Crappie, Black	17.4%	72.6%	0.03%	82.4%	49.3%	0.02%	0.2%	35.2%
Bullhead, Brown	12.1%	58.5%	0.03%	70.2%	88.3%	0.01%	0.3%	23.5%
Bass, Smallmouth	19.2%	77.6%	0.03%	84.7%	58.0%	0.02%	0.2%	37.9%
Pikeminnow, Northern	16.6%	71.2%	0.03%	78.9%	62.4%	0.02%	0.2%	33.1%
MEAN (MPAF) (abs val)	**10.2%**	**51.9%**	**0.07%**	**53.7%**	**72.6%**	**0.12%**	**0.2%**	**20.2%**
Median (absolute values)	**11.0%**	**56.9%**	**0.03%**	**59.9%**	**73.2%**	**0.02%**	**0.2%**	**21.9%**
Max (absolute values)	**19.2%**	**84.3%**	**0.33%**	**84.7%**	**170.7%**	**0.89%**	**0.3%**	**37.9%**
Min (absolute values)	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**0.0%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	5.0%	15.7%	0.0%	2.2%	0.0%	3.2%	49.9%	0.0%
Zooplankton	47.6%	49.4%	7.1%	2.2%	0.0%	3.2%	49.9%	0.0%
Benthos								
Clam (Corbicula sp)	0.1%	0.3%	0.0%	0.0%	97.4%	0.0%	0.2%	49.9%
Oligochaete	40.1%	45.4%	44.3%	0.1%	6.5%	0.1%	2.2%	47.8%
Insect Larvae	0.1%	0.2%	0.0%	0.0%	99.0%	0.0%	0.0%	50.0%
Amphipod	38.6%	44.7%	44.1%	0.1%	7.7%	0.1%	1.8%	48.2%
Crayfish	40.6%	45.9%	46.3%	0.0%	85.6%	0.1%	1.0%	49.0%
Fish								
Juvenile Fish	36.7%	44.2%	44.4%	0.1%	89.5%	0.1%	1.3%	48.8%
Carp	28.5%	39.1%	39.6%	0.1%	82.7%	0.1%	1.5%	48.6%
Sucker, Largescale	36.4%	43.5%	44.0%	0.0%	83.4%	0.1%	1.1%	49.0%
Chinook, Salmon (juv)	70.9%	61.0%	61.0%	0.1%	88.8%	0.1%	1.9%	48.2%
Peamouth	36.4%	44.1%	44.2%	0.1%	83.9%	0.1%	1.6%	48.4%
Sculpin	50.3%	51.1%	51.8%	0.0%	95.2%	0.1%	0.8%	49.2%
Crappie, Black	68.5%	61.5%	62.2%	0.1%	89.8%	0.1%	1.2%	48.8%
Bullhead, Brown	42.4%	47.0%	47.7%	0.0%	92.3%	0.0%	0.6%	49.4%
Bass, Smallmouth	79.1%	66.4%	67.1%	0.1%	92.2%	0.1%	1.1%	48.9%
Pikeminnow, Northern	65.8%	59.2%	59.9%	0.0%	92.3%	0.1%	1.0%	49.0%
MEAN (MPAF) (abs val)	**40.4%**	**42.3%**	**39.0%**	**0.3%**	**69.8%**	**0.4%**	**6.9%**	**43.1%**
Median (absolute values)	**40.1%**	**45.4%**	**44.3%**	**0.1%**	**88.8%**	**0.1%**	**1.2%**	**48.8%**
Max (absolute values)	**79.1%**	**66.4%**	**67.1%**	**2.2%**	**99.0%**	**3.2%**	**49.9%**	**50.0%**
Min (absolute values)	**0.1%**	**0.2%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

B.2.6

Table 1 - Arnot-Gobas Model Output for Sensitivity Runs
Spatial Scale - Swan Island Kow - 6.5

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Species								
Plankton								
Various Plankton and Algae	4.0	4	4	4	4	4	4	4
Zooplankton	11.2	7	11	11	21	12	11	11
Benthos								
Clam (Corbicula sp)	320.1	204	320	128	601	320	320	320
Oligochaete	149	114	160	96	288	160	160	138
Insect Larvae	383.7	264	384	154	665	384	384	384
Amphipod	149	118	159	90	301	159	158	138
Crayfish	482.7	343	519	136	1072	520	519	434
Fish								
Juvenile Fish	1161	236	1236	338	1369	1239	1235	993
Carp	1788	934	1887	616	1920	1890	1886	1486
Sucker, Largescale	2151	1061	2315	582	3020	2318	2314	1785
Chinook, Salmon (juv)	1788	409	2002	262	1901	2008	2002	1400
Peamouth	1888	990	2023	648	2242	2027	2022	1523
Sculpin	2715	839	2959	409	3090	2964	2958	2203
Crappie, Black	10166	3239	11312	840	9402	11332	11308	7410
Bullhead, Brown	1752	821	1895	336	2369	1897	1894	1495
Bass, Smallmouth	12548	3303	14034	807	11349	14060	14029	9206
Pikeminnow, Northern	7399	2324	8235	738	7282	8249	8232	5530

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Species								
Plankton								
Various Plankton and Algae	3	5	4	5	4	5	2	4
Zooplankton	14	7	11	13	11	14	6	11
Benthos								
Clam (Corbicula sp)	320	320	320	320	634	320	320	160
Oligochaete	181	118	109	161	206	161	157	83
Insect Larvae	384	384	384	384	766	384	384	192
Amphipod	177	121	111	159	212	160	156	82
Crayfish	579	390	349	521	927	522	513	265
Fish								
Juvenile Fish	1308	1003	901	1244	2314	1248	1211	643
Carp	1916	1663	1487	1895	3481	1899	1860	969
Sucker, Largescale	2466	1846	1621	2325	4670	2330	2282	1189
Chinook, Salmon (juv)	2254	1350	1114	2019	3719	2027	1953	1050
Peamouth	2083	1689	1478	2033	3607	2039	1989	1044
Sculpin	3222	2189	1865	2973	5666	2980	2915	1521
Crappie, Black	12054	8268	6660	11368	21046	11396	11140	5823
Bullhead, Brown	2067	1445	1264	1901	3507	1904	1876	966
Bass, Smallmouth	15244	9849	7873	14104	26566	14140	13817	7228
Pikeminnow, Northern	8915	5897	4784	8274	15475	8294	8115	4234

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.00%	0.00%	0.00%	0.00%	0.00%	6.0%	0.0%	0.0%
Zooplankton	-1.2%	-35.8%	0.00%	-2.8%	89.1%	6.0%	0.0%	-3.0%
Benthos								
Clam (Corbicula sp)	0.0%	-36.4%	0.00%	-60.0%	87.8%	0.0%	0.0%	0.0%
Oligochaete	-6.8%	-28.5%	0.04%	-40.0%	80.4%	0.2%	0.0%	-13.9%
Insect Larvae	0.0%	-31.1%	0.00%	-60.0%	73.2%	0.0%	0.0%	0.0%
Amphipod	-6.2%	-25.7%	0.03%	-43.0%	89.6%	0.2%	0.0%	-12.7%
Crayfish	-7.0%	-33.8%	0.02%	-73.9%	106.6%	0.1%	0.0%	-16.3%
Fish								
Juvenile Fish	-6.1%	-80.9%	0.01%	-72.6%	10.8%	0.2%	0.0%	-19.7%
Carp	-5.2%	-50.5%	0.02%	-67.3%	1.8%	0.2%	0.0%	-21.2%
Sucker, Largescale	-7.0%	-54.2%	0.02%	-74.8%	30.5%	0.2%	0.0%	-22.9%
Chinook, Salmon (juv)	-10.7%	-79.6%	0.01%	-86.9%	-5.0%	0.3%	0.0%	-30.1%
Peamouth	-6.6%	-51.0%	0.01%	-68.0%	10.9%	0.2%	0.0%	-24.7%
Sculpin	-8.2%	-71.6%	0.01%	-86.2%	4.5%	0.2%	0.0%	-25.5%
Crappie, Black	-10.1%	-71.4%	0.01%	-92.6%	-16.9%	0.2%	0.0%	-34.5%
Bullhead, Brown	-7.5%	-56.7%	0.01%	-82.3%	25.0%	0.1%	0.0%	-21.1%
Bass, Smallmouth	-10.6%	-76.5%	0.01%	-94.3%	-19.1%	0.2%	0.0%	-34.4%
Pikeminnow, Northern	-10.1%	-71.8%	0.01%	-91.0%	-11.6%	0.2%	0.0%	-32.8%
MEAN (with negatives)	**-6.1%**	**-50.3%**	**0.01%**	**-64.4%**	**32.8%**	**0.9%**	**0.0%**	**-18.4%**
Median (with negatives)	**-6.8%**	**-51.0%**	**0.0%**	**-72.6%**	**10.9%**	**0.2%**	**0.0%**	**-21.1%**
Max (with negatives)	**0.0%**	**0.0%**	**0.04%**	**0.0%**	**106.6%**	**6.0%**	**0.0%**	**0.0%**
Min (with negatives)	**-10.7%**	**-80.9%**	**0.00%**	**-94.3%**	**-19.1%**	**0.0%**	**0.0%**	**-34.5%**
# that decreased	**14**	**16**	**0**	**16**	**4**	**0**	**13**	**16**
percentage that decreased	**82%**	**94%**	**0%**	**94%**	**24%**	**0%**	**76%**	**94%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	-16.1%	21.1%	0.0%	16.4%	0.0%	24.6%	-49.9%	0.0%
Zooplankton	21.3%	-34.9%	-4.4%	16.4%	0.0%	24.6%	-49.9%	0.0%
Benthos								
Clam (Corbicula sp)	0.0%	0.0%	0.0%	0.0%	98.0%	0.1%	-0.1%	-49.9%
Oligochaete	13.2%	-26.0%	-31.9%	0.7%	28.7%	1.0%	-2.1%	-48.0%
Insect Larvae	0.0%	0.0%	0.0%	0.0%	99.5%	0.0%	0.0%	-50.0%
Amphipod	11.6%	-23.8%	-29.8%	0.5%	33.7%	0.8%	-1.7%	-48.4%
Crayfish	11.6%	-24.9%	-32.8%	0.4%	78.7%	0.6%	-1.2%	-48.8%
Fish								
Juvenile Fish	5.8%	-18.8%	-27.1%	0.7%	87.2%	1.0%	-2.0%	-48.0%
Carp	1.6%	-11.8%	-21.2%	0.5%	84.6%	0.7%	-1.4%	-48.7%
Sucker, Largescale	6.6%	-20.3%	-30.0%	0.5%	101.8%	0.7%	-1.4%	-48.6%
Chinook, Salmon (juv)	12.6%	-32.6%	-44.4%	0.8%	85.7%	1.2%	-2.5%	-47.6%
Peamouth	3.0%	-16.5%	-26.9%	0.5%	78.4%	0.8%	-1.6%	-48.4%
Sculpin	8.9%	-26.0%	-37.0%	0.5%	91.5%	0.7%	-1.5%	-48.6%
Crappie, Black	6.6%	-26.9%	-41.1%	0.5%	86.1%	0.7%	-1.5%	-48.5%
Bullhead, Brown	9.1%	-23.7%	-33.3%	0.3%	85.1%	0.5%	-1.0%	-49.0%
Bass, Smallmouth	8.6%	-29.8%	-43.9%	0.5%	89.3%	0.8%	-1.5%	-48.5%
Pikeminnow, Northern	8.3%	-28.4%	-41.9%	0.5%	87.9%	0.7%	-1.4%	-48.6%
MEAN (with negatives)	**6.6%**	**-19.0%**	**-26.2%**	**2.3%**	**71.5%**	**3.5%**	**-7.1%**	**-42.9%**
Median (with negatives)	**8.3%**	**-23.8%**	**-30.0%**	**0.5%**	**85.7%**	**0.7%**	**-1.5%**	**-48.5%**
Max (with negatives)	**21.3%**	**21.1%**	**0.0%**	**16.4%**	**101.8%**	**24.6%**	**0.0%**	**0.0%**
Min (with negatives)	**-16.1%**	**-34.9%**	**-44.4%**	**0.0%**	**0.0%**	**0.0%**	**-49.9%**	**-50.0%**
# that decreased	**3**	**15**	**14**	**0**	**0**	**0**	**17**	**15**
percentage that decreased	**18%**	**88%**	**82%**	**0%**	**0%**	**0%**	**100%**	**88%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (μg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.0%	0.0%	0.00%	0.0%	0.0%	6.03%	0.0%	0.0%
Zooplankton	1.2%	35.8%	0.00%	2.8%	89.1%	6.03%	0.0%	3.0%
Benthos								
Clam (Corbicula sp)	0.0%	36.4%	0.00%	60.0%	87.8%	0.02%	0.0%	0.0%
Oligochaete	6.8%	28.5%	0.04%	40.0%	80.4%	0.25%	0.0%	13.9%
Insect Larvae	0.0%	31.1%	0.00%	60.0%	73.2%	0.00%	0.0%	0.0%
Amphipod	6.2%	25.7%	0.03%	43.0%	89.6%	0.20%	0.0%	12.7%
Crayfish	7.0%	33.8%	0.02%	73.9%	106.6%	0.15%	0.0%	16.3%
Fish								
Juvenile Fish	6.1%	80.9%	0.01%	72.6%	10.8%	0.25%	0.0%	19.7%
Carp	5.2%	50.5%	0.02%	67.3%	1.8%	0.17%	0.0%	21.2%
Sucker, Largescale	7.0%	54.2%	0.02%	74.8%	30.5%	0.17%	0.0%	22.9%
Chinook, Salmon (juv)	10.7%	79.6%	0.01%	86.9%	5.0%	0.30%	0.0%	30.1%
Peamouth	6.6%	51.0%	0.01%	68.0%	10.9%	0.20%	0.0%	24.7%
Sculpin	8.2%	71.6%	0.01%	86.2%	4.5%	0.18%	0.0%	25.5%
Crappie, Black	10.1%	71.4%	0.01%	92.6%	16.9%	0.18%	0.0%	34.5%
Bullhead, Brown	7.5%	56.7%	0.01%	82.3%	25.0%	0.12%	0.0%	21.1%
Bass, Smallmouth	10.6%	76.5%	0.01%	94.3%	19.1%	0.19%	0.0%	34.4%
Pikeminnow, Northern	10.1%	71.8%	0.01%	91.0%	11.6%	0.18%	0.0%	32.8%
MEAN (MPAF) (abs val)	**6.1%**	**50.3%**	**0.01%**	**64.4%**	**39.0%**	**0.86%**	**0.0%**	**18.4%**
Median (absolute values)	**6.8%**	**51.0%**	**0.01%**	**72.6%**	**19.1%**	**0.18%**	**0.0%**	**21.1%**
Max (absolute values)	**10.7%**	**80.9%**	**0.04%**	**94.3%**	**106.6%**	**6.03%**	**0.0%**	**34.5%**
Min (absolute values)	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**0.0%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	16.1%	21.1%	0.0%	16.4%	0.0%	24.6%	49.9%	0.0%
Zooplankton	21.3%	34.9%	4.4%	16.4%	0.0%	24.6%	49.9%	0.0%
Benthos								
Clam (Corbicula sp)	0.0%	0.0%	0.0%	0.0%	98.0%	0.1%	0.1%	49.9%
Oligochaete	13.2%	26.0%	31.9%	0.7%	28.7%	1.0%	2.1%	48.0%
Insect Larvae	0.0%	0.0%	0.0%	0.0%	99.5%	0.0%	0.0%	50.0%
Amphipod	11.6%	23.8%	29.8%	0.5%	33.7%	0.8%	1.7%	48.4%
Crayfish	11.6%	24.9%	32.8%	0.4%	78.7%	0.6%	1.2%	48.8%
Fish								
Juvenile Fish	5.8%	18.8%	27.1%	0.7%	87.2%	1.0%	2.0%	48.0%
Carp	1.6%	11.8%	21.2%	0.5%	84.6%	0.7%	1.4%	48.7%
Sucker, Largescale	6.6%	20.3%	30.0%	0.5%	101.8%	0.7%	1.4%	48.6%
Chinook, Salmon (juv)	12.6%	32.6%	44.4%	0.8%	85.7%	1.2%	2.5%	47.6%
Peamouth	3.0%	16.5%	26.9%	0.5%	78.4%	0.8%	1.6%	48.4%
Sculpin	8.9%	26.0%	37.0%	0.5%	91.5%	0.7%	1.5%	48.6%
Crappie, Black	6.6%	26.9%	41.1%	0.5%	86.1%	0.7%	1.5%	48.5%
Bullhead, Brown	9.1%	23.7%	33.3%	0.3%	85.1%	0.5%	1.0%	49.0%
Bass, Smallmouth	8.6%	29.8%	43.9%	0.5%	89.3%	0.8%	1.5%	48.5%
Pikeminnow, Northern	8.3%	28.4%	41.9%	0.5%	87.9%	0.7%	1.4%	48.6%
MEAN (MPAF) (abs val)	**8.5%**	**21.5%**	**26.2%**	**2.3%**	**71.5%**	**3.5%**	**7.1%**	**42.9%**
Median (absolute values)	**8.6%**	**23.8%**	**30.0%**	**0.5%**	**85.7%**	**0.7%**	**1.5%**	**48.5%**
Max (absolute values)	**21.3%**	**34.9%**	**44.4%**	**16.4%**	**101.8%**	**24.6%**	**49.9%**	**50.0%**
Min (absolute values)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

B.2.7

Table 1 - Arnot-Gobas Model Output for Sensitivity Runs
Spatial Scale - Swan Island   Kow - 7.5

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Species								
Plankton								
Various Plankton and Algae	0.9	0.9	0.9	0.9	0.9	1.0	0.9	0.9
Zooplankton	18.2	12.3	17.9	16.9	26.1	20.4	17.9	17.4
Benthos								
Clam (Corbicula sp)	319.5	203.3	319.5	127.8	599.9	319.5	319.4	319.5
Oligochaete	204.6	156.9	213.0	112.4	354.1	213.9	212.9	187.1
Insect Larvae	383.6	264.2	383.6	153.5	664.4	383.6	383.5	383.6
Amphipod	195.1	153.8	202.0	102.6	351.5	202.7	201.9	179.8
Crayfish	541.6	402.5	565.2	142.9	1020.7	566.8	565.0	454.3
Fish								
Juvenile Fish	833.8	267.5	866.8	273.3	1051.7	872.3	866.5	630.9
Carp	1038.5	657.5	1083.1	413.7	1323.7	1085.6	1082.6	760.4
Sucker, Largescale	1450.3	870.3	1527.4	439.0	2048.9	1533.0	1526.7	1027.0
Chinook, Salmon (juv)	1204.3	444.8	1285.4	212.8	1321.2	1296.4	1285.0	788.3
Peamouth	1055.4	682.2	1105.1	412.1	1453.1	1109.0	1104.7	753.7
Sculpin	1820.7	796.3	1912.3	330.5	2197.4	1919.8	1911.8	1278.6
Crappie, Black	4384.4	2046.4	4699.1	533.1	4832.8	4716.8	4697.6	2556.7
Bullhead, Brown	1419.0	794.7	1489.0	298.3	1884.9	1492.6	1488.5	1064.5
Bass, Smallmouth	5817.9	2341.5	6248.2	545.4	6018.7	6274.1	6246.3	3345.2
Pikeminnow, Northern	3705.1	1734.0	3963.4	520.1	4238.3	3978.0	3962.1	2261.8

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Species								
Plankton								
Various Plankton and Algae	0.6	1.6	0.9	1.3	0.9	1.6	0.5	0.9
Zooplankton	16.8	18.1	19.9	25.8	17.9	31.5	9.0	17.9
Benthos								
Clam (Corbicula sp)	319.4	319.6	319.5	319.6	632.6	319.6	319.4	159.7
Oligochaete	205.1	214.1	172.6	216.2	303.3	218.6	209.1	110.1
Insect Larvae	383.6	383.6	383.6	383.6	765.4	383.6	383.6	191.7
Amphipod	194.7	203.8	168.0	204.5	297.9	206.3	199.1	103.7
Crayfish	498.6	628.7	467.1	570.6	1017.4	574.6	558.8	288.6
Fish								
Juvenile Fish	680.9	1148.4	781.2	884.3	1601.0	897.0	846.9	452.8
Carp	824.4	1516.9	985.1	1091.6	1925.9	1097.9	1072.9	550.8
Sucker, Largescale	1138.2	2130.4	1316.8	1545.7	2896.4	1559.1	1506.1	783.8
Chinook, Salmon (juv)	894.5	1948.6	1054.6	1320.3	2351.2	1345.4	1246.0	681.4
Peamouth	822.1	1608.1	994.1	1117.8	1958.8	1127.0	1090.4	566.5
Sculpin	1408.9	2751.4	1652.3	1936.3	3656.7	1953.6	1885.1	982.4
Crappie, Black	2918.7	8436.1	3990.0	4755.9	8740.2	4796.9	4634.2	2411.7
Bullhead, Brown	1172.3	1933.5	1268.8	1500.9	2759.9	1509.5	1475.3	757.3
Bass, Smallmouth	3847.0	11129.6	5218.9	6330.9	11803.9	6390.5	6154.2	3214.7
Pikeminnow, Northern	2577.2	6683.4	3321.0	4010.3	7421.8	4044.3	3909.7	2033.1

