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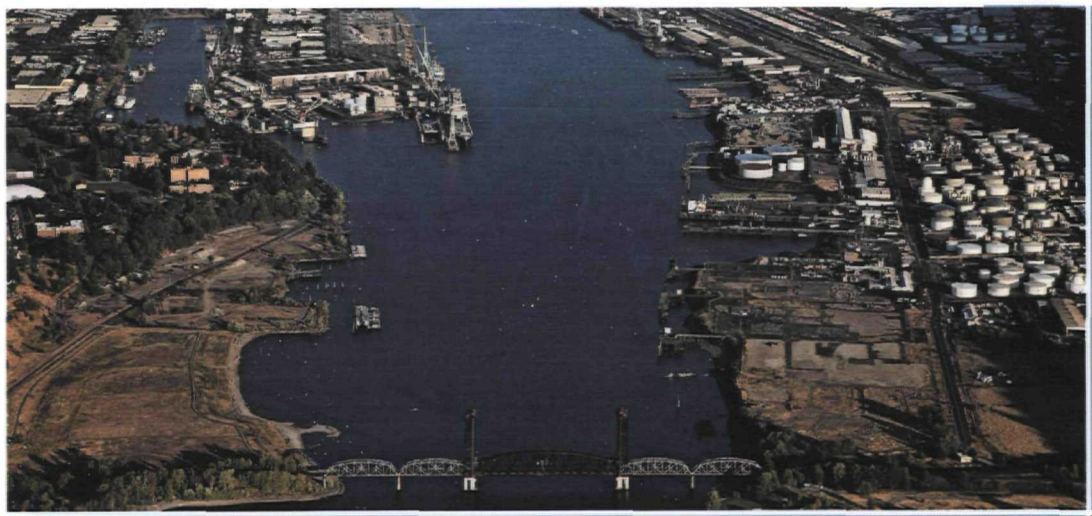

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Draft Remedial Investigation Report

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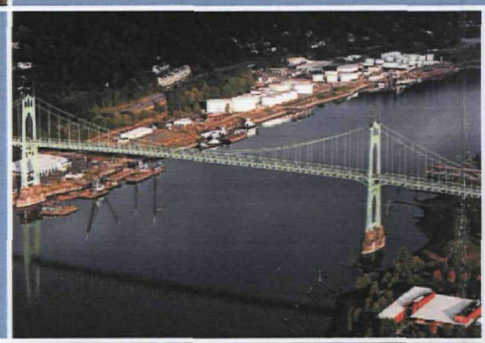

Prepared for

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APPENDIX E, ATTACHMENT 3. DATA TABLE OF UPLAND SOILS CHEMISTRY
APPENDIX F. BASELINE HUMAN HEALTH RISK ASSESSMENT
APPENDIX G. BASELINE ECOLOGICAL RISK ASSESSMENT.
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REMEDIAL INVESTIGATION REPORT

APPENDIX E
LOADING, FATE, AND TRANSPORT SUPPORTING INFORMATION AND CALCULATIONS

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TABLE OF CONTENTS

TABLE OF CONTENTS i

LIST OF FIGURES iii

LIST OF TABLES v

LIST OF MAPS vii

E1.0 INTRODUCTION 1

E2.0 UPSTREAM SURFACE WATER LOADING ESTIMATES 2
- E2.1 Data Sources 2
- E2.2 Approach 4
  - E2.2.1 Surface Water Flow Rates 4
  - E2.2.2 Surface Water Concentration Subaveraging 7
- E2.3 Surface Water Loading Results 9
- E2.4 Uncertainty 9
  - E2.4.1 Comparison of Sediment Trap Data to Surface Water Suspended Solids 10

E3.0 STORMWATER LOADING ESTIMATES 12
- E3.1 Background and Context 12
- E3.2 RI/FS Stormwater Sampling Objectives 13
- E3.3 Overall Loading Methods 13
  - E3.3.1 Estimation of Long-Term Loads 14
- E3.4 Data Sources 14
  - E3.4.1 Database Development and Rules 16
  - E3.4.2 Reclassification Analysis 16
- E3.5 Approach 17
  - E3.5.1 Stormwater Composite Sample Approach 17
  - E3.5.2 Stormwater Sediment Trap Sample Approach 18
  - E3.5.3 Stormwater Flow Rates 19
- E3.6 Stormwater Loading Results 20
- E3.7 Uncertainty 20
  - E3.7.1 Records Excluded from Loading Analysis 21
  - E3.7.2 Comparison of Extrapolated to Measured Loads 22
  - E3.7.3 Processed Data versus Unprocessed Data 25
  - E3.7.4 Results and Discussion 26

E4.0 PERMITTED NON-STORMWATER POINT SOURCE DISCHARGE LOADING ESTIMATES 28
- E4.1 Data Sources 28
- E4.2 Approach 30

E4.2.1 Load Estimates from DMRs 30
E4.3 Permitted Point Source Discharge Loading Results 31
E4.4 Uncertainty 31

E5.0 ATMOSPHERIC DEPOSITION LOADING ESTIMATES 33
E5.1 Approach 33
E5.1.1 Dry Deposition 33
E5.1.2 Wet Deposition 35
E5.1.3 Total Deposition 37
E5.2 Data Sources 37
E5.3 Atmospheric Deposition Loading Results 39
E5.4 Uncertainty 39

E6.0 GROUNDWATER LOADING ESTIMATES 41
E6.1 Upland Groundwater Plume Loading Estimates 41
E6.1.1 Data Sources 41
E6.1.2 Approach 42
E6.1.3 Upland Groundwater Plume Loading Results 45
E6.1.4 Uncertainty 45
E6.2 Groundwater Discharge Advective Loading Estimates 46
E6.2.1 Approach 46
E6.2.2 Data Sources 51
E6.2.3 Groundwater Discharge Advective Loading Results 55
E6.2.4 Uncertainty 55

E7.0 RIVERBANK EROSION 57

REFERENCES 58

Attachment E-1 Stormwater Loading Preliminary Data Analysis Steps
Attachment E-2 Memorandum on Portland Harbor Stormwater Runoff Modeling (City of Portland 2008)
Attachment E-3 Data Table of Upland Soils Chemistry

LIST OF FIGURES

Figure E2-1. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, DDx Pesticides (Summed Parameters)

Figure E2-2. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, DDx Pesticides (4,4'-DDD and 4,4'-DDT)

Figure E2-3. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, Metals (As, Cr, Cu, Pb)

Figure E2-4. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, Metals (Hg, Ni, Zn)

Figure E2-5. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, PCB Congeners (077, 081, 105, 118)

Figure E2-6. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, PCB Congeners (126, 156 & 157, 169)

Figure E2-7. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, Total PCB Congeners and PCB TEQ (ND=0)

Figure E2-8. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, PAHs

Figure E2-9. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, Non-DDx Pesticides

Figure E2-10. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, Total PCDD/Fs and TCDD TEQ (ND=0)

Figure E2-11. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, Bis(2-ethylhexyl)phthalate

Figure E2-12. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, Hexachlorobenzene

Figure E2-13. Bar Charts of Surface Water Concentrations, RM 11 and RM 16 Comparison, Tributyltin Ion

Figure E2-14. Scatter Plots of Sediment Trap Accumulation Rate and Surface Water Total Suspended Solids, and Sediment Trap and Surface Water Organic Carbon Fraction

Figure E2-15. Scatter Plots of Surface Water and Sediment Trap Concentrations, Total PCB Congeners

Figure E2-16. Scatter Plots of Surface Water and Sediment Trap Concentrations, TCDD TEQ (ND=0)

Figure E2-17. Scatter Plots of Surface Water and Sediment Trap Concentrations, Total DDx

Figure E2-18. Scatter Plots of Surface Water and Sediment Trap Concentrations, Total PAHs

Figure E3-1. Plots of Stormwater Uncertainty Evaluation, PCB Congeners, Total PCB Congeners (TEQ – Mammalian 2005 TEFs), Benzo(a)pyrene, and Lead Evaluation of Segregated Samples at OF-18

Figure E3-2. Plot of Stormwater Uncertainty Evaluation, Median Comparison Between Processed and Unprocessed Data

Figure E3-3. Plot of Stormwater Uncertainty Evaluation, Upper Bound Comparison Between Processed and Unprocessed Data

Figure E6-1. Groundwater Plume Loading Estimate Approach, Kinder Morgan Linnton TZW Study Area

Figure E6-2. Groundwater Plume Loading Estimate Approach, ARCO and ExxonMobil TZW Study Areas

Figure E6-3. Groundwater Plume Loading Estimate Approach, Gasco and Siltronic TZW Study Areas

Figure E6-4. Groundwater Plume Loading Estimate Approach, Rhone Poulenc TZW Study Area

Figure E6-5. Groundwater Plume Loading Estimate Approach, Arkema TZW Study Area

Figure E6-6. Groundwater Plume Loading Estimate Approach, Willbridge TZW Study Area

Figure E6-7. Groundwater Plume Loading Estimate Approach, Gunderson TZW Study Area

LIST OF TABLES

Table E2-1. Summary of Annual Flow and Flow Fractions for the Willamette River

Table E2-2. Mann-Whitney U-test Results of the Comparison of RM 16 and RM 11 Concentrations

Table E2-3. Summary of Samples Excluded from Upstream Surface Water Loading Calculations

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations

Table E2-5. High Flow, Low Flow, and Annual Surface Water Upstream Load Estimates at RM 11.8

Table E3-1. Summary of Non-representative Locations by Analyte

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

Table E3-3. Yearly Runoff Volumes for 50th Percentile Flow Year

Table E3-4. Land Use Type Percentages by Study Area, Model Cell, and Non-representative Location

Table E3-5a. Summary of Annual Stormwater Loads by Study Area and Model Cell – Stormwater Composite Runoff

Table E3-5b. Summary of Annual Stormwater Loads by Study Area and Model Cell – Stormwater Outfall Sediment Traps (Non-normalized)

Table E3-6. Evaluation of Segregated Samples at OF-18

Table E3-7. Sediment Trap Comparison of Measured Loads versus Calculated Loads

Table E3-8. Composite Water Comparison of Annual Measured Loads versus Calculated Loads

Table E3-9. Processed Data versus Unprocessed Data

Table E4-1. Direct Permitted Dischargers Estimated Annual Loads

Table E5-1a. Ambient Air Concentration Data Used for Dry Deposition Annual Load Calculations

Table E5-1b. Wet Deposition Flux Data Used for Wet Deposition Annual Load Calculations

Table E5-2. Dry, Wet, and Total Annual Load Estimates for Atmospheric Deposition to the Study Area River Surface

Table E6-1. Groundwater Flow Zone Areas and Estimated Flow Rates

Table E6-2. Estimated Upland Groundwater Plume Annual Loading to the Water Column, by Upland Site

Table E6-3. Summary of Hydrogeologic Information Gathered from the CSMs

Table E6-4. Percent Inclusion in Subsurface Advective Loading Calculations

Table E6-5. K_{ow} and K_{oc} Values Compiled for Equilibrium Partitioning Chemical Loading Calculations

Table E6-6. K_d Values Compiled for Equilibrium Partitioning Chemical Loading Calculations

Table E6-7. Surface Sediment Advective Annual Loads

Table E6-8. Subsurface Sediment Advective Annual Loads

Table E7-1. Summary of Available Bank Chemistry Data

LIST OF MAPS

Map E3-1a. PCB 077 - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-1b. PCB 077 - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-2a. PCB 081 - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-2b. PCB 081 - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-3a. PCB 105 - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-3b. PCB 105 - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-4a. PCB 118 - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-4b. PCB 118 - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-5a. PCB 126 - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-5b. PCB 126 - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-6a. PCB 156&157 - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-6b. PCB 156&157 - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-7a. PCB 169 - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-7b. PCB 169 - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell -

Map E3-8a. Total PCBs - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-8b. Total PCBs - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-9a. PCB TEQ - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-9b. PCB TEQ - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-10a. Naphthalene - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-10b. Naphthalene - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-11a. Benzo(a)pyrene - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-11b. Benzo(a)pyrene - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-12a. Total Carcinogenic PAHs - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-12b. Total Carcinogenic PAHs - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-13a. Total PAHs Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-13b. Total PAHs - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-14a. 4,4'-DDD - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-14b. 4,4'-DDD - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-15a. 4,4'-DDT - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-15b. 4,4'-DDT - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-16a. Total of 2,4' and 4,4'-DDE - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-16b. Total of 2,4' and 4,4'-DDE - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-17a. Total of 2,4' and 4,4'-DDD - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-17b. Total of 2,4' and 4,4'-DDD - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-18a. Total of 2,4' and 4,4'-DDT - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-18b. Total of 2,4' and 4,4'-DDT - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-19a. Total DDx -Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-19b. Total DDx - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-20a. Total Chlordanes - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell-

Map E3-20b. Total Chlordanes - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-21a. Aldrin - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-21b. Aldrin - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-22a. Dieldrin - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-22b. Dieldrin - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-23a. γ-Hexachlorocyclohexane - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-23b. γ-Hexachlorocyclohexane - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-24a. Hexachlorobenzene - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-24b. Hexachlorobenzene - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-25a. Bis(2-ethylhexyl)phthalate - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-25b. Bis(2-ethylhexyl)phthalate - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-26a. Arsenic - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-26b. Arsenic - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-27a. Chromium - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-27b. Chromium - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-28a. Copper - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-28b. Copper - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-29a. Lead - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-29b. Lead - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-30a. Mercury - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-30b. Mercury - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-31a. Nickel - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-31b. Nickel - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-32a. Zinc - Composite Water Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E3-32b. Zinc - Sediment Trap Based Basin Weighted Mean Annual Load Estimates by AFT Model Cell

Map E6-1. Thiessen Polygons Used for Subsurface Advective Loading, Total PCBs and Total PCDD/Fs

Map E6-2. Thiessen Polygons Used for Subsurface Advective Loading, Total DDx and Total PAHs

Map E7-1. Riverbank Sampling Stations Relative to Bank Conditions

LIST OF ACRONYMS

AIRS	Aerometric Information Retrieval System
ATSDR	Agency for Toxic Substances and Disease Registry
BAP	benzo(a)pyrene
BEHP	bis-2(ethylhexyl) phthalate
bml	below mudline
CADAMP	California Ambient Dioxin Air Monitoring Program
CASTnet	Clean Air Status and Trends Network
cfs	cubic feet per second
C_{sed}	estimated chemical concentration in sediment
C_{TZW}	estimated chemical concentration in pore water
CSM	conceptual site model
DDx	2,4'- and 4,4'-DDD, -DDE, -DDT
DEQ	Oregon Department of Environmental Quality
DMR	Discharge Monitoring Report
DOC	dissolved organic carbon
EDI	equal discharge increment
EOSM	Evraz Oregon Steel Mills
EPA	U.S. Environmental Protection Agency
EPI	Estimation Program Interface
ESB	Equilibrium Sediment Benchmarks
f_{oc}	fraction of organic carbon
FS	feasibility study
FSP	field sampling plan
FSR	field sampling report
GIS	geographic information system
GOF	goodness of fit
IC	indicator chemical
IMPROVE	Interagency Monitoring of Protected Visual Environments
K_d	solid/water partitioning coefficient
K_{oc}	organic carbon partitioning coefficient
K_{ow}	octanol-water partitioning coefficient
LASAR	Laboratory Analytical Storage and Retrieval
LWG	Lower Willamette Group
MDN	Mercury Deposition Network
NADP	National Air Deposition Program
NATA	National Air Toxics Assessment
NB/NS	near bottom/near surface
NJADN	New Jersey Air Deposition Network
NPDES	National Pollutant Discharge Elimination System
ORNL-RIAS	Oak Ridge National Laboratory-Risk Assessment Information System
PAH	polycylic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD/F	polychlorinated dibenzo-p-dioxin/furan

PD	percent difference
RI	remedial investigation
ROS	Regression on Order Statistics
RM	river mile
RPD	relative percent difference
SCRA	site characterization and risk assessment
SSR	stormwater sampling rationale
TCDD	tetrachlorodibenzo-p-dioxin
TEF	toxicity equivalency factor
TEQ	toxic equivalent concentration
TOC	total organic carbon
TSS	total suspended solids
TZW	transition zone water
UCL	upper confidence limit
USGS	U.S. Geological Survey
VI	vertically integrated
VI-EMW	vertically integrated: east-middle-west
VOC	volatile organic compound

E1.0 INTRODUCTION

This appendix presents the calculations performed to estimate current loading, fate, and transport terms as part of the Portland Harbor Remedial Investigation (RI).[1] An overview of loading, fate, and transport processes that are relevant for the Study Area, the general approaches taken to assess the applicable mechanisms, and a summary of loading calculation results are presented and discussed in Section 6 of the RI Report. Additional details of the calculation methods, including all assumptions and the complete set of results, are presented here for each term. Specifically, estimates for the following current loading terms are presented in this appendix:

- Upstream surface water
- Stormwater runoff
- Permitted discharges (non-stormwater)
- Atmospheric deposition
- Upland groundwater plumes
- Advective transport from subsurface sediment
- Advective transport from surface sediment.

In addition to these mass loading/transfer estimates, supporting items in this appendix include:

- Attachment E-1: Stormwater Loading Preliminary Data Analysis Steps
- Attachment E-2: Memorandum on Portland Harbor Stormwater Runoff Modeling (City of Portland 2008, pers. comm.)
- Attachment E-3: Data table of available upland soils chemistry to support any future evaluation of bank erosion loading in the feasibility study (FS) or remedial design step.

[1] The focus of this analysis is on current loading terms to the Study Area and current in-river fate and transport processes. It is recognized that each loading term has a corresponding historical component that may be significant to the Study Area; however, insufficient quantitative data are available to support estimates of these historical terms. Therefore, historical loading is discussed primarily in qualitative terms in Section 6.1.8. Further, Section 4 identifies historical upland sources and pathways. Historical sources and loading are discussed again in Section 10, relative to current cross-media distribution of chemicals.

E2.0 UPSTREAM SURFACE WATER LOADING ESTIMATES

The mass loading of the surface water loading indicator chemicals (ICs; Table 6.0-1) was estimated using a quantitative approach based on empirical data. The purpose of this analysis was to estimate the dissolved and suspended chemical mass flux entering via surface water at the upstream (river mile [RM] 11.8) end of the Study Area. Additionally, the annual surface water chemical mass fluxes were estimated at sample transects located upstream of the Study Area (RM 16) and within the Study Area (RM 11, RM 6.3, and RM 4). The mass flux leaving the Study Area through Multnomah Channel (RM 3) and at the downstream end of the Study Area (RM 2) was also estimated. This appendix section presents the detailed steps taken to generate these loading estimates, from data sources and data treatment to the calculation approach. This section also presents the complete loading results, as well as a brief discussion of the associated uncertainty in the results. This analysis supports the discussion in Section 6.1 and Section 10 of the RI report.

E2.1 DATA SOURCES

Estimates of surface water loads entering the Study Area at the upstream (RM 11.8) boundary were based on Round 2A and 3A surface water chemical concentration data from RM 16 and 11 (the two nearest sampling transects), and U.S. Geological Survey (USGS) flow information from RM 12.8 (Morrison Bridge Station 14211720). In addition to upstream loading evaluations, surface water loads were also calculated for transects located at RM 6.3 and RM 4 to offer additional insight into the changing conditions across the Study Area. The mass flux leaving the Study Area through Multnomah Channel (RM 3) and at the downstream end of the Study Area (RM 2) was also estimated. Three surface water sampling events from the Round 2 sampling effort and four surface water sampling events from the Round 3 sampling effort provided the analytical data for the surface water loading calculations:

- November 2004 (Round 2A, Low Flow)
- March 2005 (Round 2A, Low Flow)
- July 2005 (Round 2A, Low Flow)
- January 2006 (Round 3A, High Flow)
- September 2006 (Round 3A, Low Flow)
- November 2006 (Round 3A, Stormwater-Influenced Low Flow)
- January/February 2007 (Round 3A, High Flow[2])

[2] The January 2007 high-flow event involved sampling at only three stations (W023M, W024, and W025M) due to an unexpected change in flow conditions; therefore, the sampling event was restarted in February 2007. Results from both of those sampling events are included in this event data set.

As noted in the list above, three types of sampling events were targeted: low river flow rate (low flow; <50,000 cubic feet per second [cfs]), high river flow rate (high flow; >50,000 cfs), and stormwater influenced (stormwater; sampling during low flow conditions with active runoff in the Study Area). Overall, the sampling events were well distributed over the average water year, capturing the range of flow conditions, including base flow, rising limb, peak flow, and falling limb conditions (see Figure 5.3-1). The surface water sampling events are discussed in Section 2.2.6 of the RI Report, and sampling locations are shown in Map 2.2-4. Also in the RI report, Section 5.3.1 and Tables 5.3-2 through 5.3-7 summarize sampling methods specific to each transect location and sampling event.

The RI data set and data summation methods were used in surface water loading calculations. Section 2 details the RI data set and data treatment, and the full RI data set for surface water for all sampled chemicals is presented in the site characterization and risk assessment (SCRA) database (Appendix A3).

Loading estimates were calculated for total, particulate, and dissolved phases for all surface water ICs. The IC list is presented in Table 6.0-1 and discussed in the RI Report in Section 6.1.1.1. Particulate and dissolved chemical concentrations measured in surface water with the XAD column sample collection technique were used for all volatile organic compound (VOC), pesticide, polychlorinated biphenyl (PCB), polychlorinated dibenzo-p-dioxin/furan (PCDD/F), and polycyclic aromatic hydrocarbon (PAH) loading calculations. Total concentrations were derived from the sum of the particulate and dissolved concentrations. Samples for total and dissolved metal analysis were collected using a peristaltic pump sampling method. Particulate metal concentrations were derived as the difference between the total and dissolved concentrations. Bis(2-ethylhexyl)phthalate (BEHP) was sampled with either XAD or peristaltic pump techniques in different sampling events. Where available, XAD data were used. Peristaltic BEHP data was used in all other cases. Results below detection limits were assigned a concentration of zero for the loading calculations prior to calculation of chemical total concentrations (XAD), particulate concentrations (peristaltic), or transect data subaveraging.

For transects located at RM 16, 11, 6.3, and 4, average discharge rates (recorded as cfs) for each event are based on 30-minute measurements collected by the USGS at the stream flow gauging station located at the Morrison Bridge at RM 12.8 (Station 14211720) (USGS 2008).[3] Because of the complicating influence of water from the Columbia River on Willamette River flow volume and direction at the RM 2 and Multnomah Channel transect locations (described in Section 5.3), average discharge rates were obtained from hydrodynamic modeling of the Willamette River performed by WEST Consultants (WEST 2006).

[3] Note: The flow rate values presented here are daily mean stream flow measurements from the USGS National Water Information System, www.waterdata.usgs.gov. These values were taken from the USGS Web site on June 16, 2008, and are considered to be draft and subject to change by USGS, which may refine ratings and calculations as needed.

E2.2 APPROACH

The flow rate data and analytical data described above were used to estimate annual surface water mass loading to the Study Area at RM 11.8 (combined RM 16 and 11 data sets) and at individual transects both upstream and within the Study Area (RM 16, 11, 6.3, and 4), and leaving the Study Area (Multnomah Channel and RM 2). As a first step, the average annual hydrograph (based on the 28-year period of record hydrograph record from 1975 through 2003) for the Study Area was divided based on a 50,000 cfs threshold into high-flow and low-flow portions. This step is described in detail in the following subsection (E2.2.1). Next, the surface water analytical data set was used to generate estimated concentration ranges for high-flow and low-flow conditions for each transect. This step is described in detail in subsection E2.2.2. Annual loads for high-flow and low-flow portions of the hydrograph were then estimated as the product of the concentrations and the flow rate. The annual mass loading estimates were generated by adding the fractional loading contributions estimated for high-flow and low-flow conditions for the year:

> Annual surface water chemical load (kg/yr) = high-flow chemical load (kg/yr) + low-flow chemical load (kg/yr).

To express the uncertainty in these estimates, a range of annual loading was calculated based on the ranges in concentration for each IC. These ranges are presented in terms of lower, central, and upper annual loading estimates. Loading estimates and ranges were generated for each IC for total, dissolved, and particulate fractions. To illuminate any seasonal differences in surface water loading, ranges of loading estimates were also compiled for each IC and each transect for high-flow and low-flow river conditions.

E2.2.1 Surface Water Flow Rates

For the loading estimate calculations for RM 16, 11, 6.3, and 4, estimates of the average annual volume of water entering the Study Area during high-flow and low-flow periods were needed. To estimate these values, recent daily flow records (2004 through 2006[4]) and the 28-year average hydrograph (1975–2003) were evaluated. The daily records for these hydrographs were categorized as high flow (>50,000 cfs) or low flow (<50,000 cfs). (Note that the November 2006 stormwater-influenced low-flow sampling event was considered a low-flow event for this loading analysis.) For each hydrograph, the total annual high-flow volume was calculated as the sum of each individual daily flow with a volume greater than 50,000 cfs. Similarly, the total annual low-flow volume for each annual hydrograph was calculated as the sum of each individual daily flow with a volume less than 50,000 cfs. The high-flow and low-flow annual volume totals were divided by the total annual volume to determine the fraction of the total volume that can be attributed to high- or low-flow conditions for each year. Total flow volumes and high-flow:low-flow volume fractions for the individual years and the 28-year average are

[4] Daily flow data from October 1, 2007 –December 1, 2007 were not available; therefore, 2007 annual volume totals and high-flow:low-flow volume fractions were not calculated.

presented in Table E2-1. Because the data sets compared well, the 28-year hydrograph was considered adequately representative for use as the basis for defining the high-flow:low-flow volume ratio for a typical year. Fifty-two percent of the total annual volume occurred during high-flow conditions and 48 percent during low-flow conditions, for a volume ratio of 1.07. The average annual duration of the low-flow period is 268 days, while high flows occur for a much shorter period of 98 days.

The Round 2A and 3A surface water sampling events and daily hydrograph data for the years characterized by those events (2004 through 2007) are presented in the RI Report Figures 5.3-2 through 5.3-5. Surface water sampling events superimposed on the 36-year average annual hydrograph are presented in the RI Report Figure 5.3-1.

Due to the complicating influence of water from the Columbia River on river flow volume and direction in the lower reaches of the Willamette River (described in Section 5.3), the total annual flows used in loading estimates for the transects at Multnomah Channel (RM 3) and RM 2 were based on hydrodynamic model results (WEST 2006). These results quantify the distribution of the Willamette River flow volume between the main river channel and Multnomah Channel. Based on the model results, three flow conditions are typically observed in the Columbia/Willamette River system during the water year:

- Columbia River and Willamette River at low flow: Multnomah Channel carries up to 60 percent of the Willamette River flow
- Columbia River at low flow, Willamette River at high flow: Multnomah Channel carries 30 percent of the Willamette River flow
- Columbia River at high flow, Willamette River at low flow: Multnomah Channel carries 100 percent of the Willamette River flow, plus some flow from the Columbia River.

To determine river flow volumes from model outputs for use in loading calculations, daily average flow velocities were calculated from model outputs for each transect: RM 4[5] flow was calculated as the sum of the flow in model cells 35, 36, and 37 in the northerly direction; Multnomah Channel flow was calculated as the sum of the flow in the westerly direction for model cell 38; and RM 2 flow was calculated as the sum of the flow in model cells 39, 40, and 41 in the northerly direction. To determine the typical daily flow volume at each transect, the average daily flux rate (in units of cubic meters per second) for the years 2003 through 2007 was calculated, then multiplied by the number of seconds in a day. The annual flow volume for each transect was estimated by summing the individual daily average flow volumes.

[5] Modeled flows for RM 4 were evaluated to support estimation of flows at RM 2 and Multnomah Channel, as well as for comparison to flows measured at the USGS Morrison Bridge gauge at RM 12.8. Load estimates at RM 4 were calculated using the USGS Morrison Bridge data.

The calculation of flow rates and volumes under the first two Columbia/Willamette flow conditions listed above is straightforward—the flow of the Willamette estimated at RM 4 is assigned to the main stem and Multnomah Channel at the appropriate ratios (40 percent and 60 percent, respectively, for conditions of low flow in both rivers; 70 percent and 30 percent, respectively, when the Willamette River is at high flow relative to the Columbia). Under the last flow condition, when the Columbia River stage is higher than that of the Willamette River, some amount of Columbia River flow travels up the Willamette River main channel, mixing with Willamette River water and discharging through Multnomah Channel. Under conditions when Columbia River water travels upstream all the way to RM 2, modeled flow velocity results for the RM 2 transect are negative, indicating a flow direction reversal. During periods of flow reversal at RM 2, the Willamette River flow volume at RM 2 was assumed to be zero and all Willamette River flow (plus some Columbia River flow) was assumed to leave the Study Area through Multnomah Channel.

Hydrodynamic model results spanning the period from January 1, 2003 through December 31, 2007 were utilized. This time period encompasses the surface water sampling events (November 2004 through February 2007). Average annual hydrographs generated from model results are presented in Figures 5.3-6 and 5.3-7. The average annual hydrograph for RM 4 produced using the model results was found to be consistent with the 28-year annual average hydrograph measured at the USGS Morrison Bridge gauge at RM 12.8. Under no flow conditions was a flow reversal observed at RM 4.

For loading calculations, periods of low flow (<50,000 cfs) and high flow (>50,000 cfs) in the Willamette River were assigned to the RM 2 and Multnomah Channel transect data based on the daily flow records from the 28-year hydrograph of Morrison Bridge flows. Therefore, the same dates that met the conditions for high flow or low flow at upriver transects (RM 16, RM 11, RM 6.3, and RM 4) were assigned as high flow or low flow for RM 2 and Multnomah Channel, regardless of the actual flow volume estimated at those transects on a particular date. This approach was taken in order to take into account the relative Willamette River flow volume at RM 2 and Multnomah Channel separate from the flows associated with the Columbia River. This allowed a consistent attribution of concentration data for all transects.

During periods of flow reversal at RM 2, it is assumed that all of the Willamette River is discharging through Multnomah Channel, along with some water from the Columbia River. Therefore, if a sampling event occurred during a period of backflow, the measured concentrations would be affected by the mixing of Willamette and Columbia river water. The dates of surface water sampling events were compared to the hydrodynamic model results for actual (not average) years. This comparison indicated that none of the sampling events at Multnomah Channel or RM 2 occurred during a period of Columbia River backflow at RM 2. Based on this, it is reasonable to assume that the analytical concentration data used in loading calculations were not influenced by mixing with Columbia River water. The loading analysis is only concerned with the mass flux of chemicals leaving the Study Area. This allows the discharge of Columbia

River water down Multnomah Channel to be ignored, simplifying the calculations of loading at the Multnomah Channel transect.

E2.2.2 Surface Water Concentration Subaveraging

This section describes the treatment of chemical concentration data in support of the loading analyses, including data reduction for defining the upstream boundary of the Study Area and concentration "subaveraging." Subaveraging refers to the process used to generate a single average chemical concentration at a transect location where multiple samples were collected during a given sampling event.

Transect surface water samples involve vertically integrated (VI) sample composites collected from multiple lateral substations across the width of the river channel. Transect sampling is designed to estimate integrated water concentration through a cross section of the river or fraction of a cross section at a point in time. The transect sample concentration data used in the loading calculations comprise three different sample collection techniques:

- Equal Discharge Increment (EDI) Sampling – Samples were vertically and horizontally integrated over the entire cross section of the river. EDI samples were collected at RM 11, 6.3, and 4 during Round 2A.
- Vertically Integrated: East-Middle-West (VI-EMW) Sampling – The cross-river transect was sampled at three discreet points: east bank, middle, and west bank. Each east, middle, and west sample is vertically composited over the depth of the river. VI-EMW samples were collected at RM 11 and RM 2 during Round 3A.
- Near-Bottom/Near-Surface (NB/NS) Sampling – Samples were collected from two vertical points in the water column and integrated horizontally across the width of the river transect. The NB sample was collected at a depth of 1 ft off the river bottom. The NS sample was collected 3 ft below the surface. NB/NS samples were collected at RM 16, 6.3, 4, and Multnomah Channel during Round 3A.

Multiple sampling events were conducted between 2004 and 2007 under both low-flow and high-flow river conditions. For the loading estimates, it was necessary to generate concentration values representative of high-flow and low-flow conditions. These representative concentrations were calculated by separately averaging the individual sample concentrations that were collected during high-flow or low-flow conditions for each transect. For those locations where field replicate, VI-EMW, or NB/NS samples were collected, the individual discreet replicate/normal and NB/NS sample pairs, or east, middle, west sample triplicates, were subaveraged prior to the calculation of the high-flow or low-flow all-sample averages. Data points with concentrations below analytical detection limits were set equal to zero prior to subaveraging, consistent with the treatment of detection limits applied to all loading calculations.

A minimum, mean, and maximum concentration value were identified for each transect for high-flow and low-flow conditions from the corresponding set of subaveraged results (subaveraged to one value per transect per sampling event). These minimum, mean, and maximum values were applied to generate the ranges of lower, central, and upper surface water loading estimates for high-flow and low-flow conditions.

E2.2.2.1 Upstream Surface Water Concentration Subaveraging

Chemical loading to the site via upstream (RM 11.8) surface water was estimated by combining the RM 16 and 11 chemical concentration data sets (field replicate, VI-EMW, and NB/NS discreet samples were subaveraged prior to combining the data sets, as described above) to determine representative high-flow and low-flow minimum, mean, and maximum chemical concentrations entering the Study Area. To assess whether the RM 16 and 11 data sets for each IC represented the same population of upstream data (in particular, whether the RM 11 data may be influenced by a source area between RM 16 and 11), a comprehensive graphical and statistical comparison of the chemical data from both transects was conducted.

The RM 16 and 11 analyte concentrations were analyzed on a chemical-by-chemical basis to determine the following:

- IC concentrations to be combined for RM 16 and 11
- IC concentrations to be combined for RM 16 and 11 following exclusion of outlying samples
- IC concentrations to be evaluated separately for RM 16 and 11.

For each chemical, the Mann-Whitney U-test was applied to compare the subaveraged (field replicate, VI-EMW, and NB/NS sample subaverages) RM 16 and 11 data sets. The Mann-Whitney U-test tests the null hypothesis that the two data sets were drawn from a single population. At a significance level of $\alpha = 0.05$, the null hypothesis was accepted for all of the ICs, indicating that no statistically significant difference could be shown between the RM 16 and 11 data sets. The Mann-Whitney U-test results are presented in Table E2-2.

Figures E2-1 through E2-13 present bar charts of RM 16 and RM 11 chemical concentrations for discreet sample concentration data (prior to subaveraging of field replicate, VI-EMW, and NB/NS samples); subaveraged field replicate, VI-EMW, and NB/NS concentrations; and final high-flow and low-flow average concentrations. These charts were visually analyzed to identify high-concentration samples that were not likely to be representative of conditions upstream of the Study Area. In particular, discreet VI samples collected at the RM 11 east station and RM 11 EDI samples were scrutinized for elevated concentration values due to a potential chemical source on the east bank of the river at RM 11.3, and best professional judgment was applied to identify those samples that exhibited notably higher concentrations than other RM 11 or RM 16 samples for a given analyte. These samples, which are identified in Table E2-3, were excluded from all

upstream concentration calculations and loading estimates. (Note that these samples are excluded from upstream loading calculations only, but they are included in the individual river mile loading estimates presented in Table E2-4.)

E2.3 SURFACE WATER LOADING RESULTS

Based on the calculations described above, loading estimates for each surface water IC were generated for the minimum, mean, and maximum concentrations for high-flow, low-flow, and total annual flow (high-flow plus low-flow) conditions for dissolved, particulate, and total concentration fractions. The complete results are presented in Table E2-4 (individual river miles) and Table E2-5 (upstream of the Study Area).

Section 6.1.1.1 of the RI Report presents an overview of the surface water loading analysis as well as a general interpretation and summary graphical presentation of the surface water loading results. Additional discussion of these results is presented in Section 10 in the context of the conceptual site model (CSM) and cross-media evaluations.

E2.4 UNCERTAINTY

Uncertainty associated with the surface water loading estimates is related primarily to the adequacy and representativeness of the analytical data set. The data sets are derived from grab samples, not time-weighted composites. Further, a limited number of samples were collected under a limited number of flow conditions. This prohibits a thorough understanding of temporal and flow variability in surface water quality, and is an important source of uncertainty of unknown magnitude. Another source of uncertainty is associated with the use of modeled flow data for the RM 2 and Multnomah Channel loading results.

Compared to other loading terms described in Section 6 and Appendix E, the surface water loading estimates are considered to be reasonably good estimates of the typical current annual loads, with lower uncertainty relative to other loading term estimates, considering the use of empirical site data in all calculation steps, the advanced sampling techniques applied in data collection, and the consistent patterns in the data sets by event type (as discussed in Section 5.3).

The concentration range observed among the sampling events is the only direct insight available into the uncertainty associated with this approach. Sediment trap data provide some additional perspective into the suspended solids loading estimates because they reflect longer sampling periods (four quarterly samples); however, for direct comparison, these samples are spatially limited (not representative of the entire transect) and mechanism-limited (not necessarily likely to equally capture particles of all sizes). The sediment trap results are discussed in comparison to surface water suspended solids in the following section.

E2.4.1 Comparison of Sediment Trap Data to Surface Water Suspended Solids

Sediment trap data were collected in 16 locations over four consecutive quarters (see Section 5.2 for details). Each of these data sets represents continuous measurement of suspended solids over the sampling period, at a near-bottom point in the river, which is in contrast to the event-specific snapshot record represented by the surface water suspended solids data set. While the sediment trap data are not directly comparable to the measurements of surface water suspended solids concentrations, it is worthwhile to compare the findings and look for trends that could inform uncertainty in the surface water suspended solids loading estimates. The sediment trap samples also differ from the surface water suspended solids data because the sediment trap data represent the record for a single near-bottom point in space in the river, as opposed to the vertically and horizontally integrated surface water sample transects. Additionally, it is conceivable that the some of the finer grained and/or less dense suspended solids measured in surface water might not be captured in the sediment traps.

To inform the loading analysis, sediment trap data from RM 15 to 1.8 were plotted with all of the surface water transect data for high-flow and low-flow events for physical parameters and selected analytes (total PCB Aroclors, TCDD TEQ [tetrachlorodibenzo-p-dioxin toxic equivalent concentration], total DDx [2,4′- and 4,4′-DDD, -DDE, -DDT], and total PAHs).

Mass and fraction of organic carbon (f_{oc})[6] in the sediment trap and surface water data sets were compared to evaluate physical characteristics. Because sediment traps do not quantify the mass of sediments moving through the river, direct comparison of mass loading estimates was not possible. Instead, the sediment accumulation rates (mass/area/time) were plotted against total suspended solids (TSS) values using a double y-axis plot. This plot, Figure E2-14 (upper plot), shows that the highest accumulation rates across the plotted range correspond to the first quarter of sediment trap sampling, which was the period of highest flow during the sampled year. This is consistent with the observed higher TSS values in the highest flow surface water samples. The records do not agree as well in comparison of f_{oc} results (Figure E2-14, lower plot). The sediment trap data show a fairly narrow range of observed f_{oc} values (1.1 to 3.5%); however, the surface water suspended solids data shows a much larger range (0 to 30%). In particular, higher f_{oc} values for TSS are apparent for low-flow conditions at transects at RM 11 and 6.3; similar high values are not observed in the sediment trap data set. These differences might reflect more variability in detrital organic carbon loads in the surface water TSS fraction than in materials captured by the sediment traps. Alternately, they might illustrate the difference in the limited spatial representativeness of the sediment trap samples as compared to the surface water transects. Finally, these values could reflect

[6] f_{oc} was not analyzed in surface water TSS samples; therefore, the f_{oc} for each TSS sample was calculated as the difference of the surface water total organic carbon (TOC) and the dissolved organic carbon (DOC), all divided by total suspended solids, such that f_{oc} = (TOC - DOC)/TSS. For f_{oc} calculations, non-detect values were set equal to one-half detection limits. Additionally, if DOC > TOC, the f_{oc} was set equal to 0.

the uncertainty in the surface water estimate of f_{oc} for cases where TSS values were very low or below detection limits. For this estimate, variability in TSS values may result in relatively large variability in the calculated f_{oc} value.

For comparison of concentrations between the sediment trap and surface water data sets, surface water particulate concentrations for transects were compared to the sediment trap solids dry weight concentrations. Figures E2-15 through E2-18 present this comparison for total PCB congeners, TCDD TEQ, total DDx, and total PAHs. For total PCB congeners (Figure E2-15), the surface water TSS and sediment trap data concentration ranges are comparable, with the exception of two elevated sediment trap concentrations at RM 11 (ST007). At RM 11, the sediment trap samples were taken near an expected source of PCBs (source areas are discussed in Section 4 of the RI Report). Therefore, it is reasonable that the sediment trap PCB concentrations at this location are biased high relative to the nearby surface water transect TSS samples. It is interesting to note that during periods of higher flow (Q1 and Q2), the sediment trap samples from that location do not show such a strong signal from the local source.

For TCDD TEQ (Figure E2-16), the sediment trap samples show generally larger ranges of solids concentrations than the corresponding proximal surface water TSS samples. The exception to this is found around RM 16, where the range of sediment trap concentrations and surface water concentrations are comparable.

Total DDx results (Figure E2-17) show good comparability of sediment trap and surface water TSS concentration ranges along the river, with the exception of the lowest flow sediment trap sample (Q4) at RM 11.3, which is elevated relative to the surface water transect range. Again, this may reflect a local source area influencing the sediment trap samples during low-flow conditions.

The total PAHs comparison (Figure E2-18) indicates that the surface water TSS concentration range is generally larger than the associated proximal sediment trap concentration range. The exception to this for PAHs is found at RM 6 (ST005), where several elevated sediment trap sample results (the highest of which is from the lowest flow period, Q4) are higher in concentration than the surface water TSS results at RM 6.3. This likely reflects the influence of the known PAH source areas near ST005.

In summary, comparison of the sediment trap and surface water TSS data suggests that the surface water TSS data reasonably approximate the longer-term sediment concentrations provided by the sediment traps, in spite of the snapshot nature of the surface water samples. While several sediment traps show higher chemical concentration ranges due to proximity to known source areas, the surface water TSS data generally show comparable-to-higher ranges of concentrations. Because the surface water loading estimates present results in terms of these concentration ranges, it is expected that the estimates are reasonable representations of a full year of conditions.

E3.0 STORMWATER LOADING ESTIMATES

This section presents the methods for conducting stormwater loading estimate calculations for the stormwater loading IC list (Table 6.0-1) using stormwater composite water and sediment trap data collected as part of the Portland Harbor RI/FS. The detailed steps taken to calculate stormwater loading estimates, from data sources/data treatment to calculation approach, are described below. This section also presents the complete stormwater loading estimate results, as well as a brief discussion of the associated uncertainty. The stormwater loading estimate results are summarized in Section 6.1.2 and further discussed in Section 10.1 of the RI Report.

E3.1 BACKGROUND AND CONTEXT

In November 2006, the U.S. Environmental Protection Agency (EPA) and Lower Willamette Group (LWG) determined that stormwater data were needed to complete the RI/FS, and that such data would need to be collected in the 2006/2007 wet-weather season to fit within the overall RI/FS project schedule. They convened a Stormwater Technical Team, which included representatives from EPA, Oregon Department of Environmental Quality (DEQ), and LWG, to develop the framework for a sampling plan. The sampling framework described in the Field Sampling Plan (FSP) was developed by the Stormwater Technical Team and is based on an EPA memorandum dated December 13, 2006 (Koch et al. 2006, pers. comm.). This framework was discussed and approved by Portland Harbor managers from EPA, DEQ, the Tribes, and LWG on December 20, 2006.

The Stormwater Technical Team evaluated a range of stormwater data collection technical approaches and selected those described in the framework, and elaborated on in the Stormwater Sampling Rationale (SSR), based on 1) the ability to meet the objectives for data as agreed to by the Portland Harbor managers, and 2) practicability in terms of schedule, cost, and feasibility.

The sampling framework was initially designed to complete stormwater data collection by the end of the 2006/2007 wet-weather season (i.e., May/June 2007). The Stormwater Technical Team reviewed sample completeness information after the end of the 2006/2007 season (Round 3A) and identified several substantial data needs to meet the originally intended FSP and SSR objectives. A second round of sampling was conducted in the late portion of 2007 and the early portion of 2008 (per the FSP Addendum) in order to collect as much data as possible while still staying within the constraints of the RI/FS schedule. Per the EPA letter dated March 24, 2008 (EPA 2008f) and its attached table, it was determined that the data collection activities associated with the FSP Addendum had been completed and there were no remaining stormwater data gaps for the purposes of the RI/FS.

E3.2 RI/FS STORMWATER SAMPLING OBJECTIVES

The following are the objectives of the RI/FS stormwater sampling program as discussed by the Stormwater Technical Team and accepted by EPA:

- Understand stormwater contribution to in-river fish tissue chemical burdens
- Determine the potential for recontamination of sediment (after cleanup) from stormwater inputs.

Several evaluation and modeling tools will use the stormwater loading estimates to meet the above objectives. Sections 6 and 10 of the RI contain an empirical evaluation of source, fate, and transport that relies directly on the stormwater data and annual loading estimates without intermediary use of the Fate and Transport Model. However, it should be noted that the data evaluation in this section uses data generated for use in the Fate and Transport Model, and the scale of the loading assessment is therefore defined by the scale of the model input.

The stormwater loading estimates developed using the methods described in this report are not in any way intended for use in evaluating stormwater source controls at individual upland sites.

E3.3 OVERALL LOADING METHODS

In general, to estimate stormwater loads, a chemical concentration in stormwater and the volume of stormwater discharge (i.e., time-integrated flows) must be known. These terms can be either directly measured or estimated through indirect means (e.g., runoff modeling of stormwater volumes).

As stated above, the purpose of the RI/FS stormwater sampling effort was to provide data for evaluating the potential risk of sediment recontamination from stormwater discharges to the river. Because the scope of this data collection effort was to provide sufficient data for an RI/FS-level evaluation of stormwater loads and contributions to potential in-river risk and recontamination issues for the Study Area, it was not necessary to collect measurements directly from every stormwater discharge to the Study Area. Direct measurements of stormwater loads from every discharge location would require an unreasonably large number of samples for the Harbor-wide assessment.

Instead, the stormwater sampling location rationale was designed in accordance with a commonly used approach of applying "representative" estimates of stormwater chemical concentrations for various land use types (Schueler 1987). A land-use-based chemical load modeling approach was used to estimate loads across the entire Study Area. Chemical loading models use site characteristics (e.g., land use and percent impervious area) and land-use-specific loading rates to estimate overall loading into the receiving waters. This approach has been modified to better fit the unique data needs and land use

characteristics of the Study Area, as well as the practical constraints for this sampling effort.

E3.3.1 Estimation of Long-Term Loads

Ideally, estimation of long-term loads would involve a large number of samples taken over the course of many years and from many types of storms, pollutant sources, and runoff conditions. However, such an approach is not necessary to meet the objectives for the FSP and would have caused unacceptable schedule delays for the RI/FS. Therefore, both stormwater composite water chemistry samples and sediment trap chemistry samples were collected at the locations discussed in Section E3.4 of this appendix. These two measurements provide data to support two independent means of estimating stormwater chemical loads as explained below in Sections E3.5.1 and E3.5.2.

It is anticipated that these two methods (composite water and sediment traps) will result in different predictions of mass loading at most locations. It is beneficial to estimate loads via two independent methods because each method has intrinsic measurement artifacts that lead to differing load estimates. The advantages and disadvantages of each method are to some extent complementary. By using two approaches, the disadvantages of each method can be better understood and the two loading estimates provide a better overall sense of the potential range of chemical loads. The advantages and disadvantages of both methods are further discussed in the SSR.

It should be noted that loads estimated from the snapshot of stormwater composite water and sediment trap data in this study by definition cannot include any future changes that may occur in the watersheds, such as source controls and/or changing land uses over time. Consequently, these future changes must be evaluated on a more general basis using tools that are commonly applied to watersheds in the absence of detailed stormwater chemical data. This subject will be discussed in more detail in the recontamination analysis that will be undertaken for the FS.

E3.4 DATA SOURCES

The stormwater composite water and sediment trap data were collected in accordance with the Round 3A Stormwater FSP and Addendum (Anchor and Integral 2007a, 2007b) and its companion document, the Round 3A SSR (Anchor and Integral 2007c) and analyzed in accordance with the Quality Assurance Project Plan Addendum 8 (Integral 2007). The field sampling activities are described in detail in the Round 3A Upland Stormwater Sampling Field Sampling Report (FSR; Anchor and Integral 2007d) and the FSR Addendum (Anchor and Integral 2008). Data were collected during a total of 15 storm events, with each outfall sampled an average of three times. Sediment traps were left in place for 3 to 7 months during two separate sampling periods. Due to the limited time span of sample collection and the known variability of stormwater, this data should be considered to represent a "snap shot" of stormwater entering the Study Area during the sampling period.

As detailed in Section 4.4.1.2, samples from three general categories of land use locations were included to obtain a practicable and sufficient data set. Samples were collected from a subset of drainage basins/outfalls within each category in the Study Area. These locations were sampled by the LWG and Port of Portland (Terminal 4) during two sampling efforts in the spring/summer of 2007 (Round 3A) and the fall/winter of 2007–2008 (Round 3B). One additional site (GE Decommissioning) was sampled by GE during the same time frame. Results from the GE investigation are included in the overall LWG stormwater data set. In early 2008, the City of Portland collected three additional samples to supplement the residential data set, and these samples are included as well. The three categories of locations are:

- **Representative Land Use Locations.** Twelve locations were selected as representative of five land uses (based on zoning) within the overall drainage area. These land use types are as follows:[7]
  - Residential land use (two locations) representing approximately 8 percent of the overall drainage basin to the Study Area
  - Major transportation corridors (two locations) representing approximately 2 percent of the basin
  - Heavy industrial land use (five locations) representing approximately 25 percent of the basin
  - Light industrial land use (four locations) representing approximately 8 percent of the basin
  - Parks/open space land use (one location) representing approximately 57 percent of the basin
- **Specific (Non-Representative) Industrial Locations.** Fifteen industrial locations were selected with potentially non-representative chemical sources that cannot be easily extrapolated from generalized land use measurements.
- **Multiple Land Use Locations.** Two locations were selected to directly measure stormwater discharge from relatively large basins that have a mixture of land use zones to provide a cross-check with land use loading estimates. Additionally, as discussed in the Round 3A FSR, during the first round of sampling, the Highway 30 location was inadvertently sampled in a location that included runoff from both highway and industrial areas. The samples from this location were renamed as "Yeon Mixed Use" and will also be used as a cross-check for land use loading estimates as further discussed in Section E3.7.2.

[7] Another kind of land use commonly evaluated in stormwater investigations is the "commercial" category, but this is a very minor use (less than 1 percent) within the overall drainage and was judged not to warrant a specific sampling location. Data from the residential land use type was used for commercial land use areas.

E3.4.1 Database Development and Rules

The data-handling rules described in *Guidelines for data reporting, data averaging, and treatment of non-detected values for the Round 1 database* (Kennedy/Jenks et al. 2004) are typically used to create a simpler data set for SCRA database users. The resulting data set contains only one result per analyte per sample and involves creating a SCRA database that excludes laboratory QA results, contains only the most appropriate dilution result and analytical method for each analyte, and contains the average of the replicates. For the stormwater data set, there were several deviations from the SCRA database rules, based on agreements made by the Stormwater Technical Team to include all results, including laboratory replicates and field duplicate results, in the stormwater project database. Therefore, the SCRA reduction step of reporting only one result for a sample was not employed for the stormwater project database because the Stormwater Technical Team requested inclusion of all laboratory replicate and field duplicate results for additional evaluation. A detailed summary of how laboratory replicate and field duplicates were treated is included in Attachment E-1.

The RI data summation methods were used in stormwater loading calculations. Section 2 of the RI Report details the RI data treatment.

Once the LWG database was prepared, it was queried to reduce it to a "working database" to include only those stormwater ICs as detailed in Table 6.0-1.

E3.4.2 Reclassification Analysis

Prior to conducting loading calculations, the data set was evaluated in order to determine whether or not *a priori* assumptions about representative land use locations versus non-representative land use locations were correct. A detailed summary of how this reclassification analysis was conducted is included in Attachment E-1.

The reclassification analysis resulted in many locations being reclassified from non-representative to representative and a smaller number of locations being reclassified from representative to non-representative. Summary statistics on the stormwater data were compiled after this reclassification analysis was completed. A summary of the non-representative locations for each IC is included in Table E3-1.

Several locations were reclassified as non-representative solely on the basis of outlier non-detect values. These locations are listed in Table E3-1 for reference and also shown in Maps 4.4-1a–d, but the non-representative loading rates from these sites were not included in the calculation of total loads; instead the "representative" land use loading rate was applied. These locations and corresponding chemicals include:

- Schnitzer WR-384: PCB 169
- GE Decommissioning Facility: arsenic

- Arkema WR-96: dieldrin and total chlordanes
- OF-22B: 4,4'-DDT and gamma-hexachlorocyclohexane.

E3.5 APPROACH

The stormwater composite water and sediment trap data described above were used to estimate annual stormwater mass loading rates to each Fate and Transport Model cell within the Study Area.

E3.5.1 Stormwater Composite Sample Approach

As a first step, the stormwater analytical data set was used to generate estimated concentration ranges for each land use and "non-representative" site, as shown in Table E3-2. The specific details of these calculations are included in Attachment E-1. Next, the stormwater runoff volumes draining to each Fate and Transport Model cell were calculated for each land use and "non-representative" location using the City of Portland's GRID model as summarized in Section E3.5.3 below and as described in detail in Attachment E-2. Loads were then estimated as a product of the calculated concentration estimates and the flow rate from the 50th percentile flow year in order to estimate a central tendency. The annual mass loads were generated by adding the loading contributions from each land use and non-representative site for each Fate and Transport Model segment:

> Annual stormwater chemical load (kg/yr) = heavy industrial stormwater chemical load (kg/yr) + light industrial stormwater chemical load (kg/yr) + residential stormwater chemical load (kg/yr) + parks/open space stormwater chemical load (kg/yr) + major transportation stormwater chemical load (kg/yr) + "non-representative" site stormwater chemical load (kg/yr)

To express the uncertainty in these estimates, a range of loading rates was calculated for each IC by multiplying the 50th percentile flow year runoff volumes by a range of concentration estimates, including the geometric mean, basin-weighted mean, 5th percentile, and 95th percentile. The basin-weighted mean was weighted using a unitless weighting factor for each sample location based on its runoff volume divided by the sum of all volumes for all locations within a particular land use.

Stormwater loads for pesticides were approached in a slightly different manner than loads for metals, PAHs, or PCBs due to a lack of representative composite water samples. Pesticides were only analyzed at a small subset of locations in composite water samples, but they were analyzed at nearly all locations in sediment trap samples.

Composite water samples collected from parks/open space or transportation land uses were not analyzed for pesticides; additionally, limited composite water samples (i.e., one or two) from light industrial and residential land uses were analyzed for pesticides. However, a larger number of sediment trap samples from each of the aforementioned

land uses was collected and analyzed for pesticides. In order to more accurately approximate the annual pesticide loads to the Study Area, sediment trap data and statistics were substituted for composite water statistics for light industrial, parks/open space, residential, and transportation land uses. This method was also used for non-representative locations that did not have composite water data (i.e., WR-147). The appropriate sediment trap data for a specific land use or non-representative location were multiplied by the geomean TSS value for the land use or location to obtain a "surrogate" composite water value. These surrogate composite water values were then used to calculate stormwater composite water loads to the Study Area.

E3.5.2 Stormwater Sediment Trap Sample Approach

The approach for stormwater sediment trap data is identical to the approach described above for composite water, except before calculating an annual surface water chemical load, the chemical solids load (a concentration in terms of mass per volume of water) similar to that obtained via stormwater composite water was calculated. The measured sediment concentration statistics (e.g., µg/kg) were multiplied by a central tendency (i.e., geometric mean) of the TSS concentration (in kg/L) measured in composite water for a particular land use to obtain a concentration or chemical solids loading estimate (e.g., µg/L). The stormwater sediment trap chemical solids concentrations are presented in Table E3-2.

Annual loads were then estimated as a product of the chemical solids loading rate and the runoff volumes from the 50th percentile flow year. The annual mass loads were simply generated by adding the loading contributions from each land use and non-representative site for each Fate and Transport Model cell:

> Annual stormwater chemical load (kg/yr) = heavy industrial stormwater chemical load (kg/yr) + light industrial stormwater chemical load (kg/yr) + residential stormwater chemical load (kg/yr) + parks/open space stormwater chemical load (kg/yr) + major transportation stormwater chemical load (kg/yr) + non-representative site stormwater chemical load (kg/yr).

To express the uncertainty in these estimates, a range of loading estimates was calculated for each IC by multiplying the runoff volume from the 50th percentile flow year by a range of chemical solids loading estimates, including the geometric mean, basin-weighted mean, 5th percentile, and 95th percentile. The basin-weighted mean was weighted using a unitless weighting factor for each sample location based on its runoff volume divided by the sum of all volumes for all locations within a particular land use.

For non-representative locations with sediment trap data that were either not collected (i.e., OF-22B) or unavailable due to sampling method inconsistencies (i.e., WR-96), composite water data were substituted in order to calculate a load from that location. In this case, composite water statistics were used as "surrogate" for sediment trap statistics.

Surrogate sediment trap statistics were then used to calculate the stormwater sediment trap loads to the Study Area.

E3.5.3 Stormwater Flow Rates

As detailed in Attachment E-2, and summarized in this section, runoff volumes were calculated for each land use category and "non-representative" location by the City of Portland Bureau of Environmental Services using the GRID model.

E3.5.3.1 Description of GRID model

The GRID model is a geographic information system (GIS)-based reconnaissance-level pollutant model developed by the City of Portland Bureau of Environmental Services to calculate stormwater runoff volumes and TSS loading rates. The GRID model was used as a part of this stormwater loading calculations effort to provide flow volumes only.

Data compiled for each 100-ft by 100-ft grid cell includes precipitation, pervious/ impervious area, and zoning area (or land use). With these data, runoff volumes for various land use types are calculated using a series of equations known as the "Simple Method" developed by Schueler (1987).

The equation for runoff volume using the Simple Method is:

$$R = P * Pj * Rv$$

Where,

R = Annual runoff per unit area (cm/month)

P = Annual rainfall (cm)

Pj = Fraction of monthly rainfall events that produce runoff (usually 0.9)

Rv = Runoff coefficient (unitless).

The annual runoff per unit area, R, will then be converted to units of volume/month (e.g., L/month) based on the depth (cm) of runoff times the area (e.g., cm^2) in question.

E3.5.3.2 Runoff Volumes

As previously discussed, runoff volumes were calculated, using the City of Portland Bureau of Environmental Service's GRID model. Runoff volumes were calculated for each land use Fate and Transport Model shoreline cell based on the GRID-model-determined watersheds draining to the corresponding segment of shoreline. Additionally, runoff volumes were calculated for each non-representative location listed in Table E3-1, as loads to the Study Area from these locations were input into the model separately since they were deemed to be non-representative through the data analysis explained in

Attachment E-1. Additional discussion on calculating volumes from non-representative sites is also included in Attachment E-2

For the purposes of Section 6 (loading) and Section 10 (CSM), yearly runoff volumes were generated using rainfall records from 2002, which is the 50th percentile river flow year. The volumes for each land use and non-representative basin are summarized by Fate and Transport Model cell in Table E3-3. For reference, a summary of land use percentages by Study Area, Fate and Transport Model cell, and non-representative location is included in Table E3-4.

E3.6 STORMWATER LOADING RESULTS

As discussed in Section E3.4 above, the Portland Harbor Study Area is divided into five representative land use types based on zoning: heavy industrial, light industrial, open space, residential/commercial, and major transportation. Applied concentrations and runoff volumes by land use and non-representative locations are shown in Table E3-2 and Table E3-3, respectively.

Stormwater loading estimates for composite water and sediment trap data are presented in Tables E3-5a (composite) and E3-5b (sediment trap) by basin. Each basin corresponds to the Fate and Transport Model cell number. The annual loads were calculated using the applied concentrations and yearly runoff volumes as discussed in Section E3.5.2. For each analyte and basin, the load estimate geometric mean, basin-weighted mean, 95th percentile, and 5th percentile are presented in units of kilograms per year. Section 6.1.2 of the main report further discusses loading estimates by land use, including a summary of relative loading percentages to the Study Area by land use area and non-representative location in Tables 6.1-5a–b.

The estimated annual loads to the Study Area are presented graphically in Maps E3-1a–b through E3-32a–b. The same color ramping scale is used for both composite water and sediment trap maps so that comparisons between the two separate loading estimates can be made.

E3.7 UNCERTAINTY

Sections 6 (loading) and 10 (CSM) of the RI provide an empirical evaluation of source, fate, and transport that relies directly on the stormwater data and annual loading estimates without intermediary use of the Fate and Transport Model. However, it should be noted that the data evaluation in this section uses data generated for use in the Fate and Transport Model, and the scale of the loading assessment is therefore defined by the scale of the model input. Therefore, one inherent uncertainty of this analysis is that it is limited to this scale and cannot be used, for example, in evaluating stormwater source controls at individual upland sites. The scale of the model cells (i.e., each river mile), however, is adequately spatially refined to support comparison of stormwater loading term estimates with estimates of other loading terms.

Data used to estimate the stormwater loads were collected during a total of 15 storm events, with each outfall sampled an average of three times. Sediment traps were left in place for 3 to 7 months during two separate sampling periods. Due to the limited time span of sampling and the known variability of stormwater, these data should be considered to represent a "snapshot" of stormwater entering the Study Area during the sampling period. Therefore, there is a general uncertainty regarding the degree to which the results might vary if a different set or several additional "snapshots" had been instead sampled.

The methodology for calculating stormwater loading assumes that concentrations measured in individual sampled outfalls at non-representative sites are indicative of concentrations for all stormwater discharging from that upland site. This methodology has inherent uncertainty associated with it, as concentrations can vary significantly based on the physical characteristics of the drainage basins associated with the stormwater discharges. For example, if a drainage basin that was sampled drains a known upland source area, the concentrations measured in this discharge will be significantly higher than stormwater discharges at the remainder of the upland site. Thus, this example will overestimate stormwater loading for this site.

The uncertainties associated with the runoff volume estimates from the City of Portland Bureau of Environmental Service's GRID model are discussed in Attachment E-2 (see Assumptions and Limitations of Analysis discussion). It should also be noted that the loads generated in this report are annual loads based on the 50th percentile river flow year. Later in the RI/FS process, a wider range of loads on a monthly basis for a range of different flow years will be generated for use in the Fate and Transport Model.

E3.7.1 Records Excluded from Loading Analysis

Particular records were peremptorily excluded from the working database due to various factors identified by the Stormwater Technical Team. There is some general study uncertainty represented by these decisions as compared to including these records in the loading analysis. These outfall locations are shown on the Stormwater Drainage Basin Characterization Maps 4.4-1a–d. The following data were not included per discussions with the Stormwater Technical Team and EPA:

- St. Johns Bridge (WR-510) – After the conclusion of Round 3A sampling, the Stormwater Technical Team and EPA discussed that the data from St. Johns Bridge may not be representative of long-term transportation loadings from general highway runoff because the bridge was recently repaired, repaved, and repainted. Therefore, a new location (Hwy 30B) was selected for sampling during Round 3B so there would still be two major transportation locations. These St. Johns Bridge data were not included in the loading calculations presented in the RI, but may be included in loading inputs to the Fate and Transport Model, based on future evaluations of this data set. However, since the major transportation

- Arkema WR-96 – Due to insufficient sediment volume collected in sediment traps through both rounds of sampling at WR-96, the Stormwater Technical Team suggested the use of sediment collected from within the outfall structure at this location for sediment sample analysis because there was a large amount of sediment accumulated around the sediment trap bottles. Because this sediment was collected differently from other sampling locations, the "non-representative" loading estimates, based on sediment trap data, from this site were not included in the loading calculations or discussed in Section 6 and Section 10, and instead the loading estimate from the composite water data was used.

E3.7.2 Comparison of Extrapolated to Measured Loads

As discussed above, not all runoff within the Study Area was sampled. Rather, sites that were representative of general land use types were sampled and used to extrapolate to other locations, on a land use basis, where runoff was not directly sampled. To provide an estimate of overall uncertainty created by this "representative" method, load values obtained from actual samples at three basins with multiple land uses were compared to the range of calculated loads using the extrapolated land use load method.

These sampled multiple land use basins, as shown in Map 4.4-1c include the following locations:

- OF-18 is an estimated 413-acre basin containing heavy industrial, residential, open space and major transportation (Hwy 30) land use.
- OF-19 is a 485-acre basin containing heavy industrial, open space, and major transportation land use.
- Yeon Mixed Use is an 18-acre sub-basin that drains to the river at OF-18. This basin includes major transportation land use and heavy industrial land use.

Extrapolated loads for each of these basins were calculated using generalized stormwater loading criteria for each land use developed from the stormwater data. For example, the stormwater loading in the Yeon Mixed Use basin could be calculated in two ways:

- Stormwater loading using measured concentrations:

$$L_{Yeon\ Mixed\ Use} = C_w \times V$$

Where:

L = Load (kg/year)

C_w = Measured concentration (μg/L) for Yeon Mixed Use

V = Volume of discharge from land use for 50% flow year.

- Stormwater loading using extrapolated data:

$$L_{Yeon\ Mixed\ Use} = (C_w \times V)_{heavy\ industrial} + (C_w \times V)_{major\ transportation}$$

Where;

L = Load (kg/year)

C_w = Concentration (μg/L) for particular land use

V = Volume of discharge from land use for 50% flow year.

Total PAHs, total PCB congeners, total PCB TEQ – mammalian TEF (toxicity equivalency factor), total DDx, BEHP, hexachlorobenzene, lead, and mercury were included in this comparative assessment.[8] Loads based on stormwater composite data and sediment trap data were evaluated. This assessment focused on: 1) whether the measured loading value was within the upper- and lower-bound range of calculated values (defined as the 95th and 5th percentiles, respectively) using the representative method; and 2) the relative percent difference (RPD) of the measured load and mean representative calculated load. The RPD was calculated as the absolute difference between the measured and mean represented calculated load divided by the average:

$$RPD = \frac{|L_M - \bar{x}_C|}{\left(\left[L_M + \bar{x}_C\right]/2\right)} \times 100$$

Where:

RPD = Relative percent difference

L_m = Measured load

x_c = Mean calculated load.

E3.7.2.1 OF-18 Segregation Evaluation

Prior to comparing measured to representative calculated loads for OF-18, an analysis was conducted on the effect of data segregation at this location as a result of the duplicate/replicate analysis performed on composite water data. As a result of this analysis, nine results were flagged in the data set due to divergence between the normal and duplicate result. The effect of removing these samples on the measured load relative to the calculated loads was assessed to determine the overall effect on the measured load.

[8] BEHP and hexachlorobenzene were included in the comparison for sediment trap based loads only.

Graphical comparison of the measured loading values, with and without the segregated data included, to the range of calculated loads was performed for benzo(a)pyrene (BAP), lead, PCB-077, PCB-105, PCB-106/118, PCB-126, PCB-156/157, total PCB congeners, and total PCB congener (TEQ) – mammalian 2005 TEFs.

Results of the comparison of loads with and without segregated data to calculated loads for OF-18 are provided in Figure E3-1 and Table E3-6. On the figure, the "data with the segregated data" (pink squares) include the segregated data points. The "data without the segregated data" (dark blue squares) do not include the segregated data points. For all analytes evaluated, the "data without the segregated data" had lower measured loading values than the "data with the segregated data" loads. For BAP and lead, both measured values fell above the upper-bound (95th percentile; shown as blue triangles with yellow borders) of the calculated loading values. For individual PCBs, total PCB congeners, and total PCB TEQ, the unsegregated data (i.e., "data without the segregated data") loading values fell within the range of calculated loads. Loads measured using "data with the segregated data" exceeded the upper-bound calculated load for two PCB congeners, as well as total PCB congeners. Based on this evaluation, the effect of segregating data for OF-18 reduced the loading estimates, tending to bring them more in line with calculated loading values. This segregation is also generally consistent with the methods used throughout this study to extrapolate load calculations. Therefore, the results discussed below focus on the analysis using the "data without the segregated data."

E3.7.2.2 Results and Discussion

Results of the comparison between measured and calculated representative loads based on sediment trap data for OF-18, OF-19, and Yeon-NW35 are presented in Table E3-7. In general, measured loads were within the range of calculated loads and were reasonably close to calculated estimates of central tendency (i.e., mean). RPDs between measured loads and mean calculated loads were typically less than 100 percent. OF-18 showed the greatest variability between measured and calculated loads for the analytes evaluated. Mercury, total PCB congeners, total DDx, BEHP, and hexachlorobenzene had measured loads that exceeded the 95th percentile calculated load and had RPD values exceeding 100 percent. Measured loads for mercury, lead, and BEHP exceeded the calculated upper-bound estimate and had RPDs exceeding 100 percent at OF-19 on a dry-weight basis. No analytes met these conditions at Yeon-NW35.[9] However, no measured loads exceeded the upper-bound estimate of calculated loads by more than a factor of 4. Measured loading estimates only fell below the lower-bound estimate of calculated loads for total DDTs at OF-19.

Comparison of calculated and measured loads using stormwater composite data for OF-18, OF-19, and Yeon-NW35 is provided in Table E3-8. At OF-18, measured loads exceeded the upper-bound calculated load for lead, mercury, and PAHs; however, the RPD only exceeded 100 percent for lead. At OF-19 the measured load for lead exceeded

[9] Only total PCB congeners and total PCB congeners (TEQ) – mammalian 2005 TEFs were evaluated at this location.

the calculated upper-bound load but had an RPD of only 84 percent. Finally, the total PCB congeners (TEQ) – mammalian 2005 TEFs measured load at Yeon-NW35 fell below the calculated lower-bound estimate and had an RPD exceeding 100 percent. Frequently, the range of calculated loads had a relatively small range (often less than a factor of 10), which may account for the measured loads exceeding upper-bound estimates but with relatively low RPDs. In general, measured loads were between the mean and upper-bound calculated loads, indicating reasonable agreement between the two methods of determining loads for mixed land use locations. When measured loads did exceed the upper-bound calculated loads, it was by a factor of 2.5 or less. Overall, this comparison appears to indicate that the representative loads are a reasonable estimate of loads from larger mixed land use basins had they been measured in the same general time period. This validates that the representative land use loading method is a reasonable method for estimating loads for the larger Study Area drainage basin, although a level of uncertainty normally expected for estimating stormwater loads via a variety of methods appears to exist.

E3.7.3 Processed Data versus Unprocessed Data

As part of the uncertainty analysis, the effect of data processing on the composite stormwater data set used for loading calculations was evaluated. Processing data refers to the steps undertaken to evaluate the composite water and sediment trap data set as discussed in Appendix E3.4 and Attachment E-1 (i.e., evaluation of duplicates and replicates, reclassification analysis, analysis of high non-detects in sediment trap samples, averaging the samples by site). Specifically, measures of central tendency (median) and upper-bound estimates (95th percentile) of stormwater analytes were compared on a land-use-specific basis using: 1) the final data set used for loading calculations discussed in this section (hereafter referred to as "processed data"); and 2) unprocessed data that has not undergone any prior analysis. Processed data used in this analysis are summarized in Appendix E3.6, while unprocessed data are discussed in Section 4.4.1.2 and presented in Appendix C1. The concept behind this comparison is that the uncertainty associated with a whole series of data processing decisions can be understood by comparing to a method that contains no processing of data. By understanding the overall level of variation of all the processing steps, the general level of uncertainty associated with any particular processing decision can be put in better context. It is important to note that such a comparison has no bearing on what method (processed versus unprocessed) is more technically "correct." It is a relative comparison only.

Table E3-9 provides a side-by-side comparison of processed and unprocessed data set summary statistics for selected stormwater analytes used in loading calculations. Summary statistics include number of samples, number of detects, frequency of detection, mean, median, and 95th percentile values. In addition, the difference in number of samples in each data set and the percent difference for the mean, median, and 95th percentile were calculated. The percent difference (PD) was calculated as:

$$PD = \frac{(X_U - X_P)}{\left[\frac{(X_U + X_P)}{2}\right]} \times 100$$

Where:

PD = percent difference

XU = value of unprocessed data set summary statistic (e.g., mean)

XP = value of processed data set summary statistic.

Larger PD values reflect increasing differences in the statistic of interest between the two data sets. The sign (positive or negative) indicates the direction of the difference. A positive PD indicates that the unprocessed data statistic exceeds the processed data statistic, while a negative value indicates that the processed data set statistic is the larger value.

Figures E3-2 and E3-3 are scatter plots of paired unprocessed versus processed data set median and 95th percentile values, respectively. For these graphs, all stormwater analytes included in the loading analysis are shown. Each symbol represents the paired median or 95th percentile values on an analyte- and land-use-specific basis. Symbols are varied to represent the different analyte classes (e.g., metals, PCBs, etc.) included in the scatter plot. Processed data are plotted as the x-axis variable and unprocessed data as the y-axis variable. A line representing a 1:1 relationship (i.e., slope[m] = 1) is included on each graph. Ideally, if there were no differences between data sets, all points on these graphs would fall on this line (i.e., PD = 0). Points that lie to the right of the line indicate that the processed statistic value for that point exceeds the paired unprocessed statistic value (i.e., PD > 1), while points to the left indicate the unprocessed statistic value is greater (i.e., PD < 1).

E3.7.4 Results and Discussion

In general, differences between median values in the processed and unprocessed data sets were small. PDs did not exceed 200 percent and infrequently exceeded 100 percent. The greatest variability and highest PD values were observed for pesticides in the light industrial land use classification. These differences are primarily due to low sample count (n = 1 to 6) and the low frequency of detection (0 to 67 percent). Based on Figure E3-2, median values tended to cluster near the 1:1 trendline, indicating relatively low differences in median values. Values did occur more frequently to the right of the trendline, indicating that median values tended to be higher in the processed data set. Variability tends to increase at the lower end of the scatter plot, primarily due to pesticide values near the detection limit and/or low sample counts for these analytes. Overall, differences are considered relatively low between median values in these data sets.

As expected, 95th percentile values were generally larger for the unprocessed data set, but not extremely so. All PD values were less than 200 percent, but values above 100 percent were more frequently observed than for the median statistic. Figure E3-3 illustrates this difference. In this plot, values frequently occur to the left of the trendline, indicating that the unprocessed 95th percentile usually exceeded the corresponding processed value. These differences are primarily related to the removal of outliers from the representative data set during the reclassification analysis of stormwater data for loading calculations. Again, pesticides in the light industrial land use showed the greatest variability and PD values, due to the same reasons previously cited for the median value analysis.

In the context of the stormwater loading analysis uncertainty (e.g., modeling, sampling, analysis uncertainties), the uncertainty associated with the stormwater processing on summary statistics for analyte values is considered relatively low. For example, this uncertainty appears to be lower than the uncertainty associated with the representative land use load calculation approach (as compared to measuring concentrations directly) previously discussed. Therefore, it seems very unlikely that much uncertainty is created by the individual processing step.

E4.0 PERMITTED NON-STORMWATER POINT SOURCE DISCHARGE LOADING ESTIMATES

Point source permitted non-stormwater discharges to the river compose another external loading term to the Study Area. This section presents the data sources, approach, and results of the semi-quantitative estimation of the annual mass load of chemicals to the system via this loading mechanism. This appendix section supports Section 6.1.3 of the RI Report.

E4.1 DATA SOURCES

This loading analysis focused on National Pollutant Discharge Elimination System (NPDES)-permitted discharges from commercial, industrial, private, or municipal outfalls within the river mile range of the Study Area (RM 1.8 to 11.8). Data compilation for this analysis involved identifying the list of active NPDES permit holders discharging to the Study Area, obtaining copies of those permits, and obtaining discharge monitoring records for those permits. Those activities and products are described in this section. Note that this analysis is specifically limited to permitted wastewater discharges to the Study Area and does not represent stormwater discharges (included in stormwater loading term analysis; Section 6.1.2 and Appendix E3.0) or other types of point sources.

DEQ issues two types of NPDES permits: general and individual. General permits are issued to dischargers with operations and waste streams that fit into categories that can be regulated with a standard set of monitoring requirements. Individual permits are issued to facilities with processes or wastewater/stormwater flows that merit unique monitoring requirements. Per agreement with EPA, the loading analysis for permitted direct discharges focused on all Individual Permits, GEN15A General Permits, and GEN13 General Permits.[10] All active NPDES permits inside the Study Area were located using DEQ's Facility Profiler 2.0[11] and the DEQ Wastewater Permits Database.[12] Permitted facilities located within one-half mile of the riverbank between RM 1.9 and 11.8 were sought and compiled using the Facility Profiler and the Wastewater Permits Database. The search revealed 81 NDPES stormwater-permitted (not including construction permits) and 32 NPDES wastewater-permitted discharges to the Study Area. This complete set of permitted facilities is presented in RI Report Section 4.4. Of these permitted facilities, 14 are current wastewater-discharge-permitted facilities with either Individual or GEN 15A permits. The locations of these 14 facilities are listed in Table E4-1 and presented on Map 6.1-1 in Section 6.1.3 of the RI Report.

[10] Per DEQ (DEQ personal communication 2008), GEN 13 permits were discontinued in 2006; therefore, there are no current GEN 13 permits to include in this analysis. Activities covered under the GEN13 permit (oily stormwater) were subsequently included under the GEN12Z general stormwater permit. GEN 12Z permits are not included in this loading term.

[11] DEQ's Facility Profiler 2.0: (http://deq12.deq.state.or.us/fp20/)

[12] DEQ Wastewater Permits Database: (http://www.deq.state.or.us/wq/sisdata/sisdata.asp)

For these facilities, the NPDES permits, as well as the most recent two years of Discharge Monitoring Reports (DMRs) for these permits, were assembled from information provided by DEQ on June 3, 2008.[13] From these permits and DMRs, water chemical concentration data and discharge/flow data were compiled for each facility. These data were available for 10 of the 14 relevant NPDES-permitted discharges:

- Evraz Oregon Steel Mills (EOSM)
- Kinder Morgan/Portland Bulk Terminal 4
- Koppers Inc.
- Starlink Logistics, Inc.
- Siltronic Corporation
- ARCO Products Company
- Kinder Morgan Liquid Terminals
- Equilon Enterprises
- Pinnacle Condominium Complex
- Univar USA.

The remaining four NPDES wastewater-permitted discharges listed below were not included in the loading calculations due to insufficient data for calculations and are shaded orange in Map 6.1-1.

Below are the facilities and the reasons they were not included:

- Ash Grove – No flow or chemical data reported
- Columbia River Sand and Gravel – No flow data reported and no chemical analysis required (only TSS and turbidity monitored)
- Vigor (Cascade General) – No flow data reported on DMRs
- The Metropolitan Condominium Complex – No flow or concentration data reported.

The discharge information from these sites would be expected to increase the upper and lower end estimates of total loading to the Study Area for the chemicals included in their permits. The lack of data for these facilities is not expected to represent a significant loading data gap for any parameters.

[13] Information for the Pinnacle Condominium Complex was provided on June 2, 2009.

E4.2 APPROACH

The information described above was gathered into an Excel database, including information on each outfall regulated by each of the permits. (Note: One facility permit may regulate multiple outfalls, generating multiple DMRs.) The database compiled all chemical concentration information, as well as discharge information, in chronological order, including all available monthly and quarterly records. This database was used to estimate annual loads, based on the product of reported monthly or quarterly discharge rates and chemical concentrations.

For each permitted discharging facility, a range of annual chemical loading was estimated, as described below.

E4.2.1 Load Estimates from DMRs

Total monthly discharge volume and chemical concentration data, for select reported chemicals, was reported monthly on DMRs for all facilities except ARCO and Pinnacle. For these two facilities, discharge volume and chemical concentration data are reported on a quarterly basis. For the Starlink facility, metals are reported on a monthly basis, while DDT is reported quarterly. The method for calculating average annual loading for DMRs submitted monthly is shown below.

For each facility, a total monthly load was calculated for each month of the most recent two years of data using the following equation:

$$L_{monthly}\left(kg/mo\right) = C_{monthly}\left(mg/L\right) \times Q_{monthly}\left(L/mo\right) \times 10^{-6}\left(kg/mg\right)$$

Where,

$L_{monthly}$ = monthly load

$C_{monthly}$ = single monthly concentration measurement reported in DMR

$Q_{monthly}$ = single monthly discharge volume.[14]

The total annual load for each of the most recent two years was then calculated from monthly loads by summing the twelve calculated monthly loads:

[14] Total monthly discharge data were available for Koppers and Starlink. DMRs for other facilities reported a single daily flow volume. Daily flows were multiplied by the total number of days in the month to estimate $Q_{monthly}$. For Kinder Morgan Terminal 4, total monthly volume was estimated based on the reported average flow of 6 cfs because no individual daily or monthly flow measurements were provided in the DMRs. The same approach was applied to generate quarterly flow volume estimates from daily measurements for the ARCO and Pinnacle facilities.

$$L_{annual_1}\left(\frac{kg}{yr}\right) = \sum L_{monthly_1}\left(\frac{kg}{mo}\right)$$

$$L_{annual_2}\left(\frac{kg}{yr}\right) = \sum L_{monthly_2}\left(\frac{kg}{mo}\right)$$

Where,

L_{annual_1} = average annual load, year 1

L_{annual_2} = average annual load, year 2.

Finally, a range of annual loads was estimated by taking the minimum, average, and maximum values of the estimated annual loads (L_{annual_1} and L_{annual_2}) for the most recent two years.

Loads for the following seven permitted dischargers were calculated using monthly monitoring data: Univar, EOSM, Kinder Morgan/Portland Bulk Terminal 4, Koppers, Siltronic, Starlink, and Kinder Morgan Liquid Terminal.

The same general approach was applied for the ARCO and Pinnacle facility data and for Starlink DDT data, which are submitted quarterly: total quarterly loads were estimated and summed to generate total annual loads for the most recent two years. A range of annual loads was estimated by taking the minimum, average, and maximum values of the estimated annual loads.

The resulting DMR-based estimates of lower, upper, and central annual chemical loading for each IC chemical are reported in Table E4-1.

E4.3 PERMITTED POINT SOURCE DISCHARGE LOADING RESULTS

DMR-based loading estimates for each chemical were summed for all facilities to generate the range of annual loading estimates to the Study Area by permitted wastewater discharges. Due to limited analyte lists in the DMRs and the permits, data for some IC-list parameters were not available for all facilities. Additionally, several IC-list chemicals were never monitored at any of the facilities. These results are presented in Table E4-1 for the subset of IC chemicals for which data were available, and discussed in Section 6.1.3 of the RI Report.

E4.4 UNCERTAINTY

While there is uncertainty associated with the annual estimates for this loading term, the findings are expected to be reasonably representative of the relative significance of this pathway (as defined above) for current loading of ICs to the Study Area. The primary source of uncertainty in these estimates is the limited monitoring records available for

many sites. It should be noted that there are four sites that could not be included in this assessment due to lack of information. If there is flow related to these permits, then discharge information from these sites would be expected to increase the upper and lower end estimates of total loading to the Study Area for the chemicals included in their permits. It should also be reiterated here that this analysis is specifically limited to permitted wastewater discharges to the Study Area and does not represent stormwater discharges (included in stormwater loading term analysis; Section 6.1.2) or other types of point sources.

E5.0 ATMOSPHERIC DEPOSITION LOADING ESTIMATES

As described in Section 6.1.4 of the RI Report, atmospheric deposition is a potential source term for loading of ICs to the Study Area. This section presents the analysis performed to generate semi-quantitative air deposition loading estimates, including the detailed approach, data sources, results, and a discussion of uncertainty. Air deposition to land, which could subsequently be transported to the Study Area via stormwater runoff, is not included in this analysis and is considered as part of the stormwater analysis (Section 6.1.2 of the RI Report), though it is discussed qualitatively in Section 6.1.4. Additional literature information about the mechanism of atmospheric loading can be found in a variety of references including Wesley and Hicks (2000), Seinfeld and Pandis (1998), Bidleman (1988), and EPA (2005a).

E5.1 APPROACH

As discussed in Section 6.1.4 of the RI Report, atmospheric deposition is the sum of both dry and wet deposition. Under conditions of no precipitation, gases and particles are deposited to the ground surface in a process known as dry deposition. During precipitation events, gases and particles can be scavenged by rain droplets, frozen precipitation elements (freezing rain or snow), or fog droplets that deposit to the surface. This latter process is known as wet deposition. The following subsections present the details of the approach applied to assess dry, wet, and total deposition loading to the Study Area.

E5.1.1 Dry Deposition

The flux of an analyte to a surface from dry deposition can be estimated as

$$F_i = C_i \cdot v_{d,i} \cdot A$$

Where,

F_i = the mass loading to the surface (kg y^{-1}) for species *i*

C_i = the air concentration of species *i* (μg m^{-3}) measured at some reference height from the depositing surface

$v_{d,i}$ = the deposition velocity (cm s^{-1}) for species *i*

A = the surface area (m^2)

(Seinfeld and Pandis 1998; Reinfelder et al. 2004; note that unit conversions are necessary to ensure dimensional consistency).

The deposition velocity term parameterizes the fundamental processes that transport a depositing species to the surface. The rate at which a species is deposited to a surface

depends on the level of atmospheric turbulence, chemical properties of the depositing species (e.g., molecular diffusivity, water solubility, and vapor pressure), and properties of the surface. Gases may absorb reversibly or irreversibly to the surface; the same is true for species loosely absorbed to particles (i.e., species that could be removed from the particle by reaction with the depositing surface). Particles—and thus species sorbed to particles—will adhere to the surface; particles deposited to water will be subject to the general processes affecting suspended solids.

Of the three terms used in the calculation of mass flux to the Study Area surface[15]—surface area, deposition velocity, and concentration—the surface area is known with the greatest certainty and has the smallest temporal variability (varies only a few percent at most with seasonal flow rates and tidal changes; typical value from GIS analysis = 94,633,454 ft^2).

Because of the number and complexity of the physical and chemical processes embedded in the deposition velocity parameter, this term can be difficult to specify properly (Seinfeld and Pandis 1998). Dry deposition velocity for the Study Area calculations was assigned based on findings from Zufall et al. (1998). Zufall et al. (1998), in their evaluation of data from the New Jersey Air Deposition Network (NJADN),[16] showed that dry deposition of particulate matter is dominated by relatively large particles, even though atmospheric particle size distributions are dominated by particles less than 1 μm mass median diameter. The NJADN study selected a value of 0.5 cm/s for dry deposition velocity to reflect the disproportional influence of larger particles in dry deposition, especially in urbanized and industrialized regions (Reinfelder et al. 2004; Franz et al. 1998). Considering the similar urban environment and meteorological conditions between the Study Area and the NJADN site, a dry deposition velocity of 0.5 cm/s was chosen for calculating dry deposition loading.

Atmospheric IC concentrations are also difficult to specify as they can vary temporally and spatially. Concentration can be estimated through direct measurements or numerical models, both of which have associated uncertainties. The data sources applied to assign atmospheric IC concentrations are discussed in Section E5.2.

The general approach used in this analysis to estimate mass flux to the Study Area is to capture the uncertainty and variability of both the deposition velocity and concentration by employing a range of estimates for each parameter. For dry deposition, the upper-bound estimates of deposition velocity and concentration are combined to provide an upper-bound estimate of mass flux; an analogous procedure is used to provide a lower-bound mass flux estimate. Given the uncertainty and variability inherent in each of

[15] The Study Area surface is assumed to be the river water surface from RM 1.9 to 11.8 (i.e., riverbanks and upland zones are not included).

[16] The NJADN was established in late 1997 as a research and air monitoring network (1) to characterize the regional atmospheric levels of hazardous air pollutants, (2) to estimate atmospheric loadings to aquatic and terrestrial ecosystems, (3) to identify and quantify regional versus local sources and sinks, and (4) to identify environmental variables controlling atmospheric concentrations of PCBs, PAHs, chlorinated pesticides, trace metals, mercury, and nutrients.

the input parameters, where a central estimate can be provided, this estimate is uncertain at least within the upper- and lower-bound ranges presented.

E5.1.2 Wet Deposition

For certain analytes, wet deposition can be an important term in total atmospheric loading. Three fundamental steps describe the wet deposition process: 1) transport of the species (gas or particle) to the precipitation element; 2) uptake (or "scavenging") of the species by the precipitation element; and 3) delivery of the species to the Earth's surface. Accurate determination of wet deposition flux is significantly more challenging than dry deposition flux for several reasons. First, almost all of these processes can be reversible. For instance, particles scavenged by rain droplets may be re-aerosolized by evaporation of the rain droplet during its descent to the Earth. Second, these processes occur across a large of physical scales (e.g., from oxidation/reduction [redox] reactions within rain droplets to macroscale processes such as synoptic weather). Third, the presence of multiple phases of both precipitation elements and chemicals can affect the rate of uptake of the species by a precipitation element by orders of magnitude (Poster and Baker 1996). Finally, the size of particulate analytes and precipitation elements greatly influences the rate of precipitation scavenging.

The most reliable way available to estimate wet deposition is to collect all precipitation in suitable samplers, measure the chemical concentrations, and calculate the daily wet deposition flux in the sampling period (Reinfelder et al. 2004):

$$Flux_{wet} = C_{precip} \cdot PI$$

Where,

$Flux_{wet}$ = the wet deposition flux ($\mu g/m^2/day$)

C_{precip} = the chemical-specific concentration in the precipitation sample ($\mu g/m^3$)

PI = the precipitation intensity (m/day).

For seasonal and annual wet deposition flux, volume-weighted mean concentration, which is calculated by total mass of chemical divided by total precipitation volume, should be used as concentration in precipitation. Subsequently, the total annual wet deposition loading (kg/year) is calculated by multiplying the volume-weighted mean concentration ($\mu g/m^3$) by the area of interest (m^2) and by the total annual deposition (m/year), plus by the unit conversion factor (10^{-9} kg/μg).

Study Area-specific wet deposition monitoring results are only available for total PCBs for 2007 (MWH 2008) and mercury (Hope 2005). Wet deposition estimates for PCBs were calculated as described above using data collected by MWH Americas, Inc. during May to June 2007. For mercury, findings from Hope (2005) were considered for comparison with estimates based on NJADN data (see next paragraph). Briefly, the

Hope (2005) study used precipitation monitoring data from Oregon Mercury Deposition Network sites (one site near Beaverton and one site near the southern end of the basin), and found wet deposition estimates comparable to those generated by the NJADN ratio approach described in the following paragraph.[17]

For the chemicals that lack Study Area-specific monitoring results, values were estimated by calculation. An NJADN study by Reinfelder et al. (2004) showed that the wet deposition flux can be estimated from 1) the total atmospheric concentration, 2) the fraction of the chemical present in the particulate-associated and gaseous phases, 3) the precipitation intensity, 4) the Henry's Law constant, and 5) the particle scavenging coefficient. The following equations were applied to estimate loads to the Study Area based on monitoring results from NJADN (Reinfelder et al. 2004), with correction by ratios[18] to Study Area total atmospheric concentrations and total annual precipitation.

$$WDep = WDep_{NJADN} \cdot f_{Conc} \cdot f_{Precip}$$

$$f_{Conc} = Ci_{SA}/Ci_{Jersey\ City}$$

$$f_{Precip} = P_{Portland}/P_{Jersey\ City} = 0.88$$

Where,

WDep = wet deposition loading to the Study Area (kg/year)

$WDep_{NJADN}$ = wet deposition loading collected by NJADN (kg/year)

f_{Conc} = atmospheric concentration correction factor

f_{Precip} = annual precipitation factor

Ci_{SA} = atmospheric chemical concentration for chemical i in the Study Area ($\mu g/m^3$)

$Ci_{Jersey\ City}$ = atmospheric chemical concentration for chemical i in Jersey City ($\mu g/m^3$)

$P_{Portland}$ = annual precipitation in Portland (based on 30 year average; inch/year)

[17] Hope (2005) calculated dry, wet, and total mercury loading rates to surface water for the entire Willamette River basin (398,000,000 m^2). When scaled down to the sub-area of the basin represented by the Study Area (8,791,735 m^2, 2% of the open water area estimated by Hope), Hope estimates a total atmospheric mercury load of 0.08 kg/yr. This result is slight lower than, but comparable to, the lower mercury load (0.11 kg/yr) presented here.

[18] Because the wet deposition flux is proportional to the atmospheric concentration and precipitation intensity, the two correction factors convert the NJADN monitoring results to be Study Area-specific.

$P_{Jersey\ City}$ = annual precipitation in Jersey City (based on 30 year average; inch/year).

(Please note that unit conversions are necessary to ensure dimensional consistency.)

E5.1.3 Total Deposition

For each IC, the central estimate of total deposition loading to the Study Area was estimated by summing the dry deposition loading and the wet deposition loading estimates, where available. Because only central estimates could be generated for wet deposition loading, upper and lower estimates of the total loads were based on an assumption of that the ratio between the central wet and dry estimates was consistent across the range. Specifically, the ratio of the central estimate for wet deposition to the central estimate for dry deposition was calculated and assumed to be representative of the wet:dry ratios for the upper and lower values. From this ratio, upper and lower wet deposition values were estimated and included in the range of estimates for total deposition. Total loading estimates reflect summing of these ratio-estimated wet deposition load estimates for the lower and upper estimates. Where wet deposition data were inadequate to allow for estimation of even a central estimate, total loads were assigned based on the dry deposition estimates, and the lack of wet deposition contribution to the estimate is noted.

E5.2 DATA SOURCES

In an effort to collect atmospheric deposition and air sampling and monitoring data, a wide range of databases were reviewed for pertinent data related to the Lower Willamette River Study Area, including the following:

- Agency for Toxic Substances and Disease Registry online toxicological profile records (ATSDR 2008)
- California Ambient Dioxin Air Monitoring Program (CADAMP; CARB 2004)
- EPA AIRS (Aerometric Information Retrieval System; EPA 2008b)
- EPA Interagency Monitoring of Protected Visual Environments (IMPROVE; USFS 2008)
- EPA NADP (National Air Deposition Program; EPA 2008d)
- EPA Clean Air Status and Trends Network (CASTnet; EPA 2008c)
- EPA Mercury Deposition Network (MDN; EPA 2008d)
- EPA National Air Toxics Assessment (NATA) Modeled Ambient Concentrations (EPA 1996)
- EPA NATA Monitored Ambient Concentrations (EPA 2008a)

- EPA National Dioxin Air Monitoring Network (NDAMN; EPA 2008e)
- MWH Americas, Inc. (MWH 2008)
- National Park Service monitoring networks (NPS 2008)
- New Jersey Atmospheric Deposition Network (Reinfelder et al. 2004)
- Oregon DEQ all data sources including Laboratory Analytical Storage and Retrieval (LASAR; DEQ 2006)
- Oregon Mercury Deposition Network sites (one site near Beaverton and one site near the southern end of the basin), as reported in Hope (2005).

Based on this review of available atmospheric data for the list of combined loading ICs (Table 6.0-1), the LASAR, NJADN, EPA NATA modeled and monitored ambient concentrations, CADAMP, MWH Americas, Oregon Mercury Deposition Network (as reported in Hope 2005), and ATSDR (2002a, 2002b) data sources were used. Portland-specific data were available from the LASAR database and MWH Americas, Inc. In all, data from seven LASAR stations were used in these calculations. Each station identification number was then used as a primary parameter for data querying. Of the chemicals on the combined IC loading list (Table 6.0-1), only seven metals (arsenic, chromium, copper, lead, mercury, nickel, and zinc) and two PAH analytes (BAP and naphthalene) were available from this local empirical data source.[19] Study Area-specific wet deposition monitoring results for total PCBs were obtained from MWH Americas, Inc. (MWH 2008). The remaining information was collected from the other noted sources. Data and data sources for dry deposition air concentrations and wet deposition flux rates used in loading calculations are presented in Tables E5-1a and E5-1b, respectively.

For PAHs, empirical non-local air concentration data were available through the NJADN database. Local modeled NATA results were also available. To select the most appropriate data set, the direct monitoring results for total PAHs (the sum of the 13 site PAHs for which data was available) in the New Jersey NJADN database were compared to the NATA modeled ambient concentrations for total PAHs (the sum of 16 site PAHs) for Washington County and Multnomah County. This comparison found that the NATA modeled ambient concentrations were 2 to 4 orders of magnitude higher than the

[19] Individual high-concentration samples were observed for both BAP and naphthalene in the LASAR data. These high samples were collected on a specific sampling date at the monitoring location in the urban area of Portland near two major roads. The reported concentrations for these two chemicals are at least 2 orders of magnitude higher than the next highest monitoring values in the LASAR data set. To ensure the representativeness of these monitoring data values for BAP and naphthalene for applications to atmospheric deposition loading calculations, a thorough statistical analysis of the LASAR data was performed. The statistical analysis showed that among the reported monitoring data for BAP, a maximum value of 0.32 $\mu g/m^3$ and an average value of 0.19 $\mu g/m^3$ are outliers; therefore, they are excluded from the atmospheric loading calculations. For naphthalene, the following values determined to be statistical outliers also were excluded from the atmospheric loading calculations: 2.16 $\mu g/m^3$ as one of the maximum values, 1.87 $\mu g/m^3$ as an average value, and 1.55 $\mu g/m^3$ as a minimum value from the LASAR database.

measured New Jersey data. Based on the statistical evaluations, it is determined that the total of 13 PAHs from NJADN is a better representative value for the atmospheric deposition loading calculations than the total of 16 PAHs values reported by NATA, and the NATA total PAH data were excluded from atmospheric loading calculations. For other chemicals (hexachlorobenzene, TCDD TEQ) the modeled NATA data were the only air concentration data available; in these cases the NATA data were used in the atmospheric deposition loading calculations.

For a number of ICs on the combined IC loading list—individual PCB congeners, total PCDD/Fs, 4,4'-DDD, total of 2,4'- and 4,4'-DDD, total of 2,4'- and 4,4'-DDE, total of 2,4'- and 4,4'-DDT, BEHP, residual-range hydrocarbons and total petroleum hydrocarbons, pentachlorophenol, gamma-hexachlorocyclohexane, and tributyltin ion—no measured or modeled concentrations or wet deposition estimates were available. Therefore, no estimates of atmospheric deposition loading are provided for these ICs.

E5.3 ATMOSPHERIC DEPOSITION LOADING RESULTS

Table E5-2 presents the estimates of atmospheric dry deposition loading, wet deposition loading, and total deposition loading to the Study Area water surface. For the majority of the analytes, Table E5-2 provides lower, central, and upper tendency estimates of dry deposition loading; however, due to data limitations, only central tendency estimates could be generated for wet deposition loading. These results are discussed in Section 6.1.4.

E5.4 UNCERTAINTY

Primarily due to the limited availability of local atmospheric concentration and precipitation concentration monitoring data, atmospheric deposition to the river surface is expected to be one of the most uncertain loading terms. In the case of the atmospheric deposition loading estimates, the presented range of estimates (lower, central, upper) is not expected to fully capture/represent the uncertainty associated with this term, due to significantly limited local empirical data. The uncertainty varies by IC, and is discussed qualitatively (noting data sources and findings relative to empirically estimated terms) in Section 10.

For dry deposition loading estimates, the major uncertainties are as follows:

- The limited available local atmospheric concentration data
- The necessarily simplified calculation methodology
- The uncertainty associated with selection and uniform application of a deposition velocity.

For wet deposition loading estimates, the major uncertainties are as follows:

- The extremely limited local wet deposition monitoring data (data only found for PCBs [only a partial year of sampling record available] and mercury)
- The uncertainty associated with application of precipitation correction factors to allow for use of NJADN data.

Finally, because the total deposition loading was estimated by combining the dry and wet deposition loading, the identified uncertainties associated with dry and wet deposition loading are also relevant to the estimated total deposition loading.

E6.0 GROUNDWATER LOADING ESTIMATES

This appendix section supports Sections 6.1.5 and 6.1.6 of the RI Report. Section E6.1 presents an assessment of loading of upland groundwater plume chemicals to the water column. Section E6.2 presents an assessment of loading estimates for chemicals that desorb from sediments and are subsequently transported via groundwater advection. Within Section E6.2, advective loading from subsurface sediments to surface sediments and advective loading from surface sediments to surface water are both assessed.

E6.1 UPLAND GROUNDWATER PLUME LOADING ESTIMATES

This section presents the detailed approach, calculations, and results for the upland groundwater plume loading estimates described in Section 6.1.5 of the RI Report. For each of the nine GWPA study sites (see Appendix C2 for detailed discussion of site selection and GWPA data interpretation), groundwater chemical loads to surface water were calculated to generate a range of annual loading estimates from upland groundwater plumes to surface water at the scale of the Study Area and for the individual study sites.

It is acknowledged that these groundwater plume loading estimates are based on empirical information from only nine study sites, and it is possible that other sites will be identified that have a complete pathway for upland groundwater plumes to the Study Area. The groundwater pathway site selection process was designed to identify all sites with a reasonable likelihood of exhibiting a complete transport pathway for upland groundwater plumes to the Study Area. As described in Appendix C2, however, 83 sites lacked sufficient data to determine the completeness of the groundwater pathway. There may be additional upland sites that lack groundwater data but have complete groundwater pathways. Detailed discussion of the site selection process is presented in Appendix C2.

As discussed in Section 6.1.5, these estimates assume that observed transition zone water (TZW) concentrations are entirely attributable to upland groundwater. In some cases, the only likely pathway for a chemical to enter the transition zone is via the groundwater pathway, originating from upland groundwater plumes (e.g., certain site-specific groundwater VOCs). For this situation, these loading estimates are expected to be reasonably good approximations of mass loading from groundwater plumes to surface water. In other cases, where in-river sediment contamination may be a source of chemicals detected in surface water, the groundwater plume loading estimates may be partially redundant with advective loading estimates described below in Section E6.2.

E6.1.1 Data Sources

Data collected as part of the LWG Round 2 Groundwater Pathway Assessment, the Siltronic offshore investigation (MFA 2005; Hahn and Associates 2005) and the Gasco Offshore Investigation (Anchor 2008) were used to generate these plume loading estimates. Specifically, three types of information were used:

1. Measured TZW chemical concentrations from 150 sample locations at the nine study sites were used to estimate chemical concentrations. These samples represent the complete data set for the sample depth interval from 0 to 38 cm below mud line (bml)[20] (see Map 2.2-6). The sampling methods included in this data set are small-volume peepers, Trident, and Geoprobe. Both unfiltered and filtered (where available) results were evaluated. Section 5.4 of the RI Report provides a detailed discussion and graphical presentation of these TZW chemical concentrations.
2. Seventy-seven flow-meter measurements (24 hour, 15-minute interval records from ultrasonic seepage meters capable of positive and negative readings) were used to estimate groundwater flux within 29 flow zone areas identified at the nine study sites. The 24-hour maximum and average seepage rates are presented spatially on Figures E6-1 through E6-7. Note: In the design of the TZW study (Integral 2004), seepage meters were purposefully placed at locations where there was an indication (based on Trident temperature measurements, sediment texture, or screening results) of higher flow rates. These flow-meter measurements are presented in Appendix C2.
3. Twenty-nine site-specific flow zone areas generated from interpretation of multiple lines of evidence, including TZW chemistry results, seepage meter data, discharge mapping temperature data, sediment textures, sediment chemistry, and upland stratigraphy, were used to group analytical and flow data sets for the calculations. These flow zones are presented with discussions supporting the interpretations in Appendix C2. The flow zones are also presented in this appendix in support of the approach discussion that follows.

E6.1.2 Approach

As generally described in Section 6.1.5, groundwater plume chemical loads to surface water were estimated based on observed TZW chemical concentrations and seepage meter flow rates for each of the TZW loading ICs (Table 6.0-1). This IC list was based on the TZW ICs designated for discussion in Section 5 regarding in-river distribution (with the exceptions of the localized source chemicals of total petroleum hydrocarbons, cyanide, perchlorate, and Silvex), as well as the chemicals to be assessed by the Fate and Transport modeling effort and the RI CSM presented in Section 10. Loading was estimated for each flow zone area offshore of each TZW study site. The approach to estimating concentrations and flow rates within each flow zone, then compiling the information to calculate annual loads, is presented in the following subsections.

[20] In 2007, on behalf of Gasco, Anchor Environmental conducted an investigation of the groundwater pathway offshore of the Gasco site. Twenty-two TZW samples were collected with a Geoprobe sampler at depths between 0 and 90 cm bml. Samples collected from 0 to 38 bml were not available for this data set; therefore, all samples from the 0 to 90 cm bml interval are included in the groundwater plume loading data set. These data are presented in detail in Anchor (2008) and discussed in Appendix C2.

E6.1.2.1 TZW Concentrations

As described above, TZW sample data from the sample depth interval from 0 to 38 cm bml were used as the concentration terms in the loading calculations. These data were assigned to flow zones based on sample location. For flow zones with only one TZW sample, the concentration was applied to the entire zone. For flow zones containing multiple TZW samples, Thiessen polygons[21] were developed around each TZW sample location within the flow zone. The concentration of each sample was then applied to the corresponding partial area of the flow zone. The flow zones, TZW sample locations, and corresponding Thiessen polygons are presented in Figures E6-1 through E6-7.

In a small number of cases, more than one TZW sample was collected at a single location for a given analyte. For these collocated samples, the maximum observed concentration was used in the calculations. Chemical concentrations below laboratory-reported analytical detection limits were assigned a value of zero, in accordance with the approach for all RI loading calculations. Additionally, TZW samples were not analyzed for all target analytes at all sampling locations due to occasional limits in sample volume. For individual Thiessen polygons within a flow zone lacking data for a particular targeted chemical, the chemical concentration was estimated as the average of all other concentrations measured in the same flow zone. Finally, if an analyte was not sampled offshore of a given upland site (i.e., not on the site-specific Round 2 TZW analyte list because it was not an analyte of interest for the groundwater pathway), loading estimates for the flow zones associated with that site were not generated.

Calculations were performed with both unfiltered and filtered data sets.[22] The unfiltered data set consisted of unfiltered push probe (Trident and Geoprobe) samples, as well as small-volume peeper samples. The filtered data set consisted of the available 0.45-μm filtered push probe sampling results and the small-volume peeper results (i.e., the small-volume peeper results were used for both the filtered and unfiltered estimates). Because of sample volume limitations, filtered chemical concentrations were not collected for all analytes at all locations. Therefore, at locations where filtered samples were not collected, the average of the filtered push probe chemical concentrations within the same flow zone was used as a proxy value to complete the data set needed for the filtered load estimates.

Three flow zones covered areas that did not include any TZW sample locations. Chemical concentrations for these flow zones were estimated based on nearby TZW measurements. In particular, for the nearshore ARCO groundwater discharge zone (area = 1,900 ft^2; see Figure E6-2) the nearest TZW sample (R2-AR-02) was used. No concentration data were available for the Rhone Poulenc inferred groundwater discharge zone extension (area = 55,000 ft^2; see Figure E6-4); therefore, the chemical

[21] Thiessen polygons are formed as a network of polygons generated around seed points. In this case, the seed points are sampling locations. The polygon around each seed point delineates all areas that are closer to the seed point than any other seed point.