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.00%	0.00%	0.00%	0.00%	0.00%	14.3%	0.0%	0.0%
Zooplankton	2.1%	-31.0%	0.00%	-5.5%	46.0%	14.3%	0.0%	-2.8%
Benthos								
Clam (Corbicula sp)	0.0%	-36.4%	0.00%	-60.0%	87.8%	0.0%	0.0%	0.0%
Oligochaete	-3.9%	-26.3%	0.07%	-47.2%	66.3%	0.5%	0.0%	-12.1%
Insect Larvae	0.0%	-31.1%	0.00%	-60.0%	73.2%	0.0%	0.0%	0.0%
Amphipod	-3.4%	-23.8%	0.05%	-49.2%	74.1%	0.4%	0.0%	-11.0%
Crayfish	-4.1%	-28.8%	0.03%	-74.7%	80.6%	0.3%	0.0%	-19.6%
Fish								
Juvenile Fish	-3.8%	-69.1%	0.02%	-68.5%	21.4%	0.7%	0.0%	-27.2%
Carp	-4.1%	-39.3%	0.04%	-61.8%	22.3%	0.3%	0.0%	-29.8%
Sucker, Largescale	-5.0%	-43.0%	0.03%	-71.3%	34.2%	0.4%	0.0%	-32.7%
Chinook, Salmon (juv)	-6.3%	-65.4%	0.02%	-83.4%	2.8%	0.9%	0.0%	-38.7%
Peamouth	-4.5%	-38.3%	0.02%	-62.7%	31.5%	0.4%	0.0%	-31.8%
Sculpin	-4.8%	-58.4%	0.01%	-82.7%	14.9%	0.4%	0.0%	-33.1%
Crappie, Black	-6.7%	-56.4%	0.02%	-88.7%	2.9%	0.4%	0.0%	-45.6%
Bullhead, Brown	-4.7%	-46.6%	0.02%	-80.0%	26.6%	0.3%	0.0%	-28.5%
Bass, Smallmouth	-6.9%	-62.5%	0.01%	-91.3%	-3.7%	0.4%	0.0%	-46.5%
Pikeminnow, Northern	-6.5%	-56.2%	0.02%	-86.9%	7.0%	0.4%	0.0%	-42.9%
MEAN (with negatives)	**-3.7%**	**-41.9%**	**0.02%**	**-63.2%**	**34.6%**	**2.0%**	**0.0%**	**-23.7%**
Median (with negatives)	**-4.1%**	**-39.3%**	**0.0%**	**-68.5%**	**26.6%**	**0.4%**	**0.0%**	**-28.5%**
Max (with negatives)	**2.1%**	**0.0%**	**0.07%**	**0.0%**	**87.8%**	**14.3%**	**0.0%**	**0.0%**
Min (with negatives)	**-6.9%**	**-69.1%**	**0.00%**	**-91.3%**	**-3.7%**	**0.0%**	**0.0%**	**-46.5%**
# that decreased	**13**	**16**	**0**	**16**	**1**	**0**	**13**	**16**
percentage that decreased	**76%**	**94%**	**0%**	**94%**	**6%**	**0%**	**76%**	**94%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	-30.7%	75.7%	0.0%	44.6%	0.0%	76.6%	-49.9%	0.0%
Zooplankton	-6.1%	1.2%	11.4%	44.6%	0.0%	76.6%	-49.9%	0.0%
Benthos								
Clam (Corbicula sp)	0.0%	0.1%	0.0%	0.0%	98.0%	0.0%	0.0%	-50.0%
Oligochaete	-3.7%	0.6%	-18.9%	1.6%	42.5%	2.7%	-1.8%	-48.3%
Insect Larvae	0.0%	0.0%	0.0%	0.0%	99.5%	0.0%	0.0%	-50.0%
Amphipod	-3.6%	0.9%	-16.8%	1.3%	47.6%	2.2%	-1.4%	-48.6%
Crayfish	-11.8%	11.3%	-17.3%	1.0%	80.1%	1.7%	-1.1%	-48.9%
Fish								
Juvenile Fish	-21.4%	32.5%	-9.9%	2.0%	84.7%	3.5%	-2.3%	-47.8%
Carp	-23.9%	40.1%	-9.0%	0.8%	77.9%	1.4%	-0.9%	-49.1%
Sucker, Largescale	-25.5%	39.5%	-13.8%	1.2%	89.7%	2.1%	-1.4%	-48.7%
Chinook, Salmon (juv)	-30.4%	51.6%	-17.9%	2.7%	82.9%	4.7%	-3.1%	-47.0%
Peamouth	-25.6%	45.5%	-10.0%	1.2%	77.3%	2.0%	-1.3%	-48.7%
Sculpin	-26.3%	43.9%	-13.6%	1.3%	91.2%	2.2%	-1.4%	-48.6%
Crappie, Black	-37.9%	79.6%	-15.1%	1.2%	86.0%	2.1%	-1.4%	-48.7%
Bullhead, Brown	-21.3%	29.9%	-14.8%	0.8%	85.4%	1.4%	-0.9%	-49.1%
Bass, Smallmouth	-38.4%	78.1%	-16.5%	1.3%	88.9%	2.3%	-1.5%	-48.5%
Pikeminnow, Northern	-35.0%	68.7%	-16.2%	1.2%	87.3%	2.1%	-1.3%	-48.7%
MEAN (with negatives)	**-20.1%**	**35.2%**	**-10.5%**	**6.3%**	**71.7%**	**10.8%**	**-7.0%**	**-43.0%**
Median (with negatives)	**-23.9%**	**39.5%**	**-13.8%**	**1.2%**	**84.7%**	**2.1%**	**-1.4%**	**-48.7%**
Max (with negatives)	**0.0%**	**79.6%**	**11.4%**	**44.6%**	**99.5%**	**76.6%**	**0.0%**	**0.0%**
Min (with negatives)	**-38.4%**	**0.0%**	**-18.9%**	**0.0%**	**0.0%**	**0.0%**	**-49.9%**	**-50.0%**
# that decreased	**17**	**0**	**13**	**0**	**0**	**0**	**17**	**15**
percentage that decreased	**100%**	**0%**	**76%**	**0%**	**0%**	**0%**	**100%**	**88%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Fraction of Porewater Ventilated	Dietary Absorption Efficiency	% Moisture	Dissolved Organic Carbon	Concentration of Suspended Solids	Water Temperature
Various Plankton and Algae	0.0%	0.0%	0.00%	0.0%	0.0%	14.28%	0.0%	0.0%
Zooplankton	2.1%	31.0%	0.00%	5.5%	46.0%	14.28%	0.0%	2.8%
Benthos								
Clam (Corbicula sp)	0.0%	36.4%	0.00%	60.0%	87.8%	0.01%	0.0%	0.0%
Oligochaete	3.9%	26.3%	0.07%	47.2%	66.3%	0.51%	0.0%	12.1%
Insect Larvae	0.0%	31.1%	0.00%	60.0%	73.2%	0.00%	0.0%	0.0%
Amphipod	3.4%	23.8%	0.05%	49.2%	74.1%	0.40%	0.0%	11.0%
Crayfish	4.1%	28.8%	0.03%	74.7%	80.6%	0.32%	0.0%	19.6%
Fish								
Juvenile Fish	3.8%	69.1%	0.02%	68.5%	21.4%	0.65%	0.0%	27.2%
Carp	4.1%	39.3%	0.04%	61.8%	22.3%	0.26%	0.0%	29.8%
Sucker, Largescale	5.0%	43.0%	0.03%	71.3%	34.2%	0.39%	0.0%	32.7%
Chinook, Salmon (juv)	6.3%	65.4%	0.02%	83.4%	2.8%	0.87%	0.0%	38.7%
Peamouth	4.5%	38.3%	0.02%	62.7%	31.5%	0.37%	0.0%	31.8%
Sculpin	4.8%	58.4%	0.01%	82.7%	14.9%	0.40%	0.0%	33.1%
Crappie, Black	6.7%	56.4%	0.02%	88.7%	2.9%	0.39%	0.0%	45.6%
Bullhead, Brown	4.7%	46.6%	0.02%	80.0%	26.6%	0.26%	0.0%	28.5%
Bass, Smallmouth	6.9%	62.5%	0.01%	91.3%	3.7%	0.43%	0.0%	46.5%
Pikeminnow, Northern	6.5%	56.2%	0.02%	86.9%	7.0%	0.38%	0.0%	42.9%
MEAN (MPAF) (abs val)	**3.9%**	**41.9%**	**0.02%**	**63.2%**	**35.0%**	**2.01%**	**0.0%**	**23.7%**
Median (absolute values)	**4.1%**	**39.3%**	**0.02%**	**68.5%**	**26.6%**	**0.39%**	**0.0%**	**28.5%**
Max (absolute values)	**6.9%**	**69.1%**	**0.07%**	**91.3%**	**87.8%**	**14.28%**	**0.0%**	**46.5%**
Min (absolute values)	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**0.0%**	**0.00%**	**0.0%**	**0.0%**

Scenario	Kow (50% increase)	Kow (50% decrease)	Dissolved Oxygen	Particulate Organic Carbon	Sediment Organic Carbon	Dissolved and Particulate Organic Carbon	PCB Water Concentration	PCB Sediment Concentration
Various Plankton and Algae	30.7%	75.7%	0.0%	44.6%	0.0%	76.6%	49.9%	0.0%
Zooplankton	6.1%	1.2%	11.4%	44.6%	0.0%	76.6%	49.9%	0.0%
Benthos								
Clam (Corbicula sp)	0.0%	0.1%	0.0%	0.0%	98.0%	0.0%	0.0%	50.0%
Oligochaete	3.7%	0.6%	18.9%	1.6%	42.5%	2.7%	1.8%	48.3%
Insect Larvae	0.0%	0.0%	0.0%	0.0%	99.5%	0.0%	0.0%	50.0%
Amphipod	3.6%	0.9%	16.8%	1.3%	47.6%	2.2%	1.4%	48.6%
Crayfish	11.8%	11.3%	17.3%	1.0%	80.1%	1.7%	1.1%	48.9%
Fish								
Juvenile Fish	21.4%	32.5%	9.9%	2.0%	84.7%	3.5%	2.3%	47.8%
Carp	23.9%	40.1%	9.0%	0.8%	77.9%	1.4%	0.9%	49.1%
Sucker, Largescale	25.5%	39.5%	13.8%	1.2%	89.7%	2.1%	1.4%	48.7%
Chinook, Salmon (juv)	30.4%	51.6%	17.9%	2.7%	82.9%	4.7%	3.1%	47.0%
Peamouth	25.6%	45.5%	10.0%	1.2%	77.3%	2.0%	1.3%	48.7%
Sculpin	26.3%	43.9%	13.6%	1.3%	91.2%	2.2%	1.4%	48.6%
Crappie, Black	37.9%	79.6%	15.1%	1.2%	86.0%	2.1%	1.4%	48.7%
Bullhead, Brown	21.3%	29.9%	14.8%	0.8%	85.4%	1.4%	0.9%	49.1%
Bass, Smallmouth	38.4%	78.1%	16.5%	1.3%	88.9%	2.3%	1.5%	48.5%
Pikeminnow, Northern	35.0%	68.7%	16.2%	1.2%	87.3%	2.1%	1.3%	48.7%
MEAN (MPAF) (abs val)	**20.1%**	**35.2%**	**11.8%**	**6.3%**	**71.7%**	**10.8%**	**7.0%**	**43.0%**
Median (absolute values)	**23.9%**	**39.5%**	**13.8%**	**1.2%**	**84.7%**	**2.1%**	**1.4%**	**48.7%**
Max (absolute values)	**38.4%**	**79.6%**	**18.9%**	**44.6%**	**99.5%**	**76.6%**	**49.9%**	**50.0%**
Min (absolute values)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

Subappendix - B.3.1

Table 1 - Arnot and Gobas Model Output for Uncertainty Runs
Chemical: PCB Spatial Scale: RM 2-11

Scenario	AG-RM2-11-PCB-AVG	AG-RM2-11-PCB-MAX	AG-RM2-11-PCB-MIN
Species			
Plankton			
Various Plankton and Algae	4.7	4.5	3.1
Zooplankton	8.8	10.5	4.4
Benthos			
Clam (Corbicula sp)	22.3	196.8	4.5
Oligochaete	42.0	154.2	5.0
Insect Larvae	29.6	296.1	3.4
Amphipod	41.6	153.0	5.1
Crayfish	71.7	530.5	8.0
Fish			
Juvenile Fish	172.0	1458.4	19.5
Carp	308.7	2644.1	45.6
Sucker, Largescale	364.1	2998.1	46.8
Chinook, Salmon (juv)	268.4	3091.0	30.8
Peamouth	296.1	2263.8	44.6
Sculpin	372.7	5532.2	28.4
Crappie, Black	1207.3	25415.9	86.9
Bullhead, Brown	210.7	2499.2	20.7
Bass, Smallmouth	1726.2	41542.2	58.3
Pikeminnow, Northern	955.2	19890.6	52.9

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-PCB-AVG	AG-RM2-11-PCB-MAX	AG-RM2-11-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	-3.9	2.3	-19.1
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	2.4	17.7	-3.7
Fish			
Juvenile Fish			
Carp	-5.3	1.6	-35.8
Sucker, Largescale	-2.2	3.7	-17.5
Chinook, Salmon (juv)	4.8	55.2	-1.8
Peamouth	1.6	12.1	-4.2
Sculpin	-1.5	9.8	-19.8
Crappie, Black	9.0	189.7	-1.5
Bullhead, Brown	-1.9	6.2	-19.6
Bass, Smallmouth	1.6	37.3	-19.1
Pikeminnow, Northern	1.1	23.9	-15.7
MEAN	**0.5**	**32.7**	**-14.3**
Max	**9.0**	**189.7**	**-1.5**
Min	**-5.3**	**1.6**	**-35.8**
underpredict count	**5**	**0**	**11**
underpredict percentage	**45%**	**0%**	**100%**

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-PCB-AVG	AG-RM2-11-PCB-MAX	AG-RM2-11-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	-3.7	2.4	-18.4
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	8.8	65.5	-1.0
Fish			
Juvenile Fish			
Carp	-2.7	3.2	-18.4
Sucker, Largescale	-1.5	5.7	-11.3
Chinook, Salmon (juv)	5.3	60.6	-1.7
Peamouth	1.7	12.6	-4.0
Sculpin	1.2	17.4	-11.2
Crappie, Black	10.1	211.8	-1.4
Bullhead, Brown	1.1	12.9	-9.3
Bass, Smallmouth	2.4	58.2	-12.2
Pikeminnow, Northern	1.3	27.6	-13.6
MEAN	**2.2**	**43.4**	**-9.3**
Max	**10.1**	**211.8**	**-1.0**
Min	**-3.7**	**2.4**	**-18.4**
underpredict count	**3**	**0**	**11**
underpredict percentage	**27%**	**0%**	**100%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-PCB-AVG	AG-RM2-11-PCB-MAX	AG-RM2-11-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	3.9	2.3	19.1
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	2.4	17.7	3.7
Fish			
Juvenile Fish			
Carp	5.3	1.6	35.8
Sucker, Largescale	2.2	3.7	17.5
Chinook, Salmon (juv)	4.8	55.2	1.8
Peamouth	1.6	12.1	4.2
Sculpin	1.5	9.8	19.8
Crappie, Black	9.0	189.7	1.5
Bullhead, Brown	1.9	6.2	19.6
Bass, Smallmouth	1.6	37.3	19.1
Pikeminnow, Northern	1.1	23.9	15.7
MEAN (MPAF)	**3.2**	**32.7**	**14.3**
Geomean	**2.6**	**12.9**	**9.6**
Max	**9.0**	**189.7**	**35.8**
Min	**1.1**	**1.6**	**1.5**
# under 10	**11**	**5**	**4**
# under 5	**9**	**3**	**4**
# under 2	**5**	**1**	**2**

Table 5 - SPAF - Comparison to geomean measured value (μg/kg ww) as Factor Difference

Scenario	AG-RM2-11-PCB-AVG	AG-RM2-11-PCB-MAX	AG-RM2-11-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	3.7	2.4	18.4
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	8.8	65.5	1.0
Fish			
Juvenile Fish			
Carp	2.7	3.2	18.4
Sucker, Largescale	1.5	5.7	11.3
Chinook, Salmon (juv)	5.3	60.6	1.7
Peamouth	1.7	12.6	4.0
Sculpin	1.2	17.4	11.2
Crappie, Black	10.1	211.8	1.4
Bullhead, Brown	1.1	12.9	9.3
Bass, Smallmouth	2.4	58.2	12.2
Pikeminnow, Northern	1.3	27.6	13.6
MEAN (MPAF)	**3.6**	**43.4**	**9.3**
Geomean	**2.7**	**19.6**	**6.3**
Max	**10.1**	**211.8**	**18.4**
Min	**1.1**	**2.4**	**1.0**
# under 10	**10**	**3**	**5**
# under 5	**8**	**2**	**4**
# under 2	**5**	**0**	**3**

Subappendix B.3.2

Table 1 - Arnot and Gobas Model Output for Uncertainty Runs
Chemical: PCBs Spatial Scale: Swan Island

Scenario	AG-SI-PCB-AVG	AG-SI-PCB-MIN	AG-SI-PCB-MAX
Species			
Plankton			
Various Plankton and Algae	4.6	3.1	4.7
Zooplankton	8.5	4.3	11.0
Benthos			
Clam (Corbicula sp)	282.1	53.3	711.3
Oligochaete	106.6	11.3	299.7
Insect Larvae	338.1	37.7	990.1
Amphipod	108.3	12.1	299.3
Crayfish	361.7	42.5	1243.9
Fish			
Juvenile Fish	924.9	53.4	4160.1
Carp	1499.6	157.2	7061.5
Sucker, Largescale	1717.4	178.6	7496.3
Chinook, Salmon (juv)	1295.9	67.9	8557.2
Peamouth	1535.7	145.7	6197.3
Sculpin	2057.5	111.5	15517.2
Crappie, Black	7763.5	458.7	70919.1
Bullhead, Brown	1341.2	95.2	6958.1
Bass, Smallmouth	9353.7	436.1	103202.8
Pikeminnow, Northern	5567.0	193.5	55999.7

Table 2 - Model Bias: Comparison to mean measured value (μg/kg ww) as Factor Difference

Scenario	AG-SI-PCB-AVG	AG-SI-PCB-MIN	AG-SI-PCB-MAX
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	7.9	-1.1	27.0
Fish			
Juvenile Fish			
Carp	1.6	-5.9	7.6
Sucker, Largescale	5.4	-1.8	23.4
Chinook, Salmon (juv)			
Peamouth	11.1	1.1	44.9
Sculpin	4.2	-4.4	31.3
Crappie, Black	43.1	2.5	394.0
Bullhead, Brown	1.9	-7.5	9.7
Bass, Smallmouth	3.2	-6.7	35.2
Pikeminnow, Northern	8.3	-3.5	83.6
MEAN	**9.6**	**-3.0**	**73.0**
Max	**43.1**	**2.5**	**394.0**
Min	**1.6**	**-7.5**	**7.6**
underpredict count	**0**	**7**	**0**
underpredict percentage	**0%**	**78%**	**0%**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 3 - Model Bias: Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-PCB-AVG	AG-SI-PCB-MIN	AG-SI-PCB-MAX
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	7.9	-1.1	27.1
Fish			
Juvenile Fish			
Carp	1.6	-5.8	7.7
Sucker, Largescale			
Chinook, Salmon (juv)			
Peamouth			
Sculpin	4.2	-4.4	31.3
Crappie, Black	47.1	2.8	429.8
Bullhead, Brown	3.3	-4.3	16.9
Bass, Smallmouth	3.8	-5.6	42.0
Pikeminnow, Northern			
MEAN	**11.3**	**-3.1**	**92.5**
Max	**47.1**	**2.8**	**429.8**
Min	**1.6**	**-5.8**	**7.7**
underpredict count	**0**	**5**	**0**
underpredict percentage	**0%**	**83%**	**0%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-PCB-AVG	AG-SI-PCB-MIN	AG-SI-PCB-MAX
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	7.9	1.1	27.0
Fish			
Juvenile Fish			
Carp	1.6	5.9	7.6
Sucker, Largescale	5.4	1.8	23.4
Chinook, Salmon (juv)			
Peamouth	11.1	1.1	44.9
Sculpin	4.2	4.4	31.3
Crappie, Black	43.1	2.5	394.0
Bullhead, Brown	1.9	7.5	9.7
Bass, Smallmouth	3.2	6.7	35.2
Pikeminnow, Northern		3.5	83.6
MEAN (MPAF)	**9.8**	**3.8**	**73.0**
Geomean	**5.5**	**3.1**	**34.9**
Max	**43.1**	**7.5**	**394.0**
Min	**1.6**	**1.1**	**7.6**
# under 10	**6**	**9**	**2**
# under 5	**4**	**6**	**0**
# under 2	**2**	**3**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5 - SPAF - Comparison to geomean measured value (μg/kg ww) as Factor Difference

Scenario	AG-SI-PCB-AVG	AG-SI-PCB-MIN	AG-SI-PCB-MAX
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	7.9	1.1	27.1
Fish			
Juvenile Fish			
Carp	1.6	5.8	7.7
Sucker, Largescale			
Chinook, Salmon (juv)			
Peamouth			
Sculpin	4.2	4.4	31.3
Crappie, Black	47.1	2.8	429.8
Bullhead, Brown	3.3	4.3	16.9
Bass, Smallmouth	3.8	5.6	42.0
Pikeminnow, Northern			
MEAN (MPAF)	**11.3**	**4.0**	**92.5**
Geomean	**5.6**	**3.5**	**35.5**
Max	**47.1**	**5.8**	**429.8**
Min	**1.6**	**1.1**	**7.7**
# under 10	**5**	**6**	**1**
# under 5	**4**	**4**	**0**
# under 2	**1**	**1**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Subappendix B.3.3

Table 1 - Arnot and Gobas Model Output for Uncertainty Runs
Chemical:DDE Spatial Scale: RM 2-11

Scenario	AG-RM2-11-DDE-20	AG-RM2-11-DDE-50	AG-RM2-11-DDE-100
Species			
Plankton			
Various Plankton and Algae	0.2	0.3	0.3
Zooplankton	0.8	1.0	1.2
Benthos			
Clam (Corbicula sp)	1.4	1.8	2.3
Oligochaete	2.3	2.9	3.7
Insect Larvae	1.9	2.3	3.0
Amphipod	2.2	2.7	3.5
Crayfish	4.8	6.0	7.8
Fish			
Juvenile Fish	11.5	14.1	18.2
Carp	17.1	20.6	26.1
Sucker, Largescale	22.4	27.5	35.3
Chinook, Salmon (juv)	20.6	25.7	33.6
Peamouth	17.8	21.6	27.5
Sculpin	27.3	33.9	44.1
Crappie, Black	85.1	105.1	135.3
Bullhead, Brown	14.5	18.1	23.7
Bass, Smallmouth	126.5	156.9	202.6
Pikeminnow, Northern	69.1	85.7	110.9

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-DDE-20	AG-RM2-11-DDE-50	AG-RM2-11-DDE-100
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	-30.0	-24.3	-18.8
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	-1.3	-1.1	1.2
Fish			
Juvenile Fish			
Carp	-7.9	-6.5	-5.2
Sucker, Largescale	-5.4	-4.4	-3.4
Chinook, Salmon (juv)	-1.0	1.2	1.6
Peamouth	-7.4	-6.1	-4.8
Sculpin	-2.1	-1.6	-1.3
Crappie, Black	1.5	1.9	2.4
Bullhead, Brown	-3.2	-2.6	-2.0
Bass, Smallmouth	-1.0	1.2	1.5
Pikeminnow, Northern	-3.6	-2.9	-2.3
MEAN	**-5.6**	**-4.1**	**-2.8**
Max	**1.5**	**1.9**	**2.4**
Min	**-30.0**	**-24.3**	**-18.8**
underpredict count	**10**	**8**	**7**
underpredict percentage	**91%**	**73%**	**64%**

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-DDE-20	AG-RM2-11-DDE-50	AG-RM2-11-DDE-100
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	-18.5	-15.0	-11.6
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	1.1	1.4	1.8
Fish			
Juvenile Fish			
Carp	-7.3	-6.1	-4.8
Sucker, Largescale	-5.2	-4.2	-3.3
Chinook, Salmon (juv)	-1.0	1.2	1.6
Peamouth	-7.2	-6.0	-4.7
Sculpin	1.1	1.4	1.8
Crappie, Black	1.6	2.0	2.6
Bullhead, Brown	-3.1	-2.5	-1.9
Bass, Smallmouth	1.0	1.3	1.6
Pikeminnow, Northern	-3.1	-2.5	-1.9
MEAN	**-3.7**	**-2.6**	**-1.7**
Max	**1.6**	**2.0**	**2.6**
Min	**-18.5**	**-15.0**	**-11.6**
underpredict count	**7**	**6**	**6**
underpredict percentage	**64%**	**55%**	**55%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-DDE-20	AG-RM2-11-DDE-50	AG-RM2-11-DDE-100
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	30.0	24.3	18.8
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	1.3	1.1	1.2
Fish			
Juvenile Fish			
Carp	7.9	6.5	5.2
Sucker, Largescale	5.4	4.4	3.4
Chinook, Salmon (juv)	1.0	1.2	1.6
Peamouth	7.4	6.1	4.8
Sculpin	2.1	1.6	1.3
Crappie, Black	1.5	1.9	2.4
Bullhead, Brown	3.2	2.6	2.0
Bass, Smallmouth	1.0	1.2	1.5
Pikeminnow, Northern	3.6	2.9	2.3
MEAN (MPAF)	**5.9**	**4.9**	**4.0**
Geomean	**3.3**	**3.0**	**2.7**
Max	**30.0**	**24.3**	**18.8**
Min	**1.0**	**1.1**	**1.2**
# under 10	**10**	**10**	**10**
# under 5	**7**	**8**	**9**
# under 2	**4**	**5**	**5**

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-RM2-11-DDE-20	AG-RM2-11-DDE-50	AG-RM2-11-DDE-100
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	18.5	15.0	11.6
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	1.1	1.4	1.8
Fish			
Juvenile Fish			
Carp	7.3	6.1	4.8
Sucker, Largescale	5.2	4.2	3.3
Chinook, Salmon (juv)	1.0	1.2	1.6
Peamouth	7.2	6.0	4.7
Sculpin	1.1	1.4	1.8
Crappie, Black	1.6	2.0	2.6
Bullhead, Brown	3.1	2.5	1.9
Bass, Smallmouth	1.0	1.3	1.6
Pikeminnow, Northern	3.1	2.5	1.9
MEAN (MPAF)	**4.6**	**4.0**	**3.4**
Geomean	**2.8**	**2.8**	**2.8**
Max	**18.5**	**15.0**	**11.6**
Min	**1.0**	**1.2**	**1.6**
# under 10	**10**	**10**	**10**
# under 5	**7**	**8**	**10**
# under 2	**5**	**5**	**6**

Subappendix B.3.4

Table 1 - Arnot and Gobas Model Output for Uncertainty Runs
Chemical: DDE Spatial Scale: Swan Island

Scenario	AG-SI-DDE-20	AG-SI-DDE-50	AG-SI-DDE-100
Species			
Plankton			
Various Plankton and Algae	0.2	0.2	0.3
Zooplankton	0.8	1.0	1.3
Benthos			
Clam (Corbicula sp)	4.1	6.5	10.5
Oligochaete	2.4	3.8	6.1
Insect Larvae	4.9	7.8	12.6
Amphipod	2.3	3.7	5.9
Crayfish	7.5	12.0	19.3
Fish			
Juvenile Fish	18.8	28.8	45.1
Carp	26.6	40.7	63.7
Sucker, Largescale	33.9	52.8	83.7
Chinook, Salmon (juv)	31.9	49.6	78.0
Peamouth	29.1	44.4	69.3
Sculpin	43.4	68.0	108.2
Crappie, Black	163.2	252.8	397.6
Bullhead, Brown	26.8	42.5	68.3
Bass, Smallmouth	205.1	320.1	505.7
Pikeminnow, Northern	119.3	186.4	294.9