[22] Following sample collection protocols, filtered samples of VOCs and naphthalene were not collected. For these analytes, filtered loading estimates were not generated.

concentrations were estimated as the average concentrations of all Rhone Poulenc groundwater discharge zone samples. Finally, for the Willbridge Terminal low-to-no groundwater discharge zone (area = 780,000 ft^2; see Figure E6-6), the average chemical concentrations from the lower flow rate groundwater discharge zone were used.

E6.1.2.2 Groundwater Discharge Flow Rates

In each flow zone, loads were calculated for minimum, mean, and maximum groundwater flow rates to produce a range of loading estimates. The lower, central, and upper estimates of seepage flux rates for each flow zone (q_{lower}, $q_{central}$, and q_{upper}, in units of cm/day) were assigned based on the range of observed daily flux at each seepage meter within each zone. Seepage meter locations with negative average seepage rates (i.e., net recharge from the river to the groundwater) were included in the calculation of $q_{central}$ for each flow zone as a flux of 0 cm/d; however, the minimum q_{lower} estimate applied was 0.1 cm/day, recognizing the measurement accuracy of the Ultraseep seepage meters used in the study. Of the 29 flow zones identified offshore of the nine study sites, five did not include direct seepage meter measurements. Flow rates were applied to these five zones using professional judgment, based on flows in similar or adjacent zones.

Lower, central, and upper estimated seepage flux rates (q_{lower}, $q_{central}$, and q_{upper}) were converted to annual flow rates (Q_{lower}, $Q_{central}$, and Q_{upper} in ft^3/year) for each sample polygon area, according to the following equation:

$$Q\ (ft^3/year) = q\ (cm/day) \times A\ (ft^2) \times 0.03281 (ft/cm) \times 365\ (day/year).$$

Table E6-1 summarizes sample polygon areas, mean and maximum groundwater flow rates, and calculated groundwater discharge volumes.

E6.1.2.3 Upland Groundwater Plume Loading

Loading estimates were prepared for each polygon as the product of the flow rate and the concentration. Loading rates for each flow zone area were estimated by summing the estimated loads for each of the sample polygons within the flow zone, using the following general equation:

$$Load_{flowzone} = \Sigma(C_{sample}\ x\ A_{sample}\ x\ UnitFluxRate)$$

Where,

$Load_{flowzone}$ = the estimated annual mass loading to surface water, in units of mass per time

C_{sample} = the chemical concentration the TZW

A_{sample} = the area of the Thiessen polygon associated with the given sample

UnitFluxRate = measured groundwater-to-surface water seepage flux rate.

A range of loading estimates for each flow zone was determined by applying both the filtered and unfiltered concentrations to the calculations as well as the minimum, mean, and maximum measured seepage flux rates for the given flow zone. From the resulting six estimates, the range was determined by the central unfiltered estimate (upper load), the central filtered estimate (central load), and the minimum filtered estimate (lower load). The ranges of loading estimates for the Study Area were, in turn, generated by summing the estimates for each of the nine study sites.

E6.1.3 Upland Groundwater Plume Loading Results

The estimated ranges of upland groundwater plume annual loading offshore of individual sites, as well as at the Study Area scale (sum of all nine study sites), are presented in Table E6-2 for all upland groundwater plume loading ICs. These results are also presented graphically and discussed in Section 6.1.5 in the RI Report. Based on the calculations described above, a range of lower, central, and upper loading estimates for each analyte were generated for the minimum, mean, and maximum flow rate conditions for both filtered and unfiltered data.

E6.1.4 Uncertainty

The following sources of uncertainty are acknowledged in the upland groundwater plume loading estimates:

- The spatial resolution of the analysis is limited to the resolution of the sampling data sets, as reflected in the Thiessen polygon approach.
- There is no attempt made in these estimates to distinguish the origin of the chemicals in the TZW, and it is expected that the empirical TZW data set includes chemicals originating from sediment contamination (as assessed in the advective loading analysis in Section 6.1.6 of the RI Report and Section E6.2 of this appendix).
- The Groundwater Pathway Assessment study design specifically targeted areas of higher seepage and higher TZW concentrations for sampling in the areas offshore of the study sites.
- The TZW concentration estimates do not account for any additional chemical attenuation to sediments that may occur in the upper 38 cm bml.
- This assessment does not include loading from sites other than the nine study sites that may be discharging upland groundwater plume chemicals to the Study Area. As described in the site selection process (Appendix C2), the possibility that complete groundwater pathways will be identified in the future at other sites is acknowledged.
- Sampling was conducted during the hydrologic season of high expected groundwater flow rates to maximize the observed groundwater signal (plume

concentration and flow rate). Consequently, the lower end of the groundwater signal in the discharge areas is not captured in the empirical data set.

E6.2 GROUNDWATER DISCHARGE ADVECTIVE LOADING ESTIMATES

This section presents the estimation of loading of selected chemicals by the mechanism of groundwater advection through contaminated sediments. For the purposes of this analysis, groundwater advective loading is defined as the load resulting from chemicals partitioning from sediment solids into the dissolved phase, then migrating via groundwater advection to the surface sediments. Two advective loading terms are assessed in this section: 1) subsurface sediment advective loading, the loading from subsurface sediment (>30 cm bml) to surface sediment (<30 cm bml) via groundwater advection, and 2) surface sediment advective loading, the transport of chemicals from surface sediment (<30 cm bml) to surface water via groundwater advection. The former is assessed as an external loading mechanism to the Site, and the latter is assessed as a transport process within the Study Area. Because of the similar assumptions and approach taken to assess these terms, the calculation details are presented together in this section.

The approach and data sources used to estimate the groundwater advection loading terms for the sediment advective loading IC list (Table 6.0-1) are presented in the following subsections. The complete results are also presented. A discussion of these results is provided in the RI Report in Section 6.1.6.

E6.2.1 Approach

As described briefly in the RI Report Section 6.1.6, advective loads were estimated by first estimating pore water concentrations under an assumption of equilibrium, then applying an estimated groundwater advection rate to generate a mass loading estimate. For subsurface advective loading, the rate of chemical accumulation in surface sediment was subsequently estimated from the unit advective loading estimates. These calculations assume the condition of equilibrium in the sediment-pore water environment in all places at all times. These calculations also assume a uniform rate of groundwater advection through all sediments. As noted in the RI Report, it is recognized that these conditions do not reflect the heterogeneity of conditions throughout the Study Area; however, both of these assumptions are considered necessary to allow for development of semi-quantitative loading estimates for the entire Study Area.

Observed sediment concentrations form the basis for estimating pore water concentrations used in both surface and subsurface advective loading estimates. Prior to any calculations, Thiessen polygons were generated (with one polygon representing each sample) for all advective loading ICs from the surface and subsurface sediment data sets (data sets described in Appendix E6.2.2.1). A merged polygon set was generated by overlaying and combining the surface and subsurface polygon layers, resulting in a set of polygons each with a single subsurface and surface concentration to support calculations.

Calculations were performed for each polygon and summed to generate river-mile and Study Area-wide estimates. The following subsections describe the detailed steps taken to estimate pore water concentrations and advective flow rates.

E6.2.1.1 Pore Water Concentration Estimates

As described above, an assumption of equilibrium was made to estimate pore water concentration (C_{TZW}) from sediment concentration (C_{sed}). For the organic chemicals on the IC list, pore water concentrations were estimated from surface or subsurface sediment concentrations (for surface and subsurface advective loading estimates, respectively), the organic-carbon partitioning coefficient for the chemical (K_{oc}), and the fraction of organic carbon in the sediments (f_{oc}). This equilibrium relationship is described by the following:

$$C_{sed} = K_{oc} f_{oc} C_{TZW}$$

For metals, partitioning behavior is described by K_d values; therefore, pore water concentrations were estimated from sediment concentrations using the following expression:

$$C_{sed} = K_d C_{TZW}$$

Concentrations measured in sediments are bulk concentrations—they include both the mass of chemical associated with sediment and the mass associated with pore water in the overall sample. As a result, the measured bulk concentrations must be corrected to generate the sediment concentration (C_{sed}). This calculation requires the C_{TZW} value; therefore, an assumption of equilibrium is made in this step as well. The following equation relates the bulk sediment concentration to the concentration in the pore water and sediment (this equation is the same for both metal and organic ICs):

$$C_{bulk} = C_{sed} \cdot \frac{\%solids}{100} + C_{TZW} \cdot \left(1 - \frac{\%solids}{100}\right)$$

Replacing the C_{sed} term with the appropriate equilibrium partitioning relationship and solving for C_{TZW} produces the following equation for estimated pore water concentration for organic ICs:

$$C_{TZW} = \frac{C_{bulk}}{1 + \left(K_{oc} f_{oc} - 1\right) \cdot \frac{\%solids}{100}}$$

For metal ICs the following equation is generated by the same replacement step:

$$C_{TZW} = \frac{C_{bulk}}{1 + (K_d - 1)\frac{\%solids}{100}}$$

E6.2.1.2 Groundwater Advection Rate Estimates

As noted in Section 6.1.6 of the RI Report, the groundwater discharge rate estimate was generated by applying upland hydrogeologic data gathered for the Round 2 Report (Integral et al. 2007), applying Darcy's Law to generate an estimated total discharge rate to the river, and converting that discharge to a flux rate through the river sediment surface.

For the purposes of these loading calculations, groundwater was assumed to discharge uniformly through sediment over the entire Study Area, although it is known through direct seepage measurements that the groundwater discharge rate does vary spatially throughout the river. Because seepage measurements are not available for most of the Study Area, this assumption of uniformity is considered a reasonable approximation to support generation of a range of estimates for this loading term.

As part of the process for developing the Round 2 Report (Integral et al. 2007), the upland CSMs and CSM addenda were reviewed to generate the compilation of hydrogeologic information presented in Table E6-3. This table presents the following types of groundwater information gathered from the CSMs for each site:

- Number of wells
- Aquifer units present
- Groundwater flow direction
- Depth to groundwater
- Depth of the aquifer(s)
- Saturated thickness
- Horizontal gradient
- Vertical gradient
- Hydraulic conductivity
- Transmissivity
- Groundwater velocity.

Darcy's Law was used to generate an estimated groundwater discharge rate to the Study Area from the information gathered from the CSMs. Darcy's Law describes the relationship between groundwater flow rate (Q), the porosity of the medium, as

represented by the hydraulic conductivity (K), the hydraulic gradient ($\Delta h/\Delta l$), and the cross-sectional area (A) to the flow:

$$Q = -K*A*(\Delta h/\Delta l)$$

The unit flux (q) to the river can, in turn, be estimated as $q = Q/A_s$, where A_s is the cross-sectional area of the river sediment surface.

Therefore, to estimate the total groundwater flow rate (Q) to the river, a representative hydraulic conductivity and hydraulic gradient are needed. Additionally, the total cross-sectional area perpendicular to the groundwater flow and the sediment surface area are needed for the entire Study Area. Based on information presented in Table E6-3, unit flux values were generated for unconsolidated alluvium by multiplying the reported hydraulic conductivity by the reported hydraulic gradient. The resulting unit flux values ranged from 0.003 to 1.92 ft/day. Discarding the lowest and the highest values, the unit flux values ranged from 0.0625 to 0.15 ft/day, with an average of 0.10 ft/day.

The cross-sectional area of flow was assumed to cover both banks of the river over the complete 9.9 miles of the Study Area. The average saturated thickness was conservatively assumed to be 60 ft (saturated thickness, as reported in Table E6-3 varies from <1 to >60 ft [the full depth of the channel]). Consequently, the cross-sectional area was estimated to be:

$$9.9 \text{ miles} * 5{,}280 \text{ ft/mile} * 2 \text{ river banks} * 60 \text{ ft} = 6.3E6 \text{ ft}^2.$$

Multiplying the average unit flux by the total cross-sectional area produces a central estimate of total groundwater flow rate to the Study Area of 6.3E5 ft^3/day (7.3 cfs), with a lower estimate of 4.5 cfs and upper estimate of 11 cfs, corresponding to the lower and upper ranges of the upland hydraulic conductivity values.

To determine a unit volumetric flux rate of groundwater through the river sediments, the total groundwater discharge to the river must be divided by the area of the sediment surface. This value was approximated by the area of the sediment polygons representing the sediment concentration information over the Study Area. This area is 9.7E7 ft^2. The resulting estimated unit volumetric flux is 2.4 ft/year (0.20 cm/day), with a lower estimate of 1.5ft/year (0.12 cm/day) and an upper estimate of 3.6 ft/year (0.30 cm/day). This range was used to generate the range of loading estimates for the advective loading term.

The estimated groundwater discharge rate used in the advective loading calculations was compared with the flow rates observed by seepage meter measurements[23] as part of the groundwater plume loading estimates. The net discharge rates for flow zones evaluated at the TZW study sites ranged from 0.86 to 2.0 cm/day, with an average of 1.2 cm/day. Comparing these estimates to the range of values estimated for unit discharge for the

[23] The mean flow rates applied to the upland groundwater plume loading calculations were used in this comparison.

entire Study Area reveals that the Darcy's Law estimate range is roughly 15 percent of the unit discharge rate observed with seepage meters in the nearshore groundwater plume discharge areas. The selective placement of these seepage meters explains the disparity between the two ranges. In the design of the TZW study, seepage meters were purposefully placed at locations where there was an indication (based on pore water temperature measurements, sediment texture, or screening results) of higher flow rates. As such, the seepage meter measurements are expected to be biased high relative to an average unit discharge for the entire Study Area. Overall, the order-of-magnitude agreement between the unit flux rates developed using these two information sources offers confidence in the utility of the Darcy's Law-estimated rates.

E6.2.1.3 Advective Mass Loading Estimates

Advective loading estimates were generated from estimated pore water concentrations and groundwater flux rates for each polygon using the following equation:

$$Load_{polygon} = C_{TZW} \times A_{polygon} \times Q$$

Where,

C_{TZW} = the estimated chemical concentration in the pore water

$A_{polygon}$ = the area of the polygon

Q = the estimated annual groundwater flux rate.

For the surface sediment advective loading term, loading estimates were generated from these polygon loads by simply summing all of the polygons within the area of focus (river mile or Study Area). Note that for subsurface advective loading to surface sediments, not all polygons were summed to generate the resulting loading estimate. For chemicals migrating from subsurface pore water to result in increases in surface sediment concentrations, the pore water concentration in the subsurface interval must be greater than that in the surface interval (as estimated by equilibrium partitioning). As such, a comparison of f_{oc}-normalized sediment concentrations was made in the combined surface and subsurface polygon set. All subsurface polygons with f_{oc}-normalized sediment concentrations greater than f_{oc}-normalized sediment concentrations in the corresponding surface polygon were included in the summed loading estimate (for individual river miles and for the entire Study Area). Maps E6-1 and E6-2 indicate the polygon areas where subsurface sediment f_{oc}-normalized concentrations exceed surface sediment f_{oc}-normalized concentrations for total PCBs, total PCDD/Fs, total DDx, and total PAHs.[24] These chemical groups correspond to the four bounding IC groups discussed in detail in Section 5 of the RI Report. Table E6-4 summarizes the percent of the Study Area over

[24] These maps represent multi-component chemicals (i.e., total PCBs, DDx, PAHs, and PCDD/Fs). The polygons indicated as included in the subsurface loading assessment are those with at least one component of the given chemical group having higher OC-normalized concentration in the subsurface relative to the surface.

which subsurface advective loading was assessed (area where f_{oc}-normalized subsurface sediment concentration > f_{oc}-normalized surface sediment concentration) for each of the sediment advective loading IC chemicals. All advective mass loading estimates were generated as a range, including upper and lower estimates as well as a central estimate. The variation in these values is the result of application of the upper, lower, and primary equilibrium partitioning values to the calculations for each polygon, as well as application of the range of estimated groundwater advection rates.

The estimation of advective loading of multi-constituent analytical sums (e.g., total PCBs) was completed with an additional step to determine the loading associated with each component chemical of the analytical sum. For all analytical sums on the sediment advective IC list, polygon-by-polygon loads were calculated for each individual chemical constituent of the total, then summed to estimate the total loading. For total PCBs, the sum was calculated from chlorination-based homolog or Aroclor groups (not individual congeners). This subcomponent approach for summed ICs was taken to minimize the error that would be associated with an attempt to represent partitioning behavior of the entire group by a combined range of K_{oc} values.

E6.2.2 Data Sources

The sediment and partitioning coefficient data sources applied to the estimation of annual advective loading are described in the following subsections.

E6.2.2.1 Sediment Data

The RI data sets in the SCRA were the source of sediment concentration, density, and organic carbon content information used in these calculations. Sediment sampling locations at elevations below 13 ft NAVD88 were included in this analysis, in accordance with the definitions for the Study Area sediment data set. Additionally, all sediment samples from areas that have subsequently been dredged or capped were excluded from the data sets. From this resulting data set, unique Thiessen polygon sets of sediment data were generated for each IC for surface sediment data and subsurface sediment data over the entire Study Area (RM 1.9–11.8).[25]

For this analysis, surface sediment data were defined as sediment samples with upper and lower depth boundaries within the interval of 0 to 40 cm bml. For locations with multiple samples within this interval, the highest concentration for the given IC was taken as the representative sample.

[25] In order to provide maximum spatial resolution near the ends of the Study Area, Thiessen polygons were generated for all samples between RM 0 and 12.5. All Thiessen polygons were then trimmed to the standard Study Area definition (RM 1.9–11.8). There are a small number of sample locations (2 or less per analyte) that lie just beyond the extent of the Study Area which are used to populate the remaining portion of the Thiessen polygons within the Study Area. If the polygon crossed the Study Area boundary, data from the sample locations just beyond the Study Area boundary were used to populate the data set.

For this analysis, subsurface sediments were defined as all samples with an average depth (i.e., upper sampling depth plus lower sampling depth, divided by two) greater than 40 cm. For locations with multiple samples fitting this definition, the uppermost sample was designated as the subsurface sample for this analysis. The objective of this definition was to identify the sediment data set most representative of the sediment concentration immediately below the surface sediment interval. It is presumed that the concentrations in this interval are the best indicator of equilibrium pore water concentrations from the subsurface sediment that are loading to the surface sediment.

For sediment samples in the surface or subsurface data set with no reported f_{oc} values, f_{oc} values were assigned using spatial overlay and assignment of correlated values from the surface or subsurface total PCBs data set, which contained complete coverage of f_{oc} measurements. Where percent solids values were missing, the maximum percent solids values for the data set was applied. These areas are shown with cross-hatching on Maps E6-1 and E6-2. This assumption was made to err on the side of generating conservatively high estimates of concentration in pore water. Polygons missing percent solids data consisted of only 5 to 12 percent of the full data set, and this assumption is not expected to result in a significant impact on the final results. It should also be noted that sediment chemical concentrations reported as non-detect were assigned a value of zero for the purposes of these loading calculations.

For summed parameters (e.g., total DDx, total PCBs, etc.), Thiessen polygon sets were developed from the data set of summed parameters; however, concentrations of each subcomponent chemical were applied to the Thiessen set individually to allow for estimation of loading of each subcomponent and subsequent summing. For total PCBs, the Thiessen polygon set was generated from the set of sediment total PCB data, and the subcomponents were assigned first based on homolog data, if available (specifically, nine chlorination-based homolog groups were applied), and secondarily based on Aroclors, where homolog data were not available.

E6.2.2.2 Equilibrium Partitioning Coefficients

As described above, an assumption of equilibrium was made to estimate pore water concentrations (C_{TZW}) from sediment concentrations (C_{sed}). The approaches taken to compile partitioning coefficients for organic chemicals and metals on the IC list are described below.

E6.2.2.2.1 Organic ICs

Table E6-5 presents the compilation of octanol-water partition coefficients (K_{ow}) and organic carbon partitioning coefficients (K_{oc}) compiled for the estimation of surface and subsurface sediment advective loading. K_{ow} values describe the tendency of a chemical to partition between octanol and water. K_{oc} values describe the tendency of a chemical to partition between organic carbon (typically associated with solids) and water. Table E6-5 also presents summaries of primary values and ranges of K_{ow} and K_{oc} applied to the calculations. This section describes the steps taken to compile this table.

A literature search for K_{ow} values was conducted to compile partition coefficients. Ranges of both K_{oc} and K_{ow} values are reported widely in the scientific literature for many of the ICs to be assessed in the RI sediment advective loading analysis. For organic ICs in this analysis, K_{ow} values were compiled for conversion to K_{oc} values. K_{ow} values were chosen as the basis for K_{oc} values because they exhibit less inherent variability, as compared to K_{oc} values, since they describe the distribution of a chemical between two well-defined solutions (octanol and water). In contrast, organic carbon can vary widely in hydrophobicity, functional group content, and resulting partitioning behavior, resulting in a wide range of reported literature values for K_{oc}.

For each individual (non-summed) organic chemical on the sediment advective loading IC list (Table 6.0-1), a range of K_{ow} values was compiled from the following sources/tools, in accordance with the EPA Equilibrium Sediment Benchmarks (EPA ESB) documents for the protection of benthic organisms (e.g., EPA 2008g [tier 2 non-ionic organics], EPA 2003c [PAH mixtures]):

1. EPA ESB documents (EPA 2003a, EPA 2003b, EPA 2003c)
2. SPARC model[26] V4.2 (http://ibmlc2.chem.uga.edu/sparc) (SPARC 2009)
3. Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals (Mackay et al. 2006)[27]
4. Oak Ridge National Laboratory-Risk Assessment Information System (ORNL-RAIS) database (http://rais.ornl.gov/) (ORNL 2006)
5. ATSDR Toxicological Profiles[28] (http://www.atsdr.cdc.gov/toxpro2.html) (ATSDR 2006)
6. Other literature sources.[29]

Table E6-5 presents the K_{ow} data compiled from each of these sources.

For the purposes of this advective loading analysis, the upper and lower advective loading estimates are based on the maximum and minimum, respectively, K_{ow} values for

[26] The SPARC model numerically predicts K_{ow} values, and in addition, the model has a database of experimentally measured values; both values were compiled where available.

[27] Mackay et al. (2006) provide a range of K_{ow} values for many chemicals, as well as a selected value from this range for a subset of chemicals. In loading calculations, the range of K_{ow} values was used to determine the minimum and maximum K_{ow}. The selected value was used as the primary K_{ow} when available. When a selected K_{ow} value was not provided, the geometric mean of the minimum and maximum K_{ow} values was used as the primary K_{ow}.

[28] ATSDR Toxicological Profiles provide a range of K_{ow} values for many chemicals. In loading calculations, the range of K_{ow} value was used to determine the minimum and maximum K_{ow}. The geometric mean of the minimum and maximum K_{ow} values was used as the primary K_{ow}.

[29] For tributyltin ion, Aroclor 1262, and Aroclor 1268, K_{ow} data were not available from the primary sources. The EPA KowWIN software (EPA Estimation Program Interface [EPI], http://www.epa.gov/oppt/exposure/pubs/episuite.htm) and the literature source (Arnold et al. 1997) were used to generate K_{ow} values for tributyltin ion. The K_{ow} values for Aroclor 1260 were used in loading calculations for Aroclor 1262 and Aroclor 1268.

all of the compiled sources listed above. Prior to selection of the minimum and maximum values, the compiled set of K_{ow} values was analyzed for the presence of high or low outlying values. This analysis involved calculating the logarithm of the K_{ow} values, then plotting log K_{ow} on box-and-whisker plots. Values were identified as outliers on the box-and-whisker plots using standard metrics[30]. Outlying values were excluded from the determination of the minimum and maximum K_{ow} values.

Primary K_{ow} values are used for calculating the central estimates of annual advective loading. These are also the values that will be applied to the Fate and Transport Model (an RI/FS support product currently in development to be presented in the Final RI). These primary values were selected from the compiled data set following the order of preference listed above (i.e., if ESB values were available, those were used; if not, SPARC values were used). For PCBs only, Mackay et al. (2006) was considered the preferred reference.[31] All primary values for PCBs (congeners, homologs, and Aroclors) were calculated as the geometric mean of the minimum and maximum Mackay et al. (2006) values with outliers excluded.

For summed parameters including PCB TEQ, total PAHs, total carcinogenic PAHs, total PCDD/Fs, TCDD TEQ, total DDx, and total chlordanes, ranges of K_{ow} values were compiled from the SPARC model and Mackay et al. (2006) for subcomponents (individual chemicals) of the summed total. This approach is expected to provide more accurate loading estimates, as compared to simple application of a single range of K_{oc} values to a group of chemicals, because many of these chemical groups contain chemicals with a large range of partitioning behavior and associated K_{ow} values. For total PCBs measured as congeners, a range of K_{ow} values for the ten isomer homologs was compiled from Mackay et al. (2006). For total PCBs measured as Aroclors, K_{ow} values for the nine Aroclor groups detected in the Study Area were also compiled from Mackay et al. (2006).

To assess partitioning between water and organic matter in the Study Area, the K_{ow} values tabulated in Table E6-5 were utilized to calculate K_{oc} values using the equation provided in DiToro et al. (1991):

$$\log_{10} K_{oc} = 0.00028 + \log_{10} K_{ow} \times 0.983$$

The literature contains many K_{ow}-K_{oc} conversion equations (e.g., Gawlik et al. [1997] compiled 76 of these relationships). However, EPA found that the DiToro equation was

[30] The box-and-whisker plots are created such that the central line is the median, and the lower and upper bounds of the box are the 25th and 75th-percentiles. Outliers are defined as values that are greater than the sum of the upper 75th percentile and 1.5 times the inter-quartile range, and less than 25th percentile minus 1.5 times the inter-quartile range.

[31] The use of Mackay and Shiu (2006) as the preferred source for PCB congener K_{ow} values was based on comments from EPA on the Round 2 Report. Mackay and Shiu (2006) provide tables of K_{ow} for a selection of analytes (e.g., approximately 50 of the PCB congeners); in addition, for each compound included, a compilation of published K_{ow} values is provided.

subject to less uncertainty than other equations (EPA 2003c). Resulting K_{oc} values are presented in Table E6-5.

E6.2.2.2.2 Metal ICs

Table E6-6 presents a compilation of log K_d values for use in the surface and subsurface sediment advective loading calculations. Because metals partitioning behavior is not simply a hydrophobic mechanism, K_d values must be applied to the equation. Metal partitioning can be strongly affected by solution chemistry (for example, pH, the presence of dissolved ligands such as Cl^- or dissolved organic matter, and redox state) and by the characteristics of the sediment itself (for example, the presence of ion-exchange sites on minerals, the lability of complexation sites on sediment organic matter). These K_d values were selected from an EPA compilation of metals partitioning coefficients (EPA 2005b). The K_d values selected are specific for the partitioning of metals between sediment and pore water. This compilation provided both estimates of central tendency (mean and median) and a range of values. For these calculations the mean, minimum, and maximum K_d values were used for generation of the ranges of advective loading estimates.

E6.2.3 Groundwater Discharge Advective Loading Results

Lower, central, and upper range estimates of surface sediment advective annual loading to surface water are presented in Table E6-7 for the entire Study Area and by river mile for the sediment advective loading IC list. Lower, central, and upper range estimates of subsurface sediment advective annual loading to surface sediment are presented in Table E6-8 for the entire Study Area and by river mile. These results are discussed in Section 6.1.6 and in Section 10.

E6.2.4 Uncertainty

There is significant uncertainty associated with the advective loading estimates related to applied assumptions (i.e., equilibrium behavior of all ICs and uniform groundwater discharge rates), as well as the data sets used in the calculations (i.e., literature equilibrium partitioning coefficients, and roughly estimated groundwater discharge rates).

Related to equilibrium, the primary uncertainty is the assumption of equilibrium in all parts of the sediment/pore water environment at all times. This calculation fails to capture the sorption-desorption-resorption dynamics that occur in advective transport through sediment. Beyond the assumption of equilibrium, it should be noted that the site organic carbon associated with sediments may differ in character from that defined by the range of literature K_{oc} values. Further, this assessment ignores any chemical or biological transformation processes that may occur in the migration process.

Related to the groundwater advection annual loading estimates, there are a number of significant uncertainties. First, they are based on the limited available upland data and not on groundwater modeling of the area or direct measurement of seepage rates

representative of the entire Study Area (though they compared reasonably to the limited set of seepage measurements taken in the system). Second, the groundwater advection load estimates rely on a simple and conservatively high cross-sectional area. Third, the advection load estimates apply a projection of the sediment surface area to represent the actual sediment surface area (thereby increasing the unit discharge estimate). Finally, the assumption of a constant discharge rate fails to capture the variability in discharge rates that is expected but not quantified across the Study Area.

E7.0 RIVERBANK EROSION

No quantitative estimation of the loading of chemicals to the in-water portion of the Study Area from bank erosion is performed in this RI, per agreement with EPA, Region 10, as discussed in Section 6.1.7 of the RI Report. Information provided in Section 6.1.7 supports EPA's position that riverbank loading estimates may be derived as part of future site-specific remedial design investigations.

The LWG has reviewed multiple sources of information to identify bank soil chemistry data sets. These efforts included review of individual site summaries, summarization of beach and/or bank data collected by the LWG through 2007, and inquiry with DEQ for specific relevant site information. The data found to date are summarized in Table E7-1, and a detailed data flat file compiled for several sites is delivered electronically with this document (Attachment E-3). Map E7-1 presents the bank soil sampling locations sampled to date relative to the bank categories described in Section 6.1.7 of the RI Report.

REFERENCES

Anchor. 2008. Offshore Investigation Report, NW Natural "Gasco" Site. Anchor Environmental, L.L.C., Seattle, WA. February, 2008.

Anchor and Integral. 2007a. Portland Harbor RI/FS Round 3A Field Sampling Plan, Stormwater Sampling. Anchor Environmental, L.L.C., Seattle, WA and Integral Consulting Inc., Mercer Island, WA. March 1, 2007a.

Anchor and Integral. 2007b. Round 3A Stormwater Field Sampling Plan Addendum. Prepared for the Lower Willamette Group, Portland, OR. Anchor Environmental, L.L.C., Seattle, WA and Integral Consulting Inc., Mercer Island, WA. November 9, 2007b.

Anchor and Integral. 2007c. Round 3A Stormwater Sampling Rationale (SSR). Prepared for the Lower Willamette Group, Portland, OR. Anchor Environmental L.L.C., Seattle, WA and Integral Consulting Inc., Mercer Island, WA. March 1, 2007c.

Anchor and Integral. 2007d. Round 3A Upland Stormwater Sampling Field Sampling Report. Prepared for the Lower Willamette Group, Portland, OR. Anchor Environmental, Seattle, WA. November 30, 2007d.

Anchor and Integral. 2008. In Prep. Round 3A Upland Stormwater Sampling Field Sampling Report Addendum. Prepared for the Lower Willamette Group. Anchor Environmental, Seattle, WA.

Arnold, C.G., A. Weidenhaupt, M.M. David, S.R. Muller, S.B. Haderlein, and R.P. Schwarzenbach. 1997. Aqueous Speciation and 1-Octanol-Water Partitioning of Tributyl- and Triphenyltin: Effect of PH and Ion Composition. *Environ.Sci.Tech.* 31(9):2596-2602.

ATSDR. 2002a. Toxicological Profile for Aldrin/Dieldrin. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Atlanta, GA.

ATSDR. 2002b. Toxicological Profile for DDT, DDE, and DDD. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Atlanta, GA.

ATSDR. 2006. Finalized toxicological profiles. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Atlanta, GA. Accessed March 1,2006. http://www.atsdr.cdc.gov/.

ATSDR. 2008. Toxicological Profile for Chromium; Draft for Public Comment. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Atlanta, GA. September, 2008.

Bidleman, T.F. 1988. Atmospheric Processes: Wet and Dry Deposition of Organic Compounds Are Controlled by Their Vapor-Particle Partitioning. *Environ.Sci.Tech.* 22:361-367.

CARB. 2004. California Ambient Dioxin Air Monitoring Program (CADAMP), 2004 Results. California Air Resources Board, Sacramento, CA.

City of Portland. 2008. Personal communication (memorandum to C. Stivers regarding Portland Harbor stormwater runoff modeling). M. Liebe, BES - Systems Analysis, City of Portland, Portland, OR.

DEQ. 2006. Laboratory analytical storage and retrieval (LASAR) website, version 1.33. Oregon Department of Environmental Quality, Portland, OR. Accessed March,2009. http://www.deq.state.or.us/wq/lasar/LasarHome.htm.

DiToro, D.M., C.S. Zarba, D.J. Hansen, W.J. Berry, R.C. Swartz, C.E. Cowan, S.P. Pavlou, H.E. Allen, N.A. Thomas, and P.R. Paquin. 1991. Technical Basis for the Equilibrium Partitioning Method for Establishing Sediment Quality Criteria. *Environmental Toxicology and Chemistry* 12(10):1541-1583.

EPA. 1996. NATA Modeled Ambient Concentrations. U.S. Environmental Protection Agency, Washington, DC.

EPA. 2003a. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Dieldrin. EPA/600/R-02/010. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

EPA. 2003b. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver, and Zinc). EPA-600-R-02-011. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

EPA. 2003c. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

EPA. 2005a. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA530-R-05-006. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. September, 2005a.

EPA. 2005b. Partition Coefficients for Metals in Surface Water, Soil and Waste. EPA/600/R-05/074. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

EPA. 2008a. 1996 National-Scale Air Toxics Assessment (NATA) Monitored Ambient Concentrations. U.S. Environmental Protection Agency, Washington, DC. http://earth1.epa.gov/ttn/atw/nata/montcomp.html.

EPA. 2008b. EPA aerometric information retrieval system (AIRS). U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC. Accessed April,2008b. http://www.epa.gov/enviro/html/airs/index.html.

EPA. 2008c. EPA Clean Air Status and Trends Network (CASTNET). U.S. Environmental Protection Agency, Washington, DC. Accessed May,2008c. http://www.epa.gov/castnet/.

EPA. 2008d. EPA National Air Deposition Program (NADP). U.S. Environmental Protection Agency, Washington, DC. Accessed May,2008d. http://nadp.sws.uiuc.edu/nadpdata/state.asp?state=OR.

EPA. 2008e. National Dioxin Air Monitoring Network (NDAMN). U.S. Environmental Protection Agency, Washington, DC. Accessed May,2008e.

EPA. 2008f. Portland Harbor Superfund Site; Administrative Order on Consent for Remedial Investigation and Feasibility Study; Docket No. CERCLA-10-2001-0240. Status of Round 3 Sampling Activities Letter. U.S. Environmental Protection Agency, Washington, DC.

EPA. 2008g. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Compendium of Tier 2 Values for Nonionic Organics. EPA-600-R-02-016. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

Franz, T.P., S.J. Eisenreich, and T.M. Holson. 1998. Dry Deposition of Particulate Polychlorinated Biphenyls and Polycyclic Aromatic Hydrocarbons to Lake Michigan. *Environ.Sci.Tech.* 32:3681-3688.

Gawlik, B.M., N. Sotiriou, E.A. Feicht, S. Schulte-Hostede, and A. Kettrup. 1997. Alternatives for the Determination of the Soiil Adsorption Coefficient, KOC, of Non-Ionicorganic Compounds - a Review. *Chemosphere* 34(12):2525-2551.

Hahn and Associates. 2005. Updated Phase I Site Characterization Summary Report. Prepared for NW Natural, Portland, OR. Hahn and Associates, Inc., Portland, OR. July 22, 2005.

Hope. 2005. A Mass Budget for Mercury in the Willamette River Basin, Oregon, USA. *Water, Air, and Soil Pollution* 161:365-382.

Integral. 2007. Portland Harbor RI/FS Round 2 Quality Assurance Project Plan Addendum 8: Round 3A Stormwater Sampling. IC07-0003. Integral Consulting Inc., Mercer Island, WA.

Integral, Windward, Kennedy/Jenks, and Anchor. 2007. Portland Harbor RI/FS Round 2 Comprehensive Site Characterization Summary and Data Gaps Analysis Report. IC07-0004. Prepared for the Lower Willamette Group, Portland OR. Integral Consulting Inc., Mercer Island, WA; Windward Environmental LLC, Seattle, WA; Kennedy/Jenks Consultants, Portland, OR; Anchor Environmental L.L.C., Seattle, WA.

Kennedy/Jenks, Integral, and Windward. 2004. Portland Harbor RI/FS Technical Memorandum: Guidelines for Data Reporting, Data Averaging, and Treatment of Non-Detected Values for Round 1 Database. In: Round 1 Site Characterization Data Report (Appendix A). Prepared for the Lower Willamette Group, Portland, OR. Kennedy/Jenks Consultants, Portland, OR; Integral Consulting Inc., Mercer Island, WA; Windward Environmental, LLC, Seattle, WA. June 25, 2004.

Koch, K., C. Stivers, L. Jones, D. Sanders, L. Scheffler, A. Koulermos, and K. Tarnow. 2006. Personal communication (dated December 13, 2006 regarding framework for collecting stormwater data to support the Portland Harbor RI/FS). The Lower Willamette Group, Portland, OR.

Mackay, D., W.Y. Shiu, K.C. Ma, and S.C. Lee. 2006. *Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals*. Second Edition. CRC Press, Boca Raton, FL.

MFA. 2005. Results of In-River Sediment and Groundwater Investigation. Prepared for Siltronic Corporation. Maul Foster and Alongi, Inc., Portland, OR.

MWH. 2008. Draft Results for PCBs in Precipitation in Portland Area. MWH Americas Inc., Portland, OR. July, 2008.

NPS. 2008. National Park Services monitoring networks. http://science.nature.nps.gov/im/inventory/airquality/index.cfm.

ORNL. 2006. ORNL risk assessment information system, online searchable database. Oak Ridge National Laboratory, Oak Ridge, TN. Accessed August 2,2006. http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_select?select=csf.

Poster, D.L. and J.E. Baker. 1996. Influence of Submicron Particles on Hydrophobic Organic Contaminants in Precipitation: 2. Scavenging of Polycyclic Aromatic Hydrocarbons by Rain. *Environ.Sci.Tech.* 30:349-354.

Reinfelder, R.R., L.A. Totten, and S.J. Eisenreich. 2004. The New Jersey Atmospheric Deposition Network. Final Report. Prepared for the New Jersey Department of Environmental Protection, Trenton, NJ. Department of Environmental Sciences, Rutgers University, New Brunswick, NJ. January, 2004.

Schueler, T. 1987. Controlling Urban Runoff: a Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments, Washington, DC.

Seinfeld, J.H. and S.N. Pandis. 1998. *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*. Wiley, New York.

SPARC. 2009. SPARC (Sparc Performs Automated Reasoning in Chemistry). University of Georgia, Athens, GA. http://ibmlc2.chem.uga.edu/sparc.

USFS. 2008. Interagency Monitoring of Protected Visual Environments (IMPROVE) online data. U.S. Forest Service Pacific Northwest Region, Portland, OR. Accessed April,2008. http://www.fs.fed.us/r6/aq/imprdata.htm.

Wesley, M.L. and B.B. Hicks. 2000. A Review of the Current Status of Knowledge on Dry Deposition. *Atmosph.Environ.* 34:2261-2282.

WEST. 2006. Draft Technical Memorandum: Hydrodynamic Modeling for the Lower Willamette River, Evaluation of Flows in Multnomah Channel. WEST Consultants, Inc., Bellevue, WA. June 14, 2006.

Zufall, M.J., C.I. Davidson, P.F. Calffrey, and J.M. Ondov. 1998. *Environ.Sci.Tech.* 32:1621-1628.

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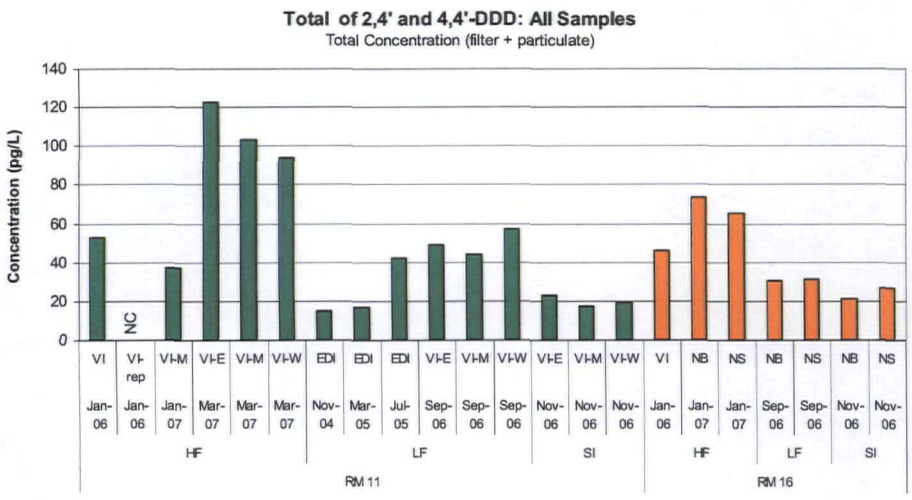

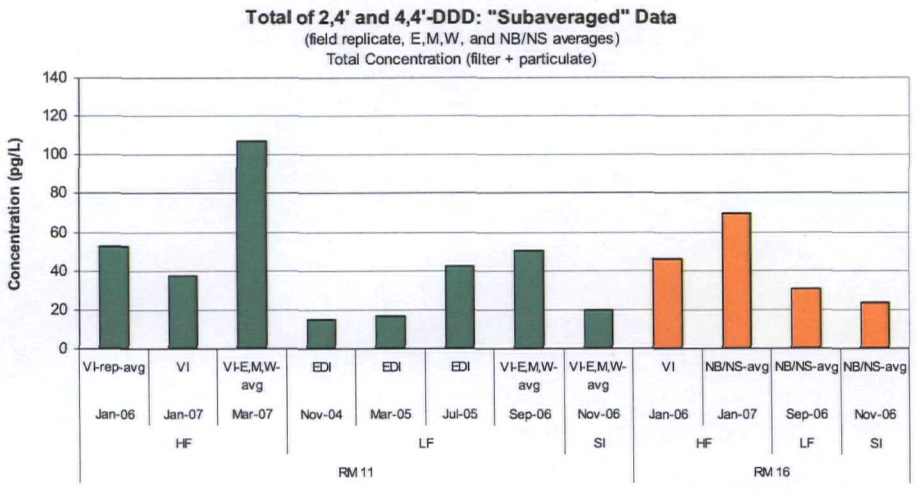

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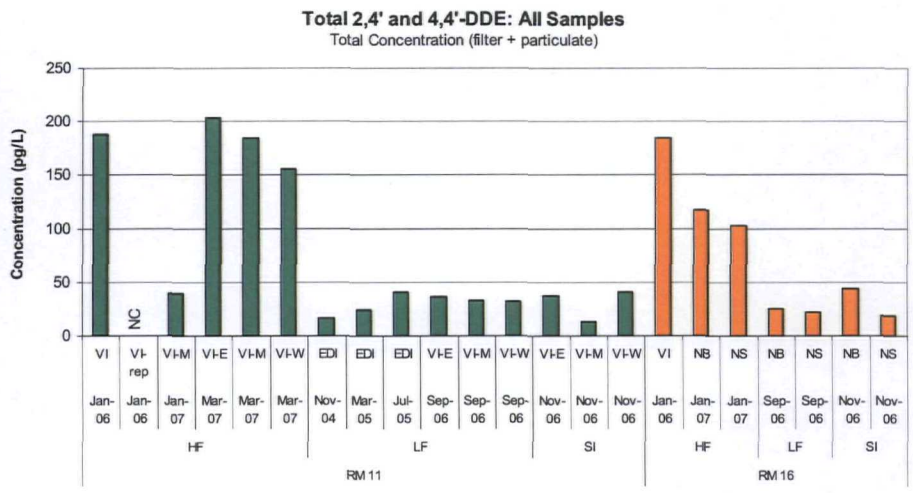

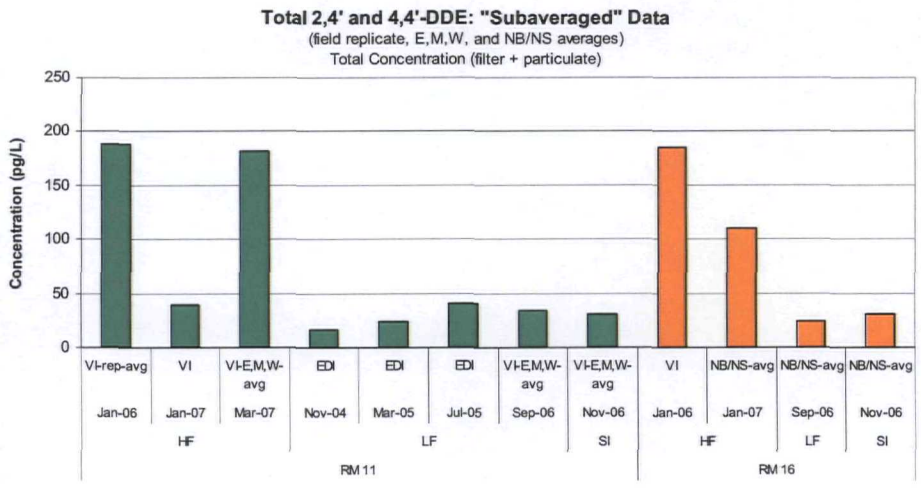

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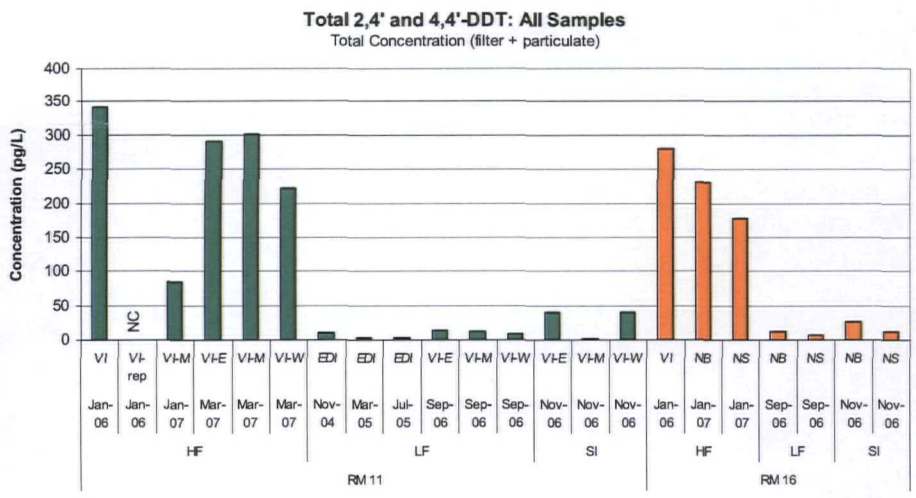

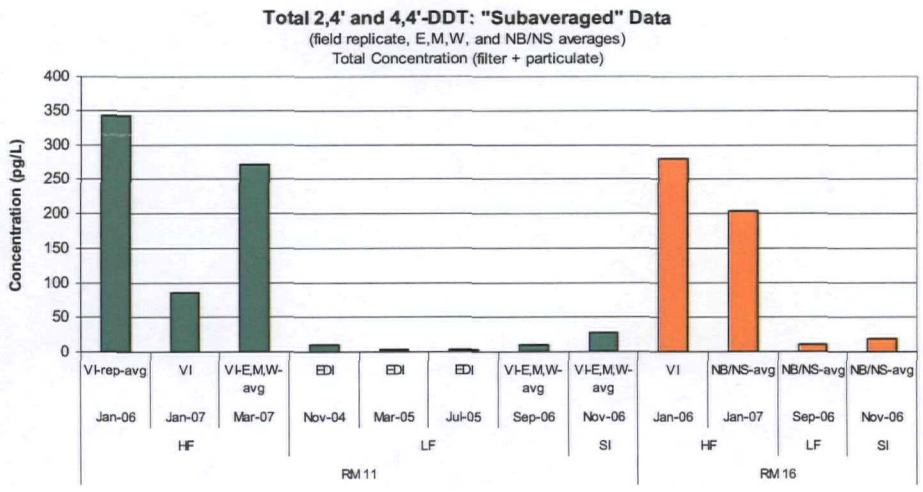

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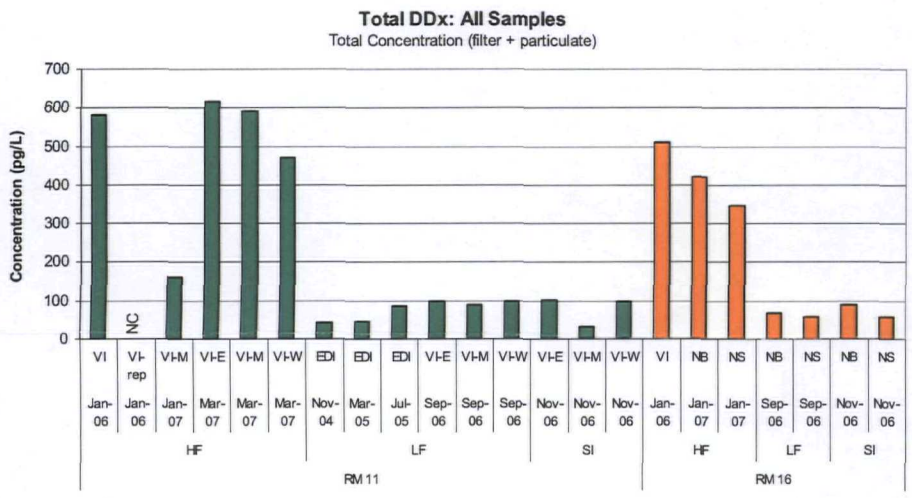

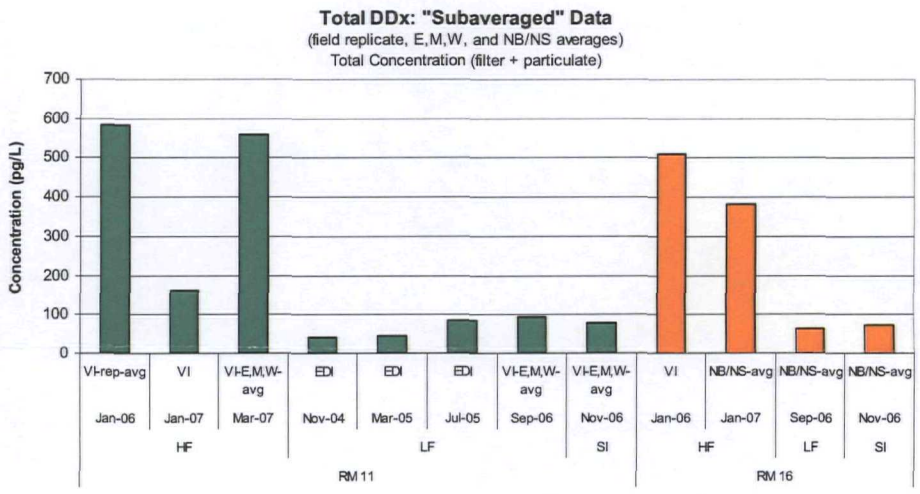

Event Type	Data Descriptor	Sample Collection Methods	
LF: Low Flow (<50 000 cfs)	NC: No sample collected	VI: Vertically Integrated Sampling	EDI: Equal-Discharge-Increment integrated sample
HF: High Flow (>50 000 cfs)	ND: Below detection limit, set to zero prior to any calculations	M: Vertically Integrated, collected mid-river	NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
SI: Low Flow-Stormwater Influenced (<50 000 cfs)		E: Vertically Integrated, collected east side of river	NS: Discharge-weighted horizontally integrated sample, collected near-surface of river
		W: Vertically Integrated, collected west side of river	

Note: Plots present data collected with XAD-column sampling method.

Figure E2-1
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
DDx Pesticides (Summed Parameters)

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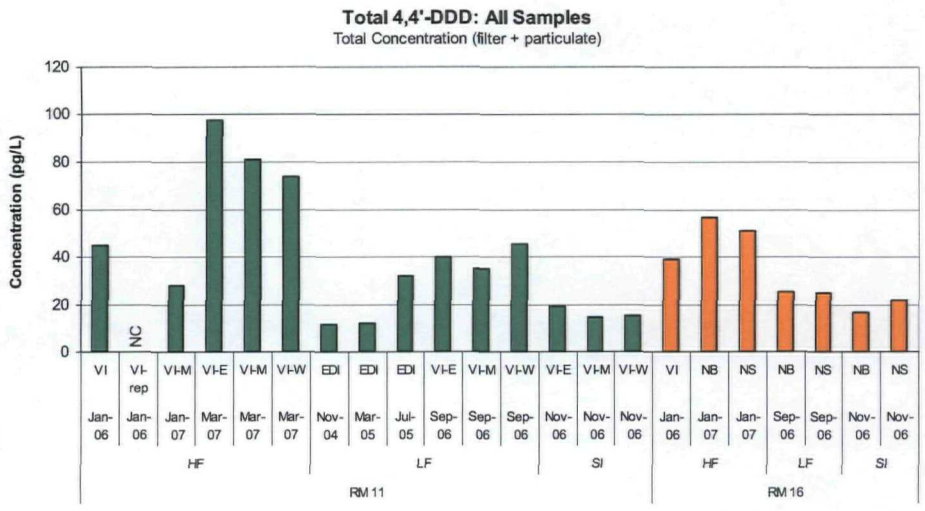
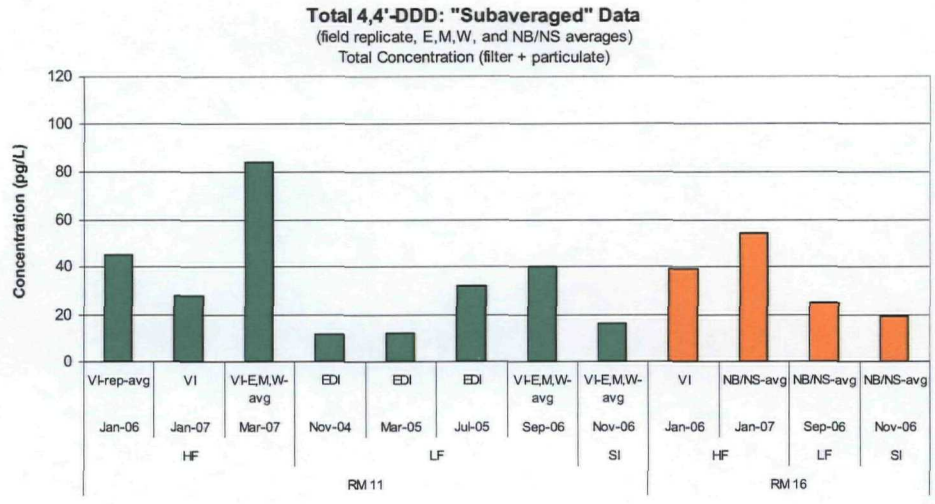
4,4'-DDD





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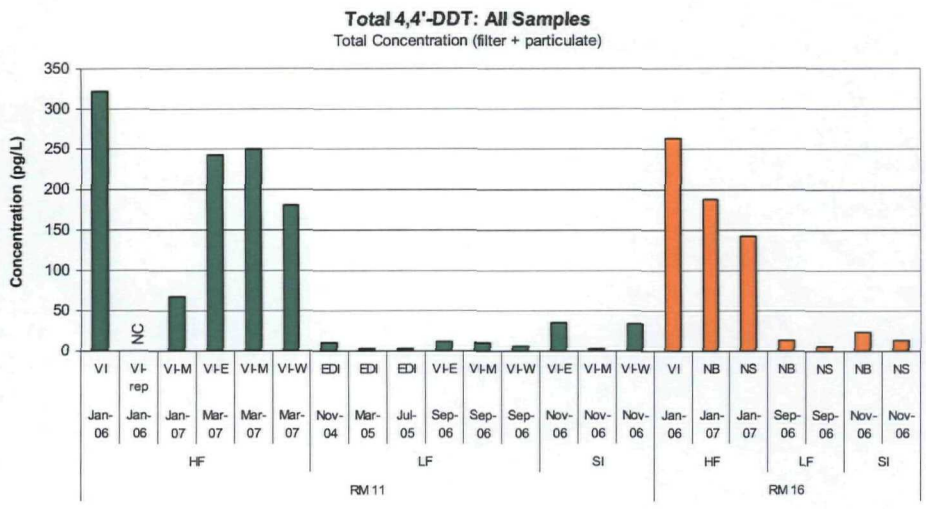

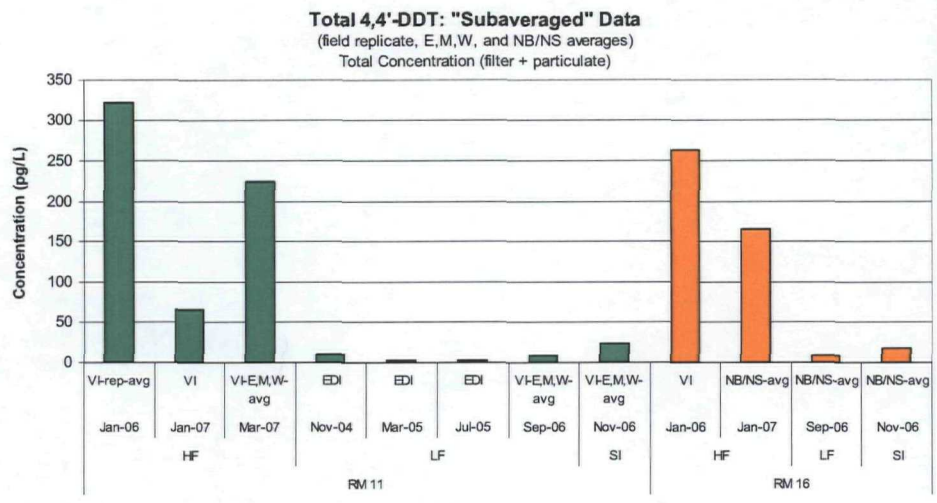

Event Type	Data Descriptor	Sample Collection Methods	
LF: Low Flow (<50 000 cfs)	NC: No sample collected	VI: Vertically Integrated Sampling	EDI: Equal-Discharge-Increment integrated sample
HF: High Flow (>50 000 cfs)	ND: Below detection limit, set to zero prior to any calculations	M: Vertically Integrated, collected mid-river	NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
SI: Low Flow-Stormwater Influenced (<50 000 cfs)		E: Vertically Integrated, collected east side of river	NS: Discharge-weighted horizontally integrated sample, collected near-surface of river
		W: Vertically Integrated, collected west side of river	

Note: Plots present data collected with XAD-column sampling method.

Figure E2-2
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
DDx Pesticides (4,4'-DDD and 4,4'-DDT)

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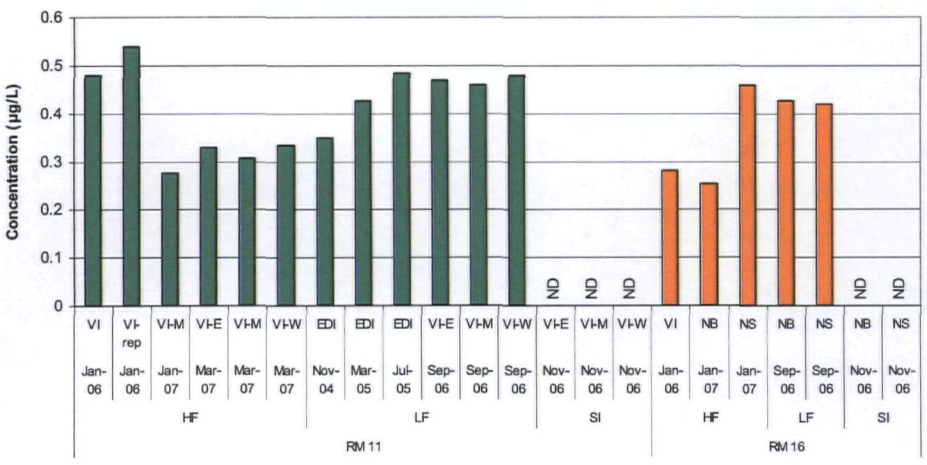
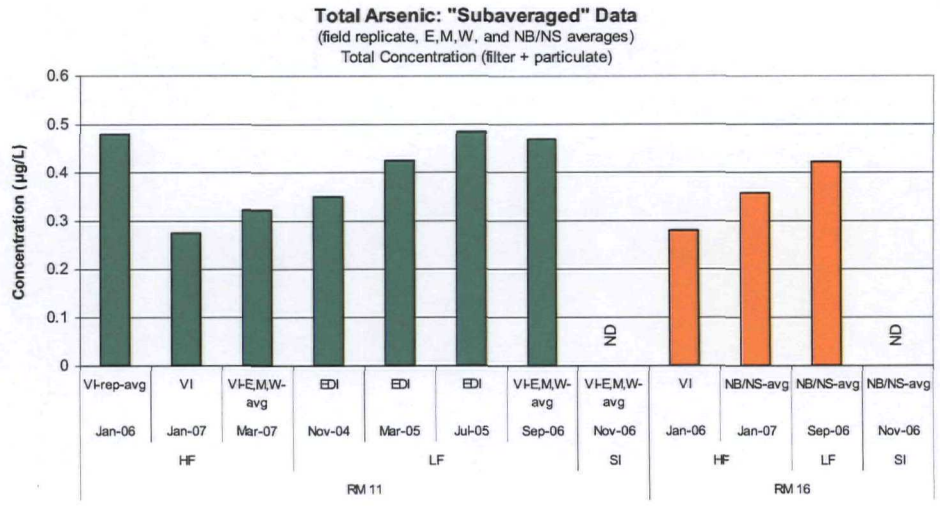
Arsenic





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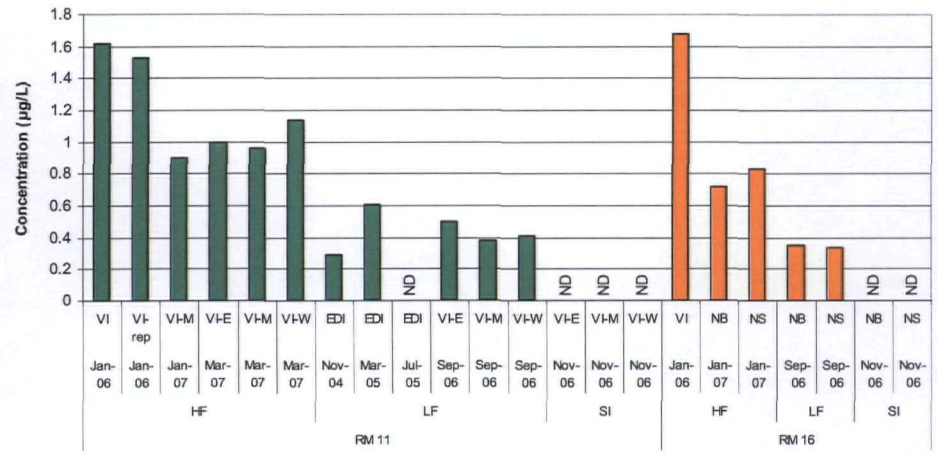

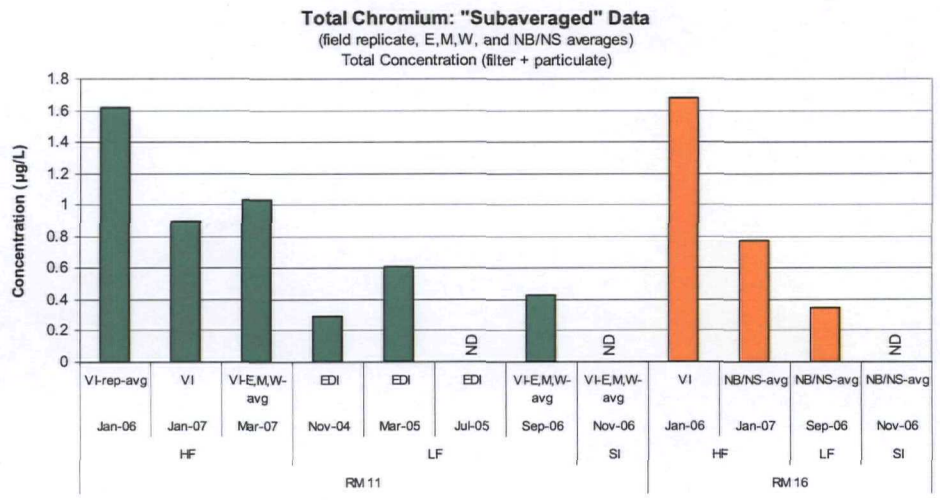

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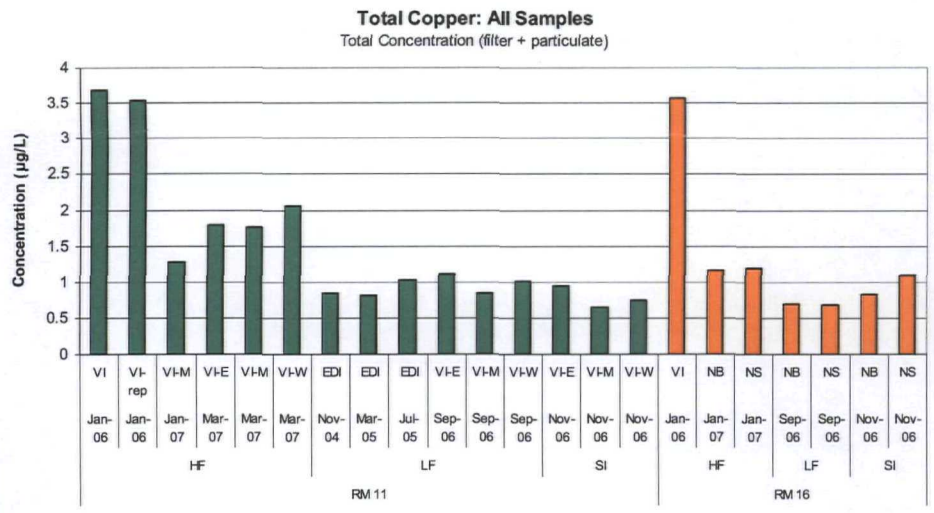

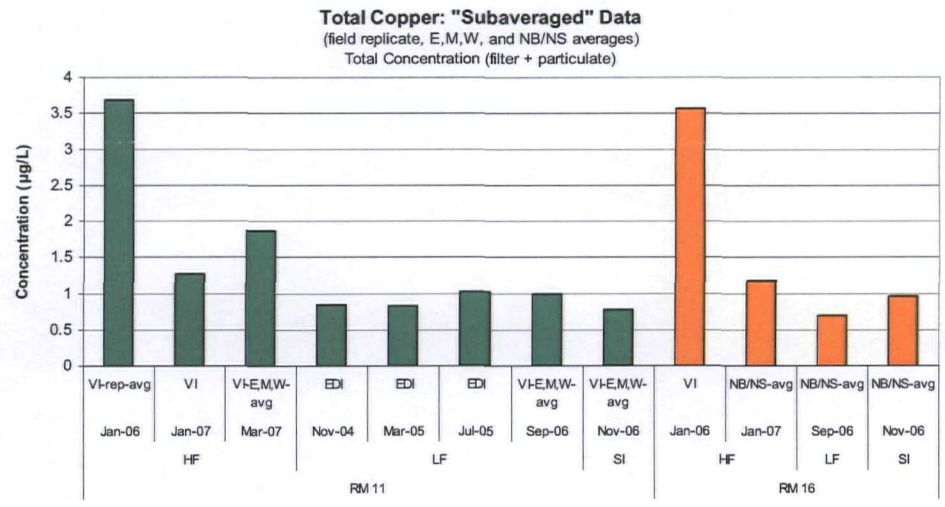

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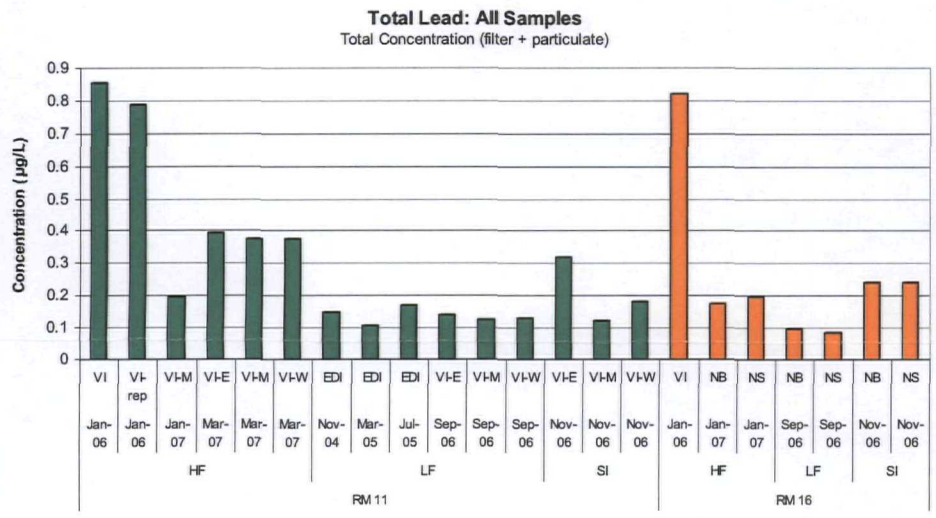

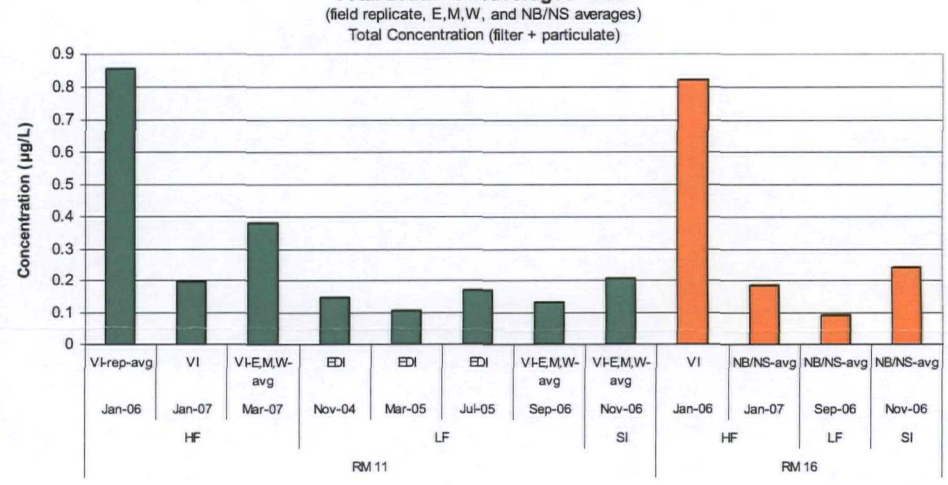

Event Type	Data Descriptor	Sample Collection Methods	
LF: Low Flow (<50 000 cfs)	NC: No sample collected	VI: Vertically Integrated Sampling	EDI: Equal-Discharge-Increment integrated sample
HF: High Flow (>50 000 cfs)	ND: Below detection limit, set to zero prior to any calculations	M: Vertically Integrated, collected mid-river	NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
SI: Low Flow-Stormwater Influenced (<50 000 cfs)		E: Vertically Integrated, collected east side of river	NS: Discharge-weighted horizontally integrated sample, collected near-surface of river
		W: Vertically Integrated, collected west side of river	

Note: Plots present data collected with Peristaltic sampling method.

Figure E2-3
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
Metals (As, Cr, Cu, Pb)

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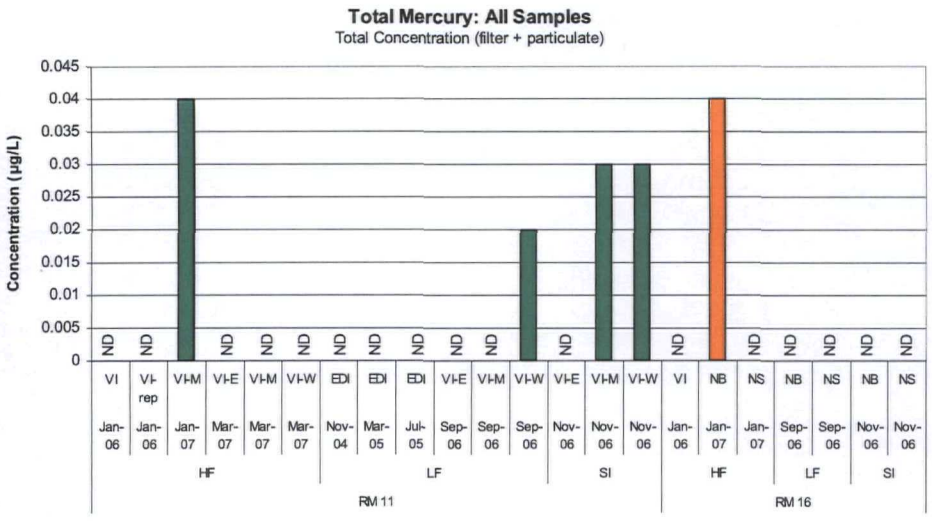
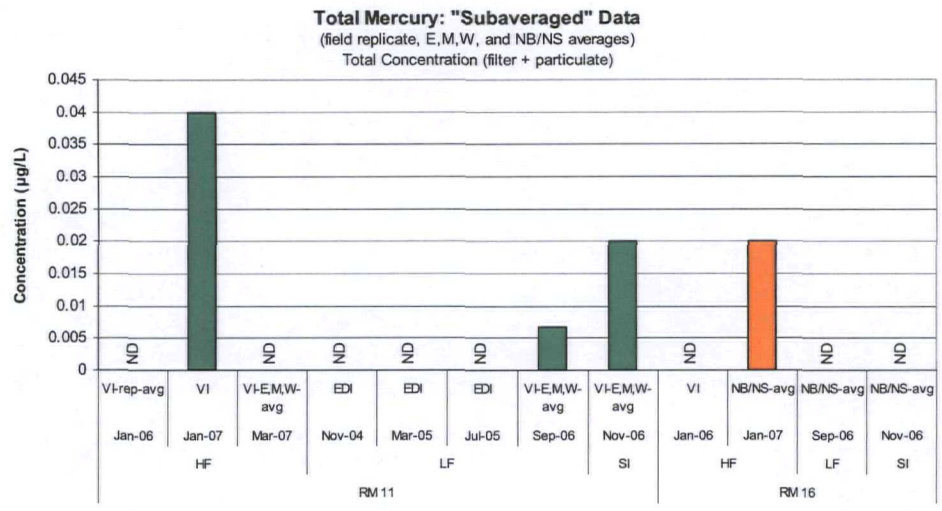
Mercury





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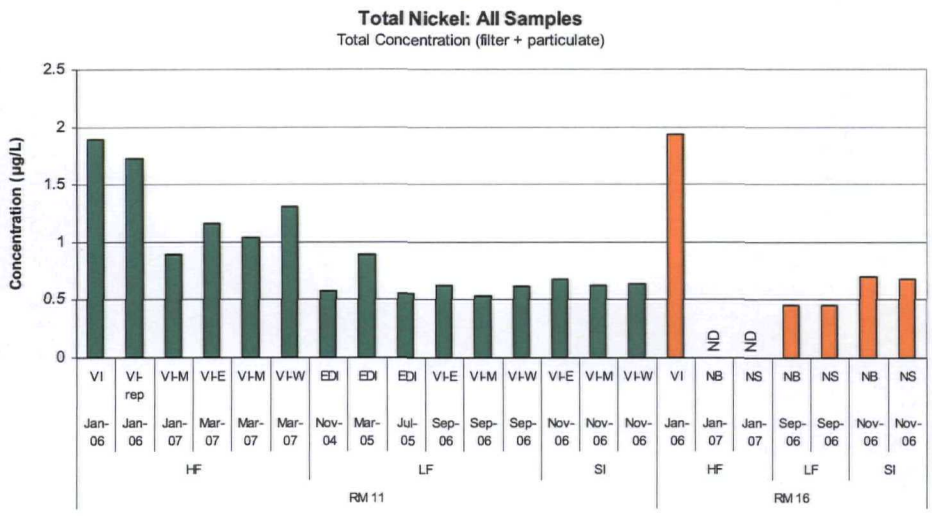

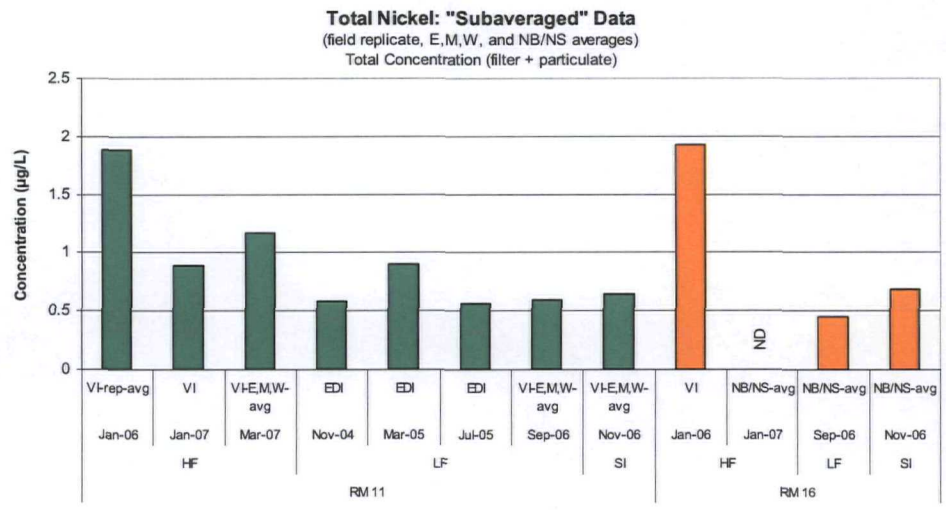

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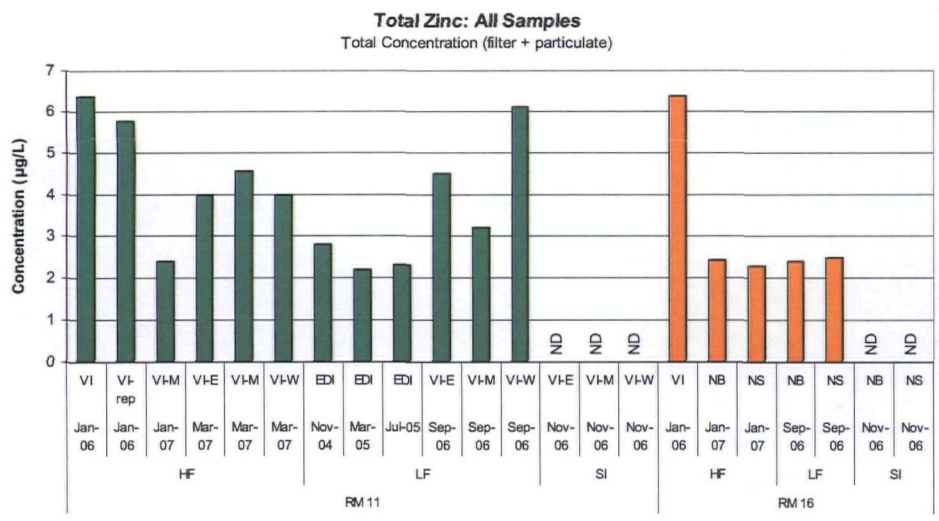

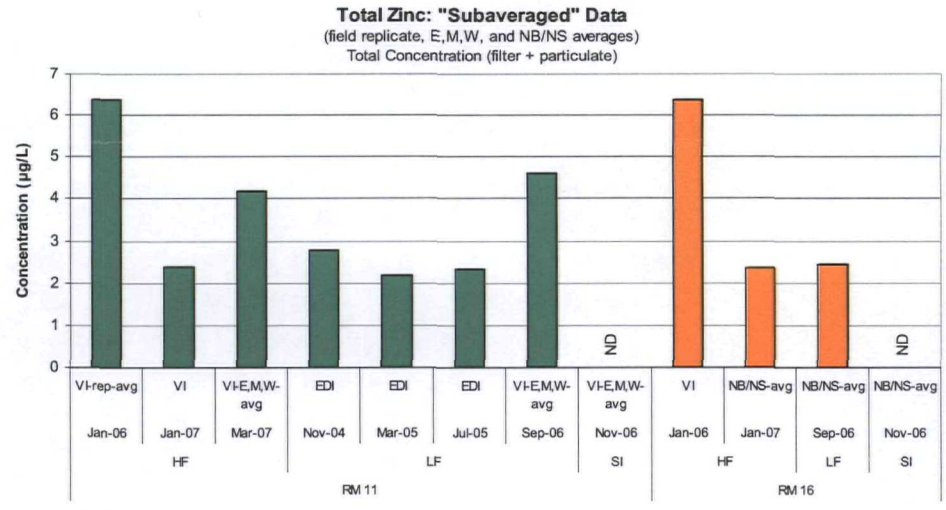

Event Type	Data Descriptor
LF: Low Flow (<50 000 cfs)	NC: No sample collected
HF: High Flow (>50 000 cfs)	ND: Below detection limit, set to zero prior to any calculations
SI: Low Flow-Stormwater Influenced (<50 000 cfs)	

Note: Plots present data collected with Peristaltic sampling method.

Sample Collection Methods

- VI: Vertically Integrated Sampling
- M: Vertically Integrated, collected mid-river
- E: Vertically Integrated, collected east side of river
- W: Vertically Integrated, collected west side of river
- EDI: Equal-Discharge-Increment integrated sample
- NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
- NS: Discharge-weighted horizontally integrated sample, collected near-surface of river

Figure E2-4
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
Metals (Hg, Ni, Zn)

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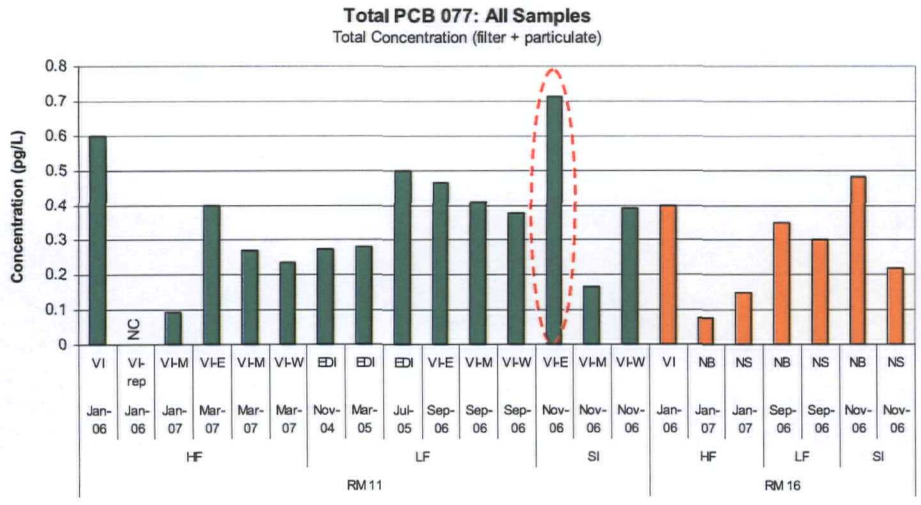
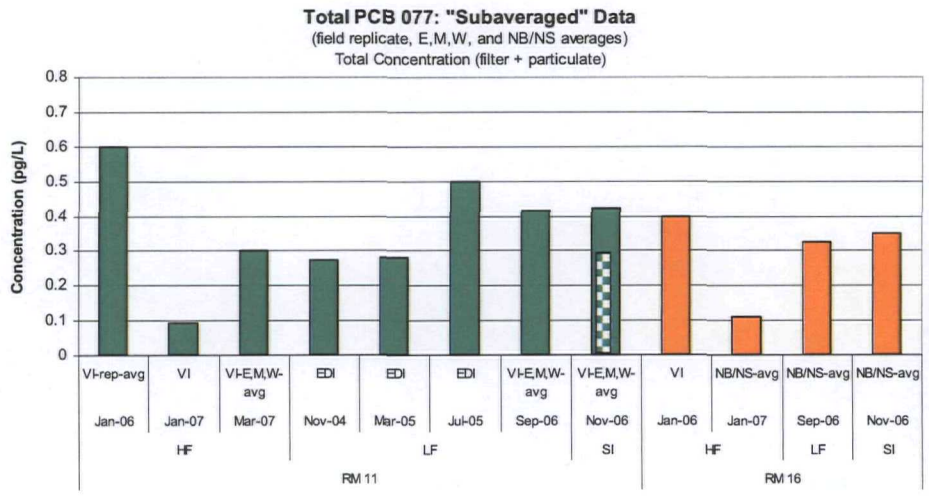
PCB 077





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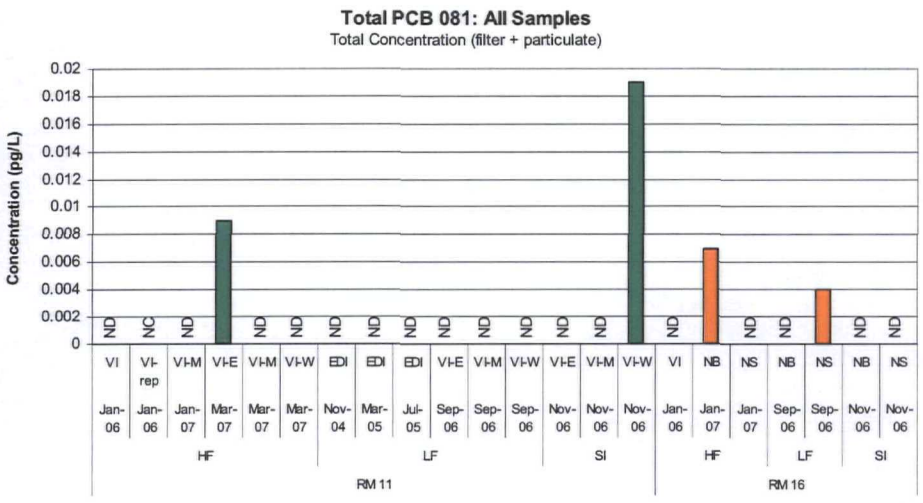

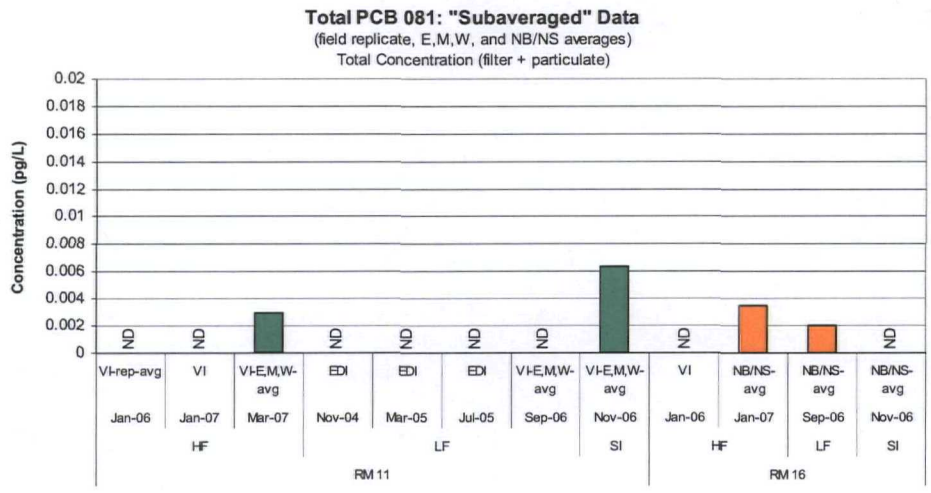

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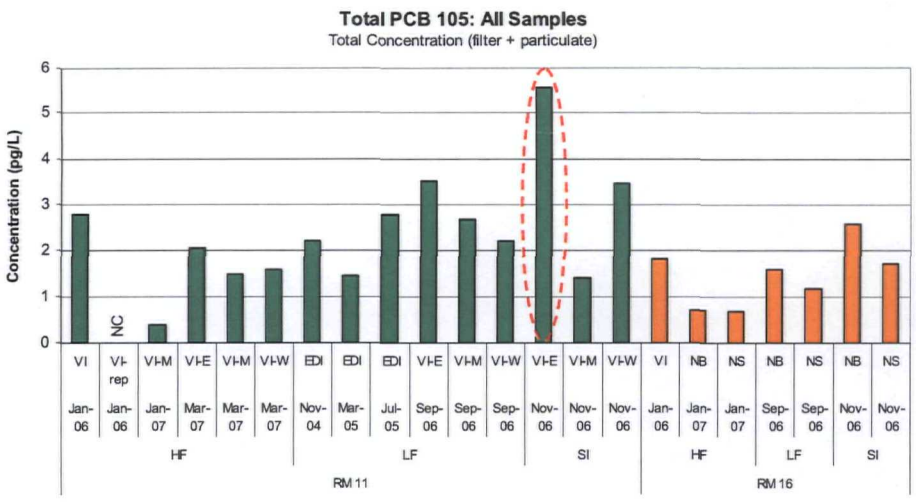

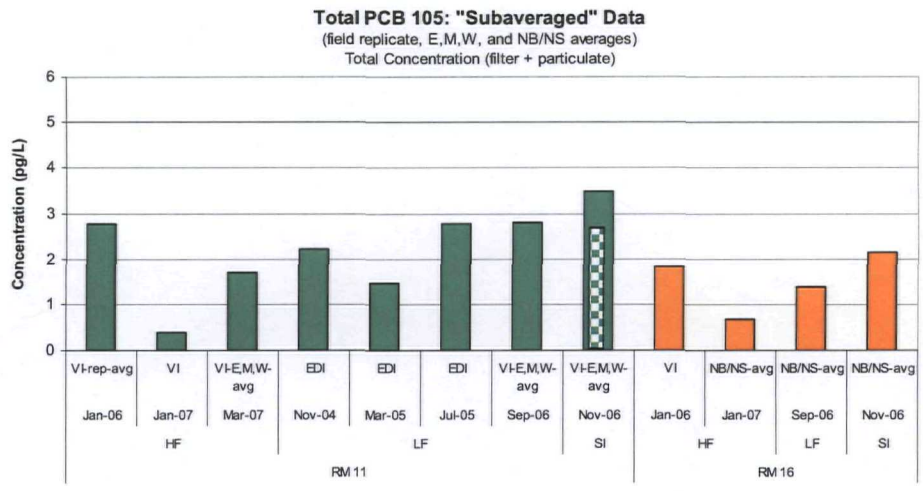

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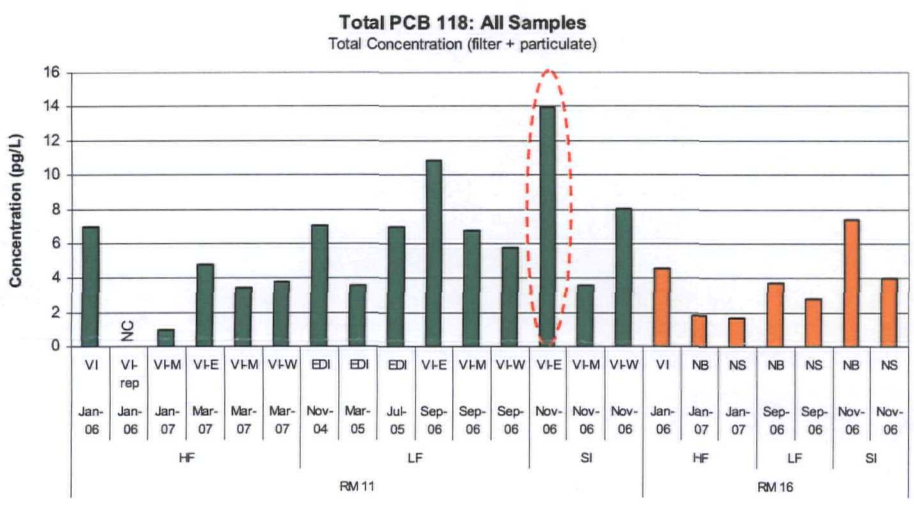

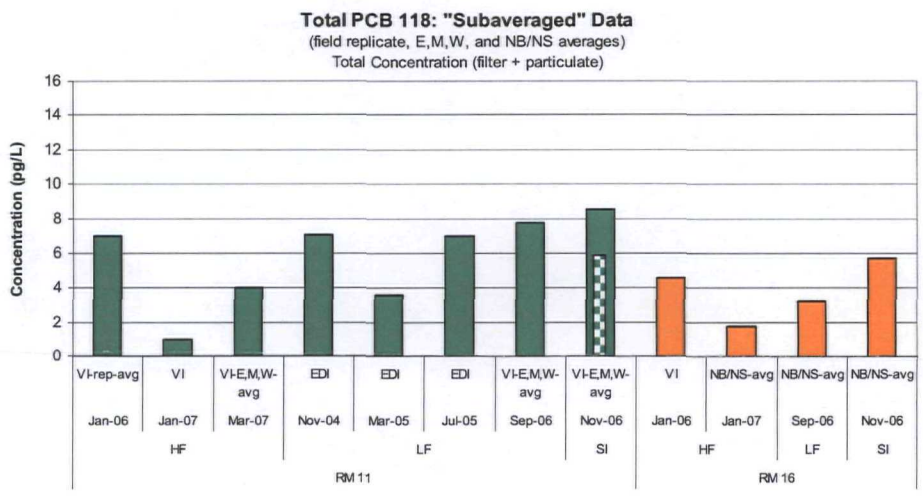

Note: Dashed red circles identify outliers and secondary green-and-white checked boxes represent subaveraged concentrations with outliers excluded.

Event Type

LF: Low Flow (<50 000 cfs)
HF: High Flow (>50 000 cfs)
SI: Low Flow-Stormwater Influenced (<50 000 cfs)

Data Descriptor

NC: No sample collected
ND: Below detection limit, set to zero prior to any calculations

Sample Collection Methods

VI: Vertically Integrated Sampling
M: Vertically Integrated, collected mid-river
E: Vertically Integrated, collected east side of river
W: Vertically Integrated, collected west side of river
EDI: Equal-Discharge-Increment integrated sample
NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
NS: Discharge-weighted horizontally integrated sample, collected near-surface of river

Note: Plots present data collected with XAD-column sampling method.

Figure E2-5
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
PCB Congeners (077, 081, 105, 118)

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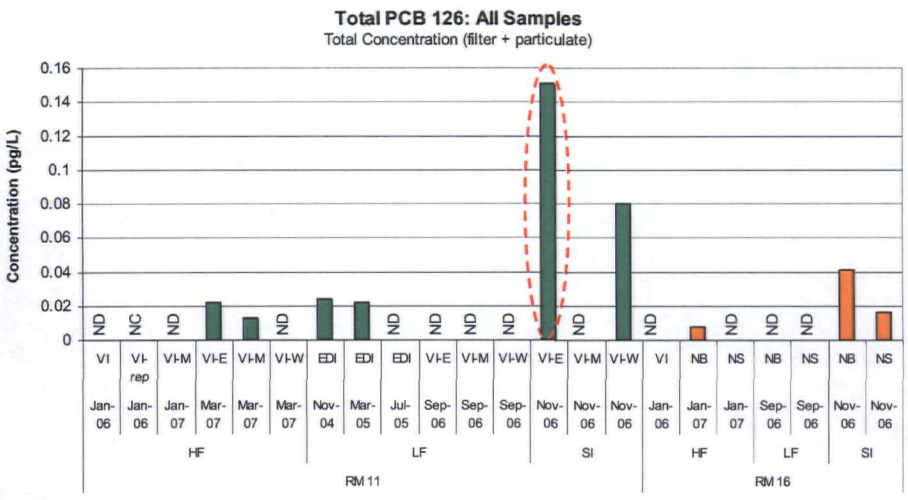
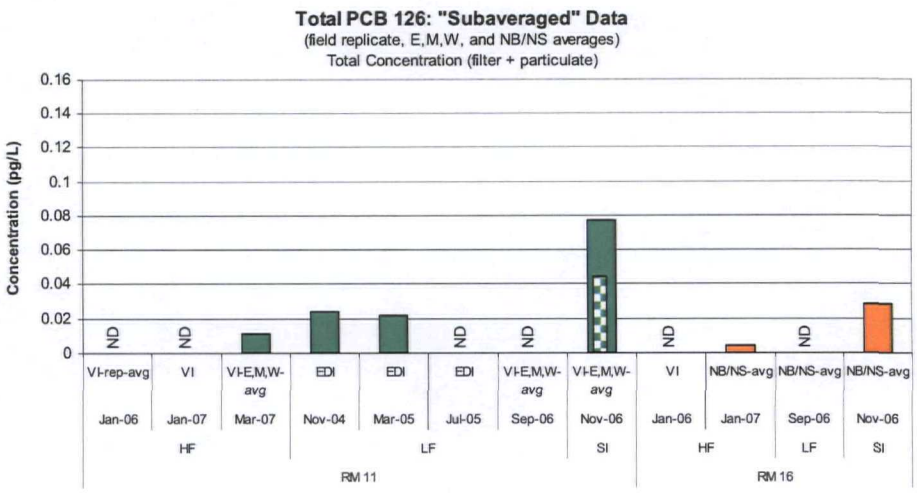
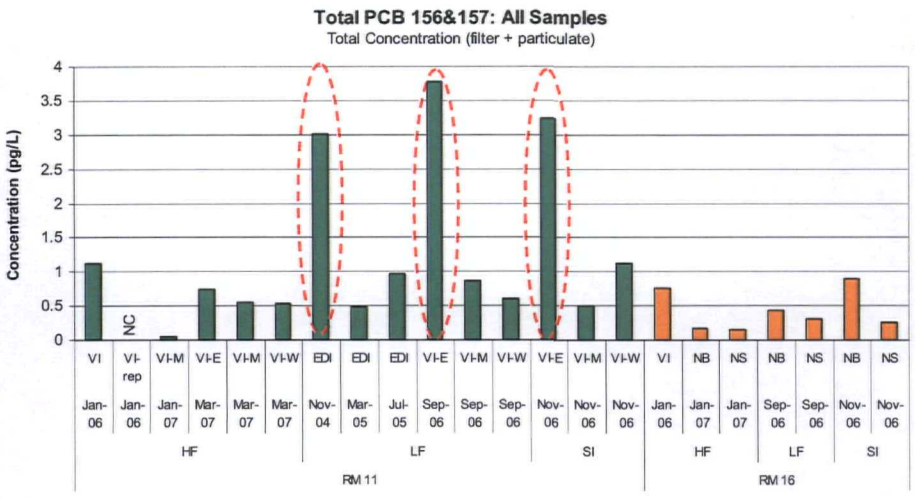
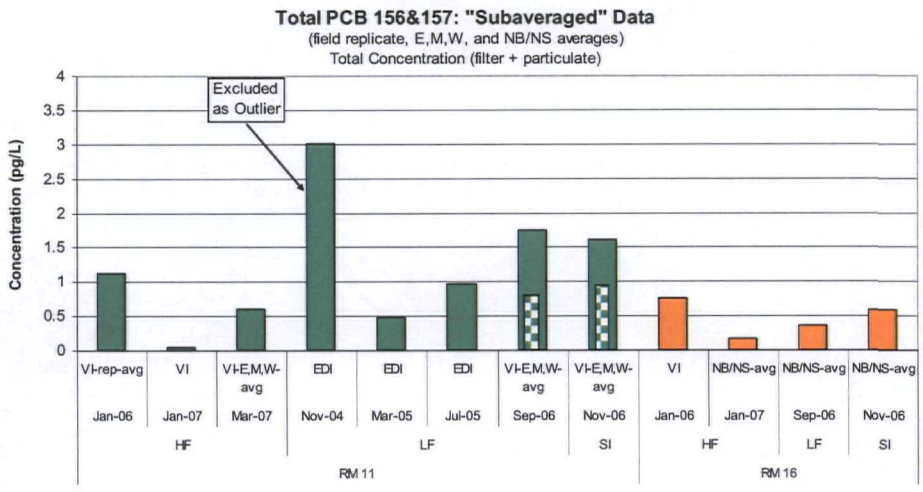
PCB 126



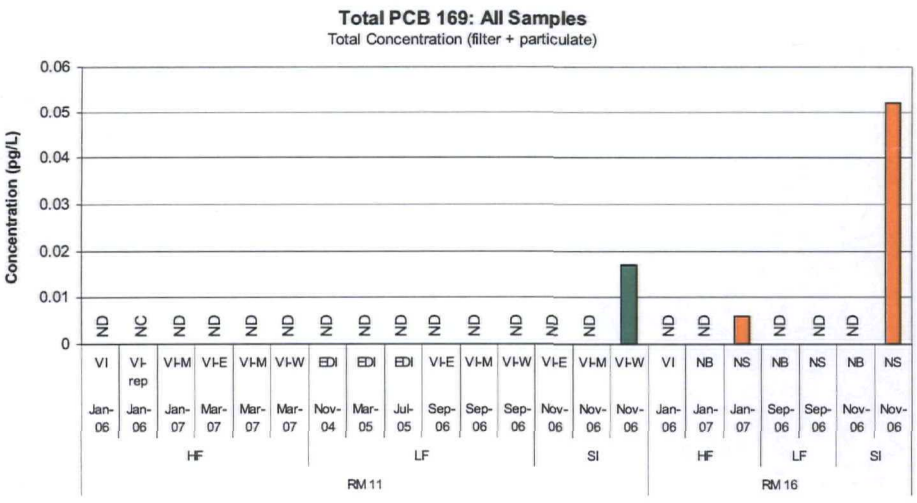


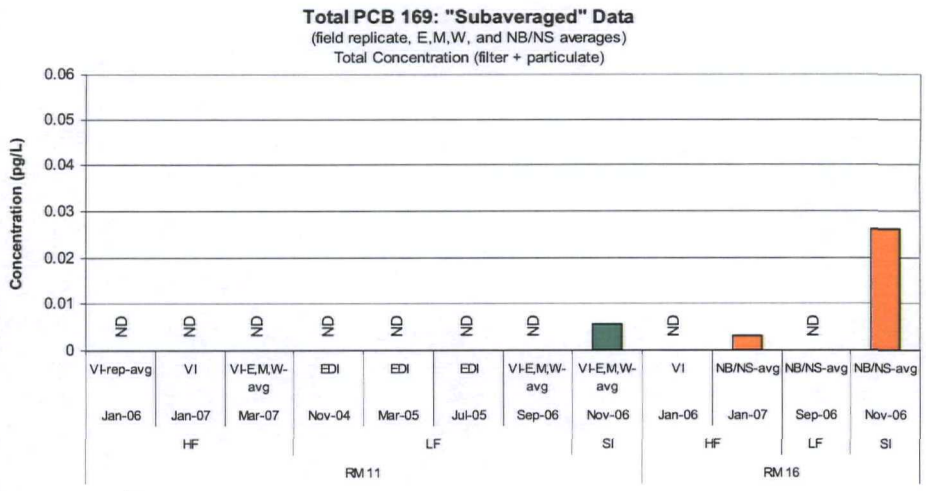
PCB 156 &157





PCB 169





Note: Dashed red circles identify outliers and secondary green-and-white checked boxes represent subaveraged concentrations with outliers excluded.

Event Type	Data Descriptor	Sample Collection Methods	
LF: Low Flow (<50 000 cfs)	NC: No sample collected	VI: Vertically Integrated Sampling	EDI: Equal-Discharge-Increment integrated sample
HF: High Flow (>50 000 cfs)	ND: Below detection limit, set to zero prior to any calculations	M: Vertically Integrated, collected mid-river	NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
SI: Low Flow-Stormwater Influenced (<50 000 cfs)		E: Vertically Integrated, collected east side of river	NS: Discharge-weighted horizontally integrated sample, collected near-surface of river
		W: Vertically Integrated, collected west side of river	

Note: Plots present data collected with XAD-column sampling method.

Figure E2-6
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
PCB Congeners (126, 156 &157, 169)

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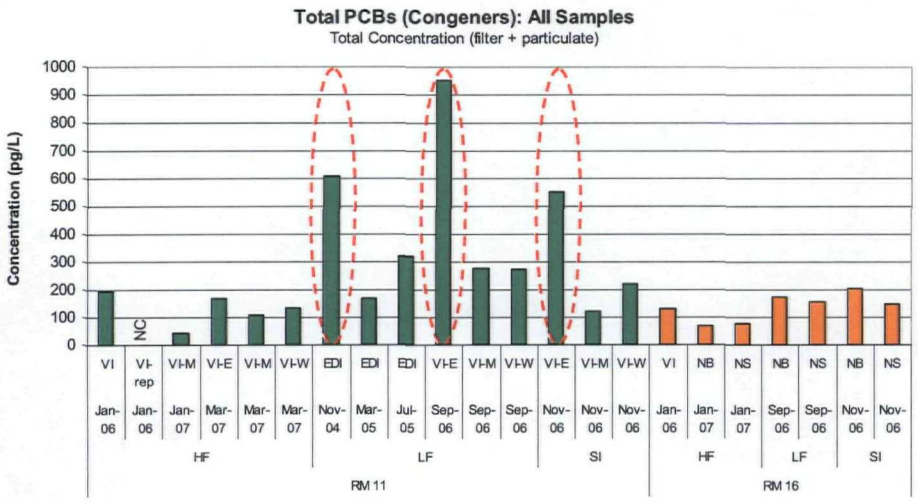
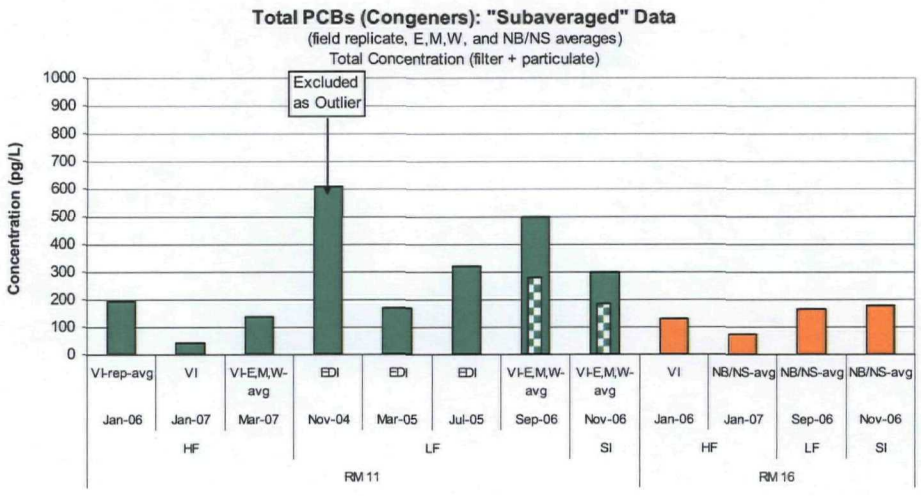
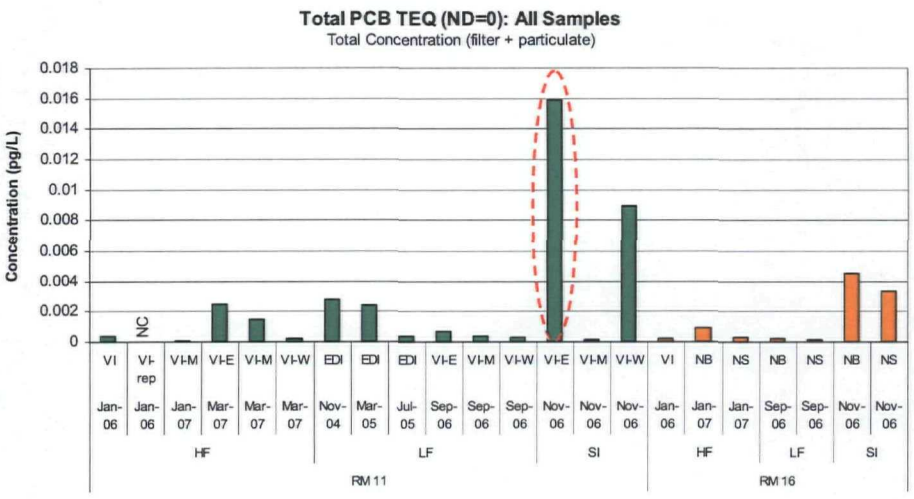
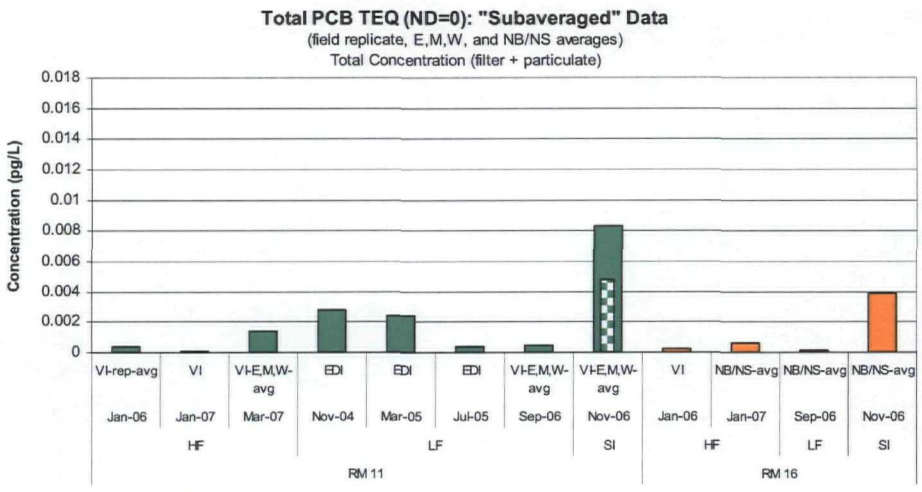
Total PCB Congeners





PCB TEQ (ND=0)





Note: Dashed red circles identify outliers and secondary green-and-white checked boxes represent subaveraged concentrations with outliers excluded.