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-DDE-20	AG-SI-DDE-50	AG-SI-DDE-100
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	3.3	5.2	8.4
Fish			
Juvenile Fish			
Carp	-4.6	-3.0	-1.9
Sucker, Largescale	-5.5	-3.5	-2.2
Chinook, Salmon (juv)			
Peamouth	-4.3	-2.8	-1.8
Sculpin	2.1	3.2	5.2
Crappie, Black	2.2	3.4	5.4
Bullhead, Brown	-1.7	-1.1	1.5
Bass, Smallmouth	2.7	4.2	6.7
Pikeminnow, Northern	1.5	2.3	3.6
MEAN	**-0.5**	**0.9**	**2.8**
Max	**3.3**	**5.2**	**8.4**
Min	**-5.5**	**-3.5**	**-2.2**
underpredict count	**4**	**4**	**3**
underpredict percentage	**44%**	**44%**	**33%**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-DDE-20	AG-SI-DDE-50	AG-SI-DDE-100
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	3.4	5.4	8.8
Fish			
Juvenile Fish			
Carp	-4.5	-3.0	-1.9
Sucker, Largescale			
Chinook, Salmon (juv)			
Peamouth			
Sculpin	2.1	3.3	5.2
Crappie, Black	2.2	3.4	5.4
Bullhead, Brown	-1.7	-1.1	1.5
Bass, Smallmouth	2.8	4.3	6.9
Pikeminnow, Northern			
MEAN	**0.7**	**2.1**	**4.3**
Max	**3.4**	**5.4**	**8.8**
Min	**-4.5**	**-3.0**	**-1.9**
underpredict count	**2**	**2**	**1**
underpredict percentage	**33%**	**33%**	**17%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-DDE-20	AG-SI-DDE-50	AG-SI-DDE-100
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	3.3	5.2	8.4
Fish			
Juvenile Fish			
Carp	4.6	3.0	1.9
Sucker, Largescale	5.5	3.5	2.2
Chinook, Salmon (juv)			
Peamouth	4.3	2.8	1.8
Sculpin	2.1	3.2	5.2
Crappie, Black	2.2	3.4	5.4
Bullhead, Brown	1.7	1.1	1.5
Bass, Smallmouth	2.7	4.2	6.7
Pikeminnow, Northern	1.5	2.3	3.6
MEAN (MPAF)	**3.1**	**3.2**	**4.1**
Geomean	**2.8**	**3.0**	**3.4**
Max	**5.5**	**5.2**	**8.4**
Min	**1.5**	**1.1**	**1.5**
# under 10	**9**	**9**	**9**
# under 5	**8**	**8**	**5**
# under 2	**2**	**1**	**3**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	AG-SI-DDE-20	AG-SI-DDE-50	AG-SI-DDE-100
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	3.4	5.4	8.8
Fish			
Juvenile Fish			
Carp	4.5	3.0	1.9
Sucker, Largescale			
Chinook, Salmon (juv)			
Peamouth			
Sculpin	2.1	3.3	5.2
Crappie, Black	2.2	3.4	5.4
Bullhead, Brown	1.7	1.1	1.5
Bass, Smallmouth	2.8	4.3	6.9
Pikeminnow, Northern			
MEAN (MPAF)	**2.8**	**3.4**	**4.9**
Geomean	**2.6**	**3.1**	**4.1**
Max	**4.5**	**5.4**	**8.8**
Min	**1.7**	**1.1**	**1.5**
# under 10	**6**	**6**	**6**
# under 5	**6**	**5**	**2**
# under 2	**1**	**1**	**2**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Appendix C. TrophicTrace Model Run

C.1.1

Table 1 - Trophic Trace Model Output for Scenario Runs

Chemical - PCBs   Spatial Scale - RM2-11

Scenario	TT-RM2-11-PCB-1a	TT-RM2-11-PCB-1b	TT-RM2-11-PCB-1c	TT-RM2-11-PCB-1d	TT-RM2-11-PCB-2a	TT-RM2-11-PCB-2b	TT-RM2-11-PCB-2c	TT-RM2-11-PCB-2d
Species								
Plankton								
Various Plankton and Algae	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Zooplankton	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Benthos								
Clam (Corbicula sp)	226.4	97.9	116.2	55.1	226.4	97.9	116.2	55.1
Oligochaete	191.8	83.0	98.5	46.7	191.8	83.0	98.5	46.7
Insect Larvae	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Amphipod	153.5	66.4	78.8	37.3	153.5	66.4	78.8	37.3
Crayfish	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Fish								
Juvenile Fish	55.9	29.1	32.9	20.2	28.2	17.8	19.3	14.4
Carp	137.0	61.4	72.2	36.2	73.4	34.3	39.9	21.3
Sucker, Largescale	113.1	52.7	61.4	32.6	60.6	52.7	61.4	32.6
Chinook, Salmon (juv)	41.5	24.0	26.5	18.2	25.0	17.3	18.4	14.7
Peamouth	113.8	52.5	61.3	32.1	78.6	37.6	43.4	23.9
Sculpin	29.9	20.2	21.6	16.9	94.5	45.8	52.8	29.6
Crappie, Black	103.4	51.5	58.9	34.1	90.7	45.5	51.9	30.4
Bullhead, Brown	69.3	34.6	39.6	23.1	159.2	71.8	84.3	42.7
Bass, Smallmouth	60.5	35.3	38.9	26.9	62.8	33.7	37.8	24.0
Pikeminnow, Northern	49.3	27.9	31.0	20.8	36.8	21.0	23.3	15.7

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-PCB-1a	TT-RM2-11-PCB-1b	TT-RM2-11-PCB-1c	TT-RM2-11-PCB-1d	TT-RM2-11-PCB-2a	TT-RM2-11-PCB-2b	TT-RM2-11-PCB-2c	TT-RM2-11-PCB-2d
Various Plankton and Algae								
Zooplankton								
Benthos								
Clam (Corbicula sp)	2.6	1.1	1.3	-1.6	2.6	1.1	1.3	-1.6
Oligochaete								
Insect Larvae								
Amphipod								
Crayfish	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9
Fish								
Juvenile Fish								
Carp	-11.9	-26.5	-22.6	-45.0	-22.2	-47.5	-40.9	-76.5
Sucker, Largescale	-7.2	-15.5	-13.3	-25.1	-13.5	-15.5	-13.3	-25.1
Chinook, Salmon (juv)	-1.4	-2.3	-2.1	-3.1	-2.2	-3.2	-3.1	-3.8
Peamouth	-1.6	-3.6	-3.1	-5.8	-2.4	-5.0	-4.3	-7.8
Sculpin	-18.8	-27.8	-26.0	-33.2	-5.9	-12.3	-10.7	-19.0
Crappie, Black	-1.3	-2.6	-2.3	-3.9	-1.5	-2.9	-2.6	-4.4
Bullhead, Brown	-5.8	-11.7	-10.2	-17.5	-2.5	-5.6	-4.8	-9.5
Bass, Smallmouth	-18.4	-31.5	-28.6	-41.4	-17.7	-33.1	-29.4	-46.5
Pikeminnow, Northern	-16.9	-29.8	-26.9	-40.1	-22.6	-39.6	-35.8	-52.9
MEAN	**-7.9**	**-14.2**	**-12.7**	**-20.2**	**-8.5**	**-15.4**	**-13.6**	**-23.0**
Max	**2.6**	**1.1**	**1.3**	**-1.6**	**2.6**	**1.1**	**1.3**	**-1.6**
Min	**-18.8**	**-31.5**	**-28.6**	**-45.0**	**-22.6**	**-47.5**	**-40.9**	**-76.5**
underpredict count	**10.0**	**10.0**	**10.0**	**11.0**	**10.0**	**10.0**	**10.0**	**11.0**
underpredict percentage	**90.9%**	**90.9%**	**90.9%**	**100.0%**	**90.9%**	**90.9%**	**90.9%**	**100.0%**

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-PCB-1a	TT-RM2-11-PCB-1b	TT-RM2-11-PCB-1c	TT-RM2-11-PCB-1d	TT-RM2-11-PCB-2a	TT-RM2-11-PCB-2b	TT-RM2-11-PCB-2c	TT-RM2-11-PCB-2d
Various Plankton and Algae								
Zooplankton								
Benthos								
Clam (Corbicula sp)	2.7	1.2	1.4	-1.5	2.7	1.2	1.4	-1.5
Oligochaete								
Insect Larvae								
Amphipod								
Crayfish	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Fish								
Juvenile Fish								
Carp	-6.1	-13.6	-11.6	-23.1	-11.4	-24.4	-21.0	-39.3
Sucker, Largescale	-4.7	-10.0	-8.6	-16.2	-8.7	-10.0	-8.6	-16.2
Chinook, Salmon (juv)	-1.2	-2.1	-1.9	-2.8	-2.0	-3.0	-2.8	-3.5
Peamouth	-1.6	-3.4	-2.9	-5.6	-2.3	-4.8	-4.1	-7.5
Sculpin	-10.6	-15.8	-14.7	-18.8	-3.4	-6.9	-6.0	-10.8
Crappie, Black	-1.2	-2.3	-2.0	-3.5	-1.3	-2.6	-2.3	-3.9
Bullhead, Brown	-2.8	-5.6	-4.9	-8.4	-1.2	-2.7	-2.3	-4.5
Bass, Smallmouth	-11.8	-20.2	-18.4	-26.5	-11.4	-21.2	-18.9	-29.8
Pikeminnow, Northern	-14.6	-25.8	-23.3	-34.7	-19.6	-34.3	-31.0	-45.8
MEAN	**-4.6**	**-8.8**	**-7.8**	**-12.7**	**-5.2**	**-9.8**	**-8.6**	**-14.7**
Max	**2.7**	**1.2**	**1.4**	**1.2**	**2.7**	**1.2**	**1.4**	**1.2**
Min	**-14.6**	**-25.8**	**-23.3**	**-34.7**	**-19.6**	**-34.3**	**-31.0**	**-45.8**
underpredict count	**9.0**	**9.0**	**9.0**	**10.0**	**9.0**	**9.0**	**9.0**	**10.0**
underpredict percentage	**81.8%**	**81.8%**	**81.8%**	**90.9%**	**81.8%**	**81.8%**	**81.8%**	**90.9%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-PCB-1a	TT-RM2-11-PCB-1b	TT-RM2-11-PCB-1c	TT-RM2-11-PCB-1d	TT-RM2-11-PCB-2a	TT-RM2-11-PCB-2b	TT-RM2-11-PCB-2c	TT-RM2-11-PCB-2d
Various Plankton and Algae								
Zooplankton								
Benthos								
Clam (Corbicula sp)	2.6	1.1	1.3	1.6	2.6	1.1	1.3	1.6
Oligochaete								
Insect Larvae								
Amphipod								
Crayfish	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Fish								
Juvenile Fish								
Carp	11.9	26.5	22.6	45.0	22.2	47.5	40.9	76.5
Sucker, Largescale	7.2	15.5	13.3	25.1	13.5	15.5	13.3	25.1
Chinook, Salmon (juv)	1.4	2.3	2.1	3.1	2.2	3.2	3.1	3.8
Peamouth	1.6	3.6	3.1	5.8	2.4	5.0	4.3	7.8
Sculpin	18.8	27.8	26.0	33.2	5.9	12.3	10.7	19.0
Crappie, Black	1.3	2.6	2.3	3.9	1.5	2.9	2.6	4.4
Bullhead, Brown	5.8	11.7	10.2	17.5	2.5	5.6	4.8	9.5
Bass, Smallmouth	18.4	31.5	28.6	41.4	17.7	33.1	29.4	46.5
Pikeminnow, Northern	16.9	29.8	26.9	40.1	22.6	39.6	35.8	52.9
MEAN (MPAF)	**8.3**	**14.4**	**12.9**	**20.2**	**9.0**	**15.6**	**13.8**	**23.0**
Geomean	**5.5**	**8.6**	**7.9**	**11.9**	**5.7**	**8.7**	**7.9**	**12.4**
Max	**18.8**	**31.5**	**28.6**	**45.0**	**22.6**	**47.5**	**40.9**	**76.5**
Min	**1.3**	**1.1**	**1.3**	**1.6**	**1.5**	**1.1**	**1.3**	**1.6**
# under 10	**7**	**5**	**5**	**5**	**7**	**6**	**6**	**6**
# under 5	**4**	**4**	**4**	**3**	**5**	**4**	**5**	**3**
# under 2	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-PCB-1a	TT-RM2-11-PCB-1b	TT-RM2-11-PCB-1c	TT-RM2-11-PCB-1d	TT-RM2-11-PCB-2a	TT-RM2-11-PCB-2b	TT-RM2-11-PCB-2c	TT-RM2-11-PCB-2d
Various Plankton and Algae								
Zooplankton								
Benthos								
Clam (Corbicula sp)	2.7	1.2	1.4	1.5	2.7	1.2	1.4	1.5
Oligochaete								
Insect Larvae								
Amphipod								
Crayfish	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Fish								
Juvenile Fish								
Carp	6.1	13.6	11.6	23.1	11.4	24.4	21.0	39.3
Sucker, Largescale	4.7	10.0	8.6	16.2	8.7	10.0	8.6	16.2
Chinook, Salmon (juv)	1.2	2.1	1.9	2.8	2.0	3.0	2.8	3.5
Peamouth	1.6	3.4	2.9	5.6	2.3	4.8	4.1	7.5
Sculpin	10.6	15.8	14.7	18.8	3.4	6.9	6.0	10.8
Crappie, Black	1.2	2.3	2.0	3.5	1.3	2.6	2.3	3.9
Bullhead, Brown	2.8	5.6	4.9	8.4	1.2	2.7	2.3	4.5
Bass, Smallmouth	11.8	20.2	18.4	26.5	11.4	21.2	18.9	29.8
Pikeminnow, Northern	14.6	25.8	23.3	34.7	19.6	34.3	31.0	45.8
MEAN (MPAF)	**5.3**	**9.2**	**8.3**	**12.9**	**5.9**	**10.2**	**9.0**	**14.9**
Geomean	**3.5**	**5.5**	**5.1**	**7.6**	**3.7**	**5.6**	**5.1**	**7.9**
Max	**14.6**	**25.8**	**23.3**	**34.7**	**19.6**	**34.3**	**31.0**	**45.8**
Min	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
# under 10	**8**	**6**	**7**	**6**	**8**	**7**	**8**	**6**
# under 5	**7**	**5**	**6**	**4**	**7**	**6**	**6**	**5**
# under 2	**4**	**2**	**3**	**2**	**3**	**2**	**2**	**2**

C.1.2

Table 1 - Trophic Trace Model Output for Scenario Runs
Chemical - PCBs Spatial Scale - Swan Island

Scenario	TT-SI-PCB-1a	TT-SI-PCB-1b	TT-SI-PCB-1c	TT-SI-PCB-1d	TT-SI-PCB- 2a	TT-SI-PCB-2b	TT-SI-PCB-2c	TT-SI-PCB-2d
Species								
Plankton								
Various Plankton and Algae	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Zooplankton	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Benthos								
Clam (Corbicula sp)	789.8	341.5	405.6	192.1	789.8	341.5	405.6	192.1
Oligochaete	669.3	289.4	343.7	162.8	669.3	289.4	343.7	162.8
Insect Larvae	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Amphipod	535.4	231.5	275.0	130.2	535.4	231.5	275.0	130.2
Crayfish	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Fish								
Juvenile Fish	178.4	82.1	95.9	50.0	74.5	37.8	43.1	25.6
Carp	483.3	211.2	250.0	120.5	247.7	109.7	129.4	63.7
Sucker, Largescale	398.9	176.3	208.1	102.1	199.8	89.6	105.3	52.8
Chinook, Salmon (juv)	121.3	58.5	67.5	37.6	59.7	32.3	36.2	23.1
Peamouth	388.5	171.4	202.4	99.0	260.6	116.3	136.9	68.2
Sculpin	73.1	38.7	43.6	27.2	303.4	136.0	159.9	80.2
Crappie, Black	349.5	158.0	185.4	94.2	299.3	135.8	159.2	81.3
Bullhead, Brown	227.3	103.0	120.7	61.5	556.7	243.7	288.4	139.4
Bass, Smallmouth	172.4	83.6	96.3	54.0	187.0	87.4	101.7	54.2
Pikeminnow, Northern	287.4	69.5	80.4	44.1	106.8	51.4	59.3	32.9

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-PCB-1a	TT-SI-PCB-1b	TT-SI-PCB-1c	TT-SI-PCB-1d	TT-SI-PCB- 2a	TT-SI-PCB-2b	TT-SI-PCB-2c	TT-SI-PCB-2d
Various Plankton and Algae								
Zooplankton								
Benthos								
Clam (Corbicula sp)								
Oligochaete								
Insect Larvae								
Amphipod								
Crayfish	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
Fish								
Juvenile Fish								
Carp	-1.9	-4.4	-3.7	-7.7	-3.8	-8.5	-7.2	-14.7
Sucker, Largescale	1.2	-1.8	-1.5	-3.1	-1.6	-3.6	-3.0	-6.1
Chinook, Salmon (juv)								
Peamouth	2.8	1.2	1.5	-1.4	1.9	-1.2	-1.0	-2.0
Sculpin	-6.8	-12.8	-11.4	-18.2	-1.6	-3.6	-3.1	-6.2
Crappie, Black	1.9	-1.1	1.0	-1.9	1.7	-1.3	-1.1	-2.2
Bullhead, Brown	-3.1	-6.9	-5.9	-11.6	-1.3	-2.9	-2.5	-5.1
Bass, Smallmouth	-17.0	-35.1	-30.5	-54.4	-15.7	-33.6	-28.9	-54.2
Pikeminnow, Northern	-2.3	-9.6	-8.3	-15.2	-6.3	-13.0	-11.3	-20.4
MEAN	**-3.9**	**-8.9**	**-7.6**	**-13.7**	**-4.0**	**-8.6**	**-7.5**	**-13.4**
Max	**2.8**	**1.2**	**1.5**	**-1.4**	**1.9**	**-1.2**	**-1.0**	**-2.0**
Min	**-17.0**	**-35.1**	**-30.5**	**-54.4**	**-15.7**	**-33.6**	**-28.9**	**-54.2**
underpredict count	**6**	**8**	**7**	**9**	**7**	**9**	**9**	**9**
underpredict percentage	**0.67**	**0.89**	**0.78**	**1.00**	**0.78**	**1.00**	**1.00**	**1.00**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-PCB-1a	TT-SI-PCB-1b	TT-SI-PCB-1c	TT-SI-PCB-1d	TT-SI-PCB- 2a	TT-SI-PCB-2b	TT-SI-PCB-2c	TT-SI-PCB-2d
Various Plankton and Algae								
Zooplankton								
Benthos								
Clam (Corbicula sp)								
Oligochaete								
Insect Larvae								
Amphipod								
Crayfish	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
Fish								
Juvenile Fish								
Carp	-1.9	-4.3	-3.7	-7.6	-3.7	-8.3	-7.1	-14.4
Sucker, Largescale								
Chinook, Salmon (juv)								
Peamouth								
Sculpin	-6.8	-12.8	-11.4	-18.2	-1.6	-3.6	-3.1	-6.2
Crappie, Black	2.1	-1.0	1.1	-1.8	1.8	-1.2	-1.0	-2.0
Bullhead, Brown	-1.8	-4.0	-3.4	-6.7	1.4	-1.7	-1.4	-2.9
Bass, Smallmouth	-14.3	-29.4	-25.5	-45.5	-13.1	-28.1	-24.2	-45.4
Pikeminnow, Northern	-2.3	-9.6	-8.3	-15.2	-6.3	-13.0	-11.3	-20.4
MEAN	**-5.4**	**-10.2**	**-8.7**	**-14.9**	**-4.2**	**-8.8**	**-7.7**	**-13.4**
Max	**2.1**	**-1.0**	**1.1**	**-1.8**	**1.8**	**-1.2**	**-1.0**	**-2.0**
Min	**-14.3**	**-29.4**	**-25.5**	**-45.5**	**-13.1**	**-28.1**	**-24.2**	**-45.4**
underpredict count	**5**	**6**	**5**	**6**	**4**	**6**	**6**	**6**
underpredict percentage	**0.83**	**1.00**	**0.83**	**1.00**	**0.67**	**1.00**	**1.00**	**1.00**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-PCB-1a	TT-SI-PCB-1b	TT-SI-PCB-1c	TT-SI-PCB-1d	TT-SI-PCB- 2a	TT-SI-PCB-2b	TT-SI-PCB-2c	TT-SI-PCB-2d
Various Plankton and Algae								
Zooplankton								
Benthos								
Clam (Corbicula sp)								
Oligochaete								
Insect Larvae								
Amphipod								
Crayfish	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Fish								
Juvenile Fish								
Carp	1.9	4.4	3.7	7.7	3.8	8.5	7.2	14.7
Sucker, Largescale	1.2	1.8	1.5	3.1	1.6	3.6	3.0	6.1
Chinook, Salmon (juv)								
Peamouth	2.8	1.2	1.5	1.4	1.9	1.2	1.0	2.0
Sculpin	6.8	12.8	11.4	18.2	1.6	3.6	3.1	6.2
Crappie, Black	1.9	1.1	1.0	1.9	1.7	1.3	1.1	2.2
Bullhead, Brown	3.1	6.9	5.9	11.6	1.3	2.9	2.5	5.1
Bass, Smallmouth	17.0	35.1	30.5	54.4	15.7	33.6	28.9	54.2
Pikeminnow, Northern	2.3	9.6	8.3	15.2	6.3	13.0	11.3	20.4
MEAN (MPAF)	**5.2**	**9.2**	**8.2**	**13.7**	**4.8**	**8.6**	**7.5**	**13.4**
Geomean	**3.6**	**5.3**	**4.8**	**7.8**	**3.2**	**5.1**	**4.4**	**8.0**
Max	**17.0**	**35.1**	**30.5**	**54.4**	**15.7**	**33.6**	**28.9**	**54.2**
Min	**1.2**	**2.2**	**3.2**	**4.2**	**5.2**	**6.2**	**7.2**	**8.2**
# under 10	**8**	**7**	**7**	**5**	**8**	**7**	**7**	**6**
# under 5	**6**	**4**	**4**	**3**	**6**	**5**	**5**	**2**
# under 2	**3**	**3**	**3**	**2**	**5**	**2**	**2**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-PCB-1a	TT-SI-PCB-1b	TT-SI-PCB-1c	TT-SI-PCB-1d	TT-SI-PCB- 2a	TT-SI-PCB-2b	TT-SI-PCB-2c	TT-SI-PCB-2d
Various Plankton and Algae								
Zooplankton								
Benthos								
Clam (Corbicula sp)								
Oligochaete								
Insect Larvae								
Amphipod								
Crayfish	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Fish								
Juvenile Fish								
Carp	1.9	4.3	3.7	7.6	3.7	8.3	7.1	14.4
Sucker, Largescale								
Chinook, Salmon (juv)								
Peamouth								
Sculpin	6.8	12.8	11.4	18.2	1.6	3.6	3.1	6.2
Crappie, Black	2.1	1.0	1.1	1.8	1.8	1.2	1.0	2.0
Bullhead, Brown	1.8	4.0	3.4	6.7	1.4	1.7	1.4	2.9
Bass, Smallmouth	14.3	29.4	25.5	45.5	13.1	28.1	24.2	45.4
Pikeminnow, Northern								
MEAN (MPAF)	**6.1**	**10.2**	**9.1**	**14.9**	**5.2**	**8.8**	**7.7**	**13.4**
Geomean	**4.3**	**6.3**	**5.8**	**9.4**	**3.5**	**5.1**	**4.4**	**7.8**
Max	**14.3**	**29.4**	**25.5**	**45.5**	**13.1**	**28.1**	**24.2**	**45.4**
Min	**1.8**	**1.0**	**1.1**	**1.8**	**1.4**	**1.2**	**1.0**	**2.0**
# under 10	**5**	**4**	**4**	**4**	**5**	**5**	**5**	**4**
# under 5	**3**	**3**	**3**	**1**	**4**	**3**	**3**	**2**
# under 2	**2**	**1**	**1**	**1**	**3**	**2**	**2**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

C.1.3

Table 1 - Trophic Trace Model Output for Scenario Runs

Chemical - DDE Spatial Scale - RM2-11

Scenario	TT-RM2-11-DDE-1a	TT-RM2-11-DDE-1b	TT-RM2-11-DDE-1c	TT-RM2-11-DDE-1d	TT-RM2-11-DDE-1e	TT-RM2-11-DDE-1f	TT-RM2-11-DDE-1g	TT-RM2-11-DDE-1h	TT-RM2-11-DDE-1i
Species									
Plankton									
Various Plankton and Algae	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Zooplankton	0.8	0.8	0.8	0.5	0.5	0.5	0.1	0.1	0.1
Benthos									
Clam (Corbicula sp)	4.9	13.8	2.9	4.9	13.8	2.9	4.9	13.8	2.9
Oligochaete	4.2	11.7	2.5	4.2	11.7	2.5	4.2	11.7	2.5
Insect Larvae	0.9	0.9	0.9	0.6	0.6	0.6	0.1	0.1	0.1
Amphipod	3.3	9.4	2.0	3.3	9.4	2.0	3.3	9.4	2.0
Crayfish	0.6	0.6	0.6	0.4	0.4	0.4	0.1	0.1	0.1
Fish									
Juvenile Fish	1.8	3.7	1.4	1.7	3.6	1.2	1.0	2.5	0.7
Carp	3.1	8.2	2.0	3.1	8.3	2.0	2.8	7.7	1.7
Sucker, Largescale	2.9	6.9	2.0	2.8	7.0	1.8	2.3	6.1	1.4
Chinook, Salmon (juv)	1.7	3.0	1.4	1.5	2.8	1.2	0.6	1.3	0.5
Peamouth	2.7	6.9	1.8	2.7	7.0	1.8	2.3	6.1	1.4
Sculpin	1.6	2.3	1.4	1.3	2.0	1.2	0.5	0.9	0.4
Crappie, Black	2.9	6.4	2.1	2.8	6.5	2.0	1.8	4.4	1.2
Bullhead, Brown	2.2	4.7	1.6	2.0	4.5	1.4	1.1	2.8	0.7
Bass, Smallmouth	2.3	4.0	1.9	2.1	3.9	1.7	1.1	2.2	0.8
Pikeminnow, Northern	1.9	3.3	1.5	1.7	3.2	1.3	0.9	2.1	0.7

Scenario	TT-RM2-11-DDE-2a	TT-RM2-11-DDE-2b	TT-RM2-11-DDE-2c	TT-RM2-11-DDE-2d	TT-RM2-11-DDE-2e	TT-RM2-11-DDE-2f	TT-RM2-11-DDE-2g	TT-RM2-11-DDE-2h	TT-RM2-11-DDE-2i
Species									
Plankton									
Various Plankton and Algae	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Zooplankton	0.8	0.8	0.8	0.5	0.5	0.5	0.1	0.1	0.1
Benthos									
Clam (Corbicula sp)	4.9	13.8	2.9	4.9	13.8	2.9	4.9	13.8	2.9
Oligochaete	4.2	11.7	2.5	4.2	11.7	2.5	4.2	11.7	2.5
Insect Larvae	0.9	0.9	0.9	0.6	0.6	0.6	0.1	0.1	0.1
Amphipod	3.3	9.4	2.0	3.3	9.4	2.0	3.3	9.4	2.0
Crayfish	0.6	0.6	0.6	0.4	0.4	0.4	0.1	0.1	0.1
Fish									
Juvenile Fish	1.4	2.1	1.2	1.1	1.9	1.0	0.6	1.1	0.4
Carp	1.8	4.5	1.3	1.8	4.5	1.2	1.5	4.1	1.0
Sucker, Largescale	1.7	3.8	1.2	1.6	3.7	1.1	1.3	3.2	0.8
Chinook, Salmon (juv)	1.4	2.0	1.3	1.1	1.7	1.0	0.4	0.7	0.4
Peamouth	2.0	4.8	1.4	2.0	4.8	1.3	1.6	4.1	1.0
Sculpin	2.7	6.2	1.9	2.5	6.1	1.7	1.6	4.0	1.0
Crappie, Black	2.6	5.8	1.9	2.5	5.7	1.8	1.5	3.8	1.0
Bullhead, Brown	3.9	10.3	2.5	3.8	10.1	2.4	2.5	6.8	1.5
Bass, Smallmouth	2.1	4.2	1.7	2.0	4.1	1.5	1.0	2.3	0.7
Pikeminnow, Northern	1.5	2.6	1.2	1.3	2.4	1.0	0.7	1.7	0.5

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	**TT-RM2-11-DDE-1a**	**TT-RM2-11-DDE-1b**	**TT-RM2-11-DDE-1c**	**TT-RM2-11-DDE-1d**	**TT-RM2-11-DDE-1e**	**TT-RM2-11-DDE-1f**	**TT-RM2-11-DDE-1g**	**TT-RM2-11-DDE-1h**	**TT-RM2-11-DDE-1i**
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)	-8.7	-3.1	-14.7	-8.7	-3.1	-14.7	-8.7	-3.1	-14.7
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	-10.4	-10.4	-10.4	-15.1	-15.1	-15.1	-74.2	-74.2	-74.2
Fish									
Juvenile Fish									
Carp	-43.6	-16.6	-68.8	-43.3	-16.2	-69.3	-47.8	-17.5	-78.3
Sucker, Largescale	-42.3	-17.5	-62.1	-43.6	-17.4	-65.8	-52.9	-19.8	-84.6
Chinook, Salmon (juv)	-12.4	-7.0	-15.0	-14.2	-7.6	-17.7	-34.0	-16.3	-45.0
Peamouth	-48.3	-19.2	-73.4	-48.5	-18.9	-74.9	-57.8	-21.8	-91.8
Sculpin	-35.9	-24.7	-40.0	-42.9	-27.7	-48.8	-108.3	-62.5	-129.6
Crappie, Black	-19.4	-8.7	-26.8	-19.8	-8.6	-28.1	-30.6	-12.5	-45.5
Bullhead, Brown	-21.5	-10.0	-28.9	-23.8	-10.5	-33.2	-42.5	-16.9	-64.7
Bass, Smallmouth	-56.8	-32.5	-68.3	-62.4	-33.7	-77.2	-124.0	-59.4	-164.2
Pikeminnow, Northern	-134.6	-75.4	-163.5	-151.2	-79.3	-190.0	-273.0	-122.0	-378.3
MEAN	**-39.4**	**-20.5**	**-52.0**	**-43.0**	**-21.7**	**-57.7**	**-77.6**	**-38.7**	**-106.5**
Max	**-8.7**	**-3.1**	**-10.4**	**-8.7**	**-3.1**	**-14.7**	**-8.7**	**-3.1**	**-14.7**
Min	**-134.6**	**-75.4**	**-163.5**	**-151.2**	**-79.3**	**-190.0**	**-273.0**	**-122.0**	**-378.3**
underpredict count	**11.00**	**11.00**	**11.00**	**11.00**	**11.00**	**11.00**	**11.00**	**11.00**	**11**
underpredict percentage	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**100%**

Scenario	TT-RM2-11-DDE-2a	TT-RM2-11-DDE-2b	TT-RM2-11-DDE-2c	TT-RM2-11-DDE-2d	TT-RM2-11-DDE-2e	TT-RM2-11-DDE-2f	TT-RM2-11-DDE-2g	TT-RM2-11-DDE-2h	TT-RM2-11-DDE-2i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)	-8.7	-3.1	-14.7	-8.7	-3.1	-14.7	-8.7	-3.1	-14.7
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	-10.4	-10.4	-10.4	-15.1	-15.1	-15.1	-74.2	-74.2	-74.2
Fish									
Juvenile Fish									
Carp	-73.4	-30.3	-107.9	-75.1	-30.1	-113.3	-88.0	-33.2	-139.8
Sucker, Largescale	-73.4	-32.3	-102.9	-76.8	-32.4	-110.9	-96.2	-37.5	-148.7
Chinook, Salmon (juv)	-15.3	-10.7	-16.9	-18.5	-12.3	-20.8	-50.0	-29.2	-59.5
Peamouth	-65.1	-27.4	-94.1	-66.6	-27.3	-98.3	-82.1	-32.0	-126.8
Sculpin	-21.0	-9.1	-29.8	-22.2	-9.3	-32.3	-35.9	-14.2	-54.9
Crappie, Black	-21.1	-9.6	-28.8	-22.0	-9.7	-30.9	-36.1	-14.8	-53.2
Bullhead, Brown	-12.0	-4.6	-18.8	-12.4	-4.7	-19.6	-18.8	-6.9	-30.7
Bass, Smallmouth	-61.8	-31.4	-79.0	-67.1	-32.4	-88.5	-129.9	-57.5	-181.0
Pikeminnow, Northern	-169.7	-98.3	-202.9	-197.6	-106.0	-245.4	-341.5	-149.6	-480.0
MEAN	**-48.3**	**-24.3**	**-64.2**	**-52.9**	**-25.7**	**-71.8**	**-87.4**	**-41.1**	**-124.0**
Max	**-8.7**	**-3.1**	**-10.4**	**-8.7**	**-3.1**	**-14.7**	**-8.7**	**-3.1**	**-14.7**
Min	**-169.7**	**-98.3**	**-202.9**	**-197.6**	**-106.0**	**-245.4**	**-341.5**	**-149.6**	**-480.0**
underpredict count	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**
underpredict percentage	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-DDE-1a	TT-RM2-11-DDE-1b	TT-RM2-11-DDE-1c	TT-RM2-11-DDE-1d	TT-RM2-11-DDE-1e	TT-RM2-11-DDE-1f	TT-RM2-11-DDE-1g	TT-RM2-11-DDE-1h	TT-RM2-11-DDE-1i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)	-5.4	-1.9	-9.1	-5.4	-1.9	-9.1	-5.4	-1.9	-9.1
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	-7.3	-7.3	-7.3	-10.7	-10.7	-10.7	-52.2	-52.2	-52.2
Fish									
Juvenile Fish									
Carp	-40.2	-15.3	-63.6	-39.9	-15.0	-63.9	-44.1	-16.1	-72.3
Sucker, Largescale	-40.3	-16.7	-59.2	-41.5	-16.6	-62.7	-50.5	-18.9	-80.7
Chinook, Salmon (juv)	-12.3	-6.9	-14.9	-14.1	-7.5	-17.6	-33.8	-16.2	-44.8
Peamouth	-47.1	-18.7	-71.6	-47.3	-18.5	-73.0	-56.4	-21.3	-89.6
Sculpin	-15.5	-10.7	-17.3	-18.5	-12.0	-21.1	-46.7	-27.0	-55.9
Crappie, Black	-18.3	-8.2	-25.3	-18.7	-8.1	-26.5	-28.9	-11.8	-42.9
Bullhead, Brown	-20.5	-9.6	-27.6	-22.7	-10.0	-31.6	-40.6	-16.1	-61.7
Bass, Smallmouth	-53.4	-30.6	-64.2	-58.7	-31.7	-72.6	-116.6	-55.9	-154.4
Pikeminnow, Northern	-113.8	-63.7	-138.2	-127.8	-67.0	-160.6	-230.7	-103.1	-319.8
MEAN	**-34.0**	**-17.2**	**-45.3**	**-36.9**	**-18.1**	**-49.9**	**-64.2**	**-31.0**	**-89.4**
Max	**-5.4**	**-1.9**	**-7.3**	**-5.4**	**-1.9**	**-9.1**	**-5.4**	**-1.9**	**-9.1**
Min	**-113.8**	**-63.7**	**-138.2**	**-127.8**	**-67.0**	**-160.6**	**-230.7**	**-103.1**	**-319.8**
underpredict count	**11.00**	**11.00**	**11.00**	**11.00**	**11.00**	**11.00**	**11.00**	**11.00**	**11**
underpredict percentage	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**100%**

Scenario	TT-RM2-11-DDE-2a	TT-RM2-11-DDE-2b	TT-RM2-11-DDE-2c	TT-RM2-11-DDE-2d	TT-RM2-11-DDE-2e	TT-RM2-11-DDE-2f	TT-RM2-11-DDE-2g	TT-RM2-11-DDE-2h	TT-RM2-11-DDE-2i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)	-5.4	-1.9	-9.1	-5.4	-1.9	-9.1	-5.4	-1.9	-9.1
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	-7.3	-7.3	-7.3	-10.7	-10.7	-10.7	-52.2	-52.2	-52.2
Fish									
Juvenile Fish									
Carp	-67.8	-28.0	-99.6	-69.4	-27.8	-104.6	-81.2	-30.7	-129.0
Sucker, Largescale	-70.0	-30.8	-98.1	-73.2	-30.9	-105.8	-91.8	-35.7	-141.8
Chinook, Salmon (juv)	-15.2	-10.7	-16.8	-18.4	-12.2	-20.7	-49.7	-29.0	-59.2
Peamouth	-63.5	-26.8	-91.8	-64.9	-26.7	-96.0	-80.1	-31.2	-123.7
Sculpin	-9.1	-3.9	-12.9	-9.6	-4.0	-13.9	-15.5	-6.1	-23.7
Crappie, Black	-19.9	-9.1	-27.2	-20.8	-9.1	-29.2	-34.0	-14.0	-50.2
Bullhead, Brown	-11.4	-4.4	-17.9	-11.8	-4.5	-18.7	-17.9	-6.6	-29.2
Bass, Smallmouth	-58.1	-29.5	-74.2	-63.1	-30.4	-83.2	-122.1	-54.1	-170.2
Pikeminnow, Northern	-143.5	-83.1	-171.5	-167.0	-89.6	-207.4	-288.6	-126.4	-405.7
MEAN	**-42.8**	**-21.4**	**-56.9**	**-46.7**	**-22.5**	**-63.6**	**-76.2**	**-35.3**	**-108.6**
Max	**-5.4**	**-1.9**	**-7.3**	**-5.4**	**-1.9**	**-9.1**	**-5.4**	**-1.9**	**-9.1**
Min	**-143.5**	**-83.1**	**-171.5**	**-167.0**	**-89.6**	**-207.4**	**-288.6**	**-126.4**	**-405.7**
underpredict count	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**
underpredict percentage	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-DDE-1a	TT-RM2-11-DDE-1b	TT-RM2-11-DDE-1c	TT-RM2-11-DDE-1d	TT-RM2-11-DDE-1e	TT-RM2-11-DDE-1f	TT-RM2-11-DDE-1g	TT-RM2-11-DDE-1h	TT-RM2-11-DDE-1i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)	8.7	3.1	14.7	8.7	3.1	14.7	8.7	3.1	14.7
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	10.4	10.4	10.4	15.1	15.1	15.1	74.2	74.2	74.2
Fish									
Juvenile Fish									
Carp	43.6	16.6	68.8	43.3	16.2	69.3	47.8	17.5	78.3
Sucker, Largescale	42.3	17.5	62.1	43.6	17.4	65.8	52.9	19.8	84.6
Chinook, Salmon (juv)	12.4	7.0	15.0	14.2	7.6	17.7	34.0	16.3	45.0
Peamouth	48.3	19.2	73.4	48.5	18.9	74.9	57.8	21.8	91.8
Sculpin	35.9	24.7	40.0	42.9	27.7	48.8	108.3	62.5	129.6
Crappie, Black	19.4	8.7	26.8	19.8	8.6	28.1	30.6	12.5	45.5
Bullhead, Brown	21.5	10.0	28.9	23.8	10.5	33.2	42.5	16.9	64.7
Bass, Smallmouth	56.8	32.5	68.3	62.4	33.7	77.2	124.0	59.4	164.2
Pikeminnow, Northern	134.6	75.4	163.5	151.2	79.3	190.0	273.0	122.0	378.3
MEAN (MPAF)	**39.4**	**20.5**	**52.0**	**43.0**	**21.7**	**57.7**	**77.6**	**38.7**	**106.5**
Geomean	**28.8**	**14.6**	**38.2**	**31.7**	**15.5**	**42.9**	**55.5**	**25.3**	**78.6**
Max	**134.6**	**75.4**	**163.5**	**151.2**	**79.3**	**190.0**	**273.0**	**122.0**	**378.3**
Min	**8.7**	**3.1**	**10.4**	**8.7**	**3.1**	**14.7**	**8.7**	**3.1**	**14.7**
# under 10	**1**	**3**	**0**	**1**	**3**	**0**	**1**	**1**	**0**
# under 5	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**
# under 2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Scenario	TT-RM2-11-DDE-2a	TT-RM2-11-DDE-2b	TT-RM2-11-DDE-2c	TT-RM2-11-DDE-2d	TT-RM2-11-DDE-2e	TT-RM2-11-DDE-2f	TT-RM2-11-DDE-2g	TT-RM2-11-DDE-2h	TT-RM2-11-DDE-2i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)	8.7	3.1	14.7	8.7	3.1	14.7	8.7	3.1	14.7
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	10.4	10.4	10.4	15.1	15.1	15.1	74.2	74.2	74.2
Fish									
Juvenile Fish									
Carp	73.4	30.3	107.9	75.1	30.1	113.3	88.0	33.2	139.8
Sucker, Largescale	73.4	32.3	102.9	76.8	32.4	110.9	96.2	37.5	148.7
Chinook, Salmon (juv)	15.3	10.7	16.9	18.5	12.3	20.8	50.0	29.2	59.5
Peamouth	65.1	27.4	94.1	66.6	27.3	98.3	82.1	32.0	126.8
Sculpin	21.0	9.1	29.8	22.2	9.3	32.3	35.9	14.2	54.9
Crappie, Black	21.1	9.6	28.8	22.0	9.7	30.9	36.1	14.8	53.2
Bullhead, Brown	12.0	4.6	18.8	12.4	4.7	19.6	18.8	6.9	30.7
Bass, Smallmouth	61.8	31.4	79.0	67.1	32.4	88.5	129.9	57.5	181.0
Pikeminnow, Northern	169.7	98.3	202.9	197.6	106.0	245.4	341.5	149.6	480.0
MEAN (MPAF)	**48.3**	**24.3**	**64.2**	**52.9**	**25.7**	**71.8**	**87.4**	**41.1**	**124.0**
Geomean	**31.2**	**15.4**	**41.9**	**34.2**	**16.3**	**46.9**	**57.8**	**25.8**	**83.3**
Max	**169.7**	**98.3**	**202.9**	**197.6**	**106.0**	**245.4**	**341.5**	**149.6**	**480.0**
Min	**8.7**	**3.1**	**10.4**	**8.7**	**3.1**	**14.7**	**8.7**	**3.1**	**14.7**
# under 10	**1**	**4**	**0**	**1**	**4**	**0**	**1**	**2**	**0**
# under 5	**0**	**2**	**0**	**0**	**2**	**0**	**0**	**1**	**0**
# under 2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-DDE-1a	TT-RM2-11-DDE-1b	TT-RM2-11-DDE-1c	TT-RM2-11-DDE-1d	TT-RM2-11-DDE-1e	TT-RM2-11-DDE-1f	TT-RM2-11-DDE-1g	TT-RM2-11-DDE-1h	TT-RM2-11-DDE-1i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)	5.4	1.9	9.1	5.4	1.9	9.1	5.4	1.9	9.1
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	7.3	7.3	7.3	10.7	10.7	10.7	52.2	52.2	52.2
Fish									
Juvenile Fish									
Carp	40.2	15.3	63.6	39.9	15.0	63.9	44.1	16.1	72.3
Sucker, Largescale	40.3	16.7	59.2	41.5	16.6	62.7	50.5	18.9	80.7
Chinook, Salmon (juv)	12.3	6.9	14.9	14.1	7.5	17.6	33.8	16.2	44.8
Peamouth	47.1	18.7	71.6	47.3	18.5	73.0	56.4	21.3	89.6
Sculpin	15.5	10.7	17.3	18.5	12.0	21.1	46.7	27.0	55.9
Crappie, Black	18.3	8.2	25.3	18.7	8.1	26.5	28.9	11.8	42.9
Bullhead, Brown	20.5	9.6	27.6	22.7	10.0	31.6	40.6	16.1	61.7
Bass, Smallmouth	53.4	30.6	64.2	58.7	31.7	72.6	116.6	55.9	154.4
Pikeminnow, Northern	113.8	63.7	138.2	127.8	67.0	160.6	230.7	103.1	319.8
MEAN (MPAF)	**34.0**	**17.2**	**45.3**	**36.9**	**18.1**	**49.9**	**64.2**	**31.0**	**89.4**
Geomean	**23.7**	**12.0**	**31.3**	**26.0**	**12.8**	**35.2**	**45.6**	**20.8**	**64.6**
Max	**113.8**	**63.7**	**138.2**	**127.8**	**67.0**	**160.6**	**230.7**	**103.1**	**319.8**
Min	**5.4**	**1.9**	**7.3**	**5.4**	**1.9**	**9.1**	**5.4**	**1.9**	**9.1**
# under 10	**2**	**5**	**2**	**1**	**3**	**1**	**1**	**1**	**1**
# under 5	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**
# under 2	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**

Scenario	TT-RM2-11-DDE-2a	TT-RM2-11-DDE-2b	TT-RM2-11-DDE-2c	TT-RM2-11-DDE-2d	TT-RM2-11-DDE-2e	TT-RM2-11-DDE-2f	TT-RM2-11-DDE-2g	TT-RM2-11-DDE-2h	TT-RM2-11-DDE-2i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)	5.4	1.9	9.1	5.4	1.9	9.1	5.4	1.9	9.1
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	7.3	7.3	7.3	10.7	10.7	10.7	52.2	52.2	52.2
Fish									
Juvenile Fish									
Carp	67.8	28.0	99.6	69.4	27.8	104.6	81.2	30.7	129.0
Sucker, Largescale	70.0	30.8	98.1	73.2	30.9	105.8	91.8	35.7	141.8
Chinook, Salmon (juv)	15.2	10.7	16.8	18.4	12.2	20.7	49.7	29.0	59.2
Peamouth	63.5	26.8	91.8	64.9	26.7	96.0	80.1	31.2	123.7
Sculpin	9.1	3.9	12.9	9.6	4.0	13.9	15.5	6.1	23.7
Crappie, Black	19.9	9.1	27.2	20.8	9.1	29.2	34.0	14.0	50.2
Bullhead, Brown	11.4	4.4	17.9	11.8	4.5	18.7	17.9	6.6	29.2
Bass, Smallmouth	58.1	29.5	74.2	63.1	30.4	83.2	122.1	54.1	170.2
Pikeminnow, Northern	143.5	83.1	171.5	167.0	89.6	207.4	288.6	126.4	405.7
MEAN (MPAF)	**42.8**	**21.4**	**56.9**	**46.7**	**22.5**	**63.6**	**76.2**	**35.3**	**108.6**
Geomean	**25.6**	**12.6**	**34.4**	**28.1**	**13.4**	**38.6**	**47.5**	**21.2**	**68.4**
Max	**143.5**	**83.1**	**171.5**	**167.0**	**89.6**	**207.4**	**288.6**	**126.4**	**405.7**
Min	**5.4**	**1.9**	**7.3**	**5.4**	**1.9**	**9.1**	**5.4**	**1.9**	**9.1**
# under 10	**3**	**5**	**2**	**2**	**4**	**1**	**1**	**3**	**1**
# under 5	**0**	**3**	**0**	**0**	**3**	**0**	**0**	**1**	**0**
# under 2	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**

C.1.4

Table 1 - Trophic Trace Model Output for Scenario Runs

Chemical - DDE Spatial Scale - Swan Island

Scenario	TT-SI-DDE-1a	TT-SI-DDE-1b	TT-SI-DDE-1c	TT-SI-DDE-1d	TT-SI-DDE-1e	TT-SI-DDE-1f	TT-SI-DDE-1g	TT-SI-DDE-1h	TT-SI-DDE-1i
Species									
Plankton									
Various Plankton and Algae	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Zooplankton	0.8	0.8	0.8	0.5	0.5	0.5	0.1	0.1	0.1
Benthos									
Clam (Corbicula sp)	3.4	9.5	2.0	3.4	9.5	2.0	3.4	9.5	2.0
Oligochaete	2.9	8.0	1.7	2.9	8.0	1.7	2.9	8.0	1.7
Insect Larvae	0.9	0.9	0.9	0.6	0.6	0.6	0.1	0.1	0.1
Amphipod	2.3	6.4	1.3	2.3	6.4	1.3	2.3	6.4	1.3
Crayfish	0.6	0.6	0.6	0.4	0.4	0.4	0.1	0.1	0.1
Fish									
Juvenile Fish	1.5	2.9	1.2	1.4	2.7	1.1	0.8	1.8	0.6
Carp	2.3	5.9	1.5	2.3	6.0	1.5	2.1	5.5	1.3
Sucker, Largescale	2.2	5.2	1.6	2.1	5.2	1.5	1.7	4.5	1.1
Chinook, Salmon (juv)	1.5	2.4	1.3	1.3	2.2	1.1	0.5	1.0	0.4
Peamouth	2.0	4.9	1.4	2.0	5.0	1.3	1.7	4.3	1.1
Sculpin	1.4	1.9	1.3	1.2	1.7	1.1	0.4	0.7	0.4
Crappie, Black	2.3	4.8	1.7	2.2	4.9	1.7	1.5	3.5	1.0
Bullhead, Brown	1.8	3.5	1.4	1.6	3.3	1.2	0.9	2.1	0.6
Bass, Smallmouth	2.0	3.2	1.7	1.8	3.0	1.5	0.9	1.6	0.7
Pikeminnow, Northern	1.6	2.6	1.4	1.4	2.5	1.2	0.7	1.5	0.6