Event Type	Data Descriptor	Sample Collection Methods	
LF: Low Flow (<50 000 cfs)	NC: No sample collected	VI: Vertically Integrated Sampling	EDI: Equal-Discharge-Increment integrated sample
HF: High Flow (>50 000 cfs)	ND: Below detection limit, set to zero prior to any calculations	M: Vertically Integrated, collected mid-river	NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
SI: Low Flow-Stormwater Influenced (<50 000 cfs)		E: Vertically Integrated, collected east side of river	NS: Discharge-weighted horizontally integrated sample, collected near-surface of river
		W: Vertically Integrated, collected west side of river	

Note: Plots present data collected with XAD-column sampling method.

Figure E2-7
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
Total PCB Congeners and PCB TEQ (ND=0)

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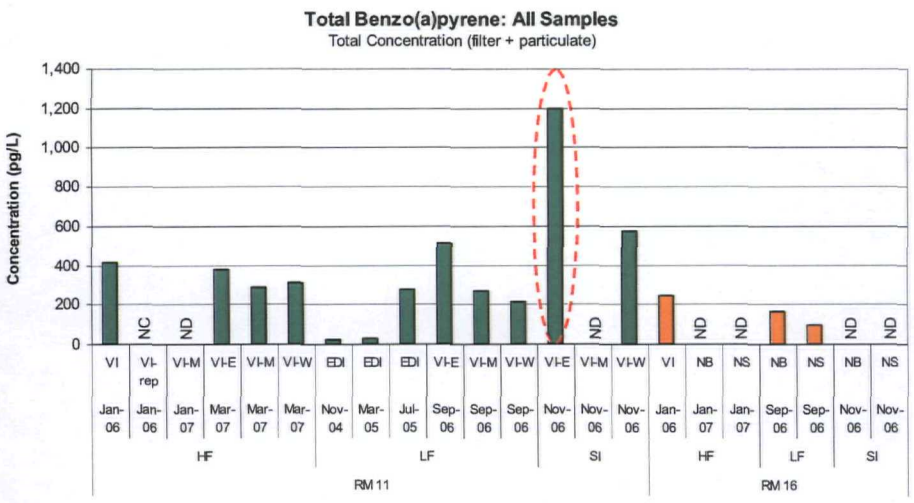
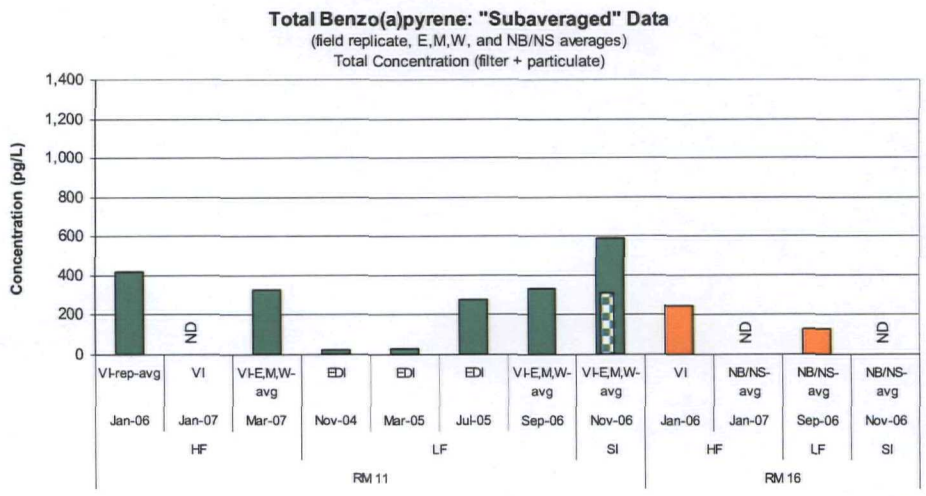
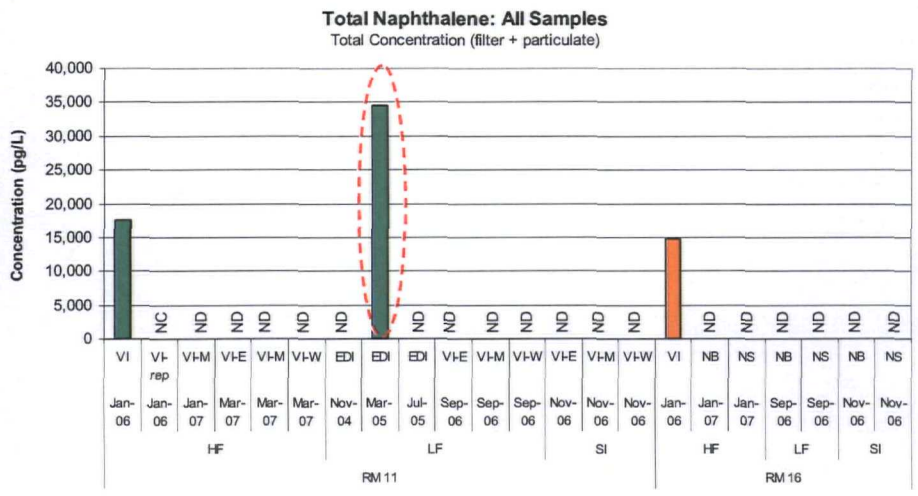
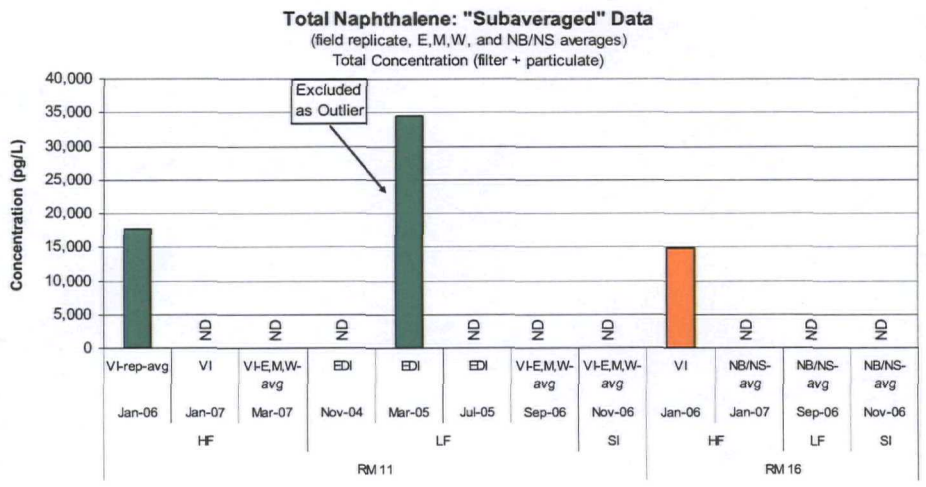
Benzo(a)pyrene



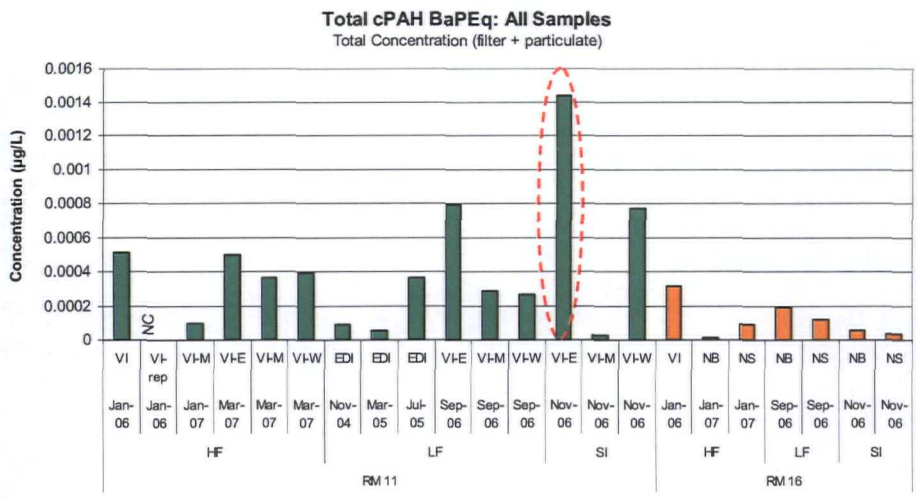


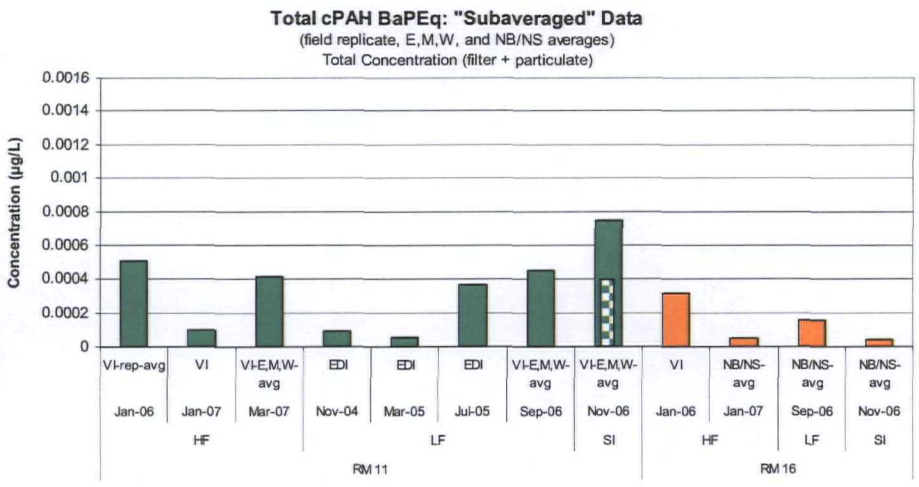
Naphthalene



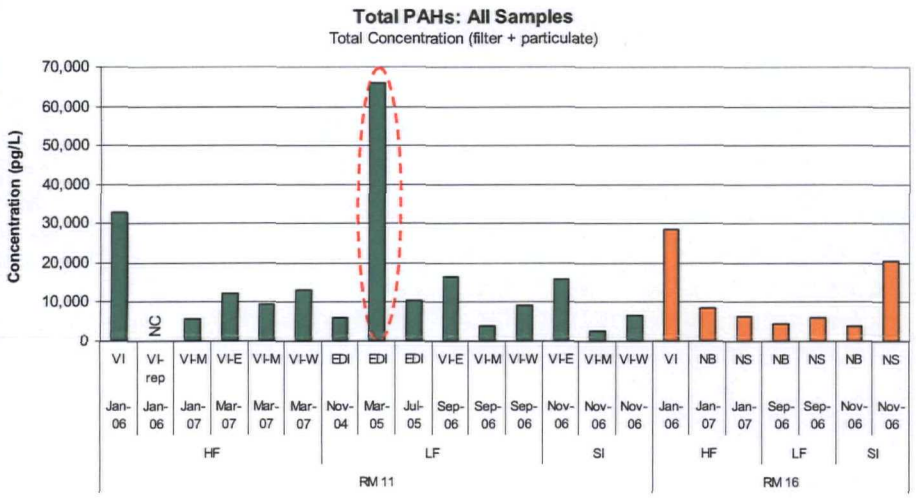


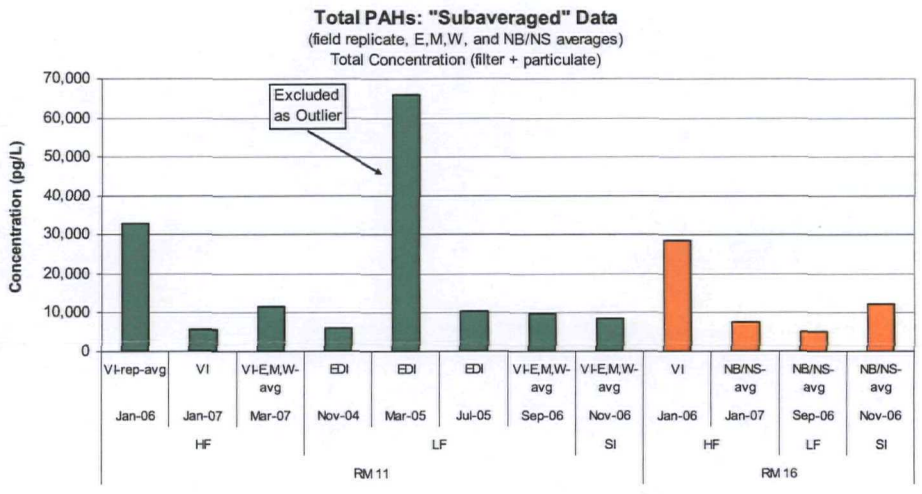
Total cPAH BaPEq





Total PAHs





Note: Dashed red circles identify outliers and secondary green-and-white checked boxes represent subaveraged concentrations with outliers excluded.

Event Type

LF: Low Flow (<50 000 cfs)
HF: High Flow (>50 000 cfs)
SI: Low Flow-Stormwater Influenced (<50 000 cfs)

Data Descriptor

NC: No sample collected
ND: Below detection limit, set to zero prior to any calculations

Sample Collection Methods

VI: Vertically Integrated Sampling
M: Vertically Integrated, collected mid-river
E: Vertically Integrated, collected east side of river
W: Vertically Integrated, collected west side of river
EDI: Equal-Discharge-Increment integrated sample
NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
NS: Discharge-weighted horizontally integrated sample, collected near-surface of river

Note: Plots present data collected with XAD-column sampling method.

Figure E2-8
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Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
PAHs

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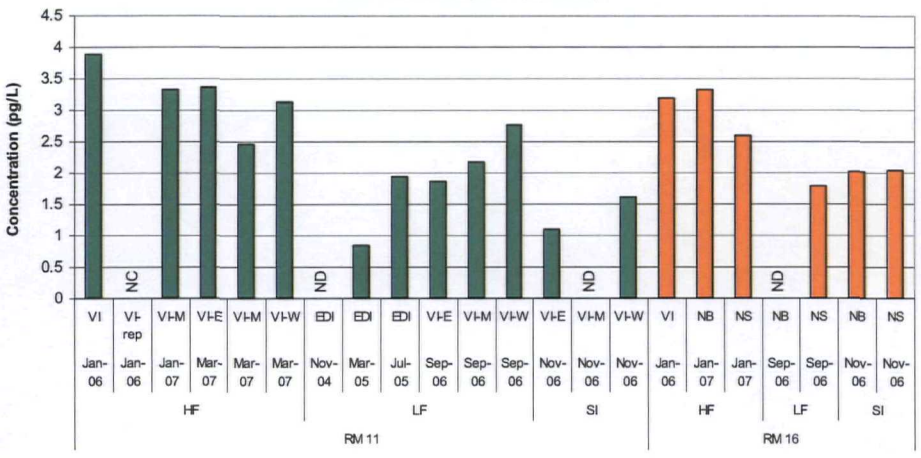
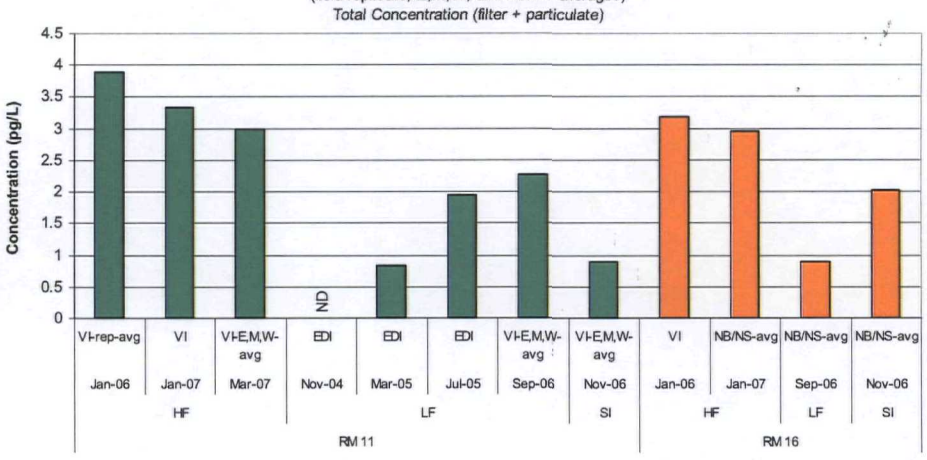
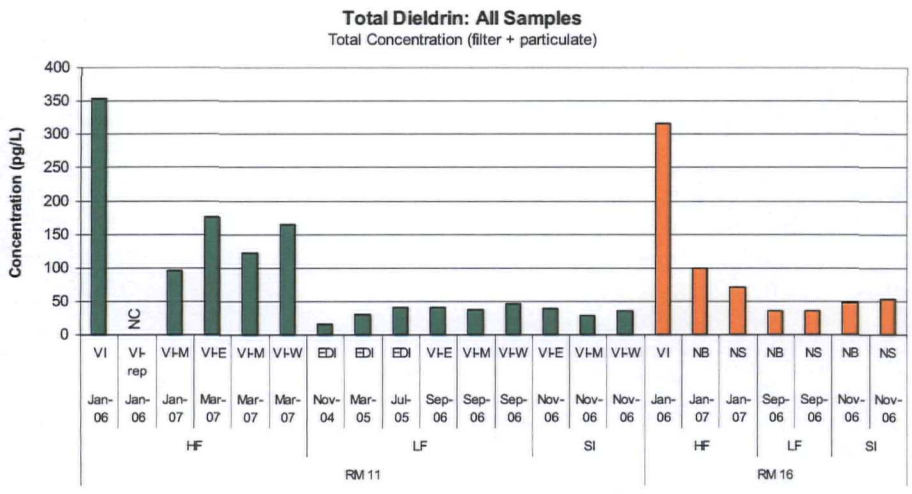
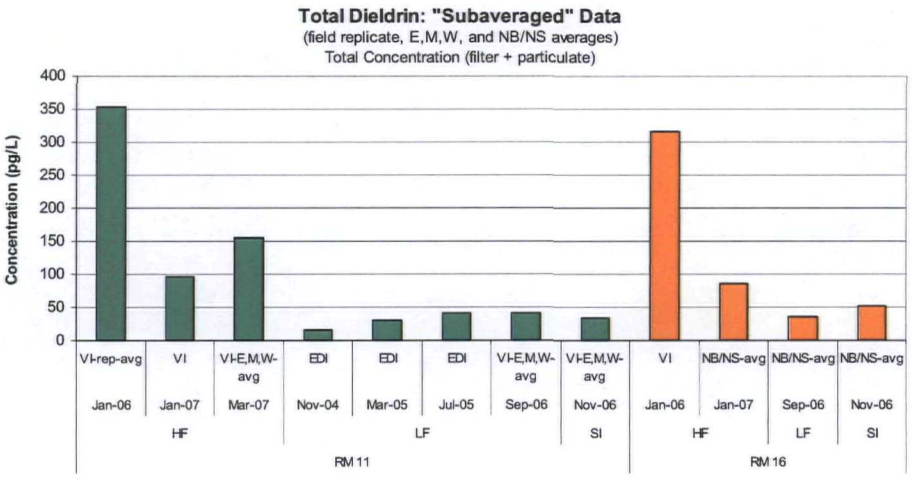
Aldrin



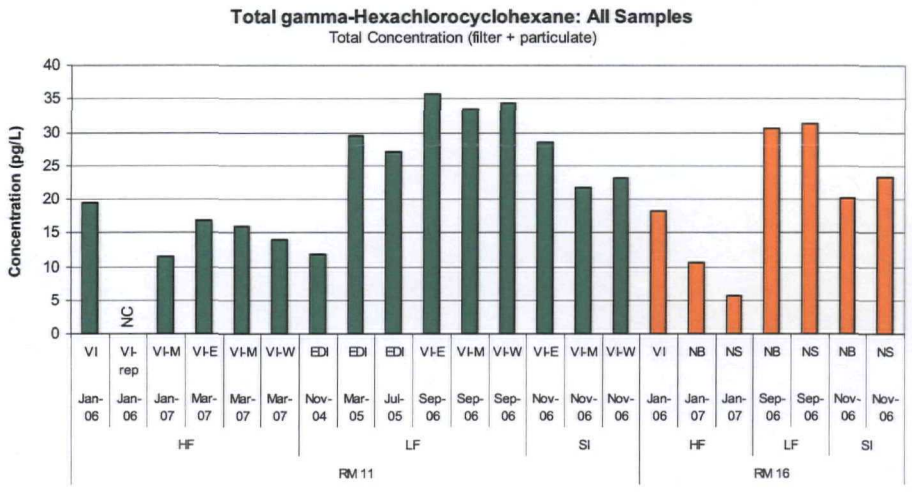


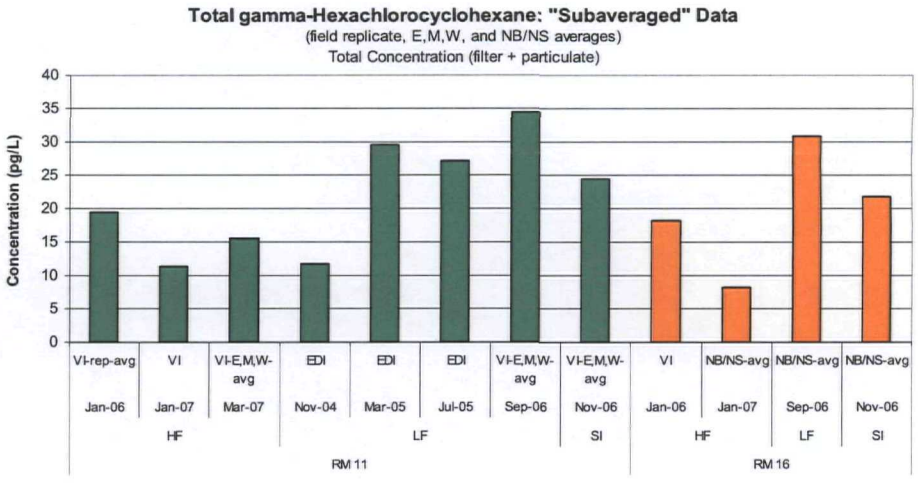
Dieldrin



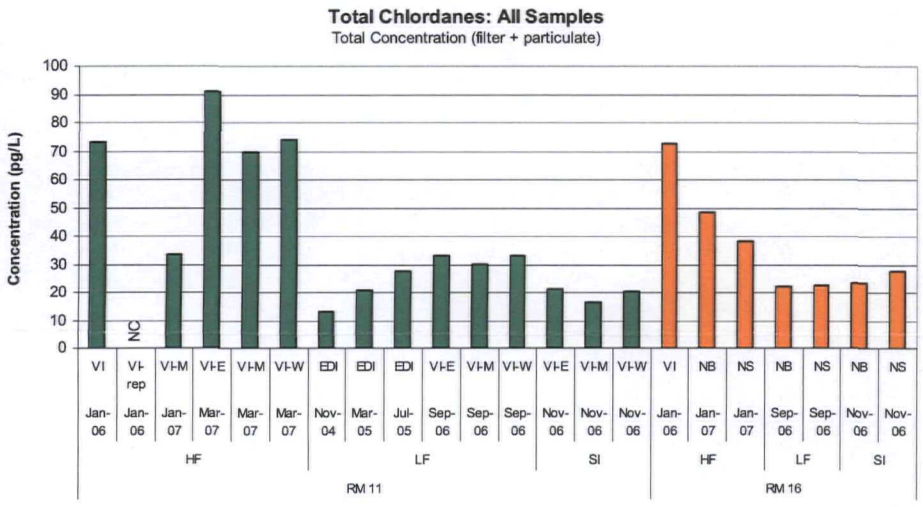


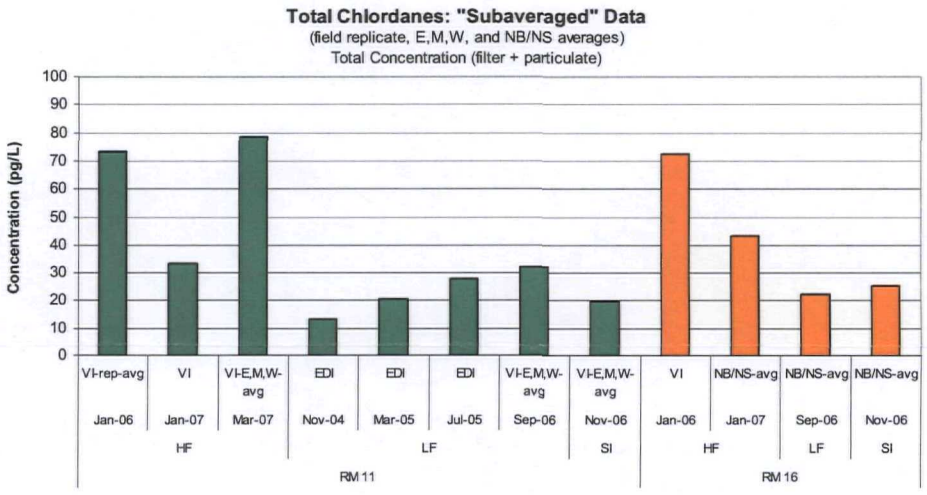
gamma-Hexachlorocyclohexane





Total Chlordanes





Event Type	Data Descriptor
LF: Low Flow (<50 000 cfs)	NC: No sample collected
HF: High Flow (>50 000 cfs)	ND: Below detection limit, set to zero prior to any calculations
SI: Low Flow-Stormwater Influenced (<50 000 cfs)	

Note: Plots present data collected with XAD-column sampling method.

Sample Collection Methods

- VI: Vertically Integrated Sampling
- M: Vertically Integrated, collected mid-river
- E: Vertically Integrated, collected east side of river
- W: Vertically Integrated, collected west side of river
- EDI: Equal-Discharge-Increment integrated sample
- NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
- NS: Discharge-weighted horizontally integrated sample, collected near-surface of river

Figure E2-9
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
Non-DDx Pesticides

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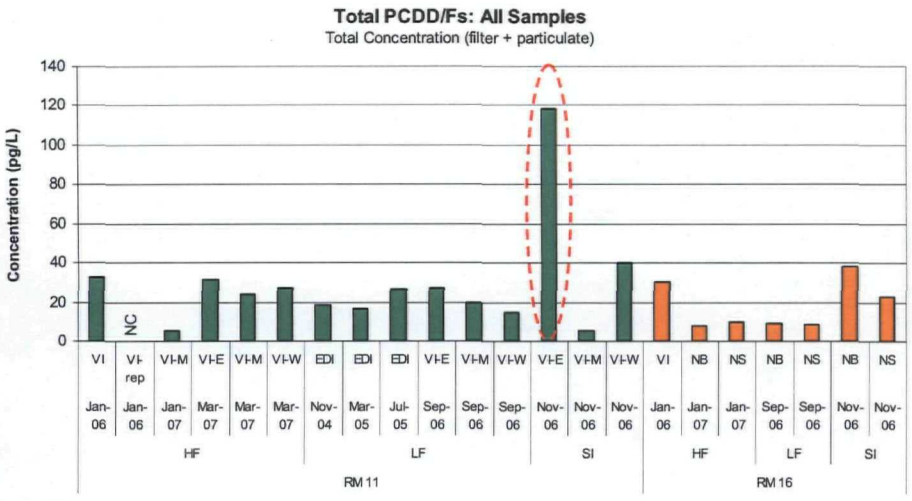
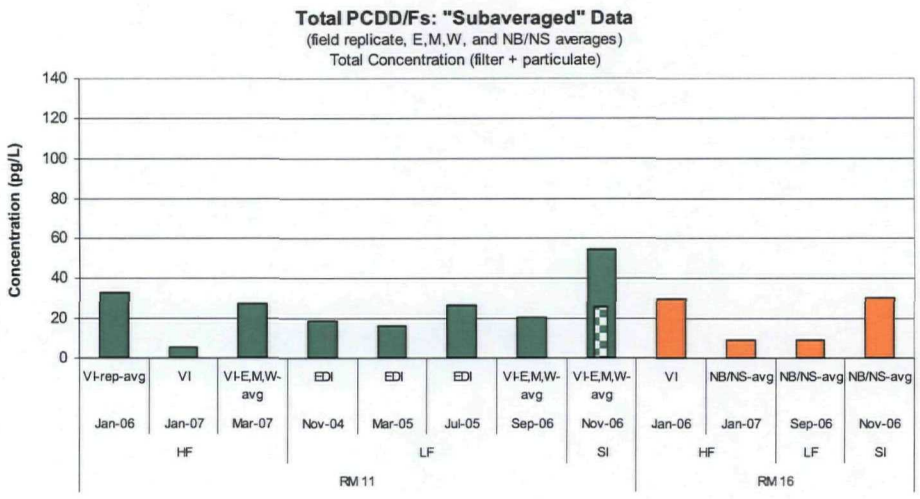
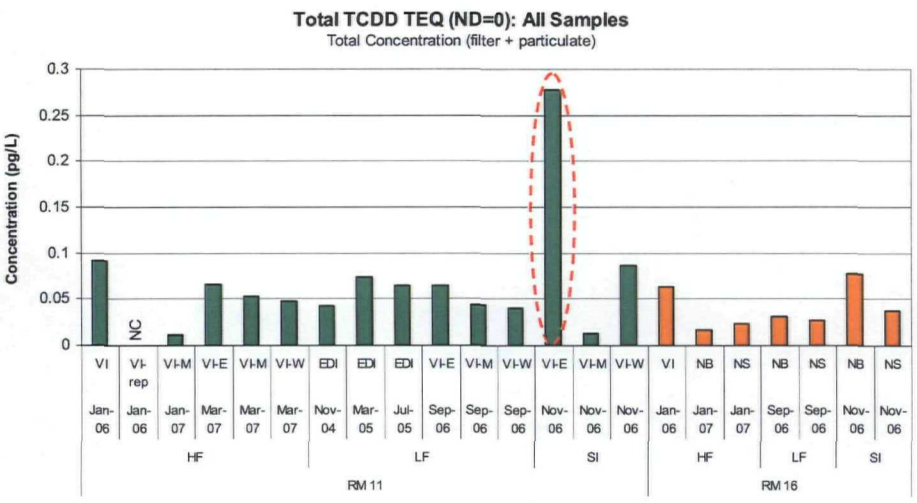
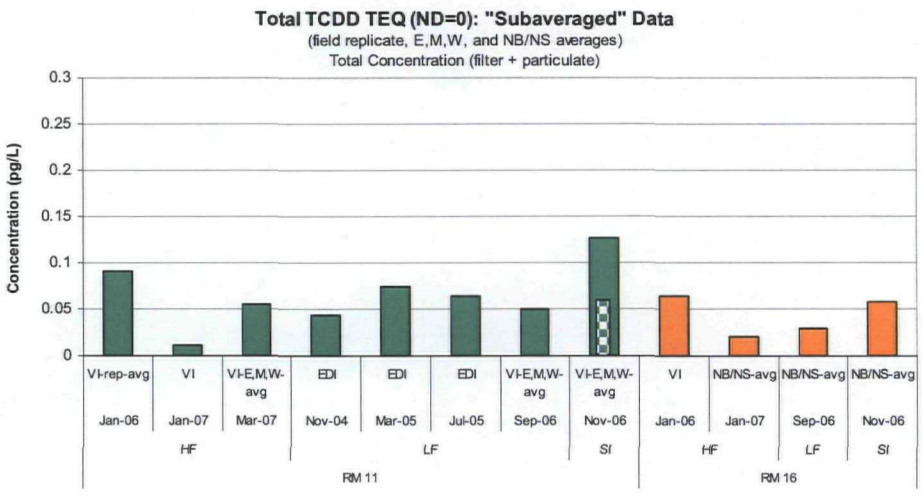
Total PCDD/Fs





TCDD TEQ (ND=0)





Note: Dashed red circles identify outliers and secondary green-and-white checked boxes represent subaveraged concentrations with outliers excluded.

Event Type	Data Descriptor	Sample Collection Methods	
LF: Low Flow (<50 000 cfs)	NC: No sample collected	VI: Vertically Integrated Sampling	EDI: Equal-Discharge-Increment integrated sample
HF: High Flow (>50 000 cfs)	ND: Below detection limit, set to zero prior to any calculations	M: Vertically Integrated, collected mid-river	NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
SI: Low Flow-Stormwater Influenced (<50 000 cfs)		E: Vertically Integrated, collected east side of river	NS: Discharge-weighted horizontally integrated sample, collected near-surface of river
		W: Vertically Integrated, collected west side of river	

Note: Plots present data collected with XAD-column sampling method.

Figure E2-10
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
Total PCDD/Fs and TCDD TEQ (ND=0)

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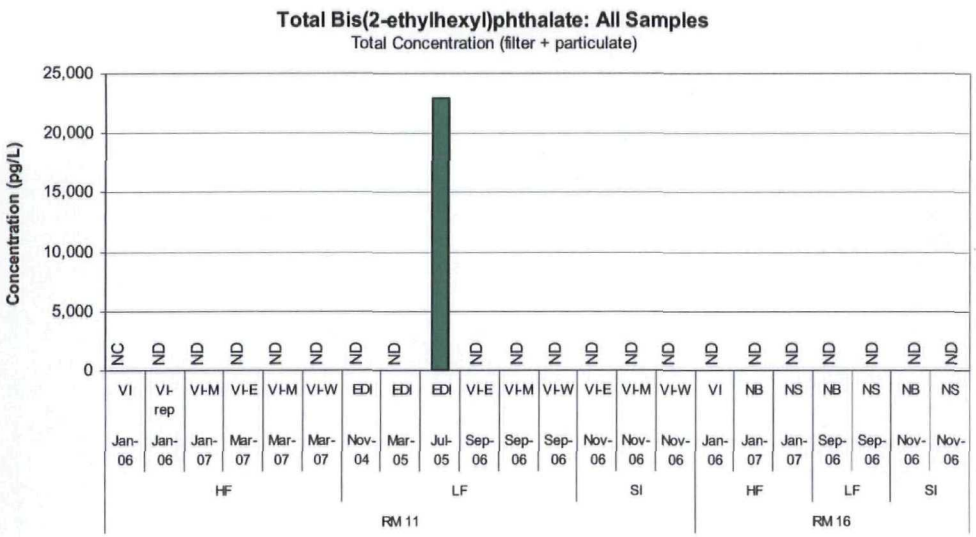
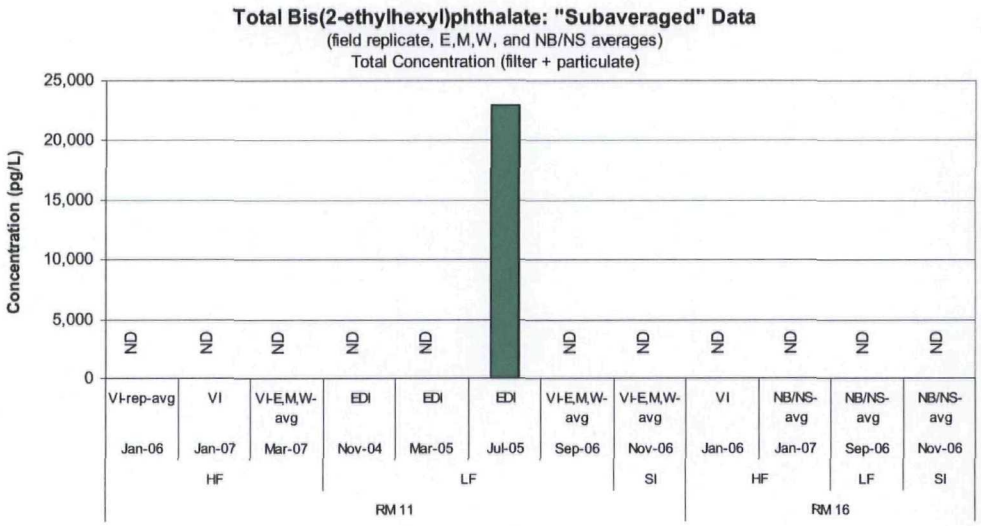
Bis(2-ethylhexyl)phthalate





Note: Plots present data collected with both Peristaltic and XAD-column sampling methods.

Event Type	Data Descriptor	Sample Collection Methods	
LF: Low Flow (<50 000 cfs) HF: High Flow (>50 000 cfs) SI: Low Flow-Stormwater Influenced (<50 000 cfs)	NC: No sample collected ND: Below detection limit, set to zero prior to any calculations	VI: Vertically Integrated Sampling M: Vertically Integrated, collected mid-river E: Vertically Integrated, collected east side of river W: Vertically Integrated, collected west side of river	EDI: Equal-Discharge-Increment Integrated Sample NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river NS: Discharge-weighted horizontally integrated sample, collected near-surface of river

Figure E2-11
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
Bis(2-ethylhexyl)phthalate

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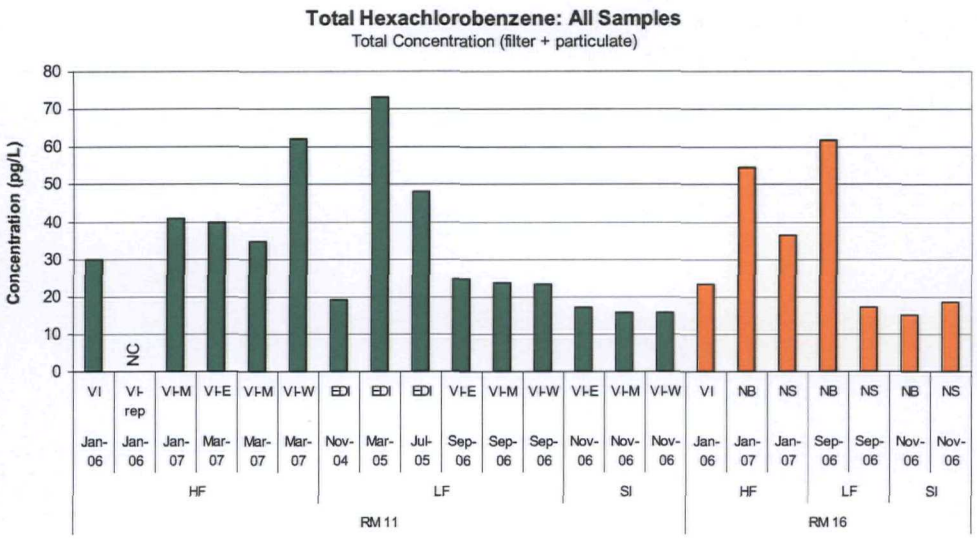
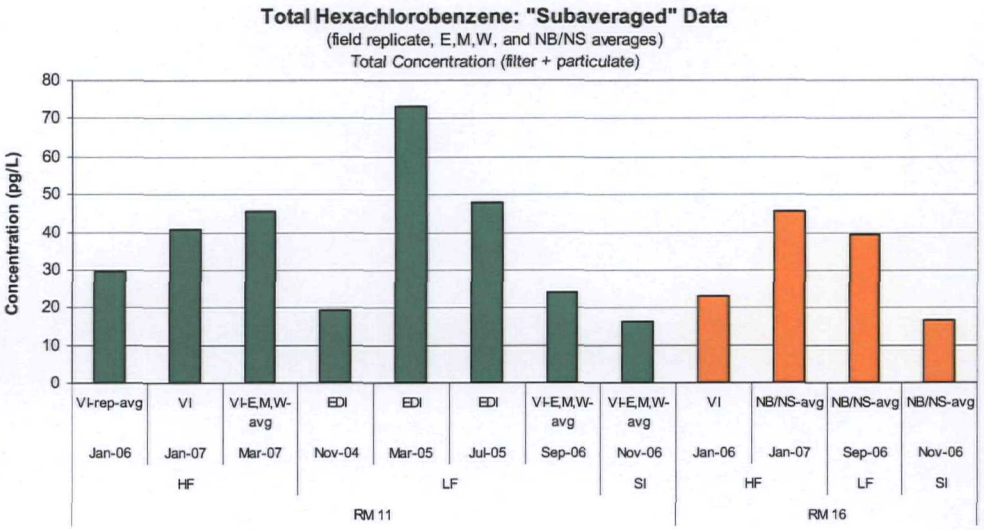
Hexachlorobenzene





Note: Plots present data collected with both Peristaltic and XAD-column sampling methods.

Event Type	Data Descriptor
LF: Low Flow (<50 000 cfs) HF: High Flow (>50 000 cfs) SI: Low Flow-Stormwater Influenced (<50 000 cfs)	NC: No sample collected ND: Below detection limit, set to zero prior to any calculations

Sample Collection Methods

VI: Vertically Integrated Sampling
M: Vertically Integrated, collected mid-river
E: Vertically Integrated, collected east side of river
W: Vertically Integrated, collected west side of river

EDI: Equal-Discharge-Increment Integrated Sample
NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
NS: Discharge-weighted horizontally integrated sample, collected near-surface of river

Figure E2-12
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
Hexachlorobenzene

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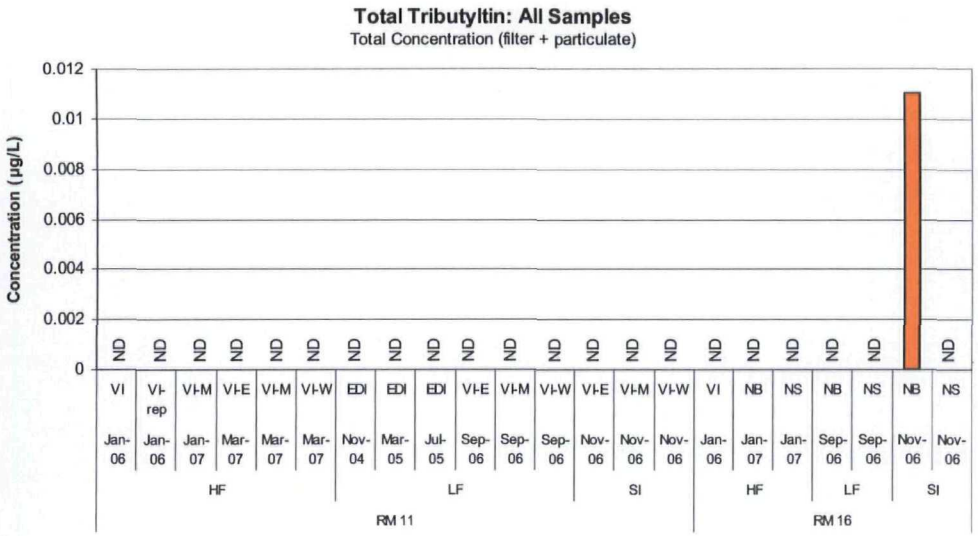
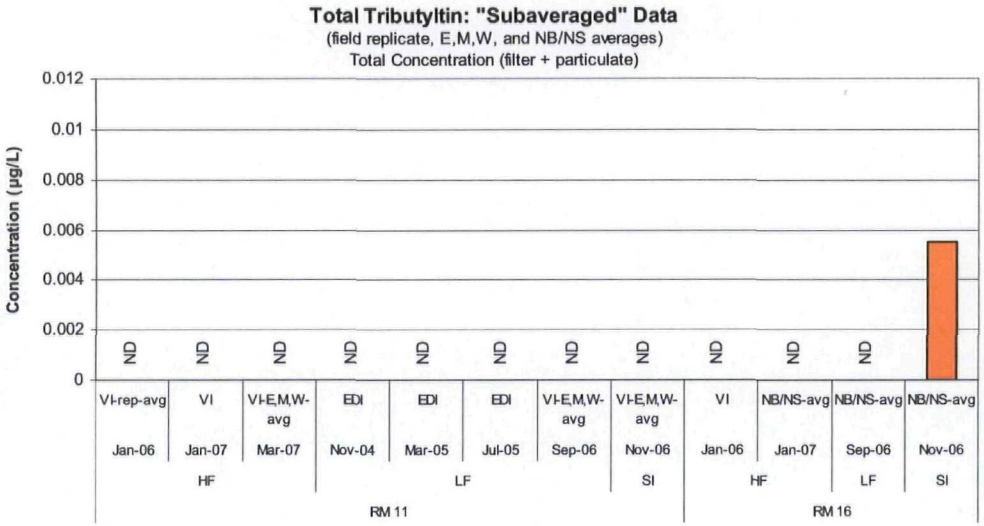
Tributyltin Ion





Note: Plots present data collected with both Peristaltic and XAD-column sampling methods.

Event Type	Data Descriptor
LF: Low Flow (<50 000 cfs) HF: High Flow (>50 000 cfs) SI: Low Flow-Stormwater Influenced (<50 000 cfs)	NC: No sample collected ND: Below detection limit, set to zero prior to any calculations

Sample Collection Methods

- VI: Vertically Integrated Sampling
- M: Vertically Integrated, collected mid-river
- E: Vertically Integrated, collected east side of river
- W: Vertically Integrated, collected west side of river
- EDI: Equal-Discharge-Increment Integrated Sample
- NB: Discharge-weighted horizontally integrated sample, collected near-bottom of river
- NS: Discharge-weighted horizontally integrated sample, collected near-surface of river

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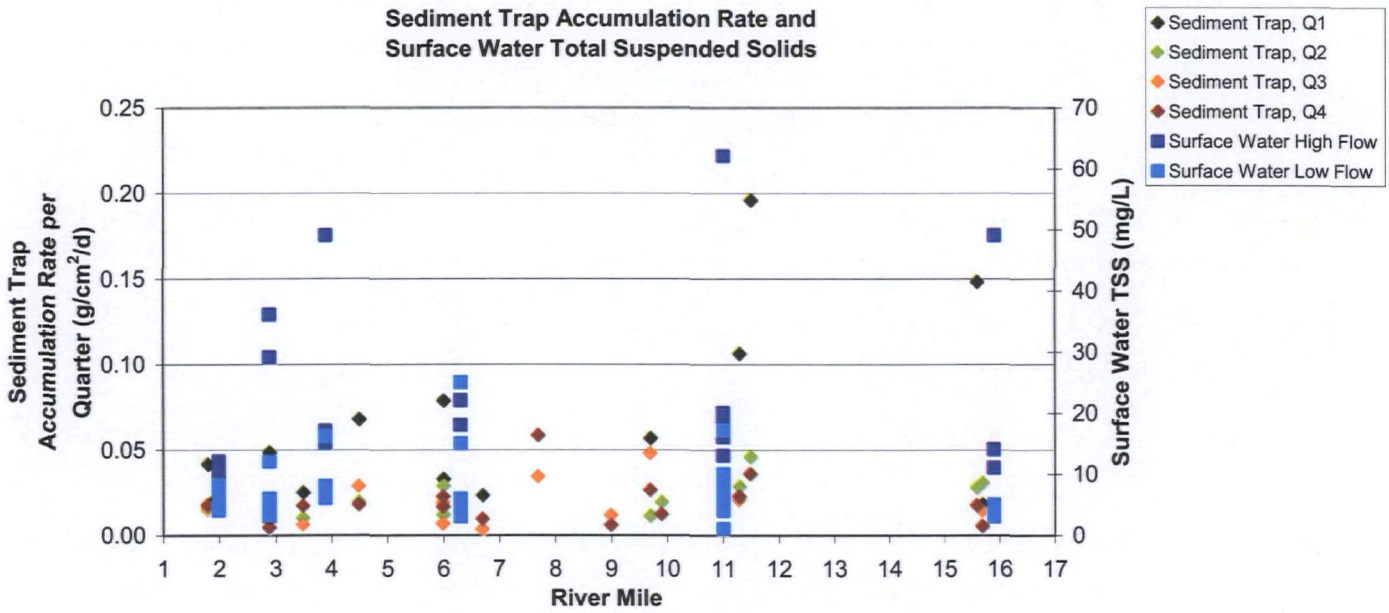
Figure E2-13
Portland Harbor RI/FS
Draft Remedial Investigation Report
Bar Charts of Surface Water Concentrations
RM 11 and RM 16 Comparison
Tributyltin Ion



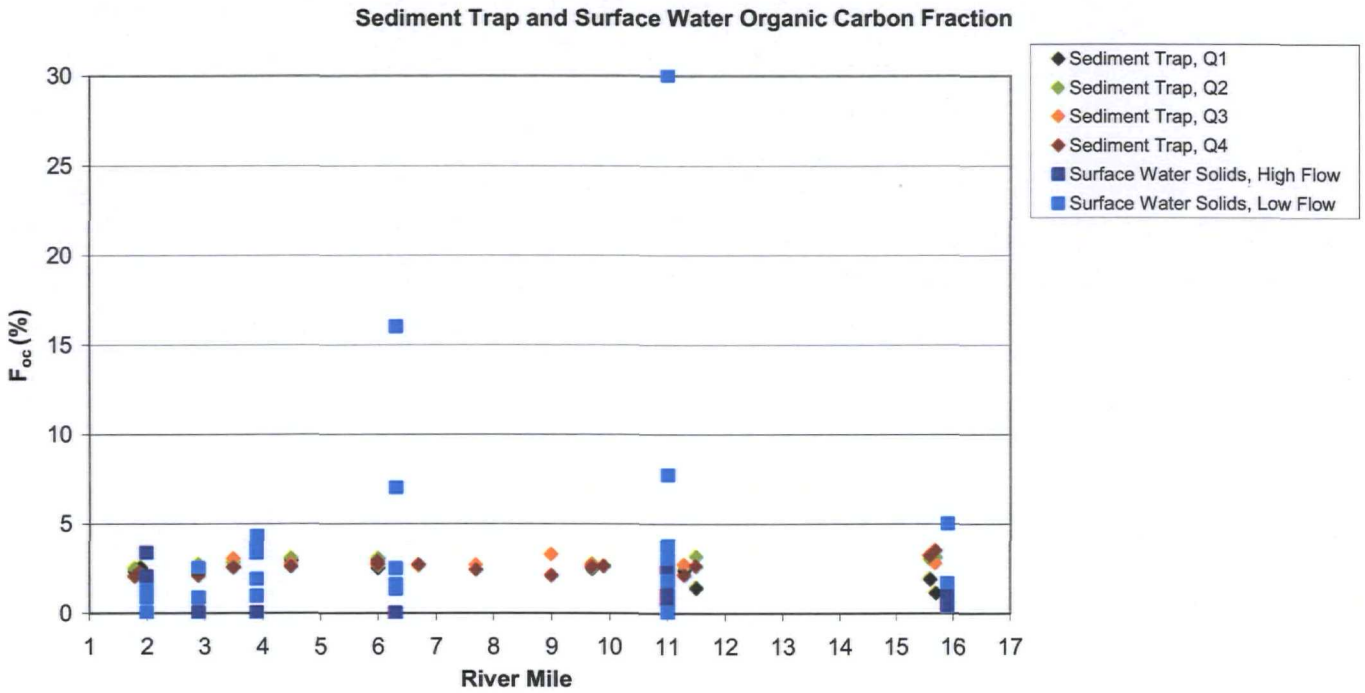


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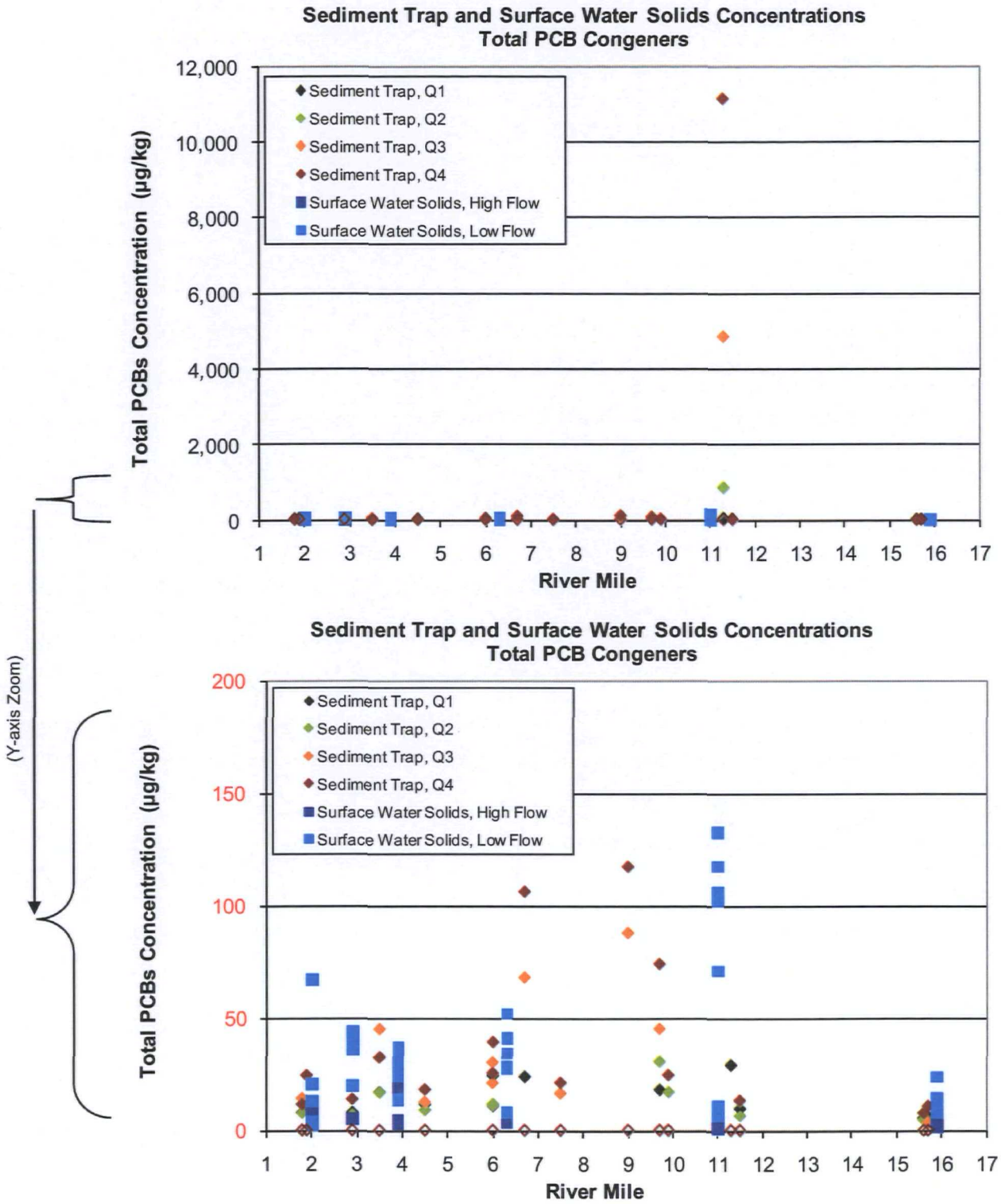
Figure E2-14
Portland Harbor RI/FS
Draft Remedial Investigation Report
Scatter Plots of Sediment Trap Accumulation Rate and Surface Water Total Suspended Solids, and Sediment Trap and Surface Water Organic Carbon Fraction



Note: Values below laboratory detection limits shown at the full detection limit as hollow symbols.

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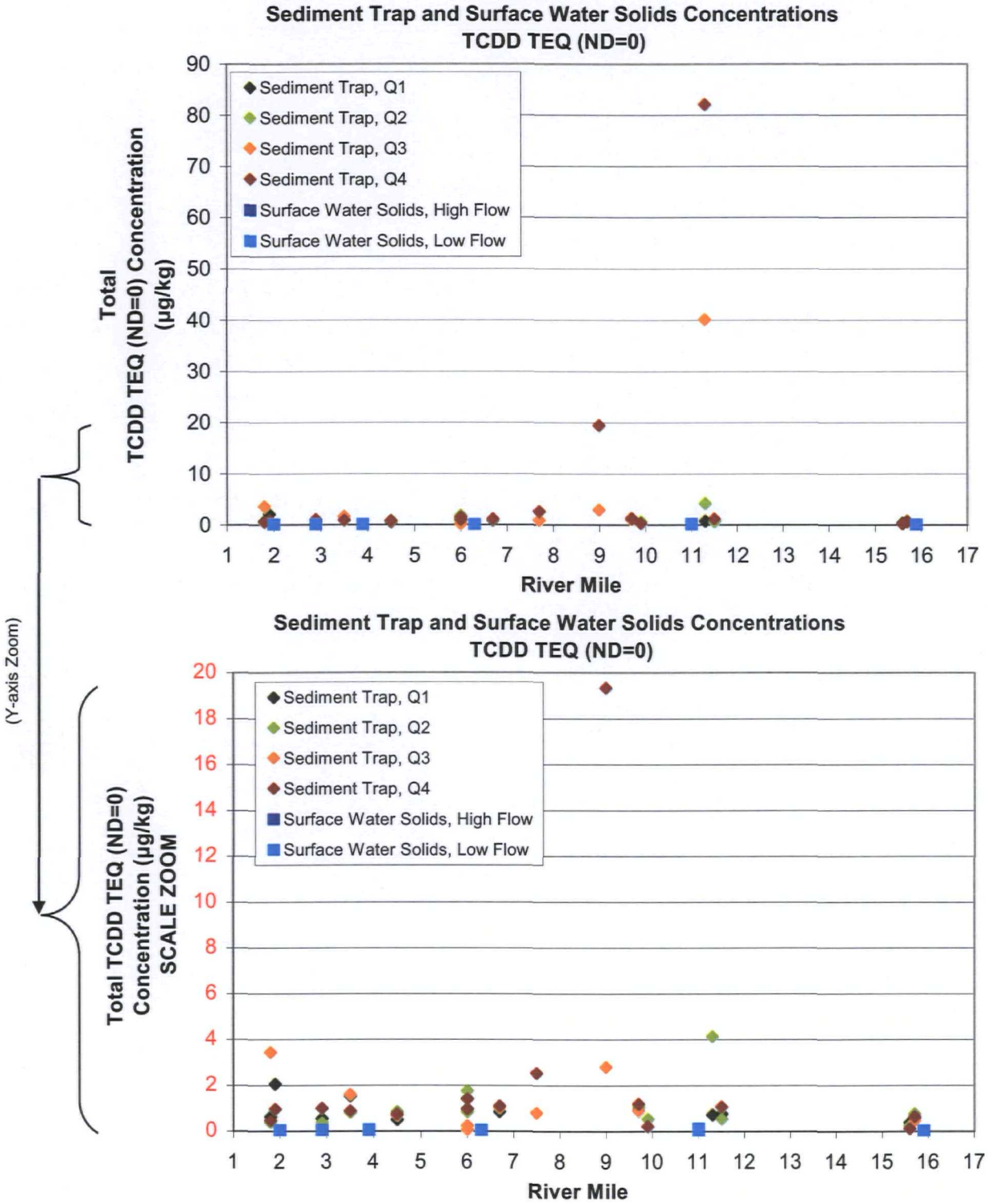
Figure E2-15
Portland Harbor RI/FS
Draft Remedial Investigation Report
Scatter Plots of Surface Water and Sediment Trap Concentrations
Total PCB Congeners



Note: Values below laboratory detection limits shown at the full detection limit as hollow symbols.

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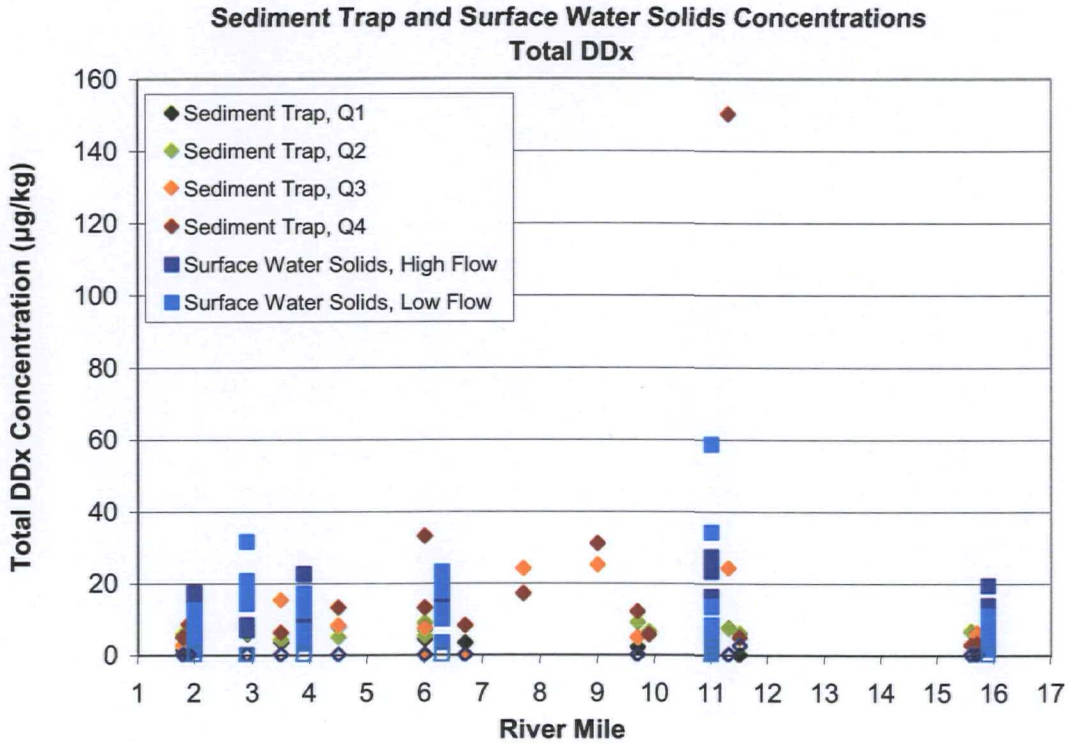
Figure E2-16
Portland Harbor RI/FS
Draft Remedial Investigation Report
Scatter Plots of Surface Water and Sediment Trap Concentrations
TCDD TEQ (ND=0)



Note: Values below laboratory detection limits shown at the full detection limit as hollow symbols.

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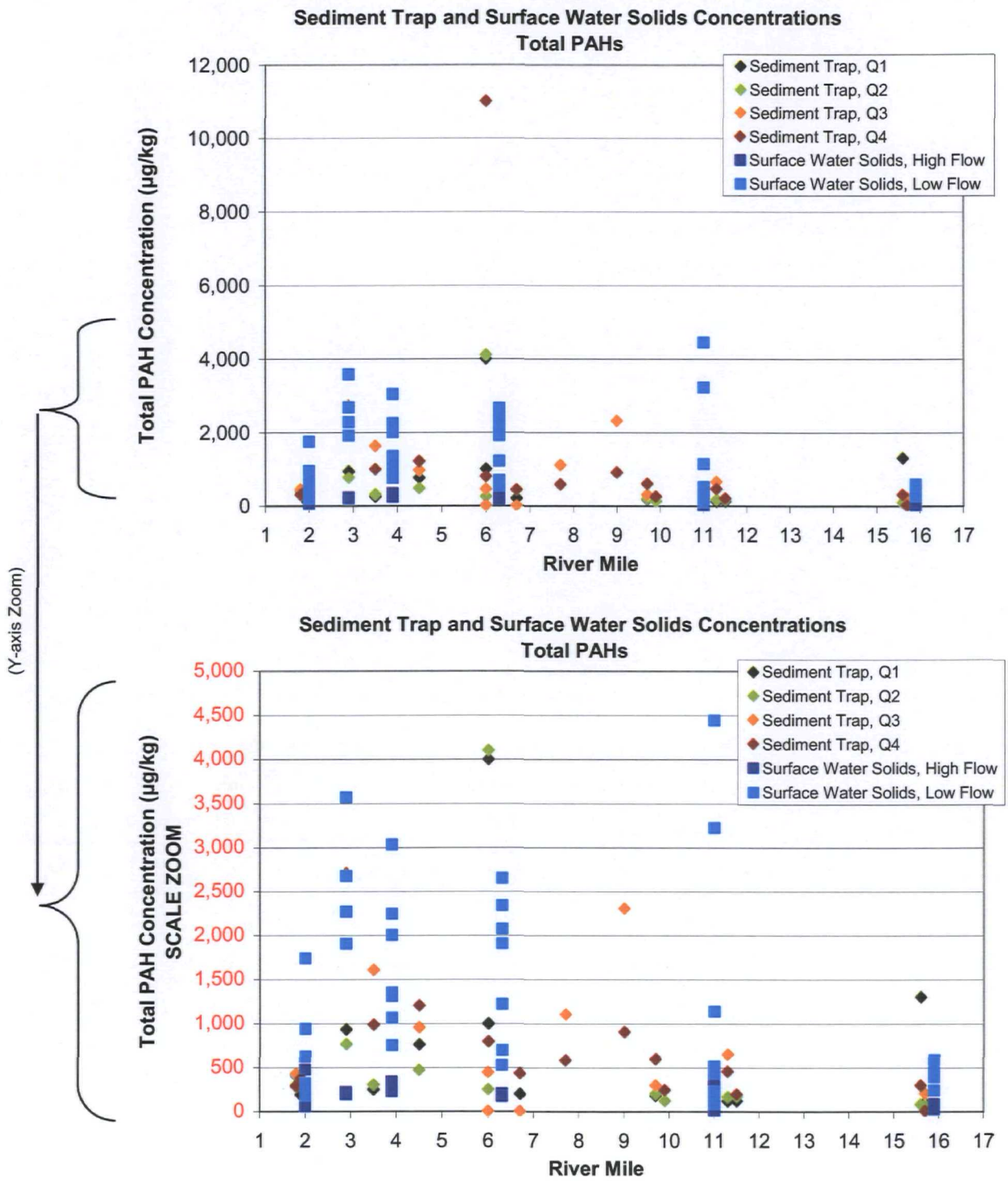
Figure E2-17
Portland Harbor RI/FS
Draft Remedial Investigation Report
Scatter Plots of Surface Water and Sediment Trap Concentrations
Total DDx



Note: Values below laboratory detection limits shown at the full detection limit as hollow symbols.

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Figure E2-18

Portland Harbor RI/FS

Draft Remedial Investigation Report

Scatter Plots of Surface Water and Sediment Trap Concentrations

Total PAHs

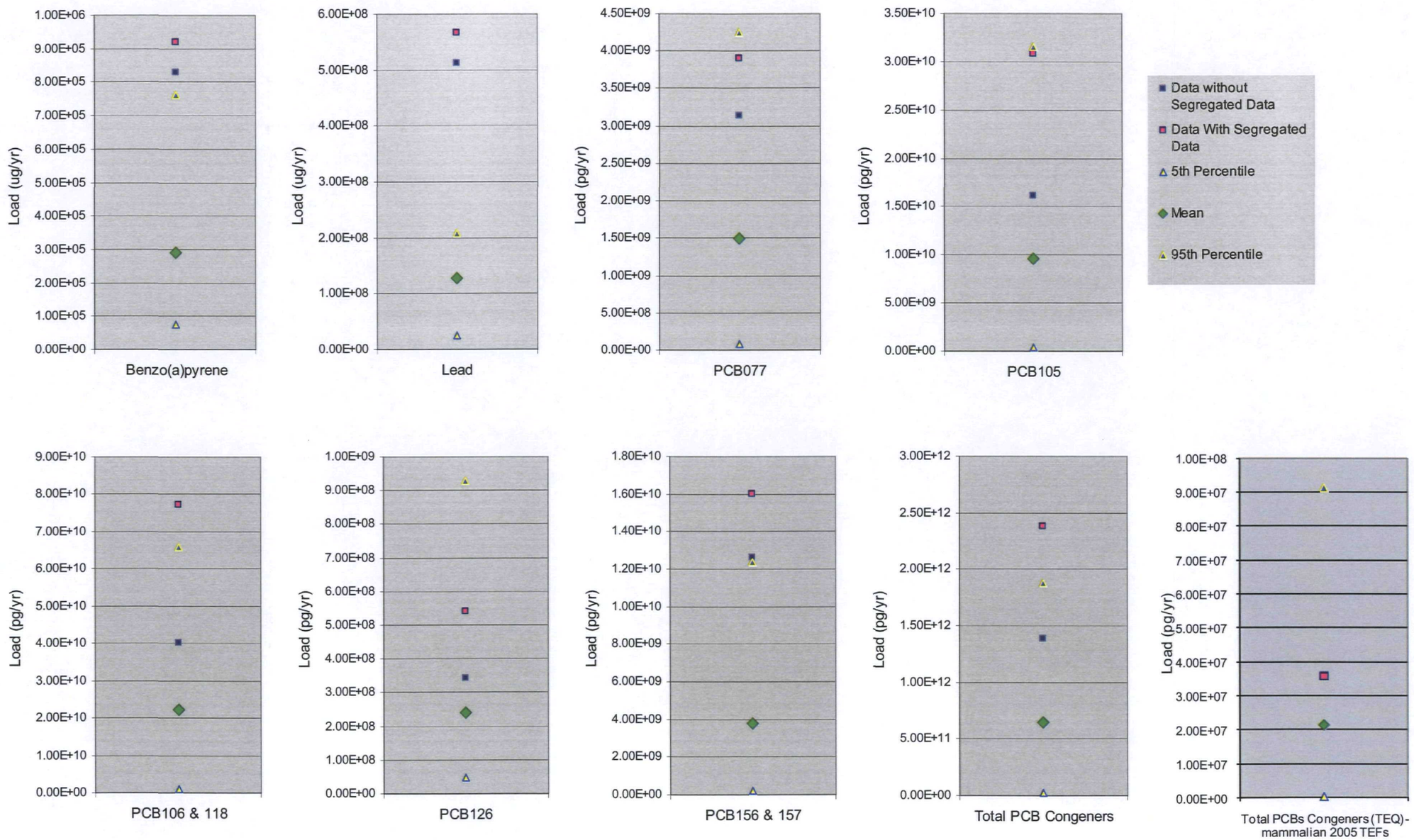

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Figure E3-1
Portland Harbor RI/FS
Draft Remedial Investigation Report
Plots of Stormwater Uncertainty Evaluation,
PCB Congeners, Total PCB Congeners, Total PCB Congeners (TEQ- Mammalian 2005 TEFs),
Benzo(a)pyrene, and Lead Evaluation of Segregated Samples at OF-18

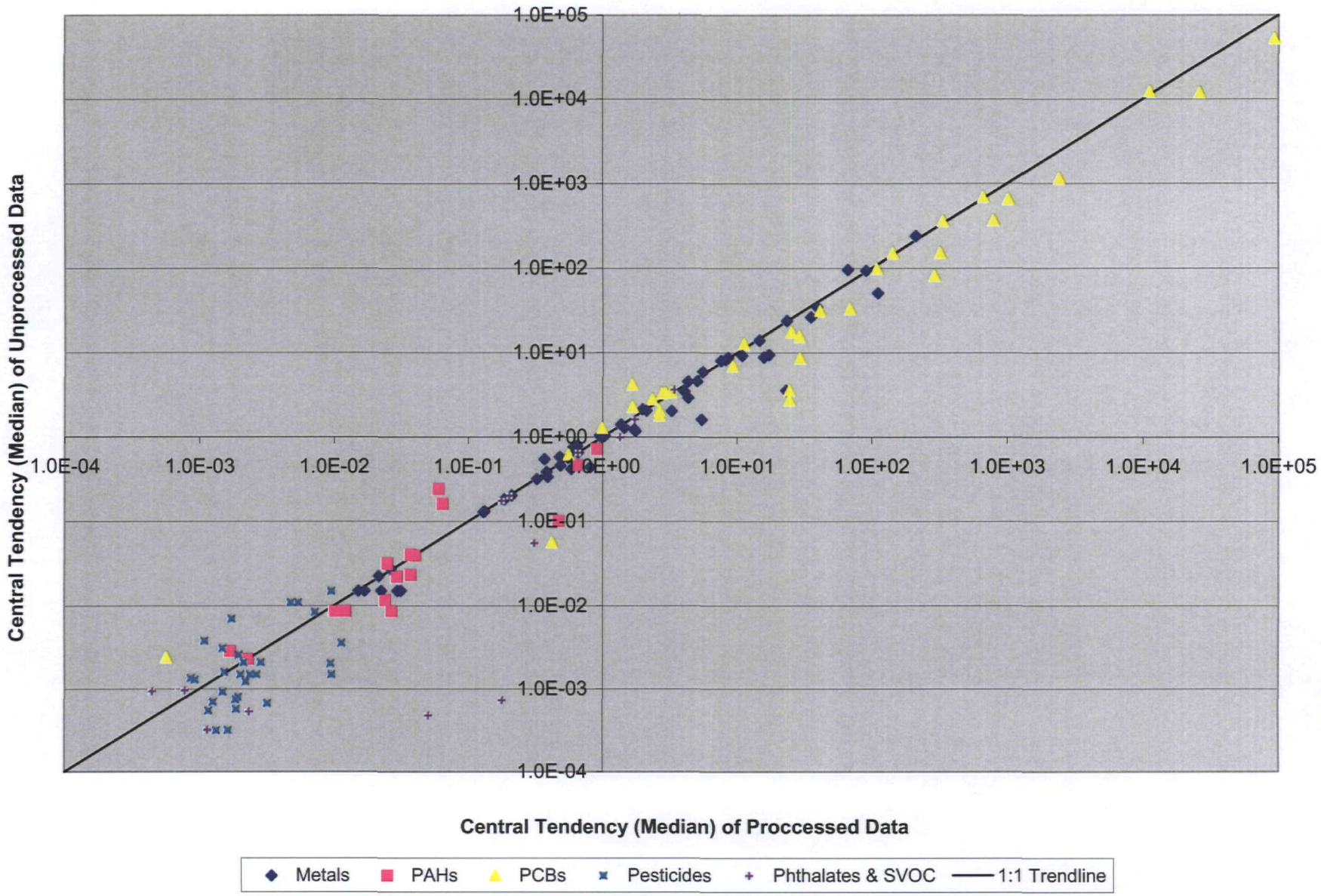

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Figure E3-2
Portland Harbor RI/FS
Draft Remedial Investigation Report
Plot of Stormwater Uncertainty Evaluation,
Median Comparison Between Processed and Unprocessed Data

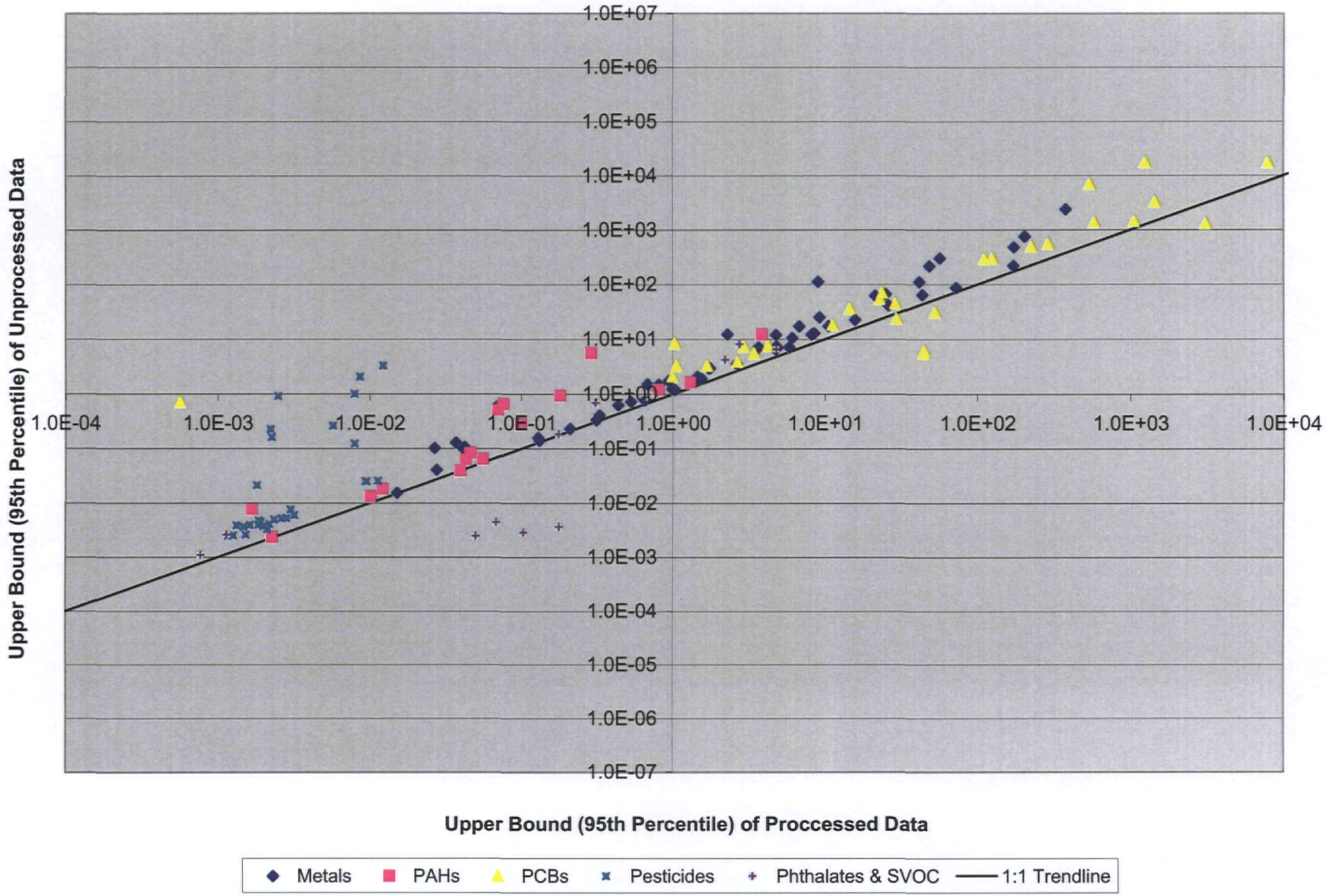

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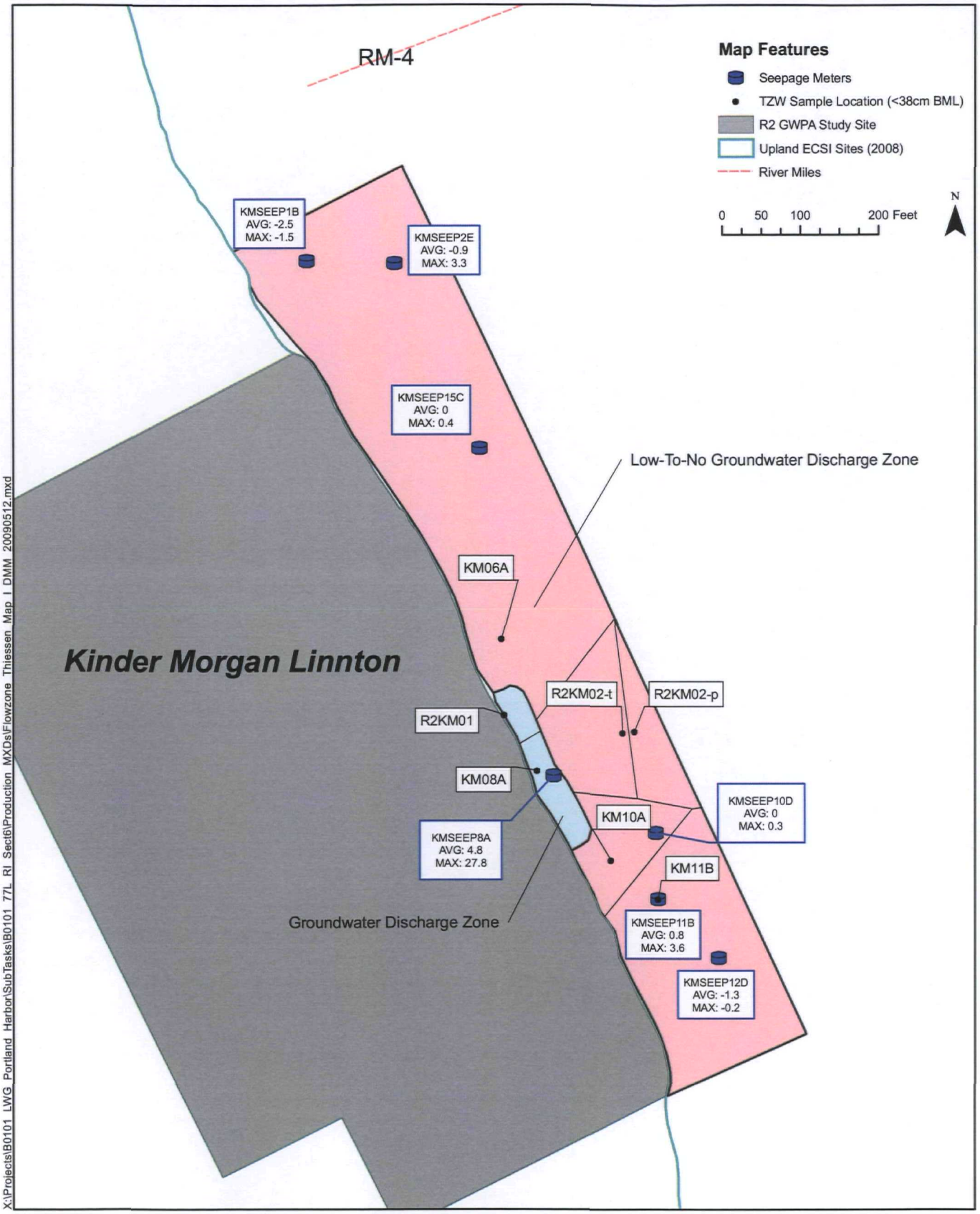
Figure E3-3
Portland Harbor RI/FS
Draft Remedial Investigation Report
Plot of Stormwater Uncertainty Evaluation,
Upper Bound Comparison Between Processed and Unprocessed Data



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FEATURE SOURCES:
Property and Taxlot Boundaries: Metro RLIS

t Indicates sample collected by Trident sampler
p Indicates sample collected by small volume peeper
PS Indicates sample collected during the GWPA Pilot Study

Figure E6-1
Portland Harbor RI/FS
Draft Remedial Investigation Report
Groundwater Plume Loading Estimate Approach
Kinder Morgan Linnton TZW Study Area

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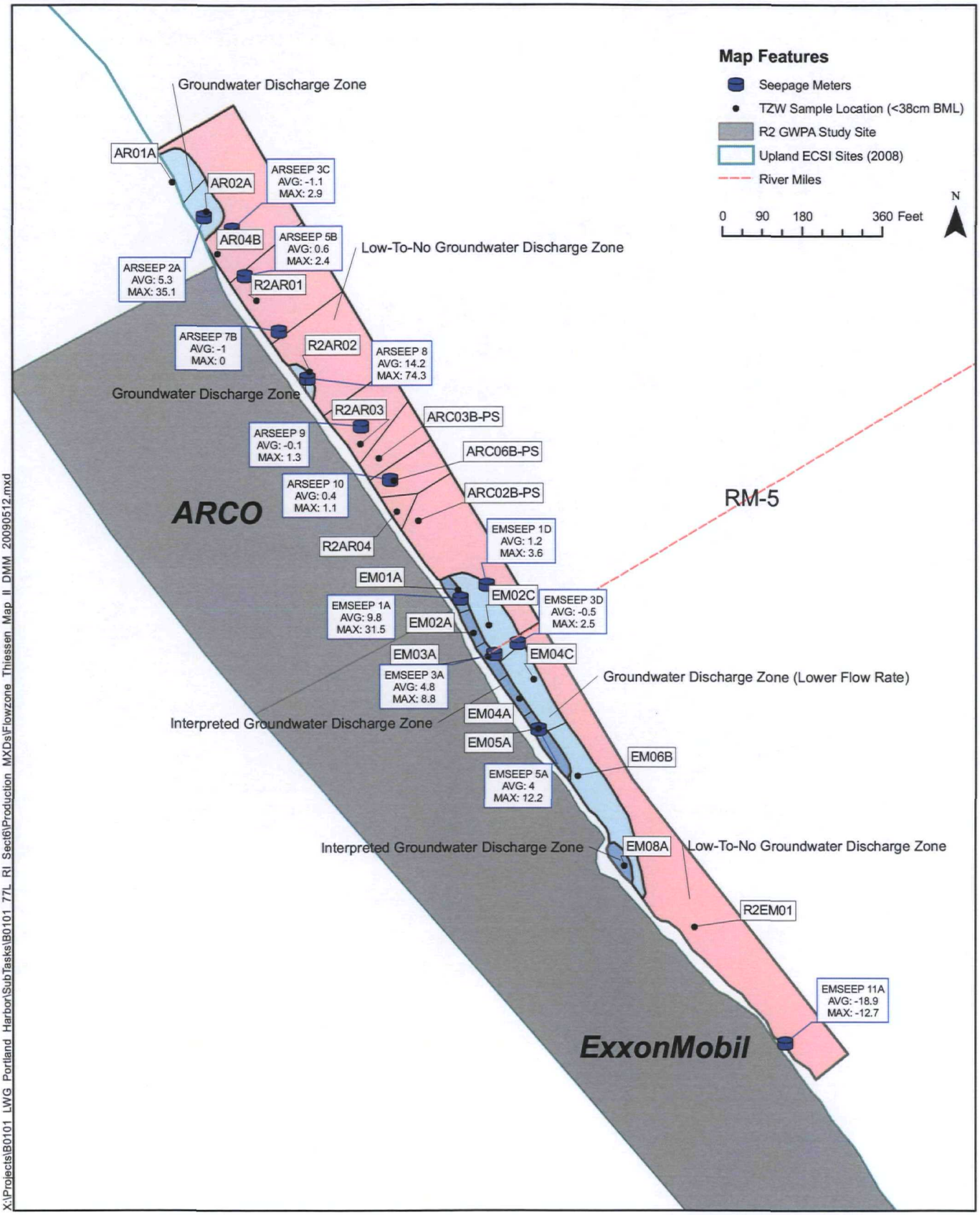

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FEATURE SOURCES:
Property and Taxlot Boundaries: Metro RLIS

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PS Indicates sample collected during the GWPA Pilot Study

Figure E6-2
Portland Harbor RI/FS
Draft Remedial Investigation Report
Groundwater Plume Loading Estimate Approach
ARCO and ExxonMobil TZW Study Areas

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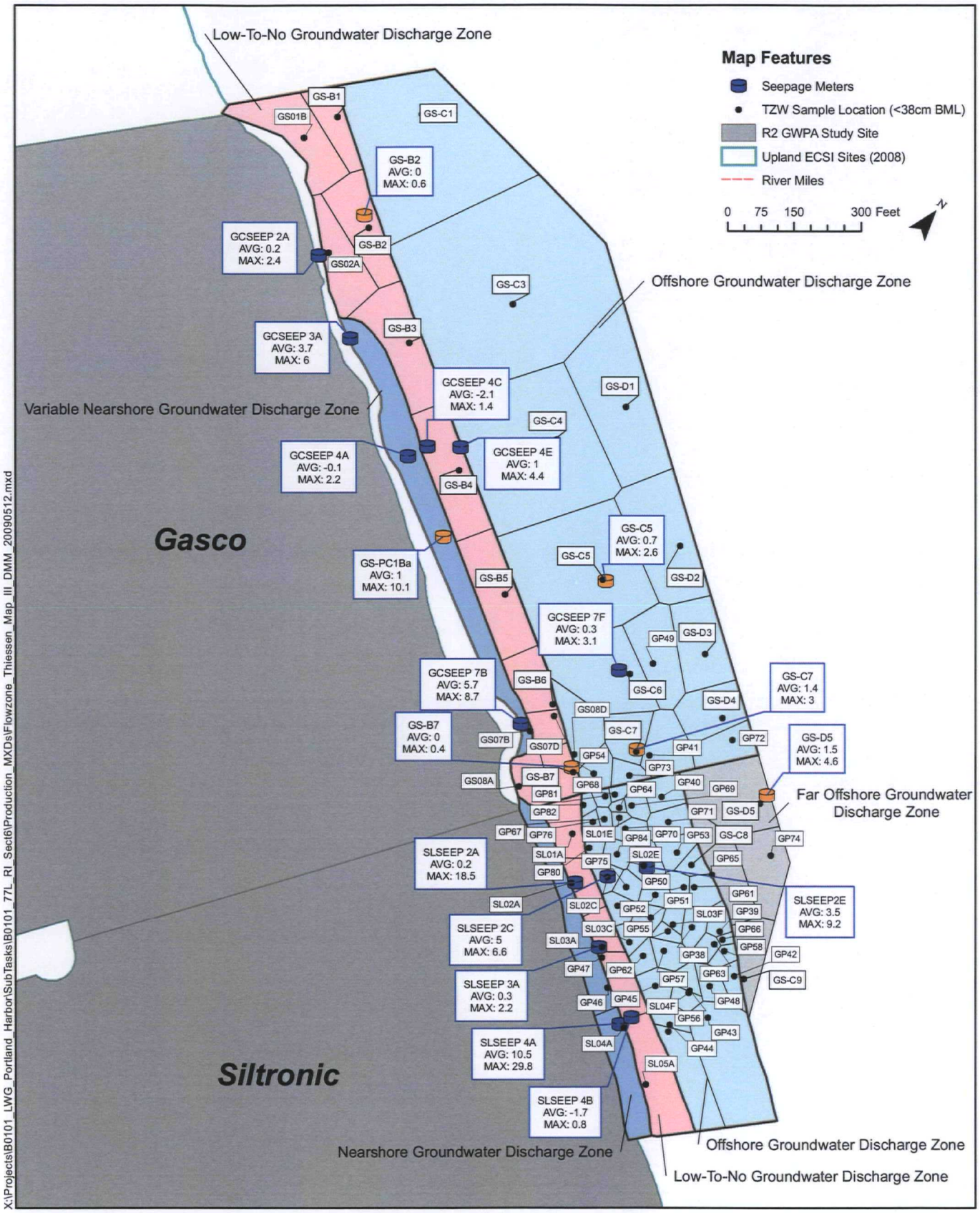

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FEATURE SOURCES:
Property and Taxlot Boundaries: Metro RLIS

t Indicates sample collected by Trident sampler
p Indicates sample collected by small volume peeper
PS Indicates sample collected during the GWPA Pilot Study

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Figure E6-3
Portland Harbor RI/FS
Draft Remedial Investigation Report
Groundwater Plume Loading Estimate Approach
Gasco and Siltronic TZW Study Areas

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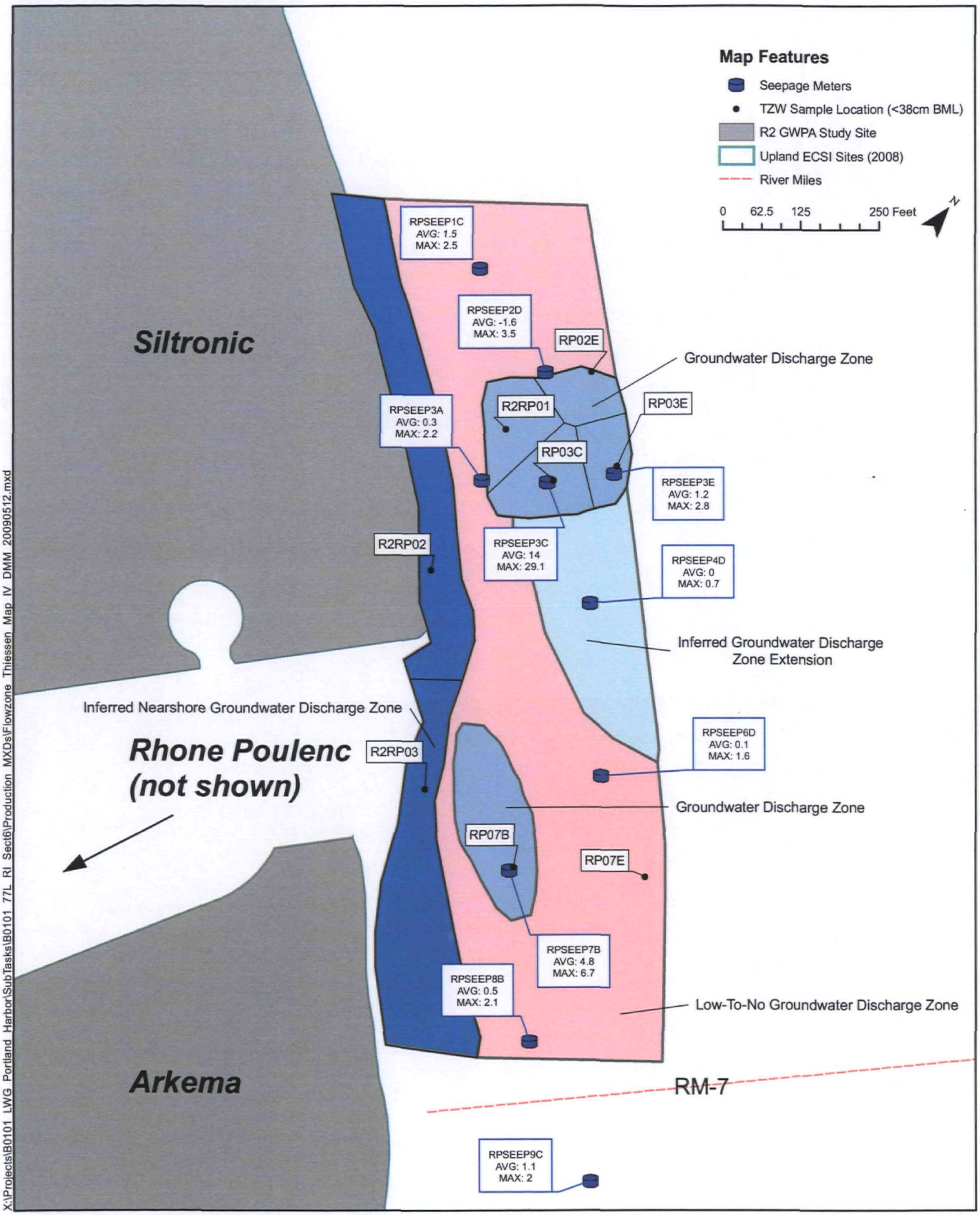

FEATURE SOURCES:
Property and Taxlot Boundaries: Metro RLIS

t Indicates sample collected by Trident sampler
p Indicates sample collected by small volume peeper
PS Indicates sample collected during the GWPA Pilot Study

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Figure E6-4
Portland Harbor RI/FS
Draft Remedial Investigation Report
Groundwater Plume Loading Estimate Approach
Rhone Poulenc TZW Study Area

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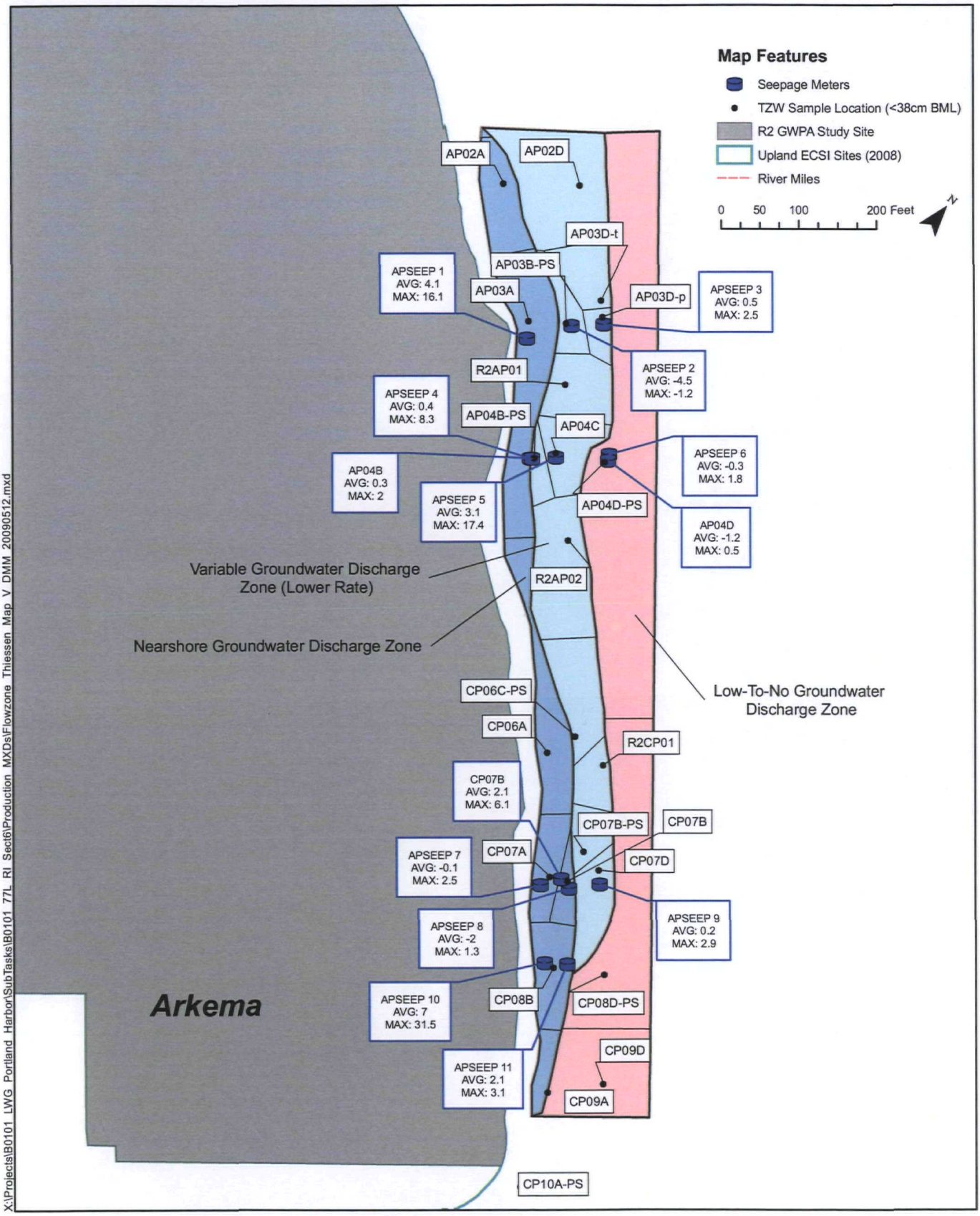

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FEATURE SOURCES:
Property and Taxlot Boundaries: Metro RLIS

t Indicates sample collected by Trident sampler
p Indicates sample collected by small volume peeper
PS Indicates sample collected during the GWPA Pilot Study

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Figure E6-5
Portland Harbor RI/FS
Draft Remedial Investigation Report
Groundwater Plume Loading Estimate Approach
Arkema TZW Study Area

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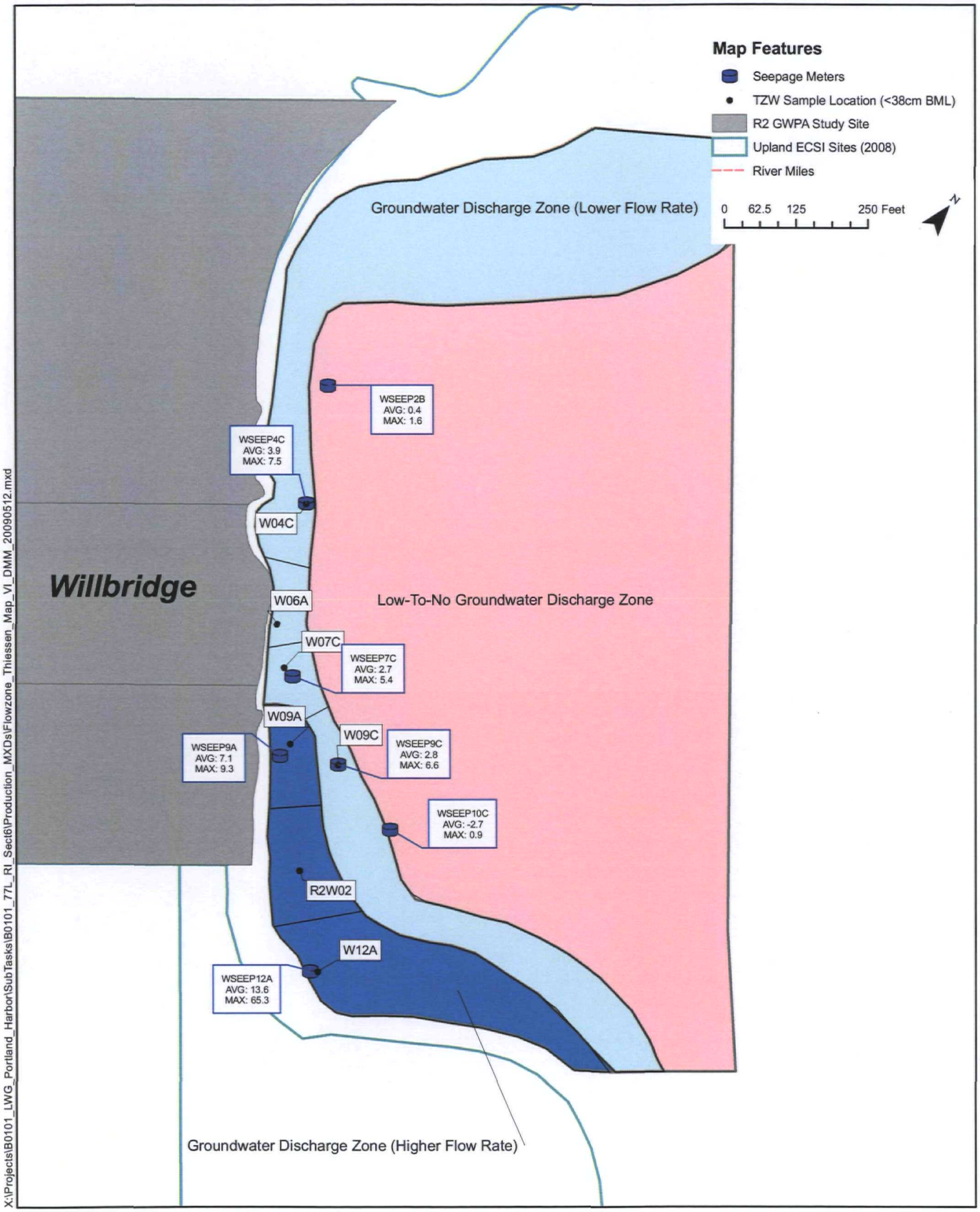

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FEATURE SOURCES:
Property and Taxlot Boundaries: Metro RLIS

t Indicates sample collected by Trident sampler
p Indicates sample collected by small volume peeper
PS Indicates sample collected during the GWPA Pilot Study

Figure E6-6
Portland Harbor RI/FS
Draft Remedial Investigation Report
Groundwater Plume Loading Estimate Approach
Willbridge TZW Study Area

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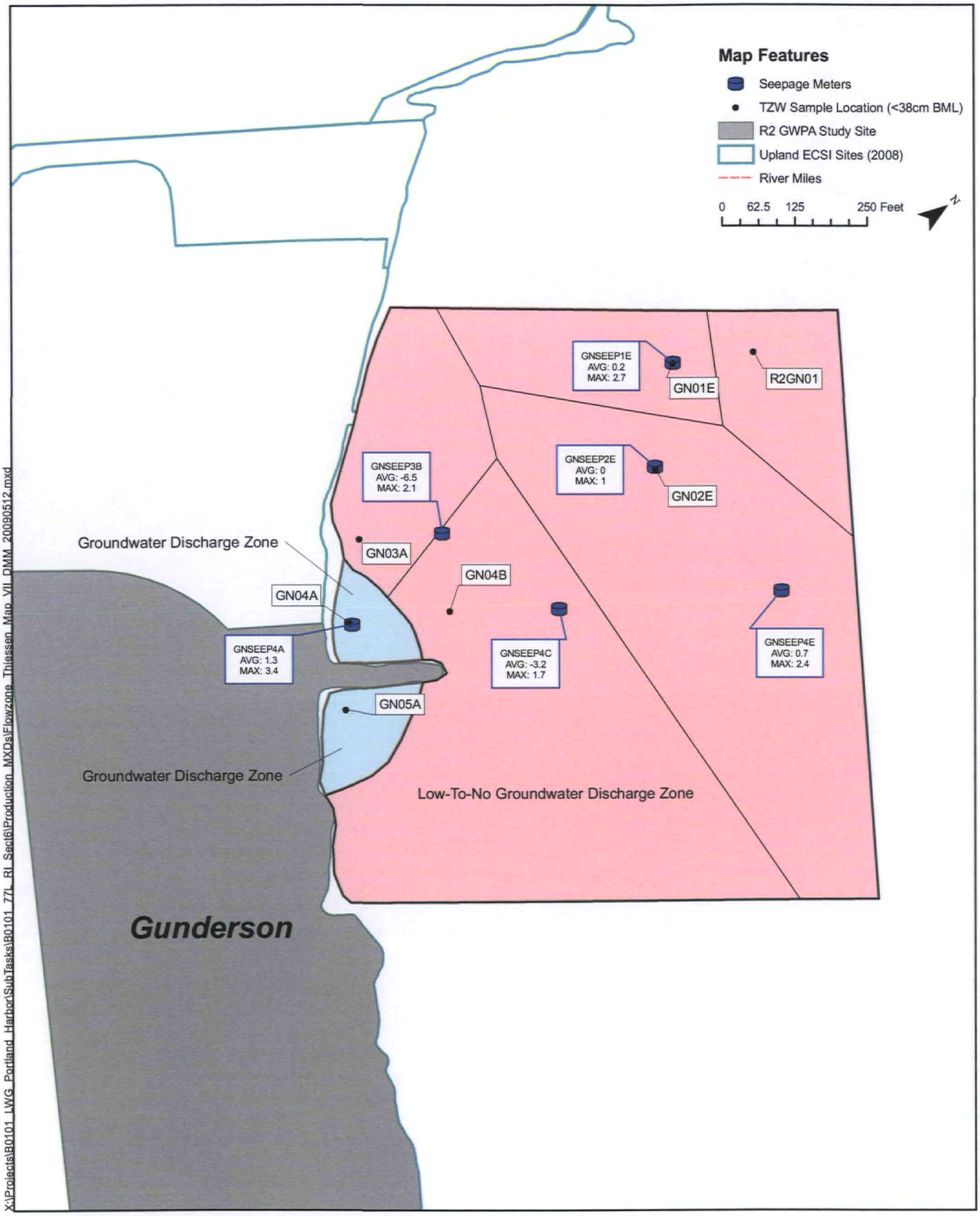

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FEATURE SOURCES:
Property and Taxlot Boundaries: Metro RLIS

t Indicates sample collected by Trident sampler
p Indicates sample collected by small volume peeper
PS Indicates sample collected during the GWPA Pilot Study

Figure E6-7
Portland Harbor RI/FS
Draft Remedial Investigation Report
Groundwater Plume Loading Estimate Approach
Gunderson TZW Study Area

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Table E2-1. Summary of Annual Flow and Flow Fractions for the Willamette River.[a,b]

Year	Volume (cf)			Flow Based Volume Fraction	
	Total	High Flow	Low Flow	High Flow	Low Flow
2004	9.0E+11	3.5E+11	5.4E+11	39%	61%
2005	7.4E+11	1.5E+11	5.8E+11	21%	79%
2006	1.4E+12	8.9E+11	5.0E+11	64%	36%
Average (2004-2006)	1.0E+12	4.7E+11	5.4E+11	46%	54%
Average (1975-2003)	1.0E+12	5.3E+11	4.9E+11	52%	48%

Notes:

[a] Measured at the USGS gauging station at Morrison Bridge.