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Scenario	TT-SI-DDE-2a	TT-SI-DDE-2b	TT-SI-DDE-2c	TT-SI-DDE-2d	TT-SI-DDE-2e	TT-SI-DDE-2f	TT-SI-DDE-2g	TT-SI-DDE-2h	TT-SI-DDE-2i
Species									
Plankton									
Various Plankton and Algae	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Zooplankton	0.8	0.8	0.8	0.5	0.5	0.5	0.1	0.1	0.1
Benthos									
Clam (Corbicula sp)	3.4	9.5	2.0	3.4	9.5	2.0	3.4	9.5	2.0
Oligochaete	2.9	8.0	1.7	2.9	8.0	1.7	2.9	8.0	1.7
Insect Larvae	0.9	0.9	0.9	0.6	0.6	0.6	0.1	0.1	0.1
Amphipod	2.3	6.4	1.3	2.3	6.4	1.3	2.3	6.4	1.3
Crayfish	0.6	0.6	0.6	0.4	0.4	0.4	0.1	0.1	0.1
Fish									
Juvenile Fish	1.2	1.7	1.1	1.0	1.5	0.9	0.5	0.9	0.4
Carp	1.4	3.2	1.0	1.3	3.2	0.9	1.1	2.9	0.7
Sucker, Largescale	1.3	2.8	1.0	1.2	2.7	0.9	0.9	2.3	0.6
Chinook, Salmon (juv)	1.3	1.7	1.2	1.0	1.5	1.0	0.4	0.6	0.3
Peamouth	1.6	3.5	1.1	1.5	3.5	1.1	1.2	3.0	0.8
Sculpin	2.1	4.5	1.5	1.9	4.3	1.4	1.1	2.6	0.7
Crappie, Black	2.1	4.3	1.6	2.0	4.3	1.5	1.2	2.9	0.9
Bullhead, Brown	2.9	7.3	1.9	2.8	7.2	1.8	1.9	5.0	1.2
Bass, Smallmouth	1.7	3.1	1.4	1.6	3.0	1.2	0.8	1.6	0.6
Pikeminnow, Northern	1.3	2.0	1.1	1.1	1.8	0.9	0.6	1.2	0.4

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-DDE-1a	TT-SI-DDE-1b	TT-SI-DDE-1c	TT-SI-DDE-1d	TT-SI-DDE-1e	TT-SI-DDE-1f	TT-SI-DDE-1g	TT-SI-DDE-1h	TT-SI-DDE-1i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)									
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	-4.1	-4.1	-4.1	-6.0	-6.0	-6.0	-28.8	-28.8	-28.8
Fish									
Juvenile Fish									
Carp	-53.4	-20.8	-82.6	-53.4	-20.4	-83.9	-59.4	-22.0	-96.3
Sucker, Largescale	-82.8	-35.7	-117.9	-86.4	-35.8	-126.8	-108.0	-41.3	-169.7
Chinook, Salmon (juv)									
Peamouth	-61.4	-25.4	-90.1	-62.0	-25.1	-92.7	-74.1	-28.8	-114.7
Sculpin	-14.7	-10.9	-16.0	-17.9	-12.5	-19.8	-49.2	-30.9	-56.7
Crappie, Black	-31.9	-15.3	-42.3	-32.8	-15.1	-44.6	-49.1	-21.0	-70.3
Bullhead, Brown	-26.4	-13.3	-34.0	-29.7	-14.0	-39.6	-54.5	-22.5	-80.3
Bass, Smallmouth	-37.8	-23.6	-43.8	-42.2	-24.9	-50.1	-88.6	-46.0	-111.9
Pikeminnow, Northern	-51.2	-31.2	-59.9	-58.5	-33.4	-70.5	-111.0	-53.2	-146.9
MEAN	**-40.4**	**-20.0**	**-54.5**	**-43.2**	**-20.8**	**-59.3**	**-69.2**	**-32.7**	**-97.3**
Max	**-4.1**	**-4.1**	**-4.1**	**-6.0**	**-6.0**	**-6.0**	**-28.8**	**-21.0**	**-28.8**
Min	**-82.8**	**-35.7**	**-117.9**	**-86.4**	**-35.8**	**-126.8**	**-111.0**	**-53.2**	**-169.7**
underpredict count	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**
underpredict percentage	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Scenario	TT-SI-DDE-2a	TT-SI-DDE-2b	TT-SI-DDE-2c	TT-SI-DDE-2d	TT-SI-DDE-2e	TT-SI-DDE-2f	TT-SI-DDE-2g	TT-SI-DDE-2h	TT-SI-DDE-2i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)									
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	-4.1	-4.1	-4.1	-6.0	-6.0	-6.0	-28.8	-28.8	-28.8
Fish									
Juvenile Fish									
Carp	-87.4	-38.0	-123.5	-90.7	-38.0	-132.0	-109.1	-42.2	-169.4
Sucker, Largescale	-143.2	-67.2	-192.1	-152.4	-68.1	-211.2	-199.4	-80.4	-298.8
Chinook, Salmon (juv)									
Peamouth	-80.5	-36.0	-111.5	-83.1	-36.0	-117.9	-103.8	-42.2	-154.7
Sculpin	-10.2	-4.7	-13.9	-11.0	-4.9	-15.4	-19.5	-8.0	-28.8
Crappie, Black	-34.7	-17.0	-45.4	-36.7	-17.2	-49.3	-59.3	-25.7	-84.2
Bullhead, Brown	-16.2	-6.4	-24.7	-16.7	-6.5	-26.0	-25.2	-9.4	-40.5
Bass, Smallmouth	-43.6	-24.0	-53.4	-48.3	-25.2	-60.7	-99.5	-47.9	-131.2
Pikeminnow, Northern	-64.9	-40.8	-74.8	-76.7	-44.8	-91.4	-140.1	-65.8	-187.9
MEAN	**-53.9**	**-26.5**	**-71.5**	**-58.0**	**-27.4**	**-78.9**	**-87.2**	**-38.9**	**-124.9**
Max	**-4.1**	**-4.1**	**-4.1**	**-6.0**	**-4.9**	**-6.0**	**-19.5**	**-8.0**	**-28.8**
Min	**-143.2**	**-67.2**	**-192.1**	**-152.4**	**-68.1**	**-211.2**	**-199.4**	**-80.4**	**-298.8**
underpredict count	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**	**9.0**
underpredict percentage	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-DDE-1a	TT-SI-DDE-1b	TT-SI-DDE-1c	TT-SI-DDE-1d	TT-SI-DDE-1e	TT-SI-DDE-1f	TT-SI-DDE-1g	TT-SI-DDE-1h	TT-SI-DDE-1i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)									
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	-3.9	-3.9	-3.9	-5.6	-5.6	-5.6	-27.3	-27.3	-27.3
Fish									
Juvenile Fish									
Carp	-52.5	-20.4	-81.1	-52.4	-20.1	-82.3	-58.4	-21.6	-94.5
Sucker, Largescale									
Chinook, Salmon (juv)									
Peamouth									
Sculpin	-14.6	-10.8	-15.8	-17.7	-12.4	-19.6	-48.7	-30.6	-56.1
Crappie, Black	-31.8	-15.2	-42.1	-32.7	-15.1	-44.4	-48.9	-20.9	-70.1
Bullhead, Brown	-25.3	-12.7	-32.6	-28.5	-13.5	-38.0	-52.3	-21.6	-77.0
Bass, Smallmouth	-36.8	-22.9	-42.6	-41.1	-24.2	-48.8	-86.2	-44.8	-108.9
Pikeminnow, Northern									
MEAN	**-27.5**	**-14.3**	**-36.4**	**-29.7**	**-15.1**	**-39.8**	**-53.6**	**-27.8**	**-72.3**
Max	**-3.9**	**-3.9**	**-3.9**	**-5.6**	**-5.6**	**-5.6**	**-27.3**	**-20.9**	**-27.3**
Min	**-52.5**	**-22.9**	**-81.1**	**-52.4**	**-24.2**	**-82.3**	**-86.2**	**-44.8**	**-108.9**
underpredict count	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**	**6.0**
underpredict percentage	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Scenario	TT-SI-DDE-2a	TT-SI-DDE-2b	TT-SI-DDE-2c	TT-SI-DDE-2d	TT-SI-DDE-2e	TT-SI-DDE-2f	TT-SI-DDE-2g	TT-SI-DDE-2h	TT-SI-DDE-2i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)									
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	-3.9	-3.9	-3.9	-5.6	-5.6	-5.6	-27.3	-27.3	-27.3
Fish									
Juvenile Fish									
Carp	-85.8	-37.3	-121.3	-89.1	-37.3	-129.6	-107.1	-41.5	-166.3
Sucker, Largescale									
Chinook, Salmon (juv)									
Peamouth									
Sculpin	-10.1	-4.6	-13.7	-10.9	-4.8	-15.2	-19.3	-7.9	-28.5
Crappie, Black	-34.6	-16.9	-45.2	-36.5	-17.1	-49.1	-59.1	-25.5	-83.9
Bullhead, Brown	-15.5	-6.1	-23.7	-16.0	-6.2	-24.9	-24.2	-9.0	-38.8
Bass, Smallmouth	-42.4	-23.4	-52.0	-47.0	-24.6	-59.1	-96.8	-46.7	-127.7
Pikeminnow, Northern									
MEAN	**-32.1**	**-15.4**	**-43.3**	**-34.2**	**-15.9**	**-47.3**	**-55.6**	**-26.3**	**-78.8**
Max	**-3.9**	**-3.9**	**-3.9**	**-5.6**	**-4.8**	**-5.6**	**-19.3**	**-7.9**	**-27.3**
Min	**-85.8**	**-37.3**	**-121.3**	**-89.1**	**-37.3**	**-129.6**	**-107.1**	**-46.7**	**-166.3**
underpredict count	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**
underpredict percentage	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	**TT-SI-DDE-1a**	**TT-SI-DDE-1b**	**TT-SI-DDE-1c**	**TT-SI-DDE-1d**	**TT-SI-DDE-1e**	**TT-SI-DDE-1f**	**TT-SI-DDE-1g**	**TT-SI-DDE-1h**	**TT-SI-DDE-1i**
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)									
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	4.1	4.1	4.1	6.0	6.0	6.0	28.8	28.8	28.8
Fish									
Juvenile Fish									
Carp	53.4	20.8	82.6	53.4	20.4	83.9	59.4	22.0	96.3
Sucker, Largescale	82.8	35.7	117.9	86.4	35.8	126.8	108.0	41.3	169.7
Chinook, Salmon (juv)									
Peamouth	61.4	25.4	90.1	62.0	25.1	92.7	74.1	28.8	114.7
Sculpin	14.7	10.9	16.0	17.9	12.5	19.8	49.2	30.9	56.7
Crappie, Black	31.9	15.3	42.3	32.8	15.1	44.6	49.1	21.0	70.3
Bullhead, Brown	26.4	13.3	34.0	29.7	14.0	39.6	54.5	22.5	80.3
Bass, Smallmouth	37.8	23.6	43.8	42.2	24.9	50.1	88.6	46.0	111.9
Pikeminnow, Northern	51.2	31.2	59.9	58.5	33.4	70.5	111.0	53.2	146.9
MEAN (MPAF)	**40.4**	**20.0**	**54.5**	**43.2**	**20.8**	**59.3**	**69.2**	**32.7**	**97.3**
Geomean	**31.0**	**17.1**	**39.2**	**34.7**	**18.4**	**44.8**	**63.9**	**31.1**	**87.0**
Max	**82.8**	**35.7**	**117.9**	**86.4**	**35.8**	**126.8**	**111.0**	**53.2**	**169.7**
Min	**1.2**	**2.2**	**3.2**	**4.2**	**5.2**	**6.2**	**7.2**	**8.2**	**9.2**
# under 10	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**
# under 5	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
# under 2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Scenario	TT-SI-DDE-2a	TT-SI-DDE-2b	TT-SI-DDE-2c	TT-SI-DDE-2d	TT-SI-DDE-2e	TT-SI-DDE-2f	TT-SI-DDE-2g	TT-SI-DDE-2h	TT-SI-DDE-2i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)									
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	4.1	4.1	4.1	6.0	6.0	6.0	28.8	28.8	28.8
Fish									
Juvenile Fish									
Carp	87.4	38.0	123.5	90.7	38.0	132.0	109.1	42.2	169.4
Sucker, Largescale	143.2	67.2	192.1	152.4	68.1	211.2	199.4	80.4	298.8
Chinook, Salmon (juv)									
Peamouth	80.5	36.0	111.5	83.1	36.0	117.9	103.8	42.2	154.7
Sculpin	10.2	4.7	13.9	11.0	4.9	15.4	19.5	8.0	28.8
Crappie, Black	34.7	17.0	45.4	36.7	17.2	49.3	59.3	25.7	84.2
Bullhead, Brown	16.2	6.4	24.7	16.7	6.5	26.0	25.2	9.4	40.5
Bass, Smallmouth	43.6	24.0	53.4	48.3	25.2	60.7	99.5	47.9	131.2
Pikeminnow, Northern	64.9	40.8	74.8	76.7	44.8	91.4	140.1	65.8	187.9
MEAN (MPAF)	**53.9**	**26.5**	**71.5**	**58.0**	**27.4**	**78.9**	**87.2**	**38.9**	**124.9**
Geomean	**34.4**	**17.9**	**44.4**	**38.2**	**19.1**	**50.5**	**66.8**	**30.8**	**93.5**
Max	**143.2**	**67.2**	**192.1**	**152.4**	**68.1**	**211.2**	**199.4**	**80.4**	**298.8**
Min	**1.2**	**2.2**	**3.2**	**4.2**	**5.2**	**6.2**	**7.2**	**8.2**	**9.2**
# under 10	**1**	**3**	**1**	**1**	**3**	**1**	**0**	**2**	**0**
# under 5	**1**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**
# under 2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-DDE-1a	TT-SI-DDE-1b	TT-SI-DDE-1c	TT-SI-DDE-1d	TT-SI-DDE-1e	TT-SI-DDE-1f	TT-SI-DDE-1g	TT-SI-DDE-1h	TT-SI-DDE-1i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)									
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	3.9	3.9	3.9	5.6	5.6	5.6	27.3	27.3	27.3
Fish									
Juvenile Fish									
Carp	52.5	20.4	81.1	52.4	20.1	82.3	58.4	21.6	94.5
Sucker, Largescale									
Chinook, Salmon (juv)									
Peamouth									
Sculpin	14.6	10.8	15.8	17.7	12.4	19.6	48.7	30.6	56.1
Crappie, Black	31.8	15.2	42.1	32.7	15.1	44.4	48.9	20.9	70.1
Bullhead, Brown	25.3	12.7	32.6	28.5	13.5	38.0	52.3	21.6	77.0
Bass, Smallmouth	36.8	22.9	42.6	41.1	24.2	48.8	86.2	44.8	108.9
Pikeminnow, Northern									
MEAN (MPAF)	**27.5**	**14.3**	**36.4**	**29.7**	**15.1**	**39.8**	**53.6**	**27.8**	**72.3**
Geomean	**21.1**	**12.5**	**25.8**	**24.2**	**13.8**	**30.1**	**50.8**	**26.7**	**66.3**
Max	**52.5**	**22.9**	**81.1**	**52.4**	**24.2**	**82.3**	**86.2**	**44.8**	**108.9**
Min	**3.9**	**3.9**	**3.9**	**5.6**	**5.6**	**5.6**	**27.3**	**20.9**	**27.3**
# under 10	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**
# under 5	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
# under 2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Scenario	TT-SI-DDE-2a	TT-SI-DDE-2b	TT-SI-DDE-2c	TT-SI-DDE-2d	TT-SI-DDE-2e	TT-SI-DDE-2f	TT-SI-DDE-2g	TT-SI-DDE-2h	TT-SI-DDE-2i
Various Plankton and Algae									
Zooplankton									
Benthos									
Clam (Corbicula sp)									
Oligochaete									
Insect Larvae									
Amphipod									
Crayfish	3.9	3.9	3.9	5.6	5.6	5.6	27.3	27.3	27.3
Fish									
Juvenile Fish									
Carp	85.8	37.3	121.3	89.1	37.3	129.6	107.1	41.5	166.3
Sucker, Largescale									
Chinook, Salmon (juv)									
Peamouth									
Sculpin	10.1	4.6	13.7	10.9	4.8	15.2	19.3	7.9	28.5
Crappie, Black	34.6	16.9	45.2	36.5	17.1	49.1	59.1	25.5	83.9
Bullhead, Brown	15.5	6.1	23.7	16.0	6.2	24.9	24.2	9.0	38.8
Bass, Smallmouth	42.4	23.4	52.0	47.0	24.6	59.1	96.8	46.7	127.7
Pikeminnow, Northern									
MEAN (MPAF)	**32.1**	**15.4**	**43.3**	**34.2**	**15.9**	**47.3**	**55.6**	**26.3**	**78.8**
Geomean	**20.6**	**10.9**	**26.7**	**23.1**	**11.8**	**30.5**	**44.5**	**21.4**	**61.5**
Max	**85.8**	**37.3**	**121.3**	**89.1**	**37.3**	**129.6**	**107.1**	**46.7**	**166.3**
Min	**3.9**	**3.9**	**3.9**	**5.6**	**4.8**	**5.6**	**19.3**	**7.9**	**27.3**
# under 10	**1**	**3**	**1**	**1**	**3**	**1**	**0**	**2**	**0**
# under 5	**1**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**0**
# under 2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

C.2.1

Table 1. Trophic Trace initial predicted values (µg/kg ww) for sensitivity runs

Chemical - parameterized for average values of "Total PCBs"

Spatial Scale - RM 2-11 Kow - 5.5

Species	ug/kg (ww)
Plankton and Primary Producers	
Various Plankton and Algae	0.2
Zooplankton	1.3
Invertebrates	
Clam (Corbicula sp)	214.1
Oligochaete	181.5
Insect Larvae	1.5
Amphipod	145.2
Crayfish	1.0
Fish	
Juvenile Fish	33.2
Carp	112.8
Sucker, Largescale	87.5
Chinook, Salmon (juv)	14.8
Peamouth	85.2
Sculpin	10.4
Crappie, Black	42.9
Bullhead, Brown	35.2
Bass, Smallmouth	26.6
Pikeminnow, Northern	26.9

Table 2. Trophic Trace initial predicted values (µg/kg ww) for sensitivity runs

Chemical - parameterized for average values of "Total PCBs"

Spatial Scale - RM2-11 Kow - 6.5

Species	ug/kg (ww)
Plankton and Primary Producers	
Various Plankton and Algae	1.4
Zooplankton	11.0
Invertebrates	
Clam (Corbicula sp)	214.1
Oligochaete	181.5
Insect Larvae	13.2
Amphipod	145.2
Crayfish	8.6
Fish	
Juvenile Fish	58.5
Carp	130.6
Sucker, Largescale	110.4
Chinook, Salmon (juv)	47.3
Peamouth	110.2
Sculpin	36.3
Crappie, Black	82.4
Bullhead, Brown	72.8
Bass, Smallmouth	66.5
Pikeminnow, Northern	53.6

Table 3. Trophic Trace sensitivity initial predicted values
Chemical - parameterized for average values of "Total PCBs"
Spatial Scale - RM 2-11 Kow - 7.5

Species	ug/kg (ww)
Plankton and Primary Producers	
Various Plankton and Algae	5.7
Zooplankton	46.7
Invertebrates	
Clam (Corbicula sp)	214.1
Oligochaete	181.5
Insect Larvae	56.0
Amphipod	145.2
Crayfish	36.5
Fish	
Juvenile Fish	64.6
Carp	100.9
Sucker, Largescale	96.4
Chinook, Salmon (juv)	54.7
Peamouth	88.2
Sculpin	51.5
Crappie, Black	67.9
Bullhead, Brown	77.9
Bass, Smallmouth	57.1
Pikeminnow, Northern	58.3

Table 4. Trophic Trace initial predicted values
Chemical - parameterized for average values of "Total PCBs"
Spatial Scale - Swan Island Kow - 6.5

Species	ug/kg (ww)
Plankton and Primary Producers	
Various Plankton and Algae	1.3
Zooplankton	10.9
Invertebrates	
Clam (Corbicula sp)	747.1
Oligochaete	633.1
Insect Larvae	13.1
Amphipod	506.5
Crayfish	8.1
Fish	
Juvenile Fish	176.7
Carp	456.0
Sucker, Largescale	380.1
Chinook, Salmon (juv)	128.7
Peamouth	369.9
Sculpin	80.2
Crappie, Black	253.1
Bullhead, Brown	227.2
Bass, Smallmouth	175.8
Pikeminnow, Northern	146.1

C.2.2

Table 1 - Trophic Trace Model Output for Sensitivity Runs Spatial Scale - RM2-11 Kow - 5.5

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	Koc increase	Koc decrease
Species							
Plankton							
Various Plankton and Algae	0.2	0.1	0.2	0.2	0.1	0.2	0.2
Zooplankton	1.3	0.6	1.3	1.9	0.6	1.3	1.3
Benthos							
Clam (Corbicula sp)	214.1	107.1	214.1	214.1	214.1	214.1	214.1
Oligochaete	181.5	90.7	181.5	181.5	181.5	181.5	181.5
Insect Larvae	1.5	0.8	1.5	2.3	0.8	1.5	1.5
Amphipod	145.2	72.6	145.2	145.2	145.2	145.2	145.2
Crayfish	1.0	0.5	1.0	1.5	0.5	1.0	1.0
Fish							
Juvenile Fish	30.8	14.5	38.0	38.8	23.3	33.2	33.2
Carp	107.4	57.9	166.5	119.5	96.4	112.8	112.8
Sucker, Largescale	82.9	52.8	123.3	94.4	72.0	87.5	87.5
Chinook, Salmon (juv)	13.1	5.0	14.9	20.0	8.0	14.8	14.8
Peamouth	80.3	37.6	114.9	93.3	67.6	85.2	85.3
Sculpin	9.4	4.0	12.7	14.3	5.3	10.3	10.4
Crappie, Black	38.5	15.6	63.2	52.2	27.2	42.8	42.9
Bullhead, Brown	31.9	12.0	35.5	43.0	22.8	35.1	35.2
Bass, Smallmouth	23.5	9.7	42.9	34.4	14.8	26.5	26.6
Pikeminnow, Northern	24.8	10.6	38.1	32.1	18.3	26.9	27.0

Scenario	DOC decrease	POC decrease	DOC & POC decrease	Sed OC decrease	Sed PCB decrease	Water PCB decrease	BSAF decrease
Species							
Plankton							
Various Plankton and Algae	0.2	0.2	0.2	0.2	0.2	0.1	0.2
Zooplankton	1.3	1.3	1.3	1.3	1.3	0.6	1.3
Benthos							
Clam (Corbicula sp)	214.1	214.1	214.1	428.3	107.1	214.1	107.1
Oligochaete	181.5	181.5	181.5	362.9	90.7	181.5	90.7
Insect Larvae	1.5	1.5	1.5	1.5	1.5	0.8	1.5
Amphipod	145.2	145.2	145.2	290.3	72.6	145.2	72.6
Crayfish	1.0	1.0	1.0	1.0	1.0	0.5	1.0
Fish							
Juvenile Fish	33.2	33.2	33.2	57.8	18.2	31.6	18.2
Carp	112.8	112.8	112.8	202.3	57.4	111.7	57.4
Sucker, Largescale	87.5	87.5	87.5	133.4	45.2	86.1	45.2
Chinook, Salmon (juv)	14.8	14.8	14.8	25.5	9.0	13.2	9.0
Peamouth	85.3	85.2	85.3	160.3	44.3	83.5	44.3
Sculpin	10.4	10.4	10.4	15.6	7.2	8.3	7.2
Crappie, Black	42.9	42.9	42.9	78.8	23.8	40.5	23.8
Bullhead, Brown	35.2	35.2	35.2	67.8	18.7	34.0	18.7
Bass, Smallmouth	26.6	26.6	26.6	44.9	16.1	23.7	16.1
Pikeminnow, Northern	27.0	26.9	27.0	48.7	15.5	24.9	15.5