[b] As of 7/3/2008 discharge data was unavailable for the 10/1/2007 to 12/1/2007 period; therefore, total volume and flow-based volume fractions were not calculated for 2007.

USGS - U.S. Geological Survey

Table E2-2. Mann-Whitney U-test Results of the Comparison of RM 16 and RM 11 Concentrations.

	Sample Count		Rank Sum			
Analyte	**RM 11**	**RM 16**	**RM 11**	**RM 16**	**p-level**	**Significance [a]**
PCBs						
PCB077	8	4	55	23	0.610	No
PCB081	8	4	49	29	0.544	No
PCB105	8	4	60	18	0.174	No
PCB118	8	4	60	18	0.174	No
PCB126	8	4	53	25	0.856	No
PCB156 & PCB157	8	4	61	17	0.126	No
Total PCB Congeners	8	4	61	17	0.126	No
PCB TEQ (ND=0)	8	4	55	23	0.610	No
PCDD/Fs						
Total PCDD/Fs	8	4	54	24	0.734	No
TCDD TEQ (ND=0)	8	4	58	20	0.308	No
DDx Pesticides						
4,4'-DDD	8	4	50	28	0.734	No
4,4'-DDT	8	4	48	30	0.497	No
Total of 2,4' and 4,4'-DDE	8	4	51	27	0.865	No
Total of 2,4' and 4,4'-DDD	8	4	50	28	0.734	No
Total of 2,4' and 4,4'-DDT	8	4	49	29	0.610	No
Total DDx	8	4	52	26	1.000	No
PAHs						
Naphthalene	8	4	53	25	0.824	No
Benzo(a)pyrene	8	4	61	17	0.124	No
Total Carcinogenic PAHs	8	4	58	20	0.308	No
cPAH BaPEq	8	4	62	16	0.089	No
Total PAHs	8	4	54	24	0.734	No
SVOCs						
Bis(2-ethylhexyl)phthalate	3	0	--	--	--	--
Hexachlorobenzene	8	4	56	22	0.497	No
Pesticides (non-DDx)						
Total Chlordanes	8	4	50	28	0.734	No
γ-Hexachlorocyclohexane	8	4	54	24	0.734	No
Aldrin	8	4	51	27	0.865	No
Dieldrin	8	4	48	30	0.497	No
Metals						
Arsenic	8	4	58	21	0.349	No
Chromium	8	4	51	27	0.864	No
Copper	8	4	53	25	0.865	No
Lead	8	4	51	27	0.865	No
Mercury	8	4	54	24	0.685	No
Nickel	8	4	56	22	0.497	No
Zinc	8	4	53	25	0.865	No

Notes:

[a] Significance evaluated at the 0.05 level. A value with $p < 0.05$ is considered to show a significant difference between RM 11 and RM 16 data.

-- Insufficient data to perform operation.
BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
RM - river mile
SVOC - semivolatile organic compound
TEQ - toxic equivalent concentration

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Table E2-3. Summary of Samples Excluded from Upstream Surface Water Loading Calculations.

		River Mile	11	11	11	11	11
		Collection Method	EDI	EDI	VI, east	VI, east	EDI
		Sample ID	LW2-W023	LW2-W2023	LW3-W2023-E	LW3-W3023-E	LW3-W1023
		Flow Event Type	Low Flow	Low Flow	Low Flow	Stormwater Influenced	High Flow
		Sample Date	11/17/2004	3/7/2005	9/6/2006	11/2/2006	1/20/2006
Analyte Name	**Filtration**	**Units**					
PCBs							
PCB077	Dissolved	pg/L	--	--	--	0.224 U	--
PCB077	Particulate	pg/L	--	--	--	0.714	--
PCB077	Total	pg/L	--	--	--	0.714	--
PCB105	Dissolved	pg/L	--	--	--	0.906	--
PCB105	Particulate	pg/L	--	--	--	4.66	--
PCB105	Total	pg/L	--	--	--	5.57	--
PCB118	Dissolved	pg/L	--	--	--	2.25	--
PCB118	Particulate	pg/L	--	--	--	11.7	--
PCB118	Total	pg/L	--	--	--	14	--
PCB126	Dissolved	pg/L	--	--	--	0.151	--
PCB126	Particulate	pg/L	--	--	--	0.0449 U	--
PCB126	Total	pg/L	--	--	--	0.151	--
PCB156 & PCB157	Dissolved	pg/L	0.279	--	0.279	0.236 J	--
PCB156 & PCB157	Particulate	pg/L	3.49	--	3.49	3	--
PCB156 & PCB157	Total	pg/L	3.77	--	3.77	3.236 J	--
Total PCB Congeners	Dissolved	pg/L	42.4 J	--	287 J	144 J	--
Total PCB Congeners	Particulate	pg/L	566 J	--	663 J	408 J	--
Total PCB Congeners	Total	pg/L	608 J	--	950 J	553 J	--
PCB TEQ (ND=0)	Dissolved	pg/L	--	--	--	0.000108 J	--
PCB TEQ (ND=0)	Particulate	pg/L	--	--	--	0.0158 J	--
PCB TEQ (ND=0)	Total	pg/L	--	--	--	0.0159 J	--
PCDD/Fs							
Total PCDD/Fs	Dissolved	pg/L	--	--	--	9.35	--
Total PCDD/Fs	Particulate	pg/L	--	--	--	109	--
Total PCDD/Fs	Total	pg/L	--	--	--	118	--
TCDD TEQ (ND=0)	Dissolved	pg/L	--	--	--	0.033 J	--
TCDD TEQ (ND=0)	Particulate	pg/L	--	--	--	0.245 J	--
TCDD TEQ (ND=0)	Total	pg/L	--	--	--	0.278 J	--
PAHs							
Naphthalene	Dissolved	pg/L	--	34500	--	--	--
Naphthalene	Particulate	pg/L	--	1010 U	--	--	--
Naphthalene	Total	pg/L	--	34500	--	--	--
Benzo(a)pyrene	Dissolved	pg/L	--	--	--	198 J	--
Benzo(a)pyrene	Particulate	pg/L	--	--	--	1000 J	--
Benzo(a)pyrene	Total	pg/L	--	--	--	1198 J	--
Total Carcinogenic PAHs	Dissolved	µg/L	--	--	--	0.0012 JT	--
Total Carcinogenic PAHs	Particulate	µg/L	--	--	--	0.0057 JT	--
Total Carcinogenic PAHs	Total	µg/L	--	--	--	0.0069 JT	--
cPAH BaPEq	Dissolved	µg/L	--	--	--	0.000000287 JT	--
cPAH BaPEq	Particulate	µg/L	--	--	--	0.00079 JT	--
cPAH BaPEq	Total	µg/L	--	--	--	0.00079 JT	--
Total PAHs	Dissolved	pg/L	--	65500 J	--	--	--
Total PAHs	Particulate	pg/L	--	482	--	--	--
Total PAHs	Total	pg/L	--	66000 J	--	--	--

Notes: -- Sample not excluded from analysis.

BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
EDI - equal discharge increment
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
TEQ - toxic equivalent concentration
VI - vertically integrated

Reason codes for qualifiers:
J - The associated numerical value is an estimated quantity.
T - The associated numerical value was mathematically derived (e.g., from summing multiple analyte results such as Aroclors, or calculating the average of multiple results for a single analyte). Also indicates all results that are selected for reporting in preference to other available results (e.g., for parameters reported by multiple methods) for the Round 2 data.
U - The material was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit.

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Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

Analyte	Units	Load Estimation Type	Filtration	RM 16 High Flow	RM 16 Low Flow	RM 16 Annual	RM 11 High Flow	RM 11 Low Flow	RM 11 Annual	RM 6.3 High Flow	RM 6.3 Low Flow	RM 6.3 Annual
PCBs												
PCB077	kg/yr	Lower	Total	0.00167	0.00455	0.00622	0.00139	0.0038	0.00519	0.00427	0.00545	0.00972
PCB077	kg/yr	Upper	Total	0.00596	0.00487	0.0108	0.00891	0.00697	0.0159	0.00427	0.0135	0.0178
PCB077	kg/yr	Central	Total	0.00381	0.00471	0.00852	0.00493	0.00529	0.0102	0.00427	0.00855	0.0128
PCB077	kg/yr	Lower	Particulate	0.00115	0.00173	0.00288	0.000506	0.00211	0.00261	0.00305	0.00306	0.00611
PCB077	kg/yr	Upper	Particulate	0.00433	0.00487	0.00921	0.00728	0.00592	0.0132	0.00305	0.00873	0.0118
PCB077	kg/yr	Central	Particulate	0.00274	0.0033	0.00604	0.00382	0.00343	0.00724	0.00305	0.00502	0.00808
PCB077	kg/yr	Lower	Dissolved	0.000521	0	0.000521	0.000824	0	0.000824	0.00122	0.00239	0.00361
PCB077	kg/yr	Upper	Dissolved	0.00162	0.00282	0.00444	0.00162	0.00357	0.0052	0.00122	0.0048	0.00602
PCB077	kg/yr	Central	Dissolved	0.00107	0.00141	0.00248	0.00111	0.00186	0.00297	0.00122	0.00353	0.00475
PCB081	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
PCB081	kg/yr	Upper	Total	0.0000521	0.0000279	0.00008	0.0000447	0.0000884	0.000133	0	0.00017	0.00017
PCB081	kg/yr	Central	Total	0.0000261	0.000014	0.00004	0.0000149	0.0000177	0.0000326	0	0.0000339	0.0000339
PCB081	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
PCB081	kg/yr	Upper	Dissolved	0	0	0	0	0	0	0	0	0
PCB081	kg/yr	Central	Dissolved	0	0	0	0	0	0	0	0	0
PCB081	kg/yr	Lower	Particulate	0	0	0	0	0	0	0	0	0
PCB081	kg/yr	Upper	Particulate	0.0000521	0.0000279	0.00008	0.0000447	0.0000884	0.000133	0	0.00017	0.00017
PCB081	kg/yr	Central	Particulate	0.0000261	0.000014	0.00004	0.0000149	0.0000177	0.0000326	0	0.0000339	0.0000339
PCB105	kg/yr	Lower	Total	0.0103	0.0193	0.0296	0.00591	0.0205	0.0264	0.0194	0.0263	0.0457
PCB105	kg/yr	Upper	Total	0.0273	0.0301	0.0574	0.0415	0.0486	0.0902	0.0194	0.0741	0.0935
PCB105	kg/yr	Central	Total	0.0188	0.0247	0.0435	0.0243	0.0356	0.0599	0.0194	0.0477	0.0671
PCB105	kg/yr	Lower	Dissolved	0.00471	0.00586	0.0106	0.00368	0.00413	0.00781	0.00532	0.0111	0.0164
PCB105	kg/yr	Upper	Dissolved	0.00722	0.0106	0.0178	0.00847	0.0181	0.0266	0.00532	0.0236	0.0289
PCB105	kg/yr	Central	Dissolved	0.00596	0.00823	0.0142	0.00586	0.012	0.0178	0.00532	0.0168	0.0221
PCB105	kg/yr	Lower	Particulate	0.00561	0.00866	0.0143	0.00223	0.0123	0.0145	0.0141	0.0152	0.0293
PCB105	kg/yr	Upper	Particulate	0.0201	0.0242	0.0443	0.0331	0.0369	0.07	0.0141	0.0505	0.0645
PCB105	kg/yr	Central	Particulate	0.0129	0.0164	0.0293	0.0184	0.0237	0.0421	0.0141	0.0309	0.045
PCB118	kg/yr	Lower	Total	0.0265	0.0457	0.0723	0.0149	0.0505	0.0655	0.0477	0.0741	0.122
PCB118	kg/yr	Upper	Total	0.0682	0.0797	0.148	0.104	0.119	0.223	0.0477	0.206	0.253
PCB118	kg/yr	Central	Total	0.0474	0.0627	0.11	0.0596	0.0948	0.154	0.0477	0.129	0.177
PCB118	kg/yr	Lower	Particulate	0.0135	0.0196	0.0331	0.005	0.0292	0.0342	0.0333	0.0399	0.0732
PCB118	kg/yr	Upper	Particulate	0.0488	0.0539	0.103	0.0807	0.0902	0.171	0.0333	0.138	0.171
PCB118	kg/yr	Central	Particulate	0.0312	0.0368	0.0679	0.0437	0.0636	0.107	0.0333	0.0812	0.115
PCB118	kg/yr	Lower	Dissolved	0.0131	0.0258	0.0389	0.00993	0.0112	0.0211	0.0144	0.0342	0.0486
PCB118	kg/yr	Upper	Dissolved	0.0194	0.0261	0.0455	0.0234	0.0484	0.0717	0.0144	0.0679	0.0823
PCB118	kg/yr	Central	Dissolved	0.0162	0.026	0.0422	0.0159	0.0312	0.0472	0.0144	0.0478	0.0622
PCB126	kg/yr	Lower	Total	0	0	0	0	0	0	0.000201	0.00023	0.000431
PCB126	kg/yr	Upper	Total	0.0000596	0.000398	0.000457	0.000174	0.00108	0.00125	0.000201	0.000666	0.000867
PCB126	kg/yr	Central	Total	0.0000298	0.000199	0.000229	0.0000579	0.000343	0.000401	0.000201	0.000482	0.000683
PCB126	kg/yr	Lower	Particulate	0	0	0	0	0	0	0.000201	0.00023	0.000431
PCB126	kg/yr	Upper	Particulate	0.0000596	0.000398	0.000457	0.000174	0.00108	0.00125	0.000201	0.000574	0.000775
PCB126	kg/yr	Central	Particulate	0.0000298	0.000199	0.000229	0.0000579	0.000322	0.00038	0.000201	0.00041	0.000611
PCB126	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
PCB126	kg/yr	Upper	Dissolved	0	0	0	0	0.000108	0.000108	0	0.000233	0.000233
PCB126	kg/yr	Central	Dissolved	0	0	0	0	0.0000215	0.0000215	0	0.0000715	0.0000715

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

Analyte	Units	Load Estimation Type	Filtration	RM 16 High Flow	RM 16 Low Flow	RM 16 Annual	RM 11 High Flow	RM 11 Low Flow	RM 11 Annual	RM 6.3 High Flow	RM 6.3 Low Flow	RM 6.3 Annual
PCB156 & PCB157	kg/yr	Lower	Total	0.00247	0.00511	0.00758	0.000849	0.00681	0.00766	0.00737	0.0143	0.0217
PCB156 & PCB157	kg/yr	Upper	Total	0.0113	0.00817	0.0194	0.0167	0.0421	0.0589	0.00737	0.0333	0.0407
PCB156 & PCB157	kg/yr	Central	Total	0.00687	0.00664	0.0135	0.00891	0.0219	0.0308	0.00737	0.0221	0.0295
PCB156 & PCB157	kg/yr	Lower	Dissolved	0	0	0	0	0.000783	0.000783	0	0.00332	0.00332
PCB156 & PCB157	kg/yr	Upper	Dissolved	0.00238	0.00179	0.00418	0.00238	0.00365	0.00604	0	0.00574	0.00574
PCB156 & PCB157	kg/yr	Central	Dissolved	0.00119	0.000897	0.00209	0.000794	0.00221	0.003	0	0.00418	0.00418
PCB156 & PCB157	kg/yr	Lower	Particulate	0.00247	0.00332	0.00579	0.000849	0.00535	0.0062	0.00737	0.0108	0.0181
PCB156 & PCB157	kg/yr	Upper	Particulate	0.00889	0.00817	0.0171	0.0144	0.0413	0.0557	0.00737	0.0276	0.0349
PCB156 & PCB157	kg/yr	Central	Particulate	0.00568	0.00575	0.0114	0.00812	0.0197	0.0278	0.00737	0.0179	0.0253
PCB169	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Upper	Total	0.0000447	0.000363	0.000408	0	0.0000791	0.0000791	0	0	0
PCB169	kg/yr	Central	Total	0.0000223	0.000182	0.000204	0	0.0000158	0.0000158	0	0	0
PCB169	kg/yr	Lower	Particulate	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Upper	Particulate	0.0000447	0	0.0000447	0	0	0	0	0	0
PCB169	kg/yr	Central	Particulate	0.0000223	0	0.0000223	0	0	0	0	0	0
PCB169	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Upper	Dissolved	0	0.000363	0.000363	0	0.0000791	0.0000791	0	0	0
PCB169	kg/yr	Central	Dissolved	0	0.000182	0.000182	0	0.0000158	0.0000158	0	0	0
Total PCB Congeners	kg/yr	Lower	Total	1.11	2.32	3.42	0.625	2.39	3.01	2	3.62	5.62
Total PCB Congeners	kg/yr	Upper	Total	1.93	2.47	4.4	2.9	8.49	11.4	2	11.3	13.3
Total PCB Congeners	kg/yr	Central	Total	1.52	2.39	3.91	1.86	5.31	7.17	2	6.79	8.79
Total PCB Congeners	kg/yr	Lower	Particulate	0.326	0.484	0.81	0.109	0.941	1.05	1.1	1.54	2.64
Total PCB Congeners	kg/yr	Upper	Particulate	1.16	1.1	2.26	1.89	7.9	9.79	1.1	5.3	6.4
Total PCB Congeners	kg/yr	Central	Particulate	0.743	0.793	1.54	1.07	3.4	4.48	1.1	3.12	4.23
Total PCB Congeners	kg/yr	Lower	Dissolved	0.765	1.37	2.13	0.515	0.591	1.11	0.9	2.08	2.98
Total PCB Congeners	kg/yr	Upper	Dissolved	0.782	1.83	2.61	1	3.11	4.12	0.9	6.01	6.91
Total PCB Congeners	kg/yr	Central	Dissolved	0.773	1.6	2.37	0.784	1.9	2.69	0.9	3.66	4.56
PCB TEQ (ND=0)	kg/yr	Lower	Total	0.00000397	0.00000269	0.00000665	0.000000806	0.00000542	0.00000623	0.0000229	0.0000283	0.0000513
PCB TEQ (ND=0)	kg/yr	Upper	Total	0.00000873	0.0000549	0.0000636	0.0000209	0.000117	0.000138	0.0000229	0.0000745	0.0000974
PCB TEQ (ND=0)	kg/yr	Central	Total	0.00000635	0.0000288	0.0000351	0.00000923	0.0000404	0.0000496	0.0000229	0.0000555	0.0000784
PCB TEQ (ND=0)	kg/yr	Lower	Particulate	0.00000289	0.00000119	0.00000408	0.000000309	0.00000298	0.00000329	0.0000222	0.0000263	0.0000485
PCB TEQ (ND=0)	kg/yr	Upper	Particulate	0.00000812	0.000043	0.0000511	0.0000202	0.000113	0.000133	0.0000222	0.0000647	0.0000869
PCB TEQ (ND=0)	kg/yr	Central	Particulate	0.00000551	0.0000221	0.0000276	0.00000842	0.0000361	0.0000446	0.0000222	0.0000458	0.000068
PCB TEQ (ND=0)	kg/yr	Lower	Dissolved	0.000000606	0.0000015	0.0000021	0.000000496	0.000000581	0.00000108	0.000000735	0.00000201	0.00000274
PCB TEQ (ND=0)	kg/yr	Upper	Dissolved	0.00000108	0.0000119	0.0000129	0.00000123	0.0000119	0.0000132	0.000000735	0.0000256	0.0000263
PCB TEQ (ND=0)	kg/yr	Central	Dissolved	0.000000841	0.00000667	0.00000752	0.000000813	0.00000423	0.00000505	0.000000735	0.00000968	0.0000104
PCDD/Fs												
Total PCDD/Fs	kg/yr	Lower	Total	0.133	0.124	0.257	0.0798	0.234	0.313	0.27	0.318	0.589
Total PCDD/Fs	kg/yr	Upper	Total	0.447	0.427	0.874	0.486	0.762	1.25	0.27	0.493	0.764
Total PCDD/Fs	kg/yr	Central	Total	0.29	0.276	0.565	0.325	0.382	0.707	0.27	0.403	0.673
Total PCDD/Fs	kg/yr	Lower	Particulate	0.0892	0.0996	0.189	0.0477	0.221	0.269	0.234	0.305	0.539
Total PCDD/Fs	kg/yr	Upper	Particulate	0.385	0.376	0.761	0.428	0.696	1.12	0.234	0.47	0.705
Total PCDD/Fs	kg/yr	Central	Particulate	0.237	0.238	0.475	0.285	0.35	0.634	0.234	0.379	0.614
Total PCDD/Fs	kg/yr	Lower	Dissolved	0.0438	0.0246	0.0685	0.0317	0.00684	0.0386	0.0362	0.011	0.0472
Total PCDD/Fs	kg/yr	Upper	Dissolved	0.0616	0.0512	0.113	0.0574	0.0666	0.124	0.0362	0.0381	0.0743
Total PCDD/Fs	kg/yr	Central	Dissolved	0.0527	0.0379	0.0906	0.0404	0.0325	0.0729	0.0362	0.0234	0.0595

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

Analyte	Units	Load Estimation Type	Filtration	RM 16 High Flow	RM 16 Low Flow	RM 16 Annual	RM 11 High Flow	RM 11 Low Flow	RM 11 Annual	RM 6.3 High Flow	RM 6.3 Low Flow	RM 6.3 Annual
TCDD TEQ (ND=0)	kg/yr	Lower	Total	0.0003	0.000407	0.000707	0.000169	0.0006	0.000769	0.000568	0.000867	0.00143
TCDD TEQ (ND=0)	kg/yr	Upper	Total	0.000947	0.000802	0.00175	0.00136	0.00176	0.00312	0.000568	0.00153	0.00209
TCDD TEQ (ND=0)	kg/yr	Central	Total	0.000623	0.000604	0.00123	0.000784	0.000997	0.00178	0.000568	0.00118	0.00175
TCDD TEQ (ND=0)	kg/yr	Lower	Particulate	0.000189	0.000295	0.000484	0.0000741	0.000542	0.000616	0.000466	0.000822	0.00129
TCDD TEQ (ND=0)	kg/yr	Upper	Particulate	0.000675	0.00071	0.00138	0.00114	0.00155	0.00269	0.000466	0.00144	0.00191
TCDD TEQ (ND=0)	kg/yr	Central	Particulate	0.000432	0.000502	0.000934	0.000648	0.000909	0.00156	0.000466	0.00113	0.0016
TCDD TEQ (ND=0)	kg/yr	Lower	Dissolved	0.000112	0.0000926	0.000204	0.0000916	0.00000779	0.0000994	0.000102	0.00000599	0.000108
TCDD TEQ (ND=0)	kg/yr	Upper	Dissolved	0.000272	0.000111	0.000383	0.000222	0.000209	0.000431	0.000102	0.0000872	0.000189
TCDD TEQ (ND=0)	kg/yr	Central	Dissolved	0.000192	0.000102	0.000294	0.000136	0.0000884	0.000224	0.000102	0.0000534	0.000155
DDx Pesticides												
4,4'-DDD	kg/yr	Lower	Total	0.585	0.272	0.857	0.418	0.162	0.58	1.03	0.525	1.56
4,4'-DDD	kg/yr	Upper	Total	0.809	0.351	1.16	1.25	0.564	1.82	1.03	2.17	3.2
4,4'-DDD	kg/yr	Central	Total	0.697	0.311	1.01	0.782	0.314	1.1	1.03	1.17	2.2
4,4'-DDD	kg/yr	Lower	Particulate	0.359	0	0.359	0.0758	0	0.0758	0.661	0.136	0.797
4,4'-DDD	kg/yr	Upper	Particulate	0.405	0.0743	0.479	0.872	0.139	1.01	0.661	0.952	1.61
4,4'-DDD	kg/yr	Central	Particulate	0.382	0.0372	0.419	0.472	0.0769	0.549	0.661	0.418	1.08
4,4'-DDD	kg/yr	Lower	Dissolved	0.18	0.272	0.452	0.206	0.0579	0.263	0.372	0.292	0.663
4,4'-DDD	kg/yr	Upper	Dissolved	0.45	0.276	0.726	0.38	0.425	0.806	0.372	1.22	1.59
4,4'-DDD	kg/yr	Central	Dissolved	0.315	0.274	0.589	0.309	0.237	0.547	0.372	0.754	1.13
4,4'-DDT	kg/yr	Lower	Total	2.46	0.13	2.59	0.999	0.0407	1.04	2.88	0.234	3.11
4,4'-DDT	kg/yr	Upper	Total	3.92	0.248	4.16	4.79	0.33	5.12	2.88	0.779	3.65
4,4'-DDT	kg/yr	Central	Total	3.19	0.189	3.38	3.05	0.138	3.18	2.88	0.454	3.33
4,4'-DDT	kg/yr	Lower	Particulate	1.39	0.105	1.5	0.29	0	0.29	2.08	0.13	2.21
4,4'-DDT	kg/yr	Upper	Particulate	2.95	0.188	3.14	3.74	0.261	4	2.08	0.713	2.79
4,4'-DDT	kg/yr	Central	Particulate	2.17	0.146	2.32	2.16	0.0989	2.26	2.08	0.35	2.43
4,4'-DDT	kg/yr	Lower	Dissolved	0.967	0.0254	0.992	0.709	0.0202	0.729	0.798	0.0659	0.863
4,4'-DDT	kg/yr	Upper	Dissolved	1.07	0.0609	1.13	1.06	0.0691	1.13	0.798	0.141	0.939
4,4'-DDT	kg/yr	Central	Dissolved	1.02	0.0431	1.06	0.884	0.0388	0.923	0.798	0.104	0.901
Total of 2,4' and 4,4'-DDE	kg/yr	Lower	Total	1.64	0.332	1.97	0.596	0.234	0.83	2.54	0.427	2.97
Total of 2,4' and 4,4'-DDE	kg/yr	Upper	Total	2.75	0.435	3.18	2.8	0.571	3.37	2.54	1.18	3.72
Total of 2,4' and 4,4'-DDE	kg/yr	Central	Total	2.19	0.383	2.58	2.03	0.411	2.44	2.54	0.772	3.31
Total of 2,4' and 4,4'-DDE	kg/yr	Lower	Particulate	0.874	0.126	1	0	0.162	0.162	1.72	0.207	1.92
Total of 2,4' and 4,4'-DDE	kg/yr	Upper	Particulate	1.83	0.215	2.04	1.92	0.242	2.16	1.72	0.717	2.43
Total of 2,4' and 4,4'-DDE	kg/yr	Central	Particulate	1.35	0.171	1.52	1.26	0.197	1.46	1.72	0.386	2.1
Total of 2,4' and 4,4'-DDE	kg/yr	Lower	Dissolved	0.765	0.206	0.971	0.596	0.0717	0.667	0.823	0.221	1.04
Total of 2,4' and 4,4'-DDE	kg/yr	Upper	Dissolved	0.922	0.22	1.14	0.882	0.329	1.21	0.823	0.491	1.31
Total of 2,4' and 4,4'-DDE	kg/yr	Central	Dissolved	0.843	0.213	1.06	0.769	0.214	0.983	0.823	0.386	1.21
Total of 2,4' and 4,4'-DDD	kg/yr	Lower	Total	0.687	0.334	1.02	0.556	0.207	0.763	1.32	0.779	2.1
Total of 2,4' and 4,4'-DDD	kg/yr	Upper	Total	1.04	0.43	1.47	1.59	0.701	2.29	1.32	2.98	4.3
Total of 2,4' and 4,4'-DDD	kg/yr	Central	Total	0.861	0.382	1.24	0.979	0.402	1.38	1.32	1.66	2.98
Total of 2,4' and 4,4'-DDD	kg/yr	Lower	Particulate	0.437	0	0.437	0.0958	0	0.0958	0.806	0.216	1.02
Total of 2,4' and 4,4'-DDD	kg/yr	Upper	Particulate	0.453	0.0893	0.542	1.06	0.166	1.22	0.806	1.25	2.06
Total of 2,4' and 4,4'-DDD	kg/yr	Central	Particulate	0.445	0.0446	0.489	0.561	0.0952	0.656	0.806	0.561	1.37
Total of 2,4' and 4,4'-DDD	kg/yr	Lower	Dissolved	0.234	0.334	0.568	0.26	0.0815	0.342	0.514	0.452	0.967
Total of 2,4' and 4,4'-DDD	kg/yr	Upper	Dissolved	0.599	0.341	0.94	0.532	0.535	1.07	0.514	1.72	2.24
Total of 2,4' and 4,4'-DDD	kg/yr	Central	Dissolved	0.417	0.337	0.754	0.417	0.307	0.724	0.514	1.1	1.61

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

		Load Estimation		RM 16			RM 11			RM 6.3		
Analyte	**Units**	**Type**	**Filtration**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**
Total of 2,4' and 4,4'-DDT	kg/yr	Lower	Total	3.03	0.138	3.17	1.26	0.0531	1.31	3.46	0.309	3.77
Total of 2,4' and 4,4'-DDT	kg/yr	Upper	Total	4.18	0.272	4.45	5.1	0.388	5.49	3.46	0.936	4.4
Total of 2,4' and 4,4'-DDT	kg/yr	Central	Total	3.61	0.205	3.81	3.47	0.162	3.63	3.46	0.558	4.02
Total of 2,4' and 4,4'-DDT	kg/yr	Lower	Particulate	1.69	0.109	1.8	0.345	0	0.345	2.45	0.162	2.61
Total of 2,4' and 4,4'-DDT	kg/yr	Upper	Particulate	3.1	0.211	3.32	3.94	0.305	4.24	2.45	0.836	3.29
Total of 2,4' and 4,4'-DDT	kg/yr	Central	Particulate	2.4	0.16	2.56	2.4	0.114	2.51	2.45	0.408	2.86
Total of 2,4' and 4,4'-DDT	kg/yr	Lower	Dissolved	1.08	0.0293	1.1	0.914	0.0202	0.935	1.01	0.0998	1.11
Total of 2,4' and 4,4'-DDT	kg/yr	Upper	Dissolved	1.35	0.0609	1.41	1.17	0.0838	1.25	1.01	0.205	1.21
Total of 2,4' and 4,4'-DDT	kg/yr	Central	Dissolved	1.21	0.0451	1.26	1.07	0.0484	1.12	1.01	0.15	1.16
Total DDx	kg/yr	Lower	Total	5.71	0.9	6.61	2.41	0.597	3.01	7.32	1.51	8.84
Total DDx	kg/yr	Upper	Total	7.62	1.04	8.66	8.69	1.33	10	7.32	5.1	12.4
Total DDx	kg/yr	Central	Total	6.66	0.971	7.63	6.48	0.975	7.46	7.32	2.99	10.3
Total DDx	kg/yr	Lower	Particulate	3	0.324	3.32	0.441	0.199	0.639	4.97	0.678	5.65
Total DDx	kg/yr	Upper	Particulate	5.38	0.426	5.81	6.39	0.519	6.91	4.97	2.81	7.78
Total DDx	kg/yr	Central	Particulate	4.19	0.375	4.57	4.22	0.406	4.63	4.97	1.35	6.33
Total DDx	kg/yr	Lower	Dissolved	2.23	0.576	2.81	1.97	0.173	2.14	2.35	0.82	3.17
Total DDx	kg/yr	Upper	Dissolved	2.71	0.614	3.32	2.5	0.851	3.35	2.35	2.29	4.64
Total DDx	kg/yr	Central	Dissolved	2.47	0.595	3.07	2.26	0.57	2.83	2.35	1.63	3.98
PAHs												
Naphthalene	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
Naphthalene	kg/yr	Upper	Total	220	0	220	262	482	744	0	214	214
Naphthalene	kg/yr	Central	Total	110	0	110	87.5	96.3	184	0	45.5	45.5
Naphthalene	kg/yr	Lower	Particulate	0	0	0	0	0	0	0	0	0
Naphthalene	kg/yr	Upper	Particulate	0	0	0	15.2	0	15.2	0	14.1	14.1
Naphthalene	kg/yr	Central	Particulate	0	0	0	5.06	0	5.06	0	2.82	2.82
Naphthalene	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
Naphthalene	kg/yr	Upper	Dissolved	220	0	220	247	482	729	0	214	214
Naphthalene	kg/yr	Central	Dissolved	110	0	110	82.4	96.3	179	0	42.7	42.7
Benzo(a)pyrene	kg/yr	Lower	Total	0	0	0	0	0.367	0.367	4.74	0.56	5.3
Benzo(a)pyrene	kg/yr	Upper	Total	3.66	1.82	5.49	6.2	8.25	14.4	4.74	25	29.8
Benzo(a)pyrene	kg/yr	Central	Total	1.83	0.911	2.74	3.68	3.49	7.18	4.74	13.3	18
Benzo(a)pyrene	kg/yr	Lower	Particulate	0	0	0	0	0	0	4.56	0	4.56
Benzo(a)pyrene	kg/yr	Upper	Particulate	3.66	1.82	5.49	5.67	7.33	13	4.56	25	29.6
Benzo(a)pyrene	kg/yr	Central	Particulate	1.83	0.911	2.74	3.47	3.16	6.63	4.56	12.7	17.2
Benzo(a)pyrene	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0.174	0	0.174
Benzo(a)pyrene	kg/yr	Upper	Dissolved	0	0	0	0.521	0.921	1.44	0.174	1.75	1.92
Benzo(a)pyrene	kg/yr	Central	Dissolved	0	0	0	0.213	0.337	0.55	0.174	0.596	0.77
Total Carcinogenic PAHs	kg/yr	Lower	Total	5.24	6.19	11.4	2.09	10.6	12.7	29.2	22.9	52.1
Total Carcinogenic PAHs	kg/yr	Upper	Total	25.5	14.7	40.1	36.9	45.4	82.4	29.2	136	165
Total Carcinogenic PAHs	kg/yr	Central	Total	15.4	10.4	25.8	23.4	23	46.3	29.2	79.3	109
Total Carcinogenic PAHs	kg/yr	Lower	Particulate	4.91	5.1	10	2.09	6.7	8.79	27.6	16.8	44.3
Total Carcinogenic PAHs	kg/yr	Upper	Particulate	22.3	10.5	32.8	32.8	37.3	70	27.6	128	155
Total Carcinogenic PAHs	kg/yr	Central	Particulate	13.6	7.78	21.4	21.2	18.3	39.5	27.6	67.2	94.7
Total Carcinogenic PAHs	kg/yr	Lower	Dissolved	0.328	1.1	1.42	0	2.79	2.79	1.68	5.1	6.77
Total Carcinogenic PAHs	kg/yr	Upper	Dissolved	3.13	4.19	7.32	4.17	8.14	12.3	1.68	32.1	33.8
Total Carcinogenic PAHs	kg/yr	Central	Dissolved	1.73	2.64	4.37	2.14	4.65	6.79	1.68	12.1	13.8

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

Analyte	Units	Load Estimation Type	Filtration	RM 16 High Flow	RM 16 Low Flow	RM 16 Annual	RM 11 High Flow	RM 11 Low Flow	RM 11 Annual	RM 6.3 High Flow	RM 6.3 Low Flow	RM 6.3 Annual
cPAH BaPEq	kg/yr	Lower	Total	0.184	0.623	0.807	0.078	0.800	0.878	6.03	1.63	7.66
cPAH BaPEq	kg/yr	Upper	Total	4.68	2.18	6.86	7.58	10.4	18.0	6.03	34.1	40.1
cPAH BaPEq	kg/yr	Central	Total	2.43	1.40	3.83	4.63	4.77	9.40	6.03	17.5	23.6
cPAH BaPEq	kg/yr	Lower	Particulate	0.151	0.619	0.770	0.078	0.262	0.340	5.80	0.839	6.64
cPAH BaPEq	kg/yr	Upper	Particulate	4.57	2.15	6.72	6.93	9.39	16.3	5.80	34.1	39.9
cPAH BaPEq	kg/yr	Central	Particulate	2.36	1.38	3.75	4.35	4.33	8.68	5.80	16.6	22.4
cPAH BaPEq	kg/yr	Lower	Dissolved	0.0330	0.0042	0.0372	0	0.00335	0.00335	0.230	0.0	0.238
cPAH BaPEq	kg/yr	Upper	Dissolved	0.106	0.0336	0.140	0.654	1.03	1.68	0.230	2.69	2.93
cPAH BaPEq	kg/yr	Central	Dissolved	0.070	0.0189	0.088	0.275	0.443	0.718	0.230	0.926	1.16
Total PAHs	kg/yr	Lower	Total	112	74.4	187	84.6	85.7	170	145	189	334
Total PAHs	kg/yr	Upper	Total	427	172	599	490	921	1410	145	673	818
Total PAHs	kg/yr	Central	Total	270	123	393	249	282	532	145	459	604
Total PAHs	kg/yr	Lower	Particulate	6.71	14.4	21.1	2.14	6.73	8.87	54.7	48.4	103
Total PAHs	kg/yr	Upper	Particulate	60.1	34.1	94.2	97.7	88.5	186	54.7	297	351
Total PAHs	kg/yr	Central	Particulate	33.4	24.3	57.7	51.6	36.8	88.4	54.7	151	206
Total PAHs	kg/yr	Lower	Dissolved	106	60	166	82.5	30.6	113	90	68	158
Total PAHs	kg/yr	Upper	Dissolved	367	138	505	392	915	1310	90	575	665
Total PAHs	kg/yr	Central	Dissolved	236	99	335	198	246	443	90	309	399
SVOCs												
Bis(2-ethylhexyl)phthalate	kg/yr	Lower	Total	0	0	0	0	0	0	16400	0	16400
Bis(2-ethylhexyl)phthalate	kg/yr	Upper	Total	15600	0	15600	16400	321	16700	16400	155	16500
Bis(2-ethylhexyl)phthalate	kg/yr	Central	Total	7820	0	7820	7280	64.2	7350	16400	30.9	16400
Bis(2-ethylhexyl)phthalate	kg/yr	Lower	Particulate	--	--	--	--	0	0	--	0	0
Bis(2-ethylhexyl)phthalate	kg/yr	Upper	Particulate	--	--	--	--	82.2	82.2	--	66.5	66.5
Bis(2-ethylhexyl)phthalate	kg/yr	Central	Particulate	--	--	--	--	27.4	27.4	--	22.2	22.2
Bis(2-ethylhexyl)phthalate	kg/yr	Lower	Dissolved	--	--	--	--	0	0	--	0	0
Bis(2-ethylhexyl)phthalate	kg/yr	Upper	Dissolved	--	--	--	--	239	239	--	88.1	88.1
Bis(2-ethylhexyl)phthalate	kg/yr	Central	Dissolved	--	--	--	--	79.6	79.6	--	29.4	29.4
Hexachlorobenzene	kg/yr	Lower	Total	0.347	0.235	0.581	0.442	0.228	0.67	0.512	0.257	0.769
Hexachlorobenzene	kg/yr	Upper	Total	0.677	0.55	1.23	0.678	1.02	1.7	0.512	0.859	1.37
Hexachlorobenzene	kg/yr	Central	Total	0.512	0.392	0.904	0.577	0.505	1.08	0.512	0.522	1.03
Hexachlorobenzene	kg/yr	Lower	Particulate	0	0	0	0	0	0	0.0763	0	0.0763
Hexachlorobenzene	kg/yr	Upper	Particulate	0.107	0.316	0.423	0.159	0.349	0.508	0.0763	0.085	0.161
Hexachlorobenzene	kg/yr	Central	Particulate	0.0535	0.158	0.212	0.084	0.111	0.195	0.0763	0.055	0.131
Hexachlorobenzene	kg/yr	Lower	Dissolved	0.24	0.234	0.474	0.283	0.219	0.502	0.436	0.257	0.693
Hexachlorobenzene	kg/yr	Upper	Dissolved	0.677	0.235	0.911	0.611	0.673	1.28	0.436	0.773	1.21
Hexachlorobenzene	kg/yr	Central	Dissolved	0.458	0.234	0.693	0.493	0.393	0.886	0.436	0.467	0.903

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

Analyte	Units	Load Estimation Type	Filtration	RM 16 High Flow	RM 16 Low Flow	RM 16 Annual	RM 11 High Flow	RM 11 Low Flow	RM 11 Annual	RM 6.3 High Flow	RM 6.3 Low Flow	RM 6.3 Annual
Pesticides (non-DDx)												
Total Chlordanes	kg/yr	Lower	Total	0.646	0.314	0.96	0.5	0.187	0.686	1	0.264	1.27
Total Chlordanes	kg/yr	Upper	Total	1.08	0.356	1.44	1.17	0.451	1.62	1	0.618	1.62
Total Chlordanes	kg/yr	Central	Total	0.865	0.335	1.2	0.919	0.318	1.24	1	0.431	1.43
Total Chlordanes	kg/yr	Lower	Particulate	0.18	0	0.18	0.0433	0.0321	0.0754	0.42	0	0.42
Total Chlordanes	kg/yr	Upper	Particulate	0.377	0.0502	0.427	0.526	0.0914	0.617	0.42	0.204	0.625
Total Chlordanes	kg/yr	Central	Particulate	0.278	0.0251	0.303	0.326	0.0657	0.392	0.42	0.101	0.521
Total Chlordanes	kg/yr	Lower	Dissolved	0.467	0.263	0.73	0.456	0.11	0.566	0.584	0.263	0.846
Total Chlordanes	kg/yr	Upper	Dissolved	0.706	0.356	1.06	0.68	0.36	1.04	0.584	0.414	0.997
Total Chlordanes	kg/yr	Central	Dissolved	0.586	0.31	0.896	0.592	0.252	0.844	0.584	0.329	0.913
γ-Hexachlorocyclohexane	kg/yr	Lower	Total	0.122	0.304	0.425	0.171	0.165	0.336	0.232	0.331	0.563
γ-Hexachlorocyclohexane	kg/yr	Upper	Total	0.271	0.432	0.703	0.289	0.482	0.771	0.232	0.468	0.7
γ-Hexachlorocyclohexane	kg/yr	Central	Total	0.196	0.368	0.564	0.231	0.356	0.587	0.232	0.391	0.623
γ-Hexachlorocyclohexane	kg/yr	Lower	Particulate	0	0	0	0	0	0	0.00544	0	0.00544
γ-Hexachlorocyclohexane	kg/yr	Upper	Particulate	0.00305	0.00295	0.006	0.00859	0.00293	0.0115	0.00544	0.0035	0.00893
γ-Hexachlorocyclohexane	kg/yr	Central	Particulate	0.00153	0.00147	0.003	0.00551	0.000586	0.0061	0.00544	0.00159	0.00703
γ-Hexachlorocyclohexane	kg/yr	Lower	Dissolved	0.122	0.304	0.425	0.162	0.165	0.327	0.226	0.331	0.557
γ-Hexachlorocyclohexane	kg/yr	Upper	Dissolved	0.268	0.429	0.697	0.289	0.482	0.771	0.226	0.465	0.691
γ-Hexachlorocyclohexane	kg/yr	Central	Dissolved	0.195	0.367	0.561	0.225	0.356	0.581	0.226	0.39	0.616
Aldrin	kg/yr	Lower	Total	0.0441	0.0125	0.0566	0.0445	0	0.0445	0.0401	0	0.0401
Aldrin	kg/yr	Upper	Total	0.0475	0.0283	0.0758	0.0579	0.0317	0.0896	0.0401	0.0612	0.101
Aldrin	kg/yr	Central	Total	0.0458	0.0204	0.0662	0.0507	0.0166	0.0673	0.0401	0.0277	0.0678
Aldrin	kg/yr	Lower	Particulate	0.00605	0	0.00605	0.00706	0	0.00706	0.011	0	0.011
Aldrin	kg/yr	Upper	Particulate	0.0186	0.0021	0.0207	0.0293	0.0063	0.0356	0.011	0.0237	0.0347
Aldrin	kg/yr	Central	Particulate	0.0123	0.00105	0.0134	0.0181	0.00293	0.0211	0.011	0.00921	0.0202
Aldrin	kg/yr	Lower	Dissolved	0.0289	0.0104	0.0393	0.0265	0	0.0265	0.029	0	0.029
Aldrin	kg/yr	Upper	Dissolved	0.0381	0.0283	0.0663	0.0426	0.0261	0.0687	0.029	0.0375	0.0665
Aldrin	kg/yr	Central	Dissolved	0.0335	0.0193	0.0528	0.0326	0.0137	0.0463	0.029	0.0185	0.0475
Dieldrin	kg/yr	Lower	Total	1.26	0.489	1.75	1.42	0.234	1.66	2.14	0.417	2.56
Dieldrin	kg/yr	Upper	Total	4.71	0.711	5.42	5.26	0.584	5.84	2.14	0.632	2.77
Dieldrin	kg/yr	Central	Total	2.99	0.6	3.59	3	0.455	3.45	2.14	0.533	2.67
Dieldrin	kg/yr	Lower	Particulate	0.11	0.0112	0.121	0	0.0175	0.0175	0.271	0	0.271
Dieldrin	kg/yr	Upper	Particulate	0.687	0.103	0.79	0.76	0.0446	0.804	0.271	0.0447	0.316
Dieldrin	kg/yr	Central	Particulate	0.398	0.0573	0.456	0.352	0.0293	0.381	0.271	0.0245	0.296
Dieldrin	kg/yr	Lower	Dissolved	1.15	0.478	1.63	1.42	0.2	1.62	1.87	0.417	2.29
Dieldrin	kg/yr	Upper	Dissolved	4.02	0.607	4.63	4.5	0.561	5.06	1.87	0.596	2.47
Dieldrin	kg/yr	Central	Dissolved	2.59	0.543	3.13	2.64	0.425	3.07	1.87	0.509	2.38

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

Analyte	Units	Load Estimation Type	Filtration	RM 16 High Flow	RM 16 Low Flow	RM 16 Annual	RM 11 High Flow	RM 11 Low Flow	RM 11 Annual	RM 6.3 High Flow	RM 6.3 Low Flow	RM 6.3 Annual
Metals												
Arsenic	kg/yr	Lower	Total	4170	0	4170	4110	0	4110	5010	0	5010
Arsenic	kg/yr	Upper	Total	5310	5900	11200	7600	6770	14400	5010	6980	12000
Arsenic	kg/yr	Central	Total	4740	2950	7690	5510	4830	10300	5010	4940	9950
Arsenic	kg/yr	Lower	Particulate	1190	0	1190	1330	0	1330	1090	0	1090
Arsenic	kg/yr	Upper	Particulate	2500	391	2890	4470	921	5390	1090	6370	7460
Arsenic	kg/yr	Central	Particulate	1850	195	2040	2470	605	3070	1090	1700	2790
Arsenic	kg/yr	Lower	Dissolved	2810	0	2810	2780	0	2780	3920	0	3920
Arsenic	kg/yr	Upper	Dissolved	2980	5510	8490	3210	6050	9260	3920	6280	10200
Arsenic	kg/yr	Central	Dissolved	2890	2750	5650	3040	4230	7270	3920	3240	7160
Chromium	kg/yr	Lower	Total	11500	0	11500	13400	0	13400	17700	0	17700
Chromium	kg/yr	Upper	Total	25000	4850	29900	23500	8520	32000	17700	6280	24000
Chromium	kg/yr	Central	Total	18300	2430	20700	17400	3710	21100	17700	2900	20600
Chromium	kg/yr	Lower	Particulate	1120	0	1120	6550	0	6550	9980	0	9980
Chromium	kg/yr	Upper	Particulate	25000	4850	29900	23500	6000	29500	9980	4890	14900
Chromium	kg/yr	Central	Particulate	13100	2430	15500	15100	3040	18200	9980	1870	11800
Chromium	kg/yr	Lower	Dissolved	0	0	0	0	0	0	7740	0	7740
Chromium	kg/yr	Upper	Dissolved	10400	0	10400	6850	3350	10200	7740	4050	11800
Chromium	kg/yr	Central	Dissolved	5210	0	5210	2280	670	2950	7740	1840	9590
Copper	kg/yr	Lower	Total	17500	9670	27200	19100	10900	30000	30200	11000	41200
Copper	kg/yr	Upper	Total	53200	13500	66600	53700	14400	68100	30200	19800	50100
Copper	kg/yr	Central	Total	35300	11600	46900	33500	12500	46000	30200	14400	44600
Copper	kg/yr	Lower	Particulate	10100	2480	12600	11900	3120	15000	13600	3980	17600
Copper	kg/yr	Upper	Particulate	43000	6560	49600	30200	5450	35700	13600	8240	21900
Copper	kg/yr	Central	Particulate	26600	4520	31100	20100	4220	24400	13600	5630	19300
Copper	kg/yr	Lower	Dissolved	7370	6910	14300	7150	6420	13600	16600	6280	22900
Copper	kg/yr	Upper	Dissolved	10100	7190	17300	23500	11000	34500	16600	11600	28200
Copper	kg/yr	Central	Dissolved	8750	7050	15800	13400	8810	22200	16600	8770	25400
Lead	kg/yr	Lower	Total	2780	1280	4060	2930	1520	4460	5960	1760	7720
Lead	kg/yr	Upper	Total	12200	3360	15600	12200	2900	15100	5960	3210	9180
Lead	kg/yr	Central	Total	7510	2320	9830	6960	2150	9110	5960	2310	8270
Lead	kg/yr	Lower	Particulate	2780	1280	4060	2930	1300	4230	3410	1580	4990
Lead	kg/yr	Upper	Particulate	12200	2960	15200	12100	2500	14600	3410	2790	6200
Lead	kg/yr	Central	Particulate	7510	2120	9630	6840	1910	8750	3410	2050	5460
Lead	kg/yr	Lower	Dissolved	0	0	0	0	0	0	2550	140	2690
Lead	kg/yr	Upper	Dissolved	0	401	401	179	419	598	2550	419	2970
Lead	kg/yr	Central	Dissolved	0	201	201	114	244	358	2550	256	2810
Mercury	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
Mercury	kg/yr	Upper	Total	298	0	298	596	279	875	0	0	0
Mercury	kg/yr	Central	Total	149	0	149	199	74.5	273	0	0	0
Mercury	kg/yr	Lower	Particulate	0	0	0	0	0	0	0	0	0
Mercury	kg/yr	Upper	Particulate	149	0	149	596	279	875	0	0	0
Mercury	kg/yr	Central	Particulate	74.5	0	74.5	199	74.5	273	0	0	0
Mercury	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
Mercury	kg/yr	Upper	Dissolved	149	0	149	0	93.1	93.1	0	0	0
Mercury	kg/yr	Central	Dissolved	74.5	0	74.5	0	18.6	18.6	0	0	0

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

		Load Estimation		RM 16			RM 11			RM 6.3		
Analyte	**Units**	**Type**	**Filtration**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**
Nickel	kg/yr	Lower	Total	0	6280	6280	13300	7820	21100	19700	8310	28000
Nickel	kg/yr	Upper	Total	28700	9630	38400	27000	12600	39500	19700	18800	38500
Nickel	kg/yr	Central	Total	14400	7960	22300	19200	9180	28400	19700	10800	30500
Nickel	kg/yr	Lower	Particulate	0	1050	1050	6400	745	7150	9010	1120	10100
Nickel	kg/yr	Upper	Particulate	22300	1190	23500	19900	7820	27700	9010	9080	18100
Nickel	kg/yr	Central	Particulate	11200	1120	12300	13200	2810	16000	9010	3600	12600
Nickel	kg/yr	Lower	Dissolved	6400	5100	11500	0	0	0	10600	0	10600
Nickel	kg/yr	Upper	Dissolved	7520	8590	16100	11000	10900	21900	10600	15500	26100
Nickel	kg/yr	Central	Dissolved	6960	6840	13800	6030	6370	12400	10600	7220	17900
Zinc	kg/yr	Lower	Total	35400	0	35400	35700	0	35700	60300	0	60300
Zinc	kg/yr	Upper	Total	95000	34200	129000	90400	64200	155000	60300	44000	104000
Zinc	kg/yr	Central	Total	65200	17100	82300	62800	33300	96100	60300	29000	89300
Zinc	kg/yr	Lower	Particulate	35400	0	35400	35700	0	35700	60300	0	60300
Zinc	kg/yr	Upper	Particulate	95000	34200	129000	90400	64200	155000	60300	44000	104000
Zinc	kg/yr	Central	Particulate	65200	17100	82300	62800	17100	80000	60300	14600	74900
Zinc	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
Zinc	kg/yr	Upper	Dissolved	0	0	0	0	30700	30700	0	26500	26500
Zinc	kg/yr	Central	Dissolved	0	0	0	0	16100	16100	0	14400	14400
Butyltins												
Tributyltin Ion	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
Tributyltin Ion	kg/yr	Upper	Total	0	76.8	76.8	0	0	0	0	6.98	6.98
Tributyltin Ion	kg/yr	Central	Total	0	38.4	38.4	0	0	0	0	1.4	1.4

Notes:

-- Analyte not sampled.
BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
SVOC - semivolatile organic compound
TEQ - toxic equivalent concentration

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

		Load Estimation		RM 4			Fraction of Willamette Load Leaving via Multnomah Channel at RM 2			Fraction of Willamette Load Leaving via Multnomah Channel at RM 3		
Analyte	**Units**	**Type**	**Filtration**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**
PCBs												
PCB077	kg/yr	Lower	Total	0.00529	0.00469	0.00998	0.00094	0.00234	0.00328	0.00235	0.00342	0.00577
PCB077	kg/yr	Upper	Total	0.00844	0.0139	0.0223	0.00271	0.00330	0.00600	0.00235	0.00948	0.01180
PCB077	kg/yr	Central	Total	0.00687	0.00955	0.0164	0.00183	0.00282	0.00464	0.00235	0.00645	0.00880
PCB077	kg/yr	Lower	Particulate	0.00365	0.0026	0.00625	0.00094	0.00024	0.00118	0.00184	0.00342	0.00526
PCB077	kg/yr	Upper	Particulate	0.00663	0.00824	0.0149	0.00174	0.00196	0.00371	0.00184	0.00525	0.00709
PCB077	kg/yr	Central	Particulate	0.00514	0.00569	0.0108	0.00134	0.00110	0.00244	0.00184	0.00434	0.00618
PCB077	kg/yr	Lower	Dissolved	0.00164	0.00209	0.00373	0.00000	0.00133	0.00133	0.00051	0.00000	0.00051
PCB077	kg/yr	Upper	Dissolved	0.00182	0.00563	0.00745	0.00096	0.00211	0.00307	0.00051	0.00423	0.00474
PCB077	kg/yr	Central	Dissolved	0.00173	0.00387	0.0056	0.00048	0.00172	0.00220	0.00051	0.00211	0.00263
PCB081	kg/yr	Lower	Total	0	0	0	0	0	0	0.0000266	0	0.0000266
PCB081	kg/yr	Upper	Total	0.0000968	0.000202	0.000299	0.000000	0.000078	0.000078	0.000027	0.000344	0.000371
PCB081	kg/yr	Central	Total	0.0000484	0.0000405	0.0000889	0.000000	0.000039	0.000039	0.000027	0.000172	0.000199
PCB081	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0.0000266	0	0.0000266
PCB081	kg/yr	Upper	Dissolved	0	0	0	0.000000	0.000000	0.000000	0.000027	0.000180	0.000207
PCB081	kg/yr	Central	Dissolved	0	0	0	0.000000	0.000000	0.000000	0.000027	0.000090	0.000117
PCB081	kg/yr	Lower	Particulate	0	0	0	0	0	0	0	0	0
PCB081	kg/yr	Upper	Particulate	0.0000968	0.000202	0.000299	0	0.0000783	0.0000783	0	0.000164	0.000164
PCB081	kg/yr	Central	Particulate	0.0000484	0.0000405	0.0000889	0	0.0000391	0.0000391	0	0.000082	0.000082
PCB105	kg/yr	Lower	Total	0.0281	0.0205	0.0486	0.0071	0.0090	0.0161	0.0114	0.0298	0.0411
PCB105	kg/yr	Upper	Total	0.0378	0.0741	0.112	0.0129	0.0182	0.0312	0.0114	0.0464	0.0577
PCB105	kg/yr	Central	Total	0.0329	0.0488	0.0817	0.0100	0.0136	0.0236	0.0114	0.0381	0.0494
PCB105	kg/yr	Lower	Dissolved	0.00721	0.00888	0.0161	0.0045	0.0009	0.0053	0.0091	0.0188	0.0280
PCB105	kg/yr	Upper	Dissolved	0.00891	0.0255	0.0344	0.0088	0.0107	0.0195	0.0091	0.0294	0.0385
PCB105	kg/yr	Central	Dissolved	0.00806	0.0168	0.0248	0.0066	0.0058	0.0124	0.0091	0.0241	0.0332
PCB105	kg/yr	Lower	Particulate	0.0209	0.0117	0.0325	0.0026	0.0075	0.0101	0.0022	0.0110	0.0132
PCB105	kg/yr	Upper	Particulate	0.0289	0.0487	0.0776	0.0042	0.0081	0.0123	0.0022	0.0170	0.0192
PCB105	kg/yr	Central	Particulate	0.0249	0.032	0.0569	0.0034	0.0078	0.0112	0.0022	0.0140	0.0162
PCB118	kg/yr	Lower	Total	0.0739	0.0546	0.129	0.0182	0.0217	0.0399	0.0287	0.0754	0.1040
PCB118	kg/yr	Upper	Total	0.103	0.204	0.307	0.0326	0.0442	0.0768	0.0287	0.1230	0.1510
PCB118	kg/yr	Central	Total	0.0886	0.128	0.216	0.0254	0.0330	0.0584	0.0287	0.0991	0.1280
PCB118	kg/yr	Lower	Particulate	0.0553	0.0283	0.0837	0.0109	0.0019	0.0128	0.0223	0.0461	0.0683
PCB118	kg/yr	Upper	Particulate	0.0776	0.13	0.208	0.0210	0.0251	0.0461	0.0223	0.0753	0.0976
PCB118	kg/yr	Central	Particulate	0.0665	0.0809	0.147	0.0160	0.0135	0.0295	0.0223	0.0607	0.0830
PCB118	kg/yr	Lower	Dissolved	0.0186	0.0262	0.0449	0.0073	0.0191	0.0264	0.0064	0.0293	0.0357
PCB118	kg/yr	Upper	Dissolved	0.0256	0.0741	0.0998	0.0116	0.0198	0.0314	0.0064	0.0475	0.0539
PCB118	kg/yr	Central	Dissolved	0.0221	0.0469	0.0691	0.0094	0.0195	0.0289	0.0064	0.0384	0.0448
PCB126	kg/yr	Lower	Total	0	0	0	0	0.0000675	0.0000675	0.000136	0	0.000136
PCB126	kg/yr	Upper	Total	0.000298	0.00101	0.00131	0.0000732	0.0001190	0.0001920	0.0001360	0.0003650	0.0005010
PCB126	kg/yr	Central	Total	0.000149	0.000429	0.000578	0.0000366	0.0000931	0.0001300	0.0001360	0.0001830	0.0003180
PCB126	kg/yr	Lower	Particulate	0	0	0	0	0.00000405	0.00000405	0.000136	0	0.000136
PCB126	kg/yr	Upper	Particulate	0.000298	0.000894	0.00119	0.0000732	0.0001190	0.0001920	0.0001360	0.0003650	0.0005010
PCB126	kg/yr	Central	Particulate	0.000149	0.000405	0.000554	0.0000366	0.0000614	0.0000980	0.0001360	0.0001830	0.0003180
PCB126	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
PCB126	kg/yr	Upper	Dissolved	0	0.000119	0.000119	0	0.0000634	0.0000634	0	0.0000000	0.0000000
PCB126	kg/yr	Central	Dissolved	0	0.0000237	0.0000237	0	0.0000317	0.0000317	0	0.0000000	0.0000000

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

		Load Estimation		RM 4			Fraction of Willamette Load Leaving via Multnomah Channel at RM 2			Fraction of Willamette Load Leaving via Multnomah Channel at RM 3		
Analyte	**Units**	**Type**	**Filtration**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**
PCB156 & PCB157	kg/yr	Lower	Total	0.0139	0.00797	0.0219	0.00210	0.00183	0.00392	0.00688	0.01020	0.01700
PCB156 & PCB157	kg/yr	Upper	Total	0.0179	0.0309	0.0487	0.00445	0.00480	0.00925	0.00688	0.01890	0.02580
PCB156 & PCB157	kg/yr	Central	Total	0.0159	0.0201	0.036	0.00327	0.00331	0.00659	0.00688	0.01450	0.02140
PCB156 & PCB157	kg/yr	Lower	Dissolved	0	0.00192	0.00192	0.00210	0.00026	0.00235	0.00580	0.01020	0.01600
PCB156 & PCB157	kg/yr	Upper	Dissolved	0	0.00575	0.00575	0.00417	0.00480	0.00897	0.00580	0.01500	0.02080
PCB156 & PCB157	kg/yr	Central	Dissolved	0	0.00346	0.00346	0.00313	0.00253	0.00566	0.00580	0.01260	0.01840
PCB156 & PCB157	kg/yr	Lower	Particulate	0.0139	0.00605	0.0199	0	0.00000	0.00000	0.00107	0.00000	0.00107
PCB156 & PCB157	kg/yr	Upper	Particulate	0.0179	0.0251	0.043	0.000281	0.00157	0.00185	0.00107	0.00390	0.00498
PCB156 & PCB157	kg/yr	Central	Particulate	0.0159	0.0166	0.0325	0.00014	0.00079	0.00093	0.00107	0.00195	0.00303
PCB169	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Upper	Total	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Central	Total	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Lower	Particulate	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Upper	Particulate	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Central	Particulate	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Upper	Dissolved	0	0	0	0	0	0	0	0	0
PCB169	kg/yr	Central	Dissolved	0	0	0	0	0	0	0	0	0
Total PCB Congeners	kg/yr	Lower	Total	3.11	3.19	6.3	0.72	1.67	2.39	1.40	3.35	4.75
Total PCB Congeners	kg/yr	Upper	Total	3.95	11.3	15.2	1.30	2.58	3.88	1.40	6.99	8.38
Total PCB Congeners	kg/yr	Central	Total	3.53	6.68	10.2	1.01	2.13	3.13	1.40	5.17	6.57
Total PCB Congeners	kg/yr	Lower	Particulate	2.02	1.3	3.32	0.31	0.06	0.38	0.87	1.45	2.32
Total PCB Congeners	kg/yr	Upper	Particulate	2.85	4.68	7.53	0.60	0.68	1.28	0.87	2.57	3.43
Total PCB Congeners	kg/yr	Central	Particulate	2.44	2.86	5.29	0.46	0.37	0.83	0.87	2.01	2.88
Total PCB Congeners	kg/yr	Lower	Dissolved	1.09	1.89	2.98	0.40	1.61	2.01	0.53	1.90	2.43
Total PCB Congeners	kg/yr	Upper	Dissolved	1.1	6.58	7.68	0.70	1.90	2.61	0.53	4.42	4.95
Total PCB Congeners	kg/yr	Central	Dissolved	1.09	3.82	4.92	0.55	1.76	2.31	0.53	3.16	3.69
PCB TEQ (ND=0)	kg/yr	Lower	Total	0.00000577	0.0000113	0.0000171	0.00000095	0.00000803	0.00000897	0.00001540	0.00000399	0.00001930
PCB TEQ (ND=0)	kg/yr	Upper	Total	0.0000343	0.00011	0.000145	0.00000919	0.00001430	0.00002350	0.00001540	0.00004360	0.00005900
PCB TEQ (ND=0)	kg/yr	Central	Total	0.0000201	0.0000502	0.0000702	0.00000507	0.00001120	0.00001620	0.00001540	0.00002380	0.00003920
PCB TEQ (ND=0)	kg/yr	Lower	Particulate	0.00000452	0.00000745	0.000012	0.00000065	0.00000052	0.00000117	0.00001500	0.00000278	0.00001780
PCB TEQ (ND=0)	kg/yr	Upper	Particulate	0.0000334	0.0000961	0.000129	0.00000860	0.00001340	0.00002200	0.00001500	0.00004100	0.00005600
PCB TEQ (ND=0)	kg/yr	Central	Particulate	0.0000189	0.0000453	0.0000642	0.00000462	0.00000694	0.00001160	0.00001500	0.00002190	0.00003690
PCB TEQ (ND=0)	kg/yr	Lower	Dissolved	0.000000986	0.0000014	0.00000238	0.00000030	0.00000094	0.00000123	0.00000036	0.00000121	0.00000157
PCB TEQ (ND=0)	kg/yr	Upper	Dissolved	0.00000125	0.0000143	0.0000156	0.00000059	0.00000751	0.00000810	0.00000036	0.00000262	0.00000297
PCB TEQ (ND=0)	kg/yr	Central	Dissolved	0.00000112	0.00000488	0.000006	0.00000045	0.00000422	0.00000467	0.00000036	0.00000191	0.00000227
PCDD/Fs												
Total PCDD/Fs	kg/yr	Lower	Total	0.3	0.333	0.633	0.111	0.026	0.137	0.157	0.285	0.442
Total PCDD/Fs	kg/yr	Upper	Total	0.656	0.705	1.36	0.128	0.081	0.209	0.157	0.478	0.635
Total PCDD/Fs	kg/yr	Central	Total	0.478	0.492	0.97	0.119	0.054	0.173	0.157	0.382	0.539
Total PCDD/Fs	kg/yr	Lower	Particulate	0.25	0.318	0.567	0.077	0.011	0.089	0.142	0.270	0.412
Total PCDD/Fs	kg/yr	Upper	Particulate	0.599	0.65	1.25	0.100	0.066	0.165	0.142	0.350	0.491
Total PCDD/Fs	kg/yr	Central	Particulate	0.424	0.458	0.882	0.089	0.039	0.127	0.142	0.310	0.452
Total PCDD/Fs	kg/yr	Lower	Dissolved	0.0503	0.0106	0.0608	0.028	0.014	0.043	0.015	0.015	0.031
Total PCDD/Fs	kg/yr	Upper	Dissolved	0.057	0.055	0.112	0.033	0.016	0.049	0.015	0.128	0.144
Total PCDD/Fs	kg/yr	Central	Dissolved	0.0536	0.0339	0.0875	0.031	0.015	0.046	0.015	0.072	0.087

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

		Load Estimation		RM 4			Fraction of Willamette Load Leaving via Multnomah Channel at RM 2			Fraction of Willamette Load Leaving via Multnomah Channel at RM 3		
Analyte	**Units**	**Type**	**Filtration**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**
TCDD TEQ (ND=0)	kg/yr	Lower	Total	0.000861	0.000693	0.00155	0.000246	0.000089	0.000335	0.000360	0.000976	0.001340
TCDD TEQ (ND=0)	kg/yr	Upper	Total	0.00128	0.00457	0.00585	0.000258	0.000185	0.000443	0.000360	0.001310	0.001670
TCDD TEQ (ND=0)	kg/yr	Central	Total	0.00107	0.00194	0.00302	0.000252	0.000137	0.000389	0.000360	0.001140	0.001500
TCDD TEQ (ND=0)	kg/yr	Lower	Particulate	0.000723	0.000666	0.00139	0.000129	0.000021	0.000150	0.000337	0.000694	0.001030
TCDD TEQ (ND=0)	kg/yr	Upper	Particulate	0.00106	0.00442	0.00548	0.000190	0.000153	0.000343	0.000337	0.000901	0.001240
TCDD TEQ (ND=0)	kg/yr	Central	Particulate	0.000892	0.00185	0.00274	0.000160	0.000087	0.000247	0.000337	0.000797	0.001130
TCDD TEQ (ND=0)	kg/yr	Lower	Dissolved	0.000138	0.0000264	0.000165	0.000069	0.000032	0.000100	0.000024	0.000076	0.000100
TCDD TEQ (ND=0)	kg/yr	Upper	Dissolved	0.000223	0.000157	0.00038	0.000117	0.000068	0.000184	0.000024	0.000614	0.000638
TCDD TEQ (ND=0)	kg/yr	Central	Dissolved	0.000181	0.000094	0.000275	0.000093	0.000050	0.000142	0.000024	0.000345	0.000369
DDx Pesticides												
4,4'-DDD	kg/yr	Lower	Total	0.852	0.532	1.38	0.300	0.245	0.545	0.374	0.593	0.967
4,4'-DDD	kg/yr	Upper	Total	1.14	2.97	4.12	0.369	0.628	0.998	0.374	2.380	2.760
4,4'-DDD	kg/yr	Central	Total	0.998	1.2	2.2	0.335	0.437	0.772	0.374	1.490	1.860
4,4'-DDD	kg/yr	Lower	Particulate	0.602	0.00565	0.607	0.088	0.023	0.110	0.234	0.201	0.435
4,4'-DDD	kg/yr	Upper	Particulate	0.716	0.949	1.67	0.144	0.041	0.185	0.234	0.753	0.987
4,4'-DDD	kg/yr	Central	Particulate	0.659	0.326	0.985	0.116	0.032	0.148	0.234	0.477	0.711
4,4'-DDD	kg/yr	Lower	Dissolved	0.25	0.318	0.569	0.212	0.204	0.417	0.140	0.393	0.533
4,4'-DDD	kg/yr	Upper	Dissolved	0.427	2.02	2.45	0.225	0.606	0.831	0.140	1.630	1.770
4,4'-DDD	kg/yr	Central	Dissolved	0.339	0.873	1.21	0.219	0.405	0.624	0.140	1.010	1.150
4,4'-DDT	kg/yr	Lower	Total	3.41	0.0514	3.46	0.711	0.030	0.741	0.552	0.261	0.813
4,4'-DDT	kg/yr	Upper	Total	4.56	0.65	5.21	0.791	0.065	0.856	0.552	0.399	0.952
4,4'-DDT	kg/yr	Central	Total	3.98	0.278	4.26	0.751	0.047	0.798	0.552	0.330	0.883
4,4'-DDT	kg/yr	Lower	Particulate	2.35	0	2.35	0.442	0.00363	0.446	0.387	0.193	0.580
4,4'-DDT	kg/yr	Upper	Particulate	3.38	0.543	3.92	0.544	0.048	0.591	0.387	0.320	0.707
4,4'-DDT	kg/yr	Central	Particulate	2.87	0.19	3.06	0.493	0.026	0.518	0.387	0.257	0.643
4,4'-DDT	kg/yr	Lower	Dissolved	1.06	0.0514	1.11	0.248	0.017	0.265	0.166	0.068	0.234
4,4'-DDT	kg/yr	Upper	Dissolved	1.18	0.127	1.3	0.269	0.026	0.295	0.166	0.079	0.245
4,4'-DDT	kg/yr	Central	Dissolved	1.12	0.0878	1.21	0.258	0.022	0.280	0.166	0.074	0.239
Total of 2,4' and 4,4'-DDE	kg/yr	Lower	Total	2.63	0.354	2.98	0.717	0.166	0.883	0.816	0.401	1.220
Total of 2,4' and 4,4'-DDE	kg/yr	Upper	Total	3.05	1.4	4.45	0.795	0.213	1.010	0.816	0.972	1.790
Total of 2,4' and 4,4'-DDE	kg/yr	Central	Total	2.84	0.756	3.59	0.756	0.189	0.946	0.816	0.687	1.500
Total of 2,4' and 4,4'-DDE	kg/yr	Lower	Particulate	1.66	0.157	1.82	0.353	0.015	0.368	0.557	0.208	0.765
Total of 2,4' and 4,4'-DDE	kg/yr	Upper	Particulate	2.08	0.765	2.84	0.437	0.072	0.508	0.557	0.495	1.050
Total of 2,4' and 4,4'-DDE	kg/yr	Central	Particulate	1.87	0.391	2.26	0.395	0.043	0.438	0.557	0.351	0.909
Total of 2,4' and 4,4'-DDE	kg/yr	Lower	Dissolved	0.967	0.197	1.16	0.359	0.094	0.453	0.259	0.194	0.453
Total of 2,4' and 4,4'-DDE	kg/yr	Upper	Dissolved	0.973	0.634	1.61	0.365	0.199	0.563	0.259	0.477	0.736
Total of 2,4' and 4,4'-DDE	kg/yr	Central	Dissolved	0.97	0.365	1.34	0.362	0.146	0.508	0.259	0.335	0.594
Total of 2,4' and 4,4'-DDD	kg/yr	Lower	Total	0.992	0.79	1.78	0.396	0.357	0.753	0.477	0.838	1.310
Total of 2,4' and 4,4'-DDD	kg/yr	Upper	Total	1.51	4.21	5.72	0.488	0.914	1.400	0.477	3.570	4.050
Total of 2,4' and 4,4'-DDD	kg/yr	Central	Total	1.25	1.71	2.96	0.442	0.636	1.080	0.477	2.200	2.680
Total of 2,4' and 4,4'-DDD	kg/yr	Lower	Particulate	0.676	0.00913	0.685	0.110	0.030	0.141	0.279	0.264	0.543
Total of 2,4' and 4,4'-DDD	kg/yr	Upper	Particulate	0.894	1.24	2.14	0.177	0.053	0.231	0.279	1.030	1.310
Total of 2,4' and 4,4'-DDD	kg/yr	Central	Particulate	0.785	0.435	1.22	0.144	0.042	0.186	0.279	0.645	0.924
Total of 2,4' and 4,4'-DDD	kg/yr	Lower	Dissolved	0.316	0.494	0.811	0.285	0.304	0.590	0.198	0.574	0.772
Total of 2,4' and 4,4'-DDD	kg/yr	Upper	Dissolved	0.615	2.97	3.59	0.310	0.884	1.190	0.198	2.540	2.740
Total of 2,4' and 4,4'-DDD	kg/yr	Central	Dissolved	0.466	1.28	1.74	0.298	0.594	0.892	0.198	1.560	1.760

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

		Load Estimation		RM 4			Fraction of Willamette Load Leaving via Multnomah Channel at RM 2			Fraction of Willamette Load Leaving via Multnomah Channel at RM 3		
Analyte	**Units**	**Type**	**Filtration**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**
Total of 2,4' and 4,4'-DDT	kg/yr	Lower	Total	4.15	0.0847	4.24	0.873	0.046	0.919	0.663	0.326	0.989
Total of 2,4' and 4,4'-DDT	kg/yr	Upper	Total	4.87	0.832	5.7	0.969	0.080	1.050	0.663	0.508	1.170
Total of 2,4' and 4,4'-DDT	kg/yr	Central	Total	4.51	0.363	4.87	0.921	0.063	0.984	0.663	0.417	1.080
Total of 2,4' and 4,4'-DDT	kg/yr	Lower	Particulate	2.79	0	2.79	0.518	0.004	0.522	0.446	0.232	0.678
Total of 2,4' and 4,4'-DDT	kg/yr	Upper	Particulate	3.56	0.664	4.22	0.633	0.056	0.690	0.446	0.378	0.824
Total of 2,4' and 4,4'-DDT	kg/yr	Central	Particulate	3.17	0.234	3.41	0.576	0.030	0.606	0.446	0.305	0.751
Total of 2,4' and 4,4'-DDT	kg/yr	Lower	Dissolved	1.31	0.0847	1.4	0.336	0.024	0.360	0.217	0.093	0.311
Total of 2,4' and 4,4'-DDT	kg/yr	Upper	Dissolved	1.36	0.168	1.53	0.355	0.042	0.397	0.217	0.130	0.347
Total of 2,4' and 4,4'-DDT	kg/yr	Central	Dissolved	1.33	0.129	1.46	0.345	0.033	0.378	0.217	0.111	0.329
Total DDx	kg/yr	Lower	Total	8.29	1.38	9.67	1.99	0.60	2.59	1.96	1.56	3.52
Total DDx	kg/yr	Upper	Total	8.91	6.44	15.4	2.25	1.17	3.43	1.96	5.05	7.00
Total DDx	kg/yr	Central	Total	8.6	2.83	11.4	2.12	0.89	3.01	1.96	3.31	5.26
Total DDx	kg/yr	Lower	Particulate	5.35	0.353	5.7	0.98	0.05	1.03	1.28	0.70	1.99
Total DDx	kg/yr	Upper	Particulate	6.31	2.67	8.98	1.25	0.18	1.43	1.28	1.90	3.18
Total DDx	kg/yr	Central	Particulate	5.83	1.06	6.89	1.11	0.12	1.23	1.28	1.30	2.58
Total DDx	kg/yr	Lower	Dissolved	2.6	0.798	3.4	1.00	0.42	1.43	0.67	0.86	1.54
Total DDx	kg/yr	Upper	Dissolved	2.94	3.77	6.71	1.00	1.12	2.13	0.67	3.15	3.82
Total DDx	kg/yr	Central	Dissolved	2.77	1.77	4.54	1.00	0.77	1.78	0.67	2.00	2.68
PAHs												
Naphthalene	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
Naphthalene	kg/yr	Upper	Total	353	242	595	0	0	0	0	5.77	5.77
Naphthalene	kg/yr	Central	Total	176	48.4	225	0	0	0	0	2.88	2.88
Naphthalene	kg/yr	Lower	Particulate	0	0	0	0	0	0	0	0	0
Naphthalene	kg/yr	Upper	Particulate	11.7	11.7	23.3	0	0	0	0	5.77	5.77
Naphthalene	kg/yr	Central	Particulate	5.85	2.33	8.18	0	0	0	0	2.88	2.88
Naphthalene	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
Naphthalene	kg/yr	Upper	Dissolved	341	230	571	0	0	0	0	0	0
Naphthalene	kg/yr	Central	Dissolved	171	46.1	217	0	0	0	0	0	0
Benzo(a)pyrene	kg/yr	Lower	Total	6.59	8.24	14.8	0	0.13	0.13	3.02	11.1	14.1
Benzo(a)pyrene	kg/yr	Upper	Total	13.2	30	43.1	2.21	1.53	3.74	3.02	18.2	21.2
Benzo(a)pyrene	kg/yr	Central	Total	9.87	16	25.9	1.11	0.83	1.94	3.02	14.7	17.7
Benzo(a)pyrene	kg/yr	Lower	Particulate	6.24	7.75	14	0	0.13	0.13	2.90	11.1	14.0
Benzo(a)pyrene	kg/yr	Upper	Particulate	12.2	28.8	41	2.21	1.53	3.74	2.90	17.2	20.2
Benzo(a)pyrene	kg/yr	Central	Particulate	9.24	15.7	24.9	1.11	0.83	1.94	2.90	14.2	17.1
Benzo(a)pyrene	kg/yr	Lower	Dissolved	0.351	0	0.351	0	0	0	0.123	0	0.123
Benzo(a)pyrene	kg/yr	Upper	Dissolved	0.908	1.21	2.12	0	0	0	0.123	0.952	1.080
Benzo(a)pyrene	kg/yr	Central	Dissolved	0.63	0.339	0.969	0	0	0	0.123	0.476	0.599
Total Carcinogenic PAHs	kg/yr	Lower	Total	44.6	50.7	95.3	5.40	6.92	12.3	19.0	52.9	71.9
Total Carcinogenic PAHs	kg/yr	Upper	Total	71.5	170	241	15.2	10.4	25.6	19.0	100	119
Total Carcinogenic PAHs	kg/yr	Central	Total	58	97	155	10.3	8.63	18.9	19.0	76.5	95.5
Total Carcinogenic PAHs	kg/yr	Lower	Particulate	38	44.7	82.7	5.40	0.71	6.11	17.6	52.9	70.5
Total Carcinogenic PAHs	kg/yr	Upper	Particulate	61.1	147	208	13.4	9.31	22.7	17.6	81.0	98.5
Total Carcinogenic PAHs	kg/yr	Central	Particulate	49.5	82.7	132	9.41	5.01	14.4	17.6	66.9	84.5
Total Carcinogenic PAHs	kg/yr	Lower	Dissolved	6.63	6	12.6	0	1.04	1.04	1.46	0	1.46
Total Carcinogenic PAHs	kg/yr	Upper	Dissolved	10.4	26.5	37	1.80	6.21	8.01	1.46	19.0	20.5
Total Carcinogenic PAHs	kg/yr	Central	Dissolved	8.53	14.3	22.8	0.90	3.62	4.52	1.46	9.52	11.0

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

		Load Estimation		RM 4			Fraction of Willamette Load Leaving via Multnomah Channel at RM 2			Fraction of Willamette Load Leaving via Multnomah Channel at RM 3		
Analyte	**Units**	**Type**	**Filtration**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**
cPAH BaPEq	kg/yr	Lower	Total	8.93	10.6	19.5	0.18	0.44	0.62	3.87	12.90	16.80
cPAH BaPEq	kg/yr	Upper	Total	20.6	38.1	58.7	3.41	1.96	5.36	3.87	23.70	27.60
cPAH BaPEq	kg/yr	Central	Total	14.8	20.7	35.5	1.79	1.20	2.99	3.87	18.30	22.20
cPAH BaPEq	kg/yr	Lower	Particulate	8.35	9.87	18.2	0.18	0.19	0.37	3.70	12.90	16.60
cPAH BaPEq	kg/yr	Upper	Particulate	16.2	36.3	52.5	2.83	1.96	4.79	3.70	22.10	25.80
cPAH BaPEq	kg/yr	Central	Particulate	12.3	19.8	32.1	1.51	1.07	2.58	3.70	17.50	21.20
cPAH BaPEq	kg/yr	Lower	Dissolved	0.570	0.048	0.618	0	0	0	0.17	0	0.17
cPAH BaPEq	kg/yr	Upper	Dissolved	4.38	1.83	6.21	0.58	0.24	0.82	0.17	1.62	1.80
cPAH BaPEq	kg/yr	Central	Dissolved	2.47	0.875	3.35	0.29	0.12	0.41	0.17	0.81	0.98
Total PAHs	kg/yr	Lower	Total	328	231	559	69	55	124	81	208	288
Total PAHs	kg/yr	Upper	Total	885	835	1720	96	141	237	81	524	604
Total PAHs	kg/yr	Central	Total	606	513	1120	83	98	180	81	366	446
Total PAHs	kg/yr	Lower	Particulate	71.9	62.8	135	5.4	5.7	11	35	113	148
Total PAHs	kg/yr	Upper	Particulate	165	323	488	26	22	48	35	193	227
Total PAHs	kg/yr	Central	Particulate	118	170	289	15	14	29	35	153	188
Total PAHs	kg/yr	Lower	Dissolved	256	155	411	64	32	96	46	94	140
Total PAHs	kg/yr	Upper	Dissolved	720	685	1400	71	135	206	46	331	377
Total PAHs	kg/yr	Central	Dissolved	488	343	831	67	84	151	46	213	259
SVOCs												
Bis(2-ethylhexyl)phthalate	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
Bis(2-ethylhexyl)phthalate	kg/yr	Upper	Total	9680	127	9810	4880	3640	8530	0	6880	6880
Bis(2-ethylhexyl)phthalate	kg/yr	Central	Total	4840	42.3	4880	2440	1820	4260	0	3440	3440
Bis(2-ethylhexyl)phthalate	kg/yr	Lower	Particulate	--	0	0	0	0	0	0	0	0
Bis(2-ethylhexyl)phthalate	kg/yr	Upper	Particulate	--	76.5	76.5	0	0	0	0	0	0
Bis(2-ethylhexyl)phthalate	kg/yr	Central	Particulate	--	25.5	25.5	0	0	0	0	0	0
Bis(2-ethylhexyl)phthalate	kg/yr	Lower	Dissolved	--	0	0	0	0	0	0	0	0
Bis(2-ethylhexyl)phthalate	kg/yr	Upper	Dissolved	--	50.4	50.4	0	0	0	0	0	0
Bis(2-ethylhexyl)phthalate	kg/yr	Central	Dissolved	--	16.8	16.8	0	0	0	0	0	0
Hexachlorobenzene	kg/yr	Lower	Total	0.407	0.253	0.659	0.340	0.073	0.413	0.216	0.200	0.416
Hexachlorobenzene	kg/yr	Upper	Total	0.613	0.704	1.32	0.342	0.080	0.422	0.216	0.307	0.523
Hexachlorobenzene	kg/yr	Central	Total	0.51	0.461	0.971	0.341	0.076	0.418	0.216	0.254	0.470
Hexachlorobenzene	kg/yr	Lower	Particulate	0.078	0	0.078	0.000	0	0.000	0.043	0.0221	0.065
Hexachlorobenzene	kg/yr	Upper	Particulate	0.13	0.0885	0.218	0.034	0.004	0.037	0.043	0.063	0.106
Hexachlorobenzene	kg/yr	Central	Particulate	0.104	0.0544	0.158	0.017	0.002	0.019	0.043	0.043	0.086
Hexachlorobenzene	kg/yr	Lower	Dissolved	0.277	0.253	0.53	0.307	0.069	0.376	0.173	0.178	0.351
Hexachlorobenzene	kg/yr	Upper	Dissolved	0.535	0.616	1.15	0.342	0.080	0.422	0.173	0.244	0.417
Hexachlorobenzene	kg/yr	Central	Dissolved	0.406	0.407	0.813	0.324	0.075	0.399	0.173	0.211	0.384

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

Analyte	Units	Load Estimation Type	Filtration	RM 4			Fraction of Willamette Load Leaving via Multnomah Channel at RM 2			Fraction of Willamette Load Leaving via Multnomah Channel at RM 3		
				High Flow	Low Flow	Annual	High Flow	Low Flow	Annual	High Flow	Low Flow	Annual
Pesticides (non-DDx)												
Total Chlordanes	kg/yr	Lower	Total	1.03	0.239	1.27	0.339	0.071	0.410	0.316	0.392	0.708
Total Chlordanes	kg/yr	Upper	Total	1.38	0.712	2.09	0.381	0.127	0.508	0.316	0.454	0.770
Total Chlordanes	kg/yr	Central	Total	1.2	0.397	1.6	0.360	0.099	0.459	0.316	0.423	0.739
Total Chlordanes	kg/yr	Lower	Particulate	0.383	0	0.383	0.044	0	0.044	0.123	0.0834	0.206
Total Chlordanes	kg/yr	Upper	Particulate	0.562	0.198	0.76	0.103	0.002	0.105	0.123	0.114	0.237
Total Chlordanes	kg/yr	Central	Particulate	0.473	0.0609	0.534	0.073	0.001	0.074	0.123	0.099	0.222
Total Chlordanes	kg/yr	Lower	Dissolved	0.649	0.187	0.836	0.279	0.069	0.348	0.193	0.309	0.502
Total Chlordanes	kg/yr	Upper	Dissolved	0.815	0.514	1.33	0.295	0.127	0.422	0.193	0.340	0.533
Total Chlordanes	kg/yr	Central	Dissolved	0.732	0.336	1.07	0.287	0.098	0.385	0.193	0.324	0.518
γ-Hexachlorocyclohexane	kg/yr	Lower	Total	0.269	0.311	0.58	0.085	0.085	0.170	0.080	0.114	0.194
γ-Hexachlorocyclohexane	kg/yr	Upper	Total	0.276	0.485	0.761	0.091	0.116	0.207	0.080	0.304	0.384
γ-Hexachlorocyclohexane	kg/yr	Central	Total	0.272	0.387	0.659	0.088	0.100	0.188	0.080	0.209	0.289
γ-Hexachlorocyclohexane	kg/yr	Lower	Particulate	0	0	0	0.00301	0	0.00301	0.00132	0.0016	0.00291
γ-Hexachlorocyclohexane	kg/yr	Upper	Particulate	0.00572	0.00306	0.00878	0.00341	0.00039	0.00380	0.00132	0.00778	0.00909
γ-Hexachlorocyclohexane	kg/yr	Central	Particulate	0.00286	0.000613	0.00347	0.00321	0.00019	0.00341	0.00132	0.00469	0.00600
γ-Hexachlorocyclohexane	kg/yr	Lower	Dissolved	0.263	0.311	0.574	0.08160	0.08450	0.16600	0.07850	0.10600	0.18500
γ-Hexachlorocyclohexane	kg/yr	Upper	Dissolved	0.276	0.482	0.758	0.08800	0.11600	0.20400	0.07850	0.30200	0.38100
γ-Hexachlorocyclohexane	kg/yr	Central	Dissolved	0.269	0.387	0.656	0.08480	0.10000	0.18500	0.07850	0.20400	0.28300
Aldrin	kg/yr	Lower	Total	0.0536	0.00413	0.0577	0.02200	0.00601	0.02800	0.02190	0.04430	0.06620
Aldrin	kg/yr	Upper	Total	0.0538	0.0653	0.119	0.05480	0.01380	0.06860	0.02190	0.04760	0.06950
Aldrin	kg/yr	Central	Total	0.0537	0.0296	0.0833	0.03840	0.00988	0.04830	0.02190	0.04600	0.06780
Aldrin	kg/yr	Lower	Particulate	0.0134	0	0.0134	0.00406	0	0.00406	0.00791	0.0144	0.02230
Aldrin	kg/yr	Upper	Particulate	0.0261	0.0151	0.0411	0.01210	0.00335	0.01540	0.00791	0.02570	0.03360
Aldrin	kg/yr	Central	Particulate	0.0197	0.00527	0.025	0.00807	0.00167	0.00975	0.00791	0.02010	0.02800
Aldrin	kg/yr	Lower	Dissolved	0.0277	0	0.0277	0.01790	0.00266	0.02060	0.01400	0.0186	0.03260
Aldrin	kg/yr	Upper	Dissolved	0.0402	0.0503	0.0905	0.04270	0.01380	0.05650	0.01400	0.03320	0.04720
Aldrin	kg/yr	Central	Dissolved	0.034	0.0243	0.0582	0.03030	0.00821	0.03850	0.01400	0.02590	0.03990
Dieldrin	kg/yr	Lower	Total	2.36	0.384	2.74	0.801	0.118	0.919	0.820	0.358	1.180
Dieldrin	kg/yr	Upper	Total	5.71	0.668	6.38	1.060	0.173	1.230	0.820	0.451	1.270
Dieldrin	kg/yr	Central	Total	4.04	0.513	4.55	0.931	0.145	1.080	0.820	0.405	1.220
Dieldrin	kg/yr	Lower	Particulate	0.257	0	0.257	0.067	0.00133	0.068	0.114	0	0.114
Dieldrin	kg/yr	Upper	Particulate	0.8	0.0607	0.86	0.072	0.003	0.075	0.114	0.000	0.114
Dieldrin	kg/yr	Central	Particulate	0.528	0.0174	0.546	0.069	0.002	0.071	0.114	0.000	0.114
Dieldrin	kg/yr	Lower	Dissolved	2.1	0.384	2.48	0.734	0.115	0.849	0.706	0.358	1.060
Dieldrin	kg/yr	Upper	Dissolved	4.91	0.607	5.52	0.988	0.172	1.160	0.706	0.451	1.160
Dieldrin	kg/yr	Central	Dissolved	3.51	0.496	4	0.861	0.143	1.000	0.706	0.405	1.110

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

		Load Estimation		RM 4			Fraction of Willamette Load Leaving via Multnomah Channel at RM 2			Fraction of Willamette Load Leaving via Multnomah Channel at RM 3		
Analyte	**Units**	**Type**	**Filtration**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**
Metals												
Arsenic	kg/yr	Lower	Total	4710	5450	10200	2410	0	2410	2010	4740	6750
Arsenic	kg/yr	Upper	Total	8040	7680	15700	2510	2440	4950	2010	5240	7250
Arsenic	kg/yr	Central	Total	6380	6530	12900	2460	1220	3680	2010	4990	7000
Arsenic	kg/yr	Lower	Particulate	789	810	1600	653	0	653	687	212	899
Arsenic	kg/yr	Upper	Particulate	4910	6440	11400	723	148	871	687	4740	5430
Arsenic	kg/yr	Central	Particulate	2850	2910	5760	688	74	762	687	2480	3160
Arsenic	kg/yr	Lower	Dissolved	3130	0	3130	1680	0	1680	1320	0	1320
Arsenic	kg/yr	Upper	Dissolved	3920	6700	10600	1860	2290	4150	1320	5030	6350
Arsenic	kg/yr	Central	Dissolved	3530	3620	7150	1770	1150	2920	1320	2510	3840
Chromium	kg/yr	Lower	Total	14700	0	14700	5830	0	5830	8680	0	8680
Chromium	kg/yr	Upper	Total	18600	10300	28900	8600	1540	10100	8680	5130	13800
Chromium	kg/yr	Central	Total	16700	5430	22100	7210	769	7980	8680	2570	11200
Chromium	kg/yr	Lower	Particulate	5660	0	5660	3940	0	3940	4710	0	4710
Chromium	kg/yr	Upper	Particulate	18600	10300	28900	5830	1190	7010	4710	5130	9840
Chromium	kg/yr	Central	Particulate	12100	4150	16300	4880	594	5470	4710	2570	7280
Chromium	kg/yr	Lower	Dissolved	0	0	0	0	0	0	3970	0	3970
Chromium	kg/yr	Upper	Dissolved	9080	3630	12700	4670	351	5020	3970	0	3970
Chromium	kg/yr	Central	Dissolved	4540	1280	5830	2330	175	2510	3970	0	3970
Copper	kg/yr	Lower	Total	27000	11700	38700	10800	3470	14200	14600	9260	23900
Copper	kg/yr	Upper	Total	45400	18600	64000	11200	4580	15700	14600	13400	28100
Copper	kg/yr	Central	Total	36200	15100	51300	11000	4020	15000	14600	11300	26000
Copper	kg/yr	Lower	Particulate	9980	1950	11900	6220	1210	7440	8200	3390	11600
Copper	kg/yr	Upper	Particulate	34000	7890	41800	6410	1310	7720	8200	5190	13400
Copper	kg/yr	Central	Particulate	22000	5580	27600	6310	1260	7580	8200	4290	12500
Copper	kg/yr	Lower	Dissolved	11500	7890	19400	4360	2250	6620	6420	5870	12300
Copper	kg/yr	Upper	Dissolved	17000	10800	27700	4940	3270	8210	6420	8250	14700
Copper	kg/yr	Central	Dissolved	14200	9480	23700	4650	2760	7410	6420	7060	13500
Lead	kg/yr	Lower	Total	5760	1680	7440	1530	644	2170	3030	2280	5310
Lead	kg/yr	Upper	Total	9770	4160	13900	2530	690	3220	3030	2300	5330
Lead	kg/yr	Central	Total	7770	3090	10900	2030	667	2700	3030	2290	5320
Lead	kg/yr	Lower	Particulate	3520	1520	5040	1530	602	2130	2270	2280	4550
Lead	kg/yr	Upper	Particulate	9770	4160	13900	2460	614	3070	2270	2300	4570
Lead	kg/yr	Central	Particulate	6650	2890	9530	1990	608	2600	2270	2290	4560
Lead	kg/yr	Lower	Dissolved	0	0	0	0	29.7	29.7	759	0	759
Lead	kg/yr	Upper	Dissolved	2240	433	2670	76	88	164	759	0	759
Lead	kg/yr	Central	Dissolved	1120	201	1320	38	59	97	759	0	759
Mercury	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
Mercury	kg/yr	Upper	Total	0	0	0	366	0	366	0	212	212
Mercury	kg/yr	Central	Total	0	0	0	183	0	183	0	106	106
Mercury	kg/yr	Lower	Particulate	0	0	0	0	0	0	0	0	0
Mercury	kg/yr	Upper	Particulate	0	0	0	366	0	366	0	212	212
Mercury	kg/yr	Central	Particulate	0	0	0	183	0	183	0	106	106
Mercury	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
Mercury	kg/yr	Upper	Dissolved	0	140	140	0	0	0	0	0.0	0.0
Mercury	kg/yr	Central	Dissolved	0	27.9	27.9	0	0	0	0	0.0	0.0

Table E2-4. High Flow, Low Flow, and Annual Surface Water Load Estimates at River Transect Stations.

		Load Estimation		RM 4			Fraction of Willamette Load Leaving via Multnomah Channel at RM 2			Fraction of Willamette Load Leaving via Multnomah Channel at RM 3		
Analyte	**Units**	**Type**	**Filtration**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**	**High Flow**	**Low Flow**	**Annual**
Nickel	kg/yr	Lower	Total	16900	0	16900	7580	2920	10500	8250	3170	11400
Nickel	kg/yr	Upper	Total	23100	10700	33800	7960	3080	11000	8250	7730	16000
Nickel	kg/yr	Central	Total	20000	7470	27500	7770	3000	10800	8250	5450	13700
Nickel	kg/yr	Lower	Particulate	4470	0	4470	2550	324	2870	3670	2120	5790
Nickel	kg/yr	Upper	Particulate	16400	10600	27000	7960	513	8480	3670	2330	6000
Nickel	kg/yr	Central	Particulate	10400	4570	15000	5250	418	5670	3670	2220	5900
Nickel	kg/yr	Lower	Dissolved	6700	0	6700	0	2400	2400	4580	1060	5640
Nickel	kg/yr	Upper	Dissolved	12400	7540	20000	5030	2750	7790	4580	5400	9980
Nickel	kg/yr	Central	Dissolved	9570	2900	12500	2520	2580	5090	4580	3230	7810
Zinc	kg/yr	Lower	Total	73000	0	73000	20100	0	20100	29000	0	29000
Zinc	kg/yr	Upper	Total	74800	53100	128000	22100	12100	34200	29000	36500	65500
Zinc	kg/yr	Central	Total	73900	31600	105000	21100	6040	27200	29000	18300	47300
Zinc	kg/yr	Lower	Particulate	37500	0	37500	20100	0	20100	29000	0	29000
Zinc	kg/yr	Upper	Particulate	73000	53100	126000	22100	12100	34200	29000	36500	65500
Zinc	kg/yr	Central	Particulate	55300	18200	73500	21100	6040	27200	29000	18300	47300
Zinc	kg/yr	Lower	Dissolved	0	0	0	0	0	0	0	0	0
Zinc	kg/yr	Upper	Dissolved	37200	25000	62200	0	6880	6880	0	0	0
Zinc	kg/yr	Central	Dissolved	18600	13400	32000	0	3440	3440	0	0	0
Butyltins												
Tributyltin Ion	kg/yr	Lower	Total	0	0	0	0	0	0	0	0	0
Tributyltin Ion	kg/yr	Upper	Total	0	0	0	0	0	0	0	0	0
Tributyltin Ion	kg/yr	Central	Total	0	0	0	0	0	0	0	0	0

Notes:

-- Analyte not sampled.
BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
SVOC - semivolatile organic compound
TEQ - toxic equivalent concentration

Table E2-5. High Flow, Low Flow, and Annual Surface Water Upstream Load Estimates at RM 11.8.

Analyte	Load Estimation Type	Filtration	Units	Upstream Load High Flow	Low Flow	Annual
Metals						
Arsenic	Lower	Total	kg/yr	4110	0	4110
Arsenic	Upper	Total	kg/yr	7600	6770	14400
Arsenic	Central	Total	kg/yr	5200	4290	9490
Arsenic	Lower	Particulate	kg/yr	1190	0	1190
Arsenic	Upper	Particulate	kg/yr	4470	921	5390
Arsenic	Central	Particulate	kg/yr	2220	488	2710
Arsenic	Lower	Dissolved	kg/yr	2780	0	2780
Arsenic	Upper	Dissolved	kg/yr	3210	6050	9260
Arsenic	Central	Dissolved	kg/yr	2980	3810	6790
Chromium	Lower	Total	kg/yr	11500	0	11500
Chromium	Upper	Total	kg/yr	25000	8520	33500
Chromium	Central	Total	kg/yr	17800	3350	21100
Chromium	Lower	Particulate	kg/yr	1120	0	1120
Chromium	Upper	Particulate	kg/yr	25000	6000	31000
Chromium	Central	Particulate	kg/yr	14300	2870	17200
Chromium	Lower	Dissolved	kg/yr	0	0	0
Chromium	Upper	Dissolved	kg/yr	10400	3350	13800
Chromium	Central	Dissolved	kg/yr	3460	479	3930
Copper	Lower	Total	kg/yr	17500	9670	27200
Copper	Upper	Total	kg/yr	53700	14400	68100
Copper	Central	Total	kg/yr	34200	12200	46500
Copper	Lower	Particulate	kg/yr	10100	2480	12600
Copper	Upper	Particulate	kg/yr	43000	6560	49600
Copper	Central	Particulate	kg/yr	22700	4300	27000
Copper	Lower	Dissolved	kg/yr	7150	6420	13600
Copper	Upper	Dissolved	kg/yr	23500	11000	34500
Copper	Central	Dissolved	kg/yr	11500	8300	19800
Lead	Lower	Total	kg/yr	2780	1280	4060
Lead	Upper	Total	kg/yr	12200	3360	15600
Lead	Central	Total	kg/yr	7180	2200	9380
Lead	Lower	Particulate	kg/yr	2780	1280	4060
Lead	Upper	Particulate	kg/yr	12200	2960	15200
Lead	Central	Particulate	kg/yr	7110	1970	9080
Lead	Lower	Dissolved	kg/yr	0	0	0
Lead	Upper	Dissolved	kg/yr	179	419	598
Lead	Central	Dissolved	kg/yr	68.5	232	300
Mercury	Lower	Total	kg/yr	0	0	0
Mercury	Upper	Total	kg/yr	596	279	875
Mercury	Central	Total	kg/yr	179	53.2	232
Mercury	Lower	Particulate	kg/yr	0	0	0
Mercury	Upper	Particulate	kg/yr	596	279	875
Mercury	Central	Particulate	kg/yr	149	53.2	202
Mercury	Lower	Dissolved	kg/yr	0	0	0
Mercury	Upper	Dissolved	kg/yr	149	93.1	242
Mercury	Central	Dissolved	kg/yr	29.8	13.3	43.1
Nickel	Lower	Total	kg/yr	0	6280	6280
Nickel	Upper	Total	kg/yr	28700	12600	41300
Nickel	Central	Total	kg/yr	17300	8830	26100
Nickel	Lower	Particulate	kg/yr	0	745	745
Nickel	Upper	Particulate	kg/yr	22300	7820	30200
Nickel	Central	Particulate	kg/yr	12400	2330	14700

Table E2-5. High Flow, Low Flow, and Annual Surface Water Upstream Load Estimates at RM 11.8.

Analyte	Load Estimation Type	Filtration	Units	Upstream Load High Flow	Low Flow	Annual
Nickel	Lower	Dissolved	kg/yr	0	0	0
Nickel	Upper	Dissolved	kg/yr	11000	10900	21900
Nickel	Central	Dissolved	kg/yr	6400	6500	12900
Zinc	Lower	Total	kg/yr	35400	0	35400
Zinc	Upper	Total	kg/yr	95000	64200	159000
Zinc	Central	Total	kg/yr	63800	28700	92400
Zinc	Lower	Particulate	kg/yr	35400	0	35400
Zinc	Upper	Particulate	kg/yr	95000	64200	159000
Zinc	Central	Particulate	kg/yr	63800	17100	80900
Zinc	Lower	Dissolved	kg/yr	0	0	0
Zinc	Upper	Dissolved	kg/yr	0	30700	30700
Zinc	Central	Dissolved	kg/yr	0	11500	11500
Butyltins						
Tributyltin Ion	Lower	Total	kg/yr	0	0	0
Tributyltin Ion	Upper	Total	kg/yr	0	76.8	76.8
Tributyltin Ion	Central	Total	kg/yr	0	11	11
PCBs						
PCB077	Lower	Total	kg/yr	0.00139	0.00380	0.00519
PCB077	Upper	Total	kg/yr	0.00891	0.00697	0.0159
PCB077	Central	Total	kg/yr	0.00448	0.00483	0.00931
PCB077	Lower	Particulate	kg/yr	0.000506	0.00173	0.00224
PCB077	Upper	Particulate	kg/yr	0.00728	0.00487	0.0122
PCB077	Central	Particulate	kg/yr	0.00339	0.0031	0.00649
PCB077	Lower	Dissolved	kg/yr	0.000521	0	0.000521
PCB077	Upper	Dissolved	kg/yr	0.00162	0.00357	0.0052
PCB077	Central	Dissolved	kg/yr	0.00109	0.00173	0.00283
PCB081	Lower	Total	kg/yr	0	0	0
PCB081	Upper	Total	kg/yr	0.0000521	0.0000884	0.000141
PCB081	Central	Total	kg/yr	0.0000194	0.0000166	0.000036
PCB081	Lower	Dissolved	kg/yr	0	0	0
PCB081	Upper	Dissolved	kg/yr	0.0000521	0.0000884	0.000141
PCB081	Central	Dissolved	kg/yr	0.0000194	0.0000166	0.000036
PCB081	Lower	Particulate	kg/yr	0	0	0
PCB081	Upper	Particulate	kg/yr	0	0	0
PCB081	Central	Particulate	kg/yr	0	0	0
PCB105	Lower	Total	kg/yr	0.0059	0.0193	0.0252
PCB105	Upper	Total	kg/yr	0.04154	0.0393	0.0808
PCB105	Central	Total	kg/yr	0.0221	0.0304	0.0525
PCB105	Lower	Dissolved	kg/yr	0.0037	0.0041	0.0078
PCB105	Upper	Dissolved	kg/yr	0.00847	0.01810	0.02658
PCB105	Central	Dissolved	kg/yr	0.00590	0.0108	0.0167
PCB105	Lower	Particulate	kg/yr	0.0022	0.0087	0.0109
PCB105	Upper	Particulate	kg/yr	0.03306	0.02681	0.0599
PCB105	Central	Particulate	kg/yr	0.0162	0.0196	0.0358
PCB118	Lower	Total	kg/yr	0.0149	0.0457	0.0607
PCB118	Upper	Total	kg/yr	0.104	0.109	0.213
PCB118	Central	Total	kg/yr	0.0547	0.0802	0.1350
PCB118	Lower	Particulate	kg/yr	0.005	0.0196	0.0246
PCB118	Upper	Particulate	kg/yr	0.0807	0.0873	0.168
PCB118	Central	Particulate	kg/yr	0.0387	0.0507	0.0894
PCB118	Lower	Dissolved	kg/yr	0.00993	0.0112	0.0211
PCB118	Upper	Dissolved	kg/yr	0.0234	0.0484	0.0717
PCB118	Central	Dissolved	kg/yr	0.016	0.0296	0.0456

Table E2-5. High Flow, Low Flow, and Annual Surface Water Upstream Load Estimates at RM 11.8.

Analyte	Load Estimation Type	Filtration	Units	Upstream Load High Flow	Low Flow	Annual
PCB126	Lower	Total	kg/yr	0	0	0
PCB126	Upper	Total	kg/yr	0.000174	0.000558	0.000732
PCB126	Central	Total	kg/yr	0.0000467	0.000228	0.000275
PCB126	Lower	Particulate	kg/yr	0	0	0
PCB126	Upper	Particulate	kg/yr	0.000174	0.000558	0.000732
PCB126	Central	Particulate	kg/yr	0.0000467	0.000213	0.00026
PCB126	Lower	Dissolved	kg/yr	0	0	0
PCB126	Upper	Dissolved	kg/yr	0	0.000108	0.000108
PCB126	Central	Dissolved	kg/yr	0	0.0000154	0.0000154
PCB156 & PCB157	Lower	Total	kg/yr	0.0008	0.00511	0.0060
PCB156 & PCB157	Upper	Total	kg/yr	0.016740	0.01363	0.03037
PCB156 & PCB157	Central	Total	kg/yr	0.0081	0.0092	0.0173
PCB156 & PCB157	Lower	Dissolved	kg/yr	0	0	0
PCB156 & PCB157	Upper	Dissolved	kg/yr	0.00238	0.00353	0.00592
PCB156 & PCB157	Central	Dissolved	kg/yr	0.00095	0.00185	0.00281
PCB156 & PCB157	Lower	Particulate	kg/yr	0.00085	0.00332	0.0042
PCB156 & PCB157	Upper	Particulate	kg/yr	0.01436	0.01045	0.02481
PCB156 & PCB157	Central	Particulate	kg/yr	0.0071	0.0074	0.0145
PCB169	Lower	Total	kg/yr	0	0	0
PCB169	Upper	Total	kg/yr	0.0000447	0.000363	0.000408
PCB169	Central	Total	kg/yr	0.00000894	0.0000632	0.0000721
PCB169	Lower	Particulate	kg/yr	0	0	0
PCB169	Upper	Particulate	kg/yr	0.0000447	0	0.0000447
PCB169	Central	Particulate	kg/yr	0.00000894	0	0.00000894
PCB169	Lower	Dissolved	kg/yr	0	0	0
PCB169	Upper	Dissolved	kg/yr	0	0.000363	0.000363
PCB169	Central	Dissolved	kg/yr	0	0.0000632	0.0000632
Total PCB Congeners	Lower	Total	kg/yr	0.625	2.32	2.94
Total PCB Congeners	Upper	Total	kg/yr	2.9	4.5	7.39
Total PCB Congeners	Central	Total	kg/yr	1.72	2.99	4.71
Total PCB Congeners	Lower	Particulate	kg/yr	0.109	0.484	0.593
Total PCB Congeners	Upper	Particulate	kg/yr	1.89	1.65	3.54
Total PCB Congeners	Central	Particulate	kg/yr	0.942	1.08	2.02
Total PCB Congeners	Lower	Dissolved	kg/yr	0.515	1.27	1.78
Total PCB Congeners	Upper	Dissolved	kg/yr	1.00	2.85	3.85
Total PCB Congeners	Central	Dissolved	kg/yr	0.780	1.90	2.68
PCB TEQ (ND=0)	Lower	Total	kg/yr	0.000000806	0.00000269	0.00000349
PCB TEQ (ND=0)	Upper	Total	kg/yr	0.0000209	0.0000638	0.0000847
PCB TEQ (ND=0)	Central	Total	kg/yr	0.00000808	0.0000295	0.0000376
PCB TEQ (ND=0)	Lower	Particulate	kg/yr	0.000000309	0.00000119	0.0000015
PCB TEQ (ND=0)	Upper	Particulate	kg/yr	0.0000202	0.0000591	0.0000792
PCB TEQ (ND=0)	Central	Particulate	kg/yr	0.00000726	0.0000244	0.0000317

Table E2-5. High Flow, Low Flow, and Annual Surface Water Upstream Load Estimates at RM 11.8.

Analyte	Load Estimation Type	Filtration	Units	Upstream Load High Flow	Low Flow	Annual
PCB TEQ (ND=0)	Lower	Dissolved	kg/yr	0.000000496	0.000000581	0.00000108
PCB TEQ (ND=0)	Upper	Dissolved	kg/yr	0.00000123	0.0000119	0.0000132
PCB TEQ (ND=0)	Central	Dissolved	kg/yr	0.000000824	0.00000509	0.00000591
PCDD/Fs						
Total PCDD/Fs	Lower	Total	kg/yr	0.0798	0.124	0.204
Total PCDD/Fs	Upper	Total	kg/yr	0.486	0.427	0.913
Total PCDD/Fs	Central	Total	kg/yr	0.311	0.288	0.599
Total PCDD/Fs	Lower	Particulate	kg/yr	0.0477	0.0996	0.147
Total PCDD/Fs	Upper	Particulate	kg/yr	0.428	0.376	0.804
Total PCDD/Fs	Central	Particulate	kg/yr	0.266	0.259	0.524
Total PCDD/Fs	Lower	Dissolved	kg/yr	0.0317	0.00684	0.0386
Total PCDD/Fs	Upper	Dissolved	kg/yr	0.0616	0.0523	0.114
Total PCDD/Fs	Central	Dissolved	kg/yr	0.0453	0.0295	0.0748
TCDD TEQ (ND=0)	Lower	Total	kg/yr	0.000169	0.000407	0.000575
TCDD TEQ (ND=0)	Upper	Total	kg/yr	0.00136	0.00103	0.00239
TCDD TEQ (ND=0)	Central	Total	kg/yr	0.00072	0.000733	0.00145
TCDD TEQ (ND=0)	Lower	Particulate	kg/yr	0.0000741	0.000295	0.000369
TCDD TEQ (ND=0)	Upper	Particulate	kg/yr	0.00114	0.000987	0.00212
TCDD TEQ (ND=0)	Central	Particulate	kg/yr	0.000562	0.000659	0.00122
TCDD TEQ (ND=0)	Lower	Dissolved	kg/yr	0.0000916	0.00000779	0.0000994
TCDD TEQ (ND=0)	Upper	Dissolved	kg/yr	0.000272	0.000153	0.000425
TCDD TEQ (ND=0)	Central	Dissolved	kg/yr	0.000158	0.000074	0.000232
Pesticides						
4,4'-DDD	Lower	Total	kg/yr	0.418	0.162	0.58
4,4'-DDD	Upper	Total	kg/yr	1.25	0.564	1.82
4,4'-DDD	Central	Total	kg/yr	0.748	0.313	1.06
4,4'-DDD	Lower	Particulate	kg/yr	0.0758	0	0.0758
4,4'-DDD	Upper	Particulate	kg/yr	0.872	0.139	1.01
4,4'-DDD	Central	Particulate	kg/yr	0.436	0.0656	0.502
4,4'-DDD	Lower	Dissolved	kg/yr	0.18	0.0579	0.238
4,4'-DDD	Upper	Dissolved	kg/yr	0.45	0.425	0.875
4,4'-DDD	Central	Dissolved	kg/yr	0.312	0.248	0.56
4,4'-DDT	Lower	Total	kg/yr	0.999	0.0407	1.04
4,4'-DDT	Upper	Total	kg/yr	4.79	0.33	5.12
4,4'-DDT	Central	Total	kg/yr	3.1	0.152	3.25
4,4'-DDT	Lower	Particulate	kg/yr	0.29	0	0.29
4,4'-DDT	Upper	Particulate	kg/yr	3.74	0.261	4
4,4'-DDT	Central	Particulate	kg/yr	2.16	0.112	2.28
4,4'-DDT	Lower	Dissolved	kg/yr	0.709	0.0202	0.729
4,4'-DDT	Upper	Dissolved	kg/yr	1.07	0.0691	1.14
4,4'-DDT	Central	Dissolved	kg/yr	0.937	0.04	0.977
Total of 2,4' and 4,4'-DDE	Lower	Total	kg/yr	0.596	0.234	0.83
Total of 2,4' and 4,4'-DDE	Upper	Total	kg/yr	2.8	0.571	3.37
Total of 2,4' and 4,4'-DDE	Central	Total	kg/yr	2.1	0.403	2.5
Total of 2,4' and 4,4'-DDE	Lower	Particulate	kg/yr	0	0.126	0.126
Total of 2,4' and 4,4'-DDE	Upper	Particulate	kg/yr	1.92	0.242	2.16
Total of 2,4' and 4,4'-DDE	Central	Particulate	kg/yr	1.3	0.189	1.49
Total of 2,4' and 4,4'-DDE	Lower	Dissolved	kg/yr	0.596	0.0717	0.667
Total of 2,4' and 4,4'-DDE	Upper	Dissolved	kg/yr	0.922	0.329	1.25
Total of 2,4' and 4,4'-DDE	Central	Dissolved	kg/yr	0.799	0.214	1.01
Total of 2,4' and 4,4'-DDD	Lower	Total	kg/yr	0.556	0.207	0.763
Total of 2,4' and 4,4'-DDD	Upper	Total	kg/yr	1.59	0.701	2.29
Total of 2,4' and 4,4'-DDD	Central	Total	kg/yr	0.932	0.396	1.33

Table E2-5. High Flow, Low Flow, and Annual Surface Water Upstream Load Estimates at RM 11.8.

Analyte	Load Estimation Type	Filtration	Units	Upstream Load High Flow	Low Flow	Annual
Total of 2,4' and 4,4'-DDD	Lower	Particulate	kg/yr	0.0958	0	0.0958
Total of 2,4' and 4,4'-DDD	Upper	Particulate	kg/yr	1.06	0.166	1.22
Total of 2,4' and 4,4'-DDD	Central	Particulate	kg/yr	0.515	0.0807	0.595
Total of 2,4' and 4,4'-DDD	Lower	Dissolved	kg/yr	0.234	0.0815	0.316
Total of 2,4' and 4,4'-DDD	Upper	Dissolved	kg/yr	0.599	0.535	1.13
Total of 2,4' and 4,4'-DDD	Central	Dissolved	kg/yr	0.417	0.316	0.733
Total of 2,4' and 4,4'-DDT	Lower	Total	kg/yr	1.26	0.0531	1.31
Total of 2,4' and 4,4'-DDT	Upper	Total	kg/yr	5.1	0.388	5.49
Total of 2,4' and 4,4'-DDT	Central	Total	kg/yr	3.52	0.175	3.7
Total of 2,4' and 4,4'-DDT	Lower	Particulate	kg/yr	0.345	0	0.345
Total of 2,4' and 4,4'-DDT	Upper	Particulate	kg/yr	3.94	0.305	4.24
Total of 2,4' and 4,4'-DDT	Central	Particulate	kg/yr	2.4	0.127	2.52
Total of 2,4' and 4,4'-DDT	Lower	Dissolved	kg/yr	0.914	0.0202	0.935
Total of 2,4' and 4,4'-DDT	Upper	Dissolved	kg/yr	1.35	0.0838	1.43
Total of 2,4' and 4,4'-DDT	Central	Dissolved	kg/yr	1.13	0.0475	1.18
Total DDx	Lower	Total	kg/yr	2.41	0.597	3.01
Total DDx	Upper	Total	kg/yr	8.69	1.33	10
Total DDx	Central	Total	kg/yr	6.55	0.974	7.53
Total DDx	Lower	Particulate	kg/yr	0.441	0.199	0.639
Total DDx	Upper	Particulate	kg/yr	6.39	0.519	6.91
Total DDx	Central	Particulate	kg/yr	4.21	0.397	4.61
Total DDx	Lower	Dissolved	kg/yr	1.97	0.173	2.14
Total DDx	Upper	Dissolved	kg/yr	2.71	0.851	3.56
Total DDx	Central	Dissolved	kg/yr	2.34	0.577	2.92
Total Chlordanes	Lower	Total	kg/yr	0.5	0.187	0.686
Total Chlordanes	Upper	Total	kg/yr	1.17	0.451	1.62
Total Chlordanes	Central	Total	kg/yr	0.897	0.323	1.22
Total Chlordanes	Lower	Particulate	kg/yr	0.0433	0	0.0433
Total Chlordanes	Upper	Particulate	kg/yr	0.526	0.0914	0.617
Total Chlordanes	Central	Particulate	kg/yr	0.307	0.0541	0.361
Total Chlordanes	Lower	Dissolved	kg/yr	0.456	0.11	0.566
Total Chlordanes	Upper	Dissolved	kg/yr	0.706	0.36	1.07
Total Chlordanes	Central	Dissolved	kg/yr	0.59	0.269	0.859
γ-Hexachlorocyclohexane	Lower	Total	kg/yr	0.122	0.165	0.286
γ-Hexachlorocyclohexane	Upper	Total	kg/yr	0.289	0.482	0.771
γ-Hexachlorocyclohexane	Central	Total	kg/yr	0.217	0.36	0.577
γ-Hexachlorocyclohexane	Lower	Particulate	kg/yr	0	0	0
γ-Hexachlorocyclohexane	Upper	Particulate	kg/yr	0.00859	0.00295	0.0115
γ-Hexachlorocyclohexane	Central	Particulate	kg/yr	0.00392	0.00084	0.00476
γ-Hexachlorocyclohexane	Lower	Dissolved	kg/yr	0.122	0.165	0.286
γ-Hexachlorocyclohexane	Upper	Dissolved	kg/yr	0.289	0.482	0.771
γ-Hexachlorocyclohexane	Central	Dissolved	kg/yr	0.213	0.359	0.572
Aldrin	Lower	Total	kg/yr	0.0441	0	0.0441
Aldrin	Upper	Total	kg/yr	0.0579	0.0317	0.0896
Aldrin	Central	Total	kg/yr	0.0487	0.0177	0.0664
Aldrin	Lower	Particulate	kg/yr	0.00605	0	0.00605
Aldrin	Upper	Particulate	kg/yr	0.0293	0.0063	0.0356
Aldrin	Central	Particulate	kg/yr	0.0158	0.00239	0.0182
Aldrin	Lower	Dissolved	kg/yr	0.0265	0	0.0265
Aldrin	Upper	Dissolved	kg/yr	0.0426	0.0283	0.0709
Aldrin	Central	Dissolved	kg/yr	0.0329	0.0153	0.0482

Table E2-5. High Flow, Low Flow, and Annual Surface Water Upstream Load Estimates at RM 11.8.

Analyte	Load Estimation Type	Filtration	Units	Upstream Load High Flow	Low Flow	Annual
Dieldrin	Lower	Total	kg/yr	1.26	0.234	1.5
Dieldrin	Upper	Total	kg/yr	5.26	0.711	5.97
Dieldrin	Central	Total	kg/yr	2.99	0.496	3.49
Dieldrin	Lower	Particulate	kg/yr	0	0.0112	0.0112
Dieldrin	Upper	Particulate	kg/yr	0.76	0.103	0.863
Dieldrin	Central	Particulate	kg/yr	0.371	0.0373	0.408
Dieldrin	Lower	Dissolved	kg/yr	1.15	0.2	1.35
Dieldrin	Upper	Dissolved	kg/yr	4.5	0.607	5.11
Dieldrin	Central	Dissolved	kg/yr	2.62	0.459	3.08
PAHs						
Naphthalene	Lower	Total	kg/yr	0	0	0
Naphthalene	Upper	Total	kg/yr	262	0	262
Naphthalene	Central	Total	kg/yr	96.6	0	96.6
Naphthalene	Lower	Particulate	kg/yr	0	0	0
Naphthalene	Upper	Particulate	kg/yr	15.2	0	15.2
Naphthalene	Central	Particulate	kg/yr	3.04	0	3.04
Naphthalene	Lower	Dissolved	kg/yr	0	0	0
Naphthalene	Upper	Dissolved	kg/yr	247	0	247
Naphthalene	Central	Dissolved	kg/yr	93.5	0	93.5
Benzo(a)pyrene	Lower	Total	kg/yr	0	0	0
Benzo(a)pyrene	Upper	Total	kg/yr	6.2	4.62	10.8
Benzo(a)pyrene	Central	Total	kg/yr	2.94	2.15	5.09
Benzo(a)pyrene	Lower	Particulate	kg/yr	0	0	0
Benzo(a)pyrene	Upper	Particulate	kg/yr	5.67	4.62	10.3
Benzo(a)pyrene	Central	Particulate	kg/yr	2.81	2.04	4.86
Benzo(a)pyrene	Lower	Dissolved	kg/yr	0	0	0
Benzo(a)pyrene	Upper	Dissolved	kg/yr	0.521	0.395	0.916
Benzo(a)pyrene	Central	Dissolved	kg/yr	0.128	0.109	0.237
Total Carcinogenic PAHs	Lower	Total	kg/yr	2.09	6.19	8.28
Total Carcinogenic PAHs	Upper	Total	kg/yr	36.9	23.2	60.1
Total Carcinogenic PAHs	Central	Total	kg/yr	20.2	15.7	35.9
Total Carcinogenic PAHs	Lower	Particulate	kg/yr	2.09	5.1	7.18
Total Carcinogenic PAHs	Upper	Particulate	kg/yr	32.8	19.2	52
Total Carcinogenic PAHs	Central	Particulate	kg/yr	18.2	12.3	30.5
Total Carcinogenic PAHs	Lower	Dissolved	kg/yr	0	1.1	1.1
Total Carcinogenic PAHs	Upper	Dissolved	kg/yr	4.17	5.03	9.2
Total Carcinogenic PAHs	Central	Dissolved	kg/yr	1.97	3.46	5.44
cPAH BaPEq	Lower	Total	kg/yr	0.078	0.623	0.7
cPAH BaPEq	Upper	Total	kg/yr	7.58	6.26	13.8
cPAH BaPEq	Central	Total	kg/yr	3.75	3.12	6.87
cPAH BaPEq	Lower	Particulate	kg/yr	0.078	0.262	0.340
cPAH BaPEq	Upper	Particulate	kg/yr	6.93	6.26	13.2
cPAH BaPEq	Central	Particulate	kg/yr	3.56	2.94	6.50
cPAH BaPEq	Lower	Dissolved	kg/yr	0	0.00335	0.00335
cPAH BaPEq	Upper	Dissolved	kg/yr	0.654	0.538	1.19
cPAH BaPEq	Central	Dissolved	kg/yr	0.193	0.175	0.368
Total PAHs	Lower	Total	kg/yr	84.6	74.4	159
Total PAHs	Upper	Total	kg/yr	490	172	662
Total PAHs	Central	Total	kg/yr	257	123	380
Total PAHs	Lower	Particulate	kg/yr	2.14	14.4	16.5
Total PAHs	Upper	Particulate	kg/yr	97.7	88.5	186
Total PAHs	Central	Particulate	kg/yr	44.3	37.6	81.9

Table E2-5. High Flow, Low Flow, and Annual Surface Water Upstream Load Estimates at RM 11.8.

Analyte	Load Estimation Type	Filtration	Units	Upstream Load High Flow	Low Flow	Annual
Total PAHs	Lower	Dissolved	kg/yr	82.5	30.6	113
Total PAHs	Upper	Dissolved	kg/yr	392	138	530
Total PAHs	Central	Dissolved	kg/yr	213	85.2	298
Phthalates						
Bis(2-ethylhexyl)phthalate	Lower	Total	kg/yr	0	0	0
Bis(2-ethylhexyl)phthalate	Upper	Total	kg/yr	16400	321	16700
Bis(2-ethylhexyl)phthalate	Central	Total	kg/yr	7500	107	7540
Bis(2-ethylhexyl)phthalate	Lower	Particulate	kg/yr	0	0	0
Bis(2-ethylhexyl)phthalate	Upper	Particulate	kg/yr	0	82.2	82.2
Bis(2-ethylhexyl)phthalate	Central	Particulate	kg/yr	0	27.4	27.4
Bis(2-ethylhexyl)phthalate	Lower	Dissolved	kg/yr	0	0	0
Bis(2-ethylhexyl)phthalate	Upper	Dissolved	kg/yr	0	239	239
Bis(2-ethylhexyl)phthalate	Central	Dissolved	kg/yr	0	79.6	79.6
SVOCs						
Hexachlorobenzene	Lower	Total	kg/yr	0.347	0.228	0.574
Hexachlorobenzene	Upper	Total	kg/yr	0.678	1.02	1.7
Hexachlorobenzene	Central	Total	kg/yr	0.551	0.473	1.02
Hexachlorobenzene	Lower	Particulate	kg/yr	0	0	0
Hexachlorobenzene	Upper	Particulate	kg/yr	0.159	0.349	0.508
Hexachlorobenzene	Central	Particulate	kg/yr	0.0718	0.125	0.197
Hexachlorobenzene	Lower	Dissolved	kg/yr	0.24	0.219	0.459
Hexachlorobenzene	Upper	Dissolved	kg/yr	0.677	0.673	1.35
Hexachlorobenzene	Central	Dissolved	kg/yr	0.479	0.348	0.827

Notes:

BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbons
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
RM - river mile
SVOC - semivolatile organic compound
TEQ - toxic equivalent concentration

Table E3-1. Summary of Non-representative Locations by Analyte

Analyte	Non-representative Locations				
Metals					
Arsenic	OF-17/Manhole 2[a,b]	WR-96[a,c]			
Chromium	WR-183/Basin R[a]	WR-123	WR-22	WR-384	
Copper	WR-183/Basin R[a]	WR-142/145[a]	WR-147[a]	WR-161	WR-384
Lead	WR-183/Basin R[a]	OF-22B[a]	WR-147[a]	WR-384	
Mercury	WR-183/Basin R[a]	OF-22B[a]	WR-384	WR-96[c]	
Nickel	WR-183/Basin R[a]	WR-384			
Zinc	WR-183/Basin R[a]	WR-142/145[a]	WR-161	WR-384	
PCBs					
PCB077	WR-384				
PCB081	WR-384				
PCB105	WR-384				
PCB118	WR-384				
PCB126	WR-384				
PCB156 & PCB157	WR-384				
PCB169	WR-384[b]				
Total PCBs	WR-384				
PCB TEQ	WR-384				
Pesticides					
4,4'-DDD	OF-22B[a]	WR-96[c]			
4,4'-DDT	OF-22B[a,b]	WR-96[c]			
Total of 2,4'- and 4,4'-DDE	OF-22B[a]	WR-96[c]			
Total of 2,4'- and 4,4'-DDD	OF-22B[a]	WR-96[c]			
Total of 2,4'- and 4,4'-DDT	OF-22B[a]	WR-96[c]			
Total DDx	OF-22B[a]	WR-96[c]			
Total Chlordanes	OF-22B[a]	WR-147[d]	WR-96[b,c]		
γ-Hexachlorocyclohexane	OF-22B[a,b]				
Hexachlorobenzene					
Aldrin	OF-22B[a]				
Dieldrin	OF-22B[a]	WR-96[b,c]			
PAHs					
Naphthalene					
Benzo(a)pyrene	WR-20/Basin L	WR-107	WR-14	WR-384	
Total Carcinogenic PAHs BaPEq	WR-20/Basin L	WR-107	WR-14	WR-384	
Total PAHs	WR-20/Basin L	WR-384			
Phthalates					
Bis(2-ethylhexyl)phthalate	WR-20/Basin L	WR-142/145[a]			

Notes:

[a] Sediment trap samples not collected or available. Composite water data from the appropriate location were substituted during calculation of sediment pesticide loads as described in Appendix Section E3.5.

[b] Location excluded from loading totals because although the location was classified as non-representative, all composite water and sediment samples were non-detect.

[c] Sediment trap samples excluded from analysis because sample was from catch basin solids as opposed to in-line sediment samples. Composite water data from the appropriate location were substituted during calculation of sediment pesticide loads as described in Appendix Section E3.5. This location will be addressed during uncertainty analysis.

[d] Composite water samples not collected or available. Sediment data from the appropriate location were substituted during calculation of composite water pesticide loads as described in Appendix Section E3.5.

BaPEq - benzo(a)pyrene equivalents
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbons
PCB - polychlorinated biphenyl

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Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

Analyte	Composite Water				Non-normalized Sediment Trap			
	Geomean Concentration (mass/L)	Basin Weighted Mean Concentration (mass/L)	95th Percentile Concentration (mass/L)	5th Percentile Concentration (mass/L)	Geomean Concentration (mass/L)	Basin Weighted Mean Concentration (mass/L)	95th Percentile Concentration (mass/L)	5th Percentile Concentration (mass/L)
Metals (µg/L)								
Arsenic								
Land Use								
Heavy Industrial	1.06E+00	3.72E+00	6.75E+00	1.12E-01	5.50E-01	9.35E-01	2.37E+00	1.60E-01
Light Industrial	5.45E-01	1.12E+00	1.54E+00	2.14E-01	1.19E-01	1.23E-01	1.34E-01	1.05E-01
Residential	5.29E-01	5.33E-01	7.91E-01	3.68E-01	1.93E-01	2.61E-01	3.55E-01	1.14E-01
Major Transportation	1.14E+00	1.31E+00	1.62E+00	8.25E-01	3.03E-01	3.03E-01	3.03E-01	3.03E-01
Parks/Open Space	2.09E-01	2.09E-01	2.09E-01	2.09E-01	3.01E-02	3.01E-02	3.01E-02	3.01E-02
Non-representative Locations								
OF-17/Manhole 2	5.53E+00	5.53E+00	5.53E+00	5.53E+00	--	--	--	--
WR-96	1.82E+01	1.82E+01	1.82E+01	1.82E+01	--	--	--	--
Chromium								
Land Use								
Heavy Industrial	3.75E+00	5.19E+00	8.97E+00	1.45E+00	2.00E+00	1.23E+00	8.37E+00	8.10E-01
Light Industrial	3.65E+00	2.95E+00	6.07E+00	1.97E+00	4.27E+00	4.19E+00	4.83E+00	3.79E+00
Residential	3.52E+00	4.62E+00	9.16E+00	1.71E+00	1.94E+00	2.32E+00	2.95E+00	1.33E+00
Major Transportation	8.48E+00	9.10E+00	1.05E+01	6.95E+00	4.75E+00	4.75E+00	4.75E+00	4.75E+00
Parks/Open Space	1.71E+00	1.71E+00	1.71E+00	1.71E+00	3.59E-01	3.59E-01	3.59E-01	3.59E-01
Non-representative Locations								
WR-183/Basin R	1.73E+02	1.73E+02	1.73E+02	1.73E+02	--	--	--	--
WR-123	3.33E+01	3.33E+01	3.33E+01	3.33E+01	1.64E+01	1.64E+01	1.64E+01	1.64E+01
WR-22	1.16E+02	1.16E+02	1.16E+02	1.16E+02	1.13E+02	1.13E+02	1.13E+02	1.13E+02
WR-384	6.05E+01	6.05E+01	6.05E+01	6.05E+01	1.29E+01	1.29E+01	1.29E+01	1.29E+01
Copper								
Land Use								
Heavy Industrial	2.16E+01	3.54E+01	5.65E+01	5.74E+00	5.10E+00	6.96E+00	2.14E+01	1.91E+00
Light Industrial	9.99E+00	1.24E+01	1.57E+01	5.99E+00	2.05E+00	2.05E+00	2.08E+00	2.02E+00
Residential	1.45E+01	1.53E+01	2.50E+01	9.06E+00	3.38E+00	4.09E+00	5.26E+00	2.27E+00
Major Transportation	4.06E+01	4.61E+01	5.63E+01	3.00E+01	1.33E+01	1.33E+01	1.33E+01	1.33E+01
Parks/Open Space	1.75E+00	1.75E+00	1.75E+00	1.75E+00	2.45E-01	2.45E-01	2.45E-01	2.45E-01
Non-representative Locations								
WR-183/Basin R	2.88E+02	2.88E+02	2.88E+02	2.88E+02	--	--	--	--
WR-142/145	2.19E+02	2.19E+02	2.19E+02	2.19E+02	--	--	--	--
WR-147	1.40E+02	1.40E+02	1.40E+02	1.40E+02	--	--	--	--
WR-161	2.07E+02	2.07E+02	2.07E+02	2.07E+02	3.71E+03	3.71E+03	3.71E+03	3.71E+03
WR-384	2.04E+02	2.04E+02	2.04E+02	2.04E+02	3.56E+01	3.56E+01	3.56E+01	3.56E+01

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

	Composite Water				Non-normalized Sediment Trap			
Analyte	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**
Lead								
Land Use								
Heavy Industrial	1.31E+01	2.85E+01	4.82E+01	3.33E+00	7.70E+00	8.48E+00	3.12E+01	2.47E+00
Light Industrial	1.21E+01	9.63E+00	2.60E+01	5.07E+00	1.70E+01	1.66E+01	2.14E+01	1.36E+01
Residential	1.07E+01	1.90E+01	4.14E+01	4.67E+00	5.70E+00	6.37E+00	7.70E+00	4.31E+00
Major Transportation	1.72E+01	1.97E+01	2.42E+01	1.25E+01	9.99E+00	9.99E+00	9.99E+00	9.99E+00
Parks/Open Space	8.03E-01	8.03E-01	8.03E-01	8.03E-01	1.76E-01	1.76E-01	1.76E-01	1.76E-01
Non-representative Locations								
WR-183/Basin R	8.92E+02	8.92E+02	8.92E+02	8.92E+02	--	--	--	--
OF-22B	1.01E+02	1.01E+02	1.01E+02	1.01E+02	--	--	--	--
WR-147	6.34E+01	6.34E+01	6.34E+01	6.34E+01	--	--	--	--
WR-384	3.77E+02	3.77E+02	3.77E+02	3.77E+02	8.67E+01	8.67E+01	8.67E+01	8.67E+01
Mercury								
Land Use								
Heavy Industrial	2.00E-02	3.04E-02	7.01E-02	5.63E-03	6.50E-03	9.03E-03	1.40E-02	4.08E-03
Light Industrial	2.00E-02	1.83E-02	2.66E-02	1.34E-02	4.35E-03	5.76E-03	7.67E-03	2.66E-03
Residential	2.87E-02	2.88E-02	4.20E-02	2.03E-02	6.51E-03	6.38E-03	7.80E-03	5.47E-03
Major Transportation	1.50E-02	1.50E-02	1.50E-02	1.50E-02	5.49E-03	5.49E-03	5.49E-03	5.49E-03
Parks/Open Space	1.50E-02	1.50E-02	1.50E-02	1.50E-02	6.43E-04	6.43E-04	6.43E-04	6.43E-04
Non-representative Locations								
WR-183/Basin R	3.81E-01	3.81E-01	3.81E-01	3.81E-01	--	--	--	--
OF-22B	3.26E-01	3.26E-01	3.26E-01	3.26E-01	--	--	--	--
WR-384	8.70E-01	8.70E-01	8.70E-01	8.70E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01
WR-96	3.27E-01	3.27E-01	3.27E-01	3.27E-01	2.17E-03	2.17E-03	2.17E-03	2.17E-03
Nickel								
Land Use								
Heavy Industrial	4.80E+00	6.47E+00	1.05E+01	2.01E+00	1.93E+00	1.66E+00	5.67E+00	8.10E-01
Light Industrial	2.06E+00	2.22E+00	2.62E+00	1.75E+00	8.47E-01	8.44E-01	8.61E-01	8.33E-01
Residential	2.79E+00	2.92E+00	4.74E+00	1.75E+00	1.03E+00	1.31E+00	1.73E+00	6.49E-01
Major Transportation	5.95E+00	6.53E+00	7.71E+00	4.66E+00	2.98E+00	2.98E+00	2.98E+00	2.98E+00
Parks/Open Space	1.44E+00	1.44E+00	1.44E+00	1.44E+00	1.82E-01	1.82E-01	1.82E-01	1.82E-01
Non-representative Locations								
WR-183/Basin R	6.24E+01	6.24E+01	6.24E+01	6.24E+01	--	--	--	--
WR-384	3.58E+01	3.58E+01	3.58E+01	3.58E+01	5.26E+00	5.26E+00	5.26E+00	5.26E+00

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

Analyte	Composite Water				Non-normalized Sediment Trap			
	Geomean Concentration (mass/L)	Basin Weighted Mean Concentration (mass/L)	95th Percentile Concentration (mass/L)	5th Percentile Concentration (mass/L)	Geomean Concentration (mass/L)	Basin Weighted Mean Concentration (mass/L)	95th Percentile Concentration (mass/L)	5th Percentile Concentration (mass/L)
Zinc								
Land Use								
Heavy Industrial	1.86E+02	2.48E+02	3.75E+02	8.84E+01	4.26E+01	6.07E+01	8.54E+01	1.74E+01
Light Industrial	8.66E+01	1.25E+02	1.71E+02	4.55E+01	1.46E+01	1.44E+01	1.57E+01	1.36E+01
Residential	8.54E+01	9.62E+01	1.72E+02	4.77E+01	2.27E+01	2.74E+01	3.52E+01	1.53E+01
Major Transportation	1.99E+02	2.21E+02	2.63E+02	1.53E+02	7.19E+01	7.19E+01	7.19E+01	7.19E+01
Parks/Open Space	8.46E+00	8.46E+00	8.46E+00	8.46E+00	9.82E-01	9.82E-01	9.82E-01	9.82E-01
Non-representative Locations								
WR-183/Basin R	4.32E+03	4.32E+03	4.32E+03	4.32E+03	--	--	--	--
WR-142/145	2.62E+03	2.62E+03	2.62E+03	2.62E+03	--	--	--	--
WR-161	8.87E+02	8.87E+02	8.87E+02	8.87E+02	1.31E+03	1.31E+03	1.31E+03	1.31E+03
WR-384	1.15E+03	1.15E+03	1.15E+03	1.15E+03	2.08E+02	2.08E+02	2.08E+02	2.08E+02
PCBs (pg/L)								
PCB077								
Land Use								
Heavy Industrial	1.17E+02	3.63E+02	1.05E+03	9.30E+00	4.19E+01	7.27E+01	1.98E+02	7.69E+00
Light Industrial	4.05E+01	3.61E+01	1.10E+02	1.67E+01	1.11E+01	1.12E+01	4.76E+01	2.83E+00
Residential	2.71E+01	5.58E+01	1.24E+02	1.19E+01	1.38E+01	1.42E+01	2.22E+01	9.04E+00
Major Transportation	8.45E+01	9.60E+01	1.17E+02	6.26E+01	4.74E+01	4.64E+01	5.99E+01	3.80E+01
Parks/Open Space	2.65E+00	2.65E+00	2.65E+00	2.65E+00	1.34E-01	1.34E-01	1.34E-01	1.34E-01
Non-representative Locations								
WR-384	8.56E+03	8.56E+03	8.56E+03	8.56E+03	2.01E+03	2.01E+03	2.01E+03	2.01E+03
PCB081								
Land Use								
Heavy Industrial	2.70E+00	4.41E+00	1.45E+01	8.03E-01	3.99E+00	9.18E+00	2.32E+01	5.85E-01
Light Industrial	2.66E+00	2.49E+00	4.21E+00	2.05E+00	9.46E-01	8.30E-01	1.99E+00	5.09E-01
Residential	9.60E+00	2.00E+01	4.45E+01	4.21E+00	1.05E+00	1.18E+00	2.10E+00	5.88E-01
Major Transportation	5.00E+00	5.53E+00	6.57E+00	3.87E+00	2.99E+00	4.06E+00	8.26E+00	1.42E+00
Parks/Open Space	9.88E-01	9.88E-01	9.88E-01	9.88E-01	1.26E-01	1.26E-01	1.26E-01	1.26E-01
Non-representative Locations								
WR-384	3.80E+02	3.80E+02	3.80E+02	3.80E+02	3.43E+02	3.43E+02	3.43E+02	3.43E+02

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

	Composite Water				Non-normalized Sediment Trap			
Analyte	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**
PCB105								
Land Use								
Heavy Industrial	7.97E+02	2.34E+03	7.84E+03	5.06E+01	2.60E+02	5.18E+02	1.36E+03	5.87E+01
Light Industrial	1.76E+02	1.62E+02	5.36E+02	8.86E+01	6.73E+01	6.13E+01	2.37E+02	2.04E+01
Residential	1.38E+02	2.61E+02	5.75E+02	6.03E+01	1.36E+02	1.79E+02	3.55E+02	6.57E+01
Major Transportation	3.80E+02	4.14E+02	4.84E+02	3.03E+02	2.09E+02	2.05E+02	2.59E+02	1.71E+02
Parks/Open Space	1.12E+01	1.12E+01	1.12E+01	1.12E+01	2.19E+00	2.19E+00	2.19E+00	2.19E+00
Non-representative Locations								
WR-384	7.19E+04	7.19E+04	7.19E+04	7.19E+04	1.91E+04	1.91E+04	1.91E+04	1.91E+04
PCB118								
Land Use								
Heavy Industrial	1.81E+03	5.44E+03	1.64E+04	1.00E+02	6.07E+02	1.25E+03	3.35E+03	1.54E+02
Light Industrial	4.15E+02	3.82E+02	1.24E+03	2.10E+02	1.50E+02	1.42E+02	5.59E+02	4.23E+01
Residential	3.26E+02	6.46E+02	1.43E+03	1.42E+02	3.29E+02	4.33E+02	8.60E+02	1.59E+02
Major Transportation	8.95E+02	9.69E+02	1.12E+03	7.22E+02	4.89E+02	4.79E+02	5.95E+02	4.06E+02
Parks/Open Space	2.88E+01	2.88E+01	2.88E+01	2.88E+01	5.42E+00	5.42E+00	5.42E+00	5.42E+00
Non-representative Locations								
WR-384	1.70E+05	1.70E+05	1.70E+05	1.70E+05	3.65E+04	3.65E+04	3.65E+04	3.65E+04
PCB126								
Land Use								
Heavy Industrial	2.56E+01	5.17E+01	2.24E+02	3.59E+00	8.07E+00	1.11E+01	4.30E+01	3.23E+00
Light Industrial	9.64E+00	1.33E+01	2.37E+01	4.69E+00	2.17E+00	1.81E+00	4.88E+00	9.34E-01
Residential	1.30E+01	2.39E+01	5.24E+01	5.65E+00	2.57E+00	2.68E+00	4.30E+00	1.64E+00
Major Transportation	1.06E+01	1.11E+01	1.22E+01	9.32E+00	5.87E+00	5.78E+00	7.90E+00	4.45E+00
Parks/Open Space	2.93E+00	2.93E+00	2.93E+00	2.93E+00	1.01E-01	1.01E-01	1.01E-01	1.01E-01
Non-representative Locations								
WR-384	9.91E+02	9.91E+02	9.91E+02	9.91E+02	2.58E+02	2.58E+02	2.58E+02	2.58E+02
PCB156 & PCB157								
Land Use								
Heavy Industrial	3.36E+02	9.20E+02	3.07E+03	2.21E+01	1.04E+02	1.92E+02	5.74E+02	3.00E+01
Light Industrial	6.95E+01	6.28E+01	1.92E+02	3.81E+01	2.26E+01	2.06E+01	8.07E+01	7.44E+00
Residential	5.52E+01	9.99E+01	2.18E+02	2.41E+01	4.32E+01	4.70E+01	8.08E+01	2.53E+01
Major Transportation	1.38E+02	1.46E+02	1.66E+02	1.15E+02	7.86E+01	7.70E+01	9.64E+01	6.48E+01
Parks/Open Space	4.90E+00	4.90E+00	4.90E+00	4.90E+00	5.35E-01	5.35E-01	5.35E-01	5.35E-01
Non-representative Locations								
WR-384	2.77E+04	2.77E+04	2.77E+04	2.77E+04	6.05E+03	6.05E+03	6.05E+03	6.05E+03

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

	Composite Water				Non-normalized Sediment Trap			
Analyte	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**
PCB169								
Land Use								
Heavy Industrial	4.17E+00	3.70E+00	2.94E+01	2.82E+00	7.34E-01	6.68E-01	3.19E+00	4.10E-01
Light Industrial	2.62E+00	2.98E+00	3.41E+00	1.89E+00	3.24E-01	5.94E-01	1.09E+00	1.41E-01
Residential	1.06E+01	2.01E+01	4.42E+01	4.62E+00	2.02E-01	2.02E-01	2.02E-01	2.01E-01
Major Transportation	3.61E+00	3.60E+00	3.62E+00	3.59E+00	7.15E-01	7.13E-01	1.03E+00	5.11E-01
Parks/Open Space	1.67E+00	1.67E+00	1.67E+00	1.67E+00	3.06E-01	3.06E-01	3.06E-01	3.06E-01
Non-representative Locations								
WR-384	1.59E+01	1.59E+01	1.59E+01	1.59E+01	2.52E+01	2.52E+01	2.52E+01	2.52E+01
Total PCBs								
Land Use								
Heavy Industrial	5.36E+04	1.58E+05	4.68E+05	2.48E+03	1.76E+04	3.28E+04	7.82E+04	4.61E+03
Light Industrial	1.53E+04	1.46E+04	4.38E+04	9.15E+03	4.33E+03	4.27E+03	1.84E+04	1.21E+03
Residential	8.53E+03	2.13E+04	4.85E+04	3.90E+03	6.72E+03	8.11E+03	1.53E+04	3.48E+03
Major Transportation	2.92E+04	3.25E+04	3.88E+04	2.24E+04	1.60E+04	1.57E+04	1.97E+04	1.31E+04
Parks/Open Space	2.88E+02	2.88E+02	2.88E+02	2.88E+02	8.29E+01	8.29E+01	8.29E+01	8.29E+01
Non-representative Locations								
WR-384	5.13E+06	5.13E+06	5.13E+06	5.13E+06	1.08E+06	1.08E+06	1.08E+06	1.08E+06
PCB TEQ								
Land Use								
Heavy Industrial	1.27E+00	5.31E+00	2.28E+01	2.94E-03	3.85E-01	1.14E+00	4.49E+00	4.17E-03
Light Industrial	4.82E-01	4.99E-01	1.02E+00	2.92E-01	7.24E-02	1.30E-01	5.05E-01	1.40E-02
Residential	3.57E-02	4.46E-01	1.05E+00	5.65E-02	2.66E-01	2.77E-01	4.47E-01	1.68E-01
Major Transportation	8.70E-01	9.38E-01	1.08E+00	7.06E-01	6.04E-01	5.95E-01	8.09E-01	4.61E-01
Parks/Open Space	5.63E-04	5.63E-04	5.63E-04	5.63E-04	8.03E-05	8.03E-05	8.03E-05	8.03E-05
Non-representative Locations								
WR-384	1.04E+02	1.04E+02	1.04E+02	1.04E+02	2.70E+01	2.70E+01	2.70E+01	2.70E+01
Pesticides (µg/L)								
4,4'-DDD								
Land Use								
Heavy Industrial	1.49E-03	1.61E-03	2.24E-03	1.04E-03	3.88E-04	4.78E-04	1.61E-03	1.90E-04
Light Industrial	1.85E-03	1.85E-03	1.85E-03	1.85E-03	6.54E-05	8.02E-05	4.02E-04	2.34E-05
Residential	1.61E-03	1.61E-03	1.61E-03	1.61E-03	2.27E-04	4.70E-04	1.05E-03	9.94E-05
Major Transportation	--	--	--	--	1.80E-04	1.80E-04	1.80E-04	1.80E-04
Parks/Open Space	--	--	--	--	4.02E-06	4.02E-06	4.02E-06	4.02E-06
Non-representative Locations								
OF-22B	8.08E-02	8.08E-02	8.08E-02	8.08E-02	--	--	--	--
WR-96	3.55E-01	3.55E-01	3.55E-01	3.55E-01	6.68E-02	6.68E-02	6.68E-02	6.68E-02

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

	Composite Water				Non-normalized Sediment Trap			
Analyte	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**
4,4'-DDT								
Land Use								
Heavy Industrial	4.94E-03	5.78E-03	7.83E-03	3.01E-03	1.68E-03	2.36E-03	1.29E-02	2.75E-04
Light Industrial	9.26E-03	9.26E-03	9.26E-03	9.26E-03	1.55E-04	1.43E-04	5.05E-04	7.52E-05
Residential	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.46E-03	2.87E-03	5.29E-03	1.32E-03
Major Transportation	--	--	--	--	4.95E-04	4.95E-04	4.95E-04	4.95E-04
Parks/Open Space	--	--	--	--	3.21E-05	3.21E-05	3.21E-05	3.21E-05
Non-representative Locations								
OF-22B	2.92E-02	2.92E-02	2.92E-02	2.92E-02	--	--	--	--
WR-96	1.66E+00	1.66E+00	1.66E+00	1.66E+00	1.07E+00	1.07E+00	1.07E+00	1.07E+00
Total of 2,4' and 4,4'-DDE								
Land Use								
Heavy Industrial	9.93E-04	1.34E-03	2.47E-03	4.10E-04	3.84E-04	3.88E-04	1.70E-03	9.55E-05
Light Industrial	1.90E-03	1.90E-03	1.90E-03	1.90E-03	1.80E-04	1.77E-04	3.31E-04	8.42E-05
Residential	2.60E-03	2.60E-03	2.60E-03	2.60E-03	8.64E-04	1.28E-03	2.67E-03	3.94E-04
Major Transportation	--	--	--	--	3.06E-04	3.06E-04	3.06E-04	3.06E-04
Parks/Open Space	--	--	--	--	4.02E-05	4.02E-05	4.02E-05	4.02E-05
Non-representative Locations								
OF-22B	3.53E-02	3.53E-02	3.53E-02	3.53E-02	--	--	--	--
WR-96	1.07E+00	1.07E+00	1.07E+00	1.07E+00	4.20E-02	4.20E-02	4.20E-02	4.20E-02
Total of 2,4' and 4,4'-DDD								
Land Use								
Heavy Industrial	1.85E-03	2.78E-03	5.66E-03	7.81E-04	6.38E-04	5.95E-04	2.29E-03	1.90E-04
Light Industrial	3.15E-03	3.15E-03	3.15E-03	3.15E-03	1.14E-04	1.08E-04	4.06E-04	5.20E-05
Residential	1.83E-03	1.83E-03	1.83E-03	1.83E-03	4.86E-04	7.79E-04	1.66E-03	2.16E-04
Major Transportation	--	--	--	--	1.80E-04	1.80E-04	1.80E-04	1.80E-04
Parks/Open Space	--	--	--	--	4.02E-06	4.02E-06	4.02E-06	4.02E-06
Non-representative Locations								
OF-22B	8.23E-02	8.23E-02	8.23E-02	8.23E-02	--	--	--	--
WR-96	5.43E-01	5.43E-01	5.43E-01	5.43E-01	8.64E-02	8.64E-02	8.64E-02	8.64E-02

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

	Composite Water				Non-normalized Sediment Trap			
Analyte	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**
Total of 2,4' and 4,4'-DDT								
Land Use								
Heavy Industrial	3.25E-03	5.36E-03	8.53E-03	1.01E-03	2.41E-03	3.88E-03	2.54E-02	3.45E-04
Light Industrial	9.41E-03	9.41E-03	9.41E-03	9.41E-03	1.68E-04	1.63E-04	6.42E-04	7.52E-05
Residential	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.71E-03	3.33E-03	6.38E-03	1.38E-03
Major Transportation	--	--	--	--	4.95E-04	4.95E-04	4.95E-04	4.95E-04
Parks/Open Space	--	--	--	--	3.82E-05	3.82E-05	3.82E-05	3.82E-05
Non-representative Locations								
OF-22B	1.57E-02	1.57E-02	1.57E-02	1.57E-02	--	--	--	--
WR-96	2.63E+00	2.63E+00	2.63E+00	2.63E+00	1.32E+00	1.32E+00	1.32E+00	1.32E+00
Total DDx								
Land Use								
Heavy Industrial	7.78E-03	9.37E-03	1.22E-02	4.16E-03	3.79E-03	4.72E-03	2.65E-02	9.04E-04
Light Industrial	1.12E-02	1.12E-02	1.12E-02	1.12E-02	2.77E-04	2.76E-04	9.64E-04	9.39E-05
Residential	2.80E-03	2.80E-03	2.80E-03	2.80E-03	4.10E-03	5.39E-03	1.07E-02	1.99E-03
Major Transportation	--	--	--	--	3.06E-04	3.06E-04	3.06E-04	3.06E-04
Parks/Open Space	--	--	--	--	7.83E-05	7.83E-05	7.83E-05	7.83E-05
Non-representative Locations								
OF-22B	1.21E-01	1.21E-01	1.21E-01	1.21E-01	--	--	--	--
WR-96	4.27E+00	4.27E+00	4.27E+00	4.27E+00	1.44E+00	1.44E+00	1.44E+00	1.44E+00
Total Chlordanes								
Land Use								
Heavy Industrial	5.14E-03	5.44E-03	7.85E-03	2.53E-03	4.13E-04	1.04E-03	1.58E-03	8.07E-05
Light Industrial	2.33E-03	2.33E-03	2.33E-03	2.33E-03	3.57E-04	4.50E-04	5.35E-04	2.27E-04
Residential	1.98E-03	1.98E-03	1.98E-03	1.98E-03	6.01E-04	7.16E-04	9.09E-04	4.13E-04
Major Transportation	--	--	--	--	7.92E-04	7.92E-04	7.92E-04	7.92E-04
Parks/Open Space	--	--	--	--	4.02E-06	4.02E-06	4.02E-06	4.02E-06
Non-representative Locations								
OF-22B	6.47E-02	6.47E-02	6.47E-02	6.47E-02	--	--	--	--
WR-147	--	--	--	--	1.42E-02	1.42E-02	1.42E-02	1.42E-02
WR-96	9.33E-02	9.33E-02	9.33E-02	9.33E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

	Composite Water				Non-normalized Sediment Trap			
Analyte	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**	**Geomean Concentration (mass/L)**	**Basin Weighted Mean Concentration (mass/L)**	**95th Percentile Concentration (mass/L)**	**5th Percentile Concentration (mass/L)**
γ-Hexachlorocyclohexane								
Land Use								
Heavy Industrial	1.71E-03	1.85E-03	2.99E-03	9.06E-04	1.63E-04	2.14E-04	7.27E-04	4.24E-05
Light Industrial	2.16E-03	2.16E-03	2.16E-03	2.16E-03	1.70E-04	1.52E-04	4.11E-04	9.71E-05
Residential	1.51E-03	1.51E-03	1.51E-03	1.51E-03	1.29E-04	2.79E-04	6.25E-04	5.70E-05
Major Transportation	--	--	--	--	3.87E-05	3.87E-05	3.87E-05	3.87E-05
Parks/Open Space	--	--	--	--	1.31E-06	1.31E-06	1.31E-06	1.31E-06
Non-representative Locations								
OF-22B	6.42E-03	6.42E-03	6.42E-03	6.42E-03	--	--	--	--
WR-96	--	--	--	--	--	--	--	--
Hexachlorobenzene								
Land Use								
Heavy Industrial	6.16E-04	1.73E-02	6.79E-02	4.50E-05	1.21E-04	1.39E-04	4.46E-04	3.44E-05
Light Industrial	1.76E-01	1.76E-01	1.76E-01	1.76E-01	8.93E-05	9.66E-05	4.07E-04	2.68E-05
Residential	4.97E-02	4.97E-02	4.97E-02	4.97E-02	3.69E-04	3.88E-04	6.35E-04	2.30E-04
Major Transportation	--	--	--	--	1.08E-04	1.08E-04	1.08E-04	1.08E-04
Parks/Open Space	--	--	--	--	1.41E-06	1.41E-06	1.41E-06	1.41E-06
Aldrin								
Land Use								
Heavy Industrial	9.27E-04	8.95E-04	1.78E-03	4.67E-04	1.09E-04	1.59E-04	1.21E-03	2.24E-05
Light Industrial	1.32E-03	1.32E-03	1.32E-03	1.32E-03	6.93E-05	6.10E-05	1.75E-04	3.90E-05
Residential	1.25E-03	1.25E-03	1.25E-03	1.25E-03	5.53E-05	2.67E-04	6.24E-04	3.73E-05
Major Transportation	--	--	--	--	4.95E-05	4.95E-05	4.95E-05	4.95E-05
Parks/Open Space	--	--	--	--	2.41E-06	2.41E-06	2.41E-06	2.41E-06
Non-representative Locations								
OF-22B	1.53E-02	1.53E-02	1.53E-02	1.53E-02	--	--	--	--
Dieldrin								
Land Use								
Heavy Industrial	8.58E-04	1.21E-03	2.20E-03	3.61E-04	1.22E-04	1.18E-04	4.46E-04	3.12E-05
Light Industrial	1.46E-03	1.46E-03	1.46E-03	1.46E-03	1.22E-04	1.14E-04	4.07E-04	5.70E-05
Residential	1.15E-03	1.15E-03	1.15E-03	1.15E-03	3.34E-04	3.65E-04	6.33E-04	1.94E-04
Major Transportation	--	--	--	--	1.80E-04	1.80E-04	1.80E-04	1.80E-04
Parks/Open Space	--	--	--	--	4.02E-06	4.02E-06	4.02E-06	4.02E-06
Non-representative Locations								
OF-22B	1.27E-01	1.27E-01	1.27E-01	1.27E-01	--	--	--	--
WR-96	6.96E-03	6.96E-03	6.96E-03	6.96E-03	1.25E-05	1.25E-05	1.25E-05	1.25E-05

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

Analyte	Composite Water				Non-normalized Sediment Trap			
	Geomean Concentration (mass/L)	Basin Weighted Mean Concentration (mass/L)	95th Percentile Concentration (mass/L)	5th Percentile Concentration (mass/L)	Geomean Concentration (mass/L)	Basin Weighted Mean Concentration (mass/L)	95th Percentile Concentration (mass/L)	5th Percentile Concentration (mass/L)
PAHs (µg/L)								
Naphthalene								
Land Use								
Heavy Industrial	2.80E-02	6.59E-02	9.83E-02	7.75E-03	2.82E-03	1.92E-02	2.14E-01	1.76E-04
Light Industrial	2.90E-02	3.23E-02	5.53E-02	1.62E-02	3.37E-03	2.89E-03	4.46E-03	2.57E-03
Residential	1.65E-02	2.03E-02	3.91E-02	8.35E-03	1.70E-03	1.70E-03	1.70E-03	1.70E-03
Major Transportation	7.02E-02	7.79E-02	9.29E-02	5.40E-02	1.98E-02	1.98E-02	1.98E-02	1.98E-02
Parks/Open Space	1.00E-02	1.00E-02	1.00E-02	1.00E-02	4.52E-05	4.52E-05	4.52E-05	4.52E-05
Benzo(a)pyrene								
Land Use								
Heavy Industrial	3.47E-02	6.18E-02	1.79E-01	8.58E-03	3.57E-02	6.31E-02	2.10E-01	5.10E-03
Light Industrial	3.42E-02	3.27E-02	4.24E-02	2.54E-02	4.54E-02	3.60E-02	7.34E-02	2.85E-02
Residential	1.54E-02	2.22E-02	4.57E-02	7.09E-03	3.52E-02	3.52E-02	3.52E-02	3.52E-02
Major Transportation	1.03E-01	1.06E-01	1.14E-01	9.25E-02	6.12E-02	6.12E-02	6.12E-02	6.12E-02
Parks/Open Space	2.25E-03	2.25E-03	2.25E-03	2.25E-03	5.62E-04	5.62E-04	5.62E-04	5.62E-04
Non-representative Locations								
WR-20/Basin L	2.19E+00	2.19E+00	2.19E+00	2.19E+00	4.75E+00	4.75E+00	4.75E+00	4.75E+00
WR-107	3.57E-01	3.57E-01	3.57E-01	3.57E-01	1.10E+00	1.10E+00	1.10E+00	1.10E+00
WR-14	2.54E-01	2.54E-01	2.54E-01	2.54E-01	4.82E-01	4.82E-01	4.82E-01	4.82E-01
WR-384	6.32E-01	6.32E-01	6.32E-01	6.32E-01	5.33E-01	5.33E-01	5.33E-01	5.33E-01
Total Carcinogenic PAHs BaPEq								
Land Use								
Heavy Industrial	5.15E-02	9.98E-02	2.86E-01	9.00E-03	4.58E-02	9.63E-02	3.13E-01	4.12E-03
Light Industrial	5.68E-02	5.40E-02	7.55E-02	3.76E-02	7.49E-02	5.68E-02	1.38E-01	3.99E-02
Residential	2.19E-02	3.32E-02	6.95E-02	9.91E-03	5.13E-02	5.13E-02	5.13E-02	5.13E-02
Major Transportation	1.69E-01	1.76E-01	1.93E-01	1.49E-01	8.37E-02	8.37E-02	8.37E-02	8.37E-02
Parks/Open Space	1.66E-03	1.66E-03	1.66E-03	1.66E-03	7.41E-04	7.41E-04	7.41E-04	7.41E-04
Non-representative Locations								
WR-20/Basin L	3.50E+00	3.50E+00	3.50E+00	3.50E+00	7.01E+00	7.01E+00	7.01E+00	7.01E+00
WR-107	5.40E-01	5.40E-01	5.40E-01	5.40E-01	1.56E+00	1.56E+00	1.56E+00	1.56E+00
WR-14	5.17E-01	5.17E-01	5.17E-01	5.17E-01	8.50E-01	8.50E-01	8.50E-01	8.50E-01
WR-384	1.24E+00	1.24E+00	1.24E+00	1.24E+00	9.67E-01	9.67E-01	9.67E-01	9.67E-01

Table E3-2. Concentration Range Estimates by Land Use and Non-representative Locations

Analyte	Composite Water				Non-normalized Sediment Trap			
	Geomean Concentration (mass/L)	Basin Weighted Mean Concentration (mass/L)	95th Percentile Concentration (mass/L)	5th Percentile Concentration (mass/L)	Geomean Concentration (mass/L)	Basin Weighted Mean Concentration (mass/L)	95th Percentile Concentration (mass/L)	5th Percentile Concentration (mass/L)
Total PAHs								
Land Use								
Heavy Industrial	9.40E-01	1.32E+00	3.81E+00	1.26E-01	1.12E+00	1.56E+00	2.19E+01	8.74E-02
Light Industrial	7.19E-01	8.14E-01	1.29E+00	4.83E-01	5.71E-01	4.72E-01	7.92E-01	4.02E-01
Residential	2.76E-01	3.90E-01	7.98E-01	1.29E-01	3.48E-01	3.48E-01	3.48E-01	3.48E-01
Major Transportation	2.12E+00	2.25E+00	2.53E+00	1.79E+00	1.01E+00	1.01E+00	1.01E+00	1.01E+00
Parks/Open Space	1.20E-02	1.20E-02	1.20E-02	1.20E-02	6.11E-03	6.11E-03	6.11E-03	6.11E-03
Non-representative Locations								
WR-20/Basin L	2.34E+01	2.34E+01	2.34E+01	2.34E+01	4.29E+01	4.29E+01	4.29E+01	4.29E+01
WR-384	1.44E+01	1.44E+01	1.44E+01	1.44E+01	9.59E+00	9.59E+00	9.59E+00	9.59E+00
Phthalates (µg/L)								
Bis(2-ethylhexyl)phthalate								
Land Use								
Heavy Industrial	1.36E+00	1.89E+00	2.72E+00	6.91E-01	4.04E-01	4.35E-01	3.55E+00	5.17E-02
Light Industrial	1.77E+00	2.05E+00	2.19E+00	1.46E+00	5.47E-01	4.75E-01	8.23E-01	3.82E-01
Residential	3.05E+00	3.10E+00	4.75E+00	2.05E+00	3.48E-01	3.48E-01	3.48E-01	3.48E-01
Major Transportation	--	--	--	--	1.71E+00	1.71E+00	1.71E+00	1.71E+00
Parks/Open Space	3.07E-01	3.07E-01	3.07E-01	3.07E-01	3.01E-04	3.01E-04	3.01E-04	3.01E-04
Non-representative Locations								
WR-20/Basin L	8.30E+00	8.30E+00	8.30E+00	8.30E+00	7.36E+00	7.36E+00	7.36E+00	7.36E+00
WR-142/145	4.95E+00	4.95E+00	4.95E+00	4.95E+00	--	--	--	--

Notes:

The values presented in these tables are preliminary and will change slightly before the Final RI Report. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

-- Analyte not sampled

BaPEq - benzo(a)pyrene equivalents

cPAH - carcinogenic polycyclic aromatic hydrocarbon

DDx - 2,4'- and 4,4'-DDD, DDE, and DDT

EPA - U.S. Environmental Protection Agency

PAH - polycyclic aromatic hydrocarbons

PCB - polychlorinated biphenyl

PCDD/Fs - dioxins/furans

TEQ - toxic equivalent concentration

Table E3-3. Yearly Runoff Volumes for 50th Percentile Flow Year.

	Total Land Use Flows (Liters)[a]						Non-representative Location Flows (Liters)							Non-representative Location Flows (Liters)						
Grid Model Area	Parks/Open Space	Major Transportation	Light Industrial	Heavy Industrial	Residential / Commercial	Total	Location	Parks/Open Space	Major Transportation	Light Industrial	Heavy Industrial	Residential / Commercial	Total	Location	Parks/Open Space	Major Transportation	Light Industrial	Heavy Industrial	Residential / Commercial	Total
FT01	151,949,003	97,953,496	182,383,122	11,643,855	261,235,731	705,165,206														
FT03	11,312,225	155,917,630	283,391,473	27,011,728	185,712,858	663,345,914														
FT04	-	-	12,233,242	99,150,039	39,439,451	150,822,732														
FT06	18,968,887	14,587,510	11,053,909	248,872,532	22,260,121	315,742,959														
FT07	-	-	-	139,287,522	-	139,287,522														
FT09	7,999,042	-	1,455,580	169,159,762	101,473	178,715,858														
FT10	413,680,332	27,748,879	13,314,646	1,065,404,539	49,881,961	1,570,030,357	OF-17/Manhole 2	-	-	-	10,327,126	-	10,327,126							
FT12	865,616	-	59,848,517	2,227,596	-	62,941,729														
FT13	125,226,316	47,385,782	-	1,350,153,647	1,577,899	1,524,343,644	WR-147	-	-	-	70,412,953	-	70,412,953	WR-142-145	-	-	-	118,117,726	-	118,117,726
FT15	-	-	97,789,135	97,967,194	-	195,756,329														
FT16	25,649,953	-	1,172,129,732	105,464,004	12,357,191	1,315,600,881														
FT17	208,731,515	8,794,200	-	561,451,523	2,792,763	781,770,002	WR-14	-	-	-	9,143,554	-	9,143,554							
FT19	4,395,754	-	14,340,148	88,748,607	92,070,708	199,555,218	WR-161	-	-	-	66,103,840	-	66,103,840							
FT20	2,677,434	1,376,901	-	180,930,763	-	184,985,098	WR-96	-	-	-	75,838,612	-	75,838,612	OF-22B	2,186,114	-	-	46,300,435	-	48,486,549
FT22	14,984,280	-	460,152	21,599,653	29,667,966	66,712,052														
FT23	224,811,466	20,469,227	-	198,680,709	2,599,195	446,560,596	WR-107	-	12,937	-	30,165,634	-	30,178,572							
FT25	15,660,536	1,331,132	23,568,810	19,423	77,156,107	117,736,008														
FT26	156,651,697	47,772,601	-	69,121,695	21,283,561	294,829,554														
FT28	22,076,671	9,930,604	132,429,421	92,376,020	69,382,294	326,195,009														
FT29	62,051,723	10,124,101	-	129,079,020	25,249,010	226,503,853														
FT31	4,052,348	-	103,997,972	287,695,735	41,276,249	437,022,305														
FT32	109,988,778	7,161,441	2,118,248	59,049,878	15,201,804	193,520,149														
FT34	2,481,944	-	80,591,829	197,515,895	-	280,589,668	WR-20/Basin L	141,604	-	647,707	39,986,343	-	40,775,654	WR-183/Basin R	-	-	-	20,283,792	-	20,283,792
FT35	119,452,723	30,798,155	5,705,061	102,766,862	1,758,485	260,481,287														
FT37	-	-	-	659,933,967	-	659,933,967	WR-384	-	-	-	188,986,299	-	188,986,299	WR-123	-	-	-	5,167,852	-	5,167,852
FT38	6,784,546	-	-	589,329	-	7,373,875														
FT39	4,599,100	-	-	51,763,761	-	56,362,862														
FT41	-	-	-	376,001,772	-	376,001,772	WR-22	-	-	-	155,095,938	-	155,095,938							
FT42	13,863,779	-	-	-	-	13,863,779														
FT44	-	-	-	76,831,050	-	76,831,050														
Total	1,728,915,668	481,351,658	2,196,810,997	6,470,498,083	951,004,828	11,828,581,233														

Notes:

All calculations based on 50th Percentile Flow Year (2002).

[a] Total Land Use Flows include flows for Non-representative Locations.

- = zero flow

Table E3-4. Land Use Type Percentages by Study Area, Model Cell, and Non-representative Location

	Land Use Type				
Area	**Heavy Industrial**	**Light Industrial**	**Residential / Commercial**	**Major Transportation**	**Parks/Open Space**
Study Area					
Study Area	25%	8%	8%	2%	57%
Model Cell[a] and Non-representative Locations					
FT01	0%	8%	41%	8%	42%
FT03	6%	38%	29%	23%	4%
FT04	60%	12%	29%	0%	0%
FT06	61%	3%	10%	5%	21%
FT07	100%	0%	0%	0%	0%
FT09	74%	3%	0%	0%	23%
FT10	17%	0%	4%	0%	79%
OF-17/Manhole 2	100%	0%	0%	0%	0%
FT12	7%	91%	0%	0%	2%
FT13	41%	0%	0%	1%	57%
WR-142-145	100%	0%	0%	0%	0%
WR-147	100%	0%	0%	0%	0%
FT15	58%	42%	0%	0%	0%
FT16	9%	75%	4%	0%	12%
FT17	11%	0%	1%	0%	88%
WR-14	100%	0%	0%	0%	0%
FT19	20%	10%	59%	0%	11%
WR-161	100%	0%	0%	0%	0%
FT20	95%	0%	0%	2%	3%
OF-22B	76%	0%	0%	0%	24%
WR-96	100%	0%	0%	0%	0%
FT22	31%	1%	29%	0%	39%
FT23	6%	0%	0%	1%	92%
WR-107	99%	0%	0%	1%	0%
FT25	0%	13%	54%	1%	33%
FT26	6%	0%	4%	4%	86%
FT28	22%	31%	34%	3%	11%
FT29	16%	0%	10%	1%	73%
FT31	33%	19%	40%	0%	7%
FT32	9%	1%	3%	1%	86%
FT34	83%	15%	0%	0%	2%
WR-183/Basin R	100%	0%	0%	0%	0%
WR-20/Basin L	92%	5%	0%	0%	3%
FT35	14%	0%	0%	3%	83%
FT37	100%	0%	0%	0%	0%
WR-123	100%	0%	0%	0%	0%
WR-384	100%	0%	0%	0%	0%
FT38	4%	0%	0%	0%	96%
FT39	37%	0%	0%	0%	63%
FT41	100%	0%	0%	0%	0%
WR-22	100%	0%	0%	0%	0%
FT42	0%	0%	0%	0%	100%
FT44	100%	0%	0%	0%	0%

Notes:

[a] Model cell land use percentages include non-representative locations.

Table E3-5a. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Composite Runoff.

	Study Area FT01 - FT44				RM 11-11.7 W FT01				RM 11-11.7 E FT03				RM 10.3-11 W FT04			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	1.08E+01	2.91E+01	4.98E+01	3.67E+00	3.93E-01	5.47E-01	7.56E-01	2.49E-01	4.61E-01	7.24E-01	1.02E+00	2.63E-01	1.33E-01	4.03E-01	7.19E-01	2.82E-02
Chromium	7.44E+01	8.30E+01	1.18E+02	5.43E+01	2.72E+00	2.96E+00	4.89E+00	1.76E+00	3.13E+00	3.27E+00	5.31E+00	2.02E+00	5.55E-01	7.32E-01	1.32E+00	2.36E-01
Copper	2.82E+02	3.73E+02	5.21E+02	1.68E+02	1.01E+01	1.14E+01	1.58E+01	6.73E+00	1.25E+01	1.45E+01	1.94E+01	8.24E+00	2.84E+00	4.26E+00	6.78E+00	1.00E+00
Lead	2.26E+02	3.24E+02	5.04E+02	1.42E+02	6.96E+00	9.10E+00	1.86E+01	3.53E+00	8.46E+00	1.01E+01	2.01E+01	4.35E+00	1.87E+00	3.69E+00	6.73E+00	5.76E-01
Mercury	4.40E-01	5.00E-01	7.75E-01	3.29E-01	1.51E-02	1.49E-02	2.04E-02	1.16E-02	1.41E-02	1.38E-02	1.97E-02	1.02E-02	3.36E-03	4.37E-03	8.93E-03	1.52E-03
Nickel	5.06E+01	6.19E+01	9.02E+01	3.09E+01	1.96E+00	2.10E+00	2.81E+00	1.48E+00	2.18E+00	2.38E+00	3.13E+00	1.62E+00	6.11E-01	7.84E-01	1.26E+00	2.90E-01
Zinc	2.18E+03	2.66E+03	3.63E+03	1.44E+03	6.11E+01	7.37E+01	1.07E+02	3.81E+01	7.66E+01	9.45E+01	1.32E+02	4.81E+01	2.29E+01	2.99E+01	4.60E+01	1.12E+01
PCBs																
PCB077	2.51E-03	4.08E-03	8.64E-03	1.76E-03	2.45E-05	3.52E-05	7.67E-05	1.28E-05	3.29E-05	4.54E-05	1.01E-04	1.70E-05	1.32E-05	3.87E-05	1.10E-04	1.59E-06
PCB081	1.08E-04	1.28E-04	2.19E-04	8.89E-05	3.66E-06	6.41E-06	1.34E-05	2.01E-06	3.40E-06	5.41E-06	1.09E-05	2.00E-06	6.78E-07	1.26E-06	3.25E-06	2.71E-07
PCB105	1.93E-02	2.91E-02	6.48E-02	1.43E-02	1.17E-04	1.67E-04	3.89E-04	6.39E-05	1.57E-04	2.22E-04	5.46E-04	8.51E-05	8.67E-05	2.44E-04	8.07E-04	8.48E-06
PCB118	4.52E-02	6.83E-02	1.40E-01	3.38E-02	2.74E-04	4.01E-04	9.05E-04	1.52E-04	3.67E-04	5.27E-04	1.23E-03	2.02E-04	1.97E-04	5.69E-04	1.70E-03	1.81E-05
PCB126	3.92E-04	5.74E-04	1.71E-03	2.35E-04	6.93E-06	1.08E-05	2.23E-05	3.73E-06	7.52E-06	1.14E-05	2.44E-05	3.96E-06	3.17E-06	6.23E-06	2.45E-05	6.37E-07
PCB156 & PCB157	7.63E-03	1.13E-02	2.52E-02	5.55E-03	4.52E-05	6.33E-05	1.45E-04	2.55E-05	6.05E-05	8.40E-05	2.04E-04	3.39E-05	3.63E-05	9.59E-05	3.15E-04	3.60E-06
PCB169	4.75E-05	5.42E-05	2.45E-04	3.14E-05	3.91E-06	6.43E-06	1.31E-05	2.19E-06	3.41E-06	5.25E-06	1.05E-05	2.05E-06	8.64E-07	1.19E-06	4.70E-06	4.85E-07
Total PCBs	1.36E+00	2.03E+00	4.07E+00	1.02E+00	8.55E-03	1.33E-02	2.99E-02	4.96E-03	1.19E-02	1.74E-02	4.01E-02	6.89E-03	5.83E-03	1.67E-02	4.88E-02	5.11E-04
PCB TEQ	2.91E-05	5.49E-05	1.67E-04	2.06E-05	1.97E-07	3.61E-07	8.34E-07	1.37E-07	3.13E-07	5.14E-07	1.27E-06	2.03E-07	1.34E-07	5.50E-07	2.31E-06	6.09E-09
Pesticides																
4,4'-DDD	4.07E-02	4.17E-02	4.70E-02	3.76E-02	1.07E-04	1.74E-04	3.92E-04	6.06E-05	1.29E-04	1.82E-04	3.97E-04	8.12E-05	1.57E-04	1.79E-04	2.68E-04	1.07E-04
4,4'-DDT	1.60E-01	1.66E-01	1.82E-01	1.47E-01	7.83E-04	8.97E-04	1.62E-03	4.48E-04	7.13E-04	8.08E-04	1.41E-03	4.26E-04	5.89E-04	6.88E-04	9.91E-04	3.51E-04
Total of 2,4' and 4,4'-DDE	9.08E-02	9.34E-02	1.02E-01	8.64E-02	3.06E-04	4.19E-04	8.23E-04	1.59E-04	2.87E-04	3.73E-04	7.05E-04	1.56E-04	1.35E-04	1.85E-04	3.54E-04	5.72E-05
Total of 2,4' and 4,4'-DDD	5.77E-02	6.39E-02	8.36E-02	5.05E-02	1.87E-04	2.74E-04	5.91E-04	9.32E-05	2.00E-04	2.79E-04	6.04E-04	1.04E-04	2.04E-04	3.08E-04	6.31E-04	8.66E-05
Total of 2,4' and 4,4'-DDT	2.24E-01	2.38E-01	2.62E-01	2.09E-01	8.30E-04	1.02E-03	1.94E-03	4.40E-04	7.16E-04	8.87E-04	1.67E-03	3.83E-04	4.31E-04	6.65E-04	1.11E-03	1.56E-04
Total DDx	3.84E-01	3.95E-01	4.20E-01	3.59E-01	1.25E-03	1.61E-03	3.16E-03	6.27E-04	1.10E-03	1.38E-03	2.64E-03	5.57E-04	9.37E-04	1.14E-03	1.64E-03	4.92E-04
Total Chlordanes	3.85E-02	4.08E-02	5.64E-02	2.15E-02	3.60E-04	4.10E-04	5.05E-04	2.57E-04	4.75E-04	5.31E-04	6.56E-04	3.33E-04	5.38E-04	5.73E-04	8.21E-04	2.70E-04
γ-Hexachlorocyclohexane	1.16E-02	1.26E-02	2.09E-02	6.15E-03	8.88E-05	1.26E-04	2.77E-04	4.71E-05	1.25E-04	1.51E-04	3.19E-04	6.86E-05	1.77E-04	1.96E-04	3.26E-04	9.32E-05
Hexachlorobenzene	4.59E-03	1.12E-01	4.39E-01	2.91E-04	1.31E-04	2.02E-04	7.91E-04	5.24E-07	1.27E-04	4.68E-04	1.83E-03	1.21E-06	7.67E-05	1.72E-03	6.73E-03	4.46E-06
Aldrin	6.93E-03	6.90E-03	1.32E-02	3.89E-03	4.31E-05	9.64E-05	2.21E-04	2.75E-05	6.27E-05	9.87E-05	2.21E-04	3.83E-05	9.49E-05	1.00E-04	2.03E-04	4.83E-05
Dieldrin	1.23E-02	1.46E-02	2.18E-02	8.87E-03	1.38E-04	1.48E-04	2.83E-04	8.35E-05	1.48E-04	1.61E-04	3.20E-04	9.00E-05	9.97E-05	1.36E-04	2.48E-04	4.41E-05
PAHs																
Naphthalene	3.12E-01	5.71E-01	8.56E-01	1.37E-01	1.83E-02	2.11E-02	3.21E-02	1.20E-02	2.31E-02	2.70E-02	4.02E-02	1.49E-02	3.78E-03	7.73E-03	1.20E-02	1.30E-03
Benzo(a)pyrene	5.80E-01	7.53E-01	1.53E+00	3.86E-01	2.11E-02	2.32E-02	3.33E-02	1.60E-02	2.95E-02	3.16E-02	4.32E-02	2.32E-02	4.47E-03	7.40E-03	2.01E-02	1.44E-03
Total Carcinogenic PAHs BaPEq	9.47E-01	1.25E+00	2.50E+00	6.21E-01	3.35E-02	3.72E-02	5.44E-02	2.44E-02	4.80E-02	5.16E-02	7.21E-02	3.61E-02	6.67E-03	1.19E-02	3.20E-02	1.74E-03
Total PAHs	1.24E+01	1.51E+01	3.23E+01	6.52E+00	4.24E-01	4.88E-01	7.39E-01	3.01E-01	6.12E-01	6.89E-01	1.01E+00	4.44E-01	1.13E-01	1.56E-01	4.25E-01	2.34E-02
Phthalates																
Bis(2-ethylhexyl)phthalate	1.68E+01	2.08E+01	2.79E+01	1.10E+01	1.18E+00	1.25E+00	1.72E+00	8.56E-01	1.11E+00	1.21E+00	1.58E+00	8.15E-01	2.76E-01	3.35E-01	4.84E-01	1.67E-01

Table E3-5a. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Composite Runoff.

	RM 10.3-11 E FT06				RM 9.9-10.3 W FT07				RM 10-10.3 E FT09				RM 9.4-9.9 W FT10			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	3.02E-01	9.73E-01	1.74E+00	5.43E-02	1.48E-01	5.18E-01	9.40E-01	1.56E-02	1.82E-01	6.32E-01	1.15E+00	2.09E-02	1.28E+00	4.13E+00	7.38E+00	2.49E-01
Chromium	1.21E+00	1.59E+00	2.69E+00	5.55E-01	5.22E-01	7.22E-01	1.25E+00	2.02E-01	6.53E-01	8.96E-01	1.54E+00	2.63E-01	5.16E+00	6.76E+00	1.11E+01	2.56E+00
Copper	6.44E+00	9.98E+00	1.56E+01	2.17E+00	3.01E+00	4.93E+00	7.87E+00	8.00E-01	3.69E+00	6.02E+00	9.59E+00	9.95E-01	2.57E+01	4.06E+01	6.39E+01	8.20E+00
Lead	3.90E+00	7.92E+00	1.36E+01	1.19E+00	1.82E+00	3.96E+00	6.72E+00	4.64E-01	2.24E+00	4.84E+00	8.21E+00	5.77E-01	1.55E+01	3.23E+01	5.48E+01	4.53E+00
Mercury	6.35E-03	8.91E-03	1.92E-02	2.50E-03	2.79E-03	4.23E-03	9.77E-03	7.84E-04	3.54E-03	5.29E-03	1.20E-02	1.09E-03	2.97E-02	4.07E-02	8.38E-02	1.38E-02
Nickel	1.39E+00	1.82E+00	2.88E+00	6.54E-01	6.68E-01	9.02E-01	1.46E+00	2.80E-01	8.26E-01	1.11E+00	1.79E+00	3.54E-01	6.04E+00	7.85E+00	1.23E+01	2.98E+00
Zinc	5.22E+01	6.85E+01	1.03E+02	2.60E+01	2.59E+01	3.45E+01	5.22E+01	1.23E+01	3.17E+01	4.21E+01	6.37E+01	1.51E+01	2.13E+02	2.80E+02	4.21E+02	1.05E+02
PCBs																
PCB077	3.14E-05	9.35E-05	2.67E-04	3.73E-06	1.63E-05	5.06E-05	1.46E-04	1.30E-06	1.99E-05	6.16E-05	1.78E-04	1.62E-06	1.30E-04	3.94E-04	1.13E-03	1.36E-05
PCB081	1.01E-06	1.67E-06	4.76E-06	3.91E-07	3.76E-07	6.15E-07	2.02E-06	1.12E-07	4.69E-07	7.60E-07	2.47E-06	1.47E-07	3.94E-06	6.29E-06	1.83E-05	1.61E-06
PCB105	2.09E-04	5.96E-04	1.98E-03	1.95E-05	1.11E-04	3.26E-04	1.09E-03	7.05E-06	1.35E-04	3.96E-04	1.33E-03	8.78E-06	8.74E-04	2.53E-03	8.41E-03	7.11E-05
PCB118	4.75E-04	1.39E-03	4.14E-03	4.15E-05	2.51E-04	7.57E-04	2.28E-03	1.40E-05	3.06E-04	9.21E-04	2.77E-03	1.75E-05	1.98E-03	5.87E-03	1.76E-02	1.49E-04
PCB126	6.99E-06	1.38E-05	5.74E-05	1.26E-06	3.57E-06	7.20E-06	3.12E-05	5.01E-07	4.38E-06	8.79E-06	3.79E-05	6.39E-07	2.96E-05	5.79E-05	2.43E-04	5.64E-06
PCB156 & PCB157	8.77E-05	2.34E-04	7.74E-04	8.22E-06	4.68E-05	1.28E-04	4.28E-04	3.07E-06	5.70E-05	1.56E-04	5.20E-04	3.83E-06	3.68E-04	9.92E-04	3.29E-03	3.04E-05
PCB169	1.39E-06	1.48E-06	8.43E-06	9.09E-07	5.81E-07	5.15E-07	4.10E-06	3.92E-07	7.24E-07	6.45E-07	5.00E-06	4.93E-07	5.80E-06	5.77E-06	3.44E-05	4.05E-06
Total PCBs	1.41E-02	4.05E-02	1.19E-01	1.14E-03	7.46E-03	2.20E-02	6.52E-02	3.45E-04	9.08E-03	2.68E-02	7.92E-02	4.35E-04	5.86E-02	1.71E-01	5.03E-01	3.70E-03
PCB TEQ	3.36E-07	1.35E-06	5.72E-06	1.55E-08	1.77E-07	7.40E-07	3.17E-06	4.10E-10	2.16E-07	8.99E-07	3.86E-06	9.33E-10	1.39E-06	5.71E-06	2.44E-05	2.97E-08
Pesticides																
4,4'-DDD	3.79E-04	4.14E-04	5.88E-04	2.63E-04	2.07E-04	2.24E-04	3.12E-04	1.44E-04	2.52E-04	2.72E-04	3.79E-04	1.76E-04	1.60E-03	1.74E-03	2.45E-03	1.12E-03
4,4'-DDT	1.29E-03	1.51E-03	2.08E-03	7.86E-04	6.88E-04	8.05E-04	1.09E-03	4.19E-04	8.37E-04	9.78E-04	1.33E-03	5.09E-04	5.42E-03	6.33E-03	8.64E-03	3.30E-03
Total of 2,4' and 4,4'-DDE	2.74E-04	3.68E-04	6.82E-04	1.17E-04	1.38E-04	1.86E-04	3.44E-04	5.71E-05	1.69E-04	2.27E-04	4.18E-04	6.99E-05	1.13E-03	1.52E-03	2.79E-03	4.83E-04
Total of 2,4' and 4,4'-DDD	4.74E-04	7.14E-04	1.45E-03	2.02E-04	2.57E-04	3.88E-04	7.88E-04	1.09E-04	3.12E-04	4.71E-04	9.58E-04	1.32E-04	2.00E-03	3.01E-03	6.12E-03	8.50E-04
Total of 2,4' and 4,4'-DDT	8.79E-04	1.42E-03	2.28E-03	2.92E-04	4.53E-04	7.47E-04	1.19E-03	1.41E-04	5.51E-04	9.08E-04	1.45E-03	1.72E-04	3.63E-03	5.91E-03	9.45E-03	1.18E-03
Total DDx	2.04E-03	2.46E-03	3.28E-03	1.09E-03	1.08E-03	1.30E-03	1.69E-03	5.79E-04	1.32E-03	1.59E-03	2.06E-03	7.05E-04	8.54E-03	1.03E-02	1.35E-02	4.57E-03
Total Chlordanes	1.31E-03	1.39E-03	1.99E-03	6.53E-04	7.16E-04	7.58E-04	1.09E-03	3.52E-04	8.70E-04	9.21E-04	1.33E-03	4.28E-04	5.53E-03	5.86E-03	8.44E-03	2.74E-03
γ-Hexachlorocyclohexane	4.31E-04	4.68E-04	7.63E-04	2.28E-04	2.38E-04	2.57E-04	4.16E-04	1.26E-04	2.90E-04	3.13E-04	5.06E-04	1.53E-04	1.83E-03	1.99E-03	3.22E-03	9.71E-04
Hexachlorobenzene	1.64E-04	4.32E-03	1.69E-02	1.12E-05	8.58E-05	2.42E-03	9.46E-03	6.26E-06	1.04E-04	2.93E-03	1.15E-02	7.60E-06	6.80E-04	1.85E-02	7.23E-02	4.79E-05
Aldrin	2.33E-04	2.30E-04	4.60E-04	1.18E-04	1.29E-04	1.25E-04	2.48E-04	6.51E-05	1.57E-04	1.51E-04	3.02E-04	7.91E-05	9.93E-04	9.70E-04	1.93E-03	5.03E-04
Dieldrin	2.25E-04	3.14E-04	5.68E-04	9.75E-05	1.20E-04	1.69E-04	3.06E-04	5.03E-05	1.45E-04	2.05E-04	3.72E-04	6.12E-05	9.39E-04	1.32E-03	2.38E-03	4.02E-04
PAHs																
Naphthalene	8.87E-03	1.85E-02	2.75E-02	3.27E-03	3.90E-03	9.17E-03	1.37E-02	1.08E-03	4.86E-03	1.13E-02	1.68E-02	1.42E-03	3.71E-02	7.79E-02	1.14E-01	1.45E-02
Benzo(a)pyrene	1.09E-02	1.78E-02	4.78E-02	3.97E-03	4.83E-03	8.61E-03	2.50E-02	1.19E-03	5.94E-03	1.05E-02	3.04E-02	1.51E-03	4.20E-02	7.12E-02	1.98E-01	1.33E-02
Total Carcinogenic PAHs BaPEq	1.64E-02	2.88E-02	7.64E-02	5.09E-03	7.17E-03	1.39E-02	3.98E-02	1.25E-03	8.81E-03	1.70E-02	4.85E-02	1.59E-03	6.21E-02	1.14E-01	3.15E-01	1.54E-02
Total PAHs	2.79E-01	3.78E-01	1.02E+00	6.59E-02	1.31E-01	1.83E-01	5.31E-01	1.75E-02	1.60E-01	2.24E-01	6.47E-01	2.21E-02	1.09E+00	1.50E+00	4.19E+00	2.01E-01
Phthalates																
Bis(2-ethylhexyl)phthalate	4.31E-01	5.68E-01	8.12E-01	2.40E-01	1.89E-01	2.63E-01	3.79E-01	9.63E-02	2.35E-01	3.26E-01	4.66E-01	1.22E-01	1.75E+00	2.32E+00	3.29E+00	9.85E-01

Table E3-5a. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Composite Runoff.

	RM 9.3-10 E FT12				RM 8.2-9.4 W FT13				RM 8.2-9.4 E FT15				RM 8.2-9.2 E FT16			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	3.51E-02	7.57E-02	1.07E-01	1.32E-02	1.51E+00	5.11E+00	9.22E+00	2.17E-01	1.57E-01	4.74E-01	8.12E-01	3.18E-02	7.62E-01	1.72E+00	2.53E+00	2.72E-01
Chromium	2.28E-01	1.89E-01	3.85E-01	1.23E-01	5.68E+00	7.65E+00	1.28E+01	2.51E+00	7.23E-01	7.96E-01	1.47E+00	3.35E-01	4.76E+00	4.10E+00	8.22E+00	2.53E+00
Copper	6.48E-01	8.20E-01	1.07E+00	3.73E-01	6.30E+01	7.92E+01	1.04E+02	4.40E+01	3.10E+00	4.67E+00	7.07E+00	1.15E+00	1.42E+01	1.85E+01	2.47E+01	7.78E+00
Lead	7.56E-01	6.40E-01	1.66E+00	3.12E-01	2.22E+01	4.20E+01	6.75E+01	9.42E+00	2.47E+00	3.73E+00	7.27E+00	8.22E-01	1.58E+01	1.45E+01	3.61E+01	6.38E+00
Mercury	1.26E-03	1.17E-03	1.76E-03	8.30E-04	2.97E-02	4.37E-02	9.74E-02	1.02E-02	3.92E-03	4.76E-03	9.47E-03	1.87E-03	2.63E-02	2.54E-02	3.94E-02	1.70E-02
Nickel	1.35E-01	1.49E-01	1.81E-01	1.10E-01	6.94E+00	9.24E+00	1.47E+01	3.12E+00	6.72E-01	8.52E-01	1.28E+00	3.68E-01	3.00E+00	3.36E+00	4.27E+00	2.32E+00
Zinc	5.61E+00	8.03E+00	1.11E+01	2.92E+00	5.49E+02	6.26E+02	7.85E+02	4.26E+02	2.67E+01	3.65E+01	5.34E+01	1.31E+01	1.22E+02	1.74E+02	2.42E+02	6.34E+01
PCBs																
PCB077	2.69E-06	2.97E-06	8.95E-06	1.02E-06	1.62E-04	4.96E-04	1.42E-03	1.59E-05	1.54E-05	3.91E-05	1.14E-04	2.55E-06	6.03E-05	8.14E-05	2.42E-04	2.08E-05
PCB081	1.66E-07	1.60E-07	2.85E-07	1.26E-07	4.02E-06	6.38E-06	2.01E-05	1.40E-06	5.24E-07	6.76E-07	1.83E-06	2.79E-07	3.55E-06	3.66E-06	7.04E-06	2.57E-06
PCB105	1.23E-05	1.49E-05	4.96E-05	5.43E-06	1.10E-03	3.18E-03	1.06E-02	8.42E-05	9.54E-05	2.45E-04	8.21E-04	1.36E-05	2.93E-04	4.41E-04	1.46E-03	1.10E-04
PCB118	2.89E-05	3.50E-05	1.11E-04	1.28E-05	2.48E-03	7.39E-03	2.22E-02	1.74E-04	2.17E-04	5.70E-04	1.73E-03	3.04E-05	6.82E-04	1.03E-03	3.20E-03	2.60E-04
PCB126	6.36E-07	9.15E-07	1.92E-06	2.91E-07	3.55E-05	7.07E-05	3.03E-04	5.67E-06	3.45E-06	6.37E-06	2.42E-05	8.10E-07	1.42E-05	2.14E-05	5.21E-05	6.02E-06
PCB156 & PCB157	4.91E-06	5.81E-06	1.84E-05	2.33E-06	4.61E-04	1.25E-03	4.16E-03	3.59E-05	3.97E-05	9.63E-05	3.20E-04	5.89E-06	1.18E-04	1.72E-04	5.52E-04	4.74E-05
PCB169	1.68E-07	1.88E-07	2.71E-07	1.21E-07	6.03E-06	5.40E-06	4.02E-05	4.19E-06	6.66E-07	6.53E-07	3.22E-06	4.61E-07	3.69E-06	4.17E-06	7.69E-06	2.61E-06
Total PCBs	1.04E-03	1.23E-03	3.66E-03	5.53E-04	7.37E-02	2.15E-01	6.34E-01	4.45E-03	6.75E-03	1.69E-02	5.01E-02	1.14E-03	2.37E-02	3.41E-02	1.01E-01	1.10E-02
PCB TEQ	3.17E-08	4.17E-08	1.12E-07	1.75E-08	1.76E-06	7.21E-06	3.08E-05	3.76E-08	1.72E-07	5.69E-07	2.33E-06	2.88E-08	7.00E-07	1.15E-06	3.62E-06	3.43E-07
Pesticides																
4,4'-DDD	7.23E-06	8.38E-06	2.90E-05	3.71E-06	2.02E-03	2.18E-03	3.03E-03	1.41E-03	1.52E-04	1.65E-04	2.59E-04	1.04E-04	2.36E-04	2.70E-04	7.20E-04	1.38E-04
4,4'-DDT	2.03E-05	2.15E-05	4.77E-05	1.12E-05	6.70E-03	7.83E-03	1.06E-02	4.09E-03	4.99E-04	5.80E-04	8.17E-04	3.02E-04	7.34E-04	8.14E-04	1.48E-03	4.22E-04
Total of 2,4' and 4,4'-DDE	1.30E-05	1.36E-05	2.53E-05	5.99E-06	1.36E-03	1.83E-03	3.36E-03	5.74E-04	1.15E-04	1.48E-04	2.74E-04	4.84E-05	3.28E-04	3.66E-04	6.82E-04	1.48E-04
Total of 2,4' and 4,4'-DDD	1.09E-05	1.27E-05	3.69E-05	4.85E-06	2.50E-03	3.77E-03	7.65E-03	1.06E-03	1.92E-04	2.83E-04	5.94E-04	8.16E-05	3.34E-04	4.30E-04	1.09E-03	1.46E-04
Total of 2,4' and 4,4'-DDT	1.73E-05	2.18E-05	5.75E-05	6.80E-06	4.42E-03	7.27E-03	1.16E-02	1.40E-03	3.35E-04	5.41E-04	8.99E-04	1.07E-04	5.74E-04	7.99E-04	1.73E-03	2.13E-04
Total DDx	3.40E-05	3.74E-05	8.48E-05	1.50E-05	1.05E-02	1.27E-02	1.65E-02	5.64E-03	7.89E-04	9.45E-04	1.28E-03	4.17E-04	1.20E-03	1.38E-03	2.55E-03	5.75E-04
Total Chlordanes	3.28E-05	3.90E-05	4.95E-05	1.92E-05	7.62E-03	8.00E-03	1.11E-02	4.27E-03	5.38E-04	5.77E-04	8.21E-04	2.70E-04	9.68E-04	1.11E-03	1.47E-03	5.38E-04
γ-Hexachlorocyclohexane	1.40E-05	1.32E-05	3.12E-05	7.83E-06	2.31E-03	2.50E-03	4.04E-03	1.22E-03	1.84E-04	1.96E-04	3.33E-04	9.82E-05	3.82E-04	3.77E-04	8.04E-04	2.10E-04
Hexachlorobenzene	6.72E-06	3.86E-05	1.51E-04	1.00E-07	8.38E-04	2.34E-02	9.17E-02	6.07E-05	6.91E-05	1.70E-03	6.65E-03	4.40E-06	1.74E-04	1.83E-03	7.16E-03	4.74E-06
Aldrin	6.21E-06	5.65E-06	1.45E-05	3.38E-06	1.25E-03	1.21E-03	2.41E-03	6.34E-04	9.76E-05	9.36E-05	1.92E-04	4.96E-05	1.80E-04	1.69E-04	4.01E-04	9.55E-05
Dieldrin	9.23E-06	9.50E-06	2.92E-05	4.22E-06	1.17E-03	1.65E-03	2.97E-03	4.97E-04	9.60E-05	1.30E-04	2.55E-04	4.09E-05	2.38E-04	2.66E-04	7.16E-04	1.07E-04
PAHs																
Naphthalene	1.81E-03	2.09E-03	3.54E-03	9.96E-04	4.24E-02	9.39E-02	1.38E-01	1.43E-02	5.58E-03	9.62E-03	1.50E-02	2.34E-03	3.74E-02	4.54E-02	7.59E-02	2.02E-02
Benzo(a)pyrene	2.13E-03	2.10E-03	2.94E-03	1.54E-03	5.20E-02	8.88E-02	2.48E-01	1.63E-02	6.74E-03	9.26E-03	2.17E-02	3.32E-03	4.40E-02	4.52E-02	6.92E-02	3.08E-02
Total Carcinogenic PAHs BaPEq	3.52E-03	3.46E-03	5.16E-03	2.27E-03	7.78E-02	1.43E-01	3.95E-01	1.95E-02	1.06E-02	1.51E-02	3.54E-02	4.56E-03	7.24E-02	7.43E-02	1.20E-01	4.52E-02
Total PAHs	4.51E-02	5.17E-02	8.59E-02	2.92E-02	1.37E+00	1.88E+00	5.27E+00	2.56E-01	1.62E-01	2.08E-01	5.00E-01	5.96E-02	9.46E-01	1.10E+00	1.93E+00	5.81E-01
Phthalates																
Bis(2-ethylhexyl)phthalate	1.09E-01	1.27E-01	1.37E-01	8.89E-02	2.30E+00	2.96E+00	3.98E+00	1.48E+00	3.05E-01	3.86E-01	4.80E-01	2.10E-01	2.26E+00	2.65E+00	2.92E+00	1.81E+00

Table E3-5a. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Composite Runoff.

	RM 7.4-8.2 W FT17				RM 7.4-8.2 E FT19				RM 6.8-7.4 W FT20				RM 6.8-7.4 E FT22			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	6.50E-01	2.14E+00	3.85E+00	1.15E-01	1.52E-01	3.96E-01	6.95E-01	4.77E-02	1.49E+00	1.77E+00	2.09E+00	1.39E+00	4.20E-02	9.98E-02	1.73E-01	1.65E-02
Chromium	2.55E+00	3.36E+00	5.51E+00	1.24E+00	7.16E-01	9.35E-01	1.73E+00	3.22E-01	6.94E-01	9.55E-01	1.64E+00	2.77E-01	2.13E-01	2.76E-01	4.94E-01	1.09E-01
Copper	1.29E+01	2.07E+01	3.26E+01	3.88E+00	1.57E+01	1.61E+01	1.75E+01	1.48E+01	3.97E+00	6.47E+00	1.03E+01	1.08E+00	9.29E-01	1.25E+00	1.99E+00	4.22E-01
Lead	7.70E+00	1.64E+01	2.76E+01	2.16E+00	2.32E+00	4.42E+00	8.47E+00	8.02E-01	6.71E+00	8.78E+00	1.14E+01	5.39E+00	6.18E-01	1.20E+00	2.29E+00	2.25E-01
Mercury	1.46E-02	2.04E-02	4.28E-02	6.48E-03	4.77E-03	5.67E-03	1.05E-02	2.63E-03	4.19E-02	4.25E-02	4.48E-02	4.10E-02	1.52E-03	1.74E-03	3.00E-03	9.54E-04
Nickel	3.05E+00	4.00E+00	6.27E+00	1.47E+00	7.19E-01	8.82E-01	1.41E+00	3.71E-01	8.80E-01	1.18E+00	1.91E+00	3.74E-01	2.09E-01	2.49E-01	3.90E-01	1.18E-01
Zinc	1.08E+02	1.43E+02	2.15E+02	5.29E+01	7.20E+01	7.49E+01	8.54E+01	6.57E+01	3.39E+01	4.51E+01	6.82E+01	1.62E+01	6.72E+00	8.39E+00	1.34E+01	3.47E+00
PCBs																
PCB077	6.70E-05	2.06E-04	5.92E-04	6.36E-06	1.35E-05	3.79E-05	1.06E-04	2.17E-06	2.13E-05	6.59E-05	1.90E-04	1.78E-06	3.39E-06	9.56E-06	2.65E-05	6.00E-07
PCB081	1.79E-06	2.79E-06	8.54E-06	7.03E-07	1.17E-06	2.27E-06	5.45E-06	4.93E-07	4.98E-07	8.09E-07	2.64E-06	1.53E-07	3.59E-07	7.03E-07	1.65E-06	1.58E-07
PCB105	4.54E-04	1.32E-03	4.41E-03	3.36E-05	8.61E-05	2.34E-04	7.57E-04	1.14E-05	1.45E-04	4.24E-04	1.42E-03	9.60E-06	2.16E-05	5.86E-05	1.87E-04	3.09E-06
PCB118	1.03E-03	3.07E-03	9.22E-03	6.91E-05	1.96E-04	5.48E-04	1.60E-03	2.52E-05	3.28E-04	9.85E-04	2.97E-03	1.92E-05	4.93E-05	1.37E-04	3.97E-04	6.92E-06
PCB126	1.51E-05	2.98E-05	1.27E-04	2.73E-06	3.62E-06	6.99E-06	2.50E-05	9.19E-07	4.66E-06	9.37E-06	4.05E-05	6.71E-07	9.87E-07	1.88E-06	6.44E-06	2.91E-07
PCB156 & PCB157	1.91E-04	5.19E-04	1.73E-03	1.45E-05	3.59E-05	9.18E-05	2.95E-04	4.75E-06	6.10E-05	1.67E-04	5.56E-04	4.16E-06	9.00E-06	2.29E-05	7.30E-05	1.28E-06
PCB169	2.75E-06	2.51E-06	1.70E-05	1.98E-06	1.39E-06	2.23E-06	6.74E-06	7.10E-07	7.65E-07	6.78E-07	5.34E-06	5.19E-07	4.31E-07	7.01E-07	1.97E-06	2.24E-07
Total PCBs	3.04E-02	8.92E-02	2.63E-01	1.66E-03	5.76E-03	1.62E-02	4.66E-02	7.12E-04	9.73E-03	2.87E-02	8.47E-02	4.80E-04	1.42E-03	4.06E-03	1.16E-02	1.78E-04
PCB TEQ	7.23E-07	2.99E-06	1.28E-05	8.14E-09	1.23E-07	5.19E-07	2.13E-06	9.65E-09	2.32E-07	9.62E-07	4.13E-06	1.51E-09	2.88E-08	1.28E-07	5.24E-07	1.88E-09
Pesticides																
4,4'-DDD	8.38E-04	9.07E-04	1.26E-03	5.85E-04	1.54E-04	1.87E-04	3.01E-04	1.02E-04	3.09E-02	3.09E-02	3.09E-02	3.09E-02	3.89E-05	4.88E-05	7.97E-05	2.54E-05
4,4'-DDT	2.79E-03	3.26E-03	4.42E-03	1.70E-03	6.68E-04	7.79E-04	1.19E-03	3.90E-04	1.26E-01	1.27E-01	1.27E-01	1.26E-01	1.80E-04	2.11E-04	3.27E-04	1.05E-04
Total of 2,4' and 4,4'-DDE	5.71E-04	7.65E-04	1.40E-03	2.42E-04	1.70E-04	2.39E-04	4.70E-04	7.40E-05	8.31E-02	8.31E-02	8.32E-02	8.31E-02	4.78E-05	6.76E-05	1.33E-04	2.12E-05
Total of 2,4' and 4,4'-DDD	1.04E-03	1.57E-03	3.18E-03	4.42E-04	2.10E-04	3.20E-04	6.60E-04	9.00E-05	4.52E-02	4.53E-02	4.55E-02	4.52E-02	5.44E-05	8.33E-05	1.72E-04	2.34E-05
Total of 2,4' and 4,4'-DDT	1.85E-03	3.03E-03	4.82E-03	5.86E-04	5.40E-04	7.85E-04	1.35E-03	2.18E-04	2.01E-01	2.01E-01	2.01E-01	2.00E-01	1.51E-04	2.15E-04	3.74E-04	6.35E-05
Total DDx	4.40E-03	5.29E-03	6.87E-03	2.36E-03	1.07E-03	1.33E-03	2.08E-03	5.54E-04	3.30E-01	3.30E-01	3.31E-01	3.30E-01	2.91E-04	3.64E-04	5.82E-04	1.50E-04
Total Chlordanes	2.90E-03	3.06E-03	4.42E-03	1.43E-03	5.17E-04	5.55E-04	7.88E-04	2.66E-04	3.83E-03	3.87E-03	4.19E-03	3.48E-03	1.29E-04	1.39E-04	1.97E-04	6.70E-05
γ-Hexachlorocyclohexane	9.61E-04	1.04E-03	1.68E-03	5.09E-04	1.66E-04	1.92E-04	3.29E-04	8.70E-05	3.09E-04	3.34E-04	5.41E-04	1.64E-04	4.09E-05	4.83E-05	8.33E-05	2.13E-05
Hexachlorobenzene	3.48E-04	9.74E-03	3.81E-02	2.52E-05	9.00E-05	1.54E-03	6.03E-03	3.99E-06	1.12E-04	3.14E-03	1.23E-02	8.13E-06	2.43E-05	3.75E-04	1.47E-03	9.71E-07
Aldrin	5.21E-04	5.04E-04	1.00E-03	2.63E-04	8.83E-05	1.05E-04	2.18E-04	4.55E-05	8.66E-04	8.62E-04	9.81E-04	8.04E-04	2.17E-05	2.73E-05	5.71E-05	1.13E-05
Dieldrin	4.85E-04	6.84E-04	1.24E-03	2.06E-04	1.09E-04	1.43E-04	2.59E-04	5.07E-05	6.27E-03	6.31E-03	6.45E-03	6.20E-03	2.86E-05	3.71E-05	6.64E-05	1.36E-05
PAHs																
Naphthalene	1.85E-02	3.98E-02	5.82E-02	6.94E-03	4.46E-03	8.23E-03	1.32E-02	1.73E-03	5.19E-03	1.21E-02	1.79E-02	1.50E-03	1.26E-03	2.19E-03	3.46E-03	5.73E-04
Benzo(a)pyrene	2.29E-02	3.79E-02	1.03E-01	8.36E-03	5.00E-03	8.00E-03	2.07E-02	1.79E-03	6.43E-03	1.13E-02	3.26E-02	1.69E-03	1.26E-03	2.04E-03	5.28E-03	4.41E-04
Total Carcinogenic PAHs BaPEq	3.51E-02	6.18E-02	1.65E-01	1.14E-02	7.41E-03	1.27E-02	3.29E-02	2.26E-03	9.56E-03	1.83E-02	5.20E-02	1.84E-03	1.81E-03	3.19E-03	8.30E-03	5.31E-04
Total PAHs	5.50E-01	7.62E-01	2.17E+00	8.92E-02	1.19E-01	1.64E-01	4.30E-01	3.00E-02	1.73E-01	2.41E-01	6.93E-01	2.52E-02	2.90E-02	4.05E-02	1.07E-01	6.93E-03
Phthalates																
Bis(2-ethylhexyl)phthalate	8.34E-01	1.13E+00	1.60E+00	4.58E-01	4.28E-01	4.84E-01	7.11E-01	2.72E-01	2.46E-01	3.43E-01	4.93E-01	1.26E-01	1.25E-01	1.38E-01	2.05E-01	8.10E-02

Table E3-5a. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Composite Runoff.