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	Koc increase	Koc decrease
Various Plankton and Algae	0.00%	-50.00%	0.00%	48.68%	-49.56%	-0.9%	0.9%
Zooplankton	0.0%	-50.0%	0.00%	48.7%	-49.6%	-0.9%	0.9%
Benthos							
Clam (Corbicula sp)	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Oligochaete	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Insect Larvae	0.0%	-50.0%	0.00%	48.7%	-49.6%	-0.9%	0.9%
Amphipod	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Crayfish	0.0%	-50.0%	0.00%	48.7%	-49.6%	-0.9%	0.9%
Fish							
Juvenile Fish	-7.2%	-56.3%	14.61%	16.8%	-29.7%	-0.1%	0.1%
Carp	-4.7%	-48.6%	47.63%	5.9%	-14.5%	0.0%	0.0%
Sucker, Largescale	-5.2%	-39.6%	40.91%	7.8%	-17.7%	0.0%	0.0%
Chinook, Salmon (juv)	-11.2%	-66.0%	0.73%	35.5%	-45.9%	-0.2%	0.2%
Peamouth	-5.8%	-55.9%	34.76%	9.5%	-20.7%	0.0%	0.0%
Sculpin	-9.8%	-61.1%	21.98%	37.6%	-49.1%	-0.3%	0.3%
Crappie, Black	-10.2%	-63.7%	47.48%	21.7%	-36.6%	-0.1%	0.1%
Bullhead, Brown	-9.4%	-65.8%	0.90%	22.3%	-35.2%	-0.1%	0.1%
Bass, Smallmouth	-11.6%	-63.7%	61.32%	29.6%	-44.1%	-0.2%	0.2%
Pikeminnow, Northern	-8.0%	-60.6%	41.38%	19.4%	-32.1%	-0.1%	0.1%
MEAN (with negatives)	**-4.9%**	**-54.8%**	**18.34%**	**23.6%**	**-30.8%**	**-0.3%**	**0.3%**
Median (with negatives)	**-5.2%**	**-50.0%**	**0.9%**	**21.7%**	**-35.2%**	**-0.1%**	**0.1%**
Max (with negatives)	**0.0%**	**-39.6%**	**61.32%**	**48.7%**	**0.0%**	**0.0%**	**0.9%**
Min (with negatives)	**-11.6%**	**-66.0%**	**0.00%**	**0.0%**	**-49.6%**	**-0.9%**	**0.0%**
# that decreased	**10**	**17**	**0**	**0**	**14**	**14**	**0**
percentage that decreased	**59%**	**100%**	**0%**	**0%**	**82%**	**82%**	**0%**

MEAN (fish)	**-8.3%**	**-58.1%**	**31.2%**	**20.6%**	**-32.6%**	**-0.1%**	**0.1%**
Max (fish)	**-4.7%**	**-39.6%**	**61.3%**	**37.6%**	**-14.5%**	**0.0%**	**0.3%**
Min (fish)	**-11.6%**	**-66.0%**	**0.7%**	**5.9%**	**-49.1%**	**-0.3%**	**0.0%**

Table 2 (continued) - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as %change

Scenario	DOC decrease	POC decrease	DOC and POC decrease	Sed OC decrease	Sediment PCB decrease	Water PCB decrease	BSAF decrease
Various Plankton and Algae	0.9%	0.0%	0.9%	0.0%	0.0%	-50.0%	0.0%
Zooplankton	0.9%	0.0%	0.9%	0.0%	0.0%	-50.0%	0.0%
Benthos							
Clam (Corbicula sp)	0.0%	0.0%	0.0%	100.0%	-50.0%	0.0%	-50.0%
Oligochaete	0.0%	0.0%	0.0%	100.0%	-50.0%	0.0%	-50.0%
Insect Larvae	0.9%	0.0%	0.9%	0.0%	0.0%	-50.0%	0.0%
Amphipod	0.0%	0.0%	0.0%	100.0%	-50.0%	0.0%	-50.0%
Crayfish	0.9%	0.0%	0.9%	0.0%	0.0%	-50.0%	0.0%
Fish							
Juvenile Fish	0.1%	0.0%	0.1%	74.2%	-45.1%	-4.9%	-45.1%
Carp	0.0%	0.0%	0.0%	79.3%	-49.1%	-0.9%	-49.1%
Sucker, Largescale	0.0%	0.0%	0.0%	52.5%	-48.4%	-1.6%	-48.4%
Chinook, Salmon (juv)	0.2%	0.0%	0.2%	72.5%	-39.2%	-10.8%	-39.2%
Peamouth	0.0%	0.0%	0.0%	88.1%	-48.0%	-2.0%	-48.0%
Sculpin	0.3%	0.0%	0.3%	49.8%	-30.3%	-19.7%	-30.3%
Crappie, Black	0.1%	0.0%	0.1%	83.8%	-44.5%	-5.5%	-44.5%
Bullhead, Brown	0.1%	0.0%	0.1%	92.9%	-46.7%	-3.3%	-46.7%
Bass, Smallmouth	0.2%	0.0%	0.2%	69.1%	-39.3%	-10.7%	-39.3%
Pikeminnow, Northern	0.1%	0.0%	0.1%	81.0%	-42.6%	-7.4%	-42.6%
MEAN (with negatives)	**0.3%**	**0.0%**	**0.3%**	**61.4%**	**-34.3%**	**-15.7%**	**-34.3%**
Median (with negatives)	**0.1%**	**0.0%**	**0.1%**	**74.2%**	**-44.5%**	**-5.5%**	**-44.5%**
Max (with negatives)	**0.9%**	**0.0%**	**0.9%**	**100.0%**	**0.0%**	**0.0%**	**0.0%**
Min (with negatives)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**-50.0%**	**-50.0%**	**-50.0%**
# that decreased	**0**	**0**	**0**	**0**	**13**	**14**	**13**
percentage that decreased	**0%**	**0%**	**0%**	**0%**	**76%**	**82%**	**76%**

MEAN (fish)	**0.1%**	**0.0%**	**0.1%**	**74.3%**	**-43.3%**	**-6.7%**	**-43.3%**
Max (fish)	**0.3%**	**0.0%**	**0.3%**	**92.9%**	**-30.3%**	**-0.9%**	**-30.3%**
Min (fish)	**0.0%**	**0.0%**	**0.0%**	**49.8%**	**-49.1%**	**-19.7%**	**-49.1%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	Koc increase	Koc decrease
Various Plankton and Algae	0.0%	50.0%	0.00%	48.7%	49.6%	0.86%	0.9%
Zooplankton	0.0%	50.0%	0.00%	48.7%	49.6%	0.86%	0.9%
Benthos							
Clam (Corbicula sp)	0.0%	50.0%	0.00%	0.0%	0.0%	0.00%	0.0%
Oligochaete	0.0%	50.0%	0.00%	0.0%	0.0%	0.00%	0.0%
Insect Larvae	0.0%	50.0%	0.00%	48.7%	49.6%	0.86%	0.9%
Amphipod	0.0%	50.0%	0.00%	0.0%	0.0%	0.00%	0.0%
Crayfish	0.0%	50.0%	0.00%	48.7%	49.6%	0.86%	0.9%
Fish							
Juvenile Fish	7.2%	56.3%	14.61%	16.8%	29.7%	0.08%	0.1%
Carp	4.7%	48.6%	47.63%	5.9%	14.5%	0.02%	0.0%
Sucker, Largescale	5.2%	39.6%	40.91%	7.8%	17.7%	0.03%	0.0%
Chinook, Salmon (juv)	11.2%	66.0%	0.7%	35.5%	45.9%	0.2%	0.2%
Peamouth	5.8%	55.9%	34.8%	9.5%	20.7%	0.0%	0.0%
Sculpin	9.8%	61.1%	22.0%	37.6%	49.1%	0.3%	0.3%
Crappie, Black	10.2%	63.7%	47.5%	21.7%	36.6%	0.1%	0.1%
Bullhead, Brown	9.4%	65.8%	0.9%	22.3%	35.2%	0.1%	0.1%
Bass, Smallmouth	11.6%	63.7%	61.3%	29.6%	44.1%	0.2%	0.2%
Pikeminnow, Northern	8.0%	60.6%	41.4%	19.4%	32.1%	0.1%	0.1%
MEAN (MPAF) (absolute values)	**4.9%**	**54.8%**	**18.34%**	**23.6%**	**30.8%**	**0.27%**	**0.3%**
Median (absolute values)	**5.2%**	**50.0%**	**0.90%**	**21.7%**	**35.2%**	**0.10%**	**0.1%**
Max (absolute values)	**11.6%**	**66.0%**	**61.32%**	**48.7%**	**49.6%**	**0.86%**	**0.9%**
Min (absolute values)	**0.0%**	**39.6%**	**0.00%**	**0.0%**	**0.0%**	**0.00%**	**0.0%**

Scenario	DOC decrease	POC decrease	DOC and POC decrease	Sed OC decrease	Sediment PCB decrease	Water PCB decrease	BSAF decrease
Various Plankton and Algae	0.9%	0.0%	0.9%	0.0%	0.0%	50.0%	0.0%
Zooplankton	0.9%	0.0%	0.9%	0.0%	0.0%	50.0%	0.0%
Benthos							
Clam (Corbicula sp)	0.0%	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%
Oligochaete	0.0%	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%
Insect Larvae	0.9%	0.0%	0.9%	0.0%	0.0%	50.0%	0.0%
Amphipod	0.0%	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%
Crayfish	0.9%	0.0%	0.9%	0.0%	0.0%	50.0%	0.0%
Fish							
Juvenile Fish	0.1%	0.0%	0.1%	74.2%	45.1%	4.9%	45.1%
Carp	0.0%	0.0%	0.0%	79.3%	49.1%	0.9%	49.1%
Sucker, Largescale	0.0%	0.0%	0.0%	52.5%	48.4%	1.6%	48.4%
Chinook, Salmon (juv)	0.2%	0.0%	0.2%	72.5%	39.2%	10.8%	39.2%
Peamouth	0.0%	0.0%	0.0%	88.1%	48.0%	2.0%	48.0%
Sculpin	0.3%	0.0%	0.3%	49.8%	30.3%	19.7%	30.3%
Crappie, Black	0.1%	0.0%	0.1%	83.8%	44.5%	5.5%	44.5%
Bullhead, Brown	0.1%	0.0%	0.1%	92.9%	46.7%	3.3%	46.7%
Bass, Smallmouth	0.2%	0.0%	0.2%	69.1%	39.3%	10.7%	39.3%
Pikeminnow, Northern	0.1%	0.0%	0.1%	81.0%	42.6%	7.4%	42.6%
MEAN (MPAF) (absolute values)	**0.3%**	**0.0%**	**0.3%**	**61.4%**	**34.3%**	**15.7%**	**34.3%**
Median (absolute values)	**0.1%**	**0.0%**	**0.1%**	**74.2%**	**44.5%**	**5.5%**	**44.5%**
Max (absolute values)	**0.9%**	**0.0%**	**0.9%**	**100.0%**	**50.0%**	**50.0%**	**50.0%**
Min (absolute values)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

C.2.3

Table 1 - Trophic Trace Model Output for Sensitivity Runs

Spatial Scale - RM2-11 Kow - 6.5

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	Koc increase	Koc decrease
Species							
Plankton							
Various Plankton and Algae	1.4	0.7	1.4	1.9	0.7	1.3	1.5
Zooplankton	11.0	5.5	11.0	15.3	5.9	10.2	11.9
Benthos							
Clam (Corbicula sp)	214.1	107.1	214.1	214.1	214.1	214.1	214.1
Oligochaete	181.5	90.7	181.5	181.5	181.5	181.5	181.5
Insect Larvae	13.2	6.6	13.2	18.4	7.1	12.3	14.3
Amphipod	145.2	72.6	145.2	145.2	145.2	145.2	145.2
Crayfish	8.6	4.3	8.6	12.0	4.6	8.0	9.3
Fish							
Juvenile Fish	57.1	32.9	109.8	62.0	52.3	57.6	59.6
Carp	127.4	76.6	250.4	129.8	129.6	130.3	131.1
Sucker, Largescale	107.6	77.2	212.8	111.7	106.7	109.7	111.2
Chinook, Salmon (juv)	45.4	23.8	109.5	52.3	37.8	46.2	48.6
Peamouth	107.5	59.0	215.9	110.4	107.4	109.7	110.9
Sculpin	35.1	19.8	101.0	41.6	27.8	35.0	37.9
Crappie, Black	78.8	42.7	277.4	85.6	74.4	81.2	83.9
Bullhead, Brown	70.3	34.5	131.1	77.3	63.7	71.9	73.8
Bass, Smallmouth	63.1	35.8	281.3	71.1	56.5	64.8	68.4
Pikeminnow, Northern	51.7	28.0	160.5	57.8	46.2	52.4	55.0

Scenario	DOC decrease	POC decrease	DOC & POC decrease	Sed OC decrease	Sed PCB decrease	Water PCB decrease	BSAF decrease
Species							
Plankton							
Various Plankton and Algae	1.5	1.4	1.5	1.4	1.4	0.7	1.4
Zooplankton	11.9	11.0	11.9	11.0	11.0	5.5	11.0
Benthos							
Clam (Corbicula sp)	214.1	214.1	214.1	428.3	107.1	214.1	107.1
Oligochaete	181.5	181.5	181.5	362.9	90.7	181.5	90.7
Insect Larvae	14.3	13.2	14.3	13.2	13.2	6.6	13.2
Amphipod	145.2	145.2	145.2	290.3	72.6	145.2	72.6
Crayfish	9.3	8.6	9.3	8.6	8.6	4.3	8.6
Fish							
Juvenile Fish	59.6	58.5	59.6	95.9	35.8	52.0	35.8
Carp	131.1	130.6	131.1	231.9	68.0	127.9	68.0
Sucker, Largescale	111.2	110.4	111.2	164.8	60.3	105.3	60.3
Chinook, Salmon (juv)	48.6	47.3	48.6	75.7	31.7	39.3	31.7
Peamouth	110.9	110.2	110.9	204.0	59.1	106.2	59.1
Sculpin	37.9	36.3	37.9	50.4	27.7	26.7	27.7
Crappie, Black	83.9	82.4	83.9	142.5	50.2	73.4	50.2
Bullhead, Brown	73.8	72.8	73.8	132.3	42.8	66.4	42.8
Bass, Smallmouth	68.4	66.5	68.4	103.8	44.9	54.8	44.9
Pikeminnow, Northern	55.0	53.6	55.0	87.4	35.5	44.9	35.5

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as % change

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	Koc increase	Koc decrease
Various Plankton and Algae	0.00%	-50.00%	0.00%	39.48%	-45.93%	-7.0%	8.1%
Zooplankton	0.0%	-50.0%	0.00%	39.5%	-45.9%	-7.0%	8.1%
Benthos							
Clam (Corbicula sp)	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Oligochaete	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Insect Larvae	0.0%	-50.0%	0.00%	39.5%	-45.9%	-7.0%	8.1%
Amphipod	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Crayfish	0.0%	-50.0%	0.00%	39.5%	-45.9%	-7.0%	8.1%
Fish							
Juvenile Fish	-2.5%	-43.8%	87.61%	5.9%	-10.7%	-1.6%	1.8%
Carp	-2.5%	-41.3%	91.67%	-0.7%	-0.8%	-0.3%	0.3%
Sucker, Largescale	-2.5%	-30.1%	92.77%	1.2%	-3.3%	-0.6%	0.7%
Chinook, Salmon (juv)	-4.1%	-49.7%	131.20%	10.4%	-20.1%	-2.4%	2.8%
Peamouth	-2.5%	-46.5%	95.89%	0.2%	-2.6%	-0.5%	0.6%
Sculpin	-3.2%	-45.4%	178.06%	14.5%	-23.5%	-3.7%	4.3%
Crappie, Black	-4.4%	-48.2%	236.54%	3.8%	-9.8%	-1.5%	1.8%
Bullhead, Brown	-3.5%	-52.6%	80.01%	6.1%	-12.5%	-1.2%	1.4%
Bass, Smallmouth	-5.0%	-46.1%	323.26%	7.0%	-15.1%	-2.5%	2.9%
Pikeminnow, Northern	-3.6%	-47.7%	199.34%	7.8%	-13.8%	-2.3%	2.6%
MEAN (with negatives)	**-2.0%**	**-47.1%**	**89.20%**	**12.6%**	**-17.4%**	**-2.6%**	**3.0%**
Median (with negatives)	**-2.5%**	**-49.7%**	**87.6%**	**6.1%**	**-12.5%**	**-1.6%**	**1.8%**
Max (with negatives)	**0.0%**	**-30.1%**	**323.26%**	**39.5%**	**0.0%**	**0.0%**	**8.1%**
Min (with negatives)	**-5.0%**	**-52.6%**	**0.00%**	**-0.7%**	**-45.9%**	**-7.0%**	**0.0%**
# that decreased	**10**	**17**	**0**	**1**	**14**	**14**	**0**
percentage that decreased	**59%**	**100%**	**0%**	**6%**	**82%**	**82%**	**0%**

MEAN (fish)	**-3.4%**	**-45.2%**	**151.6%**	**5.6%**	**-11.2%**	**-1.7%**	**1.9%**
Max (fish)	**-2.5%**	**-30.1%**	**323.3%**	**14.5%**	**-0.8%**	**-0.3%**	**4.3%**
Min (fish)	**-5.0%**	**-52.6%**	**80.0%**	**-0.7%**	**-23.5%**	**-3.7%**	**0.3%**

Table 2 (continued) - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as % change

Scenario	DOC decrease	POC decrease	DOC and POC decrease	Sed OC decrease	Sediment PCB decrease	Water PCB decrease	BSAF decrease
Various Plankton and Algae	8.1%	0.0%	8.1%	0.0%	0.0%	-50.0%	0.0%
Zooplankton	8.1%	0.0%	8.1%	0.0%	0.0%	-50.0%	0.0%
Benthos							
Clam (Corbicula sp)	0.0%	0.0%	0.0%	100.0%	-50.0%	0.0%	-50.0%
Oligochaete	0.0%	0.0%	0.0%	100.0%	-50.0%	0.0%	-50.0%
Insect Larvae	8.1%	0.0%	8.1%	0.0%	0.0%	-50.0%	0.0%
Amphipod	0.0%	0.0%	0.0%	100.0%	-50.0%	0.0%	-50.0%
Crayfish	8.1%	0.0%	8.1%	0.0%	0.0%	-50.0%	0.0%
Fish							
Juvenile Fish	1.8%	0.0%	1.8%	63.9%	-38.9%	-11.1%	-38.9%
Carp	0.3%	0.0%	0.3%	77.5%	-47.9%	-2.1%	-47.9%
Sucker, Largescale	0.7%	0.0%	0.7%	49.2%	-45.4%	-4.6%	-45.4%
Chinook, Salmon (juv)	2.8%	0.0%	2.8%	60.0%	-33.1%	-16.9%	-33.1%
Peamouth	0.6%	0.0%	0.6%	85.1%	-46.4%	-3.6%	-46.4%
Sculpin	4.3%	0.0%	4.3%	38.8%	-23.6%	-26.4%	-23.6%
Crappie, Black	1.8%	0.0%	1.8%	72.9%	-39.1%	-10.9%	-39.1%
Bullhead, Brown	1.4%	0.0%	1.4%	81.8%	-41.2%	-8.8%	-41.2%
Bass, Smallmouth	2.9%	0.0%	2.9%	56.2%	-32.4%	-17.6%	-32.4%
Pikeminnow, Northern	2.6%	0.0%	2.6%	63.0%	-33.8%	-16.2%	-33.8%
MEAN (with negatives)	**3.0%**	**0.0%**	**3.0%**	**55.8%**	**-31.3%**	**-18.7%**	**-31.3%**
Median (with negatives)	**1.8%**	**0.0%**	**1.8%**	**63.0%**	**-38.9%**	**-11.1%**	**-38.9%**
Max (with negatives)	**8.1%**	**0.0%**	**8.1%**	**100.0%**	**0.0%**	**0.0%**	**0.0%**
Min (with negatives)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**-50.0%**	**-50.0%**	**-50.0%**
# that decreased	**0**	**0**	**0**	**0**	**13**	**14**	**13**
percentage that decreased	**0%**	**0%**	**0%**	**0%**	**76%**	**82%**	**76%**

MEAN (fish)	**1.9%**	**0.0%**	**1.9%**	**64.8%**	**-38.2%**	**-11.8%**	**-38.2%**
Max (fish)	**4.3%**	**0.0%**	**4.3%**	**85.1%**	**-23.6%**	**-2.1%**	**-23.6%**
Min (fish)	**0.3%**	**0.0%**	**0.3%**	**38.8%**	**-47.9%**	**-26.4%**	**-47.9%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as % change

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	Koc increase	Koc decrease
Various Plankton and Algae	0.0%	50.0%	0.00%	39.5%	45.9%	6.99%	8.1%
Zooplankton	0.0%	50.0%	0.00%	39.5%	45.9%	6.99%	8.1%
Benthos							
Clam (Corbicula sp)	0.0%	50.0%	0.00%	0.0%	0.0%	0.00%	0.0%
Oligochaete	0.0%	50.0%	0.00%	0.0%	0.0%	0.00%	0.0%
Insect Larvae	0.0%	50.0%	0.00%	39.5%	45.9%	6.99%	8.1%
Amphipod	0.0%	50.0%	0.00%	0.0%	0.0%	0.00%	0.0%
Crayfish	0.0%	50.0%	0.00%	39.5%	45.9%	6.99%	8.1%
Fish							
Juvenile Fish	2.5%	43.8%	87.61%	5.9%	10.7%	1.56%	1.8%
Carp	2.5%	41.3%	91.67%	0.7%	0.8%	0.29%	0.3%
Sucker, Largescale	2.5%	30.1%	92.77%	1.2%	3.3%	0.64%	0.7%
Chinook, Salmon (juv)	4.1%	49.7%	131.20%	10.4%	20.1%	2.37%	2.8%
Peamouth	2.5%	46.5%	95.89%	0.2%	2.6%	0.51%	0.6%
Sculpin	3.2%	45.4%	178.06%	14.5%	23.5%	3.69%	4.3%
Crappie, Black	4.4%	48.2%	236.54%	3.8%	9.8%	1.52%	1.8%
Bullhead, Brown	3.5%	52.6%	80.01%	6.1%	12.5%	1.23%	1.4%
Bass, Smallmouth	5.0%	46.1%	323.26%	7.0%	15.1%	2.46%	2.9%
Pikeminnow, Northern	3.6%	47.7%	199.34%	7.8%	13.8%	2.27%	2.6%
MEAN (MPAF) (absolute values)	**2.0%**	**47.1%**	**89.20%**	**12.7%**	**17.4%**	**2.62%**	**3.0%**
Median (absolute values)	**2.5%**	**49.7%**	**87.61%**	**6.1%**	**12.5%**	**1.56%**	**1.8%**
Max (absolute values)	**5.0%**	**52.6%**	**323.26%**	**39.5%**	**45.9%**	**6.99%**	**8.1%**
Min (absolute values)	**0.0%**	**30.1%**	**0.00%**	**0.0%**	**0.0%**	**0.00%**	**0.0%**

Scenario	DOC decrease	POC decrease	DOC and POC decrease	Sed OC decrease	Sediment PCB decrease	Water PCB decrease	BSAF decrease
Various Plankton and Algae	8.1%	0.0%	8.1%	0.0%	0.0%	50.0%	0.0%
Zooplankton	8.1%	0.0%	8.1%	0.0%	0.0%	50.0%	0.0%
Benthos							
Clam (Corbicula sp)	0.0%	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%
Oligochaete	0.0%	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%
Insect Larvae	8.1%	0.0%	8.1%	0.0%	0.0%	50.0%	0.0%
Amphipod	0.0%	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%
Crayfish	8.1%	0.0%	8.1%	0.0%	0.0%	50.0%	0.0%
Fish							
Juvenile Fish	1.8%	0.0%	1.8%	63.9%	38.9%	11.1%	38.9%
Carp	0.3%	0.0%	0.3%	77.5%	47.9%	2.1%	47.9%
Sucker, Largescale	0.7%	0.0%	0.7%	49.2%	45.4%	4.6%	45.4%
Chinook, Salmon (juv)	2.8%	0.0%	2.8%	60.0%	33.1%	16.9%	33.1%
Peamouth	0.6%	0.0%	0.6%	85.1%	46.4%	3.6%	46.4%
Sculpin	4.3%	0.0%	4.3%	38.8%	23.6%	26.4%	23.6%
Crappie, Black	1.8%	0.0%	1.8%	72.9%	39.1%	10.9%	39.1%
Bullhead, Brown	1.4%	0.0%	1.4%	81.8%	41.2%	8.8%	41.2%
Bass, Smallmouth	2.9%	0.0%	2.9%	56.2%	32.4%	17.6%	32.4%
Pikeminnow, Northern	2.6%	0.0%	2.6%	63.0%	33.8%	16.2%	33.8%
MEAN (MPAF) (absolute values)	**3.0%**	**0.0%**	**3.0%**	**55.8%**	**31.3%**	**18.7%**	**31.3%**
Median (absolute values)	**1.8%**	**0.0%**	**1.8%**	**63.0%**	**38.9%**	**11.1%**	**38.9%**
Max (absolute values)	**8.1%**	**0.0%**	**8.1%**	**100.0%**	**50.0%**	**50.0%**	**50.0%**
Min (absolute values)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