	RM 6.1-6.8 W FT23				RM 6.1-6.8 E FT25				RM 5.3-6.1 W FT26				RM 5.3-6.1 E FT28			
Analyte	Geomean Loading Estimate (kg/yr)	Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	2.82E-01	8.14E-01	1.42E+00	8.69E-02	5.85E-02	7.27E-02	1.03E-01	3.78E-02	1.72E-01	3.64E-01	5.93E-01	8.76E-02	2.23E-01	5.47E-01	9.03E-01	7.69E-02
Chromium	1.31E+00	1.61E+00	2.40E+00	8.21E-01	3.96E-01	4.65E-01	8.91E-01	2.14E-01	1.01E+00	1.16E+00	1.58E+00	7.37E-01	1.19E+00	1.32E+00	2.41E+00	6.21E-01
Copper	5.56E+00	8.40E+00	1.28E+01	2.17E+00	1.44E+00	1.56E+00	2.40E+00	9.08E-01	4.02E+00	5.25E+00	7.40E+00	2.30E+00	4.77E+00	6.46E+00	9.63E+00	2.29E+00
Lead	3.16E+00	6.29E+00	1.04E+01	1.11E+00	1.15E+00	1.73E+00	3.85E+00	5.09E-01	2.08E+00	3.44E+00	5.50E+00	1.05E+00	3.75E+00	5.44E+00	1.10E+01	1.45E+00
Mercury	7.73E-03	9.79E-03	1.77E-02	4.85E-03	2.94E-03	2.90E-03	4.12E-03	2.14E-03	5.06E-03	5.78E-03	8.81E-03	3.89E-03	6.98E-03	7.70E-03	1.34E-02	4.19E-03
Nickel	1.41E+00	1.75E+00	2.58E+00	8.24E-01	2.95E-01	3.09E-01	4.61E-01	2.05E-01	9.01E-01	1.05E+00	1.42E+00	6.25E-01	1.00E+00	1.19E+00	1.75E+00	6.17E-01
Zinc	4.31E+01	5.59E+01	8.22E+01	2.27E+01	9.03E+00	1.08E+01	1.78E+01	5.09E+00	2.55E+01	3.10E+01	4.35E+01	1.58E+01	3.67E+01	4.85E+01	7.19E+01	1.92E+01
PCBs																
PCB077	2.56E-05	7.49E-05	2.12E-04	3.75E-06	3.20E-06	5.33E-06	1.24E-05	1.43E-06	1.31E-05	3.13E-05	8.13E-05	4.30E-06	1.89E-05	4.32E-05	1.22E-04	4.58E-06
PCB081	8.85E-07	1.26E-06	3.36E-06	4.72E-07	8.25E-07	1.62E-06	3.56E-06	3.94E-07	7.85E-07	1.15E-06	2.42E-06	4.85E-07	1.34E-06	2.20E-06	5.07E-06	6.98E-07
PCB105	1.69E-04	4.77E-04	1.57E-03	1.89E-05	1.55E-05	2.48E-05	5.80E-05	7.32E-06	7.80E-05	1.89E-04	5.79E-04	2.10E-05	1.11E-04	2.60E-04	8.41E-04	2.38E-05
PCB118	3.84E-04	1.11E-03	3.29E-03	4.16E-05	3.66E-05	6.07E-05	1.42E-04	1.74E-05	1.79E-04	4.40E-04	1.22E-03	4.90E-05	2.54E-04	6.08E-04	1.79E-03	5.48E-05
PCB126	6.00E-06	1.12E-05	4.55E-05	1.58E-06	1.29E-06	2.22E-06	4.67E-06	6.05E-07	3.01E-06	5.07E-06	1.76E-05	1.27E-06	4.71E-06	8.37E-06	2.76E-05	1.50E-06
PCB156 & PCB157	7.08E-05	1.87E-04	6.15E-04	7.91E-06	6.17E-06	9.47E-06	2.17E-05	2.99E-06	3.17E-05	7.35E-05	2.26E-04	8.31E-06	4.56E-05	1.02E-04	3.26E-04	1.00E-05
PCB169	1.31E-06	1.24E-06	6.42E-06	1.02E-06	9.11E-07	1.65E-06	3.52E-06	4.32E-07	9.49E-07	1.12E-06	3.41E-06	7.27E-07	1.54E-06	2.20E-06	6.31E-06	9.04E-07
Total PCBs	1.13E-02	3.22E-02	9.39E-02	1.03E-03	1.06E-03	2.04E-03	4.84E-03	5.51E-04	5.32E-03	1.30E-02	3.53E-02	1.37E-03	7.87E-03	1.83E-02	5.28E-02	1.94E-03
PCB TEQ	2.71E-07	1.08E-06	4.55E-06	1.53E-08	1.53E-08	4.75E-08	1.07E-07	1.22E-08	1.30E-07	4.21E-07	1.65E-06	3.52E-08	1.93E-07	5.97E-07	2.32E-06	4.99E-08
Pesticides																
4,4'-DDD	3.01E-04	3.25E-04	4.52E-04	2.11E-04	1.94E-05	3.85E-05	9.08E-05	8.54E-06	1.17E-04	1.30E-04	1.86E-04	8.30E-05	1.64E-04	1.94E-04	3.35E-04	1.08E-04
4,4'-DDT	1.01E-03	1.17E-03	1.59E-03	6.18E-04	1.95E-04	2.26E-04	4.21E-04	1.05E-04	4.23E-04	4.89E-04	6.83E-04	2.65E-04	6.54E-04	7.58E-04	1.16E-03	3.85E-04
Total of 2,4' and 4,4'-DDE	2.15E-04	2.84E-04	5.13E-04	9.78E-05	7.20E-05	1.04E-04	2.15E-04	3.34E-05	1.08E-04	1.41E-04	2.48E-04	5.76E-05	1.79E-04	2.40E-04	4.61E-04	8.03E-05
Total of 2,4' and 4,4'-DDD	3.73E-04	5.59E-04	1.13E-03	1.60E-04	4.05E-05	6.30E-05	1.38E-04	1.82E-05	1.47E-04	2.18E-04	4.35E-04	6.78E-05	2.21E-04	3.27E-04	6.93E-04	9.59E-05
Total of 2,4' and 4,4'-DDT	6.72E-04	1.09E-03	1.73E-03	2.24E-04	2.14E-04	2.62E-04	5.09E-04	1.09E-04	3.12E-04	4.71E-04	7.55E-04	1.29E-04	5.16E-04	7.54E-04	1.32E-03	2.05E-04
Total DDx	1.58E-03	1.90E-03	2.47E-03	8.55E-04	3.25E-04	4.24E-04	8.51E-04	1.57E-04	6.52E-04	7.89E-04	1.09E-03	3.57E-04	1.04E-03	1.28E-03	2.00E-03	5.39E-04
Total Chlordanes	1.04E-03	1.10E-03	1.58E-03	5.21E-04	5.60E-05	6.70E-05	8.40E-05	3.84E-05	4.07E-04	4.30E-04	6.00E-04	2.22E-04	5.72E-04	6.20E-04	8.67E-04	3.00E-04
γ-Hexachlorocyclohexane	3.41E-04	3.69E-04	5.96E-04	1.81E-04	1.41E-05	2.52E-05	5.81E-05	6.78E-06	1.23E-04	1.36E-04	2.22E-04	6.59E-05	1.90E-04	2.11E-04	3.74E-04	1.01E-04
Hexachlorobenzene	1.26E-04	3.44E-03	1.35E-02	8.93E-06	3.08E-05	3.37E-07	1.32E-06	1.03E-09	5.58E-05	1.20E-03	4.69E-03	3.11E-06	9.55E-05	1.60E-03	6.27E-03	4.15E-06
Aldrin	1.86E-04	1.80E-04	3.57E-04	9.45E-05	6.02E-06	2.21E-05	5.24E-05	3.91E-06	6.80E-05	7.03E-05	1.39E-04	3.58E-05	9.92E-05	1.10E-04	2.32E-04	5.15E-05
Dieldrin	1.76E-04	2.46E-04	4.42E-04	7.68E-05	2.90E-05	3.12E-05	5.87E-05	1.66E-05	7.57E-05	1.01E-04	1.74E-04	3.83E-05	1.21E-04	1.54E-04	3.02E-04	5.62E-05
PAHs																
Naphthalene	9.29E-03	1.70E-02	2.38E-02	4.91E-03	2.20E-03	2.59E-03	4.60E-03	1.26E-03	7.21E-03	1.03E-02	1.36E-02	4.86E-03	8.48E-03	1.28E-02	2.03E-02	4.20E-03
Benzo(a)pyrene	1.93E-02	2.39E-02	4.39E-02	1.46E-02	2.17E-03	2.66E-03	4.71E-03	1.30E-03	7.99E-03	1.02E-02	1.92E-02	5.52E-03	9.87E-03	1.27E-02	2.65E-02	5.61E-03
Total Carcinogenic PAHs BaPEq	2.89E-02	3.72E-02	6.90E-02	2.13E-02	3.28E-03	4.10E-03	7.43E-03	1.88E-03	1.24E-02	1.63E-02	3.07E-02	8.23E-03	1.55E-02	2.05E-02	4.32E-02	8.02E-03
Total PAHs	2.34E-01	3.11E-01	8.14E-01	6.47E-02	4.13E-02	5.25E-02	9.57E-02	2.39E-02	1.74E-01	2.08E-01	4.03E-01	9.90E-02	2.23E-01	2.79E-01	6.04E-01	1.03E-01
Phthalates																
Bis(2-ethylhexyl)phthalate	3.46E-01	4.53E-01	6.21E-01	2.12E-01	2.82E-01	2.93E-01	4.23E-01	1.97E-01	2.07E-01	2.45E-01	3.37E-01	1.39E-01	5.77E-01	6.68E-01	8.77E-01	4.06E-01

Table E3-5a. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Composite Runoff.

	RM 4.7-5.3 W FT29				RM 4.7-5.3 E FT31				RM 4.1-4.7 W FT32				RM 4.1-4.7 E FT34			
Analyte	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**
Metals																
Arsenic	1.75E-01	5.20E-01	9.21E-01	4.50E-02	3.84E-01	1.21E+00	2.14E+00	7.04E-02	1.03E-01	2.62E-01	4.48E-01	4.15E-02	2.54E-01	8.25E-01	1.46E+00	3.98E-02
Chromium	7.65E-01	9.84E-01	1.60E+00	4.07E-01	1.61E+00	2.00E+00	3.60E+00	7.01E-01	5.32E-01	6.36E-01	9.45E-01	3.54E-01	4.48E+00	4.67E+00	5.60E+00	3.93E+00
Copper	3.68E+00	5.53E+00	8.60E+00	1.38E+00	7.87E+00	1.21E+01	1.89E+01	2.66E+00	2.00E+00	2.87E+00	4.34E+00	8.97E-01	1.05E+01	1.31E+01	1.71E+01	7.34E+00
Lead	2.18E+00	4.40E+00	7.56E+00	7.24E-01	5.48E+00	9.98E+00	1.83E+01	1.68E+00	1.17E+00	2.22E+00	3.79E+00	4.56E-01	2.14E+01	2.39E+01	2.87E+01	1.91E+01
Mercury	4.39E-03	5.73E-03	1.12E-02	2.32E-03	9.09E-03	1.19E-02	2.47E-02	3.92E-03	3.42E-03	4.03E-03	6.59E-03	2.43E-03	1.29E-02	1.46E-02	2.23E-02	9.85E-03
Nickel	8.39E-01	1.07E+00	1.64E+00	4.40E-01	1.72E+00	2.22E+00	3.49E+00	8.38E-01	5.31E-01	6.37E-01	9.11E-01	3.41E-01	2.29E+00	2.60E+00	3.34E+00	1.77E+00
Zinc	2.87E+01	3.71E+01	5.59E+01	1.47E+01	6.61E+01	8.82E+01	1.33E+02	3.22E+01	1.48E+01	1.89E+01	2.79E+01	8.07E+00	1.28E+02	1.42E+02	1.68E+02	1.07E+02
PCBs																
PCB077	1.68E-05	4.95E-05	1.40E-04	2.30E-06	3.90E-05	1.11E-04	3.19E-04	4.92E-06	8.30E-06	2.34E-05	6.53E-05	1.50E-06	2.64E-05	7.47E-05	2.16E-04	3.19E-06
PCB081	7.02E-07	1.19E-06	3.13E-06	3.10E-07	1.45E-06	2.36E-06	6.45E-06	6.22E-07	4.55E-07	7.18E-07	1.70E-06	2.52E-07	7.50E-07	1.07E-06	3.21E-06	3.27E-07
PCB105	1.11E-04	3.14E-04	1.03E-03	1.18E-05	2.54E-04	7.01E-04	2.34E-03	2.63E-05	5.35E-05	1.47E-04	4.78E-04	7.49E-06	1.72E-04	4.75E-04	1.59E-03	1.72E-05
PCB118	2.52E-04	7.30E-04	2.16E-03	2.56E-05	5.76E-04	1.63E-03	4.90E-03	5.67E-05	1.22E-04	3.42E-04	1.00E-03	1.69E-05	3.90E-04	1.10E-03	3.34E-03	3.68E-05
PCB126	3.93E-06	7.57E-06	3.05E-05	8.83E-07	8.93E-06	1.73E-05	6.90E-05	1.77E-06	2.13E-06	3.84E-06	1.45E-05	6.97E-07	5.85E-06	1.13E-05	4.61E-05	1.09E-06
PCB156 & PCB157	4.65E-05	1.23E-04	4.04E-04	4.93E-06	1.06E-04	2.75E-04	9.13E-04	1.13E-05	2.24E-05	5.76E-05	1.87E-04	3.11E-06	7.20E-05	1.87E-04	6.22E-04	7.44E-06
PCB169	9.47E-07	1.12E-06	5.06E-06	6.21E-07	1.92E-06	2.21E-06	1.07E-05	1.20E-06	6.23E-07	7.39E-07	2.63E-06	4.50E-07	1.04E-06	9.74E-07	6.09E-06	7.13E-07
Total PCBs	7.44E-03	2.13E-02	6.20E-02	6.63E-04	1.74E-02	4.79E-02	1.41E-01	1.83E-03	3.57E-03	9.96E-03	2.88E-02	4.17E-04	1.18E-02	3.24E-02	9.59E-02	1.23E-03
PCB TEQ	1.74E-07	7.06E-07	2.98E-06	8.99E-09	4.18E-07	1.60E-06	6.71E-06	3.35E-08	8.31E-08	3.28E-07	1.37E-06	6.77E-09	2.90E-07	1.09E-06	4.58E-06	2.41E-08
Pesticides																
4,4'-DDD	2.00E-04	2.22E-04	3.17E-04	1.38E-04	4.44E-04	4.90E-04	7.29E-04	3.05E-04	9.31E-05	1.04E-04	1.51E-04	6.45E-05	2.99E-04	3.24E-04	4.74E-04	2.07E-04
4,4'-DDT	7.07E-04	8.25E-04	1.15E-03	4.28E-04	1.54E-03	1.80E-03	2.52E-03	9.27E-04	3.37E-04	3.92E-04	5.51E-04	2.05E-04	9.88E-04	1.15E-03	1.59E-03	6.00E-04
Total of 2,4' and 4,4'-DDE	1.56E-04	2.11E-04	3.92E-04	6.85E-05	3.40E-04	4.56E-04	8.55E-04	1.43E-04	7.88E-05	1.05E-04	1.94E-04	3.70E-05	2.11E-04	2.78E-04	5.14E-04	8.79E-05
Total of 2,4' and 4,4'-DDD	2.53E-04	3.81E-04	7.74E-04	1.08E-04	5.63E-04	8.44E-04	1.74E-03	2.39E-04	1.18E-04	1.78E-04	3.62E-04	5.12E-05	3.74E-04	5.58E-04	1.15E-03	1.58E-04
Total of 2,4' and 4,4'-DDT	4.95E-04	7.84E-04	1.27E-03	1.73E-04	1.06E-03	1.70E-03	2.79E-03	3.57E-04	2.41E-04	3.75E-04	6.10E-04	8.88E-05	6.56E-04	1.07E-03	1.74E-03	2.07E-04
Total DDx	1.12E-03	1.35E-03	1.85E-03	5.95E-04	2.44E-03	2.95E-03	4.04E-03	1.29E-03	5.33E-04	6.47E-04	8.93E-04	2.87E-04	1.56E-03	1.87E-03	2.48E-03	8.29E-04
Total Chlordanes	6.87E-04	7.28E-04	1.04E-03	3.45E-04	1.54E-03	1.64E-03	2.35E-03	7.68E-04	3.20E-04	3.39E-04	4.84E-04	1.62E-04	1.04E-03	1.11E-03	1.59E-03	5.18E-04
γ-Hexachlorocyclohexane	2.24E-04	2.46E-04	4.02E-04	1.19E-04	5.15E-04	5.59E-04	9.28E-04	2.73E-04	1.04E-04	1.14E-04	1.87E-04	5.50E-05	3.52E-04	3.77E-04	6.23E-04	1.87E-04
Hexachlorobenzene	9.00E-05	2.24E-03	8.76E-03	5.80E-06	2.02E-04	4.99E-03	1.95E-02	1.29E-05	4.31E-05	1.02E-03	4.01E-03	2.65E-06	1.29E-04	3.42E-03	1.34E-02	8.88E-06
Aldrin	1.22E-04	1.23E-04	2.46E-04	6.19E-05	2.76E-04	2.75E-04	5.57E-04	1.40E-04	5.63E-05	5.76E-05	1.16E-04	2.89E-05	1.89E-04	1.82E-04	3.66E-04	9.55E-05
Dieldrin	1.21E-04	1.68E-04	3.01E-04	5.36E-05	2.73E-04	3.75E-04	7.00E-04	1.18E-04	5.77E-05	7.91E-05	1.42E-04	2.61E-05	1.79E-04	2.48E-04	4.66E-04	7.59E-05
PAHs																
Naphthalene	5.36E-03	1.04E-02	1.52E-02	2.38E-03	1.18E-02	2.32E-02	3.57E-02	4.30E-03	3.57E-03	5.93E-03	8.28E-03	2.11E-03	7.89E-03	1.56E-02	2.39E-02	2.86E-03
Benzo(a)pyrene	6.05E-03	9.75E-03	2.56E-02	2.36E-03	1.42E-02	2.21E-02	5.78E-02	5.41E-03	3.34E-03	5.06E-03	1.24E-02	1.58E-03	9.76E-02	1.02E-01	1.21E-01	9.28E-02
Total Carcinogenic PAHs BaPEq	9.02E-03	1.56E-02	4.07E-02	3.03E-03	2.16E-02	3.57E-02	9.30E-02	6.92E-03	4.89E-03	7.95E-03	1.97E-02	2.01E-03	1.55E-01	1.63E-01	1.94E-01	1.47E-01
Total PAHs	1.51E-01	2.03E-01	5.38E-01	3.84E-02	3.57E-01	4.79E-01	1.26E+00	9.17E-02	7.78E-02	1.03E-01	2.59E-01	2.46E-02	1.16E+00	1.23E+00	1.66E+00	1.01E+00
Phthalates																
Bis(2-ethylhexyl)phthalate	2.71E-01	3.42E-01	4.90E-01	1.60E-01	7.01E-01	8.86E-01	1.21E+00	4.36E-01	1.64E-01	1.97E-01	2.71E-01	1.09E-01	6.94E-01	8.01E-01	9.42E-01	5.64E-01

Table E3-5a. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Composite Runoff.

	RM 3.3-4.1 W FT35				RM 3.3-4.1 E FT37				RM 2.9-3.1 W FT38				RM 2-3.3 W FT39			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	1.73E-01	4.55E-01	7.79E-01	6.37E-02	7.00E-01	2.45E+00	4.45E+00	7.37E-02	2.04E-03	3.61E-03	5.39E-03	1.48E-03	5.59E-02	1.93E-01	3.50E-01	6.74E-03
Chromium	8.78E-01	1.04E+00	1.50E+00	5.82E-01	1.34E+01	1.40E+01	1.58E+01	1.23E+01	1.38E-02	1.47E-02	1.69E-02	1.25E-02	2.02E-01	2.76E-01	4.72E-01	8.31E-02
Copper	3.76E+00	5.36E+00	7.88E+00	1.77E+00	4.87E+01	5.52E+01	6.52E+01	4.13E+01	2.46E-02	3.27E-02	4.51E-02	1.52E-02	1.13E+00	1.84E+00	2.93E+00	3.05E-01
Lead	2.06E+00	3.72E+00	6.02E+00	8.60E-01	7.73E+01	8.46E+01	9.39E+01	7.27E+01	1.32E-02	2.22E-02	3.39E-02	7.41E-03	6.82E-01	1.48E+00	2.50E+00	1.76E-01
Mercury	4.48E-03	5.53E-03	9.69E-03	2.94E-03	1.74E-01	1.79E-01	1.97E-01	1.67E-01	1.14E-04	1.20E-04	1.43E-04	1.05E-04	1.11E-03	1.64E-03	3.70E-03	3.60E-04
Nickel	8.65E-01	1.06E+00	1.51E+00	5.36E-01	9.02E+00	9.81E+00	1.17E+01	7.71E+00	1.26E-02	1.36E-02	1.60E-02	1.10E-02	2.55E-01	3.42E-01	5.50E-01	1.11E-01
Zinc	2.69E+01	3.41E+01	4.89E+01	1.52E+01	3.05E+02	3.34E+02	3.94E+02	2.59E+02	1.67E-01	2.03E-01	2.78E-01	1.09E-01	9.67E+00	1.29E+01	1.94E+01	4.61E+00
PCBs																
PCB077	1.52E-05	4.09E-05	1.13E-04	3.31E-06	1.67E-03	1.79E-03	2.11E-03	1.62E-03	8.69E-08	2.32E-07	6.37E-07	2.34E-08	6.07E-06	1.88E-05	5.44E-05	4.94E-07
PCB081	5.81E-07	7.91E-07	1.91E-06	3.39E-07	7.30E-05	7.38E-05	7.86E-05	7.21E-05	8.30E-09	9.31E-09	1.53E-08	7.18E-09	1.44E-07	2.33E-07	7.56E-07	4.61E-08
PCB105	9.62E-05	2.56E-04	8.26E-04	1.65E-05	1.40E-02	1.47E-02	1.73E-02	1.36E-02	5.46E-07	1.46E-06	4.70E-06	1.06E-07	4.13E-05	1.21E-04	4.06E-04	2.67E-06
PCB118	2.19E-04	5.95E-04	1.73E-03	3.74E-05	3.30E-02	3.47E-02	3.99E-02	3.22E-02	1.26E-06	3.40E-06	9.85E-06	2.55E-07	9.36E-05	2.82E-04	8.48E-04	5.33E-06
PCB126	3.39E-06	6.12E-06	2.39E-05	1.04E-06	1.99E-04	2.12E-04	2.93E-04	1.89E-04	3.50E-08	5.03E-08	1.52E-07	2.20E-08	1.34E-06	2.69E-06	1.16E-05	2.00E-07
PCB156 & PCB157	3.99E-05	1.00E-04	3.23E-04	6.66E-06	5.40E-03	5.67E-03	6.69E-03	5.25E-03	2.31E-07	5.76E-07	1.84E-06	4.62E-08	1.74E-05	4.77E-05	1.59E-04	1.16E-06
PCB169	7.73E-07	7.43E-07	3.43E-06	6.19E-07	2.75E-06	2.44E-06	1.94E-05	1.86E-06	1.38E-08	1.35E-08	2.87E-08	1.30E-08	2.24E-07	1.99E-07	1.53E-06	1.54E-07
Total PCBs	6.54E-03	1.74E-02	4.96E-02	1.04E-03	9.94E-01	1.04E+00	1.19E+00	9.70E-01	3.35E-05	9.52E-05	2.78E-04	3.41E-06	2.77E-03	8.19E-03	2.42E-02	1.30E-04
PCB TEQ	1.61E-07	5.78E-07	2.38E-06	2.39E-08	2.02E-05	2.21E-05	3.03E-05	1.96E-05	7.54E-10	3.13E-09	1.34E-08	5.56E-12	6.59E-08	2.75E-07	1.18E-06	1.55E-10
Pesticides																
4,4'-DDD	1.60E-04	1.73E-04	2.40E-04	1.13E-04	9.81E-04	1.06E-03	1.48E-03	6.85E-04	9.04E-07	9.75E-07	1.35E-06	6.39E-07	7.70E-05	8.33E-05	1.16E-04	5.37E-05
4,4'-DDT	5.32E-04	6.19E-04	8.36E-04	3.31E-04	3.26E-03	3.81E-03	5.17E-03	1.98E-03	3.13E-06	3.62E-06	4.83E-06	1.99E-06	2.56E-04	2.99E-04	4.06E-04	1.56E-04
Total of 2,4' and 4,4'-DDE	1.19E-04	1.55E-04	2.74E-04	5.76E-05	6.55E-04	8.82E-04	1.63E-03	2.71E-04	8.58E-07	1.06E-06	1.73E-06	5.14E-07	5.16E-05	6.94E-05	1.28E-04	2.14E-05
Total of 2,4' and 4,4'-DDD	1.97E-04	2.94E-04	5.93E-04	8.70E-05	1.22E-03	1.84E-03	3.73E-03	5.16E-04	1.12E-06	1.67E-06	3.36E-06	4.88E-07	9.56E-05	1.44E-04	2.93E-04	4.05E-05
Total of 2,4' and 4,4'-DDT	3.60E-04	5.78E-04	9.12E-04	1.27E-04	2.15E-03	3.54E-03	5.63E-03	6.69E-04	2.17E-06	3.42E-06	5.29E-06	8.57E-07	1.68E-04	2.78E-04	4.42E-04	5.27E-05
Total DDx	8.27E-04	9.93E-04	1.29E-03	4.50E-04	5.13E-03	6.18E-03	8.02E-03	2.75E-03	5.12E-06	6.05E-06	7.69E-06	2.98E-06	4.03E-04	4.85E-04	6.29E-04	2.16E-04
Total Chlordanes	5.56E-04	5.88E-04	8.36E-04	2.87E-04	3.39E-03	3.59E-03	5.18E-03	1.67E-03	3.06E-06	3.23E-06	4.65E-06	1.52E-06	2.66E-04	2.82E-04	4.06E-04	1.31E-04
γ-Hexachlorocyclohexane	1.78E-04	1.93E-04	3.12E-04	9.51E-05	1.13E-03	1.22E-03	1.97E-03	5.98E-04	1.02E-06	1.10E-06	1.77E-06	5.43E-07	8.85E-05	9.56E-05	1.55E-04	4.69E-05
Hexachlorobenzene	6.80E-05	1.78E-03	6.98E-03	4.62E-06	4.07E-04	1.14E-02	4.48E-02	2.97E-05	3.73E-07	1.02E-05	4.00E-05	2.65E-08	3.19E-05	8.98E-04	3.51E-03	2.33E-06
Aldrin	9.75E-05	9.46E-05	1.87E-04	5.01E-05	6.12E-04	5.90E-04	1.18E-03	3.08E-04	5.63E-07	5.44E-07	1.07E-06	2.92E-07	4.80E-05	4.63E-05	9.23E-05	2.42E-05
Dieldrin	9.55E-05	1.32E-04	2.35E-04	4.38E-05	5.66E-04	8.00E-04	1.45E-03	2.38E-04	5.33E-07	7.41E-07	1.32E-06	2.40E-07	4.44E-05	6.27E-05	1.14E-04	1.87E-05
PAHs																
Naphthalene	6.43E-03	1.06E-02	1.45E-02	3.76E-03	1.85E-02	4.35E-02	6.48E-02	5.12E-03	8.43E-05	1.07E-04	1.26E-04	7.24E-05	1.49E-03	3.46E-03	5.13E-03	4.47E-04
Benzo(a)pyrene	7.22E-03	1.01E-02	2.25E-02	4.16E-03	1.36E-01	1.49E-01	2.04E-01	1.23E-01	3.57E-05	5.17E-05	1.21E-04	2.03E-05	1.81E-03	3.21E-03	9.28E-03	4.54E-04
Total Carcinogenic PAHs BaPEq	1.11E-02	1.62E-02	3.61E-02	5.96E-03	2.58E-01	2.81E-01	3.69E-01	2.38E-01	4.16E-05	7.01E-05	1.80E-04	1.66E-05	2.67E-03	5.17E-03	1.48E-02	4.74E-04
Total PAHs	1.68E-01	2.11E-01	4.80E-01	7.26E-02	3.15E+00	3.33E+00	4.51E+00	2.77E+00	6.35E-04	8.56E-04	2.33E-03	1.55E-04	4.87E-02	6.81E-02	1.97E-01	6.56E-03
Phthalates																
Bis(2-ethylhexyl)phthalate	1.91E-01	2.48E-01	3.37E-01	1.20E-01	8.95E-01	1.25E+00	1.79E+00	4.56E-01	2.88E-03	3.20E-03	3.68E-03	2.49E-03	7.16E-02	9.93E-02	1.42E-01	3.72E-02

Table E3-5a. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Composite Runoff.

	RM 2-3.3 E FT41				RM 1-2 W FT42				RM 1-2 E FT44			
Analyte	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**
Metals												
Arsenic	3.99E-01	1.40E+00	2.54E+00	4.20E-02	2.89E-03	2.89E-03	2.89E-03	2.89E-03	8.15E-02	2.86E-01	5.19E-01	8.58E-03
Chromium	1.89E+01	1.92E+01	2.00E+01	1.84E+01	2.38E-02	2.38E-02	2.38E-02	2.38E-02	2.88E-01	3.98E-01	6.89E-01	1.12E-01
Copper	8.13E+00	1.33E+01	2.12E+01	2.16E+00	2.42E-02	2.42E-02	2.42E-02	2.42E-02	1.66E+00	2.72E+00	4.34E+00	4.41E-01
Lead	4.92E+00	1.07E+01	1.81E+01	1.25E+00	1.11E-02	1.11E-02	1.11E-02	1.11E-02	1.01E+00	2.19E+00	3.70E+00	2.56E-01
Mercury	7.53E-03	1.14E-02	2.64E-02	2.12E-03	2.08E-04	2.08E-04	2.08E-04	2.08E-04	1.54E-03	2.34E-03	5.39E-03	4.32E-04
Nickel	1.80E+00	2.43E+00	3.94E+00	7.55E-01	2.00E-02	2.00E-02	2.00E-02	2.00E-02	3.68E-01	4.97E-01	8.06E-01	1.54E-01
Zinc	6.99E+01	9.31E+01	1.41E+02	3.32E+01	1.17E-01	1.17E-01	1.17E-01	1.17E-01	1.43E+01	1.90E+01	2.88E+01	6.79E+00
PCBs												
PCB077	4.40E-05	1.37E-04	3.95E-04	3.50E-06	3.67E-08	3.67E-08	3.67E-08	3.67E-08	8.98E-06	2.79E-05	8.07E-05	7.15E-07
PCB081	1.01E-06	1.66E-06	5.46E-06	3.02E-07	1.37E-08	1.37E-08	1.37E-08	1.37E-08	2.07E-07	3.39E-07	1.11E-06	6.17E-08
PCB105	3.00E-04	8.80E-04	2.95E-03	1.90E-05	1.55E-07	1.55E-07	1.55E-07	1.55E-07	6.13E-05	1.80E-04	6.03E-04	3.89E-06
PCB118	6.79E-04	2.04E-03	6.16E-03	3.77E-05	3.99E-07	3.99E-07	3.99E-07	3.99E-07	1.39E-04	4.18E-04	1.26E-03	7.71E-06
PCB126	9.64E-06	1.94E-05	8.41E-05	1.35E-06	4.06E-08	4.06E-08	4.06E-08	4.06E-08	1.97E-06	3.97E-06	1.72E-05	2.76E-07
PCB156 & PCB157	1.26E-04	3.46E-04	1.15E-03	8.29E-06	6.79E-08	6.79E-08	6.79E-08	6.79E-08	2.58E-05	7.07E-05	2.36E-04	1.69E-06
PCB169	1.57E-06	1.39E-06	1.11E-05	1.06E-06	2.32E-08	2.32E-08	2.32E-08	2.32E-08	3.21E-07	2.84E-07	2.26E-06	2.16E-07
Total PCBs	2.01E-02	5.95E-02	1.76E-01	9.31E-04	3.99E-06	3.99E-06	3.99E-06	3.99E-06	4.11E-03	1.22E-02	3.59E-02	1.90E-04
PCB TEQ	4.79E-07	2.00E-06	8.57E-06	1.11E-09	7.81E-12	7.81E-12	7.81E-12	7.81E-12	9.79E-08	4.08E-07	1.75E-06	2.26E-10
Pesticides												
4,4'-DDD	5.59E-04	6.05E-04	8.42E-04	3.90E-04	5.57E-08	5.57E-08	5.57E-08	5.57E-08	1.14E-04	1.24E-04	1.72E-04	7.97E-05
4,4'-DDT	1.86E-03	2.17E-03	2.94E-03	1.13E-03	4.45E-07	4.45E-07	4.45E-07	4.45E-07	3.80E-04	4.44E-04	6.02E-04	2.31E-04
Total of 2,4' and 4,4'-DDE	3.73E-04	5.03E-04	9.28E-04	1.54E-04	5.57E-07	5.57E-07	5.57E-07	5.57E-07	7.63E-05	1.03E-04	1.90E-04	3.15E-05
Total of 2,4' and 4,4'-DDD	6.94E-04	1.05E-03	2.13E-03	2.94E-04	5.57E-08	5.57E-08	5.57E-08	5.57E-08	1.42E-04	2.14E-04	4.35E-04	6.00E-05
Total of 2,4' and 4,4'-DDT	1.22E-03	2.02E-03	3.21E-03	3.81E-04	5.29E-07	5.29E-07	5.29E-07	5.29E-07	2.50E-04	4.12E-04	6.56E-04	7.79E-05
Total DDx	2.93E-03	3.52E-03	4.57E-03	1.56E-03	1.09E-06	1.09E-06	1.09E-06	1.09E-06	5.98E-04	7.20E-04	9.34E-04	3.20E-04
Total Chlordanes	1.93E-03	2.05E-03	2.95E-03	9.51E-04	5.57E-08	5.57E-08	5.57E-08	5.57E-08	3.95E-04	4.18E-04	6.03E-04	1.94E-04
γ-Hexachlorocyclohexane	6.43E-04	6.95E-04	1.12E-03	3.41E-04	1.81E-08	1.81E-08	1.81E-08	1.81E-08	1.31E-04	1.42E-04	2.30E-04	6.96E-05
Hexachlorobenzene	2.32E-04	6.52E-03	2.55E-02	1.69E-05	1.95E-08	6.69E-30	9.55E-23	1.36E-15	4.73E-05	1.33E-03	5.22E-03	3.45E-06
Aldrin	3.48E-04	3.36E-04	6.70E-04	1.76E-04	3.34E-08	3.34E-08	3.34E-08	3.34E-08	7.12E-05	6.87E-05	1.37E-04	3.59E-05
Dieldrin	3.23E-04	4.56E-04	8.25E-04	1.36E-04	5.57E-08	5.57E-08	5.57E-08	5.57E-08	6.59E-05	9.31E-05	1.69E-04	2.77E-05
PAHs												
Naphthalene	1.05E-02	2.48E-02	3.69E-02	2.91E-03	1.39E-04	1.39E-04	1.39E-04	1.39E-04	2.15E-03	5.06E-03	7.55E-03	5.96E-04
Benzo(a)pyrene	1.31E-02	2.32E-02	6.74E-02	3.23E-03	3.12E-05	3.12E-05	3.12E-05	3.12E-05	2.67E-03	4.75E-03	1.38E-02	6.59E-04
Total Carcinogenic PAHs BaPEq	1.94E-02	3.75E-02	1.07E-01	3.38E-03	2.30E-05	2.30E-05	2.30E-05	2.30E-05	3.96E-03	7.67E-03	2.20E-02	6.91E-04
Total PAHs	3.53E-01	4.94E-01	1.43E+00	4.72E-02	1.66E-04	1.66E-04	1.66E-04	1.66E-04	7.22E-02	1.01E-01	2.93E-01	9.65E-03
Phthalates												
Bis(2-ethylhexyl)phthalate	5.10E-01	7.11E-01	1.02E+00	2.60E-01	4.25E-03	4.25E-03	4.25E-03	4.25E-03	1.04E-01	1.45E-01	2.09E-01	5.31E-02

Notes:

All calculations based on 50th Percentile Flow Year (2002).

The values presented in these tables are preliminary and will change slightly before the Final RI Report. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

-- = Analyte not sampled
BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
EPA - U.S. Environmental Protection Agency
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
RM - river mile
TEQ - toxic equivalent concentration

Table E3-5b. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Outfall Sediment Traps (Non-normalized)

	Study Area FT01 - FT44				RM 11-11.7 W FT01				RM 11-11.7 E FT03				RM 10.3-11 W FT04			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	4.20E+00	6.77E+00	1.61E+01	1.57E+00	1.13E-01	1.36E-01	1.79E-01	8.52E-02	1.32E-01	1.56E-01	2.15E-01	1.03E-01	6.36E-02	1.05E-01	2.50E-01	2.17E-02
Chromium	4.65E+01	4.19E+01	8.77E+01	3.75E+01	1.83E+00	1.90E+00	2.27E+00	1.57E+00	2.37E+00	2.40E+00	2.89E+00	2.09E+00	3.27E-01	2.65E-01	1.01E+00	1.79E-01
Copper	2.98E+02	3.10E+02	4.01E+02	2.77E+02	2.66E+00	2.87E+00	3.34E+00	2.32E+00	3.43E+00	3.61E+00	4.22E+00	3.12E+00	6.64E-01	8.76E-01	2.36E+00	3.04E-01
Lead	1.13E+02	1.17E+02	2.72E+02	7.10E+01	5.68E+00	5.80E+00	7.28E+00	4.65E+00	7.64E+00	7.67E+00	9.89E+00	6.29E+00	1.20E+00	1.29E+00	3.66E+00	5.81E-01
Mercury	9.34E-02	1.12E-01	1.49E-01	7.35E-02	3.21E-03	3.46E-03	4.24E-03	2.60E-03	3.48E-03	3.92E-03	4.87E-03	2.74E-03	9.54E-04	1.22E-03	1.79E-03	6.53E-04
Nickel	1.77E+01	1.62E+01	4.19E+01	1.03E+01	7.65E-01	8.34E-01	9.94E-01	6.51E-01	9.50E-01	9.93E-01	1.18E+00	8.45E-01	2.42E-01	2.26E-01	6.41E-01	1.16E-01
Zinc	4.80E+02	5.97E+02	7.61E+02	3.15E+02	1.63E+01	1.77E+01	2.02E+01	1.39E+01	2.07E+01	2.20E+01	2.45E+01	1.84E+01	5.29E+00	7.27E+00	1.00E+01	2.50E+00
PCBs																
PCB077	7.04E-04	8.97E-04	1.78E-03	4.62E-04	1.08E-05	1.12E-05	2.27E-05	6.71E-06	1.42E-05	1.50E-05	3.23E-05	8.61E-06	4.84E-06	7.90E-06	2.11E-05	1.15E-06
PCB081	9.45E-05	1.28E-04	2.21E-04	7.10E-05	8.05E-07	9.83E-07	2.01E-06	4.11E-07	1.04E-06	1.34E-06	2.87E-06	4.92E-07	4.48E-07	9.67E-07	2.41E-06	8.75E-08
PCB105	5.63E-03	7.28E-03	1.31E-02	4.18E-03	7.15E-05	8.42E-05	1.77E-04	3.86E-05	8.39E-05	9.65E-05	2.10E-04	4.62E-05	3.20E-05	5.91E-05	1.51E-04	8.66E-06
PCB118	1.16E-02	1.57E-02	3.03E-02	8.32E-03	1.69E-04	2.01E-04	4.25E-04	9.17E-05	1.96E-04	2.29E-04	5.01E-04	1.09E-04	7.50E-05	1.43E-04	3.73E-04	2.21E-05
PCB126	1.10E-04	1.28E-04	3.37E-04	7.49E-05	1.75E-06	1.74E-06	3.30E-06	1.09E-06	2.23E-06	2.21E-06	4.58E-06	1.35E-06	9.28E-07	1.23E-06	4.49E-06	3.96E-07
PCB156 & PCB157	1.92E-03	2.48E-03	5.05E-03	1.40E-03	2.44E-05	2.59E-05	5.20E-05	1.48E-05	2.95E-05	3.18E-05	6.84E-05	1.77E-05	1.23E-05	2.12E-05	6.11E-05	4.06E-06
PCB169	6.53E-06	6.69E-06	2.42E-05	3.93E-06	2.37E-07	2.85E-07	4.36E-07	1.79E-07	2.64E-07	3.38E-07	5.96E-07	1.71E-07	8.47E-08	8.15E-08	3.37E-07	5.03E-08
Total PCBs	3.37E-01	4.34E-01	7.59E-01	2.45E-01	4.33E-03	4.83E-03	1.02E-02	2.49E-03	5.45E-03	6.05E-03	1.32E-02	3.17E-03	2.06E-03	3.63E-03	8.58E-03	6.09E-04
PCB TEQ	8.22E-06	1.31E-05	3.52E-05	5.54E-06	1.46E-07	1.68E-07	3.40E-07	9.16E-08	1.74E-07	2.12E-07	4.73E-07	1.07E-07	4.96E-08	1.25E-07	4.69E-07	7.21E-09
Pesticides																
4,4'-DDD	3.37E-02	3.46E-02	4.30E-02	3.23E-02	9.39E-05	1.61E-04	3.84E-04	5.07E-05	9.92E-05	1.51E-04	3.80E-04	5.83E-05	4.82E-05	6.69E-05	2.06E-04	2.31E-05
4,4'-DDT	1.40E-01	1.44E-01	2.15E-01	1.29E-01	7.45E-04	8.57E-04	1.68E-03	4.16E-04	6.24E-04	7.15E-04	1.55E-03	3.52E-04	2.66E-04	3.49E-04	1.50E-03	8.03E-05
Total of 2,4' and 4,4'-DDE	8.69E-02	8.73E-02	9.73E-02	8.44E-02	2.99E-04	4.08E-04	8.14E-04	1.55E-04	2.70E-04	3.47E-04	6.84E-04	1.48E-04	7.44E-05	9.12E-05	2.78E-04	2.60E-05
Total of 2,4' and 4,4'-DDD	5.00E-02	5.00E-02	6.23E-02	4.68E-02	1.73E-04	2.48E-04	5.52E-04	8.63E-05	1.68E-04	2.19E-04	5.13E-04	8.80E-05	8.38E-05	9.11E-05	2.98E-04	2.79E-05
Total of 2,4' and 4,4'-DDT	2.19E-01	2.29E-01	3.70E-01	2.04E-01	8.20E-04	9.99E-04	2.13E-03	4.32E-04	6.93E-04	8.47E-04	2.13E-03	3.64E-04	3.47E-04	5.18E-04	2.78E-03	8.95E-05
Total DDX	3.59E-01	3.66E-01	5.11E-01	3.38E-01	1.21E-03	1.56E-03	3.32E-03	5.89E-04	9.92E-04	1.26E-03	3.03E-03	4.69E-04	5.41E-04	6.84E-04	3.06E-03	1.69E-04
Total Chlordanes	8.50E-03	1.28E-02	1.66E-02	5.93E-03	3.05E-04	3.59E-04	4.32E-04	2.28E-04	3.48E-04	4.12E-04	4.87E-04	2.67E-04	6.90E-05	1.37E-04	1.99E-04	2.71E-05
γ-Hexachlorocyclohexane	1.57E-03	2.01E-03	6.22E-03	5.63E-04	7.07E-05	1.07E-04	2.51E-04	3.71E-05	8.27E-05	1.07E-04	2.58E-04	4.53E-05	2.33E-05	3.41E-05	1.02E-04	7.64E-06
Hexachlorobenzene	1.39E-03	1.53E-03	4.44E-03	5.54E-04	1.25E-04	1.31E-04	2.56E-04	7.62E-05	1.14E-04	1.20E-04	2.62E-04	6.81E-05	2.77E-05	3.03E-05	7.42E-05	1.28E-05
Aldrin	1.67E-03	2.18E-03	9.52E-03	1.03E-03	3.36E-05	8.78E-05	2.14E-04	2.23E-05	4.06E-05	7.88E-05	2.06E-04	2.63E-05	1.38E-05	2.70E-05	1.47E-04	4.16E-06
Dieldrin	7.61E-03	7.60E-03	1.06E-02	6.75E-03	1.29E-04	1.36E-04	2.63E-04	7.97E-05	1.28E-04	1.31E-04	2.73E-04	8.11E-05	2.67E-05	2.75E-05	7.42E-05	1.14E-05
PAHs																
Naphthalene	3.69E-02	1.42E-01	1.41E+00	1.80E-02	3.04E-03	3.14E-03	5.70E-03	2.86E-03	4.43E-03	4.74E-03	1.05E-02	4.14E-03	3.88E-04	2.00E-03	2.14E-02	1.16E-04
Benzo(a)pyrene	7.17E-01	8.66E-01	1.86E+00	4.90E-01	2.40E-02	2.26E-02	3.11E-02	2.05E-02	2.99E-02	2.80E-02	4.26E-02	2.43E-02	5.48E-03	8.08E-03	2.31E-02	2.24E-03
Total Carcinogenic PAHs BaPEq	1.06E+00	1.34E+00	2.86E+00	7.27E-01	3.59E-02	3.32E-02	5.05E-02	2.90E-02	4.50E-02	4.13E-02	7.01E-02	3.40E-02	7.48E-03	1.23E-02	3.48E-02	2.92E-03
Total PAHs	1.27E+01	1.52E+01	1.43E+02	5.82E+00	3.08E-01	2.95E-01	5.91E-01	2.65E-01	4.14E-01	3.98E-01	1.04E+00	3.38E-01	1.32E-01	1.74E-01	2.20E+00	2.73E-02
Phthalates																
Bis(2-ethylhexyl)phthalate	5.26E+00	5.30E+00	2.61E+01	2.63E+00	3.63E-01	3.50E-01	4.50E-01	3.29E-01	4.97E-01	4.78E-01	6.60E-01	4.41E-01	6.05E-02	6.27E-02	3.75E-01	2.35E-02

Table E3-5b. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Outfall Sediment Traps (Non-normalized)

	RM 10.3-11 E FT06				RM 9.9-10.3 W FT07				RM 10-10.3 E FT09				RM 9.4-9.9 W FT10			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	1.47E-01	2.45E-01	6.03E-01	4.86E-02	7.66E-02	1.30E-01	3.30E-01	2.23E-02	9.35E-02	1.59E-01	4.01E-01	2.75E-02	6.18E-01	1.03E+00	2.56E+00	1.99E-01
Chromium	6.65E-01	4.80E-01	2.28E+00	3.49E-01	2.79E-01	1.71E-01	1.17E+00	1.13E-01	3.48E-01	2.17E-01	1.43E+00	1.46E-01	2.57E+00	1.76E+00	9.41E+00	1.26E+00
Copper	1.57E+00	2.04E+00	5.67E+00	7.47E-01	7.11E-01	9.69E-01	2.98E+00	2.66E-01	8.68E-01	1.18E+00	3.63E+00	3.28E-01	6.10E+00	8.11E+00	2.36E+01	2.65E+00
Lead	2.38E+00	2.58E+00	8.32E+00	1.01E+00	1.07E+00	1.18E+00	4.35E+00	3.43E-01	1.33E+00	1.46E+00	5.31E+00	4.39E-01	9.07E+00	9.92E+00	3.43E+01	3.37E+00
Mercury	1.90E-03	2.55E-03	3.85E-03	1.26E-03	9.05E-04	1.26E-03	1.96E-03	5.68E-04	1.11E-03	1.54E-03	2.39E-03	6.99E-04	7.73E-03	1.04E-02	1.59E-02	5.07E-03
Nickel	5.60E-01	4.97E-01	1.51E+00	2.72E-01	2.69E-01	2.31E-01	7.89E-01	1.13E-01	3.30E-01	2.83E-01	9.61E-01	1.40E-01	2.28E+00	2.00E+00	6.29E+00	1.06E+00
Zinc	1.23E+01	1.69E+01	2.33E+01	5.89E+00	5.93E+00	8.45E+00	1.19E+01	2.43E+00	7.23E+00	1.03E+01	1.45E+01	2.98E+00	4.91E+01	6.86E+01	9.53E+01	2.19E+01
PCBs																
PCB077	1.16E-05	1.92E-05	5.12E-05	2.70E-06	5.84E-06	1.01E-05	2.76E-05	1.07E-06	7.11E-06	1.23E-05	3.36E-05	1.31E-06	4.69E-05	7.96E-05	2.15E-04	9.78E-06
PCB081	1.07E-06	2.38E-06	5.97E-06	1.87E-07	5.56E-07	1.28E-06	3.23E-06	8.15E-08	6.77E-07	1.55E-06	3.93E-06	1.01E-07	4.45E-06	1.00E-05	2.51E-05	7.51E-07
PCB105	7.16E-05	1.37E-04	3.52E-04	1.88E-05	3.62E-05	7.21E-05	1.89E-04	8.17E-06	4.41E-05	8.77E-05	2.30E-04	9.98E-06	2.91E-04	5.68E-04	1.48E-03	7.17E-05
PCB118	1.67E-04	3.29E-04	8.67E-04	4.85E-05	8.46E-05	1.74E-04	4.66E-04	2.15E-05	1.03E-04	2.12E-04	5.67E-04	2.62E-05	6.81E-04	1.37E-03	3.64E-03	1.86E-04
PCB126	2.18E-06	2.93E-06	1.10E-05	9.18E-07	1.12E-06	1.55E-06	5.99E-06	4.50E-07	1.37E-06	1.88E-06	7.28E-06	5.49E-07	8.96E-06	1.22E-05	4.63E-05	3.70E-06
PCB156 & PCB157	2.82E-05	5.02E-05	1.47E-04	9.06E-06	1.44E-05	2.68E-05	7.99E-05	4.17E-06	1.76E-05	3.26E-05	9.72E-05	5.09E-06	1.15E-04	2.10E-04	6.19E-04	3.53E-05
PCB169	2.07E-07	1.94E-07	8.31E-07	1.21E-07	1.02E-07	9.31E-08	4.44E-07	5.71E-08	1.27E-07	1.16E-07	5.43E-07	7.20E-08	9.43E-07	8.77E-07	3.58E-06	5.90E-07
Total PCBs	4.80E-03	8.63E-03	2.03E-02	1.43E-03	2.44E-03	4.57E-03	1.09E-02	6.42E-04	2.98E-03	5.56E-03	1.33E-02	7.83E-04	1.96E-02	3.59E-02	8.49E-02	5.50E-03
PCB TEQ	1.11E-07	3.00E-07	1.14E-06	1.17E-08	5.37E-08	1.59E-07	6.25E-07	5.81E-10	6.53E-08	1.93E-07	7.60E-07	7.44E-10	4.42E-07	1.25E-06	4.83E-06	2.58E-08
Pesticides																
4,4'-DDD	1.05E-04	1.33E-04	4.30E-04	5.25E-05	5.41E-05	6.66E-05	2.24E-04	2.65E-05	6.58E-05	8.11E-05	2.72E-04	3.23E-05	4.32E-04	5.41E-04	1.78E-03	2.15E-04
4,4'-DDT	4.82E-04	6.61E-04	3.35E-03	1.07E-04	2.34E-04	3.29E-04	1.80E-03	3.83E-05	2.85E-04	4.00E-04	2.19E-03	4.70E-05	1.94E-03	2.69E-03	1.41E-02	3.87E-04
Total of 2,4' and 4,4'-DDE	1.22E-04	1.32E-04	4.91E-04	3.87E-05	5.35E-05	5.41E-05	2.37E-04	1.33E-05	6.56E-05	6.64E-05	2.89E-04	1.66E-05	4.80E-04	5.05E-04	1.97E-03	1.48E-04
Total of 2,4' and 4,4'-DDD	1.73E-04	1.69E-04	6.15E-04	5.52E-05	8.88E-05	8.29E-05	3.19E-04	2.64E-05	1.08E-04	1.01E-04	3.89E-04	3.22E-05	7.12E-04	6.81E-04	2.54E-03	2.20E-04
Total of 2,4' and 4,4'-DDT	6.69E-04	1.05E-03	6.49E-03	1.25E-04	3.35E-04	5.41E-04	3.54E-03	4.80E-05	4.08E-04	6.57E-04	4.30E-03	5.88E-05	2.73E-03	4.33E-03	2.75E-02	4.66E-04
Total DDX	1.04E-03	1.30E-03	6.85E-03	2.76E-04	5.28E-04	6.58E-04	3.69E-03	1.26E-04	6.43E-04	8.01E-04	4.48E-03	1.54E-04	4.29E-03	5.35E-03	2.88E-02	1.10E-03
Total Chlordanes	1.32E-04	2.92E-04	4.32E-04	4.34E-05	5.75E-05	1.45E-04	2.20E-04	1.12E-05	7.04E-05	1.77E-04	2.69E-04	1.41E-05	4.98E-04	1.18E-03	1.76E-03	1.33E-04
γ-Hexachlorocyclohexane	4.59E-05	6.18E-05	2.00E-04	1.35E-05	2.27E-05	2.99E-05	1.01E-04	5.90E-06	2.78E-05	3.65E-05	1.24E-04	7.33E-06	1.84E-04	2.46E-04	8.13E-04	5.09E-05
Hexachlorobenzene	4.10E-05	4.59E-05	1.31E-04	1.56E-05	1.69E-05	1.93E-05	6.21E-05	4.79E-06	2.07E-05	2.37E-05	7.61E-05	5.89E-06	1.52E-04	1.72E-04	5.16E-04	5.20E-05
Aldrin	2.99E-05	4.70E-05	3.18E-04	7.59E-06	1.52E-05	2.22E-05	1.68E-04	3.11E-06	1.86E-05	2.71E-05	2.05E-04	3.86E-06	1.22E-04	1.86E-04	1.32E-03	2.86E-05
Dieldrin	4.17E-05	4.15E-05	1.32E-04	1.54E-05	1.69E-05	1.64E-05	6.21E-05	4.35E-06	2.08E-05	2.02E-05	7.62E-05	5.42E-06	1.54E-04	1.52E-04	5.19E-04	5.04E-05
PAHs																
Naphthalene	1.07E-03	5.13E-03	5.37E-02	4.00E-04	3.93E-04	2.67E-03	2.98E-02	2.46E-05	4.82E-04	3.25E-03	3.62E-02	3.41E-05	3.70E-03	2.11E-02	2.29E-01	8.75E-04
Benzo(a)pyrene	1.11E-02	1.78E-02	5.48E-02	3.27E-03	4.97E-03	8.79E-03	2.93E-02	7.10E-04	6.11E-03	1.07E-02	3.57E-02	9.12E-04	4.23E-02	7.14E-02	2.29E-01	9.50E-03
Total Carcinogenic PAHs BaPEq	1.46E-02	2.70E-02	8.19E-02	3.84E-03	6.37E-03	1.34E-02	4.36E-02	5.73E-04	7.86E-03	1.64E-02	5.32E-02	7.66E-04	5.49E-02	1.09E-01	3.41E-01	1.01E-02
Total PAHs	3.08E-01	4.16E-01	5.49E+00	4.88E-02	1.56E-01	2.17E-01	3.06E+00	1.22E-02	1.91E-01	2.65E-01	3.71E+00	1.54E-02	1.25E+00	1.72E+00	2.34E+01	1.46E-01
Phthalates																
Bis(2-ethylhexyl)phthalate	1.39E-01	1.46E-01	9.25E-01	4.98E-02	5.63E-02	6.06E-02	4.94E-01	7.20E-03	6.92E-02	7.44E-02	6.01E-01	9.33E-03	5.03E-01	5.35E-01	3.85E+00	1.25E-01

Table E3-5b. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Outfall Sediment Traps (Non-normalized)

	RM 9.3-10 E FT12				RM 8.2-9.4 W FT13				RM 8.2-9.4 E FT15				RM 8.2-9.2 E FT16			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	8.34E-03	9.47E-03	1.33E-02	6.68E-03	7.61E-01	1.28E+00	3.21E+00	2.35E-01	6.55E-02	1.04E-01	2.45E-01	2.60E-02	2.00E-01	2.47E-01	4.12E-01	1.42E-01
Chromium	2.60E-01	2.54E-01	3.08E-01	2.29E-01	2.98E+00	1.93E+00	1.16E+01	1.37E+00	6.14E-01	5.30E-01	1.29E+00	4.50E-01	5.25E+00	5.08E+00	6.60E+00	4.55E+00
Copper	1.34E-01	1.39E-01	1.72E-01	1.25E-01	7.56E+00	1.01E+01	2.96E+01	3.25E+00	7.00E-01	8.82E-01	2.30E+00	3.84E-01	2.98E+00	3.20E+00	4.76E+00	2.60E+00
Lead	1.03E+00	1.01E+00	1.35E+00	8.22E-01	1.09E+01	1.19E+01	4.26E+01	3.83E+00	2.41E+00	2.45E+00	5.15E+00	1.58E+00	2.08E+01	2.04E+01	2.84E+01	1.63E+01
Mercury	2.76E-04	3.65E-04	4.91E-04	1.69E-04	9.13E-03	1.25E-02	1.93E-02	5.86E-03	1.06E-03	1.45E-03	2.13E-03	6.60E-04	5.89E-03	7.80E-03	1.06E-02	3.64E-03
Nickel	5.51E-02	5.43E-02	6.43E-02	5.18E-02	2.77E+00	2.40E+00	7.82E+00	1.26E+00	2.72E-01	2.45E-01	6.39E-01	1.61E-01	1.21E+00	1.18E+00	1.63E+00	1.07E+00
Zinc	9.71E-01	9.99E-01	1.13E+00	8.55E-01	6.11E+01	8.55E+01	1.19E+02	2.71E+01	5.60E+00	7.35E+00	9.90E+00	3.04E+00	2.19E+01	2.37E+01	2.79E+01	1.80E+01
PCBs																
PCB077	7.59E-07	8.35E-07	3.29E-06	1.87E-07	5.89E-05	1.00E-04	2.70E-04	1.22E-05	5.20E-06	8.22E-06	2.41E-05	1.03E-06	1.76E-05	2.10E-05	7.69E-05	4.25E-06
PCB081	6.56E-08	7.02E-08	1.71E-07	3.19E-08	5.54E-06	1.26E-05	3.17E-05	8.74E-07	4.83E-07	9.80E-07	2.47E-06	1.07E-07	1.55E-06	1.96E-06	4.81E-06	6.69E-07
PCB105	4.61E-06	4.83E-06	1.72E-05	1.36E-06	3.61E-04	7.09E-04	1.85E-03	8.77E-05	3.21E-05	5.67E-05	1.56E-04	7.75E-06	1.08E-04	1.29E-04	4.25E-04	3.10E-05
PCB118	1.03E-05	1.13E-05	4.09E-05	2.88E-06	8.44E-04	1.71E-03	4.55E-03	2.29E-04	7.41E-05	1.36E-04	3.83E-04	1.93E-05	2.43E-04	3.04E-04	1.02E-03	6.79E-05
PCB126	1.48E-07	1.33E-07	3.88E-07	6.32E-08	1.12E-05	1.53E-05	5.84E-05	4.59E-06	1.00E-06	1.26E-06	4.69E-06	4.08E-07	3.43E-06	3.33E-06	1.03E-05	1.46E-06
PCB156 & PCB157	1.59E-06	1.66E-06	6.11E-06	5.12E-07	1.44E-04	2.63E-04	7.79E-04	4.36E-05	1.24E-05	2.08E-05	6.41E-05	3.66E-06	3.80E-05	4.51E-05	1.56E-04	1.22E-05
PCB169	2.13E-08	3.73E-08	7.24E-08	9.60E-09	1.06E-06	9.75E-07	4.39E-06	6.17E-07	1.04E-07	1.24E-07	4.19E-07	5.39E-08	4.67E-07	7.77E-07	1.62E-06	2.18E-07
Total PCBs	2.98E-04	3.28E-04	1.28E-03	8.30E-05	2.45E-02	4.51E-02	1.07E-01	6.86E-03	2.14E-03	3.63E-03	9.46E-03	5.70E-04	7.01E-03	8.56E-03	3.00E-02	1.95E-03
PCB TEQ	5.19E-09	1.03E-08	4.02E-08	8.45E-10	5.49E-07	1.57E-06	6.10E-06	2.77E-08	4.48E-08	1.24E-07	4.89E-07	1.77E-09	1.29E-07	2.77E-07	1.07E-06	1.89E-08
Pesticides																
4,4'-DDD	4.78E-06	5.87E-06	2.76E-05	1.83E-06	5.33E-04	6.55E-04	2.18E-03	2.66E-04	4.44E-05	5.47E-05	1.97E-04	2.09E-05	1.21E-04	1.50E-04	6.53E-04	4.88E-05
4,4'-DDT	1.30E-05	1.38E-05	5.90E-05	5.14E-06	2.30E-03	3.22E-03	1.75E-02	4.01E-04	1.80E-04	2.45E-04	1.32E-03	3.43E-05	3.90E-04	4.53E-04	2.02E-03	1.34E-04
Total of 2,4' and 4,4'-DDE	1.17E-05	1.15E-05	2.36E-05	5.29E-06	5.39E-04	5.46E-04	2.32E-03	1.49E-04	5.53E-05	5.53E-05	1.99E-04	1.76E-05	2.64E-04	2.65E-04	6.01E-04	1.15E-04
Total of 2,4' and 4,4'-DDD	8.23E-06	7.79E-06	2.94E-05	3.54E-06	8.71E-04	8.14E-04	3.11E-03	2.65E-04	7.36E-05	6.89E-05	2.64E-04	2.37E-05	2.07E-04	1.99E-04	7.38E-04	8.37E-05
Total of 2,4' and 4,4'-DDT	1.54E-05	1.85E-05	9.51E-05	5.30E-06	3.28E-03	5.27E-03	3.44E-02	4.96E-04	2.52E-04	3.96E-04	2.55E-03	4.11E-05	4.85E-04	6.43E-04	3.51E-03	1.43E-04
Total DDX	2.51E-05	2.71E-05	1.17E-04	7.70E-06	5.15E-03	6.41E-03	3.58E-02	1.25E-03	3.98E-04	4.90E-04	2.69E-03	9.77E-05	7.77E-04	8.90E-04	4.06E-03	2.32E-04
Total Chlordanes	2.23E-05	2.92E-05	3.56E-05	1.38E-05	1.57E-03	2.38E-03	3.07E-03	1.14E-03	7.53E-05	1.46E-04	2.07E-04	3.01E-05	4.69E-04	6.46E-04	8.06E-04	2.80E-04
γ-Hexachlorocyclohexane	1.06E-05	9.60E-06	2.62E-05	5.91E-06	2.22E-04	2.92E-04	9.85E-04	5.93E-05	3.26E-05	3.59E-05	1.11E-04	1.36E-05	2.19E-04	2.05E-04	5.66E-04	1.19E-04
Hexachlorobenzene	5.61E-06	6.09E-06	2.53E-05	1.68E-06	1.69E-04	1.93E-04	6.09E-04	5.21E-05	2.06E-05	2.31E-05	8.35E-05	5.98E-06	1.22E-04	1.33E-04	5.31E-04	3.79E-05
Aldrin	4.39E-06	4.01E-06	1.32E-05	2.39E-06	1.50E-04	2.18E-04	1.64E-03	3.29E-05	1.75E-05	2.16E-05	1.36E-04	6.00E-06	9.35E-05	9.17E-05	3.41E-04	4.86E-05
Dieldrin	7.59E-06	7.07E-06	2.53E-05	3.49E-06	1.74E-04	1.69E-04	6.12E-04	5.15E-05	2.39E-05	2.27E-05	8.35E-05	8.64E-06	1.60E-04	1.50E-04	5.32E-04	7.26E-05
PAHs																
Naphthalene	2.08E-04	2.16E-04	7.44E-04	1.54E-04	4.75E-03	2.68E-02	2.90E-01	1.19E-03	6.06E-04	2.16E-03	2.14E-02	2.68E-04	4.27E-03	5.43E-03	2.78E-02	3.05E-03
Benzo(a)pyrene	2.79E-03	2.30E-03	4.86E-03	1.72E-03	5.12E-02	8.82E-02	2.87E-01	9.91E-03	7.93E-03	9.70E-03	2.78E-02	3.29E-03	5.74E-02	4.93E-02	1.09E-01	3.44E-02
Total Carcinogenic PAHs BaPEq	4.58E-03	3.62E-03	8.95E-03	2.40E-03	6.59E-02	1.34E-01	4.27E-01	9.70E-03	1.18E-02	1.50E-02	4.42E-02	4.31E-03	9.32E-02	7.74E-02	1.95E-01	4.79E-02
Total PAHs	3.67E-02	3.17E-02	9.63E-02	2.42E-02	1.57E+00	2.16E+00	2.97E+01	1.67E-01	1.66E-01	1.99E-01	2.23E+00	4.78E-02	7.92E-01	7.22E-01	3.25E+00	4.84E-01
Phthalates																
Bis(2-ethylhexyl)phthalate	3.36E-02	2.94E-02	5.71E-02	2.30E-02	6.28E-01	6.69E-01	4.87E+00	1.51E-01	9.31E-02	8.91E-02	4.28E-01	4.24E-02	6.88E-01	6.07E-01	1.34E+00	4.58E-01

Table E3-5b. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Outfall Sediment Traps (Non-normalized)

	RM 7.4-8.2 W FT17				RM 7.4-8.2 E FT19				RM 6.8-7.4 W FT20				RM 6.8-7.4 E FT22			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	3.18E-01	5.35E-01	1.34E+00	9.92E-02	6.84E-02	1.09E-01	2.45E-01	2.64E-02	1.00E-01	1.70E-01	4.29E-01	2.95E-02	1.81E-02	2.84E-02	6.21E-02	7.35E-03
Chromium	1.25E+00	8.14E-01	4.83E+00	5.75E-01	4.19E-01	3.84E-01	1.09E+00	2.50E-01	3.70E-01	2.30E-01	1.52E+00	1.54E-01	1.08E-01	1.03E-01	2.76E-01	6.40E-02
Copper	3.04E+00	4.09E+00	1.22E+01	1.25E+00	2.45E+02	2.46E+02	2.46E+02	2.45E+02	9.42E-01	1.28E+00	3.89E+00	3.65E-01	2.15E-01	2.76E-01	6.23E-01	1.13E-01
Lead	4.46E+00	4.90E+00	1.77E+01	1.52E+00	1.45E+00	1.58E+00	3.79E+00	8.12E-01	1.41E+00	1.55E+00	5.66E+00	4.60E-01	3.46E-01	3.82E-01	9.15E-01	1.90E-01
Mercury	3.85E-03	5.27E-03	8.09E-03	2.49E-03	1.24E-03	1.47E-03	2.08E-03	9.07E-04	1.19E-03	1.64E-03	2.55E-03	7.47E-04	3.45E-04	3.97E-04	5.48E-04	2.61E-04
Nickel	1.15E+00	9.97E-01	3.25E+00	5.21E-01	2.79E-01	2.80E-01	6.75E-01	1.44E-01	3.54E-01	3.04E-01	1.03E+00	1.51E-01	7.53E-02	7.77E-02	1.77E-01	3.99E-02
Zinc	2.48E+01	3.50E+01	4.89E+01	1.07E+01	8.99E+01	9.07E+01	9.20E+01	8.86E+01	7.81E+00	1.11E+01	1.56E+01	3.25E+00	1.61E+00	2.14E+00	2.91E+00	8.50E-01
PCBs																
PCB077	2.40E-05	4.13E-05	1.12E-04	4.70E-06	5.15E-06	7.92E-06	2.03E-05	1.56E-06	7.66E-06	1.32E-05	3.59E-05	1.44E-06	1.32E-06	2.00E-06	4.96E-06	4.37E-07
PCB081	2.29E-06	5.22E-06	1.31E-05	3.69E-07	4.65E-07	9.35E-07	2.28E-06	1.14E-07	7.26E-07	1.67E-06	4.21E-06	1.08E-07	1.20E-07	2.35E-07	5.66E-07	3.22E-08
PCB105	1.49E-04	2.93E-04	7.66E-04	3.51E-05	3.65E-05	6.33E-05	1.57E-04	1.16E-05	4.73E-05	9.39E-05	2.46E-04	1.09E-05	9.70E-06	1.65E-05	4.00E-05	3.26E-06
PCB118	3.47E-04	7.09E-04	1.89E-03	9.18E-05	8.63E-05	1.53E-04	3.84E-04	2.90E-05	1.11E-04	2.27E-04	6.07E-04	2.85E-05	2.30E-05	4.00E-05	9.82E-05	8.16E-06
PCB126	4.61E-06	6.31E-06	2.42E-05	1.88E-06	9.84E-07	1.26E-06	4.28E-06	4.51E-07	1.47E-06	2.02E-06	7.79E-06	5.91E-07	2.53E-07	3.22E-07	1.06E-06	1.20E-07
PCB156 & PCB157	5.91E-05	1.09E-04	3.23E-04	1.76E-05	1.35E-05	2.17E-05	5.95E-05	5.10E-06	1.89E-05	3.49E-05	1.04E-04	5.51E-06	3.54E-06	5.56E-06	1.48E-05	1.41E-06
PCB169	4.83E-07	4.46E-07	1.86E-06	2.99E-07	8.97E-08	8.78E-08	3.18E-07	5.82E-08	1.35E-07	1.23E-07	5.79E-07	7.57E-08	2.66E-08	2.53E-08	7.99E-08	1.95E-08
Total PCBs	1.00E-02	1.86E-02	4.41E-02	2.73E-03	2.24E-03	3.72E-03	8.61E-03	7.48E-04	3.20E-03	5.96E-03	1.42E-02	8.53E-04	5.82E-04	9.53E-04	2.15E-03	2.05E-04
PCB TEQ	2.22E-07	6.46E-07	2.53E-06	6.88E-09	5.97E-08	1.28E-07	4.47E-07	1.60E-08	7.06E-08	2.07E-07	8.13E-07	1.39E-09	1.62E-08	3.29E-08	1.10E-07	5.08E-09
Pesticides																
4,4'-DDD	2.21E-04	2.72E-04	9.07E-04	1.10E-04	5.63E-05	8.69E-05	2.45E-04	2.64E-05	3.08E-02	3.08E-02	3.09E-02	3.08E-02	1.52E-05	2.44E-05	6.61E-05	7.13E-06
4,4'-DDT	9.61E-04	1.34E-03	7.29E-03	1.69E-04	3.78E-04	4.76E-04	1.64E-03	1.47E-04	1.26E-01	1.26E-01	1.27E-01	1.26E-01	1.10E-04	1.37E-04	4.37E-04	4.57E-05
Total of 2,4' and 4,4'-DDE	2.29E-04	2.33E-04	9.73E-04	6.58E-05	1.16E-04	1.55E-04	4.02E-04	4.61E-05	8.31E-02	8.31E-02	8.32E-02	8.31E-02	3.46E-05	4.71E-05	1.17E-04	1.44E-05
Total of 2,4' and 4,4'-DDD	3.62E-04	3.39E-04	1.29E-03	1.09E-04	1.03E-04	1.26E-04	3.62E-04	3.74E-05	4.52E-02	4.52E-02	4.53E-02	4.51E-02	2.83E-05	3.61E-05	9.90E-05	1.06E-05
Total of 2,4' and 4,4'-DDT	1.37E-03	2.20E-03	1.43E-02	2.10E-04	4.65E-04	6.54E-04	2.85E-03	1.59E-04	2.01E-01	2.01E-01	2.02E-01	2.00E-01	1.33E-04	1.83E-04	7.39E-04	4.90E-05
Total DDX	2.16E-03	2.69E-03	1.49E-02	5.32E-04	7.18E-04	9.20E-04	3.35E-03	2.65E-04	3.30E-01	3.30E-01	3.31E-01	3.30E-01	2.05E-04	2.63E-04	8.91E-04	7.97E-05
Total Chlordanes	2.41E-04	5.96E-04	8.99E-04	5.43E-05	9.71E-05	1.65E-04	2.32E-04	4.85E-05	3.19E-03	3.28E-03	3.35E-03	3.15E-03	2.70E-05	4.40E-05	6.15E-05	1.42E-05
γ-Hexachlorocyclohexane	9.24E-05	1.22E-04	4.11E-04	2.46E-05	2.88E-05	4.69E-05	1.28E-04	1.04E-05	2.95E-05	3.88E-05	1.32E-04	7.73E-06	7.45E-06	1.30E-05	3.45E-05	2.67E-06
Hexachlorobenzene	7.03E-05	8.03E-05	2.54E-04	2.12E-05	4.60E-05	4.94E-05	1.04E-04	2.46E-05	2.21E-05	2.53E-05	8.09E-05	6.37E-06	1.36E-05	1.46E-05	2.87E-05	7.60E-06
Aldrin	6.24E-05	9.10E-05	6.82E-04	1.36E-05	1.58E-05	3.95E-05	1.67E-04	5.99E-06	7.56E-04	7.63E-04	9.04E-04	7.44E-04	4.07E-06	1.14E-05	4.48E-05	1.64E-06
Dieldrin	7.16E-05	6.97E-05	2.55E-04	2.05E-05	4.33E-05	4.57E-05	1.04E-04	2.15E-05	6.17E-03	6.17E-03	6.21E-03	6.15E-03	1.26E-05	1.35E-05	2.87E-05	6.51E-06
PAHs																
Naphthalene	1.77E-03	1.10E-02	1.20E-01	2.87E-04	4.55E-04	1.90E-03	1.92E-02	2.09E-04	5.38E-04	3.50E-03	3.88E-02	5.93E-05	1.13E-04	4.67E-04	4.68E-03	5.60E-05
Benzo(a)pyrene	2.49E-02	4.00E-02	1.21E-01	7.98E-03	7.06E-03	9.36E-03	2.29E-02	4.10E-03	6.54E-03	1.15E-02	3.81E-02	1.01E-03	1.84E-03	2.43E-03	5.63E-03	1.18E-03
Total Carcinogenic PAHs BaPEq	3.41E-02	6.20E-02	1.82E-01	1.11E-02	9.86E-03	1.41E-02	3.45E-02	5.66E-03	8.40E-03	1.75E-02	5.68E-02	8.62E-04	2.56E-03	3.64E-03	8.36E-03	1.64E-03
Total PAHs	6.42E-01	8.87E-01	1.23E+01	6.02E-02	1.40E-01	1.77E-01	1.99E+00	4.56E-02	2.05E-01	2.84E-01	3.97E+00	1.72E-02	3.49E-02	4.43E-02	4.85E-01	1.25E-02
Phthalates																
Bis(2-ethylhexyl)phthalate	2.43E-01	2.61E-01	2.01E+00	4.51E-02	7.57E-02	7.74E-02	3.59E-01	4.21E-02	7.55E-02	8.11E-02	6.44E-01	1.17E-02	1.93E-02	1.99E-02	8.73E-02	1.16E-02

Table E3-5b. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Outfall Sediment Traps (Non-normalized)

	RM 6.1-6.8 W FT23				RM 6.1-6.8 E FT25				RM 5.3-6.1 W FT26				RM 5.3-6.1 E FT28			
Analyte	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**
Metals																
Arsenic	1.23E-01	1.99E-01	4.84E-01	4.51E-02	1.86E-02	2.39E-02	3.15E-02	1.22E-02	6.13E-02	8.94E-02	1.90E-01	3.27E-02	8.35E-02	1.24E-01	2.65E-01	4.03E-02
Chromium	5.81E-01	4.29E-01	1.85E+00	3.43E-01	2.62E-01	2.90E-01	3.54E-01	2.04E-01	4.63E-01	4.18E-01	9.25E-01	3.68E-01	9.41E-01	8.84E-01	1.67E+00	7.24E-01
Copper	1.35E+00	1.72E+00	4.60E+00	7.13E-01	3.30E-01	3.86E-01	4.77E-01	2.44E-01	1.10E+00	1.24E+00	2.27E+00	8.55E-01	1.11E+00	1.34E+00	2.76E+00	7.39E-01
Lead	1.79E+00	1.94E+00	6.46E+00	7.45E-01	8.56E-01	8.99E-01	1.11E+00	6.70E-01	1.16E+00	1.23E+00	2.83E+00	7.67E-01	3.46E+00	3.53E+00	6.35E+00	2.44E+00
Mercury	1.57E-03	2.07E-03	3.07E-03	1.08E-03	6.22E-04	6.45E-04	8.00E-04	5.02E-04	9.51E-04	1.12E-03	1.50E-03	7.61E-04	1.70E-03	2.11E-03	2.92E-03	1.18E-03
Nickel	4.89E-01	4.34E-01	1.23E+00	2.65E-01	1.06E-01	1.28E-01	1.61E-01	7.66E-02	3.26E-01	3.13E-01	5.99E-01	2.41E-01	3.96E-01	3.89E-01	7.91E-01	2.64E-01
Zinc	1.02E+01	1.38E+01	1.88E+01	5.19E+00	2.21E+00	2.57E+00	3.20E+00	1.61E+00	7.02E+00	8.37E+00	1.02E+01	5.12E+00	8.18E+00	1.02E+01	1.31E+01	5.21E+00
PCBs																
PCB077	9.37E-06	1.55E-05	4.07E-05	2.36E-06	1.39E-06	1.42E-06	2.92E-06	8.17E-07	5.48E-06	7.56E-06	1.70E-05	2.56E-06	6.78E-06	9.65E-06	2.67E-05	2.09E-06
PCB081	8.85E-07	1.94E-06	4.81E-06	1.75E-07	1.09E-07	1.18E-07	2.22E-07	6.13E-08	4.61E-07	8.73E-07	2.06E-06	1.40E-07	5.99E-07	1.08E-06	2.64E-06	1.79E-07
PCB105	5.68E-05	1.08E-04	2.76E-04	1.58E-05	1.24E-05	1.55E-05	3.34E-05	5.81E-06	3.12E-05	4.97E-05	1.14E-04	1.39E-05	4.45E-05	7.04E-05	1.84E-04	1.44E-05
PCB118	1.33E-04	2.61E-04	6.81E-04	4.06E-05	2.96E-05	3.75E-05	8.04E-05	1.39E-05	7.32E-05	1.19E-04	2.79E-04	3.43E-05	1.04E-04	1.69E-04	4.49E-04	3.51E-05
PCB126	1.75E-06	2.35E-06	8.73E-06	7.60E-07	2.59E-07	2.59E-07	4.60E-07	1.56E-07	9.09E-07	1.12E-06	3.46E-06	4.87E-07	1.27E-06	1.51E-06	5.00E-06	5.82E-07
PCB156 & PCB157	2.24E-05	4.00E-05	1.16E-04	7.46E-06	3.98E-06	4.23E-06	8.29E-06	2.23E-06	1.19E-05	1.80E-05	4.61E-05	5.79E-06	1.64E-05	2.45E-05	7.03E-05	6.17E-06
PCB169	2.30E-07	2.17E-07	7.24E-07	1.61E-07	2.89E-08	3.53E-08	4.75E-08	2.43E-08	1.37E-07	1.33E-07	3.22E-07	1.05E-07	1.39E-07	1.68E-07	4.70E-07	8.23E-08
Total PCBs	3.85E-03	6.88E-03	1.60E-02	1.21E-03	6.44E-04	7.49E-04	1.64E-03	3.16E-04	2.13E-03	3.20E-03	6.69E-03	1.03E-03	2.82E-03	4.32E-03	1.09E-02	9.61E-04
PCB TEQ	8.96E-08	2.39E-07	9.09E-07	1.07E-08	2.30E-08	2.52E-08	4.75E-08	1.39E-08	6.12E-08	1.13E-07	3.58E-07	2.59E-08	6.96E-08	1.48E-07	5.20E-07	1.85E-08
Pesticides																
4,4'-DDD	8.23E-05	1.01E-04	3.26E-04	4.27E-05	1.93E-05	3.85E-05	9.08E-05	8.53E-06	4.09E-05	5.23E-05	1.43E-04	2.45E-05	6.21E-05	8.93E-05	2.76E-04	2.95E-05
4,4'-DDT	3.57E-04	4.94E-04	2.60E-03	7.54E-05	1.95E-04	2.26E-04	4.21E-04	1.05E-04	1.97E-04	2.53E-04	1.04E-03	7.58E-05	3.52E-04	4.42E-04	1.63E-03	1.33E-04
Total of 2,4' and 4,4'-DDE	9.38E-05	9.57E-05	3.60E-04	3.53E-05	7.20E-05	1.04E-04	2.15E-04	3.34E-05	6.59E-05	7.50E-05	1.95E-04	3.59E-05	1.23E-04	1.52E-04	3.90E-04	5.12E-05
Total of 2,4' and 4,4'-DDD	1.33E-04	1.25E-04	4.65E-04	4.28E-05	4.05E-05	6.30E-05	1.38E-04	1.82E-05	6.36E-05	6.70E-05	2.03E-04	2.69E-05	1.10E-04	1.25E-04	3.82E-04	4.12E-05
Total of 2,4' and 4,4'-DDT	5.04E-04	7.98E-04	5.09E-03	9.07E-05	2.14E-04	2.62E-04	5.09E-04	1.09E-04	2.54E-04	3.69E-04	1.92E-03	8.28E-05	4.38E-04	6.17E-04	2.88E-03	1.43E-04
Total DDX	7.88E-04	9.76E-04	5.31E-03	2.09E-04	3.25E-04	4.24E-04	8.51E-04	1.57E-04	3.76E-04	4.68E-04	2.09E-03	1.32E-04	6.76E-04	8.52E-04	3.32E-03	2.39E-04
Total Chlordanes	1.01E-04	2.26E-04	3.34E-04	3.42E-05	5.59E-05	6.69E-05	8.39E-05	3.84E-05	7.98E-05	1.26E-04	1.67E-04	5.29E-05	1.35E-04	2.14E-04	2.88E-04	7.41E-05
γ-Hexachlorocyclohexane	3.38E-05	4.44E-05	1.47E-04	9.66E-06	1.41E-05	2.52E-05	5.80E-05	6.76E-06	1.61E-05	2.28E-05	6.56E-05	6.20E-06	4.70E-05	5.98E-05	1.65E-04	2.11E-05
Hexachlorobenzene	2.76E-05	3.11E-05	9.28E-05	9.95E-06	3.08E-05	3.24E-05	5.87E-05	1.86E-05	2.16E-05	2.32E-05	4.97E-05	1.27E-05	4.97E-05	5.37E-05	1.40E-04	2.38E-05
Aldrin	2.34E-05	3.39E-05	2.43E-04	6.09E-06	6.01E-06	2.21E-05	5.24E-05	3.90E-06	1.15E-05	1.94E-05	9.96E-05	5.08E-06	2.36E-05	4.18E-05	1.79E-04	1.04E-05
Dieldrin	2.96E-05	2.90E-05	9.49E-05	1.13E-05	2.89E-05	3.12E-05	5.87E-05	1.66E-05	2.47E-05	2.52E-05	5.35E-05	1.55E-05	5.25E-05	5.32E-05	1.41E-04	2.58E-05
PAHs																
Naphthalene	9.80E-04	4.23E-03	4.30E-02	4.55E-04	2.37E-04	2.26E-04	2.67E-04	2.18E-04	1.18E-03	2.32E-03	1.58E-02	1.00E-03	1.02E-03	2.47E-03	2.07E-02	6.71E-04
Benzo(a)pyrene	4.07E-02	4.54E-02	7.01E-02	3.56E-02	3.87E-03	3.66E-03	4.54E-03	3.48E-03	6.23E-03	8.12E-03	1.83E-02	4.11E-03	1.24E-02	1.37E-02	3.22E-02	7.31E-03
Total Carcinogenic PAHs BaPEq	5.67E-02	6.52E-02	1.02E-01	4.96E-02	5.85E-03	5.42E-03	7.34E-03	5.02E-03	8.37E-03	1.19E-02	2.69E-02	5.49E-03	1.85E-02	2.08E-02	5.16E-02	1.01E-02
Total PAHs	2.46E-01	3.33E-01	4.38E+00	4.03E-02	4.18E-02	3.95E-02	4.74E-02	3.78E-02	1.34E-01	1.64E-01	1.57E+00	6.26E-02	2.14E-01	2.41E-01	2.17E+00	9.56E-02
Phthalates																
Bis(2-ethylhexyl)phthalate	1.16E-01	1.22E-01	7.41E-01	4.63E-02	4.20E-02	4.03E-02	4.86E-02	3.81E-02	1.17E-01	1.19E-01	3.34E-01	9.27E-02	1.51E-01	1.44E-01	4.78E-01	9.65E-02

Table E3-5b. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Outfall Sediment Traps (Non-normalized)

	RM 4.7-5.3 W FT29				RM 4.7-5.3 E FT31				RM 4.1-4.7 W FT32				RM 4.1-4.7 E FT34			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	8.08E-02	1.32E-01	3.19E-01	2.85E-02	1.79E-01	2.93E-01	7.09E-01	6.18E-02	4.11E-02	6.49E-02	1.51E-01	1.69E-02	1.18E-01	1.95E-01	4.78E-01	4.02E-02
Chromium	3.78E-01	2.88E-01	1.23E+00	2.09E-01	1.10E+00	8.87E-01	3.04E+00	6.83E-01	2.30E-01	1.90E-01	6.23E-01	1.50E-01	7.41E-01	5.81E-01	2.04E+00	4.66E-01
Copper	8.94E-01	1.15E+00	3.05E+00	4.54E-01	1.82E+00	2.38E+00	6.60E+00	8.54E-01	4.79E-01	6.00E-01	1.47E+00	2.74E-01	1.17E+00	1.54E+00	4.40E+00	5.41E-01
Lead	1.25E+00	1.37E+00	4.33E+00	5.39E-01	4.22E+00	4.43E+00	1.15E+01	2.31E+00	6.68E-01	7.23E-01	2.10E+00	3.31E-01	2.89E+00	3.01E+00	7.89E+00	1.59E+00
Mercury	1.10E-03	1.42E-03	2.11E-03	7.60E-04	2.59E-03	3.46E-03	5.16E-03	1.68E-03	6.02E-04	7.53E-04	1.07E-03	4.40E-04	1.64E-03	2.25E-03	3.39E-03	1.02E-03
Nickel	3.17E-01	2.88E-01	8.17E-01	1.62E-01	6.87E-01	6.19E-01	1.79E+00	3.47E-01	1.73E-01	1.61E-01	4.04E-01	1.01E-01	4.50E-01	3.95E-01	1.19E+00	2.28E-01
Zinc	6.86E+00	9.31E+00	1.27E+01	3.42E+00	1.47E+01	2.01E+01	2.77E+01	7.06E+00	3.51E+00	4.65E+00	6.23E+00	1.91E+00	9.59E+00	1.31E+01	1.81E+01	4.54E+00
PCBs																
PCB077	6.25E-06	1.02E-05	2.67E-05	1.61E-06	1.38E-05	2.27E-05	6.29E-05	2.88E-06	3.06E-06	4.88E-06	1.26E-05	8.84E-07	9.18E-06	1.53E-05	4.30E-05	1.75E-06
PCB081	5.79E-07	1.26E-06	3.14E-06	1.13E-07	1.29E-06	2.78E-06	6.97E-06	2.46E-07	2.89E-07	6.05E-07	1.48E-06	6.85E-08	8.64E-07	1.88E-06	4.74E-06	1.57E-07
PCB105	3.92E-05	7.35E-05	1.87E-04	1.11E-05	8.74E-05	1.63E-04	4.30E-04	2.17E-05	1.93E-05	3.51E-05	8.81E-05	5.97E-06	5.68E-05	1.07E-04	2.87E-04	1.32E-05
PCB118	9.20E-05	1.77E-04	4.60E-04	2.84E-05	2.04E-04	3.92E-04	1.06E-03	5.54E-05	4.53E-05	8.47E-05	2.17E-04	1.51E-05	1.32E-04	2.58E-04	7.06E-04	3.39E-05
PCB126	1.17E-06	1.57E-06	5.74E-06	5.10E-07	2.65E-06	3.49E-06	1.30E-05	1.09E-06	5.73E-07	7.53E-07	2.68E-06	2.61E-07	1.77E-06	2.34E-06	8.88E-06	7.14E-07
PCB156 & PCB157	1.53E-05	2.68E-05	7.71E-05	5.20E-06	3.40E-05	5.94E-05	1.77E-04	1.04E-05	7.45E-06	1.27E-05	3.60E-05	2.69E-06	2.23E-05	3.96E-05	1.20E-04	6.52E-06
PCB169	1.26E-07	1.18E-07	4.46E-07	8.22E-08	2.54E-07	2.64E-07	1.04E-06	1.42E-07	8.59E-08	8.26E-08	2.35E-07	6.49E-08	1.72E-07	1.81E-07	7.18E-07	9.31E-08
Total PCBs	2.60E-03	4.61E-03	1.07E-02	8.21E-04	5.78E-03	1.02E-02	2.50E-02	1.60E-03	1.27E-03	2.19E-03	5.04E-03	4.31E-04	3.82E-03	6.83E-03	1.69E-02	1.01E-03
PCB TEQ	6.26E-08	1.60E-07	5.99E-07	9.45E-09	1.29E-07	3.53E-07	1.36E-06	9.59E-09	3.13E-08	7.60E-08	2.79E-07	6.14E-09	8.20E-08	2.36E-07	9.27E-07	1.95E-09
Pesticides																
4,4'-DDD	5.79E-05	7.57E-05	2.36E-04	2.91E-05	1.28E-04	1.65E-04	5.47E-04	6.13E-05	2.82E-05	3.73E-05	1.13E-04	1.45E-05	8.19E-05	1.01E-04	3.50E-04	3.95E-05
4,4'-DDT	2.86E-04	3.84E-04	1.81E-03	7.59E-05	6.01E-04	8.12E-04	3.99E-03	1.42E-04	1.44E-04	1.90E-04	8.53E-04	4.36E-05	3.44E-04	4.78E-04	2.60E-03	6.05E-05
Total of 2,4' and 4,4'-DDE	7.70E-05	8.81E-05	2.92E-04	2.79E-05	1.65E-04	1.83E-04	6.34E-04	5.26E-05	4.28E-05	4.94E-05	1.48E-04	1.84E-05	9.05E-05	9.10E-05	3.63E-04	2.57E-05
Total of 2,4' and 4,4'-DDD	9.67E-05	9.86E-05	3.40E-04	3.20E-05	2.15E-04	2.15E-04	7.70E-04	6.89E-05	4.70E-05	4.90E-05	1.63E-04	1.63E-05	1.35E-04	1.26E-04	4.86E-04	4.16E-05
Total of 2,4' and 4,4'-DDT	3.86E-04	5.92E-04	3.45E-03	8.67E-05	8.21E-04	1.27E-03	7.65E-03	1.64E-04	1.91E-04	2.88E-04	1.61E-03	4.92E-05	4.89E-04	7.80E-04	5.08E-03	7.42E-05
Total DDX	6.01E-04	7.54E-04	3.70E-03	1.75E-04	1.29E-03	1.61E-03	8.16E-03	3.52E-04	2.98E-04	3.72E-04	1.74E-03	9.46E-05	7.71E-04	9.55E-04	5.31E-03	1.86E-04
Total Chlordanes	7.67E-05	1.61E-04	2.36E-04	2.91E-05	1.81E-04	3.77E-04	5.49E-04	6.39E-05	4.04E-05	7.96E-05	1.15E-04	1.76E-05	1.10E-04	2.42E-04	3.56E-04	3.42E-05
γ-Hexachlorocyclohexane	2.48E-05	3.52E-05	1.10E-04	7.38E-06	6.99E-05	8.90E-05	2.78E-04	2.47E-05	1.24E-05	1.76E-05	5.37E-05	4.00E-06	4.59E-05	5.46E-05	1.77E-04	1.62E-05
Hexachlorobenzene	2.61E-05	2.89E-05	7.48E-05	1.14E-05	5.94E-05	6.60E-05	1.97E-04	2.22E-05	1.39E-05	1.52E-05	3.78E-05	6.51E-06	3.11E-05	3.52E-05	1.21E-04	8.95E-06
Aldrin	1.61E-05	2.79E-05	1.72E-04	4.48E-06	4.09E-05	6.31E-05	3.92E-04	1.20E-05	8.05E-06	1.42E-05	8.19E-05	2.59E-06	2.71E-05	3.64E-05	2.53E-04	7.56E-06
Dieldrin	2.62E-05	2.65E-05	7.56E-05	1.10E-05	6.15E-05	6.09E-05	1.97E-04	2.29E-05	1.42E-05	1.45E-05	3.86E-05	6.64E-06	3.39E-05	3.25E-05	1.21E-04	1.08E-05
PAHs																
Naphthalene	6.10E-04	2.72E-03	2.79E-02	2.69E-04	1.23E-03	5.89E-03	6.21E-02	3.88E-04	3.46E-04	1.31E-03	1.28E-02	1.88E-04	8.29E-04	4.02E-03	4.27E-02	2.42E-04
Benzo(a)pyrene	6.15E-03	9.68E-03	2.87E-02	2.20E-03	1.64E-02	2.33E-02	6.95E-02	5.89E-03	3.24E-03	4.84E-03	1.36E-02	1.40E-03	2.03E-01	2.07E-01	2.33E-01	1.97E-01
Total Carcinogenic PAHs BaPEq	8.10E-03	1.46E-02	4.26E-02	2.72E-03	2.31E-02	3.57E-02	1.07E-01	7.46E-03	4.32E-03	7.27E-03	2.02E-02	1.79E-03	2.99E-01	3.05E-01	3.46E-01	2.90E-01
Total PAHs	1.64E-01	2.21E-01	2.85E+00	3.07E-02	3.97E-01	5.12E-01	6.41E+00	8.13E-02	8.07E-02	1.06E-01	1.31E+00	1.92E-02	1.97E+00	2.03E+00	5.27E+00	1.80E+00
Phthalates																
Bis(2-ethylhexyl)phthalate	7.83E-02	8.23E-02	4.84E-01	3.28E-02	1.88E-01	1.89E-01	1.12E+00	6.90E-02	4.26E-02	4.43E-02	2.29E-01	2.14E-02	4.07E-01	4.07E-01	9.25E-01	3.39E-01

Table E3-5b. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Outfall Sediment Traps (Non-normalized)

	RM 3.3-4.1 W FT35				RM 3.3-4.1 E FT37				RM 2.9-3.1 W FT38				RM 2-3.3 W FT39			
Analyte	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)	Geomean Loading Estimate (kg/yr)	Basin Weighted Mean Loading Estimate (kg/yr)	95th Percentile Loading Estimate (kg/yr)	5th Percentile Loading Estimate (kg/yr)
Metals																
Arsenic	7.05E-02	1.10E-01	2.57E-01	3.02E-02	3.63E-01	6.17E-01	1.56E+00	1.06E-01	5.28E-04	7.55E-04	1.60E-03	2.99E-04	2.86E-02	4.85E-02	1.23E-01	8.43E-03
Chromium	4.23E-01	3.44E-01	1.08E+00	2.97E-01	3.46E+00	3.10E+00	6.43E+00	2.91E+00	3.62E-03	3.16E-03	7.37E-03	2.92E-03	1.05E-01	6.53E-02	4.35E-01	4.36E-02
Copper	9.82E-01	1.17E+00	2.66E+00	6.52E-01	9.12E+00	1.00E+01	1.68E+01	7.62E+00	4.67E-03	5.76E-03	1.43E-02	2.79E-03	2.65E-01	3.61E-01	1.11E+00	1.00E-01
Lead	1.23E+00	1.31E+00	3.67E+00	6.68E-01	2.00E+01	2.04E+01	3.11E+01	1.75E+01	5.73E-03	6.19E-03	1.96E-02	2.64E-03	3.99E-01	4.40E-01	1.62E+00	1.28E-01
Mercury	9.50E-04	1.22E-03	1.75E-03	6.90E-04	3.61E-02	3.73E-02	3.97E-02	3.50E-02	8.19E-06	9.68E-06	1.26E-05	6.76E-06	3.39E-04	4.70E-04	7.30E-04	2.14E-04
Nickel	3.19E-01	2.91E-01	7.04E-01	2.03E-01	1.90E+00	1.77E+00	3.66E+00	1.38E+00	2.38E-03	2.21E-03	4.58E-03	1.71E-03	1.01E-01	8.65E-02	2.94E-01	4.28E-02
Zinc	6.83E+00	8.70E+00	1.13E+01	4.23E+00	5.93E+01	6.78E+01	7.95E+01	4.75E+01	3.18E-02	4.24E-02	5.70E-02	1.69E-02	2.21E+00	3.14E+00	4.43E+00	9.06E-01
PCBs																
PCB077	5.87E-06	9.00E-06	2.25E-05	2.01E-06	4.00E-04	4.14E-04	4.73E-04	3.84E-04	2.56E-08	4.37E-08	1.18E-07	5.44E-09	2.17E-06	3.76E-06	1.03E-05	3.98E-07
PCB081	5.24E-07	1.09E-06	2.67E-06	1.23E-07	6.66E-05	6.91E-05	7.57E-05	6.50E-05	3.20E-09	6.26E-09	1.45E-08	1.20E-09	2.07E-07	4.76E-07	1.20E-06	3.09E-08
PCB105	3.40E-05	6.04E-05	1.50E-04	1.18E-05	3.74E-03	3.86E-03	4.26E-03	3.64E-03	1.68E-07	3.20E-07	8.15E-07	4.94E-08	1.35E-05	2.68E-05	7.03E-05	3.05E-06
PCB118	7.95E-05	1.45E-04	3.68E-04	2.95E-05	7.19E-03	7.49E-03	8.48E-03	6.98E-03	3.95E-07	7.74E-07	2.01E-06	1.28E-07	3.14E-05	6.47E-05	1.73E-04	8.02E-06
PCB126	1.04E-06	1.35E-06	4.71E-06	4.89E-07	5.25E-05	5.39E-05	6.89E-05	5.02E-05	5.44E-09	7.23E-09	2.60E-08	2.59E-09	4.18E-07	5.75E-07	2.23E-06	1.68E-07
PCB156 & PCB157	1.33E-05	2.24E-05	6.26E-05	5.22E-06	1.19E-03	1.23E-03	1.41E-03	1.16E-03	6.47E-08	1.17E-07	3.42E-07	2.13E-08	5.37E-06	9.95E-06	2.97E-05	1.55E-06
PCB169	1.36E-07	1.31E-07	4.03E-07	9.56E-08	4.84E-07	4.41E-07	2.10E-06	2.71E-07	2.51E-09	2.47E-09	3.96E-09	2.32E-09	3.94E-08	3.60E-08	1.66E-07	2.26E-08
Total PCBs	2.34E-03	3.90E-03	8.78E-03	9.02E-04	2.12E-01	2.19E-01	2.40E-01	2.06E-01	1.09E-05	1.99E-05	4.66E-05	3.28E-06	9.09E-04	1.70E-03	4.05E-03	2.39E-04
PCB TEQ	5.91E-08	1.37E-07	4.90E-07	1.50E-08	5.28E-06	5.63E-06	7.21E-06	5.10E-06	2.28E-10	6.72E-10	2.65E-09	3.00E-12	1.99E-08	5.90E-08	2.32E-07	2.16E-10
Pesticides																
4,4'-DDD	4.67E-05	5.64E-05	1.75E-04	2.59E-05	2.56E-04	3.16E-04	1.06E-03	1.26E-04	2.56E-07	3.09E-07	9.74E-07	1.39E-07	2.01E-05	2.48E-05	8.32E-05	9.87E-06
4,4'-DDT	1.97E-04	2.67E-04	1.36E-03	5.01E-05	1.11E-03	1.56E-03	8.54E-03	1.81E-04	1.21E-06	1.61E-06	7.84E-06	3.80E-07	8.70E-05	1.22E-04	6.70E-04	1.44E-05
Total of 2,4' and 4,4'-DDE	5.62E-05	5.74E-05	1.96E-04	2.52E-05	2.53E-04	2.56E-04	1.12E-03	6.30E-05	4.99E-07	5.01E-07	1.27E-06	3.29E-07	2.01E-05	2.03E-05	8.82E-05	5.13E-06
Total of 2,4' and 4,4'-DDD	7.31E-05	6.92E-05	2.47E-04	2.62E-05	4.21E-04	3.93E-04	1.51E-03	1.25E-04	4.03E-07	3.78E-07	1.38E-06	1.39E-07	3.30E-05	3.08E-05	1.19E-04	9.83E-06
Total of 2,4' and 4,4'-DDT	2.73E-04	4.25E-04	2.65E-03	5.81E-05	1.59E-03	2.56E-03	1.68E-02	2.27E-04	1.68E-06	2.55E-06	1.52E-05	4.62E-07	1.25E-04	2.01E-04	1.32E-03	1.80E-05
Total DDX	4.17E-04	5.15E-04	2.76E-03	1.16E-04	2.50E-03	3.12E-03	1.75E-02	5.96E-04	2.77E-06	3.32E-06	1.61E-05	1.06E-06	1.97E-04	2.45E-04	1.37E-03	4.71E-05
Total Chlordanes	7.04E-05	1.36E-04	1.92E-04	3.52E-05	2.72E-04	6.89E-04	1.04E-03	5.33E-05	2.70E-07	6.43E-07	9.60E-07	7.48E-08	2.14E-05	5.41E-05	8.20E-05	4.20E-06
γ-Hexachlorocyclohexane	1.93E-05	2.47E-05	7.95E-05	6.36E-06	1.07E-04	1.41E-04	4.80E-04	2.80E-05	1.05E-07	1.35E-07	4.37E-07	3.38E-08	8.43E-06	1.11E-05	3.77E-05	2.20E-06
Hexachlorobenzene	1.71E-05	1.90E-05	5.28E-05	7.58E-06	7.99E-05	9.16E-05	2.94E-04	2.27E-05	8.09E-08	9.14E-08	2.72E-07	2.98E-08	6.28E-06	7.19E-06	2.31E-05	1.79E-06
Aldrin	1.35E-05	1.90E-05	1.28E-04	4.40E-06	7.20E-05	1.05E-04	7.98E-04	1.48E-05	8.06E-08	1.10E-07	7.29E-07	2.95E-08	5.66E-06	8.25E-06	6.26E-05	1.17E-06
Dieldrin	1.98E-05	1.94E-05	5.53E-05	9.90E-06	8.02E-05	7.79E-05	2.94E-04	2.06E-05	9.89E-08	9.68E-08	2.90E-07	4.57E-08	6.31E-06	6.13E-06	2.31E-05	1.64E-06
PAHs																
Naphthalene	9.27E-04	2.61E-03	2.27E-02	6.51E-04	1.86E-03	1.27E-02	1.41E-01	1.16E-04	1.97E-06	1.16E-05	1.27E-04	4.11E-07	1.46E-04	9.93E-04	1.11E-02	9.34E-06
Benzo(a)pyrene	5.94E-03	8.70E-03	2.40E-02	2.70E-03	1.17E-01	1.30E-01	2.00E-01	1.03E-01	2.48E-05	4.10E-05	1.28E-04	6.82E-06	1.85E-03	3.27E-03	1.09E-02	2.67E-04
Total Carcinogenic PAHs BaPEq	7.89E-03	1.30E-02	3.57E-02	3.41E-03	2.04E-01	2.28E-01	3.30E-01	1.85E-01	3.20E-05	6.18E-05	1.90E-04	7.45E-06	2.37E-03	4.99E-03	1.62E-02	2.16E-04
Total PAHs	1.51E-01	1.95E-01	2.29E+00	4.37E-02	2.34E+00	2.55E+00	1.21E+01	1.85E+00	7.03E-04	9.61E-04	1.30E-02	9.29E-05	5.81E-02	8.08E-02	1.14E+00	4.55E-03
Phthalates																
Bis(2-ethylhexyl)phthalate	9.80E-02	1.01E-01	4.23E-01	6.08E-02	2.67E-01	2.87E-01	2.34E+00	3.41E-02	2.40E-04	2.59E-04	2.09E-03	3.25E-05	2.09E-02	2.25E-02	1.84E-01	2.68E-03

Table E3-5b. Summary of Annual Stormwater Loads by Study Area and Model Cell - Stormwater Outfall Sediment Traps (Non-normalized)

	RM 2-3.3 E FT41				RM 1-2 W FT42				RM 1-2 E FT44			
Analyte	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**	**Geomean Loading Estimate (kg/yr)**	**Basin Weighted Mean Loading Estimate (kg/yr)**	**95th Percentile Loading Estimate (kg/yr)**	**5th Percentile Loading Estimate (kg/yr)**
Metals												
Arsenic	2.07E-01	3.52E-01	8.89E-01	6.02E-02	4.18E-04	4.18E-04	4.18E-04	4.18E-04	4.23E-02	7.18E-02	1.82E-01	1.23E-02
Chromium	1.80E+01	1.78E+01	1.94E+01	1.77E+01	4.98E-03	4.98E-03	4.98E-03	4.98E-03	1.54E-01	9.45E-02	6.43E-01	6.23E-02
Copper	1.92E+00	2.62E+00	8.05E+00	7.19E-01	3.40E-03	3.40E-03	3.40E-03	3.40E-03	3.92E-01	5.34E-01	1.65E+00	1.47E-01
Lead	2.90E+00	3.19E+00	1.17E+01	9.27E-01	2.43E-03	2.43E-03	2.43E-03	2.43E-03	5.92E-01	6.51E-01	2.40E+00	1.89E-01
Mercury	2.44E-03	3.40E-03	5.28E-03	1.53E-03	8.91E-06	8.91E-06	8.91E-06	8.91E-06	4.99E-04	6.94E-04	1.08E-03	3.13E-04
Nickel	7.27E-01	6.22E-01	2.13E+00	3.05E-01	2.53E-03	2.53E-03	2.53E-03	2.53E-03	1.48E-01	1.27E-01	4.35E-01	6.23E-02
Zinc	1.60E+01	2.28E+01	3.21E+01	6.55E+00	1.36E-02	1.36E-02	1.36E-02	1.36E-02	3.27E+00	4.66E+00	6.56E+00	1.34E+00
PCBs												
PCB077	1.58E-05	2.73E-05	7.45E-05	2.89E-06	1.85E-09	1.85E-09	1.85E-09	1.85E-09	3.22E-06	5.58E-06	1.52E-05	5.90E-07
PCB081	1.50E-06	3.45E-06	8.72E-06	2.20E-07	1.74E-09	1.74E-09	1.74E-09	1.74E-09	3.06E-07	7.05E-07	1.78E-06	4.50E-08
PCB105	9.78E-05	1.95E-04	5.10E-04	2.21E-05	3.03E-08	3.03E-08	3.03E-08	3.03E-08	2.00E-05	3.98E-05	1.04E-04	4.51E-06
PCB118	2.28E-04	4.70E-04	1.26E-03	5.80E-05	7.52E-08	7.52E-08	7.52E-08	7.52E-08	4.66E-05	9.61E-05	2.57E-04	1.19E-05
PCB126	3.03E-06	4.18E-06	1.62E-05	1.21E-06	1.41E-09	1.41E-09	1.41E-09	1.41E-09	6.20E-07	8.53E-07	3.30E-06	2.48E-07
PCB156 & PCB157	3.90E-05	7.23E-05	2.16E-04	1.13E-05	7.42E-09	7.42E-09	7.42E-09	7.42E-09	7.96E-06	1.48E-05	4.41E-05	2.30E-06
PCB169	2.76E-07	2.51E-07	1.20E-06	1.54E-07	4.25E-09	4.25E-09	4.25E-09	4.25E-09	5.64E-08	5.14E-08	2.45E-07	3.15E-08
Total PCBs	6.60E-03	1.23E-02	2.94E-02	1.73E-03	1.15E-06	1.15E-06	1.15E-06	1.15E-06	1.35E-03	2.52E-03	6.01E-03	3.54E-04
PCB TEQ	1.45E-07	4.28E-07	1.69E-06	1.57E-09	1.11E-12	1.11E-12	1.11E-12	1.11E-12	2.96E-08	8.75E-08	3.45E-07	3.21E-10
Pesticides												
4,4'-DDD	1.46E-04	1.80E-04	6.04E-04	7.16E-05	5.57E-08	5.57E-08	5.57E-08	5.57E-08	2.98E-05	3.67E-05	1.23E-04	1.46E-05
4,4'-DDT	6.31E-04	8.87E-04	4.87E-03	1.03E-04	4.45E-07	4.45E-07	4.45E-07	4.45E-07	1.29E-04	1.81E-04	9.94E-04	2.11E-05
Total of 2,4' and 4,4'-DDE	1.44E-04	1.46E-04	6.39E-04	3.59E-05	5.57E-07	5.57E-07	5.57E-07	5.57E-07	2.95E-05	2.98E-05	1.31E-04	7.34E-06
Total of 2,4' and 4,4'-DDD	2.40E-04	2.24E-04	8.62E-04	7.13E-05	5.57E-08	5.57E-08	5.57E-08	5.57E-08	4.90E-05	4.57E-05	1.76E-04	1.46E-05
Total of 2,4' and 4,4'-DDT	9.04E-04	1.46E-03	9.56E-03	1.30E-04	5.29E-07	5.29E-07	5.29E-07	5.29E-07	1.85E-04	2.98E-04	1.95E-03	2.65E-05
Total DDX	1.43E-03	1.78E-03	9.96E-03	3.40E-04	1.09E-06	1.09E-06	1.09E-06	1.09E-06	2.91E-04	3.63E-04	2.03E-03	6.94E-05
Total Chlordanes	1.55E-04	3.93E-04	5.95E-04	3.04E-05	5.57E-08	5.57E-08	5.57E-08	5.57E-08	3.17E-05	8.02E-05	1.22E-04	6.20E-06
γ-Hexachlorocyclohexane	6.12E-05	8.06E-05	2.73E-04	1.59E-05	1.81E-08	1.81E-08	1.81E-08	1.81E-08	1.25E-05	1.65E-05	5.59E-05	3.26E-06
Hexachlorobenzene	4.55E-05	5.22E-05	1.68E-04	1.29E-05	1.95E-08	1.95E-08	1.95E-08	1.95E-08	9.31E-06	1.07E-05	3.43E-05	2.64E-06
Aldrin	4.10E-05	5.98E-05	4.55E-04	8.40E-06	3.34E-08	3.34E-08	3.34E-08	3.34E-08	8.38E-06	1.22E-05	9.29E-05	1.72E-06
Dieldrin	4.57E-05	4.44E-05	1.68E-04	1.17E-05	5.57E-08	5.57E-08	5.57E-08	5.57E-08	9.34E-06	9.07E-06	3.43E-05	2.40E-06
PAHs												
Naphthalene	1.06E-03	7.21E-03	8.05E-02	6.63E-05	6.26E-07	6.26E-07	6.26E-07	6.26E-07	2.17E-04	1.47E-03	1.65E-02	1.36E-05
Benzo(a)pyrene	1.34E-02	2.37E-02	7.90E-02	1.92E-03	7.80E-06	7.80E-06	7.80E-06	7.80E-06	2.74E-03	4.85E-03	1.61E-02	3.92E-04
Total Carcinogenic PAHs BaPEq	1.72E-02	3.62E-02	1.18E-01	1.55E-03	1.03E-05	1.03E-05	1.03E-05	1.03E-05	3.52E-03	7.40E-03	2.41E-02	3.16E-04
Total PAHs	4.22E-01	5.87E-01	8.25E+00	3.29E-02	8.46E-05	8.46E-05	8.46E-05	8.46E-05	8.63E-02	1.20E-01	1.69E+00	6.71E-03
Phthalates												
Bis(2-ethylhexyl)phthalate	1.52E-01	1.64E-01	1.33E+00	1.94E-02	4.18E-06	4.18E-06	4.18E-06	4.18E-06	3.11E-02	3.35E-02	2.73E-01	3.97E-03

Notes:

All calculations based on 50th Percentile Flow Year (2002).

The values presented in these tables are preliminary and will change slightly before the Final RI Report. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

-- = Analyte not sampled
BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
EPA - U.S. Environmental Protection Agency
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
RM - river mile
TEQ - toxic equivalent concentration

Table E3-6. Evaluation of Segregated Samples at OF-18.

			Measured Loads		Calculated Loads			
Station	**Analyte**	**Units**	**Segregated Data**	**Unsegregated Data**	**5th Percentile**	**Mean**	**Geomean**	**95th Percentile**
OF18	Benzo(a)pyrene	kg	8.27E+05	9.20E+05	7.44E+04	2.90E+05	1.81E+05	7.61E+05
OF18	Lead	kg	5.11E+08	5.66E+08	2.38E+07	1.26E+08	6.39E+07	2.07E+08
OF18	PCB077	kg	3.13E+09	3.89E+09	7.56E+07	1.50E+09	5.10E+08	4.24E+09
OF18	PCB105	kg	1.61E+10	3.08E+10	3.72E+08	9.53E+09	3.37E+09	3.15E+10
OF18	PCB106 & 118	kg	4.02E+10	7.72E+10	8.28E+08	2.22E+10	7.67E+09	6.59E+10
OF18	PCB126	kg	3.42E+08	5.40E+08	4.48E+07	2.38E+08	1.33E+08	9.26E+08
OF18	PCB156 & 157	kg	1.26E+10	1.60E+10	1.59E+08	3.75E+09	1.42E+09	1.23E+10
OF18	Total PCB Congeners	kg	1.38E+12	2.38E+12	1.72E+10	6.41E+11	2.22E+11	1.88E+12
OF18	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	kg	3.58E+07	3.57E+07	1.57E+05	2.14E+07	5.25E+06	9.11E+07

Notes:

The values presented in these tables are preliminary and will change slightly before the Final RI Report. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

EPA - U.S. Environmental Protection Agency
PCB - polychlorinated biphenyl
TEF - toxicity equivalency factor
TEQ - toxic equivalent concentration

Table E3-7. Sediment Trap Comparison of Measured Loads versus Calculated Loads

Location	Analyte	Analyte Group	Units	Basis	Measured Load	Calculated Load: 5th Percentile	Calculated Load: Mean	Calculated Load: Geomean	Calculated Load: 95th Percentile	Measured Load Within Upper- and Lower-Bound Calculated Load	RPD*
OF18	Lead	Metals	kg	Dry	1.1E+08	1.4E+07	3.8E+07	3.5E+07	1.3E+08	TRUE	97
OF18	Mercury	Metals	kg	Dry	1.9E+05	2.4E+04	4.4E+04	3.4E+04	6.4E+04	FALSE	125
OF18	Total PAHs	PAHs	kg	Dry	1.3E+07	6.2E+05	6.5E+06	4.8E+06	8.8E+07	TRUE	64
OF18	Total PCB Congeners	PCB Congeners	kg	Dry	4.7E+11	2.2E+10	1.4E+11	7.4E+10	3.2E+11	FALSE	111
OF18	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	kg	Dry	4.6E+06	1.2E+05	4.7E+06	1.7E+06	1.8E+07	TRUE	1
OF18	Total DDTs	Pesticides	kg	Dry	1.3E+05	4.5E+03	2.0E+04	1.6E+04	1.1E+05	FALSE	147
OF18	Bis(2-ethylhexyl) phthalate	Phthalates	kg	Dry	1.7E+07	5.6E+05	2.1E+06	2.0E+06	1.4E+07	FALSE	157
OF18	Hexachlorobenzene	SVOCs	kg	Dry	3.3E+03	1.8E+02	6.1E+02	5.4E+02	1.8E+03	FALSE	137
OF18	Lead	Metals	kg	OC normalized	1.3E+08	8.4E+07	2.7E+08	1.8E+08	5.0E+08	TRUE	70
OF18	Mercury	Metals	kg	OC normalized	2.2E+05	1.1E+05	3.6E+05	2.0E+05	7.6E+05	TRUE	48
OF18	Total PAHs	PAHs	kg	OC normalized	1.8E+07	5.2E+06	3.9E+07	2.5E+07	9.6E+08	TRUE	76
OF18	Total PCB Congeners	PCB Congeners	kg	OC normalized	6.5E+11	6.6E+10	7.6E+11	3.0E+11	2.4E+12	TRUE	15
OF18	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	kg	OC normalized	5.3E+06	2.7E+05	2.1E+07	6.4E+06	6.8E+07	TRUE	121
OF18	Total DDTs	Pesticides	kg	OC normalized	1.8E+05	2.8E+04	1.3E+05	8.9E+04	5.7E+05	TRUE	31
OF18	Bis(2-ethylhexyl) phthalate	Phthalates	kg	OC normalized	2.4E+07	2.5E+06	9.3E+06	9.8E+06	5.1E+07	TRUE	88
OF18	Hexachlorobenzene	SVOCs	kg	OC normalized	4.0E+03	6.5E+02	3.0E+03	2.7E+03	1.4E+04	TRUE	27
OF19	Lead	Metals	kg	Dry	1.5E+08	1.2E+07	3.3E+07	3.0E+07	1.1E+08	FALSE	126
OF19	Mercury	Metals	kg	Dry	2.3E+05	2.1E+04	3.8E+04	2.9E+04	5.5E+04	FALSE	142
OF19	Total PAHs	PAHs	kg	Dry	1.6E+07	5.9E+05	5.7E+06	4.2E+06	7.6E+07	TRUE	97
OF19	Total PCB Congeners	PCB Congeners	kg	Dry	2.3E+11	2.0E+10	1.2E+11	6.5E+10	2.7E+11	TRUE	63
OF19	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	kg	Dry	9.9E+06	1.2E+05	4.1E+06	1.5E+06	1.6E+07	TRUE	84
OF19	Total DDTs	Pesticides	kg	Dry	6.7E+03	3.9E+03	1.7E+04	1.4E+04	9.2E+04	TRUE	88
OF19	Bis(2-ethylhexyl) phthalate	Phthalates	kg	Dry	2.1E+07	5.9E+05	1.9E+06	1.8E+06	1.3E+07	FALSE	167
OF19	Hexachlorobenzene	SVOCs	kg	Dry	7.4E+02	1.6E+02	5.2E+02	4.6E+02	1.6E+03	TRUE	36
OF19	Lead	Metals	kg	OC normalized	1.8E+08	7.4E+07	2.3E+08	1.5E+08	4.4E+08	TRUE	23
OF19	Mercury	Metals	kg	OC normalized	2.8E+05	9.8E+04	3.1E+05	1.7E+05	6.6E+05	TRUE	9
OF19	Total PAHs	PAHs	kg	OC normalized	2.0E+07	4.6E+06	3.4E+07	2.1E+07	8.3E+08	TRUE	49
OF19	Total PCB Congeners	PCB Congeners	kg	OC normalized	2.8E+11	5.9E+10	6.6E+11	2.6E+11	2.0E+12	TRUE	79
OF19	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	kg	OC normalized	1.2E+07	2.8E+05	1.8E+07	5.6E+06	5.9E+07	TRUE	39
OF19	Total DDTs	Pesticides	kg	OC normalized	8.3E+03	2.4E+04	1.1E+05	7.7E+04	5.0E+05	FALSE	172
OF19	Bis(2-ethylhexyl) phthalate	Phthalates	kg	OC normalized	2.6E+07	2.4E+06	8.3E+06	8.7E+06	4.5E+07	TRUE	105
OF19	Hexachlorobenzene	SVOCs	kg	OC normalized	9.3E+02	5.6E+02	2.6E+03	2.3E+03	1.2E+04	TRUE	96
Yeon-NW35	Total PCB Congeners	PCB Congeners	kg	Dry	2.2E+10	9.1E+09	4.8E+10	2.7E+10	1.1E+11	TRUE	75
Yeon-NW35	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	kg	Dry	8.3E+05	1.0E+05	1.7E+06	6.5E+05	6.3E+06	TRUE	67
Yeon-NW35	Total PCB Congeners	PCB Congeners	kg	OC normalized	1.6E+11	2.2E+10	2.6E+11	1.0E+11	8.0E+11	TRUE	44
Yeon-NW35	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	kg	OC normalized	6.3E+06	2.1E+05	7.3E+06	2.3E+06	2.3E+07	TRUE	15

Notes:

*Relative percent difference between measured load and mean calculated load

The values presented in these tables are preliminary and will change slightly before the Final RI Report. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

OC - organic carbon

EPA - U.S. Environmental Protection Agency

PAH - polycyclic aromatic hydrocarbon

PCB - polychlorinated biphenyl

RPD - relative percent difference

SVOC - semivolatile organic compound

TEF - toxicity equivalency factor

TEQ - toxic equivalent concentration

Table E3-8. Composite Water Comparison of Annual Measured Loads versus Calculated Loads

Location	Analyte	Analyte Group	Units	Measured Load	Calculated Load: 5th Percentile	Calculated Load: Mean	Calculated Load: Geomean	Calculated Load: 95th Percentile	Measured Load Within Upper- and Lower-Bound Calculated Load	RPD*
OF18	Lead	Metals	kg	5.1E+08	2.4E+07	1.3E+08	6.4E+07	2.1E+08	FALSE	121
OF18	Mercury	Metals	kg	4.9E+05	1.7E+05	2.7E+05	2.3E+05	4.3E+05	FALSE	57
OF18	Total PAHs	PAHs	kg	1.6E+07	9.7E+05	5.8E+06	4.3E+06	1.6E+07	FALSE	94
OF18	Total PCB Congeners	PCB Congeners	kg	1.4E+12	1.7E+10	6.4E+11	2.2E+11	1.9E+12	TRUE	73
OF18	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	kg	3.6E+07	1.6E+05	2.1E+07	5.3E+06	9.1E+07	TRUE	50
OF19	Lead	Metals	kg	2.7E+08	2.1E+07	1.1E+08	5.6E+07	1.8E+08	FALSE	84
OF19	Mercury	Metals	kg	2.9E+05	1.5E+05	2.4E+05	2.0E+05	3.7E+05	TRUE	20
OF19	Total PAHs	PAHs	kg	1.3E+07	9.6E+05	5.2E+06	3.8E+06	1.4E+07	TRUE	84
OF19	Total PCB Congeners	PCB Congeners	kg	4.2E+11	1.6E+10	5.6E+11	1.9E+11	1.6E+12	TRUE	28
OF19	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	kg	2.1E+07	1.8E+05	1.9E+07	4.6E+06	7.9E+07	TRUE	11
Yeon-NW35	Lead	Metals	kg	1.3E+07	7.2E+06	4.3E+07	2.1E+07	7.1E+07	TRUE	104
Yeon-NW35	Mercury	Metals	kg	3.9E+04	1.1E+04	4.4E+04	3.0E+04	9.8E+04	TRUE	12
Yeon-NW35	Total PAHs	PAHs	kg	8.7E+05	5.6E+05	2.3E+06	1.7E+06	5.7E+06	TRUE	89
Yeon-NW35	Total PCB Congeners	PCB Congeners	kg	2.7E+10	8.2E+09	2.2E+11	7.9E+10	6.4E+11	TRUE	156
Yeon-NW35	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	kg	3.0E+04	1.6E+05	7.4E+06	1.9E+06	3.1E+07	FALSE	198

Notes:

*Relative percent difference between measured load and mean calculated load

The values presented in these tables are preliminary and will change slightly before the Final RI Report. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

EPA - U.S. Environmental Protection Agency
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
TEF - toxicity equivalency factor
TEQ - toxic equivalent concentration

Table E3-9. Processed Data versus Unprocessed Data.

						Processed Data Summary Statistics (Samples Averaged by Site)							
Land Use	**Analyte**	**Fraction**	**Analyte Group**	**Units**	**Basis**	**N**	**Detects**	**FOD**	**Minimum**	**Maximum**	**Mean**	**Median**	**95th Percentile**
Heavy Industrial	Arsenic	total	Metals	µg/L	NA	19	18	5	0.05452	8.24	2.02	0.944	6.75
Heavy Industrial	Chromium	total	Metals	µg/L	NA	17	17	0	1.25	9.00	4.49	4.03	8.97
Heavy Industrial	Copper	total	Metals	µg/L	NA	15	15	0	4.88	62.8	27.4	23.2	56.5
Heavy Industrial	Lead	total	Metals	µg/L	NA	17	17	0	2.99	48.3	19.8	14.5	48.2
Heavy Industrial	Mercury	total	Metals	µg/L	NA	17	9	47	0.0043	0.0750	0.0263	0.0213	0.0701
Heavy Industrial	Nickel	total	Metals	µg/L	NA	19	19	0	1.69	12.2	5.48	5.03	10.5
Heavy Industrial	Zinc	total	Metals	µg/L	NA	16	16	0	54.1	427	213	209	375
Heavy Industrial	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	19	19	0	2121	658333	148155	92600	467796
Heavy Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	19	19	0	0.00180	31.4	6.31	2.66	22.8
Heavy Industrial	PCB077	total	PCB_Congeners	pg/L	NA	19	19	0	6.58	1875	324	108	1051
Heavy Industrial	PCB081	total	PCB_Congeners	pg/L	NA	19	10	47	0.75	25.3	4.87	1.67	14.5
Heavy Industrial	PCB105	total	PCB_Congeners	pg/L	NA	19	19	0	40.9	9150	2156	1010	7845
Heavy Industrial	PCB106 & 118	total	PCB_Congeners	pg/L	NA	19	19	0	89.8	22493	5094	2402	16388
Heavy Industrial	PCB126	total	PCB_Congeners	pg/L	NA	19	16	16	2.75	300	61.4	25.1	224
Heavy Industrial	PCB156 & 157	total	PCB_Congeners	pg/L	NA	19	19	0	15.4	4590	948	662	3071
Heavy Industrial	PCB169	total	PCB_Congeners	pg/L	NA	19	2	89	2.80	33.9	6.28	3.25	29.4
Heavy Industrial	Aldrin	total	Pesticides	µg/L	NA	5	3	40	0.000407	0.00185	0.00106	0.000848	0.00178
Heavy Industrial	Dieldrin	total	Pesticides	µg/L	NA	4	2	50	0.000275	0.00241	0.00112	0.000906	0.00220
Heavy Industrial	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	5	4	20	0.000849	0.00310	0.00191	0.00193	0.00299
Heavy Industrial	Total Chlordane	total	Pesticides	µg/L	NA	4	4	0	0.00174	0.00796	0.00598	0.00710	0.00785
Heavy Industrial	4,4'-DDD	total	Pesticides	µg/L	NA	4	3	25	0.00100	0.00234	0.00157	0.00146	0.00224
Heavy Industrial	4,4'-DDT	total	Pesticides	µg/L	NA	4	2	50	0.002873	0.00799	0.00538	0.00533	0.00783
Heavy Industrial	Sum DDD	total	Pesticides	µg/L	NA	4	3	25	0.00063	0.00634	0.00260	0.00171	0.00566
Heavy Industrial	Sum DDE	total	Pesticides	µg/L	NA	4	3	25	0.000350	0.00266	0.00129	0.00107	0.00247
Heavy Industrial	Sum DDT	total	Pesticides	µg/L	NA	4	3	25	0.000803	0.00878	0.00474	0.00469	0.00853
Heavy Industrial	Total DDTs	total	Pesticides	µg/L	NA	4	3	25	0.00330	0.0126	0.00867	0.00941	0.0122
Heavy Industrial	Benzo(a)pyrene	total	PAHs	µg/L	NA	17	16	6	0.00553	0.193	0.0552	0.0367	0.179
Heavy Industrial	Naphthalene	total	PAHs	µg/L	NA	21	11	48	0.0076	0.568	0.0597	0.0247	0.098
Heavy Industrial	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	17	16	6	0.00300	0.305	0.0883	0.0593	0.286
Heavy Industrial	Total PAHs	total	PAHs	µg/L	NA	19	18	5	0.0705	5.10	1.45	0.900	3.81
Heavy Industrial	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	9	8	11	0.645	2.93	1.52	1.34	2.72
Heavy Industrial	Hexachlorobenzene	total	SVOCs	µg/L	NA	6	4	33	0.00004	0.0901	0.0154	0.0004	0.0679
Light Industrial	Arsenic	total	Metals	µg/L	NA	4	4	0	0.200	1.65	0.763	0.602	1.54
Light Industrial	Chromium	total	Metals	µg/L	NA	4	4	0	1.87	6.08	4.14	4.31	6.07
Light Industrial	Copper	total	Metals	µg/L	NA	4	4	0	5.20	16.5	10.8	10.8	15.7
Light Industrial	Lead	total	Metals	µg/L	NA	4	4	0	4.66	26.4	15.6	15.6	26.0
Light Industrial	Mercury	total	Metals	µg/L	NA	4	2	50	0.0124	0.0268	0.0209	0.0222	0.0266
Light Industrial	Nickel	total	Metals	µg/L	NA	4	4	0	1.72	2.73	2.10	1.97	2.62
Light Industrial	Zinc	total	Metals	µg/L	NA	4	4	0	42.1	181	101	89.7	171
Light Industrial	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	4	4	0	8923	49425	20195	11217	43812
Light Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	4	4	0	0.278	1.12	0.559	0.419	1.02
Light Industrial	PCB077	total	PCB_Congeners	pg/L	NA	4	4	0	13.8	121	54.2	40.9	110
Light Industrial	PCB081	total	PCB_Congeners	pg/L	NA	4	2	50	2.01	4.53	2.81	2.35	4.21
Light Industrial	PCB105	total	PCB_Congeners	pg/L	NA	4	4	0	85.6	600	242	142	536
Light Industrial	PCB106 & 118	total	PCB_Congeners	pg/L	NA	4	4	0	201	1385	563	334	1237
Light Industrial	PCB126	total	PCB_Congeners	pg/L	NA	4	4	0	4.42	25.7	12.1	9.22	23.7
Light Industrial	PCB169	total	PCB_Congeners	pg/L	NA	4	2	50	1.75	3.50	2.71	2.79	3.41

Table E3-9. Processed Data versus Unprocessed Data.

						Processed Data Summary Statistics (Samples Averaged by Site)							
Land Use	**Analyte**	**Fraction**	**Analyte Group**	**Units**	**Basis**	**N**	**Detects**	**FOD**	**Minimum**	**Maximum**	**Mean**	**Median**	**95th Percentile**
Light Industrial	Aldrin	total	Pesticides	µg/L	NA	1	0	100	0.00132	0.00132	0.00132	0.00132	0.00132
Light Industrial	Dieldrin	total	Pesticides	µg/L	NA	1	0	100	0.00146	0.00146	0.00146	0.00146	0.00146
Light Industrial	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	1	1	0	0.00216	0.00216	0.00216	0.00216	0.00216
Light Industrial	Total Chlordane	total	Pesticides	µg/L	NA	1	1	0	0.00233	0.00233	0.00233	0.00233	0.00233
Light Industrial	4,4'-DDD	total	Pesticides	µg/L	NA	1	0	100	0.00185	0.00185	0.00185	0.00185	0.00185
Light Industrial	4,4'-DDT	total	Pesticides	µg/L	NA	1	1	0	0.00926	0.00926	0.00926	0.00926	0.00926
Light Industrial	Sum DDD	total	Pesticides	µg/L	NA	1	1	0	0.00315	0.00315	0.00315	0.00315	0.00315
Light Industrial	Sum DDE	total	Pesticides	µg/L	NA	1	0	100	0.00190	0.00190	0.00190	0.00190	0.00190
Light Industrial	Sum DDT	total	Pesticides	µg/L	NA	1	1	0	0.00941	0.00941	0.00941	0.00941	0.00941
Light Industrial	Total DDTs	total	Pesticides	µg/L	NA	1	1	0	0.0112	0.0112	0.0112	0.0112	0.0112
Light Industrial	Benzo(a)pyrene	total	PAHs	µg/L	NA	4	4	0	0.0235	0.0433	0.0350	0.0367	0.0424
Light Industrial	Naphthalene	total	PAHs	µg/L	NA	4	3	25	0.0140	0.0599	0.0330	0.0290	0.0553
Light Industrial	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	4	4	0	0.0338	0.0770	0.0594	0.0635	0.0755
Light Industrial	Total PAHs	total	PAHs	µg/L	NA	4	4	0	0.463	1.40	0.788	0.644	1.29
Light Industrial	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	3	3	0	1.43	2.24	1.80	1.73	2.19
Light Industrial	Hexachlorobenzene	total	SVOCs	µg/L	NA	1	0	100	0.176	0.176	0.176	0.176	0.176
Open Space	Arsenic	total	Metals	µg/L	NA	1	1	0	0.209	0.209	0.209	0.209	0.209
Open Space	Chromium	total	Metals	µg/L	NA	1	1	0	1.71	1.71	1.71	1.71	1.71
Open Space	Copper	total	Metals	µg/L	NA	1	1	0	1.75	1.75	1.75	1.75	1.75
Open Space	Lead	total	Metals	µg/L	NA	1	1	0	0.803	0.803	0.803	0.803	0.803
Open Space	Mercury	total	Metals	µg/L	NA	1	0	100	0.0150	0.0150	0.0150	0.0150	0.0150
Open Space	Nickel	total	Metals	µg/L	NA	1	1	0	1.44	1.44	1.44	1.44	1.44
Open Space	Zinc	total	Metals	µg/L	NA	1	1	0	8.46	8.46	8.46	8.46	8.46
Open Space	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	1	1	0	288	288	288	288	288
Open Space	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	1	1	0	0.000563	0.000563	0.000563	0.000563	0.000563
Open Space	PCB077	total	PCB_Congeners	pg/L	NA	1	1	0	2.65	2.65	2.65	2.65	2.65
Open Space	PCB081	total	PCB_Congeners	pg/L	NA	1	0	100	0.988	0.988	0.988	0.988	0.988
Open Space	PCB105	total	PCB_Congeners	pg/L	NA	1	1	0	11.2	11.2	11.2	11.2	11.2
Open Space	PCB106 & 118	total	PCB_Congeners	pg/L	NA	1	1	0	28.8	28.8	28.8	28.8	28.8
Open Space	PCB126	total	PCB_Congeners	pg/L	NA	1	0	100	2.93	2.93	2.93	2.93	2.93
Open Space	PCB169	total	PCB_Congeners	pg/L	NA	1	0	100	1.67	1.67	1.67	1.67	1.67
Open Space	Benzo(a)pyrene	total	PAHs	µg/L	NA	1	0	100	0.00225	0.00225	0.00225	0.00225	0.00225
Open Space	Naphthalene	total	PAHs	µg/L	NA	1	0	100	0.0100	0.0100	0.0100	0.0100	0.0100
Open Space	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	1	1	0	0.00166	0.00166	0.00166	0.00166	0.00166
Open Space	Total PAHs	total	PAHs	µg/L	NA	1	1	0	0.0120	0.0120	0.0120	0.0120	0.0120
Open Space	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	1	1	0	0.307	0.307	0.307	0.307	0.307
Residential	Arsenic	total	Metals	µg/L	NA	2	2	0	0.344	0.814	0.579	0.579	0.791
Residential	Chromium	total	Metals	µg/L	NA	2	2	0	1.29	9.6	5.43	5.43	9.2
Residential	Copper	total	Metals	µg/L	NA	2	2	0	8.18	25.9	17.0	17.0	25.0
Residential	Lead	total	Metals	µg/L	NA	2	2	0	2.63	43.4	23.0	23.0	41.4
Residential	Mercury	total	Metals	µg/L	NA	2	1	50	0.0191	0.0432	0.0311	0.0311	0.0420
Residential	Nickel	total	Metals	µg/L	NA	2	2	0	1.59	4.91	3.25	3.25	4.74
Residential	Zinc	total	Metals	µg/L	NA	2	2	0	40.8	179	110	109.8	172
Residential	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	2	2	0	1427	50950	26188	26188	48474
Residential	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	2	2	0	0.00115	1.11	0.555	0.5549	1.05
Residential	PCB077	total	PCB_Congeners	pg/L	NA	2	2	0	5.62	131	68	68	124
Residential	PCB081	total	PCB_Congeners	pg/L	NA	2	0	100	1.97	46.8	24.4	24.37	44.5
Residential	PCB105	total	PCB_Congeners	pg/L	NA	2	2	0	31.7	604	318	318	575
Residential	PCB106 & 118	total	PCB_Congeners	pg/L	NA	2	2	0	70.7	1504	787	787	1432
Residential	PCB126	total	PCB_Congeners	pg/L	NA	2	1	50	3.05	55.0	29.0	29.0	52.4
Residential	PCB169	total	PCB_Congeners	pg/L	NA	2	0	100	2.43	46.4	24.4	24.39	44.2

Table E3-9. Processed Data versus Unprocessed Data.

						Processed Data Summary Statistics (Samples Averaged by Site)							
Land Use	**Analyte**	**Fraction**	**Analyte Group**	**Units**	**Basis**	**N**	**Detects**	**FOD**	**Minimum**	**Maximum**	**Mean**	**Median**	**95th Percentile**
Residential	Aldrin	total	Pesticides	µg/L	NA	1	0	100	0.00125	0.00125	0.00125	0.00125	0.00125
Residential	Dieldrin	total	Pesticides	µg/L	NA	1	0	100	0.00115	0.00115	0.00115	0.00115	0.00115
Residential	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	1	1	0	0.00151	0.00151	0.00151	0.00151	0.00151
Residential	Total Chlordane	total	Pesticides	µg/L	NA	1	1	0	0.00198	0.00198	0.00198	0.00198	0.00198
Residential	4,4'-DDD	total	Pesticides	µg/L	NA	1	0	100	0.00161	0.00161	0.00161	0.00161	0.00161
Residential	4,4'-DDT	total	Pesticides	µg/L	NA	1	0	100	0.00210	0.00210	0.00210	0.00210	0.00210
Residential	Sum DDD	total	Pesticides	µg/L	NA	1	0	100	0.00183	0.00183	0.00183	0.00183	0.00183
Residential	Sum DDE	total	Pesticides	µg/L	NA	1	1	0	0.00260	0.00260	0.00260	0.00260	0.00260
Residential	Sum DDT	total	Pesticides	µg/L	NA	1	0	100	0.00210	0.00210	0.00210	0.00210	0.00210
Residential	Total DDTs	total	Pesticides	µg/L	NA	1	1	0	0.00280	0.00280	0.00280	0.00280	0.00280
Residential	Benzo(a)pyrene	total	PAHs	µg/L	NA	2	2	0	0.00495	0.0478	0.0264	0.0264	0.0457
Residential	Naphthalene	total	PAHs	µg/L	NA	2	1	50	0.0066	0.0408	0.0237	0.0237	0.0391
Residential	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	2	2	0	0.00660	0.0728	0.0397	0.0397	0.0695
Residential	Total PAHs	total	PAHs	µg/L	NA	2	2	0	0.0915	0.835	0.463	0.463	0.798
Residential	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	2	2	0	1.90	4.90	3.40	3.40	4.75
Residential	Hexachlorobenzene	total	SVOCs	µg/L	NA	1	0	100	0.04973	0.0497	0.0497	0.0497	0.0497
Residential	Total organic carbon	Total	TOC	mg/L	NA	2	2	0	9.03	9.46	9.25		
Residential	Total organic carbon	Total	Conventionals	mg/L	NA	1	1	0	3.37	3.37	3.37	3.37	3.37
Residential	Total suspended solids	Total	Conventionals	mg/L	NA	2	2	0	17.3	152.7	85.0		
Residential	Total suspended solids	Total	Conventionals	mg/L	NA	1	1	0	61.3	61	61.3	61.3333333	61.33333333

Notes:

The values presented in these tables are preliminary and will change slightly before the final draft. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

FOD - fraction of detected
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
SVOC - semivolatile organic compound
TEF - toxicity equivalency factor
TEQ - toxic equivalent concentration

Table E3-9. Processed Data versus Unprocessed Data.

						Unprocessed Data Summary Statistics												
									Detects Only					All Data				
Land Use	Analyte	Fraction	Analyte Group	Units	Basis	N	Detects	FOD	Minimum	Maximum	Mean	Median	95th Percentile	Minimum	Maximum	Mean	Median	95th Percentile
Heavy Industrial	Arsenic	total	Metals	µg/L	NA	100	91	91	0.0910	19.8	2.93	0.870	17.2	0.0910	20.0	3.12	1.03	16.9
Heavy Industrial	Chromium	total	Metals	µg/L	NA	97	94	97	0.620	495	20.0	3.56	111	0.620	495	19.4	3.44	110
Heavy Industrial	Copper	total	Metals	µg/L	NA	97	97	100	3.10	809	66.9	23.3	296	3.10	809	66.9	23.3	296
Heavy Industrial	Lead	total	Metals	µg/L	NA	97	92	95	0.616	2480	78.8	14.6	236	0.616	2480	74.9	13.7	213
Heavy Industrial	Mercury	total	Metals	µg/L	NA	100	35	35	0.0200	1.79	0.297	0.100	0.985	0.0200	1.79	0.120	0.0225	0.614
Heavy Industrial	Nickel	total	Metals	µg/L	NA	97	93	96	0.750	170	9.09	4.64	17.7	0.750	170	8.78	4.54	17.1
Heavy Industrial	Zinc	total	Metals	µg/L	NA	97	97	100	43.6	11900	547	233	2360	43.6	11900	547	233	2360
Heavy Industrial	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	85	85	100	344	11600000	362000	52100	1160000	344	11600000	362000	52100	1160000
Heavy Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	85	84	99	0.00164	264	10.3	1.85	55.8	0.00164	264	10.2	1.80	53.8
Heavy Industrial	PCB077	total	PCB_Congeners	pg/L	NA	85	76	89	4.57	18700	753	117	2520	4.57	18700	674	98.0	1430
Heavy Industrial	PCB081	total	PCB_Congeners	pg/L	NA	85	23	27	1.96	1340	76.7	6.90	128	0.673	1340	24.4	4.16	36.0
Heavy Industrial	PCB105	total	PCB_Congeners	pg/L	NA	85	81	95	14.2	167000	5410	711	18000	8.20	167000	5150	648	17100
Heavy Industrial	PCB106 & 118	total	PCB_Congeners	pg/L	NA	77	74	96	25.8	397000	13700	1330	48900	25.8	397000	13200	1140	46500
Heavy Industrial	PCB126	total	PCB_Congeners	pg/L	NA	85	63	74	2.97	2420	128	32.8	594	2.96	2420	95.9	17.3	494
Heavy Industrial	PCB156 & 157	total	PCB_Congeners	pg/L	NA	8	8	100	11.9	1300	716	687	1290	11.9	1300	716	687	1290
Heavy Industrial	PCB169	total	PCB_Congeners	pg/L	NA	85	6	7	8.94	59.8	32.4	29.5	55.5	1.19	75.5	6.62	3.40	23.9
Heavy Industrial	Aldrin	total	Pesticides	µg/L	NA	25	6	24	0.000220	0.0270	0.0118	0.0109	0.0255	0.000220	0.0270	0.00389	0.00135	0.0208
Heavy Industrial	Dieldrin	total	Pesticides	µg/L	NA	25	7	28	0.000790	0.250	0.110	0.0890	0.244	0.000400	0.250	0.0328	0.00130	0.222
Heavy Industrial	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	25	7	28	0.00100	0.00450	0.00277	0.00310	0.00417	0.000500	0.0180	0.00282	0.00260	0.00740
Heavy Industrial	Total Chlordane	total	Pesticides	µg/L	NA	25	14	56	0.000980	0.130	0.0302	0.0122	0.101	0.000980	0.540	0.0336	0.00840	0.121
Heavy Industrial	4,4'-DDD	total	Pesticides	µg/L	NA	25	13	52	0.000500	1.10	0.152	0.0790	0.536	0.000490	1.10	0.0799	0.00310	0.160
Heavy Industrial	4,4'-DDT	total	Pesticides	µg/L	NA	25	8	32	0.00610	4.80	0.851	0.163	3.51	0.00130	4.80	0.289	0.0110	0.990
Heavy Industrial	Sum DDD	total	Pesticides	µg/L	NA	25	19	76	0.000500	1.60	0.145	0.0260	0.412	0.000500	1.60	0.111	0.00700	0.256
Heavy Industrial	Sum DDE	total	Pesticides	µg/L	NA	25	16	64	0.000530	2.20	0.297	0.0255	1.29	0.000490	2.20	0.190	0.00380	0.902
Heavy Industrial	Sum DDT	total	Pesticides	µg/L	NA	25	19	76	0.000680	7.10	0.588	0.0120	2.78	0.000680	7.10	0.450	0.0110	2.03
Heavy Industrial	Total DDTs	total	Pesticides	µg/L	NA	25	22	88	0.00480	11.0	0.858	0.0185	3.51	0.00200	11.0	0.755	0.0150	3.22
Heavy Industrial	Benzo(a)pyrene	total	PAHs	µg/L	NA	85	67	79	0.00540	3.70	0.257	0.0440	1.26	0.00430	3.70	0.211	0.0400	0.918
Heavy Industrial	Naphthalene	total	PAHs	µg/L	NA	86	30	35	0.0170	4.10	0.336	0.0535	1.91	0.00300	4.10	0.139	0.0315	0.273
Heavy Industrial	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	86	76	88	0.0110	22.0	1.61	0.290	7.20	0.00430	22.0	1.43	0.240	5.45
Heavy Industrial	Total PAHs	total	PAHs	µg/L	NA	86	79	92	0.0480	37.0	3.26	0.970	13.0	0.0480	37.0	3.01	0.715	12.0
Heavy Industrial	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	48	32	67	0.370	10.0	2.77	1.75	8.14	0.190	10.0	2.07	0.985	7.97
Heavy Industrial	Hexachlorobenzene	total	SVOCs	µg/L	NA	25	4	16	0.000360	0.00180	0.00112	0.00117	0.00174	0.000150	0.0150	0.00143	0.000930	0.00435
Light Industrial	Arsenic	total	Metals	µg/L	NA	20	20	100	0.130	2.27	0.789	0.754	1.87	0.130	2.27	0.789	0.754	1.87
Light Industrial	Chromium	total	Metals	µg/L	NA	20	20	100	1.39	12.7	4.18	2.88	10.3	1.39	12.7	4.18	2.88	10.3
Light Industrial	Copper	total	Metals	µg/L	NA	20	20	100	2.92	22.9	11.5	9.09	22.2	2.92	22.9	11.5	9.09	22.2
Light Industrial	Lead	total	Metals	µg/L	NA	20	20	100	2.85	50.4	15.6	8.71	40.8	2.85	50.4	15.6	8.71	40.8
Light Industrial	Mercury	total	Metals	µg/L	NA	21	5	24	0.0300	0.0500	0.0360	0.0300	0.0480	0.0200	0.200	0.0286	0.0150	0.100
Light Industrial	Nickel	total	Metals	µg/L	NA	20	20	100	0.820	3.58	2.19	2.10	3.45	0.820	3.58	2.19	2.10	3.45
Light Industrial	Zinc	total	Metals	µg/L	NA	20	20	100	28.9	227	108	91.9	217	28.9	227	108	91.9	217
Light Industrial	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	19	19	100	1700	594000	67800	12200	393000	1700	594000	67800	12200	393000
Light Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	19	19	100	0.00336	14.5	1.62	0.0562	8.33	0.00336	14.5	1.62	0.0562	8.33
Light Industrial	PCB077	total	PCB_Congeners	pg/L	NA	19	15	79	20.6	1240	141	51.2	501	9.11	1240	113	30.8	290
Light Industrial	PCB081	total	PCB_Congeners	pg/L	NA	19	3	16	2.04	7.49	4.52	4.03	7.14	2.04	15.5	3.19	2.78	7.52
Light Industrial	PCB105	total	PCB_Congeners	pg/L	NA	19	19	100	27.6	10200	1090	148	6930	27.6	10200	1090	148	6930
Light Industrial	PCB106 & 118	total	PCB_Congeners	pg/L	NA	19	19	100	69.5	32000	2990	353	17300	69.5	32000	2990	353	17300
Light Industrial	PCB126	total	PCB_Congeners	pg/L	NA	19	9	47	5.34	136	30.8	12.0	107	4.46	136	17.0	6.91	69.8
Light Industrial	PCB169	total	PCB_Congeners	pg/L	NA	19	2	11	3.29	4.04	3.67	3.67	4.00	1.91	17.4	3.12	3.26	5.46

Table E3-9. Processed Data versus Unprocessed Data.

									Unprocessed Data Summary Statistics									
									Detects Only					All Data				
Land Use	Analyte	Fraction	Analyte Group	Units	Basis	N	Detects	FOD	Minimum	Maximum	Mean	Median	95th Percentile	Minimum	Maximum	Mean	Median	95th Percentile
Light Industrial	Aldrin	total	Pesticides	µg/L	NA	6	0	0						0.000490	0.00880	0.00124	0.000318	0.00378
Light Industrial	Dieldrin	total	Pesticides	µg/L	NA	6	0	0						0.000490	0.00880	0.00129	0.000925	0.00355
Light Industrial	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	6	1	17	0.00280	0.00280	0.00280	0.00280		0.000490	0.00880	0.00177	0.00123	0.00400
Light Industrial	Total Chlordane	total	Pesticides	µg/L	NA	6	4	67	0.00120	0.00520	0.00235	0.00150	0.00466	0.00120	0.00730	0.00232	0.00150	0.00481
Light Industrial	4,4'-DDD	total	Pesticides	µg/L	NA	6	0	0						0.000490	0.0120	0.00137	0.000575	0.00465
Light Industrial	4,4'-DDT	total	Pesticides	µg/L	NA	6	1	17	0.0310	0.0310	0.0310	0.0310		0.000850	0.0310	0.00672	0.00203	0.0244
Light Industrial	Sum DDD	total	Pesticides	µg/L	NA	6	1	17	0.00530	0.00530	0.00530	0.00530		0.000970	0.0120	0.00228	0.000675	0.00583
Light Industrial	Sum DDE	total	Pesticides	µg/L	NA	6	0	0						0.000490	0.0110	0.00153	0.000800	0.00445
Light Industrial	Sum DDT	total	Pesticides	µg/L	NA	6	2	33	0.00180	0.0310	0.0164	0.0164	0.0295	0.000850	0.0310	0.00655	0.00150	0.0244
Light Industrial	Total DDTs	total	Pesticides	µg/L	NA	6	2	33	0.00710	0.0310	0.0191	0.0191	0.0298	0.00110	0.0310	0.00774	0.00360	0.0250
Light Industrial	Benzo(a)pyrene	total	PAHs	µg/L	NA	17	16	94	0.0130	0.0920	0.0343	0.0235	0.0635	0.00490	0.0920	0.0324	0.0230	0.0616
Light Industrial	Naphthalene	total	PAHs	µg/L	NA	17	10	59	0.0150	0.110	0.0396	0.0325	0.0834	0.00350	0.110	0.0300	0.0220	0.0628
Light Industrial	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	17	17	100	0.0750	0.750	0.285	0.160	0.638	0.0750	0.750	0.285	0.160	0.638
Light Industrial	Total PAHs	total	PAHs	µg/L	NA	17	17	100	0.250	1.60	0.696	0.460	1.60	0.250	1.60	0.696	0.460	1.60
Light Industrial	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	14	14	100	1.00	4.20	1.93	1.60	4.14	1.00	4.20	1.93	1.60	4.14
Light Industrial	Hexachlorobenzene	total	SVOCs	µg/L	NA	6	0	0						0.000490	0.00880	0.00124	0.000725	0.00358
Open Space	Arsenic	total	Metals	µg/L	NA	3	3	100	0.196	0.228	0.209	0.202	0.225	0.196	0.228	0.209	0.202	0.225
Open Space	Chromium	total	Metals	µg/L	NA	3	3	100	0.870	3.05	1.71	1.22	2.87	0.870	3.05	1.71	1.22	2.87
Open Space	Copper	total	Metals	µg/L	NA	3	3	100	1.01	3.07	1.75	1.16	2.88	1.01	3.07	1.75	1.16	2.88
Open Space	Lead	total	Metals	µg/L	NA	3	3	100	0.403	1.57	0.803	0.437	1.46	0.403	1.57	0.803	0.437	1.46
Open Space	Mercury	total	Metals	µg/L	NA	4	0	0						0.0300	0.0300	0.0150	0.0150	0.0150
Open Space	Nickel	total	Metals	µg/L	NA	3	3	100	0.950	2.10	1.44	1.28	2.02	0.950	2.10	1.44	1.28	2.02
Open Space	Zinc	total	Metals	µg/L	NA	3	3	100	3.69	13.1	8.46	8.59	12.6	3.69	13.1	8.46	8.59	12.6
Open Space	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	5	3	60	80.8	641	310	208	598	52.4	641	197	80.8	554
Open Space	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	5	3	60	0.000462	0.00238	0.00155	0.00181	0.00232	0.000462	1.61	0.228	0.00238	0.710
Open Space	PCB077	total	PCB_Congeners	pg/L	NA	5	1	20	3.92	3.92	3.92	3.92		3.73	6.96	2.66	2.05	3.83
Open Space	PCB081	total	PCB_Congeners	pg/L	NA	5	0	0						1.47	4.23	1.40	1.27	2.08
Open Space	PCB105	total	PCB_Congeners	pg/L	NA	5	3	60	12.6	18.9	15.6	15.4	18.6	7.64	18.9	11.4	12.6	18.2
Open Space	PCB106 & 118	total	PCB_Congeners	pg/L	NA	5	2	40	34.2	47.3	40.8	40.8	46.6	9.80	47.3	22.1	15.4	44.7
Open Space	PCB126	total	PCB_Congeners	pg/L	NA	5	0	0						4.31	16.1	4.29	3.32	7.37
Open Space	PCB169	total	PCB_Congeners	pg/L	NA	5	0	0						1.69	6.51	2.27	2.26	3.22
Open Space	Benzo(a)pyrene	total	PAHs	µg/L	NA	3	0	0						0.00440	0.00460	0.00225	0.00225	0.00230
Open Space	Naphthalene	total	PAHs	µg/L	NA	5	0	0						0.0150	0.0280	0.00930	0.00850	0.0129
Open Space	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	5	1	20	0.00880	0.00880	0.00880	0.00880		0.00540	0.00880	0.00398	0.00280	0.00760
Open Space	Total PAHs	total	PAHs	µg/L	NA	5	1	20	0.0200	0.0200	0.0200	0.0200		0.0150	0.0200	0.0105	0.00850	0.0177
Open Space	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	5	1	20	0.830	0.830	0.830	0.830		0.0710	0.830	0.206	0.0550	0.677
Residential	Arsenic	total	Metals	µg/L	NA	6	6	100	0.255	1.36	0.556	0.415	1.17	0.255	1.36	0.556	0.415	1.17
Residential	Chromium	total	Metals	µg/L	NA	6	6	100	0.830	31.8	6.78	1.59	24.8	0.830	31.8	6.78	1.59	24.8
Residential	Copper	total	Metals	µg/L	NA	6	6	100	6.92	83.5	21.5	9.28	65.8	6.92	83.5	21.5	9.28	65.8
Residential	Lead	total	Metals	µg/L	NA	6	6	100	1.39	138	28.2	3.53	109	1.39	138	28.2	3.53	109
Residential	Mercury	total	Metals	µg/L	NA	6	2	33	0.0300	0.130	0.0800	0.0800	0.125	0.0300	0.130	0.0367	0.0150	0.105
Residential	Nickel	total	Metals	µg/L	NA	6	6	100	0.980	14.6	3.96	2.01	11.7	0.980	14.6	3.96	2.01	11.7
Residential	Zinc	total	Metals	µg/L	NA	6	6	100	30.7	609	142	49.6	477	30.7	609	142	49.6	477
Residential	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	6	6	100	1140	134000	37600	11800	117000	1140	134000	37600	11800	117000
Residential	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	6	6	100	0.000471	3.83	1.12	0.618	3.28	0.000471	3.83	1.12	0.618	3.28
Residential	PCB077	total	PCB_Congeners	pg/L	NA	6	4	67	6.82	346	139	102	316	6.30	346	94.0	32.5	296
Residential	PCB081	total	PCB_Congeners	pg/L	NA	6	0	0						1.42	13.1	3.27	3.58	5.98
Residential	PCB105	total	PCB_Congeners	pg/L	NA	6	4	67	42.5	1580	657	502	1460	31.4	1580	444	149	1370
Residential	PCB106 & 118	total	PCB_Congeners	pg/L	NA	6	5	83	53.7	3750	1260	623	3350	53.7	3750	1060	361	3250
Residential	PCB126	total	PCB_Congeners	pg/L	NA	6	3	50	11.9	36.1	21.1	15.3	34.0	3.23	36.1	12.1	8.58	30.9
Residential	PCB169	total	PCB_Congeners	pg/L	NA	6	0	0						3.17	12.5	3.08	2.72	5.53

Table E3-9. Processed Data versus Unprocessed Data.

						Unprocessed Data Summary Statistics												
									Detects Only					All Data				
Land Use	**Analyte**	**Fraction**	**Analyte Group**	**Units**	**Basis**	**N**	**Detects**	**FOD**	**Minimum**	**Maximum**	**Mean**	**Median**	**95th Percentile**	**Minimum**	**Maximum**	**Mean**	**Median**	**95th Percentile**
Residential	Aldrin	total	Pesticides	µg/L	NA	3	0	0						0.000770	0.00530	0.00125	0.000700	0.00246
Residential	Dieldrin	total	Pesticides	µg/L	NA	3	0	0						0.000500	0.00530	0.00115	0.000550	0.00244
Residential	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	3	1	33	0.00160	0.00160	0.00160	0.00160		0.000530	0.00530	0.00151	0.00160	0.00255
Residential	Total Chlordane	total	Pesticides	µg/L	NA	3	3	100	0.000540	0.00390	0.00198	0.00150	0.00366	0.000540	0.00390	0.00198	0.00150	0.00366
Residential	4,4'-DDD	total	Pesticides	µg/L	NA	3	0	0						0.000500	0.00850	0.00161	0.000320	0.00386
Residential	4,4'-DDT	total	Pesticides	µg/L	NA	3	0	0						0.00170	0.00670	0.00210	0.00210	0.00323
Residential	Sum DDD	total	Pesticides	µg/L	NA	3	0	0						0.000990	0.00850	0.00183	0.000750	0.00390
Residential	Sum DDE	total	Pesticides	µg/L	NA	3	1	33	0.000810	0.000810	0.000810	0.000810		0.000810	0.0110	0.00260	0.00150	0.00510
Residential	Sum DDT	total	Pesticides	µg/L	NA	3	0	0						0.00170	0.00670	0.00210	0.00210	0.00323
Residential	Total DDTs	total	Pesticides	µg/L	NA	3	1	33	0.000810	0.000810	0.000810	0.000810		0.000810	0.0110	0.00280	0.00210	0.00516
Residential	Benzo(a)pyrene	total	PAHs	µg/L	NA	7	5	71	0.00620	0.0990	0.0383	0.0370	0.0874	0.00440	0.0990	0.0280	0.00850	0.0816
Residential	Naphthalene	total	PAHs	µg/L	NA	7	3	43	0.0280	0.0430	0.0330	0.0280	0.0415	0.0180	0.0430	0.0200	0.0115	0.0385
Residential	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	7	7	100	0.0210	0.590	0.180	0.0390	0.497	0.0210	0.590	0.180	0.0390	0.497
Residential	Total PAHs	total	PAHs	µg/L	NA	7	7	100	0.0740	1.40	0.445	0.100	1.19	0.0740	1.40	0.445	0.100	1.19
Residential	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	6	6	100	1.00	6.70	3.78	3.60	6.45	1.00	6.70	3.78	3.60	6.45
Residential	Hexachlorobenzene	total	SVOCs	µg/L	NA	3	0	0						0.000500	0.00530	0.00113	0.000475	0.00243
Residential	Total organic carbon	Total	TOC	mg/L	NA	8	8	100	4.00	15.6	8.84	8.10	14.9	4.00	15.6	8.84	8.10	14.9
Residential	Total organic carbon	Total	Conventionals	mg/L	NA	8	8	100	4.00	15.6	8.84	8.10	14.9	4.00	15.6	8.84	8.10	14.9
Residential	Total suspended solids	Total	Conventionals	mg/L	NA	8	8	100	7.00	230	67.9	27.0	199	7.00	230	67.9	27.0	199
Residential	Total suspended solids	Total	Conventionals	mg/L	NA	8	8	100	7.00	230	67.9	27.0	199	7.00	230	67.9	27.0	199

Notes:

The values presented in these tables are preliminary and will change slightly before the final draft. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

FOD - fraction of detected
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
SVOC - semivolatile organic compound
TEF - toxicity equivalency factor
TEQ - toxic equivalent concentration

Table E3-9. Processed Data versus Unprocessed Data.

Land Use	Analyte	Fraction	Analyte Group	Units	Basis	Percent Difference				
						Minimum	Mean	Median	95th Percentile	Maximum
Heavy Industrial	Arsenic	total	Metals	µg/L	NA	50	43	9	86	83
Heavy Industrial	Chromium	total	Metals	µg/L	NA	-67	125	-16	170	193
Heavy Industrial	Copper	total	Metals	µg/L	NA	-45	84	0	136	171
Heavy Industrial	Lead	total	Metals	µg/L	NA	-132	116	-6	126	192
Heavy Industrial	Mercury	total	Metals	µg/L	NA	129	128	6	159	184
Heavy Industrial	Nickel	total	Metals	µg/L	NA	-77	46	-10	48	173
Heavy Industrial	Zinc	total	Metals	µg/L	NA	-21	88	11	145	186
Heavy Industrial	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	-144	84	-56	85	179
Heavy Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	-9	47	-38	81	158
Heavy Industrial	PCB077	total	PCB_Congeners	pg/L	NA	-36	70	-10	31	164
Heavy Industrial	PCB081	total	PCB_Congeners	pg/L	NA	-10	133	86	85	193
Heavy Industrial	PCB105	total	PCB_Congeners	pg/L	NA	-133	82	-44	74	179
Heavy Industrial	PCB106 & 118	total	PCB_Congeners	pg/L	NA	-111	89	-71	96	179
Heavy Industrial	PCB126	total	PCB_Congeners	pg/L	NA	7	44	-37	75	156
Heavy Industrial	PCB156 & 157	total	PCB_Congeners	pg/L	NA	-25	-28	4	-82	-112
Heavy Industrial	PCB169	total	PCB_Congeners	pg/L	NA	-81	5	5	-21	76
Heavy Industrial	Aldrin	total	Pesticides	µg/L	NA	-60	114	46	168	174
Heavy Industrial	Dieldrin	total	Pesticides	µg/L	NA	37	187	36	196	196
Heavy Industrial	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	-52	38	30	85	141
Heavy Industrial	Total Chlordane	total	Pesticides	µg/L	NA	-56	140	17	176	194
Heavy Industrial	4,4'-DDD	total	Pesticides	µg/L	NA	-68	192	72	194	199
Heavy Industrial	4,4'-DDT	total	Pesticides	µg/L	NA	-75	193	69	197	199
Heavy Industrial	Sum DDD	total	Pesticides	µg/L	NA	-22	191	121	191	198
Heavy Industrial	Sum DDE	total	Pesticides	µg/L	NA	33	197	112	199	200
Heavy Industrial	Sum DDT	total	Pesticides	µg/L	NA	-17	196	80	198	200
Heavy Industrial	Total DDTs	total	Pesticides	µg/L	NA	-49	195	46	198	200
Heavy Industrial	Benzo(a)pyrene	total	PAHs	µg/L	NA	-25	117	9	135	180
Heavy Industrial	Naphthalene	total	PAHs	µg/L	NA	-86	80	24	94	151
Heavy Industrial	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	36	177	121	180	195
Heavy Industrial	Total PAHs	total	PAHs	µg/L	NA	-38	70	-23	104	152
Heavy Industrial	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	-109	31	-30	98	109
Heavy Industrial	Hexachlorobenzene	total	SVOCs	µg/L	NA	114	-166	72	-176	-143
Light Industrial	Arsenic	total	Metals	µg/L	NA	-42	3	22	19	32
Light Industrial	Chromium	total	Metals	µg/L	NA	-29	1	-40	52	71
Light Industrial	Copper	total	Metals	µg/L	NA	-56	6	-17	34	32
Light Industrial	Lead	total	Metals	µg/L	NA	-48	0	-57	44	63
Light Industrial	Mercury	total	Metals	µg/L	NA	47	31	-39	116	153
Light Industrial	Nickel	total	Metals	µg/L	NA	-71	4	6	27	27
Light Industrial	Zinc	total	Metals	µg/L	NA	-37	7	2	24	23
Light Industrial	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	-136	108	8	160	169
Light Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	-195	97	-153	156	171
Light Industrial	PCB077	total	PCB_Congeners	pg/L	NA	-41	70	-28	90	164
Light Industrial	PCB081	total	PCB_Congeners	pg/L	NA	2	13	17	56	109
Light Industrial	PCB105	total	PCB_Congeners	pg/L	NA	-102	127	4	171	178
Light Industrial	PCB106 & 118	total	PCB_Congeners	pg/L	NA	-97	137	6	173	183
Light Industrial	PCB126	total	PCB_Congeners	pg/L	NA	1	33	-29	99	136
Light Industrial	PCB169	total	PCB_Congeners	pg/L	NA	9	14	16	46	133

Table E3-9. Processed Data versus Unprocessed Data.

						Percent Difference				
Land Use	**Analyte**	**Fraction**	**Analyte Group**	**Units**	**Basis**	**Minimum**	**Mean**	**Median**	**95th Percentile**	**Maximum**
Light Industrial	Aldrin	total	Pesticides	µg/L	NA	-91	-6	-122	97	148
Light Industrial	Dieldrin	total	Pesticides	µg/L	NA	-99	-12	-45	83	143
Light Industrial	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	-126	-20	-55	60	121
Light Industrial	Total Chlordane	total	Pesticides	µg/L	NA	-64	0	-43	70	103
Light Industrial	4,4'-DDD	total	Pesticides	µg/L	NA	-116	-30	-105	86	147
Light Industrial	4,4'-DDT	total	Pesticides	µg/L	NA	-166	-32	-128	90	108
Light Industrial	Sum DDD	total	Pesticides	µg/L	NA	-106	-32	-129	60	117
Light Industrial	Sum DDE	total	Pesticides	µg/L	NA	-118	-22	-81	80	141
Light Industrial	Sum DDT	total	Pesticides	µg/L	NA	-167	-36	-145	89	107
Light Industrial	Total DDTs	total	Pesticides	µg/L	NA	-164	-36	-102	77	94
Light Industrial	Benzo(a)pyrene	total	PAHs	µg/L	NA	-131	-8	-46	37	72
Light Industrial	Naphthalene	total	PAHs	µg/L	NA	-120	-9	-28	13	59
Light Industrial	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	76	131	86	158	163
Light Industrial	Total PAHs	total	PAHs	µg/L	NA	-60	-12	-33	21	13
Light Industrial	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	-35	7	-8	62	61
Light Industrial	Hexachlorobenzene	total	SVOCs	µg/L	NA	-199	-197	-198	-192	-181
Open Space	Arsenic	total	Metals	µg/L	NA	-6	0	-3	8	9
Open Space	Chromium	total	Metals	µg/L	NA	-65	0	-34	50	56
Open Space	Copper	total	Metals	µg/L	NA	-53	0	-40	49	55
Open Space	Lead	total	Metals	µg/L	NA	-66	0	-59	58	65
Open Space	Mercury	total	Metals	µg/L	NA	67	0	0	0	67
Open Space	Nickel	total	Metals	µg/L	NA	-41	0	-12	33	37
Open Space	Zinc	total	Metals	µg/L	NA	-79	0	2	39	43
Open Space	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	-138	-37	-112	63	76
Open Space	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	-20	199	123	200	200
Open Space	PCB077	total	PCB_Congeners	pg/L	NA	34	1	-25	37	90
Open Space	PCB081	total	PCB_Congeners	pg/L	NA	39	34	25	71	124
Open Space	PCB105	total	PCB_Congeners	pg/L	NA	-38	2	12	48	51
Open Space	PCB106 & 118	total	PCB_Congeners	pg/L	NA	-98	-26	-61	43	49
Open Space	PCB126	total	PCB_Congeners	pg/L	NA	38	38	13	86	139
Open Space	PCB169	total	PCB_Congeners	pg/L	NA	1	30	30	63	118
Open Space	Benzo(a)pyrene	total	PAHs	µg/L	NA	65	0	0	2	69
Open Space	Naphthalene	total	PAHs	µg/L	NA	40	-7	-16	25	95
Open Space	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	106	82	51	128	137
Open Space	Total PAHs	total	PAHs	µg/L	NA	22	-13	-34	38	50
Open Space	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	-125	-39	-139	75	92
Residential	Arsenic	total	Metals	µg/L	NA	-30	-4	-33	39	50
Residential	Chromium	total	Metals	µg/L	NA	-44	22	-109	92	107
Residential	Copper	total	Metals	µg/L	NA	-17	23	-59	90	105
Residential	Lead	total	Metals	µg/L	NA	-62	20	-147	90	104
Residential	Mercury	total	Metals	µg/L	NA	44	16	-70	86	100
Residential	Nickel	total	Metals	µg/L	NA	-47	20	-47	85	99
Residential	Zinc	total	Metals	µg/L	NA	-28	26	-76	94	109
Residential	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	-22	36	-76	83	90
Residential	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	-84	67	11	103	110
Residential	PCB077	total	PCB_Congeners	pg/L	NA	11	32	-71	82	90
Residential	PCB081	total	PCB_Congeners	pg/L	NA	-32	-153	-149	-153	-112
Residential	PCB105	total	PCB_Congeners	pg/L	NA	-1	33	-72	82	89
Residential	PCB106 & 118	total	PCB_Congeners	pg/L	NA	-27	30	-74	78	86
Residential	PCB126	total	PCB_Congeners	pg/L	NA	6	-82	-109	-52	-42
Residential	PCB169	total	PCB_Congeners	pg/L	NA	27	-155	-160	-155	-115

Table E3-9. Processed Data versus Unprocessed Data.

Land Use	Analyte	Fraction	Analyte Group	Units	Basis	Percent Difference				
						Minimum	Mean	Median	95th Percentile	Maximum
Residential	Aldrin	total	Pesticides	µg/L	NA	-47	0	-56	66	124
Residential	Dieldrin	total	Pesticides	µg/L	NA	-79	0	-71	72	129
Residential	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	-96	0	6	52	112
Residential	Total Chlordane	total	Pesticides	µg/L	NA	-114	0	-28	60	65
Residential	4,4'-DDD	total	Pesticides	µg/L	NA	-105	0	-134	82	136
Residential	4,4'-DDT	total	Pesticides	µg/L	NA	-21	0	0	42	105
Residential	Sum DDD	total	Pesticides	µg/L	NA	-60	0	-84	72	129
Residential	Sum DDE	total	Pesticides	µg/L	NA	-105	0	-54	65	123
Residential	Sum DDT	total	Pesticides	µg/L	NA	-21	0	0	42	105
Residential	Total DDTs	total	Pesticides	µg/L	NA	-110	0	-29	59	119
Residential	Benzo(a)pyrene	total	PAHs	µg/L	NA	-12	6	-103	56	70
Residential	Naphthalene	total	PAHs	µg/L	NA	92	-17	-69	-1	5
Residential	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	104	128	-2	151	156
Residential	Total PAHs	total	PAHs	µg/L	NA	-21	-4	-129	39	51
Residential	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	-62	11	6	30	31
Residential	Hexachlorobenzene	total	SVOCs	µg/L	NA	-196	-191	-196	-181	-161
Residential	Total organic carbon	Total	TOC	mg/L	NA	-77	-5	100	100	49
Residential	Total organic carbon	Total	Conventionals	mg/L	NA	17	90	83	126	129
Residential	Total suspended solids	Total	Conventionals	mg/L	NA	-85	-22	100	100	40
Residential	Total suspended solids	Total	Conventionals	mg/L	NA	-159	10	-78	106	116

Notes:

The values presented in these tables are preliminary and will change slightly before the final draft. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

FOD - fraction of detected
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
SVOC - semivolatile organic compound
TEF - toxicity equivalency factor
TEQ - toxic equivalent concentration

Table E4-1. Direct Permitted Dischargers Estimated Annual Loads (kg/yr).[a]

	Study Area All Direct Discharges			**Evraz Oregon Steel** (Oregon Steel Mills, Inc.) NPDES OR101007 IW-B08 OR-DEQ 1051 March 2006 - February 2008			**Kinder Morgan Liquid Terminals LLC** ORG910059 GEN15A OR-DEQ 549 January 2006 - December 2007			**Kinder Morgan Bulk Terminal** NPDES OR0031402 IW-B15 OR-DEQ 12595 May 2006 - April 2008			**ARCO Products Company** (BP Portland Terminal) NPDES ORG910001 GEN15A OR-DEQ 8988 July 2005 - June 2007			**Koppers Inc.** NPDES OR0000779 IW-B15 OR DEQ 92481 May 2006 - April 2008		
	RM 1.8 - 11.8			RM 2.3 East			RM 4.1 West			RM 4.6 East			RM 4.8 West			RM 6.5 West		
Analyte	**Upper**	**Central**	**Lower**	**Upper**	**Central**	**Lower**	**Upper**	**Central**	**Lower**	**Upper**	**Central**	**Lower**	**Upper**	**Central**	**Lower**	**Upper**	**Central**	**Lower**
Cyanide	0.0423	0.0423	0.0423	--	--	--	--	--	--	--	--	--	--	--	--	0.0423	0.0423	0.0423
Arsenic (Pentavalent)	0.0550	0.0550	0.0550	--	--	--	--	--	--	--	--	--	--	--	--	0.0550	0.0550	0.0550
Arsenic (Trivalent)	0.0633	0.0381	0.0129	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium	0.420	0.420	0.420	--	--	--	--	--	--	--	--	--	--	--	--	0.420	0.420	0.420
Chromium (hexavalent)	0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium (total)	0.513	0.465	0.417	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Copper	96.6	64.5	32.4	10.4	8.7	7.06	--	--	--	86.2	55.8	25.3	--	--	--	0.0175	0.0175	0.0175
Lead	123	78.9	34.8	--	--	--	--	--	--	123	79	34.6	ND	ND	ND	0.153	0.153	0.153
Mercury	0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	2.75E-04	2.75E-04	2.75E-04
Zinc	549	449	350	--	--	--	--	--	--	548	449	350	--	--	--	0.594	0.594	0.594
DDT	0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	0.0532	0.0532	0.0532	--	--	--	--	--	--	--	--	--	--	--	--	0.0532	0.0532	0.0532
Total PAHs	1.24	1.24	1.24	--	--	--	--	--	--	--	--	--	--	--	--	1.24	1.24	1.24
1,1,2-Trichloroethane	0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	3.19	3.19	3.19	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	1.71	1.71	1.71
Chloroethane	0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride	0	0	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	15.9	15.9	15.9	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	--	--	--

Table E4-1. Direct Permitted Discha

	Siltronic Corporation NPDES OR0030589 IW-B14 OR-DEQ 432 January 2006 - December 2007			**Starlink Logistics, Inc.** (Rhone Poulenc) NPDES OR0001741 IW-B15 OR-DEQ 1579 January 2006 - December 2007			**Univar USA Inc** NPDES OR0034606 IW-B15 OR-DEQ 1053 April 2006 - April 2008			**Equilon Enterprises LLC** (Shell Oil Products) NPDES ORG910003 GEN15A OR-DEQ 1261 January 2007 - October 2007			**Pinnacle Condominium Complex** NPDES OR0038156 IW-B15 OR-DEQ 91530 January 2007 - December 2008		
	RM 6.5 West			RM 7.2 West			RM 8.9 West			RM 8.8 West			RM 11.4 West		
Analyte	**Upper**	**Central**	**Lower**	**Upper**	**Central**	**Lower**	**Upper**	**Central**	**Lower**	**Upper**	**Central**	**Lower**	**Upper**	**Central**	**Lower**
Cyanide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic (Pentavalent)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic (Trivalent)	--	--	--	0.0633	0.0381	0.0129	--	--	--	--	--	--	--	--	--
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium (hexavalent)	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--
Chromium (total)	0.513	0.465	0.417	--	--	--	--	--	--	--	--	--	--	--	--
Copper	--	--	--	--	--	--	--	--	--	ND	ND	ND	0.00864	0.00533	0.00202
Lead	--	--	--	--	--	--	--	--	--	ND	ND	ND	0.00283	0.00271	0.00258
Mercury	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND
Zinc	--	--	--	--	--	--	--	--	--	ND	ND	ND	0.0329	0.0259	0.0188
DDT	--	--	--	ND	ND	ND	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PAHs	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	--	--	--	--	--	--	ND	ND	ND	--	--	--	--	--	--
Benzene	--	--	--	--	--	--	ND	ND	ND	1.48	1.48	1.48	ND	ND	ND
Chloroethane	--	--	--	--	--	--	ND	ND	ND	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--	--	ND	ND	ND	--	--	--
Trichloroethene	--	--	--	--	--	--	ND	ND	ND	--	--	--	--	--	--
Vinyl Chloride	--	--	--	--	--	--	ND	ND	ND	--	--	--	--	--	--
Total Petroleum Hydrocarbons	--	--	--	--	--	--	--	--	--	15.9	15.9	15.9	ND	ND	ND

Notes:

[a] The following NPDES-permitted sites were not included in this loading analysis:
(1) Ash Grove, RM 2.8, NPDES OR0001601 IW-B16, OR-SIS 3690 (no discharge reported)
(2) Columbia River Sand and Gravel (Linnton Sand Distribution), RM 4.7, NPDES OR0039896 IW-B16, OR-SIS 50872 (no chemical data reported)
(3) Vigor Industrial LLC, RM 8.3, NPDES OR0022942 IW-B15, OR-DEQ 316 (no discharge reported)
(4) Metropolitan Condomium Complex, RM 11.5, NPDES OR0038229 IW-B16, OR-SIS 92369 (no discharge reported)

-- No data
ND - all measurements were below instrument detection limits. A concentration of 0 mg/L was applied in loading calculations.
NPDES - National Pollutant Discharge Elimination System
PAH - polycyclic aromatic hydrocarbon

Table E5-1a. Ambient Air Concentration Data Used for Dry Deposition Annual Load Calculations.

Chemical	Value Type	Ambient Concentration Value	Units	Data Source [a]	Site	Notes
Metals						
Arsenic	Average	2.62E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Arsenic	Average	2.57E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Arsenic	Average	2.77E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Arsenic	Average	2.97E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Arsenic	Average	2.83E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Arsenic	Average	3.01E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Arsenic	Maximum	6.20E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Arsenic	Maximum	8.03E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Arsenic	Maximum	1.17E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Arsenic	Maximum	9.30E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Arsenic	Maximum	5.85E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Arsenic	Maximum	2.20E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Arsenic	Minimum	1.50E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Arsenic	Minimum	4.00E-05	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Arsenic	Minimum	1.20E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Arsenic	Minimum	1.40E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Arsenic	Minimum	1.00E-05	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Arsenic	Minimum	9.00E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Chromium	Average	1.68E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Chromium	Average	2.12E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Chromium	Average	3.62E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Chromium	Average	9.71E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Chromium	Average	2.57E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Chromium	Average	4.25E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Chromium	Maximum	3.70E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Chromium	Maximum	2.28E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Chromium	Maximum	2.68E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Chromium	Maximum	3.14E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Chromium	Maximum	9.32E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Chromium	Maximum	1.73E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Chromium	Minimum	1.10E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Chromium	Minimum	9.00E-05	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Chromium	Minimum	1.10E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Chromium	Minimum	1.50E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	

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.

Table E5-1a. Ambient Air Concentration Data Used for Dry Deposition Annual Load Calculations.

Chemical	Value Type	Ambient Concentration Value	Units	Data Source [a]	Site	Notes
Chromium	Minimum	2.00E-05	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Chromium	Minimum	8.00E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Copper	Average	1.47E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Copper	Average	6.05E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Copper	Average	1.23E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Copper	Average	1.59E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Copper	Average	9.26E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Copper	Average	2.82E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Copper	Maximum	3.43E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Copper	Maximum	2.63E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Copper	Maximum	6.33E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Copper	Maximum	3.63E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Copper	Maximum	1.58E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Copper	Maximum	2.14E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Copper	Minimum	2.40E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Copper	Minimum	2.40E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Copper	Minimum	1.50E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Copper	Minimum	3.30E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Copper	Minimum	5.00E-05	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Copper	Minimum	1.80E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Lead	Average	6.42E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Lead	Average	8.44E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Lead	Average	7.61E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Lead	Average	8.63E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Lead	Average	8.54E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Lead	Average	9.55E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Lead	Maximum	1.90E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Lead	Maximum	3.63E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Lead	Maximum	3.70E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Lead	Maximum	2.93E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Lead	Maximum	2.59E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Lead	Maximum	6.63E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Lead	Minimum	2.00E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Lead	Minimum	2.40E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Lead	Minimum	2.00E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	

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Table E5-1a. Ambient Air Concentration Data Used for Dry Deposition Annual Load Calculations.

Chemical	Value Type	Ambient Concentration Value	Units	Data Source [a]	Site	Notes
Lead	Minimum	2.20E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Lead	Minimum	1.10E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Lead	Minimum	1.80E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Mercury	Average	2.94E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Mercury	Average	2.86E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Mercury	Average	1.89E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Mercury	Average	3.33E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Mercury	Average	2.33E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Mercury	Maximum	7.82E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Mercury	Maximum	3.10E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Mercury	Maximum	3.00E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Mercury	Maximum	8.15E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Mercury	Maximum	2.80E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Mercury	Minimum	4.00E-05	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Mercury	Minimum	2.70E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Mercury	Minimum	1.60E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Mercury	Minimum	1.00E-05	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Mercury	Minimum	1.40E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Nickel	Average	2.62E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Nickel	Average	3.46E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Nickel	Average	4.97E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Nickel	Average	9.60E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Nickel	Average	2.49E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Nickel	Average	3.53E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Nickel	Maximum	6.80E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Nickel	Maximum	4.44E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Nickel	Maximum	2.48E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Nickel	Maximum	4.48E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Nickel	Maximum	1.44E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Nickel	Maximum	1.48E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Nickel	Minimum	1.90E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Nickel	Minimum	1.10E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Nickel	Minimum	1.40E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Nickel	Minimum	1.60E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Nickel	Minimum	1.00E-05	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	

Table E5-1a. Ambient Air Concentration Data Used for Dry Deposition Annual Load Calculations.

Chemical	Value Type	Ambient Concentration Value	Units	Data Source [a]	Site	Notes
Nickel	Minimum	8.00E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Zinc	Average	1.92E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Zinc	Average	1.01E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Zinc	Average	3.28E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Zinc	Average	6.13E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Zinc	Average	1.59E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Zinc	Average	3.74E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Zinc	Maximum	6.82E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Zinc	Maximum	1.09E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Zinc	Maximum	3.94E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Zinc	Maximum	2.43E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Zinc	Maximum	1.33E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Zinc	Maximum	1.65E-01	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Zinc	Minimum	8.10E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Zinc	Minimum	1.10E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Zinc	Minimum	1.80E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Zinc	Minimum	1.32E-02	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Zinc	Minimum	1.10E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Zinc	Minimum	4.80E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
PCBs						
Total PCBs	Minimum	3.80E-04	$\mu g/m^3$	EPA 1996a	Multnomah	Modeled Mean
Total PCBs	Maximum	5.20E-04	$\mu g/m^3$	EPA 1996a	Multnomah	Modeled Mean
PCB TEQ (ND=0)	Minimum	2.00E-06	ng/m^3	CARB 2004	Livermore, CA	Minimum of all 10 California sites, each of which reports the annual mean of 13 samples; WHO-97 TEFs define the TEQ
PCB TEQ (ND=0)	Maximum	1.03E-05	ng/m^3	CARB 2004	Boyle Heights, CA	Maximum of all 10 California sites, each of which reports the annual mean of 13 samples; WHO-97 TEFs define the TEQ
PCDD/Fs						
TCDD TEQ (ND=0)	Minimum	1.20E-05	ng/m^3	CARB 2004	Crockett, CA	Minimum of all 10 California sites, each of which reports the annual mean of 13 samples; WHO-97 TEFs define the TEQ
TCDD TEQ (ND=0)	Average	2.31E-05	ng/m^3	CARB 2004	Synthetic	Mean of all monitored values from California
TCDD TEQ (ND=0)	Maximum	3.30E-05	ng/m^3	CARB 2004	Wilmington, CA	Maximum of all 10 California sites, each of which reports the annual mean of 13 samples; WHO-97 TEFs define the TEQ

Table E5-1a. Ambient Air Concentration Data Used for Dry Deposition Annual Load Calculations.

Chemical	Value Type	Ambient Concentration Value	Units	Data Source [a]	Site	Notes
Pesticides						
4,4'-DDE	Minimum	6.30E-02	ng/m^3	ATSDR 2002b	Saginaw, MI	This value is the maximum monitored concentration at this location, but is the minimum of the set of Michigan measurements
4,4'-DDE	Average	9.13E-02	ng/m^3	ATSDR 2002b	Synthetic	This value is the mean of all Michigan measurements
4,4'-DDE	Maximum	1.19E-01	ng/m^3	ATSDR 2002b	Sault Ste. Marie, MI	Maximum monitored concentration at this location, and maximum of the set of Michigan measurements
4,4'-DDT	Minimum	2.10E-02	ng/m^3	ATSDR 2002b	Traverse City, MI	This value is the maximum monitored concentration at this location, but is the minimum of the set of Michigan measurements
4,4'-DDT	Average	2.90E-02	ng/m^3	ATSDR 2002b	Synthetic	This value is the mean of all Michigan measurements
4,4'-DDT	Maximum	3.50E-02	ng/m^3	ATSDR 2002b	Saginaw, MI	Maximum monitored concentration at this location, and maximum of the set of Michigan measurements
Total DDx	Average	4.90E+00	pg/m^3	NJADN 2004	Jersey City	
Total Chlordanes	Average	6.10E+00	pg/m^3	NJADN 2004	Jersey City	
Aldrin	Average	2.30E-01	pg/m^3	NJADN 2004	Jersey City	
Dieldrin	Point	1.90E-03	ng/m^3	ATSDR 2002a	Lake Michigan	Monitored annual mean of particulate dieldrin concentration over Lake Michigan
PAHs						
Naphthalene	Average	1.74E-03	µg/m^3	DEQ 2006	Portland, sampler 10136	
Naphthalene	Average	2.20E-03	µg/m^3	DEQ 2006	Portland, sampler 10139	
Naphthalene	Average	2.10E-03	µg/m^3	DEQ 2006	Portland, sampler 18399	
Naphthalene	Average	1.70E-03	µg/m^3	DEQ 2006	Portland, sampler 20481	
Naphthalene	Average	1.85E-03	µg/m^3	DEQ 2006	Portland, sampler 21889	
Naphthalene	Average	2.08E-03	µg/m^3	DEQ 2006	Portland, sampler 31924	
Naphthalene	Average	2.60E-03	µg/m^3	DEQ 2006	Portland, sampler 31939	
Naphthalene	Maximum	9.85E-03	µg/m^3	DEQ 2006	Portland, sampler 10136	
Naphthalene	Maximum	2.31E-02	µg/m^3	DEQ 2006	Portland, sampler 10139	
Naphthalene	Maximum	8.60E-03	µg/m^3	DEQ 2006	Portland, sampler 18399	
Naphthalene	Maximum	8.70E-03	µg/m^3	DEQ 2006	Portland, sampler 20481	
Naphthalene	Maximum	2.00E-02	µg/m^3	DEQ 2006	Portland, sampler 21889	
Naphthalene	Maximum	5.00E-03	µg/m^3	DEQ 2006	Portland, sampler 31924	
Naphthalene	Maximum	9.00E-03	µg/m^3	DEQ 2006	Portland, sampler 31939	
Naphthalene	Minimum	5.00E-04	µg/m^3	DEQ 2006	Portland, sampler 10136	
Naphthalene	Minimum	3.00E-04	µg/m^3	DEQ 2006	Portland, sampler 10139	
Naphthalene	Minimum	3.00E-04	µg/m^3	DEQ 2006	Portland, sampler 18399	
Naphthalene	Minimum	1.50E-04	µg/m^3	DEQ 2006	Portland, sampler 20481	

Table E5-1a. Ambient Air Concentration Data Used for Dry Deposition Annual Load Calculations.

Chemical	Value Type	Ambient Concentration Value	Units	Data Source [a]	Site	Notes
Naphthalene	Minimum	1.75E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Naphthalene	Minimum	3.00E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 31924	
Naphthalene	Minimum	3.00E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 31939	
Benzo(a)anthracene	Average	2.45E-01	$\mu g/m^3$	NJADN 2004	Jersey City	
Benzo(a)pyrene	Average	7.06E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Benzo(a)pyrene	Average	5.89E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Benzo(a)pyrene	Average	5.38E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Benzo(a)pyrene	Average	5.73E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 20481	
Benzo(a)pyrene	Average	5.17E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Benzo(a)pyrene	Average	3.44E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 31924	
Benzo(a)pyrene	Average	3.94E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 31939	
Benzo(a)pyrene	Maximum	1.99E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Benzo(a)pyrene	Maximum	2.50E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Benzo(a)pyrene	Maximum	2.30E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Benzo(a)pyrene	Maximum	2.21E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 20481	
Benzo(a)pyrene	Maximum	1.66E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Benzo(a)pyrene	Maximum	8.00E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 31924	
Benzo(a)pyrene	Maximum	1.10E-03	$\mu g/m^3$	DEQ 2006	Portland, sampler 31939	
Benzo(a)pyrene	Minimum	1.50E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 10136	
Benzo(a)pyrene	Minimum	1.50E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 10139	
Benzo(a)pyrene	Minimum	1.60E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 18399	
Benzo(a)pyrene	Minimum	1.50E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 20481	
Benzo(a)pyrene	Minimum	1.60E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Benzo(a)pyrene	Minimum	3.00E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 21889	
Benzo(a)pyrene	Minimum	3.00E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 31924	
Benzo(a)pyrene	Minimum	3.00E-04	$\mu g/m^3$	DEQ 2006	Portland, sampler 31939	
Benzo(a)pyrene	Average	1.92E-01	$\mu g/m^3$	NJADN 2004	Jersey City	
Benzo(b+k)fluoranthene	Average	6.99E-01	$\mu g/m^3$	NJADN 2004	Jersey City	
Chrysene	Average	4.44E-01	$\mu g/m^3$	NJADN 2004	Jersey City	
Dibenzo(a,h)anthracene	Average	5.32E-02	$\mu g/m^3$	NJADN 2004	Jersey City	
Indeno(1,2,3-cd)pyrene	Average	5.46E-01	$\mu g/m^3$	NJADN 2004	Jersey City	
Total Carcinogenic PAHs	Average	2.18E-03	$\mu g/m^3$	NJADN 2004	Jersey City	

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Table E5-1a. Ambient Air Concentration Data Used for Dry Deposition Annual Load Calculations.

Chemical	Value Type	Ambient Concentration Value	Units	Data Source [a]	Site	Notes
Total PAHs, 36 PAH sum [b]	Average	6.44E-03	$\mu g/m^3$	NJADN 2005	Jersey City	
Total PAHs, 13 PAH sum [c]	Average	3.93E-03	$\mu g/m^3$	NJADN 2006	Jersey City	
SVOCs						
Hexachlorobenzene	Point	9.30E-05	$\mu g/m^3$	EPA 1996a	Multnomah / Washington County	Modeled Annual Mean
Petroleum						
Diesel-Range Hydrocarbons	Minimum	2.07E+00	$\mu g/m^3$	EPA 1996a	Multnomah County	Modeled Annual Mean
Diesel-Range Hydrocarbons	Average	2.60E+00	$\mu g/m^3$	EPA 1996a	Synthetic	Average of the min and max values
Diesel-Range Hydrocarbons	Maximum	3.13E+00	$\mu g/m^3$	EPA 1996a	Washington County	Modeled Annual Mean

Notes:

[a] The references and citations used on the spreadsheet are listed below, as well as the reference for NJADN.

Reference	Citation
ATSDR 2002b	ATSDR. 2002b. Toxicological Profile for DDT, DDE, DDD. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. Atlanta, GA. September.
ATSDR 2002a	ATSDR. 2002a. Toxicological Profile for Aldrin/Dieldrin. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. Atlanta, GA. September.
CARB 2004	CARB. 2004. California Ambient Dioxin Air Monitoring Program (CADAMP). 2004 Results. California Air Resources Board. Sacramento, CA. http://www.arb.ca.gov/pub/dioxin/cadamp.php
DEQ 2006	DEQ. 2006. Laboratory Analytical Storage and Retreival (LASAR) website. Oregon Department of Environmental Quality. Verion 1.33. Downloaded from: http://www.deq.state.or.us/wq/lasar/LasarHome.htm
EPA 1996a	EPA. 1996a. NATA Modeled Ambient Concentrations. United States Environmental Protection Agency. Washington, DC. Downloaded from: http://www.epa.gov/ttn/atw/nata/natsa2.html
Hope 2005	Hope. 2005. A mass budget for mercury in the Willamette River Basin, Oregon, USA. Oregon Department of Environmental Quality. Portland, Oregon. *Water, Air, and Soil Poll.* 161:365–382.
NJADN 2004	NJADN. 2004. Final Report to the New Jersey Department of Environmental Protection (NJDEP), Michael Aucot, Program Manager, The New Jersey Atmospheric Deposition Network (NJADN).

[b] Based on the sum of all 36 PAHs included in the NJADN data set. The NJADN data set does not include the following individual PAHs generally used in summation of total PAHs for the LWG project: naphthalene, 2-methylnaphthalene, acenaphthene, and acenaphthylene.

[c] Based on the sum of the 13 site PAHs which were included in the NJADN data set. The NJADN data set does not include the following individual PAHs generally used in summation of total PAHs for the LWG project: naphthalene, 2-methylnaphthalene, acenaphthene, and acenaphthylene.

ATSDR - Agency for Toxic Substances and Disease Registry
CARB - California Air Resources Board
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DEQ - Oregon Department of Environmental Quality
EPA - U.S. Environmental Protection Agency
NJADN - New Jersey Atmospheric Deposition Network
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
SVOC - semivolatile organic compound
TEF - toxicity equivalency factor
TEQ - toxic equivalent concentration
WHO - World Health Organization

Table E5-1b. Wet Depositon Flux Data Used for Wet Deposition Annual Load Calculations.

Chemical	Value Type	Deposition Flux	Units	Data Source [a]	Site	Notes
Metals						
Arsenic	n/a	1.60E+02	µg/(m²•yr)	NJADN 2004	Jersey City	
Chromium	n/a	1.80E+02	µg/(m²•yr)	NJADN 2004	Jersey City	
Copper	n/a	2.20E+03	µg/(m²•yr)	NJADN 2004	Jersey City	
Lead	n/a	2.50E+03	µg/(m²•yr)	NJADN 2004	Jersey City	
Mercury	n/a	5.58E-06	(µg/m³) [d]	Hope 2005	Washington County and Lane County	Mean of Washington and Land County concentrations
Nickel	n/a	1.20E+03	µg/(m²•yr)	NJADN 2004	Jersey City	
Zinc	n/a	8.80E+03	µg/(m²•yr)	NJADN 2004	Jersey City	
PCBs			µg/(m²•yr)			
Total PCBs	average	1.98E+02	µg/(m²•yr)	MWH Americas, Inc. 2008	Portland	Average of three quarters of precipitation data from 2007 (315.02 pg/L, 67.95 pg/L, and 210.41 pg/L)
Pesticides			µg/(m²•yr)			
Total DDx	n/a	1.10E+00	µg/(m²•yr)	NJADN 2004	Jersey City	
Total Chlordanes	n/a	5.50E-01	µg/(m²•yr)	NJADN 2004	Jersey City	
PAHs						
Benzo(a)pyrene	n/a	3.00E+01	µg/(m²•yr)	NJADN 2004	Jersey City	
Total Carcinogenic PAHs	n/a	2.22E+02	µg/(m²•yr)	NJADN 2004	Jersey City	
Total PAHs, 36 PAH sum [b]	n/a	9.97E+02	µg/(m²•yr)	NJADN 2004	Jersey City	
Total PAHs, 13 PAH sum [c]	n/a	6.12E+02	µg/(m²•yr)	NJADN 2004	Jersey City	

Notes:

[a] The references and citations used on the spreadsheet are listed below, as well as the reference for NJADN.

Reference	Citation
Hope 2005	Hope. 2005. A mass budget for mercury in the Willamette River Basin, Oregon, USA. Oregon Department of Environmental Quality. Portland, Oregon. *Water Air and Soil Poll.* 161:365–382.
NJADN 2004	NJADN. 2004. Final Report to the New Jersey Department of Environmental Protection (NJDEP), Michael Aucot, Program Manager, The New Jersey Atmospheric Deposition Network (NJADN).
MWH Americas, Inc. 2008	MWH. 2008. Draft Results for PCBs in Precipitation in Portland Area. MWH Americas Inc. July.

[b] Based on the sum of all 36 PAHs included in the NJADN data set. The NJADN data set does not include the following individual PAHs generally used in summation of total PAHs for the LWG project: naphthalene, 2-methylnaphthalene, acenaphthene, and acenaphthylene.

[c] Based on the sum of the 13 site PAHs which were included in the NJADN data set. The NJADN data set does not include the following individual PAHs generally used in summation of total PAHs for the LWG project: naphthalene, 2-methylnaphthalene, acenaphthene, and acenaphthylene.

[d] Mercury data in units of µg/m³ and PCB data is in units of pg/L because these are precipitation data for direct conversion into wet deposition flux estimates.

cPAH - carcinogenic polycyclic aromatic hydrocarbon
NJADN - New Jersey Atmospheric Deposition Network
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl

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Table E5-2. Dry, Wet, and Total Annual Load Estimates for Atmospheric Deposition to the Study Area River Surface.

Analyte	Dry Deposition (kg/yr)			Wet Deposition (kg/yr)			Total Deposition (kg/yr)		
	Lower	Central	Upper	Lower	Central	Upper	Lower	Central	Upper
Metals									
Arsenic	1.39E-02	3.87E+00	1.11E+02	--	3.45E+00	--	2.62E-02	7.32E+00	2.10E+02
Chromium	2.77E-02	5.53E+00	1.29E+02	--	5.71E-01	--	3.06E-02	6.10E+00	1.43E+02
Copper	6.93E-02	2.00E+01	3.65E+02	--	1.06E+01	--	1.06E-01	3.06E+01	5.59E+02
Lead	1.52E-01	1.14E+01	5.03E+02	--	5.56E+00	--	2.27E-01	1.69E+01	7.49E+02
Mercury	1.39E-02	3.70E+00	1.13E+01	--	2.52E+01	--	1.08E-01	2.89E+01	8.84E+01
Nickel	1.39E-02	6.16E+00	2.00E+02	--	2.62E+00	--	1.98E-02	8.79E+00	2.85E+02
Zinc	1.52E-01	4.08E+01	5.46E+02	--	3.80E+01	--	2.94E-01	7.88E+01	1.05E+03
PCBs									
Total PCBs	5.27E-01	6.24E-01	7.21E-01	--	1.60E-03	--	5.28E-01	6.25E-01	7.23E-01
PCB TEQ (ND=0)	2.77E-06	8.53E-06	1.43E-05	--	--	--	2.77E-06	8.53E-06	1.43E-05
PCDD/Fs									
TCDD TEQ (ND=0)	1.66E-05	3.20E-05	4.57E-05	--	--	--	1.66E-05	3.20E-05	4.57E-05
DDx Pesticides									
4,4'-DDE	8.73E-02	1.27E-01	1.65E-01	--	--	--	8.73E-02	1.27E-01	1.65E-01
4,4'-DDT	2.91E-02	4.02E-02	4.85E-02	--	--	--	2.91E-02	4.02E-02	4.85E-02
Total DDx [a]	6.79E-03	1.67E-01	2.13E-01	--	3.11E-03	--	6.79E-03	1.67E-01	2.13E-01
Polycyclic Aromatic Hydrocarbons									
Naphthalene	2.08E-01	2.83E+00	3.21E+01	--	--	--	2.08E-01	2.83E+00	3.21E+01
Benzo(a)pyrene	2.08E-01	7.25E-01	3.47E+00	--	8.49E-02	--	2.08E-01	8.10E-01	3.47E+00
Total Carcinogenic PAHs	--	3.02E+00	--	--	6.27E-01	--	--	3.65E+00	--
cPAH BaPEq [b]	--	--	--	--	--	--	--	8.10E-01	--
Total PAHs [c]	--	5.45E+00	8.92E+00	--	1.73E+00	2.82E+00	--	7.18E+00	1.17E+01
Petroleum									
Diesel-Range Hydrocarbons	2.87E+03	3.60E+03	4.34E+03	--	--	--	2.87E+03	3.60E+03	4.34E+03
Semivolatile Organic Compounds									
Hexachlorobenzene	--	1.29E-01	--	--	--	--	--	1.29E-01	--
Pesticides (non-DDx)									
Total Chlordanes	--	8.46E-03	--	--	1.56E-03	--	--	1.00E-02	--
Aldrin	--	3.19E-04	--	--	--	--	--	3.19E-04	--
Dieldrin	--	2.63E-03	--	--	--	--	--	2.63E-03	--

Notes:

[a] Central and upper total DDx estimates calculated as the sum of the 4,4'-DDE and 4,4'-DDT loads.

[b] The benzo(a)pyrene loading estimate is reported here due to the lack of site-specific dry deposition estimate for cPAH BaPEq.

[c] Central estimates for total PAH atmospheric loads are based on the sum of the 13 site PAHs which were included in the NJADN data set, while the upper estimates are based on the sum all 36 PAHs included in the NJADN data set. The NJADN data set does not include the following individual PAHs generally used in summation of total PAHs for the LWG project: naphthalene, 2-methylnaphthalene, acenaphthene, and acenaphthylene.

-- Estimate not available

Bold box indicates that the total estimated was based on dry deposition rates; wet deposition data were unavailable.

BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
TEQ - toxic equivalent concentration

Table E6-1. Groundwater Flow Zone Areas and Estimated Flow Rates.

Site Name	Flow Zone ID	Flow Zone Type	Lower Measured Seepage Rate (q_{lower}, cm/d)[a]	Central Measured Seepage Rate ($q_{central}$, cm/d)[a]	Upper Measured Seepage Rate (q_{upper}, cm/d)	Flow Zone Subdivision ID	TZW Sample Location	Flow Zone Subdivision Area (A, ft^2)	Lower Calculated Flow (Q_{lower}, ft^3/yr)[b]	Central Calculated Flow ($Q_{central}$, ft^3/yr)[b]	Upper Calculated Flow (Q_{upper}, ft^3/yr)[b]
ARCO	ARCO1	Groundwater Discharge Zone	5.3	5.3	5.3	ARCO1-A	AR01A	6557	416137	416137	416137
						ARCO1-B	AR02A	6804	431813	431813	431813
	ARCO2	Low-To-No Groundwater Discharge Zone	0.1	0.2	0.6	ARCO2-A	AR04B	51876	62121	124243	372729
						ARCO2-B	ARC02B-PS	39419	47204	94409	283227
						ARCO2-C	ARC03B-PS	11408	13661	27323	81969
						ARCO2-D	ARC06B-PS	12129	14525	29049	87148
						ARCO2-E	R2AR01	34173	40923	81846	245537
						ARCO2-F	R2AR02	34684	41534	83068	249204
						ARCO2-G	R2AR03	18368	21996	43992	131977
						ARCO2-H	R2AR04	3222	3858	7716	23147
	ARCO3	Groundwater Discharge Zone	14.2	14.2	14.2	ARCO3-A	ns[c]	1894	322098	322098	322098
Arkema	ARK1	Low-To-No Groundwater Discharge Zone	0.1[d]	0.1[d]	0.1[d]	ARK1-A	AP04D-PS	52402	62752	62752	62752
						ARK1-B	CP09D	13982	16743	16743	16743
						ARK1-C	CP08D-PS	25499	30536	30536	30536
	ARK2	Nearshore Groundwater Discharge Zone	0.1	2	7	ARK2-A	AP02A	6410	7676	153512	537291
						ARK2-B	AP03A	16046	19216	384311	1345090
						ARK2-C	CP06A	10002	11977	239549	838422
						ARK2-D	CP07A	4797	5745	114897	402140
						ARK2-E	CP07B	2190	2622	52440	183539
						ARK2-F	CP08B	6222	7451	149029	521601
						ARK2-G	CP09A	2210	2646	52922	185228
	ARK3	Variable Groundwater Discharge Zone (Lower Rate)	0.1	0.95	3.1	ARK3-B	AP02D	16928	20271	192577	628410
						ARK3-C	AP03D-p	2022	2421	22999	75049
						ARK3-D	AP03D-t	4931	5904	56092	183038
						ARK3-E	AP04C	5671	6791	64513	210517
						ARK3-F	AP03B-PS	3410	4084	38796	126598
						ARK3-G	AP04B-PS	1918	2297	21818	71196
						ARK3-H	R2AP01	6810	8155	77469	252793
						ARK3-I	R2AP02	12300	14729	139927	456604
						ARK3-J	CP07D	5816	6965	66168	215917
						ARK3-K	CP06C-PS	7960	9532	90552	295484
						ARK3-L	CP07B	3436	4114	39087	127546
						ARK3-M	R2CP01	3474	4160	39522	128966
ExxonMobil	EM1	Groundwater Discharge Zone (Lower Flow Rate)	0.1	0.6	1.2	EM1-A	EM02C	12821	15353	92118	184237
						EM1-B	EM04C	10917	13074	78441	156882
						EM1-C	EM06B	19978	23923	143539	287078
	EM2	Interpreted Groundwater Discharge Zone	4	6.2	9.8	EM2-A	EM01A	2268	108628	168373	266138
						EM2-B	EM02A	1990	95330	147761	233558
						EM2-C	EM03A	2291	109763	170133	268919
						EM2-D	EM04A	2182	104537	162032	256116
						EM2-E	EM05A	4310	206435	319974	505765
	EM3	Low-To-No Groundwater Discharge Zone	0.1[d]	0.1[d]	0.1[d]	EM3-A	R2EM01	107259	128444	128444	128444
	EM4	Interpreted Groundwater Discharge Zone	4[e]	6.2[e]	9.8[e]	EM4-A	EM08A	2316	110917	171921	271746

Table E6-1. Groundwater Flow Zone Areas and Estimated Flow Rates.

Site Name	Flow Zone ID	Flow Zone Type	Lower Measured Seepage Rate (q_{lower}, cm/d)[a]	Central Measured Seepage Rate ($q_{central}$, cm/d)[a]	Upper Measured Seepage Rate (q_{upper}, cm/d)	Flow Zone Subdivision ID	TZW Sample Location	Flow Zone Subdivision Area (A, ft^2)	Lower Calculated Flow (Q_{lower}, ft^3/yr)[b]	Central Calculated Flow ($Q_{central}$, ft^3/yr)[b]	Upper Calculated Flow (Q_{upper}, ft^3/yr)[b]
Gasco	GS1	Variable Nearshore Groundwater Discharge Zone	0.1	3.13[f]	5.7[f]	GS1-A	GS07B	53384	63928	2003082	3643904
	GS2	Low-To-No Groundwater Discharge Zone	0.1	0.1[f]	0.2[f]	GS2-A	GS01B	23824	28529	28529	57058
						GS2-B	GS02A	17870	21400	21400	42800
						GS2-C	GS07D	6082	7283	7283	14565
						GS2-D	GS08A	8014	9597	9597	19194
						GS2-E	GS-B1	11011	13186	13186	26373
						GS2-F	GS-B2	19949	23889	23889	47777
						GS2-G	GS-B3	26374	31583	31583	63167
						GS2-H	GS-B4	25751	30837	30837	61673
						GS2-I	GS-B5	24660	29531	29531	59062
						GS2-J	GS-B6	11458	13721	13721	27443
						GS2-K	GS-B7	8078	9673	9673	19346
	GS3	Offshore Groundwater Discharge Zone	0.3	0.85	1.4	GS3-A	GS08D	12452	44735	126750	208764
						GS3-B	GS-C1	98460	353721	1002209	1650697
						GS3-C	GS-C3	159813	574130	1626701	2679273
						GS3-D	GS-C4	92421	332023	940733	1549443
						GS3-E	GS-C5	75170	270050	765141	1260232
						GS3-F	GS-C6	32724	117562	333093	548624
						GS3-G	GS-C7	9849	35384	100254	165124
						GS3-H	GS-D1	51684	185678	526086	866495
						GS3-I	GS-D2	37089	133244	377525	621806
						GS3-J	GS-D3	20972	75342	213470	351597
						GS3-K	GS-D4	15007	53913	152752	251592
						GS3-L	GP41	12913	46390	131437	216485
						GS3-M	GP49	19582	70350	199325	328300
						GS3-N	GP54	5887	21148	59918	98689
						GS3-O	GP72	9724	34935	98983	163031
						GS3-P	GP73	3658	13140	37231	61322
Gunderson	GN1	Groundwater Discharge Zone	1.3	1.3	1.3	GN1-A	GN04A	17344	270002	270002	270002
						GN1-B	GN05A	22210	345748	345748	345748
	GN2	Low-To-No Groundwater Discharge Zone	0.1	0.18	0.7	GN2-A	GN01E	69840	83634	150541	585438
						GN2-B	GN02E	306359	366867	660361	2568071
						GN2-C	GN03A	86271	103310	185958	723170
						GN2-D	GN04B	324220	388255	698859	2717787
						GN2-E	R2GN01	62621	74989	134980	524921
Kinder Morgan	KM1	Groundwater Discharge Zone	4.8	4.8	4.8	KM1-A	KM08A	5408	310843	310843	310843
						KM1-B	R2KM01	2326	133714	133714	133714
	KM2	Low-To-No Groundwater Discharge Zone	0.1	0.16	0.8	KM2-A	KM06A	130515	156292	250068	1250338
						KM2-B	KM10A	12541	15018	24029	120143
						KM2-C	KM11B	49095	58792	94067	470333
						KM2-D	R2KM02-p	9355	11203	17925	89626
						KM2-E	R2KM02-t	17090	20466	32745	163725
Rhone Poulenc	RP1	Groundwater Discharge Zone	1.2	7.6	14	RP1-A	R2RP01	14108	202729	1283949	2365169
						RP1-B	RP02E	8839	127014	804421	1481828
						RP1-C	RP03C	15366	220816	1398503	2576190
						RP1-D	RP03E	9486	136317	863339	1590362
	RP2	Inferred Groundwater Discharge Zone Extension	0.1[h]	0.48[h]	1.5[h]	RP2-A	ns[g]	55236	66146	317499	992186
	RP3	Inferred Nearshore Groundwater Discharge Zone	4.4	4.4	4.4	RP3-A	R2RP02	53444	2815969	2815969	2815969
						RP3-B	R2RP03	55481	2923330	2923330	2923330
	RP4	Low-To-No Groundwater Discharge Zone	0.1	0.48	1.5	RP4-A	RP07E	287671	344488	1653541	5167317
	RP5	Groundwater Discharge Zone	4.8	4.8	4.8	RP5-A	RP07B	28351	1629649	1629649	1629649

Table E6-1. Groundwater Flow Zone Areas and Estimated Flow Rates.

Site Name	Flow Zone ID	Flow Zone Type	Lower Measured Seepage Rate (q_{lower}, cm/d)[a]	Central Measured Seepage Rate ($q_{central}$, cm/d)[a]	Upper Measured Seepage Rate (q_{upper}, cm/d)	Flow Zone Subdivision ID	TZW Sample Location	Flow Zone Subdivision Area (A, ft^2)	Lower Calculated Flow (Q_{lower}, ft^3/yr)[b]	Central Calculated Flow ($Q_{central}$, ft^3/yr)[b]	Upper Calculated Flow (Q_{upper}, ft^3/yr)[b]
Siltronic	SL1	Low-To-No Groundwater Discharge Zone	0.1	0.17	0.3	SL1-A	SL01A	9852	11797	19662	35392
						SL1-B	SL02A	7258	8692	14486	26075
						SL1-C	SL03A	5775	6916	11526	20748
						SL1-D	SL05A	21508	25755	42926	77266
						SL1-E	GP47	9516	11396	18993	34187
	SL2	Nearshore Groundwater Discharge Zone	10.5	10.5	10.5	SL2-A	SL04A	16268	2045551	2045551	2045551
						SL2-B	GP46	21368	2686768	2686768	2686768
	SL3	Offshore Groundwater Discharge Zone	3.5	4.3	5	SL3-A	GS-B8	3727	156188	191888	223126
						SL3-B	GS-B9	16095	674577	828766	963682
						SL3-C	GS-C8	3037	127273	156365	181819
						SL3-D	SL01E	1005	42130	51759	60185
						SL3-E	SL02C	3302	138401	170036	197716
						SL3-F	SL02E	5227	219063	269135	312948
						SL3-G	SL03C	3149	131987	162156	188553
						SL3-H	SL03F	2336	97894	120269	139848
						SL3-I	SL04F	2750	115279	141628	164684
						SL3-K	GP38	4496	188423	231492	269176
						SL3-L	GP39	3345	140195	172239	200278
						SL3-M	GP40	6312	264548	325016	377926
						SL3-N	GP42	3823	160240	196867	228915
						SL3-O	GP43	34792	1458241	1791553	2083201
						SL3-P	GP44	4035	169123	207780	241604
						SL3-Q	GP45	5733	240289	295213	343271
						SL3-R	GP48	4586	192214	236149	274592
						SL3-S	GP50	3313	138872	170615	198389
						SL3-T	GP51	3642	152634	187522	218049
						SL3-U	GP52	4077	170868	209923	244097
						SL3-V	GP53	5011	210018	258022	300025
						SL3-W	GP55	1959	82094	100859	117277
						SL3-X	GP56	2965	124265	152668	177521
						SL3-Y	GP57	4693	196709	241671	281012
						SL3-Z	GP58	2318	97146	119351	138780
						SL3-AA	GP61	4487	188048	231030	268640
						SL3-AB	GP62	3272	137156	168505	195937
						SL3-AC	GP63	3005	125928	154712	179897
Siltronic	SL3	Offshore Groundwater Discharge Zone	3.5	4.3	5	SL3-AD	GP64	918	38464	47256	54948
						SL3-AE	GP66	825	34593	42499	49418
						SL3-AF	GP67	1778	74519	91552	106456
						SL3-AG	GP68	1418	59448	73036	84926
						SL3-AH	GP69	3481	145882	179226	208402
						SL3-AI	GP70	3824	160290	196928	228986
						SL3-AJ	GP71	6264	262561	322575	375087
						SL3-AK	GP75	3048	127748	156948	182497
						SL3-AL	GP76	1954	81908	100630	117012
						SL3-AM	GP80	2631	110278	135484	157539
						SL3-AN	GP81	1450	60762	74650	86802
						SL3-AO	GP82	1373	57534	70685	82192
						SL3-AP	GP84	3714	155657	191236	222367
	SL4	Far Offshore Groundwater Discharge Zone	1.5	1.5	1.5	SL4-A	GS-C9	11145	200190	200190	200190
						SL4-B	GS-D5	26987	484758	484758	484758
						SL4-C	GP65	17016	305659	305659	305659
						SL4-D	GP74	17044	306155	306155	306155

Table E6-1. Groundwater Flow Zone Areas and Estimated Flow Rates.

Site Name	Flow Zone ID	Flow Zone Type	Lower Measured Seepage Rate (q_{lower}, cm/d)[a]	Central Measured Seepage Rate ($q_{central}$, cm/d)[a]	Upper Measured Seepage Rate (q_{upper}, cm/d)	Flow Zone Subdivision ID	TZW Sample Location	Flow Zone Subdivision Area (A, ft^2)	Lower Calculated Flow (Q_{lower}, ft^3/yr)[b]	Central Calculated Flow ($Q_{central}$, ft^3/yr)[b]	Upper Calculated Flow (Q_{upper}, ft^3/yr)[b]
Willbridge	W1	Groundwater Discharge Zone (Higher Flow Rate)	7.1	10.4	13.6	W1-A	R2W02	22349	1900147	2769933	3639719
						W1-B	W09A	13352	1135189	1654817	2174446
						W1-C	W12A	62749	5335113	7777242	10219371
	W2	Groundwater Discharge Zone (Lower Flow Rate)	2.7	3.1	3.9	W2-A	W04C	204730	6619476	7681861	9561465
						W2-B	W06A	8996	290849	337529	420115
						W2-C	W07C	10159	328463	381180	474447
						W2-D	W09C	71156	2300671	2669914	3323191
	W3	Low-To-No Groundwater Discharge Zone	0.1	0.2	0.4	W3-A	ns[i]	781726	936122	1872243	3744486

Notes:

[a] Mean seepage rates measured with seepage meters in the GWPA Pilot Study (Integral 2004), Round 2 SCSR (Integral 2006), and the Gasco offshore investigation (Anchor 2008) were averaged for the each flow zone. Negative mean seepage rates were included in the average as 0 cm/d.