C.2.4

Table 1 - Trophic Trace Model Output for Sensitivity Runs

Spatial Scale - RM2-11 Kow - 7.5

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	DOC decrease	POC decrease
Species							
Plankton							
Various Plankton and Algae	5.7	2.9	5.7	6.5	4.2	8.4	5.7
Zooplankton	46.7	23.3	46.7	53.1	34.3	68.6	46.7
Benthos							
Clam (Corbicula sp)	214.1	107.1	214.1	214.1	214.1	214.1	214.1
Oligochaete	181.5	90.7	181.5	181.5	181.5	181.5	181.5
Insect Larvae	56.0	28.0	56.0	63.7	41.2	82.3	56.0
Amphipod	145.2	72.6	145.2	145.2	145.2	145.2	145.2
Crayfish	36.5	18.2	36.5	41.4	26.8	53.6	36.5
Fish							
Juvenile Fish	63.1	35.9	151.4	58.6	68.5	79.4	64.6
Carp	98.3	59.3	227.6	87.7	117.7	106.5	100.9
Sucker, Largescale	93.9	64.9	220.3	85.2	108.3	108.1	96.4
Chinook, Salmon (juv)	53.0	29.1	185.0	47.7	60.1	70.4	54.7
Peamouth	85.9	47.7	206.9	76.8	102.1	95.4	88.2
Sculpin	49.9	27.6	179.5	45.9	53.7	71.2	51.5
Crappie, Black	65.2	36.0	314.9	55.6	82.7	82.8	67.9
Bullhead, Brown	75.8	39.3	186.3	69.9	83.9	93.3	77.9
Bass, Smallmouth	54.3	31.1	366.0	44.4	71.9	74.2	57.1
Pikeminnow, Northern	56.3	30.5	222.0	50.7	64.6	75.4	58.3

Scenario	DOC and POC decrease	Sed OC decrease	Water PCB decrease	Sediment PCB decrease	BSAF decrease	Koc increase	Koc decrease
Species							
Plankton							
Various Plankton and Algae	8.4	5.7	2.9	5.7	5.7	4.4	8.4
Zooplankton	68.6	46.7	23.3	46.7	46.7	35.4	68.6
Benthos							
Clam (Corbicula sp)	214.1	428.3	214.1	107.1	107.1	214.1	214.1
Oligochaete	181.5	362.9	181.5	90.7	90.7	181.5	181.5
Insect Larvae	82.3	56.0	28.0	56.0	56.0	42.5	82.3
Amphipod	145.2	290.3	145.2	72.6	72.6	145.2	145.2
Crayfish	53.6	36.5	18.2	36.5	36.5	27.6	53.6
Fish							
Juvenile Fish	79.4	92.0	49.0	48.0	48.0	57.1	79.4
Carp	106.5	172.9	95.0	56.4	56.4	98.1	106.5
Sucker, Largescale	108.1	135.1	83.9	60.7	60.7	90.3	108.1
Chinook, Salmon (juv)	70.4	74.2	38.0	44.1	44.1	46.6	70.4
Peamouth	95.4	154.9	80.4	51.8	51.8	84.4	95.4
Sculpin	71.2	59.2	30.4	46.8	46.8	41.3	71.2
Crappie, Black	82.8	102.1	52.1	49.8	49.8	60.3	82.8
Bullhead, Brown	93.3	122.9	61.4	55.4	55.4	69.9	93.3
Bass, Smallmouth	74.2	75.0	38.9	46.8	46.8	48.3	74.2
Pikeminnow, Northern	75.4	79.2	40.2	47.3	47.3	49.5	75.4

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as % change

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	DOC decrease	POC decrease
Various Plankton and Algae	0.00%	-50.00%	0.00%	13.68%	-26.51%	47.0%	0.0%
Zooplankton	0.0%	-50.0%	0.00%	13.7%	-26.5%	47.0%	0.0%
Benthos							
Clam (Corbicula sp)	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Oligochaete	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Insect Larvae	0.0%	-50.0%	0.00%	13.7%	-26.5%	47.0%	0.0%
Amphipod	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Crayfish	0.0%	-50.0%	0.00%	13.7%	-26.5%	47.0%	0.0%
Fish							
Juvenile Fish	-2.4%	-44.5%	134.18%	-9.4%	6.0%	22.8%	0.0%
Carp	-2.6%	-41.2%	125.57%	-13.1%	16.6%	5.5%	0.0%
Sucker, Largescale	-2.6%	-32.7%	128.59%	-11.6%	12.4%	12.2%	0.0%
Chinook, Salmon (juv)	-3.1%	-46.8%	238.38%	-12.8%	9.9%	28.7%	0.0%
Peamouth	-2.5%	-45.9%	134.69%	-12.9%	15.8%	8.2%	0.0%
Sculpin	-3.0%	-46.4%	248.71%	-10.8%	4.4%	38.4%	0.0%
Crappie, Black	-4.0%	-47.0%	363.49%	-18.1%	21.7%	21.9%	0.0%
Bullhead, Brown	-2.7%	-49.5%	139.21%	-10.2%	7.8%	19.8%	0.0%
Bass, Smallmouth	-4.9%	-45.5%	541.11%	-22.2%	26.0%	30.0%	0.0%
Pikeminnow, Northern	-3.4%	-47.7%	280.69%	-13.1%	10.7%	29.2%	0.0%
MEAN (with negatives)	**-1.8%**	**-46.9%**	**137.3%**	**-4.7%**	**1.5%**	**23.8%**	**0.0%**
Median (with negatives)	**-2.5%**	**-47.7%**	**128.6%**	**-10.2%**	**6.0%**	**22.8%**	**0.0%**
Max (with negatives)	**0.0%**	**-32.7%**	**541.1%**	**13.7%**	**26.0%**	**47.0%**	**0.0%**
Min (with negatives)	**-4.9%**	**-50.0%**	**0.0%**	**-22.2%**	**-26.5%**	**0.0%**	**0.0%**
# that decreased	**10**	**17**	**0**	**10**	**4**	**0**	**0**
percentage that decreased	**59%**	**100%**	**0%**	**59%**	**24%**	**0%**	**0%**

MEAN (fish)	**-3.1%**	**-44.7%**	**233.5%**	**-13.4%**	**13.1%**	**21.7%**	**0.0%**
Max (fish)	**-2.4%**	**-32.7%**	**541.1%**	**-9.4%**	**26.0%**	**38.4%**	**0.0%**
Min (fish)	**-4.9%**	**-49.5%**	**125.6%**	**-22.2%**	**4.4%**	**5.5%**	**0.0%**

Table 2 (continued) Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as % change

Scenario	DOC and POC decrease	Sed OC decrease	Water PCB decrease	Sediment PCB decrease	BSAF decrease	Koc increase	Koc decrease
Various Plankton and Algae	47.0%	0.0%	-50.0%	0.0%	0.0%	-24.2%	47.0%
Zooplankton	47.0%	0.0%	-50.0%	0.0%	0.0%	-24.2%	47.0%
Benthos							
Clam (Corbicula sp)	0.0%	100.0%	0.0%	-50.0%	-50.0%	0.0%	0.0%
Oligochaete	0.0%	100.0%	0.0%	-50.0%	-50.0%	0.0%	0.0%
Insect Larvae	47.0%	0.0%	-50.0%	0.0%	0.0%	-24.2%	47.0%
Amphipod	0.0%	100.0%	0.0%	-50.0%	-50.0%	0.0%	0.0%
Crayfish	47.0%	0.0%	-50.0%	0.0%	0.0%	-24.2%	47.0%
Fish							
Juvenile Fish	22.8%	42.3%	-24.2%	-25.8%	-25.8%	-11.7%	22.8%
Carp	5.5%	71.4%	-5.9%	-44.1%	-44.1%	-2.8%	5.5%
Sucker, Largescale	12.2%	40.2%	-13.0%	-37.0%	-37.0%	-6.3%	12.2%
Chinook, Salmon (juv)	28.7%	35.8%	-30.6%	-19.4%	-19.4%	-14.8%	28.7%
Peamouth	8.2%	75.7%	-8.7%	-41.3%	-41.3%	-4.2%	8.2%
Sculpin	38.4%	15.1%	-40.8%	-9.2%	-9.2%	-19.8%	38.4%
Crappie, Black	21.9%	50.3%	-23.3%	-26.7%	-26.7%	-11.3%	21.9%
Bullhead, Brown	19.8%	57.8%	-21.1%	-28.9%	-28.9%	-10.2%	19.8%
Bass, Smallmouth	30.0%	31.4%	-31.9%	-18.1%	-18.1%	-15.5%	30.0%
Pikeminnow, Northern	29.2%	35.7%	-31.1%	-18.9%	-18.9%	-15.1%	29.2%
MEAN (with negatives)	**23.8%**	**44.4%**	**-25.3%**	**-24.7%**	**-24.7%**	**-12.3%**	**23.8%**
Median (with negatives)	**22.8%**	**40.2%**	**-24.2%**	**-25.8%**	**-25.8%**	**-11.7%**	**22.8%**
Max (with negatives)	**47.0%**	**100.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**47.0%**
Min (with negatives)	**0.0%**	**0.0%**	**-50.0%**	**-50.0%**	**-50.0%**	**-24.2%**	**0.0%**
# that decreased	**0**	**0**	**14**	**13**	**13**	**14**	**0**
percentage that decreased	**0%**	**0%**	**82%**	**76%**	**76%**	**82%**	**0%**

MEAN (fish)	**21.7%**	**45.6%**	**-23.1%**	**-26.9%**	**-26.9%**	**-11.2%**	**21.7%**
Max (fish)	**38.4%**	**75.7%**	**-5.9%**	**-9.2%**	**-9.2%**	**-2.8%**	**38.4%**
Min (fish)	**5.5%**	**15.1%**	**-40.8%**	**-44.1%**	**-44.1%**	**-19.8%**	**5.5%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	DOC decrease	POC decrease
Various Plankton and Algae	0.00%	50.00%	0.00%	13.68%	26.51%	46.96%	0.00%
Zooplankton	0.00%	50.00%	0.00%	13.68%	26.51%	46.96%	0.00%
Benthos							
Clam (Corbicula sp)	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oligochaete	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Insect Larvae	0.0%	50.0%	0.0%	13.7%	26.5%	47.0%	0.0%
Amphipod	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Crayfish	0.0%	50.0%	0.0%	13.7%	26.5%	47.0%	0.0%
Fish							
Juvenile Fish	2.4%	44.5%	134.2%	9.4%	6.0%	22.8%	0.0%
Carp	2.6%	41.2%	125.6%	13.1%	16.6%	5.5%	0.0%
Sucker, Largescale	2.6%	32.7%	128.6%	11.6%	12.4%	12.2%	0.0%
Chinook, Salmon (juv)	3.1%	46.8%	238.4%	12.8%	9.9%	28.7%	0.0%
Peamouth	2.5%	45.9%	134.7%	12.9%	15.8%	8.2%	0.0%
Sculpin	3.0%	46.4%	248.7%	10.8%	4.4%	38.4%	0.0%
Crappie, Black	4.0%	47.0%	363.5%	18.1%	21.7%	21.9%	0.0%
Bullhead, Brown	2.7%	49.5%	139.2%	10.2%	7.8%	19.8%	0.0%
Bass, Smallmouth	4.9%	45.5%	541.1%	22.2%	26.0%	30.0%	0.0%
Pikeminnow, Northern	3.4%	47.7%	280.7%	13.1%	10.7%	29.2%	0.0%
MEAN (MPAF) (abs values)	**1.8%**	**46.9%**	**137.33%**	**11.1%**	**14.0%**	**23.80%**	**0.0%**
Median (absolute values)	**2.5%**	**47.7%**	**128.59%**	**12.9%**	**12.4%**	**22.78%**	**0.0%**
Max (absolute values)	**4.9%**	**50.0%**	**541.11%**	**22.2%**	**26.5%**	**46.96%**	**0.0%**
Min (absolute values)	**0.0%**	**32.7%**	**0.00%**	**0.0%**	**0.0%**	**0.00%**	**0.0%**

Scenario	DOC and POC decrease	Sed OC decrease	Water PCB decrease	Sediment PCB decrease	BSAF decrease	Koc increase	Koc decrease
Various Plankton and Algae	46.96%	0.00%	50.00%	0.00%	0.00%	24.20%	46.97%
Zooplankton	46.96%	0.00%	50.00%	0.00%	0.00%	24.20%	46.97%
Benthos							
Clam (Corbicula sp)	0.0%	100.0%	0.0%	50.0%	50.0%	0.0%	0.0%
Oligochaete	0.0%	100.0%	0.0%	50.0%	50.0%	0.0%	0.0%
Insect Larvae	47.0%	0.0%	50.0%	0.0%	0.0%	24.2%	47.0%
Amphipod	0.0%	100.0%	0.0%	50.0%	50.0%	0.0%	0.0%
Crayfish	47.0%	0.0%	50.0%	0.0%	0.0%	24.2%	47.0%
Fish							
Juvenile Fish	22.8%	42.3%	24.2%	25.8%	25.8%	11.7%	22.8%
Carp	5.5%	71.4%	5.9%	44.1%	44.1%	2.8%	5.5%
Sucker, Largescale	12.2%	40.2%	13.0%	37.0%	37.0%	6.3%	12.2%
Chinook, Salmon (juv)	28.7%	35.8%	30.6%	19.4%	19.4%	14.8%	28.7%
Peamouth	8.2%	75.7%	8.7%	41.3%	41.3%	4.2%	8.2%
Sculpin	38.4%	15.1%	40.8%	9.2%	9.2%	19.8%	38.4%
Crappie, Black	21.9%	50.3%	23.3%	26.7%	26.7%	11.3%	21.9%
Bullhead, Brown	19.8%	57.8%	21.1%	28.9%	28.9%	10.2%	19.8%
Bass, Smallmouth	30.0%	31.4%	31.9%	18.1%	18.1%	15.5%	30.0%
Pikeminnow, Northern	29.2%	35.7%	31.1%	18.9%	18.9%	15.1%	29.2%
MEAN (MPAF) (abs values)	**23.8%**	**44.4%**	**25.3%**	**24.7%**	**24.7%**	**12.3%**	**23.8%**
Median (absolute values)	**22.8%**	**40.2%**	**24.2%**	**25.8%**	**25.8%**	**11.7%**	**22.8%**
Max (absolute values)	**47.0%**	**100.0%**	**50.0%**	**50.0%**	**50.0%**	**24.2%**	**47.0%**
Min (absolute values)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

C.2.5

Table 1 - Trophic Trace Model Output for Sensitivity Runs
Spatial Scale - Swan Island Kow - 6.5

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	Koc increase	Koc decrease
Species							
Plankton							
Various Plankton and Algae	1.3	0.7	1.3	1.9	0.7	1.2	1.5
Zooplankton	10.9	5.4	10.9	15.1	5.9	10.1	11.8
Benthos							
Clam (Corbicula sp)	747.1	373.5	747.1	747.1	747.1	747.1	747.1
Oligochaete	633.1	316.6	633.1	633.1	633.1	633.1	633.1
Insect Larvae	13.1	6.5	13.1	18.2	7.1	12.1	14.2
Amphipod	506.5	253.2	506.5	506.5	506.5	506.5	506.5
Crayfish	8.1	4.0	8.1	11.2	4.4	7.5	8.7
Fish							
Juvenile Fish	171.0	99.2	322.3	179.8	166.1	175.7	177.8
Carp	443.9	270.2	864.6	449.5	456.8	455.6	456.5
Sucker, Largescale	369.6	272.8	720.9	377.3	376.0	379.4	380.9
Chinook, Salmon (juv)	121.3	61.5	293.4	135.5	109.2	127.5	130.1
Peamouth	359.3	196.7	716.6	366.3	365.8	369.3	370.6
Sculpin	75.5	41.5	229.6	86.0	66.3	78.8	81.8
Crappie, Black	240.0	128.5	850.8	252.7	241.5	251.8	254.7
Bullhead, Brown	218.5	105.8	404.8	232.4	209.1	226.3	228.3
Bass, Smallmouth	164.0	90.9	729.9	179.0	158.7	174.1	177.8
Pikeminnow, Northern	139.4	74.0	429.5	148.9	135.6	144.8	147.6

Scenario	DOC decrease	POC decrease	DOC and POC decrease	Sed OC decrease	Sediment PCB decrease	Water PCB decrease	BSAF decrease
Species							
Plankton							
Various Plankton and Algae	1.5	1.3	1.5	1.3	1.3	0.7	1.3
Zooplankton	11.8	10.9	11.8	10.9	10.9	5.4	10.9
Benthos							
Clam (Corbicula sp)	747.1	747.1	747.1	1494.2	373.5	747.1	373.5
Oligochaete	633.1	633.1	633.1	1266.2	316.6	633.1	316.6
Insect Larvae	14.2	13.1	14.2	13.1	13.1	6.5	13.1
Amphipod	506.5	506.5	506.5	1013.0	253.2	506.5	253.2
Crayfish	8.7	8.1	8.7	8.1	8.1	4.0	8.1
Fish							
Juvenile Fish	177.8	176.7	177.8	308.9	94.9	170.2	94.9
Carp	456.5	456.0	456.5	813.5	230.7	453.3	230.7
Sucker, Largescale	380.9	380.1	380.9	572.2	195.0	375.1	195.0
Chinook, Salmon (juv)	130.1	128.7	130.1	229.8	72.4	120.6	72.4
Peamouth	370.6	369.9	370.6	699.0	189.0	365.8	189.0
Sculpin	81.8	80.2	81.8	129.7	49.5	70.7	49.5
Crappie, Black	254.7	253.1	254.7	470.5	135.7	244.0	135.7
Bullhead, Brown	228.3	227.2	228.3	439.7	120.0	220.8	120.0
Bass, Smallmouth	177.8	175.8	177.8	306.4	99.5	164.2	99.5
Pikeminnow, Northern	147.6	146.1	147.6	265.3	81.7	137.5	81.7

Table 2 - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	Koc increase	Koc decrease
Various Plankton and Algae	0.00%	-50.00%	0.00%	38.97%	-45.70%	-7.3%	8.6%
Zooplankton	0.0%	-50.0%	0.00%	39.0%	-45.7%	-7.3%	8.6%
Benthos							
Clam (Corbicula sp)	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Oligochaete	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Insect Larvae	0.0%	-50.0%	0.00%	39.0%	-45.7%	-7.3%	8.6%
Amphipod	0.0%	-50.0%	0.00%	0.0%	0.0%	0.0%	0.0%
Crayfish	0.0%	-50.0%	0.00%	39.0%	-45.7%	-7.3%	8.6%
Fish							
Juvenile Fish	-3.2%	-43.9%	82.43%	1.8%	-6.0%	-0.5%	0.6%
Carp	-2.7%	-40.8%	89.62%	-1.4%	0.2%	-0.1%	0.1%
Sucker, Largescale	-2.8%	-28.2%	89.67%	-0.7%	-1.1%	-0.2%	0.2%
Chinook, Salmon (juv)	-5.7%	-52.2%	128.04%	5.3%	-15.2%	-0.9%	1.1%
Peamouth	-2.9%	-46.8%	93.76%	-1.0%	-1.1%	-0.2%	0.2%
Sculpin	-5.9%	-48.2%	186.43%	7.3%	-17.3%	-1.7%	2.0%
Crappie, Black	-5.2%	-49.2%	236.08%	-0.2%	-4.6%	-0.5%	0.6%
Bullhead, Brown	-3.8%	-53.4%	78.13%	2.3%	-8.0%	-0.4%	0.5%
Bass, Smallmouth	-6.7%	-48.3%	315.17%	1.8%	-9.7%	-1.0%	1.1%
Pikeminnow, Northern	-4.6%	-49.3%	194.01%	1.9%	-7.1%	-0.9%	1.0%
MEAN (with negatives)	**-2.6%**	**-47.7%**	**87.84%**	**10.2%**	**-14.9%**	**-2.1%**	**2.5%**
Median (with negatives)	**-2.8%**	**-50.0%**	**82.4%**	**1.8%**	**-7.1%**	**-0.5%**	**0.6%**
Max (with negatives)	**0.0%**	**-28.2%**	**315.17%**	**39.0%**	**0.2%**	**0.0%**	**8.6%**
Min (with negatives)	**-6.7%**	**-53.4%**	**0.00%**	**-1.4%**	**-45.7%**	**-7.3%**	**0.0%**
# that decreased	**10**	**17**	**0**	**4**	**13**	**14**	**0**
percentage that decreased	**59%**	**100%**	**0%**	**24%**	**76%**	**82%**	**0%**
MEAN (fish)	**-4.3%**	**-46.0%**	**149.3%**	**1.7%**	**-7.0%**	**-0.6%**	**0.7%**
Max (fish)	**-2.7%**	**-28.2%**	**315.2%**	**7.3%**	**0.2%**	**-0.1%**	**2.0%**
Min (fish)	**-6.7%**	**-53.4%**	**78.1%**	**-1.4%**	**-17.3%**	**-1.7%**	**0.1%**

Table 2 (continued) - Model Bias - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as % change

Scenario	DOC decrease	POC decrease	DOC & POC decrease	Sed OC decrease	Sed PCB decrease	Water PCB decrease	BSAF decrease
Various Plankton and Algae	8.6%	0.0%	8.6%	0.0%	0.0%	-50.0%	0.0%
Zooplankton	8.6%	0.0%	8.6%	0.0%	0.0%	-50.0%	0.0%
Benthos							
Clam (Corbicula sp)	0.0%	0.0%	0.0%	100.0%	-50.0%	0.0%	-50.0%
Oligochaete	0.0%	0.0%	0.0%	100.0%	-50.0%	0.0%	-50.0%
Insect Larvae	8.6%	0.0%	8.6%	0.0%	0.0%	-50.0%	0.0%
Amphipod	0.0%	0.0%	0.0%	100.0%	-50.0%	0.0%	-50.0%
Crayfish	8.6%	0.0%	8.6%	0.0%	0.0%	-50.0%	0.0%
Fish							
Juvenile Fish	0.6%	0.0%	0.6%	74.8%	-46.3%	-3.7%	-46.3%
Carp	0.1%	0.0%	0.1%	78.4%	-49.4%	-0.6%	-49.4%
Sucker, Largescale	0.2%	0.0%	0.2%	50.5%	-48.7%	-1.3%	-48.7%
Chinook, Salmon (juv)	1.1%	0.0%	1.1%	78.6%	-43.8%	-6.2%	-43.8%
Peamouth	0.2%	0.0%	0.2%	89.0%	-48.9%	-1.1%	-48.9%
Sculpin	2.0%	0.0%	2.0%	61.8%	-38.3%	-11.7%	-38.3%
Crappie, Black	0.6%	0.0%	0.6%	85.9%	-46.4%	-3.6%	-46.4%
Bullhead, Brown	0.5%	0.0%	0.5%	93.5%	-47.2%	-2.8%	-47.2%
Bass, Smallmouth	1.1%	0.0%	1.1%	74.3%	-43.4%	-6.6%	-43.4%
Pikeminnow, Northern	1.0%	0.0%	1.0%	81.6%	-44.1%	-5.9%	-44.1%
MEAN (with negatives)	**2.5%**	**0.0%**	**2.5%**	**62.9%**	**-35.7%**	**-14.3%**	**-35.7%**
Median (with negatives)	**0.6%**	**0.0%**	**0.6%**	**78.4%**	**-46.3%**	**-3.7%**	**-46.3%**
Max (with negatives)	**8.6%**	**0.0%**	**8.6%**	**100.0%**	**0.0%**	**0.0%**	**0.0%**
Min (with negatives)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**-50.0%**	**-50.0%**	**-50.0%**
# that decreased	**0**	**0**	**0**	**0**	**13**	**14**	**13**
percentage that decreased	**0%**	**0%**	**0%**	**0%**	**76%**	**82%**	**76%**
MEAN (fish)	**0.7%**	**0.0%**	**0.7%**	**76.8%**	**-45.6%**	**-4.4%**	**-45.6%**
Max (fish)	**2.0%**	**0.0%**	**2.0%**	**93.5%**	**-38.3%**	**-0.6%**	**-38.3%**
Min (fish)	**0.1%**	**0.0%**	**0.1%**	**50.5%**	**-49.4%**	**-11.7%**	**-49.4%**

Table 3 - SPAF - Comparison to INITIAL PREDICTED VALUES (µg/kg ww) as percent change

Scenario	Biota Weight	Biota Lipids	Water Temperature	Kow (50% increase)	Kow (50% decrease)	Koc increase	Koc decrease
Various Plankton and Algae	0.0%	50.0%	0.00%	39.0%	45.7%	7.33%	8.6%
Zooplankton	0.0%	50.0%	0.00%	39.0%	45.7%	7.33%	8.6%
Benthos							
Clam (Corbicula sp)	0.0%	50.0%	0.00%	0.0%	0.0%	0.00%	0.0%
Oligochaete	0.0%	50.0%	0.00%	0.0%	0.0%	0.00%	0.0%
Insect Larvae	0.0%	50.0%	0.00%	39.0%	45.7%	7.33%	8.6%
Amphipod	0.0%	50.0%	0.00%	0.0%	0.0%	0.00%	0.0%
Crayfish	0.0%	50.0%	0.00%	39.0%	45.7%	7.33%	8.6%
Fish							
Juvenile Fish	3.2%	43.9%	82.43%	1.8%	6.0%	0.54%	0.6%
Carp	2.7%	40.8%	89.62%	1.4%	0.2%	0.09%	0.1%
Sucker, Largescale	2.8%	28.2%	89.67%	0.7%	1.1%	0.19%	0.2%
Chinook, Salmon (juv)	5.7%	52.2%	128.04%	5.3%	15.2%	0.92%	1.1%
Peamouth	2.9%	46.8%	93.76%	1.0%	1.1%	0.16%	0.2%
Sculpin	5.9%	48.2%	186.43%	7.3%	17.3%	1.72%	2.0%
Crappie, Black	5.2%	49.2%	236.08%	0.2%	4.6%	0.53%	0.6%
Bullhead, Brown	3.8%	53.4%	78.13%	2.3%	8.0%	0.41%	0.5%
Bass, Smallmouth	6.7%	48.3%	315.17%	1.8%	9.7%	0.97%	1.1%
Pikeminnow, Northern	4.6%	49.3%	194.01%	1.9%	7.1%	0.86%	1.0%
MEAN (MPAF) (absolute values)	**2.6%**	**47.7%**	**87.84%**	**10.6%**	**14.9%**	**2.10%**	**2.5%**
Median (absolute values)	**2.8%**	**50.0%**	**82.43%**	**1.8%**	**7.1%**	**0.54%**	**0.6%**
Max (absolute values)	**6.7%**	**53.4%**	**315.17%**	**39.0%**	**45.7%**	**7.33%**	**8.6%**
Min (absolute values)	**0.0%**	**28.2%**	**0.00%**	**0.0%**	**0.0%**	**0.00%**	**0.0%**

Scenario	DOC decrease	POC decrease	DOC & POC decrease	Sed OC decrease	Sed PCB decrease	Water PCB decrease	BSAF decrease
Various Plankton and Algae	8.6%	0.0%	8.6%	0.0%	0.0%	50.0%	0.0%
Zooplankton	8.6%	0.0%	8.6%	0.0%	0.0%	50.0%	0.0%
Benthos							
Clam (Corbicula sp)	0.0%	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%
Oligochaete	0.0%	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%
Insect Larvae	8.6%	0.0%	8.6%	0.0%	0.0%	50.0%	0.0%
Amphipod	0.0%	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%
Crayfish	8.6%	0.0%	8.6%	0.0%	0.0%	50.0%	0.0%
Fish							
Juvenile Fish	0.6%	0.0%	0.6%	74.8%	46.3%	3.7%	46.3%
Carp	0.1%	0.0%	0.1%	78.4%	49.4%	0.6%	49.4%
Sucker, Largescale	0.2%	0.0%	0.2%	50.5%	48.7%	1.3%	48.7%
Chinook, Salmon (juv)	1.1%	0.0%	1.1%	78.6%	43.8%	6.2%	43.8%
Peamouth	0.2%	0.0%	0.2%	89.0%	48.9%	1.1%	48.9%
Sculpin	2.0%	0.0%	2.0%	61.8%	38.3%	11.7%	38.3%
Crappie, Black	0.6%	0.0%	0.6%	85.9%	46.4%	3.6%	46.4%
Bullhead, Brown	0.5%	0.0%	0.5%	93.5%	47.2%	2.8%	47.2%
Bass, Smallmouth	1.1%	0.0%	1.1%	74.3%	43.4%	6.6%	43.4%
Pikeminnow, Northern	1.0%	0.0%	1.0%	81.6%	44.1%	5.9%	44.1%
MEAN (MPAF) (absolute values)	**2.5%**	**0.0%**	**2.5%**	**62.9%**	**35.7%**	**14.3%**	**35.7%**
Median (absolute values)	**0.6%**	**0.0%**	**0.6%**	**78.4%**	**46.3%**	**3.7%**	**46.3%**
Max (absolute values)	**8.6%**	**0.0%**	**8.6%**	**100.0%**	**50.0%**	**50.0%**	**50.0%**
Min (absolute values)	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

C.3.1

Table 1 - Trophic Trace Model Output for Uncertainty Runs
Chemical - PCBs Spatial Scale - RM2-11

Scenario	TT-RM2-11-PCB-AVG	TT-RM2-11-PCB-MAX	TT-RM2-11-PCB-MIN
Species			
Plankton			
Various Plankton and Algae	0.9	1.8	0.3
Zooplankton	7.3	10.0	3.9
Benthos			
Clam (Corbicula sp)	226.4	4679.8	17.0
Oligochaete	191.8	4817.5	5.1
Insect Larvae	8.8	19.1	1.3
Amphipod	153.5	3854.0	4.1
Crayfish	5.7	11.9	0.7
Fish			
Juvenile Fish	57.0	1811.0	8.7
Carp	137.5	4561.1	14.9
Sucker, Largescale	113.9	3162.8	17.6
Chinook, Salmon (juv)	42.8	1712.0	11.1
Peamouth	114.5	4013.4	15.0
Sculpin	31.5	1159.2	9.6
Crappie, Black	81.1	3965.1	19.8
Bullhead, Brown	70.3	2548.3	7.4
Bass, Smallmouth	62.5	3390.8	16.6
Pikeminnow, Northern	50.8	2028.5	12.2

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-PCB-AVG	TT-RM2-11-PCB-MAX	TT-RM2-11-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	2.6	54.2	-5.1
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	-5.2	-2.5	-43.1
Fish			
Juvenile Fish			
Carp	-11.9	2.8	-109.2
Sucker, Largescale	-7.2	3.9	-46.5
Chinook, Salmon (juv)	-1.3	30.6	-5.0
Peamouth	-1.6	21.5	-12.4
Sculpin	-17.8	2.1	-58.6
Crappie, Black	-1.7	29.6	-6.8
Bullhead, Brown	-5.7	6.3	-54.9
Bass, Smallmouth	-17.8	3.0	-67.2
Pikeminnow, Northern	-16.4	2.4	-68.2
MEAN	**-7.6**	**14.0**	**-43.4**
Max	**2.6**	**54.2**	**-5.0**
Min	**-17.8**	**-2.5**	**-109.2**
underpredict count	**10**	**1**	**11**
underpredict percentage	**91%**	**9%**	**100%**

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-PCB-AVG	TT-RM2-11-PCB-MAX	TT-RM2-11-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	2.7	56.4	-4.9
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	-1.4	1.5	-11.6
Fish			
Juvenile Fish			
Carp	-6.1	5.4	-56.1
Sucker, Largescale	-4.6	6.0	-30.0
Chinook, Salmon (juv)	-1.2	33.6	-4.6
Peamouth	-1.6	22.4	-11.9
Sculpin	-10.1	3.6	-33.1
Crappie, Black	-1.5	33.0	-6.0
Bullhead, Brown	-2.7	13.2	-26.2
Bass, Smallmouth	-11.4	4.7	-43.1
Pikeminnow, Northern	-14.2	2.8	-59.0
MEAN	**-4.7**	**16.6**	**-26.1**
Max	**2.7**	**56.4**	**-4.6**
Min	**-14.2**	**1.5**	**-59.0**
underpredict count	**10**	**0**	**11**
underpredict percentage	**91%**	**0%**	**100%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-PCB-AVG	TT-RM2-11-PCB-MAX	TT-RM2-11-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	2.6	54.2	5.1
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	5.2	2.5	43.1
Fish			
Juvenile Fish			
Carp	11.9	2.8	109.2
Sucker, Largescale	7.2	3.9	46.5
Chinook, Salmon (juv)	1.3	30.6	5.0
Peamouth	1.6	21.5	12.4
Sculpin	17.8	2.1	58.6
Crappie, Black	1.7	29.6	6.8
Bullhead, Brown	5.7	6.3	54.9
Bass, Smallmouth	17.8	3.0	67.2
Pikeminnow, Northern	16.4	2.4	68.2
MEAN (MPAF)	**8.1**	**14.4**	**43.4**
Geomean	**5.4**	**7.2**	**27.6**
Max	**17.8**	**54.2**	**109.2**
Min	**1.3**	**2.1**	**5.0**
# under 10	**7**	**7**	**3**
# under 5	**4**	**6**	**0**
# under 2	**3**	**0**	**0**

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-PCB-AVG	TT-RM2-11-PCB-MAX	TT-RM2-11-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	2.7	56.4	4.9
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	1.4	1.5	11.6
Fish			
Juvenile Fish			
Carp	6.1	5.4	56.1
Sucker, Largescale	4.6	6.0	30.0
Chinook, Salmon (juv)	1.2	33.6	4.6
Peamouth	1.6	22.4	11.9
Sculpin	10.1	3.6	33.1
Crappie, Black	1.5	33.0	6.0
Bullhead, Brown	2.7	13.2	26.2
Bass, Smallmouth	11.4	4.7	43.1
Pikeminnow, Northern	14.2	2.8	59.0
MEAN (MPAF)	**5.2**	**16.6**	**26.1**
Geomean	**3.6**	**9.3**	**18.1**
Max	**14.2**	**56.4**	**59.0**
Min	**1.2**	**1.5**	**4.6**
# under 10	**8**	**6**	**3**
# under 5	**7**	**4**	**2**
# under 2	**4**	**1**	**0**

C.3.2

Table 1 - Trophic Trace Model Output for Uncertainty Runs
Chemical - PCBs Spatial Scale - Swan Island

Scenario	TT-SI-PCB-AVG	TT-SI-PCB-MAX	TT-SI-PCB-MIN
Species			
Plankton			
Various Plankton and Algae	0.9	2.0	0.3
Zooplankton	7.3	10.9	3.9
Benthos			
Clam (Corbicula sp)	696.4	9536.4	59.8
Oligochaete	590.2	9816.9	17.8
Insect Larvae	8.8	20.9	1.3
Amphipod	472.2	7853.5	14.3
Crayfish	5.4	9.9	2.2
Fish			
Juvenile Fish	157.0	3745.2	12.7
Carp	419.4	9401.9	42.8
Sucker, Largescale	338.6	6534.2	48.2
Chinook, Salmon (juv)	108.8	3589.6	13.7
Peamouth	341.3	8336.2	34.6
Sculpin	66.7	2379.0	11.2
Crappie, Black	229.9	8349.0	39.7
Bullhead, Brown	202.3	5285.7	14.6
Bass, Smallmouth	154.2	6770.1	34.2
Pikeminnow, Northern	130.5	4234.6	19.9

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-PCB-AVG	TT-SI-PCB-MAX	TT-SI-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	-8.5	-4.6	-20.8
Fish			
Juvenile Fish			
Carp	-2.2	10.1	-21.8
Sucker, Largescale	1.1	20.4	-6.6
Chinook, Salmon (juv)			
Peamouth	2.5	60.4	-4.0
Sculpin	-7.4	4.8	-44.2
Crappie, Black	1.3	46.4	-4.5
Bullhead, Brown	-3.5	7.4	-48.9
Bass, Smallmouth	-19.0	2.3	-85.9
Pikeminnow, Northern	-5.1	6.3	-33.7
MEAN	**-4.6**	**17.1**	**-30.1**
Max	**2.5**	**60.4**	**-4.0**
Min	**-19.0**	**-4.6**	**-85.9**
underpredict count	**6**	**1**	**9**
underpredict percentage	**67%**	**11%**	**100%**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-PCB-AVG	TT-SI-PCB-MAX	TT-SI-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	-8.5	-4.6	-20.7
Fish			
Juvenile Fish			
Carp	-2.2	10.3	-21.4
Sucker, Largescale			
Chinook, Salmon (juv)			
Peamouth			
Sculpin	-7.4	4.8	-44.2
Crappie, Black	1.4	50.6	-4.2
Bullhead, Brown	-2.0	12.9	-28.1
Bass, Smallmouth	-15.9	2.8	-72.0
Pikeminnow, Northern			
MEAN	**-5.8**	**12.8**	**-31.8**
Max	**1.4**	**50.6**	**-4.2**
Min	**-15.9**	**-4.6**	**-72.0**
underpredict count	**5**	**1**	**6**
underpredict percentage	**83%**	**17%**	**100%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-PCB-AVG	TT-SI-PCB-MAX	TT-SI-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	8.5	4.6	20.8
Fish			
Juvenile Fish			
Carp	2.2	10.1	21.8
Sucker, Largescale	1.1	20.4	6.6
Chinook, Salmon (juv)			
Peamouth	2.5	60.4	4.0
Sculpin	7.4	4.8	44.2
Crappie, Black	1.3	46.4	4.5
Bullhead, Brown	3.5	7.4	48.9
Bass, Smallmouth	19.0	2.3	85.9
Pikeminnow, Northern		6.3	33.7
MEAN (MPAF)	**5.7**	**18.1**	**30.1**
Geomean	**3.7**	**10.4**	**19.1**
Max	**19.0**	**60.4**	**85.9**
Min	**1.1**	**2.3**	**4.0**
# under 10	**7**	**5**	**3**
# under 5	**5**	**3**	**2**
# under 2	**2**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-PCB-AVG	TT-SI-PCB-MAX	TT-SI-PCB-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	8.5	4.6	20.7
Fish			
Juvenile Fish			
Carp	2.2	10.3	21.4
Sucker, Largescale			
Chinook, Salmon (juv)			
Peamouth			
Sculpin	7.4	4.8	44.2
Crappie, Black	1.4	50.6	4.2
Bullhead, Brown	2.0	12.9	28.1
Bass, Smallmouth	15.9	2.8	72.0
Pikeminnow, Northern			
MEAN (MPAF)	**6.2**	**14.3**	**31.8**
Geomean	**4.3**	**8.6**	**23.4**
Max	**15.9**	**50.6**	**72.0**
Min	**1.4**	**2.8**	**4.2**
# under 10	**5**	**3**	**1**
# under 5	**3**	**3**	**1**
# under 2	**1**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.

No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

C.3.3

Table 1 - Trophic Trace Model Output for Uncertainty Runs
Chemical - DDE Spatial Scale - RM2-11

Scenario	TT-RM2-11-DDE-AVG	TT-RM2-11-DDE-MAX	TT-RM2-11-DDE-MIN
Species			
Plankton			
Various Plankton and Algae	0.1	0.2	0.1
Zooplankton	1.0	1.3	0.8
Benthos			
Clam (Corbicula sp)	18.8	23.7	15.8
Oligochaete	15.9	20.0	13.4
Insect Larvae	1.2	1.6	0.9
Amphipod	12.7	16.0	10.7
Crayfish	0.8	1.0	0.6
Fish			
Juvenile Fish	5.1	6.5	4.3
Carp	11.3	14.2	9.6
Sucker, Largescale	9.6	12.1	8.1
Chinook, Salmon (juv)	4.2	5.3	3.4
Peamouth	9.6	12.0	8.1
Sculpin	3.2	4.0	2.6
Crappie, Black	7.1	9.0	6.0
Bullhead, Brown	6.4	8.1	5.3
Bass, Smallmouth	5.7	7.2	4.8
Pikeminnow, Northern	4.6	5.9	3.9

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-DDE-AVG	TT-RM2-11-DDE-MAX	TT-RM2-11-DDE-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	-2.3	-1.8	-2.7
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	-8.1	-6.0	-10.3
Fish			
Juvenile Fish			
Carp	-11.9	-9.5	-14.1
Sucker, Largescale	-12.6	-10.0	-15.0
Chinook, Salmon (juv)	-5.0	-4.0	-6.1
Peamouth	-13.8	-11.0	-16.4
Sculpin	-17.8	-13.9	-21.6
Crappie, Black	-7.9	-6.3	-9.4
Bullhead, Brown	-7.3	-5.8	-8.8
Bass, Smallmouth	-23.1	-18.3	-27.7
Pikeminnow, Northern	-54.3	-42.9	-65.2
MEAN	**-14.9**	**-11.8**	**-17.9**
Max	**-2.3**	**-1.8**	**-2.7**
Min	**-54.3**	**-42.9**	**-65.2**
underpredict count	**11**	**11**	**11**
underpredict percentage	**100%**	**100%**	**100%**

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-DDE-AVG	TT-RM2-11-DDE-MAX	TT-RM2-11-DDE-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	-1.4	-1.1	-1.7
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	-5.7	-4.2	-7.2
Fish			
Juvenile Fish			
Carp	-11.0	-8.8	-13.1
Sucker, Largescale	-12.1	-9.6	-14.4
Chinook, Salmon (juv)	-5.0	-4.0	-6.1
Peamouth	-13.5	-10.8	-16.0
Sculpin	-7.6	-6.0	-9.2
Crappie, Black	-7.4	-5.9	-8.9
Bullhead, Brown	-7.0	-5.5	-8.4
Bass, Smallmouth	-21.7	-17.2	-26.0
Pikeminnow, Northern	-45.9	-36.2	-55.1
MEAN	**-12.6**	**-9.9**	**-15.1**
Max	**-1.4**	**-1.1**	**-1.7**
Min	**-45.9**	**-36.2**	**-55.1**
underpredict count	**11**	**11**	**11**
underpredict percentage	**100%**	**100%**	**100%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	50%	100%	20%
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	2.3	1.8	2.7
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	8.1	6.0	10.3
Fish			
Juvenile Fish			
Carp	11.9	9.5	14.1
Sucker, Largescale	12.6	10.0	15.0
Chinook, Salmon (juv)	5.0	4.0	6.1
Peamouth	13.8	11.0	16.4
Sculpin	17.8	13.9	21.6
Crappie, Black	7.9	6.3	9.4
Bullhead, Brown	7.3	5.8	8.8
Bass, Smallmouth	23.1	18.3	27.7
Pikeminnow, Northern	54.3	42.9	65.2
MEAN (MPAF)	**14.9**	**11.8**	**17.9**
Geomean	**10.9**	**8.6**	**13.1**
Max	**54.3**	**42.9**	**65.2**
Min	**2.3**	**1.8**	**2.7**
# under 10	**5**	**6**	**4**
# under 5	**1**	**2**	**1**
# under 2	**0**	**1**	**0**

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-RM2-11-DDE-AVG	TT-RM2-11-DDE-MAX	TT-RM2-11-DDE-MIN
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)	1.4	1.1	1.7
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	5.7	4.2	7.2
Fish			
Juvenile Fish			
Carp	11.0	8.8	13.1
Sucker, Largescale	12.1	9.6	14.4
Chinook, Salmon (juv)	5.0	4.0	6.1
Peamouth	13.5	10.8	16.0
Sculpin	7.6	6.0	9.2
Crappie, Black	7.4	5.9	8.9
Bullhead, Brown	7.0	5.5	8.4
Bass, Smallmouth	21.7	17.2	26.0
Pikeminnow, Northern	45.9	36.2	55.1
MEAN (MPAF)	**12.6**	**9.9**	**15.1**
Geomean	**8.9**	**7.0**	**10.7**
Max	**45.9**	**36.2**	**55.1**
Min	**1.4**	**1.1**	**1.7**
# under 10	**6**	**8**	**6**
# under 5	**1**	**3**	**1**
# under 2	**1**	**1**	**1**

C.3.4

Table 1 - Trophic Trace Model Output for Uncertainty Runs
Chemical - DDE Spatial Scale - Swan Island

Scenario	TT-SI-DDE-50	TT-SI-DDE-100	TT-SI-DDE-20
Species			
Plankton			
Various Plankton and Algae	0.1	0.2	0.1
Zooplankton	1.1	1.5	0.9
Benthos			
Clam (Corbicula sp)	26.9	43.3	17.0
Oligochaete	22.8	36.7	14.4
Insect Larvae	1.3	1.8	1.0
Amphipod	18.2	29.4	11.5
Crayfish	0.8	1.1	0.6
Fish			
Juvenile Fish	7.0	10.8	4.6
Carp	16.1	25.6	10.3
Sucker, Largescale	13.5	21.3	8.7
Chinook, Salmon (juv)	5.6	8.5	3.8
Peamouth	13.4	21.3	8.7
Sculpin	4.0	5.8	2.8
Crappie, Black	9.9	15.2	6.6
Bullhead, Brown	9.0	14.1	5.9
Bass, Smallmouth	7.4	11.2	5.1
Pikeminnow, Northern	6.1	9.3	4.2

Table 2 - Model Bias - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-DDE-50	TT-SI-DDE-100	TT-SI-DDE-20
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	-2.8	-2.1	-3.6
Fish			
Juvenile Fish			
Carp	-7.6	-4.8	-11.8
Sucker, Largescale	-13.7	-8.7	-21.2
Chinook, Salmon (juv)			
Peamouth	-9.3	-5.9	-14.4
Sculpin	-5.3	-3.6	-7.5
Crappie, Black	-7.5	-4.9	-11.2
Bullhead, Brown	-5.2	-3.3	-8.0
Bass, Smallmouth	-10.2	-6.8	-14.9
Pikeminnow, Northern	-13.3	-8.8	-19.7
MEAN	**-8.3**	**-5.4**	**-12.5**
Max	**-2.8**	**-2.1**	**-3.6**
Min	**-13.7**	**-8.8**	**-21.2**
underpredict count	**9**	**9**	**9**
underpredict percentage	**100%**	**100%**	**100%**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 3 - Model Bias - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-DDE-50	TT-SI-DDE-100	TT-SI-DDE-20
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	-2.7	-2.0	-3.5
Fish			
Juvenile Fish			
Carp	-7.4	-4.7	-11.6
Sucker, Largescale			
Chinook, Salmon (juv)			
Peamouth			
Sculpin	-5.2	-3.6	-7.5
Crappie, Black	-7.4	-4.8	-11.2
Bullhead, Brown	-5.0	-3.2	-7.7
Bass, Smallmouth	-9.9	-6.6	-14.5
Pikeminnow, Northern			
MEAN	**-6.3**	**-4.2**	**-9.3**
Max	**-2.7**	**-2.0**	**-3.5**
Min	**-9.9**	**-6.6**	**-14.5**
underpredict count	**6**	**6**	**6**
underpredict percentage	**100%**	**100%**	**100%**

Table 4 - SPAF - Comparison to mean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-DDE-50	TT-SI-DDE-100	TT-SI-DDE-20
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	2.8	2.1	3.6
Fish			
Juvenile Fish			
Carp	7.6	4.8	11.8
Sucker, Largescale	13.7	8.7	21.2
Chinook, Salmon (juv)			
Peamouth	9.3	5.9	14.4
Sculpin	5.3	3.6	7.5
Crappie, Black	7.5	4.9	11.2
Bullhead, Brown	5.2	3.3	8.0
Bass, Smallmouth	10.2	6.8	14.9
Pikeminnow, Northern	13.3	8.8	19.7
MEAN (MPAF)	**8.3**	**5.4**	**12.5**
Geomean	**7.5**	**5.0**	**11.1**
Max	**13.7**	**8.8**	**21.2**
Min	**2.8**	**2.1**	**3.6**
# under 10	**6**	**9**	**3**
# under 5	**1**	**5**	**1**
# under 2	**0**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.

Table 5 - SPAF - Comparison to geomean measured value (µg/kg ww) as Factor Difference

Scenario	TT-SI-DDE-50	TT-SI-DDE-100	TT-SI-DDE-20
Various Plankton and Algae			
Zooplankton			
Benthos			
Clam (Corbicula sp)			
Oligochaete			
Insect Larvae			
Amphipod			
Crayfish	2.7	2.0	3.5
Fish			
Juvenile Fish			
Carp	7.4	4.7	11.6
Sucker, Largescale			
Chinook, Salmon (juv)			
Peamouth			
Sculpin	5.2	3.6	7.5
Crappie, Black	7.4	4.8	11.2
Bullhead, Brown	5.0	3.2	7.7
Bass, Smallmouth	9.9	6.6	14.5
Pikeminnow, Northern			
MEAN (MPAF)	**6.3**	**4.2**	**9.3**
Geomean	**5.8**	**3.9**	**8.5**
Max	**9.9**	**6.6**	**14.5**
Min	**2.7**	**2.0**	**3.5**
# under 10	**6**	**6**	**3**
# under 5	**2**	**5**	**1**
# under 2	**0**	**0**	**0**

For Swan Island Lagoon, the measured mean value was composed of one sample for Peamouth, Northern Pikeminnow and Largescale Sucker.
No data were available for Clam or Juvenile Chinook Salmon. Geomean comparisons were not computed for these five species.