[b] Calculated according to the following equation: Q (ft^3/yr) = q (cm/d) x A (ft^2) x 0.03281(ft/cm) x 365 (d/yr).

[c] TZW chemical data not available for this flow zone. Concentrations from sample location R2AR02 used.

[d] Seepage meter seepage rate not available for this flow zone. Lines of evidence suggest that very low-to-no flow occurs in these zones (see TZW SCSR, Integral 2006e). Value of 0.1 cm/day assumed.

[e] Seepage meter seepage rate not available for this flow zone. Applied flow measurements for ExxonMobil nearshore flow zone EM2.

[f] Seepage meter GSC4E is located on the border between flow zones GS1 and GS2. GSC4E seepage rates used in mean and max flow rate estimates for both GS1 and GS2.

[g] TZW chemical data not available for this flow zone. Average of all Rhone Poulenc < 38 cm TZW concentrations applied for all analytes.

[h] Seepage meter seepage rate not available for this flow zone. Applied flow measurements for adjacent flow zone RP4 based on similar sediment texture.

[i] TZW chemical data not available for this flow zone. Average of all Willbridge flow zone W2 < 38 cm TZW concentrations applied for all analytes.

PS - Indicates location sampled during Round 2 GWPA Pilot Study (Integral 2004)
ns - Indicates no TZW samples were located in the zone identified by discharge mapping and other lines of evidence.

Table E6-2. Estimated Upland Groundwater Plume Annual Loading to the Water Column, by Upland Site.

			ARCO		Arkema		ExxonMobil		Gasco		Gunderson	
Analyte	Load Estimate	Units	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]
Metals												
Arsenic	Central	kg/yr	5.04E-01	5.67E-01	3.40E-01	3.74E-01	6.48E-01	6.54E-01	1.11E+00	3.34E+00	3.08E-01	3.17E-01
Arsenic	Lower	kg/yr	4.41E-01	4.93E-01	5.32E-02	5.37E-02	3.27E-01	3.30E-01	3.26E-01	1.12E+00	2.10E-01	2.19E-01
Arsenic	Upper	kg/yr	7.58E-01	8.64E-01	1.09E+00	1.21E+00	1.09E+00	1.10E+00	1.88E+00	5.58E+00	9.46E-01	9.55E-01
Barium	Central	kg/yr	3.84E+00	7.87E+00	4.31E+01	5.08E+01	3.89E+00	6.20E+00	2.27E+01	1.06E+02	7.43E+00	8.57E+00
Barium	Lower	kg/yr	3.30E+00	7.07E+00	1.01E+01	1.06E+01	2.21E+00	3.12E+00	6.67E+00	3.91E+01	4.67E+00	5.80E+00
Barium	Upper	kg/yr	6.00E+00	1.11E+01	1.28E+02	1.54E+02	6.32E+00	1.05E+01	3.85E+01	1.78E+02	2.54E+01	2.65E+01
Cadmium	Central	kg/yr	2.92E-04	8.95E-03	9.40E-02	9.38E-02	1.75E-03	5.49E-03	1.81E-03	1.01E-01	6.73E-03	8.33E-03
Cadmium	Lower	kg/yr	2.30E-04	8.44E-03	9.86E-03	9.84E-03	9.62E-04	2.00E-03	5.41E-04	4.19E-02	4.09E-03	5.68E-03
Cadmium	Upper	kg/yr	5.38E-04	1.10E-02	3.07E-01	3.06E-01	2.88E-03	9.92E-03	3.07E-03	1.70E-01	2.40E-02	2.55E-02
Copper	Central	kg/yr	9.68E-03	1.14E+00	8.36E-02	8.36E-02	4.82E-03	2.98E-01	7.08E-02	1.79E+01	0.00E+00	1.97E-01
Copper	Lower	kg/yr	4.84E-03	1.04E+00	8.80E-03	8.80E-03	1.74E-03	7.50E-02	2.08E-02	6.82E+00	0.00E+00	1.97E-01
Copper	Upper	kg/yr	2.90E-02	1.52E+00	2.73E-01	2.73E-01	8.82E-03	5.74E-01	1.20E-01	3.00E+01	0.00E+00	1.97E-01
Lead	Central	kg/yr	3.01E-02	1.20E+00	1.28E-02	3.11E-01	8.23E-03	3.80E-01	4.41E-02	1.01E+01	0.00E+00	2.36E-01
Lead	Lower	kg/yr	1.51E-02	1.04E+00	1.20E-03	1.95E-02	2.18E-03	1.22E-01	1.29E-02	3.87E+00	0.00E+00	2.36E-01
Lead	Upper	kg/yr	9.03E-02	1.84E+00	4.25E-02	1.07E+00	1.58E-02	7.07E-01	7.46E-02	1.70E+01	0.00E+00	2.36E-01
Manganese	Central	kg/yr	1.31E+02	1.48E+02	4.35E+02	4.54E+02	1.43E+02	1.51E+02	8.78E+02	1.31E+03	1.58E+02	1.67E+02
Manganese	Lower	kg/yr	1.17E+02	1.29E+02	1.04E+02	1.04E+02	6.92E+01	7.43E+01	2.59E+02	4.17E+02	1.03E+02	1.12E+02
Manganese	Upper	kg/yr	1.88E+02	2.24E+02	1.28E+03	1.36E+03	2.42E+02	2.56E+02	1.49E+03	2.22E+03	5.12E+02	5.21E+02
Mercury	Central	kg/yr	0.00E+00	1.15E-03	3.31E-03	6.44E-03	0.00E+00	7.04E-04	1.42E-02	3.71E-02	0.00E+00	0.00E+00
Mercury	Lower	kg/yr	0.00E+00	1.03E-03	2.14E-04	3.88E-04	0.00E+00	1.17E-04	4.12E-03	1.68E-02	0.00E+00	0.00E+00
Mercury	Upper	kg/yr	0.00E+00	1.62E-03	1.14E-02	2.22E-02	0.00E+00	1.41E-03	2.39E-02	6.31E-02	0.00E+00	0.00E+00
Nickel	Central	kg/yr	1.44E-01	5.57E-01	1.04E+00	1.22E+00	1.25E-01	2.40E-01	1.25E+00	1.17E+01	1.57E-01	2.41E-01
Nickel	Lower	kg/yr	1.25E-01	5.19E-01	1.65E-01	1.73E-01	6.39E-02	8.85E-02	3.64E-01	4.33E+00	1.08E-01	1.92E-01
Nickel	Upper	kg/yr	2.22E-01	7.08E-01	3.28E+00	3.94E+00	2.12E-01	4.37E-01	2.11E+00	1.96E+01	4.80E-01	5.64E-01
Zinc	Central	kg/yr	1.56E+00	3.89E+00	1.74E+00	2.03E+00	2.15E-01	1.13E+00	1.19E+00	6.82E+01	2.12E-01	1.39E+00
Zinc	Lower	kg/yr	8.57E-01	3.03E+00	2.21E-01	2.44E-01	1.12E-01	3.08E-01	3.54E-01	2.73E+01	1.18E-01	1.30E+00
Zinc	Upper	kg/yr	4.36E+00	7.32E+00	5.60E+00	6.57E+00	3.61E-01	2.16E+00	2.02E+00	1.15E+02	8.24E-01	2.00E+00
Pesticides												
4,4'-DDD	Central	kg/yr	--	--	2.00E-04	1.70E-02	--	--	--	--	--	--
4,4'-DDD	Lower	kg/yr	--	--	1.51E-05	1.32E-03	--	--	--	--	--	--
4,4'-DDD	Upper	kg/yr	--	--	6.80E-04	5.73E-02	--	--	--	--	--	--
4,4'-DDT	Central	kg/yr	--	--	1.71E-05	2.67E-02	--	--	--	--	--	--
4,4'-DDT	Lower	kg/yr	--	--	1.71E-05	1.48E-03	--	--	--	--	--	--
4,4'-DDT	Upper	kg/yr	--	--	1.71E-05	9.28E-02	--	--	--	--	--	--
Total of 2,4' and 4,4'-DDE	Central	kg/yr	--	--	6.93E-06	1.65E-03	--	--	--	--	--	--
Total of 2,4' and 4,4'-DDE	Lower	kg/yr	--	--	6.93E-06	1.07E-04	--	--	--	--	--	--
Total of 2,4' and 4,4'-DDE	Upper	kg/yr	--	--	6.93E-06	5.67E-03	--	--	--	--	--	--
Total of 2,4' and 4,4'-DDD	Central	kg/yr	--	--	6.43E-04	2.73E-02	--	--	--	--	--	--
Total of 2,4' and 4,4'-DDD	Lower	kg/yr	--	--	4.16E-05	2.20E-03	--	--	--	--	--	--
Total of 2,4' and 4,4'-DDD	Upper	kg/yr	--	--	2.21E-03	9.19E-02	--	--	--	--	--	--
Total of 2,4' and 4,4'-DDT	Central	kg/yr	--	--	1.71E-05	2.77E-02	--	--	--	--	--	--
Total of 2,4' and 4,4'-DDT	Lower	kg/yr	--	--	1.71E-05	1.52E-03	--	--	--	--	--	--
Total of 2,4' and 4,4'-DDT	Upper	kg/yr	--	--	1.71E-05	9.62E-02	--	--	--	--	--	--
Total DDx	Central	kg/yr	--	--	6.67E-04	5.66E-02	--	--	--	--	--	--
Total DDx	Lower	kg/yr	--	--	6.56E-05	3.83E-03	--	--	--	--	--	--
Total DDx	Upper	kg/yr	--	--	2.23E-03	1.94E-01	--	--	--	--	--	--

Table E6-2. Estimated Upland Groundwater Plume Annual Loading to the Water Column, by Upland Site.

			ARCO		Arkema		ExxonMobil		Gasco		Gunderson	
Analyte	Load Estimate	Units	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]
PAHs												
Naphthalene	Central	kg/yr	3.14E-03	8.59E-03	1.45E-01	1.45E-01	1.56E-03	5.70E-03	9.05E+01	2.18E+02	--	--
Naphthalene	Lower	kg/yr	2.99E-03	7.95E-03	7.46E-03	7.45E-03	9.21E-04	2.99E-03	2.68E+01	2.22E+01	--	--
Naphthalene	Upper	kg/yr	3.77E-03	1.12E-02	5.07E-01	5.07E-01	2.54E-03	9.60E-03	1.53E+02	3.91E+02	--	--
Benzo(a)pyrene	Central	kg/yr	1.48E-05	1.20E-03	--	--	0.00E+00	3.42E-03	6.75E-03	2.65E+00	--	--
Benzo(a)pyrene	Lower	kg/yr	7.42E-06	1.11E-03	--	--	0.00E+00	1.82E-03	2.04E-03	9.43E-01	--	--
Benzo(a)pyrene	Upper	kg/yr	4.45E-05	1.57E-03	--	--	0.00E+00	5.54E-03	1.15E-02	4.42E+00	--	--
Total Carcinogenic PAHs	Central	kg/yr	1.57E-04	4.22E-03	--	--	1.16E-03	1.91E-02	5.69E-02	1.33E+01	--	--
Total Carcinogenic PAHs	Lower	kg/yr	7.84E-05	3.64E-03	--	--	7.12E-04	1.00E-02	1.71E-02	4.76E+00	--	--
Total Carcinogenic PAHs	Upper	kg/yr	4.70E-04	6.55E-03	--	--	1.84E-03	3.11E-02	9.66E-02	2.23E+01	--	--
cPAH BaPEq	Central	kg/yr	2.26E-05	1.71E-03	--	--	6.14E-05	4.50E-03	9.31E-03	3.56E+00	--	--
cPAH BaPEq	Lower	kg/yr	1.13E-05	1.57E-03	--	--	3.76E-05	2.39E-03	2.81E-03	1.27E+00	--	--
cPAH BaPEq	Upper	kg/yr	6.78E-05	2.30E-03	--	--	9.77E-05	7.30E-03	1.58E-02	5.94E+00	--	--
Total High Molecular Weight PAHs	Central	kg/yr	7.79E-03	2.37E-02	--	--	1.99E-02	1.19E-01	6.26E-01	3.38E+01	--	--
Total High Molecular Weight PAHs	Lower	kg/yr	4.38E-03	2.01E-02	--	--	1.37E-02	7.58E-02	1.89E-01	1.16E+01	--	--
Total High Molecular Weight PAHs	Upper	kg/yr	2.14E-02	3.84E-02	--	--	2.90E-02	1.79E-01	1.06E+00	5.68E+01	--	--
Total Low Molecular Weight PAHs	Central	kg/yr	6.28E-02	8.79E-02	--	--	2.68E-01	5.41E-01	1.05E+02	2.56E+02	--	--
Total Low Molecular Weight PAHs	Lower	kg/yr	4.27E-02	6.75E-02	--	--	1.76E-01	3.65E-01	3.10E+01	3.05E+01	--	--
Total Low Molecular Weight PAHs	Upper	kg/yr	1.43E-01	1.69E-01	--	--	4.04E-01	8.11E-01	1.77E+02	4.56E+02	--	--
Total PAHs	Central	kg/yr	7.06E-02	1.11E-01	--	--	2.88E-01	6.61E-01	1.06E+02	2.90E+02	--	--
Total PAHs	Lower	kg/yr	4.71E-02	8.75E-02	--	--	1.90E-01	4.41E-01	3.13E+01	4.22E+01	--	--
Total PAHs	Upper	kg/yr	1.65E-01	2.07E-01	--	--	4.34E-01	9.91E-01	1.79E+02	5.13E+02	--	--
SVOCs												
1,2-Dichlorobenzene	Central	kg/yr	--	1.79E-03	--	1.96E-03	--	0.00E+00	--	2.06E-02	--	0.00E+00
1,2-Dichlorobenzene	Lower	kg/yr	--	8.96E-04	--	1.33E-04	--	0.00E+00	--	7.26E-03	--	0.00E+00
1,2-Dichlorobenzene	Upper	kg/yr	--	5.38E-03	--	6.73E-03	--	0.00E+00	--	3.39E-02	--	0.00E+00
VOCs												
1,2-Dichloroethane	Central	kg/yr	--	5.48E-04	--	1.22E+00	--	0.00E+00	--	0.00E+00	--	2.37E-02
1,2-Dichloroethane	Lower	kg/yr	--	2.74E-04	--	1.29E-01	--	0.00E+00	--	0.00E+00	--	2.37E-02
1,2-Dichloroethane	Upper	kg/yr	--	1.64E-03	--	3.99E+00	--	0.00E+00	--	0.00E+00	--	2.37E-02
1,1,2-Trichloroethane	Central	kg/yr	--	0.00E+00	--	5.68E-01	--	0.00E+00	--	0.00E+00	--	0.00E+00
1,1,2-Trichloroethane	Lower	kg/yr	--	0.00E+00	--	5.98E-02	--	0.00E+00	--	0.00E+00	--	0.00E+00
1,1,2-Trichloroethane	Upper	kg/yr	--	0.00E+00	--	1.85E+00	--	0.00E+00	--	0.00E+00	--	0.00E+00
1,2,4-Trimethylbenzene	Central	kg/yr	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	2.72E+00	--	0.00E+00
1,2,4-Trimethylbenzene	Lower	kg/yr	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	9.60E-01	--	0.00E+00
1,2,4-Trimethylbenzene	Upper	kg/yr	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	4.48E+00	--	0.00E+00
Benzene	Central	kg/yr	--	0.00E+00	--	3.62E+00	--	0.00E+00	--	3.27E+01	--	2.64E-03
Benzene	Lower	kg/yr	--	0.00E+00	--	3.54E+00	--	0.00E+00	--	1.82E+00	--	2.64E-03
Benzene	Upper	kg/yr	--	0.00E+00	--	3.82E+00	--	0.00E+00	--	5.92E+01	--	2.64E-03
Carbon disulfide	Central	kg/yr	--	0.00E+00	--	3.60E-03	--	0.00E+00	--	6.79E-01	--	0.00E+00
Carbon disulfide	Lower	kg/yr	--	0.00E+00	--	5.79E-04	--	0.00E+00	--	6.79E-01	--	0.00E+00
Carbon disulfide	Upper	kg/yr	--	0.00E+00	--	1.14E-02	--	0.00E+00	--	1.36E+00	--	0.00E+00
Chlorobenzene	Central	kg/yr	--	0.00E+00	--	5.35E+01	--	0.00E+00	--	8.04E-02	--	4.80E-03
Chlorobenzene	Lower	kg/yr	--	0.00E+00	--	2.93E+01	--	0.00E+00	--	2.33E-02	--	4.80E-03
Chlorobenzene	Upper	kg/yr	--	0.00E+00	--	1.15E+02	--	0.00E+00	--	1.35E-01	--	4.80E-03
Chloroethane	Central	kg/yr	--	0.00E+00	--	6.84E-03	--	0.00E+00	--	0.00E+00	--	1.63E+00
Chloroethane	Lower	kg/yr	--	0.00E+00	--	7.20E-04	--	0.00E+00	--	0.00E+00	--	1.63E+00
Chloroethane	Upper	kg/yr	--	0.00E+00	--	2.23E-02	--	0.00E+00	--	0.00E+00	--	1.63E+00
Chloroform	Central	kg/yr	--	0.00E+00	--	3.28E+00	--	0.00E+00	--	0.00E+00	--	0.00E+00
Chloroform	Lower	kg/yr	--	0.00E+00	--	2.79E-01	--	0.00E+00	--	0.00E+00	--	0.00E+00
Chloroform	Upper	kg/yr	--	0.00E+00	--	2.77E+03	--	0.00E+00	--	0.00E+00	--	0.00E+00
cis-1,2-Dichloroethene c	Central	kg/yr	--	0.00E+00	--	8.79E-02	--	2.40E-03	--	2.75E-02	--	3.33E-03
cis-1,2-Dichloroethene c	Lower	kg/yr	--	0.00E+00	--	8.37E-03	--	4.00E-04	--	9.72E-03	--	3.33E-03
cis-1,2-Dichloroethene c	Upper	kg/yr	--	0.00E+00	--	2.91E-01	--	4.80E-03	--	4.54E-02	--	3.33E-03

Table E6-2. Estimated Upland Groundwater Plume Annual Loading to the Water Column, by Upland Site.

			ARCO		Arkema		ExxonMobil		Gasco		Gunderson	
Analyte	Load Estimate	Units	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]
Methylene Chloride	Central	kg/yr	--	0.00E+00	--	8.21E+02	--	0.00E+00	--	4.69E-04	--	0.00E+00
Methylene Chloride	Lower	kg/yr	--	0.00E+00	--	8.64E+01	--	0.00E+00	--	4.69E-04	--	0.00E+00
Methylene Chloride	Upper	kg/yr	--	0.00E+00	--	2.68E+03	--	0.00E+00	--	9.37E-04	--	0.00E+00
Ethylbenzene	Central	kg/yr	--	0.00E+00	--	2.37E-02	--	0.00E+00	--	4.94E+00	--	8.81E-03
Ethylbenzene	Lower	kg/yr	--	0.00E+00	--	1.59E-03	--	0.00E+00	--	3.78E-01	--	8.81E-03
Ethylbenzene	Upper	kg/yr	--	0.00E+00	--	8.15E-02	--	0.00E+00	--	8.91E+00	--	8.81E-03
Toluene	Central	kg/yr	--	6.21E-03	--	1.97E-01	--	8.96E-03	--	1.66E+00	--	2.29E-02
Toluene	Lower	kg/yr	--	3.10E-03	--	1.81E-02	--	5.33E-03	--	4.29E-01	--	2.05E-02
Toluene	Upper	kg/yr	--	1.86E-02	--	6.56E-01	--	1.43E-02	--	2.86E+00	--	3.82E-02
Trichloroethene[c]	Central	kg/yr	--	5.73E-04	--	3.71E+00	--	0.00E+00	--	2.70E-03	--	0.00E+00
Trichloroethene[c]	Lower	kg/yr	--	2.87E-04	--	3.90E-01	--	0.00E+00	--	9.53E-04	--	0.00E+00
Trichloroethene[c]	Upper	kg/yr	--	1.72E-03	--	1.21E+01	--	0.00E+00	--	4.45E-03	--	0.00E+00
Vinyl chloride[c]	Central	kg/yr	--	0.00E+00	--	4.48E-01	--	0.00E+00	--	6.27E-03	--	2.59E-02
Vinyl chloride[c]	Lower	kg/yr	--	0.00E+00	--	4.67E-02	--	0.00E+00	--	2.21E-03	--	2.57E-02
Vinyl chloride[c]	Upper	kg/yr	--	0.00E+00	--	1.46E+00	--	0.00E+00	--	1.03E-02	--	2.71E-02
Total Xylenes	Central	kg/yr	--	3.01E-03	--	1.22E-01	--	3.04E-03	--	6.39E+00	--	2.95E-02
Total Xylenes	Lower	kg/yr	--	1.51E-03	--	7.65E-03	--	1.20E-03	--	3.69E-01	--	2.95E-02
Total Xylenes	Upper	kg/yr	--	9.04E-03	--	4.20E-01	--	5.46E-03	--	1.16E+01	--	2.95E-02

Notes:

[a] Push Probe refers to samples collected by either Trident or Geoprobe samplers.

[b] Due to sample volume limitations, filtered Push Probe samples were not collected at all sample locations. To calculate loading rate estimates at these sample locations, the average of the filtered push-probe chemical concentrations within the same flow zone was used.

[c] Station GP-67 is located in Area 2 of the Siltronic site, which is understood to be an area impacted by a direct discharge of trichloroethene. Concentrations of trichloroethene and related degradation-chain chemicals (cis-1,2-dichloroethene and vinyl chloride) measured at GP-67 are not representative of the upland groundwater plume; therefore, GP-67 was not included in loading calculations for these three chemicals for the Siltronic site or the entire Study Area. For comparison purposes, entire Study Area loads were also calculated for these three chemicals including station GP-67. These comparative loading results are as follows:

cis-1,2-Dichloroethene - central: 3.47E+02 kg/yr, lower: 3.05E+02, upper: 3.84E+02
Trichloroethene - central: 2.34E+02 kg/yr, lower: 1.88E+02, upper: 2.80E+02
Vinyl chloride - central: 5.01E+01 kg/yr, lower: 4.27E+01, upper: 5.73E+01

-- Analyte not sampled.
n/a - Indicates that filtered data were not available. Per sampling protocols, filtered samples were not collected for VOCs or naphthalene.
BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbon
SVOC - semivolatile organic compound
VOC - volatile organic compound

Table E6-2. Estimated Upland Groundwater Plume Annual Loading to the Water Column, by Upland Site.

			Kinder Morgan		Rhone Poulenc		Siltronic		Willbridge		Entire Study Area	
Analyte	**Load Estimate**	**Units**	**Peepers and Filtered Push Probe[a]**	**Peepers and Unfiltered Push Probe[b]**	**Peepers and Filtered Push Probe[a]**	**Peepers and Unfiltered Push Probe[b]**	**Peepers and Filtered Push Probe[a]**	**Peepers and Unfiltered Push Probe[b]**	**Peepers and Filtered Push Probe[a]**	**Peepers and Unfiltered Push Probe[b]**	**Peepers and Filtered Push Probe[a]**	**Peepers and Unfiltered Push Probe[b]**
Metals												
Arsenic	Central	kg/yr	1.27E-01	1.26E-01	3.23E+00	3.63E+00	3.14E+00	3.78E+00	1.76E+01	1.75E+01	2.70E+01	3.03E+01
Arsenic	Lower	kg/yr	1.16E-01	1.16E-01	1.36E+00	1.60E+00	2.69E+00	3.43E+00	1.27E+01	1.26E+01	1.82E+01	1.99E+01
Arsenic	Upper	kg/yr	2.38E-01	2.38E-01	5.69E+00	6.30E+00	3.55E+00	4.10E+00	2.31E+01	2.29E+01	3.84E+01	4.33E+01
Barium	Central	kg/yr	8.06E-01	9.53E-01	7.24E+01	1.02E+02	3.71E+01	1.38E+02	5.18E+01	7.22E+01	2.43E+02	4.92E+02
Barium	Lower	kg/yr	6.75E-01	8.22E-01	3.81E+01	5.08E+01	3.25E+01	1.15E+02	3.86E+01	5.24E+01	1.37E+02	2.85E+02
Barium	Upper	kg/yr	2.21E+00	2.36E+00	1.17E+02	1.65E+02	4.14E+01	1.57E+02	6.81E+01	9.76E+01	4.32E+02	8.03E+02
Cadmium	Central	kg/yr	2.08E-03	3.12E-03	8.59E-02	1.46E-01	9.49E-03	2.09E-01	2.54E-02	4.56E-02	2.27E-01	6.21E-01
Cadmium	Lower	kg/yr	1.37E-03	2.42E-03	6.16E-02	8.29E-02	8.76E-03	1.73E-01	1.74E-02	3.11E-02	1.05E-01	3.57E-01
Cadmium	Upper	kg/yr	9.60E-03	1.06E-02	1.21E-01	2.23E-01	1.02E-02	2.40E-01	3.36E-02	6.17E-02	5.11E-01	1.06E+00
Copper	Central	kg/yr	1.36E-03	1.90E-02	4.09E-01	5.82E+00	2.67E-02	2.82E+01	5.96E-02	3.54E+00	6.65E-01	5.72E+01
Copper	Lower	kg/yr	1.36E-03	1.90E-02	3.18E-01	3.53E+00	2.37E-02	2.31E+01	4.04E-02	2.41E+00	4.20E-01	3.72E+01
Copper	Upper	kg/yr	1.36E-03	1.90E-02	5.11E-01	8.36E+00	2.94E-02	3.27E+01	8.56E-02	4.97E+00	1.06E+00	7.86E+01
Lead	Central	kg/yr	5.30E-04	1.81E-02	1.36E-01	4.49E+00	1.65E-02	1.36E+01	1.21E-02	1.06E+00	2.60E-01	3.13E+01
Lead	Lower	kg/yr	5.30E-04	1.81E-02	1.30E-01	2.77E+00	1.46E-02	1.11E+01	8.23E-03	7.17E-01	1.84E-01	1.99E+01
Lead	Upper	kg/yr	5.30E-04	1.81E-02	1.42E-01	6.39E+00	1.81E-02	1.57E+01	1.67E-02	1.51E+00	4.01E-01	4.45E+01
Manganese	Central	kg/yr	6.40E+01	7.17E+01	1.80E+03	1.97E+03	1.76E+03	1.62E+03	2.59E+03	2.63E+03	7.96E+03	8.53E+03
Manganese	Lower	kg/yr	5.86E+01	6.63E+01	4.40E+02	5.11E+02	1.50E+03	1.39E+03	1.93E+03	1.95E+03	4.58E+03	4.76E+03
Manganese	Upper	kg/yr	1.22E+02	1.29E+02	3.49E+03	3.77E+03	1.99E+03	1.84E+03	3.41E+03	3.47E+03	1.27E+04	1.38E+04
Mercury	Central	kg/yr	0.00E+00	0.00E+00	0.00E+00	7.75E-03	6.31E-03	4.78E-02	0.00E+00	0.00E+00	2.38E-02	1.01E-01
Mercury	Lower	kg/yr	0.00E+00	0.00E+00	0.00E+00	1.25E-03	5.49E-03	3.89E-02	0.00E+00	0.00E+00	9.82E-03	5.85E-02
Mercury	Upper	kg/yr	0.00E+00	0.00E+00	0.00E+00	1.49E-02	7.03E-03	5.56E-02	0.00E+00	0.00E+00	4.23E-02	1.59E-01
Nickel	Central	kg/yr	2.47E-02	3.39E-02	2.31E+00	4.62E+00	1.11E+00	1.07E+01	3.81E+00	5.01E+00	9.97E+00	3.43E+01
Nickel	Lower	kg/yr	1.76E-02	2.68E-02	1.24E+00	2.26E+00	9.66E-01	8.82E+00	2.76E+00	3.57E+00	5.81E+00	2.00E+01
Nickel	Upper	kg/yr	1.00E-01	1.09E-01	3.69E+00	7.46E+00	1.24E+00	1.24E+01	5.01E+00	6.80E+00	1.63E+01	5.20E+01
Zinc	Central	kg/yr	1.16E-01	1.12E-01	0.00E+00	1.43E+01	4.48E-01	1.03E+02	1.04E+00	6.79E+00	6.52E+00	2.01E+02
Zinc	Lower	kg/yr	7.37E-02	7.01E-02	0.00E+00	6.80E+00	3.98E-01	8.47E+01	7.12E-01	4.60E+00	2.84E+00	1.28E+02
Zinc	Upper	kg/yr	5.64E-01	5.61E-01	0.00E+00	2.26E+01	4.92E-01	1.20E+02	1.40E+00	9.62E+00	1.56E+01	2.85E+02
Pesticides												
4,4'-DDD	Central	kg/yr	--	--	0.00E+00	1.98E-03	--	--	--	--	2.00E-04	1.89E-02
4,4'-DDD	Lower	kg/yr	--	--	0.00E+00	3.20E-04	--	--	--	--	1.51E-05	1.64E-03
4,4'-DDD	Upper	kg/yr	--	--	0.00E+00	3.83E-03	--	--	--	--	6.80E-04	6.11E-02
4,4'-DDT	Central	kg/yr	--	--	0.00E+00	0.00E+00	--	--	--	--	1.71E-05	2.67E-02
4,4'-DDT	Lower	kg/yr	--	--	0.00E+00	0.00E+00	--	--	--	--	1.71E-05	1.48E-03
4,4'-DDT	Upper	kg/yr	--	--	0.00E+00	0.00E+00	--	--	--	--	1.71E-05	9.28E-02
Total of 2,4' and 4,4'-DDE	Central	kg/yr	--	--	0.00E+00	1.98E-03	--	--	--	--	6.93E-06	3.63E-03
Total of 2,4' and 4,4'-DDE	Lower	kg/yr	--	--	0.00E+00	3.20E-04	--	--	--	--	6.93E-06	4.27E-04
Total of 2,4' and 4,4'-DDE	Upper	kg/yr	--	--	0.00E+00	3.83E-03	--	--	--	--	6.93E-06	9.49E-03
Total of 2,4' and 4,4'-DDD	Central	kg/yr	--	--	1.98E-02	2.45E-02	--	--	--	--	2.05E-02	5.17E-02
Total of 2,4' and 4,4'-DDD	Lower	kg/yr	--	--	3.20E-03	3.95E-03	--	--	--	--	3.24E-03	6.14E-03
Total of 2,4' and 4,4'-DDD	Upper	kg/yr	--	--	3.83E-02	4.72E-02	--	--	--	--	4.05E-02	1.39E-01
Total of 2,4' and 4,4'-DDT	Central	kg/yr	--	--	1.03E-03	1.30E-03	--	--	--	--	1.05E-03	2.89E-02
Total of 2,4' and 4,4'-DDT	Lower	kg/yr	--	--	1.66E-04	2.09E-04	--	--	--	--	1.83E-04	1.73E-03
Total of 2,4' and 4,4'-DDT	Upper	kg/yr	--	--	1.99E-03	2.50E-03	--	--	--	--	2.01E-03	9.87E-02
Total DDx	Central	kg/yr	--	--	2.09E-02	2.78E-02	--	--	--	--	2.16E-02	8.43E-02
Total DDx	Lower	kg/yr	--	--	3.37E-03	4.48E-03	--	--	--	--	3.44E-03	8.31E-03
Total DDx	Upper	kg/yr	--	--	4.03E-02	5.36E-02	--	--	--	--	4.25E-02	2.47E-01

Table E6-2. Estimated Upland Groundwater Plume Annual Loading to the Water Column, by Upland Site.

			Kinder Morgan		Rhone Poulenc		Siltronic		Willbridge		Entire Study Area	
Analyte	Load Estimate	Units	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]
PAHs												
Naphthalene	Central	kg/yr	0.00E+00	0.00E+00	1.03E-01	1.03E-01	3.42E+01	5.53E+02	1.60E-02	1.60E-02	1.25E+02	7.72E+02
Naphthalene	Lower	kg/yr	0.00E+00	0.00E+00	7.05E-02	7.05E-02	3.04E+01	4.50E+02	1.29E-02	1.29E-02	5.73E+01	4.73E+02
Naphthalene	Upper	kg/yr	0.00E+00	0.00E+00	1.40E-01	1.40E-01	3.76E+01	6.43E+02	2.17E-02	2.17E-02	1.92E+02	1.03E+03
Benzo(a)pyrene	Central	kg/yr	0.00E+00	0.00E+00	--	--	2.60E-03	9.18E-01	0.00E+00	0.00E+00	9.36E-03	3.57E+00
Benzo(a)pyrene	Lower	kg/yr	0.00E+00	0.00E+00	--	--	2.30E-03	7.50E-01	0.00E+00	0.00E+00	4.34E-03	1.70E+00
Benzo(a)pyrene	Upper	kg/yr	0.00E+00	0.00E+00	--	--	2.86E-03	1.07E+00	0.00E+00	0.00E+00	1.44E-02	5.49E+00
Total Carcinogenic PAHs	Central	kg/yr	1.19E-05	6.56E-04	--	--	2.51E-02	4.20E+00	0.00E+00	0.00E+00	8.34E-02	1.76E+01
Total Carcinogenic PAHs	Lower	kg/yr	7.41E-06	6.51E-04	--	--	2.20E-02	3.43E+00	0.00E+00	0.00E+00	3.99E-02	8.20E+00
Total Carcinogenic PAHs	Upper	kg/yr	5.93E-05	7.03E-04	--	--	2.79E-02	4.88E+00	0.00E+00	0.00E+00	1.27E-01	2.72E+01
cPAH BaPEq	Central	kg/yr	5.67E-06	3.22E-05	--	--	3.74E-03	1.22E+00	0.00E+00	0.00E+00	1.31E-02	4.79E+00
cPAH BaPEq	Lower	kg/yr	3.55E-06	3.01E-05	--	--	3.30E-03	9.97E-01	0.00E+00	0.00E+00	6.16E-03	2.27E+00
cPAH BaPEq	Upper	kg/yr	2.84E-05	5.49E-05	--	--	4.12E-03	1.42E+00	0.00E+00	0.00E+00	2.01E-02	7.37E+00
Total High Molecular Weight PAHs	Central	kg/yr	3.20E-03	1.57E-02	--	--	6.78E-01	1.35E+01	1.72E-02	3.02E-02	1.35E+00	4.75E+01
Total High Molecular Weight PAHs	Lower	kg/yr	2.60E-03	1.51E-02	--	--	6.06E-01	1.12E+01	1.43E-02	2.32E-02	8.30E-01	2.29E+01
Total High Molecular Weight PAHs	Upper	kg/yr	9.66E-03	2.21E-02	--	--	7.43E-01	1.55E+01	2.26E-02	3.97E-02	1.89E+00	7.26E+01
Total Low Molecular Weight PAHs	Central	kg/yr	5.37E-02	7.65E-02	--	--	5.86E+01	6.06E+02	2.95E-01	3.54E-01	1.64E+02	8.63E+02
Total Low Molecular Weight PAHs	Lower	kg/yr	5.05E-02	7.32E-02	--	--	5.21E+01	4.97E+02	2.36E-01	2.76E-01	8.36E+01	5.28E+02
Total Low Molecular Weight PAHs	Upper	kg/yr	8.86E-02	1.11E-01	--	--	6.43E+01	7.02E+02	3.94E-01	4.71E-01	2.43E+02	1.16E+03
Total PAHs	Central	kg/yr	5.72E-02	9.20E-02	--	--	5.94E+01	6.20E+02	3.13E-01	3.85E-01	1.66E+02	9.11E+02
Total PAHs	Lower	kg/yr	5.34E-02	8.82E-02	--	--	5.29E+01	5.08E+02	2.50E-01	3.00E-01	8.47E+01	5.51E+02
Total PAHs	Upper	kg/yr	9.85E-02	1.33E-01	--	--	6.52E+01	7.19E+02	4.16E-01	5.11E-01	2.45E+02	1.23E+03
SVOCs												
1,2-Dichlorobenzene	Central	kg/yr	--	0.00E+00	--	3.55E+01	--	2.06E-03	--	0.00E+00	--	3.55E+01
1,2-Dichlorobenzene	Lower	kg/yr	--	0.00E+00	--	6.44E+00	--	1.68E-03	--	0.00E+00	--	6.45E+00
1,2-Dichlorobenzene	Upper	kg/yr	--	0.00E+00	--	6.74E+01	--	2.40E-03	--	0.00E+00	--	6.75E+01
VOCs												
1,2-Dichloroethane	Central	kg/yr	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	1.25E+00
1,2-Dichloroethane	Lower	kg/yr	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	1.53E-01
1,2-Dichloroethane	Upper	kg/yr	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	4.02E+00
1,1,2-Trichloroethane	Central	kg/yr	--	0.00E+00	--	0.00E+00	--	1.98E-02	--	0.00E+00	--	5.88E-01
1,1,2-Trichloroethane	Lower	kg/yr	--	0.00E+00	--	0.00E+00	--	1.61E-02	--	0.00E+00	--	7.60E-02
1,1,2-Trichloroethane	Upper	kg/yr	--	0.00E+00	--	0.00E+00	--	2.31E-02	--	0.00E+00	--	1.88E+00
1,2,4-Trimethylbenzene	Central	kg/yr	--	0.00E+00	--	0.00E+00	--	1.76E+00	--	0.00E+00	--	4.48E+00
1,2,4-Trimethylbenzene	Lower	kg/yr	--	0.00E+00	--	0.00E+00	--	1.47E+00	--	0.00E+00	--	2.43E+00
1,2,4-Trimethylbenzene	Upper	kg/yr	--	0.00E+00	--	0.00E+00	--	2.01E+00	--	0.00E+00	--	6.49E+00
Benzene	Central	kg/yr	--	0.00E+00	--	1.61E-01	--	1.52E+01	--	0.00E+00	--	5.17E+01
Benzene	Lower	kg/yr	--	0.00E+00	--	3.45E-02	--	1.26E+01	--	0.00E+00	--	1.80E+01
Benzene	Upper	kg/yr	--	0.00E+00	--	3.01E-01	--	1.75E+01	--	0.00E+00	--	8.08E+01
Carbon disulfide	Central	kg/yr	--	6.13E-04	--	0.00E+00	--	8.06E-03	--	0.00E+00	--	6.91E-01
Carbon disulfide	Lower	kg/yr	--	3.83E-04	--	0.00E+00	--	6.56E-03	--	0.00E+00	--	6.86E-01
Carbon disulfide	Upper	kg/yr	--	3.06E-03	--	0.00E+00	--	9.38E-03	--	0.00E+00	--	1.38E+00
Chlorobenzene	Central	kg/yr	--	0.00E+00	--	1.36E+01	--	4.39E-03	--	0.00E+00	--	6.72E+01
Chlorobenzene	Lower	kg/yr	--	0.00E+00	--	3.45E+00	--	3.54E-03	--	0.00E+00	--	3.28E+01
Chlorobenzene	Upper	kg/yr	--	0.00E+00	--	2.48E+01	--	5.20E-03	--	0.00E+00	--	1.40E+02
Chloroethane	Central	kg/yr	--	0.00E+00	--	0.00E+00	--	8.94E-03	--	5.31E-02	--	1.70E+00
Chloroethane	Lower	kg/yr	--	0.00E+00	--	0.00E+00	--	7.28E-03	--	4.46E-02	--	1.68E+00
Chloroethane	Upper	kg/yr	--	0.00E+00	--	0.00E+00	--	1.04E-02	--	6.84E-02	--	1.73E+00
Chloroform	Central	kg/yr	--	1.30E-04	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	3.28E+00
Chloroform	Lower	kg/yr	--	8.11E-05	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	2.79E-01
Chloroform	Upper	kg/yr	--	6.49E-04	--	0.00E+00	--	0.00E+00	--	0.00E+00	--	2.77E+03
cis-1,2-Dichloroethene c	Central	kg/yr	--	0.00E+00	--	8.90E-01	--	3.46E+02	--	0.00E+00	--	3.47E+02
cis-1,2-Dichloroethene c	Lower	kg/yr	--	0.00E+00	--	1.61E-01	--	3.05E+02	--	0.00E+00	--	3.05E+02
cis-1,2-Dichloroethene c	Upper	kg/yr	--	0.00E+00	--	1.70E+00	--	3.82E+02	--	0.00E+00	--	3.84E+02

Table E6-2. Estimated Upland Groundwater Plume Annual Loading to the Water Column, by Upland Site.

			Kinder Morgan		Rhone Poulenc		Siltronic		Willbridge		Entire Study Area	
Analyte	Load Estimate	Units	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]	Peepers and Filtered Push Probe[a]	Peepers and Unfiltered Push Probe[b]
Methylene Chloride	Central	kg/yr	--	0.00E+00	--	0.00E+00	--	3.71E-03	--	0.00E+00	--	8.21E+02
Methylene Chloride	Lower	kg/yr	--	0.00E+00	--	0.00E+00	--	3.02E-03	--	0.00E+00	--	8.64E+01
Methylene Chloride	Upper	kg/yr	--	0.00E+00	--	0.00E+00	--	4.32E-03	--	0.00E+00	--	2.68E+03
Ethylbenzene	Central	kg/yr	--	0.00E+00	--	7.79E-03	--	4.01E+00	--	0.00E+00	--	9.00E+00
Ethylbenzene	Lower	kg/yr	--	0.00E+00	--	1.26E-03	--	3.31E+00	--	0.00E+00	--	3.70E+00
Ethylbenzene	Upper	kg/yr	--	0.00E+00	--	1.52E-02	--	4.63E+00	--	0.00E+00	--	1.36E+01
Toluene	Central	kg/yr	--	2.13E-04	--	0.00E+00	--	1.79E+00	--	5.95E-02	--	3.74E+00
Toluene	Lower	kg/yr	--	1.33E-04	--	0.00E+00	--	1.51E+00	--	4.81E-02	--	2.03E+00
Toluene	Upper	kg/yr	--	1.07E-03	--	0.00E+00	--	2.03E+00	--	8.08E-02	--	5.70E+00
Trichloroethene [c]	Central	kg/yr	--	0.00E+00	--	2.94E-02	--	7.09E-01	--	0.00E+00	--	4.45E+00
Trichloroethene [c]	Lower	kg/yr	--	0.00E+00	--	4.76E-03	--	6.55E-01	--	0.00E+00	--	1.05E+00
Trichloroethene [c]	Upper	kg/yr	--	0.00E+00	--	5.73E-02	--	2.67E+02	--	0.00E+00	--	2.80E+02
Vinyl chloride [c]	Central	kg/yr	--	0.00E+00	--	6.41E-01	--	4.90E+01	--	0.00E+00	--	5.01E+01
Vinyl chloride [c]	Lower	kg/yr	--	0.00E+00	--	1.50E-01	--	4.25E+01	--	0.00E+00	--	4.27E+01
Vinyl chloride [c]	Upper	kg/yr	--	0.00E+00	--	1.19E+00	--	5.46E+01	--	0.00E+00	--	5.73E+01
Total Xylenes	Central	kg/yr	--	0.00E+00	--	5.71E-02	--	3.01E+00	--	2.10E-02	--	9.63E+00
Total Xylenes	Lower	kg/yr	--	0.00E+00	--	2.52E-02	--	2.50E+00	--	1.58E-02	--	2.95E+00
Total Xylenes	Upper	kg/yr	--	0.00E+00	--	9.29E-02	--	3.45E+00	--	2.81E-02	--	1.56E+01

Notes:

[a] Push Probe refers to samples collected by either Trident or Geoprobe samplers.

[b] Due to sample volume limitations, filtered Push Probe samples were not collected at all sample locations. To calculate loading rate estimates at these sample locations, the average of the filtered push-probe chemical concentrations within the same flow zone was used.

[c] Station GP-67 is located in Area 2 of the Siltronic site, which is understood to be an area impacted by a direct discharge of trichloroethene. Concentrations of trichloroethene and related degradation-chain chemicals (cis-1,2-dichloroethene and vinyl chloride) measured at GP-67 are not representative of the upland groundwater plume; therefore, GP-67 was not included in loading calculations for these three chemicals for the Siltronic site or the entire Study Area. For comparison purposes, entire Study Area loads were also calculated for these three chemicals including station GP-67. These comparative loading results are as follows:

cis-1,2-Dichloroethene - central: 3.47E+02 kg/yr, lower: 3.05E+02, upper: 3.84E+02
Trichloroethene - central: 2.34E+02 kg/yr, lower: 1.88E+02, upper: 2.80E+02
Vinyl chloride - central: 5.01E+01 kg/yr, lower: 4.27E+01, upper: 5.73E+01

-- Analyte not sampled.
n/a - Indicates that filtered data were not available. Per sampling protocols, filtered samples were not collected for VOCs or naphthalene.
BaPEq - benzo(a)pyrene equivalents
cPAH - carcinogenic polycyclic aromatic hydrocarbon
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbon
SVOC - semivolatile organic compound
VOC - volatile organic compound

Table E6-3. Summary of Hydrogeologic Information Gathered from the CSMs.

Site	Number of Wells	Aquifer Units Present	Groundwater Flow Direction	Depth to Groundwater (ft bgs)	Depth of Aquifer (ft bgs)	Saturated Thickness (ft)	Horizontal Gradient (avg - linear ft/ft)	Downward Vertical Gradient (potential)	Hydraulic Conductivity K (ft/day)	Transmissivity T (ft^2/day)	Average Linear Groundwater Velocity (ft/day)
ACF Industries #794	5	Fill and Alluvium	Northeast toward the Willamette River	5-10	-	1-13	0.04	-	-	-	-
Alder Creek #2446	-	-	-	-	-	-	-	-	-	-	-
Anderson Brothers #970	-	-	-	-	-	-	-	-	-	-	-
ARCO #1528	49[a]	Channel Deposit	East toward the Willamette River	-	-	-	0.01	-	33 - 100	1,800 - 3,200	-
		Fine-grained Alluvium	-	-	-	-	0.05	-	~0.5 - 2	-	-
		Sandy Alluvial Deposits	-	-	-	-	0.05	-	~1 - 2	-	-
Arkema #398	>50	Shallow Unconfined Alluvial	East-northeast in Acid Plant Area; East-southeast in Chlorate Plant Area	-	Ground surface to 32	~20 (West); 10-15 (adjacent to the Willamette River)	0.0024 - 0.0069	-	1.2 - 34 (17 average)	-	-
	11	Intermediate Confined Alluvial	East-northeast in Acid Plant Area; East-southeast in Chlorate Plant Area	-	36 - 46	5 - 10	0.0038 - 0.0069	-	0.04 - 21 (5.8 average)	-	-
	1	Deep Confined Alluvial	East-northeast	-	40 - 45	-	-	-	0.3	-	-
	1	Columbia River Basalt Bedrock	Northeast	-	45 - >70	-	-	-	-	-	-
Babcock #2361	-	-	-	~25 (from adjacent site)	-	-	-	-	-	-	-
BES #2452	5 (40-42 ft bgs)	-	-	23-27	-	-	-	-	-	-	-
BNSF	-	-	Expected to flow north toward the Willamette River	-	-	-	-	-	-	-	-
Boydstun #2362	2 (1 MW and 1 temp well point)	-	-	26-28	15-20 (perched groundwater zones)	-	Low and variable	-	-	-	-
Burgard, Noncontiguous #none	-	Shallow Unconfined Dredge Fill and Alluvium	West toward the Willamette River	-	-	-	-	-	-	-	-
Calbag #2454	-	-	-	-	-	-	-	-	-	-	-
Cascade General #271	50 (push probe)	Fill and Upper Alluvial Deposit	Radially outward toward the Willamette River and Swan Island Lagoon	18-31	-	-	-	-	-	-	-
Chase Bag #2424	-	-	-	-	-	-	-	-	-	-	-
Chevron Asphalt	26	Upper Fill and Alluvial	North and northeast toward the Willamette River	4-17	-	-	-	-	-	-	-
	1 (Industrial water supply well, MULT 991)	Columbia River Basalt	-	27	70 to unknown	-	-	-	-	-	-
Christenson Oil #2426	-	-	-	-	-	-	-	-	-	-	-
Columbia American Plating #29	38 (Geoprobe to 15 ft.)	-	-	8-14	-	-	-	-	-	-	-
Consolidated Metco #3295	-	Sandy Alluvium/Sandy Dredge Fill	-	6-20	5-10 (thin elevated perched aquifers)	-	-	-	-	-	-
Crawford Street #2363	3	Recent Fill and Alluvium	-	29	-	-	-	-	-	-	-
Equilon #169	-	Upper Sand	North and east toward the Willamette River	8-12	Ground surface to 20	-	Southwest: 0.02; near the Willamette River 0.002	-	-	-	-
Exxon #137	>55	Shallow Alluvial	Northeast toward the Willamette River, deflected by slurry wall to the north or south ends of property	-	-	-	0.03 - 0.04	-	~4	~43	0.56
	0[c]	Deep Alluvial[b]	-	-	-	-	-	-	-	-	-
Foss Brix #2364	7 (and a river staff gauge)	Shallow (Fill/Sand)	Northeast towards the Willamette River	-	-	-	Between upland and edge of Willamette River: 0.2; Upland: 0.014	-	-	-	-

Table E6-3. Summary of Hydrogeologic Information Gathered from the CSMs.

Site	Number of Wells	Aquifer Units Present	Groundwater Flow Direction	Depth to Groundwater (ft bgs)	Depth of Aquifer (ft bgs)	Saturated Thickness (ft)	Horizontal Gradient (avg - linear ft/ft)	Downward Vertical Gradient (potential)	Hydraulic Conductivity K (ft/day)	Transmissivity T (ft^2/day)	Average Linear Groundwater Velocity (ft/day)
Fred Devine # 2365	-	-	-	-	-	-	-	-	-	-	-
Freightliner TMP II #115	5 (screened 10-20 ft bgs)	Uppermost Waterbearing Zone (Fill Sand)	Westerly	7-14	20-25	-	0.009-0.01	-	-	-	-
	-	Alluvium (flood deposit)	-	-	Up to 112	-	-	-	-	-	-
	?	Deeper Waterbearing Zone (water wells screened in this unit)	-	-	Below 100	-	-	-	-	-	-
Freightliner #2366	?	Uppermost Waterbearing Zone - Fill below 10 ft	South to southwest	10-17	-	-	-	-	-	-	-
Front Ave #1239	temporary well points only	Shallow Dredge Fill and Alluvial	-	18-35	Ground surface to 40	-	-	-	-	-	-
Gasco #84	10	Surficial Fill Deposits	Northeasterly towards the Willamette River	-	2 - 30	2 -20	0.017	0.04 - 0.4	0.0067- 26 (3.9 average)	-	0.0007 - 2.6
	14	Alluvial	Northeast towards the Willamette River	-	30 - 200	-	0.016, 0.020 and 0.030 (toward the river) are typical for the central portion of the site, while gradients ranging from 0.001 (toward the river) to 0.0030 (to the south-southwest, away from the river)	–0.002 to -0.02 (upward) and between 0.002 and 0.008 (downward) between intermediate-depth Alluvial Waterbearing Zone well and deep Alluvial. A slight upward hydraulic gradient ranging from -0.0005 to –0.002 is typical between deep Alluvial Waterbearing Zone wells	0.79	-	0.07
	-	Combined Columbia River Basalt	-	-	258 (between two basalt layers)	-	-	-	-	-	-
GE Decommissioning #	6	Fill	North toward the Willamette River	10-13	-	-	0.003	-	-	-	-
Goldendale Aluminum #2440	8 (Geoprobe)	-	West toward the Willamette River	20-22	-	-	-	-	-	-	-
Gould #49	32	Shallow Dredge Fill and Alluvial	-	-	-	-	-	-	-	-	-
Georgia Pacific Linnton #2370	-	-	-	-	-	-	-	-	-	-	-
GS Roofing #117	14	-	East toward the Willamette River	8-22	-	-	-	-	-	-	-
Gunderson #1155	65	Shallow Sand/Silt Unit (Unconsolidated Sedimentary Aquifer)	North toward the Willamette River	-	Area 1: 30 to 40 ft. thick; Area 2: up to 160 ft. thick	-	-	-	1	-	-
	-	Detrital Gravel Zone	Northeast toward the Willamette River	-	Area 1: 35 ft; Area 2: 70 to 110 ft	-	0.025 (in Southeast) to 0.003 (in Northwest)	-0.011 (in vicinity of MW-50 (shallow) and MW-43 (deep)	100	-	-
	-	Gravelly Fractured Columbia River Basalt Zone	-	-	-	-	-	-	50	-	-
	-	Fractured Columbia River Basalt Zone	-	-	-	-	-	-	10	-	-
	-	Massive Columbia River Basalt Zone	-	-	-	-	-	-	0.1	-	-
	-	Vantage Horizon	-	-	92 (near the Willamette River)	-	-	-	5	-	-

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Site	Number of Wells	Aquifer Units Present	Groundwater Flow Direction	Depth to Groundwater (ft bgs)	Depth of Aquifer (ft bgs)	Saturated Thickness (ft)	Horizontal Gradient (avg - linear ft/ft)	Downward Vertical Gradient (potential)	Hydraulic Conductivity K (ft/day)	Transmissivity T (ft^2/day)	Average Linear Groundwater Velocity (ft/day)
Jefferson Smurfitt #2371	-	Dredge Fill overlaying Alluvium	On-site flow: West toward the Willamette River or south towards Slip; Regional flow: Northeast toward confuence of the Willamette River and Columbia River	7-18	-	-	-	-	-	-	-
Kinder Morgan #1096	32	Single Shallow Aquifer (screened at ~25 ft bgs)	-	-	-	-	-	-	19.4	-	-
Lakeside Industries #2372	5 (Gunderson wells)	-	Northeast toward the Willamette River	21-34	-	-	-	0.12 (based on shallow and deep wells)	-	-	-
Linnton Oil and Fire #1189	12 (Shallow)	-	Northeast towards the Willamette River (Spring); East (Fall)	1-5	-	-	-	-	horizontal: 0.004-0.01	-	-
Linnton Plywood #2373	13 (Deep)	Fill overlaying Alluvium	Towards the Willamette River	23-33	-	-	-	-	-	-	-
MarCom #2350	13	Shallow Fill	Expected toward the Willamette River	6-16	-	-	-	-	-	-	-
Marine Finance #2352	6 (7 temp well points)	Single unconfined (Fill and Quaternary Alluvial deposits)	Northeast toward the Willamette River	7 - 20	-	-	0.045	-	-	-	-
McCall Oil #134	20 shallow (2 piezometers; max depth 28 ft bgs)	Single unit in Dredge Fill and/or Alluvium	North toward the Willamette River	12 - 25	Max ~75	-	-	-	0.0034-0.16	-	-
McCormick and Baxter #74	14	Shallow unconfined Sand Fill	South-southwest toward the Willamette River	20 - 25	-	up to 30	0.006-0.005	-	-	-	-
McWhorter #135	-	-	-	10-17	-	-	-	-	-	-	-
NW Pipe #138	9	Shallow Unconfined Lower Dredge Fill and Alluvium	Northeast: West to northwest; Southeast: South to southwest; overall towards the Willamette River	-	30	-	0.001-0.0014	-	-	-	-
Olympic Pipeline #2374	-	Shallow Waterbearing Zone	Northeast to ExxonMobil and to the Willamette River	-	-	-		-	-	-	-
Oregon Steel Mills #141	23 (16 Upland, 7 Beach)	Upper - Dredge Fill and Native Alluvium	Eastern site: West-southwest; Western site: West-northwest	-	-	30-70	East: 0.002-0.009; West: 0.02-0.06	-	vertical: 0.0074 - 0.00019	-	-
Owens Corning #1036	6 (Shallow)	-	Northeast toward the Willamette River	8-21	-	-	-	-	-	-	-
Port Terminal 1 North	-	Four units: Fill and fine grained Pleistocene flood and Recent Alluvial Facies; the Lower Troutdale/Sandy River Mudstone; and Columbia River Basalt	East to northeast toward the Willamette River and Slip 2	-	-	-	-	-	-	-	-
Port Terminal 1 South #2642	112 (push probes to max of 80 ft.), 7 MW (for GW analysis)	Three zones: Shallow unconfined Fill/Alluvial deposits; Generally confined Troutdale; Columbia River Basalt	Northeast toward the Willamette River	23	-	-	-	-	-	-	-
Port Terminal 2 #2769	9 (Geoprobe)	Sand and Silty Sand	-	21-22 (1998); 29-36 (2000)	-	-	-	-	-	-	-
Port Terminal 4, Auto Storage	53 (borings, probes, monitoring wells)	Sand Fill overlying Alluvial deposits	Toward the Willamette River	-	-	-	-	-	-	-	-

Table E6-3. Summary of Hydrogeologic Information Gathered from the CSMs.

Site	Number of Wells	Aquifer Units Present	Groundwater Flow Direction	Depth to Groundwater (ft bgs)	Depth of Aquifer (ft bgs)	Saturated Thickness (ft)	Horizontal Gradient (avg - linear ft/ft)	Downward Vertical Gradient (potential)	Hydraulic Conductivity K (ft/day)	Transmissivity T (ft^2/day)	Average Linear Groundwater Velocity (ft/day)
Port Terminal 4, Slip 1	Soil borings and monitoring wells <40 ft and well clusters	Fill Unit (10-35 ft thick)	Toward the Willamette River, Slip 1, or Slip 3	8-30 (Fill and upper alluvial units)	-	-	0.01, decreasing to 0.001 in Eastern portion of facility	-	-	-	-
		Alluvial unit (65-125 ft thick)			-	-		-	-	-	-
	-	Troutdale Formation	-	-	85-150	-	-	-	-	-	-
Port of Portland, Terminal 4, Slip 3 #272	50	-	West portion of site: toward the Willamette River; Eastern portion of site: Variable, flows away from the Willamette River to north or to south	12-23	-	-	0.01 (at head of Slip 3)	-	Sandy Fill: 28.4; Silt: 0.57	-	2
Portland Container #2375	-	Perched Zones	-	-	15-20	-	Low and variable	-	-	-	-
Premier Edible Oils #2013	14	Shallow Fill	Southwest toward the Willamette River and International Slip	-	21-25	-	-	Between 2 zones, changes seasonally (downward in dry season, upward in wet season)	-	-	-
	3	Deep - native Pleistocene and Recent Alluvial deposits		-	35-44	-	-		-	-	-
PGE Harborton #2353	-	Shallow Groundwater within sand	-	3-9	-	-	0.001-0.003	-	-	-	-
Rhone Poulenc #0155	53	Fill/Shallow Alluvium Zone	Generally towards the Willamette River	-	Ground surface to 30	-	0.00882 (between W-18 and RP-01)	0.25 feet/foot (at W-11) to a minimum of 0.013 feet/foot (at AL-05) - Between Fill and Alluvial zones	-	-	-
	188	Alluvium Zone	Southwest to northeast toward the Willamette River	-	25 - 175	-	-	-	Sandy Silt/Silty Sand: 2.38 (range of 0.01 to 10.7); Clays: 0.06 (range of 0.03 to 0.09)	-	0.15 (assuming an effective porosity of 0.14)
	26	Columbia River Basalt	Southwest to northeast towards the Willamette River	-	60 - 215	-	-	0.087 feet/foot (at W-06) to a minimum of 0.0003 feet/foot (at BTB-4) - Between alluvial and basalt zones	-	-	-
RK Storage #2376	-	-	North toward the Willamette River	25	-	-	0.04	-	-	-	-
Romar #2437	-	-	-	-	-	-	-	-	-	-	-
Ryerson #2441	-	-	-	-	-	-	-	-	-	-	-
Sante Fe Pacific #2104	-	Alluvial	East to northeast	21-28	-	-	-	-	-	-	-
Schnitzer Calbag-Steel #2355		Alluvial Groundwater Zones (Perched)	-	12-20	15-20	-	-	-	-	-	-
Schnitzer Doane #395	3	3 units: Fill, alluvial, Columbia River Basalt	-	-	-	-	-	-	-	-	-
Schnitzer-Kittridge #2442	5 (temp wells to 15 ft.)	-	North toward the Willamette River	10-15	-	-	-	-	-	-	-
Shaver #2377	-	-	-		-	-	-	-	-	-	-
Siltronic #183	8	Surficial Fill Unit	Generally north to northeast toward the Willamette River	-	Ground surface to 70	-	0.02	-	-	-	-
	19	Alluvial Water Bearing Zone	Generally north to northeast, increasingly north with increasing depth	-	104 - 124	up to 170 ft	0.003 - 0.005	-	-	-	-
South Rivergate Industrial #2980	-	-	-	-	-	-	-	-	-	-	-
ST Services #1989	-	Fill and Alluvial	Northeast towards the Willamette River	15-23	-	-	0.018-0.026	-	-	-	-
Sulzer Bingham #1235	-	-	-	18-28	-	-	-	-	-	-	-

Table E6-3. Summary of Hydrogeologic Information Gathered from the CSMs.

Site	Number of Wells	Aquifer Units Present	Groundwater Flow Direction	Depth to Groundwater (ft bgs)	Depth of Aquifer (ft bgs)	Saturated Thickness (ft)	Horizontal Gradient (avg - linear ft/ft)	Downward Vertical Gradient (potential)	Hydraulic Conductivity K (ft/day)	Transmissivity T (ft^2/day)	Average Linear Groundwater Velocity (ft/day)
Time Oil #170	45	Upper Unconfined Alluvial	West-southwest toward the Willamette River	-	10-20	<1 to <15 (seasonal)	0.007-0.012	-	40-160	180-520	0.9-6.4 (at an effective porosity of 0.3)
	32	Lower Zone - Alluvial		-	-	15-20	0.0002-0.004	-	25-130	2,100-7,000	0.02-1.7 (at an effective porosity of 0.3)
Transloader #2367	-	-	-	-	-	-	-	-	-	-	-
Triangle Park #277	7	Uppermost Waterbearing Zone (Fill and Recent Alluvial)	Southwesterly toward the Willamette River	9-25	-	-	-	-	-	-	-
Trumbull Asphalt #1160	8	Alluvium	South to southeast	7-9	-	-	0.001-0.003	-	-	-	-
UPRR #178	11 (and 2 piezometers)	Shallow - Unconfined Fill and Alluvium	West toward the Willamette River	7-25	40	Fill: 10-20; Alluvium: 100	-	-	-	-	-
US Moorings #1641	-	Discontinuous interbedded Sand and Silty Sand overlaying Columbia River Basalt	-	-	20-80	-	-	-	-	-	-
USGS Marine Safety # 1338	-	Shallow unit in Fill and Alluvium	South toward Swan Island Lagoon	7-15	-	-	-	-	-	-	-
Van Water Rogers #330	-	Shallow, Dredge Fill	West then splits south and north (due to high elevation of aquitard)	6-13	-	<5	West: 0.002; North and South: 0.006	-	horizontal: 150-300	-	-
	-	Aquitard	-	-	-	-	-	-0.1	vertical: 0.0043	-	vertical: 0.0012
	-	Deep - Gravel and Sand (Troutdale)	North to northeast	7-14	-	-	<0.001	-	-	-	-
Willamette Cove #2066	-	-	-	-	-	-	-	-	-	-	-
Willbridge #1549	143	Holocene Alluvial Deposits	-	-	Ground surface to 30	-	-	-	-	-	-
	-	Columbia River Basalt	-	-	20 - 50	-	0.02	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-

Notes:

[a] CSM does not indicate the depth of the wells.

[b] Deep aquifer investigation conducted by Kleinfelder in 1997 (no hydrogeologic information in CSM).

[c] An unknown number of historic wells that were used to determine vertical gradients have been abandoned.

- - Indicates no data available
? - Indicates unspecified number of wells
bgs - below ground surface
CSM - conceptual site model
GW - groundwater
MW - monitoring well

Table E6-4. Percent Inclusion in Subsurface Advective Loading Calculations.

Analyte	Area Percent Retained	Area Percent Excluded
Metals		
Arsenic	40%	60%
Copper	57%	43%
Lead	69%	31%
Mercury	67%	33%
Butyltins		
Tributyltin Ion	59%	41%
PCBs		
PCB077	68%	32%
PCB081	62%	38%
PCB105	68%	32%
PCB118	63%	37%
PCB126	66%	34%
PCB169	17%	83%
Total PCBs	63%	37%
Dioxins/Furans		
Total PCDD/Fs	54%	46%
Pesticides		
4,4'-DDD	70%	30%
4,4'-DDT	44%	56%
Total of 2,4' and 4,4'-DDE	68%	32%
Total of 2,4' and 4,4'-DDD	67%	33%
Total of 2,4' and 4,4'-DDT	52%	48%
Total DDx	66%	34%
Total Chlordanes	39%	61%
γ-Hexachlorocyclohexane	8%	92%
Aldrin	6%	94%
Dieldrin	12%	88%
PAHs		
Naphthalene	64%	36%
Benzo(a)pyrene	60%	40%
Total Carcinogenic PAHs	63%	37%
Total PAHs	61%	39%
Phthalates		
Bis(2-ethylhexyl)phthalate	33%	67%

Notes:

The area included was determined as the total area of Thiessen polygons for which the surface sediment concentration was equal to or less than the suburface sediment concentration.

Organic carbon-normalized concentrations were compared for all chemicals except for metals; non-normalized concentrations were used to determine retained and excluded polygon areas for metals.

DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans

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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.

Table E6-5. K_{ow} and K_{oc} Values Compiled for Equlibrium Partitioning Chemical Loading Calculations

Chemical Name	Chemical CAS number	log Kow (L/kg)			Number of Outliers Removed		log Koc (L/kg)[a]					
		Primary	Minimum (outliers excluded)	Maximum (outliers excluded)	Lower	Upper	Primary	Minimum	Maximum	Primary (outliers excluded)	Minimum (outliers excluded)	Maximum (outliers excluded)
PCBs												
Total PCBs (congeners or Aroclors)	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total PCBs (TEQ) - mammalian WHO 2005 TEFs	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Aroclor 1016	12674-11-2	5.07	4.38	5.88	1	--	5.01	3.42	5.78	n/a	4.31	5.78
Aroclor 1221	11104-28-2	3.63	2.80	4.70	--	--	4.33	2.75	4.62	n/a	2.75	4.62
Aroclor 1232	11141-16-5	4.07	3.18	5.20	--	--	4.77	3.13	5.11	n/a	3.13	5.11
Aroclor 1242	53469-21-9	4.72	3.54	6.29	1	--	5.06	0.69	6.18	n/a	3.48	6.18
Aroclor 1248	12672-29-6	5.96	5.60	6.34	--	--	5.95	5.51	6.23	n/a	5.51	6.23
Aroclor 1254	11097-69-1	6.56	6.00	7.17	1	--	6.34	4.01	7.05	n/a	5.90	7.05
Aroclor 1260	11096-82-5	7.11	6.11	8.27	1	--	6.44	4.27	8.13	n/a	6.01	8.13
Aroclor 1262[h]	37324-23-5	5.99	4.34	8.27	--	--	6.44	4.27	8.13	n/a	4.27	8.13
Aroclor 1268[h]	11100-14-4	5.99	4.34	8.27	--	--	6.44	4.27	8.13	n/a	4.27	8.13
Deca PCBs	--	8.26	8.26	8.26	--	--	8.12	8.12	8.12	n/a	8.12	8.12
Di PCBs	--	5.10	4.90	5.30	--	--	5.01	4.82	5.21	n/a	4.82	5.21
Hepta PCBs	--	6.85	6.70	7.00	--	--	6.73	6.59	6.88	n/a	6.59	6.88
Hexa PCBs	--	6.99	6.70	7.30	--	--	6.87	6.59	7.18	n/a	6.59	7.18
Mono PCBs	--	4.45	4.30	4.60	--	--	4.37	4.23	4.52	n/a	4.23	4.52
Nona PCBs	--	7.66	7.20	8.16	--	--	7.53	7.08	8.02	n/a	7.08	8.02
Octa PCBs	--	7.10	7.10	7.10	--	--	6.98	6.98	6.98	n/a	6.98	6.98
Penta PCBs	--	6.35	6.20	6.50	--	--	6.24	6.09	6.39	n/a	6.09	6.39
Tetra PCBs	--	5.82	5.60	6.05	--	1	5.93	5.51	6.39	n/a	5.51	5.95
Tri PCBs	--	5.70	5.50	5.90	--	--	5.60	5.41	5.80	n/a	5.41	5.80
PCB077[i]	32598-13-3	6.17	5.62	6.77	--	1	6.39	5.52	7.74	n/a	5.52	6.66
PCB081[i]	70362-50-4	6.29	5.96	6.64	--	--	6.18	5.86	6.53	n/a	5.86	6.53
PCB105[i]	32598-14-4	6.77	6.41	7.14	2	--	5.90	4.89	7.02	n/a	6.30	7.02
PCB118[i]	31508-00-6	6.80	6.24	7.42	--	--	6.69	6.13	7.29	n/a	6.13	7.29
PCB126[i]	57465-28-8	6.68	6.38	7.00	--	--	6.57	6.27	6.88	n/a	6.27	6.88
PCB169[i]	32774-16-6	7.50	7.39	7.62	1	--	7.18	6.89	7.49	n/a	7.26	7.49
PCB106[i]	70424-69-0	6.74	6.29	7.22	--	--	6.62	6.18	7.10	n/a	6.18	7.10
PCB114[i]	74472-37-0	6.63	6.29	6.98	--	--	6.42	6.18	6.86	n/a	6.18	6.86
PCB118[i]	31508-00-6	6.80	6.24	7.42	--	--	6.69	6.13	7.29	n/a	6.13	7.29
PCB123[i]	65510-44-3	6.57	6.19	6.98	--	--	6.35	6.09	6.86	n/a	6.09	6.86
PCB156[i]	38380-08-4	7.25	6.70	7.84	--	--	7.12	6.59	7.71	n/a	6.59	7.71
PCB157[i]	69782-90-7	7.15	6.73	7.60	--	--	7.03	6.62	7.47	n/a	6.62	7.47
PCB167[i]	52663-72-6	7.15	6.82	7.50	--	--	7.03	6.70	7.37	n/a	6.70	7.37
PCB189[i]	39635-31-9	7.43	6.75	8.18	--	--	7.10	6.64	8.04	n/a	6.64	8.04

Table E6-5. K_{ow} and K_{oc} Values Compiled for Equlibrium Partitioning Chemical Loading Calculations

		log Kow (L/kg)			Number of Outliers Removed		log Koc (L/kg)[a]					
Chemical Name	**Chemical CAS number**	**Primary**	**Minimum (outliers excluded)**	**Maximum (outliers excluded)**	**Lower**	**Upper**	**Primary**	**Minimum**	**Maximum**	**Primary (outliers excluded)**	**Minimum (outliers excluded)**	**Maximum (outliers excluded)**
PCDD/Fs												
Total Dioxins/Furans	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dioxin TEQ - mammalian WHO 2005 TEFs	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	8.34	7.90	8.52	2	1	8.20	7.24	9.09	n/a	7.77	8.38
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	8.47	7.43	11.98	--	--	8.33	7.30	11.78	n/a	7.30	11.78
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	8.34	6.90	8.50	--	--	8.20	6.78	8.36	n/a	6.78	8.36
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	7.66	7.53	7.70	2	1	7.53	6.80	7.73	n/a	7.40	7.57
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	7.81	7.12	10.89	--	--	7.68	7.00	10.71	n/a	7.00	10.71
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	7.63	6.93	7.96	--	--	7.50	6.81	7.82	n/a	6.81	7.82
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	7.74	7.58	10.40	--	--	7.61	7.45	10.22	n/a	7.45	10.22
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	7.65	7.00	7.76	--	--	7.52	6.88	7.63	n/a	6.88	7.63
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	7.77	7.58	9.78	1	1	7.64	6.78	10.22	n/a	7.45	9.61
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	6.98	6.79	7.07	1	--	6.86	6.36	6.95	n/a	6.67	6.95
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	7.06	6.30	7.55	--	1	6.94	6.19	9.63	n/a	6.19	7.42
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	7.66	6.94	7.92	--	--	7.53	6.82	7.79	n/a	6.82	7.79
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	6.95	6.76	7.11	1	2	6.83	6.39	7.69	n/a	6.64	6.99
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	6.30	5.82	6.58	--	2	6.19	5.72	7.57	n/a	5.72	6.47
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	6.38	6.15	7.18	1	1	6.27	5.29	8.78	n/a	6.05	7.06
Octachlorodibenzofuran	39001-02-0	9.02	7.90	13.93	--	--	8.87	7.77	13.69	n/a	7.77	13.69
Octachlorodibenzo-p-dioxin	3268-87-9	9.16	7.59	13.37	--	--	9.00	7.46	13.14	n/a	7.46	13.14
DDx Pesticides												
Total DDx	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sum DDT	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sum DDE	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sum DDD	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4,4'-DDD	72-54-8	6.05	5.19	6.33	3	--	5.95	4.74	6.22	n/a	5.10	6.22
4,4'-DDT	50-29-3	6.72	4.89	6.91	1	1	6.61	3.91	8.17	n/a	4.81	6.80
4,4'-DDE	72-55-9	6.90	5.43	6.96	1	--	6.78	4.21	6.84	n/a	5.34	6.84
Chlordanes (Total)	57749	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
cis-Chlordane	5103-71-9	6.42	4.75	6.42	5	--	6.31	2.73	6.31	n/a	4.67	6.31
trans-Chlordane	5103-74-2	6.42	4.75	6.42	5	--	6.31	2.73	6.31	n/a	4.67	6.31
Oxychlordane	27304-13-8	6.28	6.28	6.28	--	--	6.17	6.17	6.17	n/a	6.17	6.17
cis-Nonachlor	5103-73-1	6.78	6.78	6.78	--	--	6.67	6.67	6.67	n/a	6.67	6.67
trans-Nonachlor	39765-80-5	6.78	6.78	6.78	--	--	6.67	6.67	6.67	n/a	6.67	6.67
gamma-Hexachlorocyclohexane	58-89-9	3.73	3.25	3.90	4	1	3.67	2.76	5.23	n/a	3.20	3.83
Aldrin	309-00-2	6.39	5.39	7.50	1	--	6.28	2.96	7.37	n/a	5.30	7.37
Dieldrin	60-57-1	5.37	4.32	6.20	1	--	5.28	2.56	6.09	n/a	4.25	6.09
PAHs												
Total PAHs	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total Carcinogenic PAHs	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2-Methylnaphthalene	91-57-6	3.80	3.70	4.11	--	--	3.74	3.64	4.04	n/a	3.64	4.04
Acenaphthene	83-32-9	3.89	3.89	4.00	--	1	3.82	3.82	4.41	n/a	3.82	3.93
Acenaphthylene	208-96-8	3.70	3.55	4.08	--	--	3.64	3.49	4.01	n/a	3.49	4.01
Anthracene	120-12-7	4.61	4.20	4.80	1	1	4.53	3.39	5.25	n/a	4.13	4.72

Table E6-5. K_{ow} and K_{oc} Values Compiled for Equlibrium Partitioning Chemical Loading Calculations

		log Kow (L/kg)			Number of Outliers Removed		log Koc (L/kg)[a]					
Chemical Name	**Chemical CAS number**	**Primary**	**Minimum (outliers excluded)**	**Maximum (outliers excluded)**	**Lower**	**Upper**	**Primary**	**Minimum**	**Maximum**	**Primary (outliers excluded)**	**Minimum (outliers excluded)**	**Maximum (outliers excluded)**
Benzo(a)anthracene	56-55-3	5.76	5.33	5.91	1	--	5.66	4.90	5.81	n/a	5.24	5.81
Benzo(a)pyrene	50-32-8	6.11	5.78	6.78	--	2	6.01	5.68	7.85	n/a	5.68	6.67
Benzo(b)fluoranthene	205-99-2	6.53	5.78	6.53	--	--	6.42	5.68	6.42	n/a	5.68	6.42
Benzo(j)fluoranthene			6.40	6.44	--	--					6.29	6.33
Benzo(k)fluoranthene	207-08-9	6.45	5.94	6.84	--	1	6.34	5.84	7.08	n/a	5.84	6.72
Benzo(b+j)fluoranthene	BBJFLANTH	6.49	5.78	6.49	--	--	6.38	5.68	6.38	n/a	5.68	6.38
Benzo(b+k)fluoranthene	BKBFLANTH	6.49	5.78	7.20	--	--	6.38	5.68	7.08	n/a	5.68	7.08
Benzo(j+k)fluoranthene	BKJFLANTH	6.45	5.94	7.20	--	--	6.34	5.84	7.08	n/a	5.84	7.08
Benzo(g,h,i)perylene	191-24-2	6.96	6.22	7.10	--	--	6.84	6.11	6.98	n/a	6.11	6.98
Chrysene	218-01-9	5.80	5.50	5.91	1	--	5.70	5.07	5.81	n/a	5.41	5.81
Dibenzo(a,h)anthracene	53-70-3	7.25	6.50	7.25	1	--	7.13	5.70	7.13	n/a	6.39	7.13
Fluoranthene	206-44-0	5.25	4.47	5.25	1	--	5.16	4.39	5.16	n/a	4.39	5.16
Fluorene	86-73-7	4.05	4.05	4.23	2	1	3.98	3.84	4.25	n/a	3.98	4.16
Indeno(1,2,3-cd)pyrene	193-39-5	7.05	6.58	8.20	--	--	6.93	6.47	8.06	n/a	6.47	8.06
Naphthalene	91-20-3	3.36	3.17	3.59	2	3	3.30	2.96	3.71	n/a	3.12	3.53
Phenanthrene	85-01-8	4.65	4.30	4.67	1	1	4.57	4.21	4.59	n/a	4.23	4.59
Pyrene	129-00-0	5.18	4.50	5.52	--	--	5.09	4.42	5.43	n/a	4.42	5.43
SVOCs												
Bis(2-ethylhexyl)phthalate	117-81-7	7.55	3.58	9.68	--	--	7.42	3.52	9.52	n/a	3.52	9.52
Butyltins										n/a		
Tributyltin ion[g]	688-73-3	4.09	2.20	7.35	--	--	4.02	2.16	7.23	n/a	2.16	7.23

Notes:

[a] Calculated from Kow as log10 Koc = 0.00028 + log10Kow×0.983 (DiTorro 1991)

[b] EPA ESB

[c] SPARC available online at: http://ibmlc2.chem.uga.edu/sparc/.
The SPARC model numerically predicts Kow values, in addition, the model has a database of experimentally measured values; both values were compiled where available. The numerically predicted SPARC value was used to determine the primary Kow, which both the predicted and database values were used to determin the minimum and maximum Kow.

[d] Mackay D., W.Y. Shiu, K.C. Ma, S.C. Lee. 2006. *Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals.* 2nd edition. CRC Press.
Mackay et al. (2006) provide a range of Kow values for many chemicals, as well as a selected value from this range. In loading calculations, the range of Kow value was used to determine the minimum and maximum Kow. The selected value was used as the primary Kow when available. When a selected Kow value was not provided, the geometric mean of the minimum and maximum Kow values was used as the primary Kow.

[e] The Oak Ridge National Laboratory-Risk Assessment Information System (ORNL-RAIS) is accessible online at: http://rais.ornl.gov/

[f] ATSDR Tox Profiles: http://www.atsdr.cdc.gov/toxpro2.html
ATSDR Toxicological Profiles provide a range of Kow values for many chemicals. In loading calculations, the range of Kow value was used to determine the minimum and maximum Kow. The geometric mean of the minimum and maximum Kow values was used as the primary Kow.

[g] No value available from primary data sources. Max value is was estimated using KowWIN Software, Minimum and Primary Values are those measured by Arnold et al.1997 (Environ. Sci. Tech., 31(9), 2596-2602)
KowWIN software available online as part of EPA Estimation Program Interface (EPA) suite of programs: http://www.epa.gov/oppt/exposure/pubs/episuite.htm
ES&T, 1997, 31(9), 2596-2602. Arnold C.G., Weidenhaupt A., David M.M., Muller S.R., Haderlein S.B., Schwarzenbach R.P.

[h] The sources listed above do not provide Kow values for Aroclor 1262 or Aroclor 1268. The values for Aroclor 1260 were used as estimates for these chemicals.

[i] The use of Mackay et al. (2006) as the preferred source for PCB congener Kow values was based on comments from US EPA on the Round 2 Report.

-- Value not available
n/a Not applicable
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT

PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans

SVOC - semivolatile organic compound
TEF - toxicity equivalency factor
TEQ - toxic equivalent concentration

Table E6-5. K_{ow} and K_{oc} Values Compiled for Equlibrium Partitioning Chemical Loading Calculations

		Kow Values - Range of Selected Literature Sources									
		Primay #1	Primary #2		Primary #3 *(Primary #1 for PCB Congeners)*			Primary #4	Primary #5		
		EPA ESB[b]	**SPARC[c]**		**Mackay-Shiu[d]**			**ORNL-RAIS[e]**	**ATSDR[f]**		
Chemical Name	**Chemical CAS number**		SPARC calculator value	SPARC database value	**Primary**	**Minimum**	**Maximum**		**Primary**	**Minimum**	**Maximum**
PCBs											
Total PCBs (congeners or Aroclors)	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total PCBs (TEQ) - mammalian WHO 2005 TEFs	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Aroclor 1016	12674-11-2	--	--	--	5.10	3.48	5.88	5.62	5.60	5.60	5.60
Aroclor 1221	11104-28-2	--	--	--	4.40	2.80	4.70	4.53	4.70	4.70	4.70
Aroclor 1232	11141-16-5	--	--	--	4.85	3.18	5.20	4.53	5.10	5.10	5.10
Aroclor 1242	53469-21-9	--	--	--	5.15	0.70	5.90	6.29	5.60	5.60	5.60
Aroclor 1248	12672-29-6	--	--	--	6.05	5.60	6.30	6.34	--	--	--
Aroclor 1254	11097-69-1	--	--	--	6.45	4.08	7.17	6.79	6.50	6.50	6.50
Aroclor 1260	11096-82-5	--	--	--	6.55	4.34	7.50	8.27	6.80	6.80	6.80
Aroclor 1262[h]	37324-23-5	--	--	--	6.55	4.34	7.50	8.27	6.80	6.80	6.80
Aroclor 1268[h]	11100-14-4	--	--	--	6.55	4.34	7.50	8.27	6.80	6.80	6.80
Deca PCBs	--	--	--	--	8.26	8.26	--	--	--	--	--
Di PCBs	--	--	--	--	5.10	4.90	5.30	--	--	--	--
Hepta PCBs	--	--	--	--	6.85	6.70	7.00	--	--	--	--
Hexa PCBs	--	--	--	--	6.99	6.70	7.30	--	--	--	--
Mono PCBs	--	--	--	--	4.45	4.30	4.60	--	--	--	--
Nona PCBs	--	--	--	--	7.66	7.20	8.16	--	--	--	--
Octa PCBs	--	--	--	--	7.10	7.10	--	--	--	--	--
Penta PCBs	--	--	--	--	6.35	6.20	6.50	--	--	--	--
Tetra PCBs	--	--	--	--	6.03	5.60	6.50	--	--	--	--
Tri PCBs	--	--	--	--	5.70	5.50	5.90	--	--	--	--
PCB077[i]	32598-13-3	--	6.22	--	6.50	5.62	7.87	--	6.33	6.04	6.63
PCB081[i]	70362-50-4	--	6.23	--	6.29	5.96	6.64	--	--	--	--
PCB105[i]	32598-14-4	--	6.91	--	6.00	4.97	7.14	--	--	--	--
PCB118[i]	31508-00-6	--	6.85	--	6.80	6.24	7.42	7.12	--	--	--
PCB126[i]	57465-28-8	--	6.83	--	6.68	6.38	7.00	--	--	--	--
PCB169[i]	32774-16-6	--	7.46	--	7.31	7.01	7.62	--	7.41	7.41	7.41
PCB106[i]	70424-69-0	--	6.95	--	6.74	6.29	7.22	--	--	--	--
PCB114[i]	74472-37-0	--	6.95	--	6.53	6.29	6.78	6.98	--	--	--
PCB118[i]	31508-00-6	--	6.85	--	6.80	6.24	7.42	7.12	--	--	--
PCB123[i]	65510-44-3	--	6.83	--	6.46	6.19	6.74	6.98	--	--	--
PCB156[i]	38380-08-4	--	7.56	--	7.25	6.70	7.84	--	--	--	--
PCB157[i]	69782-90-7	--	7.54	--	7.15	6.73	7.60	--	--	--	--
PCB167[i]	52663-72-6	--	7.48	--	7.15	6.82	7.50	--	--	--	--
PCB189[i]	39635-31-9	--	8.18	--	7.22	6.75	7.72	--	--	--	--

Table E6-5. K_{ow} and K_{oc} Values Compiled for Equlibrium Partitioning Chemical Loading Calculations

		Kow Values - Range of Selected Literature Sources									
		Primay #1	Primary #2		Primary #3 *(Primary #1 for PCB Congeners)*			Primary #4	Primary #5		
		EPA ESB[b]	**SPARC[c]**		**Mackay-Shiu[d]**			**ORNL-RAIS[e]**	**ATSDR[f]**		
Chemical Name	**Chemical CAS number**		SPARC calculator value	SPARC database value	**Primary**	**Minimum**	**Maximum**		**Primary**	**Minimum**	**Maximum**
PCDD/Fs											
Total Dioxins/Furans	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dioxin TEQ - mammalian WHO 2005 TEFs	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	8.34	--	7.40	7.37	9.25	7.92	7.92	7.92	7.92
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	--	8.47	--	8.00	7.43	11.98	8.20	10.50	9.69	11.38
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	--	8.34	--	7.66	6.90	8.50	7.92	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	7.66	--	7.00	6.92	7.86	7.58	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	--	7.81	--	7.80	7.12	10.89	8.21	9.78	9.19	10.40
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	7.63	--	7.43	6.93	7.96	7.92	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	--	7.74	--	8.32	7.58	9.13	8.21	9.78	9.19	10.40
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	--	7.65	--	7.37	7.00	7.76	7.58	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	--	7.77	--	7.44	6.90	8.02	8.21	9.78	9.19	10.40
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	--	6.98	--	6.76	6.47	7.07	6.79	6.79	6.79	6.79
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	--	7.06	--	7.00	6.49	7.55	6.30	9.20	8.64	9.80
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	--	7.66	--	7.29	6.94	7.65	7.92	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	--	6.95	--	6.50	6.56	7.82	6.92	6.92	6.92	6.92
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	--	6.30	6.53	6.53	5.82	7.70	6.53	5.82	5.82	5.82
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	--	6.38	--	6.80	5.38	8.93	6.80	7.18	6.80	7.58
Octachlorodibenzofuran	39001-02-0	--	9.02	--	8.00	7.90	13.93	8.60	8.08	7.97	8.20
Octachlorodibenzo-p-dioxin	3268-87-9	--	9.16	--	8.20	7.59	13.08	8.20	10.83	8.78	13.37
DDx Pesticides											
Total DDx	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sum DDT	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sum DDE	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sum DDD	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4,4'-DDD	72-54-8	--	6.05	6.00	5.50	4.82	6.33	6.02	6.02	6.02	6.02
4,4'-DDT	50-29-3	--	6.72	--	6.19	3.98	8.31	6.91	6.91	6.91	6.91
4,4'-DDE	72-55-9	--	6.90	6.60	5.70	4.28	6.96	6.51	6.51	6.51	6.51
Chlordanes (Total)	57749	n/a	n/a	n/a	n/a	n/a	n/a	6.97	n/a	n/a	n/a
cis-Chlordane	5103-71-9	--	6.42	--	6.00	2.78	6.27	--	--	--	--
trans-Chlordane	5103-74-2	--	6.42	--	6.00	2.78	6.27	--	--	--	--
Oxychlordane	27304-13-8	--	6.28	--	--	--	--	--	--	--	--
cis-Nonachlor	5103-73-1	--	6.78	--	--	--	--	--	--	--	--
trans-Nonachlor	39765-80-5	--	6.78	--	--	--	--	--	--	--	--
gamma-Hexachlorocyclohexane	58-89-9	3.73	3.19	3.90	4.14	2.81	5.32	3.72	3.72	3.72	3.72
Aldrin	309-00-2	--	6.39	6.50	3.01	3.01	7.50	6.50	6.50	6.50	6.50
Dieldrin	60-57-1	5.37	5.82	5.40	5.20	2.60	6.20	5.40	6.20	6.20	6.20
PAHs											
Total PAHs	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total Carcinogenic PAHs	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2-Methylnaphthalene	91-57-6	--	3.80	--	3.86	3.70	4.11	3.86	3.86	3.86	3.86
Acenaphthene	83-32-9	--	3.89	4.00	3.92	3.92	4.49	3.92	3.98	3.98	3.98
Acenaphthylene	208-96-8	--	3.70	--	4.00	3.55	4.08	3.94	4.07	4.07	4.07
Anthracene	120-12-7	--	4.61	4.55	4.54	3.45	5.34	4.45	4.45	4.45	4.45

Table E6-5. K_{ow} and K_{oc} Values Compiled for Equlibrium Partitioning Chemical Loading Calculations

		Kow Values - Range of Selected Literature Sources									
		Primay #1	Primary #2		Primary #3 *(Primary #1 for PCB Congeners)*			Primary #4	Primary #5		
		EPA ESB[b]	**SPARC[c]**		**Mackay-Shiu[d]**			**ORNL-RAIS[e]**	**ATSDR[f]**		
Chemical Name	**Chemical CAS number**		SPARC calculator value	SPARC database value	**Primary**	**Minimum**	**Maximum**		**Primary**	**Minimum**	**Maximum**
Benzo(a)anthracene	56-55-3	--	5.76	5.60	5.91	4.98	5.91	5.76	5.61	5.61	5.61
Benzo(a)pyrene	50-32-8	6.11	6.11	6.45	6.04	5.78	7.99	6.13	6.06	6.06	6.06
Benzo(b)fluoranthene	205-99-2	--	6.53	6.20	5.80	5.78	5.78	5.78	6.04	6.04	6.04
Benzo(j)fluoranthene											
Benzo(k)fluoranthene	207-08-9	--	6.45	6.20	6.00	5.94	7.20	6.11	6.06	6.06	6.06
Benzo(b+j)fluoranthene	BBJFLANTH	--	6.49	--	5.80	5.78	6.44	--	--	--	--
Benzo(b+k)fluoranthene	BKBFLANTH	--	6.49	--	5.90	5.78	7.20	--	--	--	--
Benzo(j+k)fluoranthene	BKJFLANTH	--	6.45	--	6.00	5.94	7.20	--	--	--	--
Benzo(g,h,i)perylene	191-24-2	--	6.96	6.50	6.50	6.22	7.10	6.63	6.50	6.50	6.50
Chrysene	218-01-9	--	5.80	5.86	5.60	5.50	5.91	5.81	5.16	5.16	5.16
Dibenzo(a,h)anthracene	53-70-3	--	7.25	7.00	6.75	5.80	7.11	6.75	6.84	6.84	6.84
Fluoranthene	206-44-0	--	5.25	5.22	5.22	4.47	5.23	5.16	4.90	4.90	4.90
Fluorene	86-73-7	--	4.05	4.18	4.18	3.91	4.32	4.18	4.18	4.18	4.18
Indeno(1,2,3-cd)pyrene	193-39-5	--	7.05	--	7.42	6.72	8.20	6.70	6.58	6.58	6.58
Naphthalene	91-20-3	3.36	3.36	3.41	3.37	3.01	3.77	3.30	3.29	3.29	3.29
Phenanthrene	85-01-8	--	4.65	--	4.57	4.28	4.67	4.46	4.45	4.45	4.45
Pyrene	129-00-0	--	5.18	5.20	5.18	4.50	5.52	4.88	4.88	4.88	4.88
SVOCs											
Bis(2-ethylhexyl)phthalate	117-81-7	--	7.55	--	7.50	3.58	9.68	7.60	7.50	7.50	7.50
Butyltins											
Tributyltin ion[g]	688-73-3	--	--	--	--	--	--	--	--	--	--

Notes:

[a] Calculated from Kow as log10 Koc = 0.00028 + log10Kow×0.983 (DiTorro 1991)

[b] EPA ESB

[c] SPARC available online at: http://ibmlc2.chem.uga.edu/sparc/.
The SPARC model numerically predicts Kow values, in addition, the model has a database of experimentally measured values; both values were compiled where available. The numerically predicted SPARC value was used to determine the primary Kow, which both the predicted and database values were used to determin the minimum and maximum Kow.

[d] Mackay D., W.Y. Shiu, K.C. Ma, S.C. Lee. 2006. *Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals.* 2nd edition. CRC Press.
Mackay et al. (2006) provide a range of Kow values for many chemicals, as well as a selected value from this range. In loading calculations, the range of Kow value was used to determine the minimum and maximum Kow. The selected value was used as the primary Kow when available. When a selected Kow value was not provided, the geometric mean of the minimum and maximum Kow values was used as the primary Kow.

[e] The Oak Ridge National Laboratory-Risk Assessment Information System (ORNL-RAIS) is accessible online at: http://rais.ornl.gov/

[f] ATSDR Tox Profiles: http://www.atsdr.cdc.gov/toxpro2.html
ATSDR Toxicological Profiles provide a range of Kow values for many chemicals. In loading calculations, the range of Kow value was used to determine the minimum and maximum Kow. The geometric mean of the minimum and maximum Kow values was used as the primary Kow.

[g] No value available from primary data sources. Max value is was estimated using KowWIN Software, Minimum and Primary Values are those measured by Arnold et al.1997 (Environ. Sci. Tech., 31(9), 2596-2602)
KowWIN software available online as part of EPA Estimation Program Interface (EPA) suite of programs: http://www.epa.gov/oppt/exposure/pubs/episuite.htm
ES&T, 1997, 31(9), 2596-2602. Arnold C.G., Weidenhaupt A., David M.M., Muller S.R., Haderlein S.B., Schwarzenbach R.P.

[h] The sources listed above do not provide Kow values for Aroclor 1262 or Aroclor 1268. The values for Aroclor 1260 were used as estimates for these chemicals.

[i] The use of Mackay et al. (2006) as the preferred source for PCB congener Kow values was based on comments from US EPA on the Round 2 Report.

-- Value not available
n/a Not applicable
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT

PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans

SVOC - semivolatile organic compound
TEF - toxicity equivalency factor
TEQ - toxic equivalent concentration

Table E6-6. K_d Values Compiled for Equlibrium Partitioning Chemical Loading Calculations.

		log K_d (L/kg)[a]		
Analyte	**CAS Number**	**Primary**	**Minimum**	**Maximum**
Metals				
Arsenic	7440-38-2	2.4	1.6	4.3
Copper	7440-50-8	3.5	0.7	6.2
Lead	7439-92-1	4.6	2	7
Mercury	7439-97-6	4.9	3.8	6

Notes:

[a] EPA 2005. Partition Coefficients for Metals in Surface Water, Soil, and Waste.

Table E6-7. Surface Sediment Advective Annual Loads.

	Study Area RM 1.9 - RM 11.8			RM 1.9 - RM 2.9			RM 3 - RM 3.9			RM 4 - RM 4.9			RM 5 - RM 5.9			RM 6 - RM 6.9		
Analyte	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**
Metals																		
Arsenic	1.98E+02	1.22E+03	2.50E+00	3.58E+01	2.21E+02	4.52E-01	1.80E+01	1.11E+02	2.27E-01	1.88E+01	1.16E+02	2.38E-01	1.10E+01	6.85E+01	1.40E-01	1.25E+01	7.79E+01	1.58E-01
Copper	1.78E+02	9.25E+04	3.55E-01	2.38E+01	1.21E+04	4.75E-02	1.39E+01	7.27E+03	2.77E-02	1.47E+01	7.72E+03	2.94E-02	1.08E+01	5.90E+03	2.16E-02	9.31E+00	5.08E+03	1.86E-02
Lead	6.91E+00	2.73E+03	2.75E-02	7.68E-01	3.02E+02	3.06E-03	4.50E-01	1.77E+02	1.79E-03	9.90E-01	3.91E+02	3.94E-03	3.53E-01	1.40E+02	1.41E-03	1.23E+00	4.87E+02	4.90E-03
Mercury	1.36E-02	1.71E-01	1.08E-03	1.95E-03	2.46E-02	1.55E-04	1.12E-03	1.41E-02	8.91E-05	1.05E-03	1.32E-02	8.36E-05	7.51E-04	9.45E-03	5.96E-05	2.84E-03	3.57E-02	2.25E-04
Butyltins																		
Tributyltin Ion	9.76E+00	5.47E+02	6.12E-03	2.78E-02	1.43E+00	1.75E-05	4.15E-01	2.57E+01	2.60E-04	1.38E-01	8.65E+00	8.66E-05	3.81E-01	2.08E+01	2.39E-04	3.03E-01	1.93E+01	1.90E-04
PCBs																		
PCB077	5.48E-05	4.02E-04	2.98E-05	2.53E-05	1.85E-04	1.37E-05	2.38E-06	1.74E-05	1.29E-06	2.13E-06	1.56E-05	1.16E-06	1.58E-06	1.16E-05	8.56E-07	2.68E-06	1.96E-05	1.46E-06
PCB081	5.20E-06	1.10E-05	2.36E-06	1.70E-06	3.60E-06	7.73E-07	3.65E-07	7.71E-07	1.65E-07	2.27E-07	4.80E-07	1.03E-07	2.34E-07	4.95E-07	1.06E-07	2.65E-07	5.61E-07	1.20E-07
PCB105	1.77E-04	3.95E-04	7.57E-05	4.80E-05	1.07E-04	2.05E-05	2.51E-05	5.61E-05	1.08E-05	8.41E-06	1.88E-05	3.60E-06	3.53E-06	7.87E-06	1.51E-06	6.64E-06	1.48E-05	2.84E-06
PCB118	7.01E-04	2.51E-03	1.74E-04	2.85E-04	1.02E-03	7.08E-05	9.92E-05	3.56E-04	2.46E-05	7.04E-05	2.53E-04	1.75E-05	1.02E-05	3.66E-05	2.53E-06	3.60E-06	1.29E-05	8.94E-07
PCB126	3.76E-06	7.47E-06	1.84E-06	6.19E-07	1.23E-06	3.02E-07	4.26E-07	8.46E-07	2.08E-07	1.46E-07	2.89E-07	7.10E-08	1.33E-07	2.63E-07	6.48E-08	1.92E-07	3.81E-07	9.38E-08
PCB169	8.87E-09	1.16E-08	6.87E-09	8.78E-10	1.14E-09	6.80E-10	2.44E-09	3.19E-09	1.89E-09	1.22E-10	1.59E-10	9.48E-11	1.25E-09	1.63E-09	9.66E-10	2.56E-10	3.34E-10	1.98E-10
Total PCBs	1.16E-01	6.36E-01	2.85E-02	1.44E-02	2.71E-02	7.93E-03	2.78E-03	1.90E-02	9.18E-04	8.96E-03	1.13E-01	8.95E-04	8.21E-04	6.67E-03	2.46E-04	3.81E-03	2.54E-02	1.43E-03
PCDD/Fs																		
Total PCDD/Fs	1.41E-05	4.86E-05	8.71E-06	1.07E-07	9.37E-07	4.55E-08	8.29E-08	1.12E-06	2.18E-08	4.41E-07	3.85E-06	2.11E-07	1.72E-07	1.98E-06	5.99E-08	4.02E-07	2.82E-06	1.81E-07
Pesticides																		
4,4'-DDD	5.19E-03	3.63E-02	2.75E-03	3.77E-04	2.64E-03	2.00E-04	3.15E-04	2.20E-03	1.67E-04	2.80E-04	1.96E-03	1.49E-04	3.51E-04	2.46E-03	1.86E-04	1.34E-03	9.37E-03	7.10E-04
4,4'-DDT	3.60E-03	2.26E-01	2.32E-03	6.75E-05	4.24E-03	4.35E-05	1.32E-04	8.28E-03	8.49E-05	9.63E-05	6.06E-03	6.21E-05	7.63E-05	4.80E-03	4.92E-05	2.65E-04	1.67E-02	1.71E-04
Total of 2,4' and 4,4'-DDE	5.64E-04	1.55E-02	4.86E-04	4.41E-05	1.22E-03	3.81E-05	2.92E-05	8.01E-04	2.51E-05	2.87E-05	7.95E-04	2.49E-05	2.31E-05	6.35E-04	1.99E-05	1.45E-04	3.99E-03	1.25E-04
Total of 2,4' and 4,4'-DDD	8.16E-03	5.22E-02	3.95E-03	5.70E-04	3.67E-03	2.78E-04	4.18E-04	2.75E-03	2.09E-04	4.04E-04	2.62E-03	1.99E-04	4.87E-04	3.18E-03	2.41E-04	2.00E-03	1.29E-02	9.78E-04
Total of 2,4' and 4,4'-DDT	4.32E-03	2.58E-01	2.65E-03	1.21E-04	6.63E-03	6.80E-05	1.47E-04	8.98E-03	9.20E-05	1.08E-04	6.60E-03	6.76E-05	9.09E-05	5.45E-03	5.59E-05	3.23E-04	1.93E-02	1.97E-04
Total DDx	1.30E-02	3.26E-01	7.09E-03	7.35E-04	1.15E-02	3.84E-04	5.94E-04	1.25E-02	3.26E-04	5.41E-04	1.00E-02	2.91E-04	6.01E-04	9.27E-03	3.17E-04	2.47E-03	3.61E-02	1.30E-03
Total Chlordanes	3.31E-04	9.17E-03	3.31E-04	3.53E-05	8.93E-04	3.53E-05	2.10E-05	3.91E-04	2.10E-05	1.64E-05	5.37E-04	1.64E-05	1.66E-05	3.38E-04	1.66E-05	4.19E-05	9.95E-04	4.19E-05
γ-Hexachlorocyclohexane	9.38E-02	2.69E-01	6.42E-02	1.13E-02	3.27E-02	7.75E-03	1.40E-02	4.00E-02	9.60E-03	6.04E-03	1.70E-02	4.15E-03	8.92E-03	2.58E-02	6.10E-03	8.90E-03	2.53E-02	6.10E-03
Aldrin	1.00E-04	9.63E-04	8.12E-06	2.22E-05	2.13E-04	1.80E-06	1.37E-05	1.31E-04	1.11E-06	5.53E-06	5.31E-05	4.48E-07	8.98E-06	8.63E-05	7.28E-07	9.98E-06	9.59E-05	8.09E-07
Dieldrin	6.65E-04	7.14E-03	1.02E-04	1.50E-04	1.61E-03	2.30E-05	5.80E-05	6.23E-04	8.87E-06	2.73E-05	2.93E-04	4.17E-06	6.52E-05	6.99E-04	9.97E-06	3.54E-05	3.81E-04	5.42E-06
PAHs																		
Naphthalene	3.16E+01	4.80E+01	1.89E+01	1.95E+00	2.95E+00	1.17E+00	2.48E+00	3.75E+00	1.49E+00	1.77E+00	2.69E+00	1.07E+00	1.01E+01	1.54E+01	6.08E+00	1.36E+01	2.08E+01	8.15E+00
Benzo(a)pyrene	7.04E-01	1.49E+00	1.55E-01	4.20E-02	8.86E-02	9.21E-03	3.02E-02	6.36E-02	6.62E-03	7.18E-02	1.52E-01	1.58E-02	3.70E-01	7.81E-01	8.12E-02	1.69E-01	3.56E-01	3.71E-02
Total Carcinogenic PAHs	3.64E+00	9.13E+00	2.33E+00	1.92E-01	4.83E-01	1.20E-01	1.39E-01	3.54E-01	8.70E-02	3.67E-01	9.33E-01	2.32E-01	1.91E+00	4.79E+00	1.23E+00	8.86E-01	2.19E+00	5.65E-01
cPAH BaPEq	8.62E-01	1.99E+00	2.71E-01	5.01E-02	1.15E-01	1.52E-02	3.60E-02	8.28E-02	1.09E-02	8.83E-02	2.04E-01	2.79E-02	4.54E-01	1.05E+00	1.43E-01	2.07E-01	4.73E-01	6.46E-02
Total PAHs	1.96E+02	3.81E+02	1.39E+02	8.25E+00	1.59E+01	5.63E+00	5.70E+00	1.09E+01	3.64E+00	8.27E+00	1.86E+01	5.73E+00	1.04E+02	2.06E+02	7.52E+01	6.40E+01	1.18E+02	4.54E+01
Phthalates																		
Bis(2-ethylhexyl)phthalate	8.50E-03	6.64E+01	6.85E-05	2.23E-04	1.75E+00	1.80E-06	5.71E-04	4.49E+00	4.60E-06	4.80E-04	3.77E+00	3.87E-06	1.69E-03	1.28E+01	1.36E-05	1.25E-04	9.84E-01	1.01E-06

Table E6-7. Surface Sediment Advective Annual Loads.

	RM 7 - RM 7.9			RM 8 - RM 8.9			RM 9 - RM 9.9			RM 10 - RM 10.9			RM 11 - RM 11.8		
Analyte	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**
Metals															
Arsenic	2.22E+01	1.36E+02	2.81E-01	4.25E+01	2.61E+02	5.37E-01	1.76E+01	1.08E+02	2.23E-01	1.33E+01	8.24E+01	1.69E-01	6.29E+00	3.89E+01	7.95E-02
Copper	2.02E+01	1.07E+04	4.02E-02	5.22E+01	2.62E+04	1.04E-01	1.43E+01	7.40E+03	2.85E-02	1.04E+01	5.50E+03	2.08E-02	8.17E+00	4.53E+03	1.63E-02
Lead	5.88E-01	2.32E+02	2.34E-03	1.34E+00	5.28E+02	5.35E-03	5.14E-01	2.03E+02	2.05E-03	3.94E-01	1.56E+02	1.57E-03	2.80E-01	1.11E+02	1.11E-03
Mercury	1.12E-03	1.41E-02	8.90E-05	2.56E-03	3.22E-02	2.03E-04	9.38E-04	1.18E-02	7.45E-05	8.33E-04	1.05E-02	6.62E-05	4.59E-04	5.77E-03	3.64E-05
Butyltins															
Tributyltin Ion	1.18E+00	6.85E+01	7.38E-04	7.23E+00	3.97E+02	4.53E-03	5.91E-02	3.34E+00	3.70E-05	6.37E-03	3.35E-01	4.00E-06	2.38E-02	1.38E+00	1.49E-05
PCBs															
PCB077	2.82E-06	2.07E-05	1.53E-06	1.23E-05	9.05E-05	6.70E-06	4.28E-06	3.14E-05	2.33E-06	7.08E-07	5.19E-06	3.84E-07	6.13E-07	4.49E-06	3.33E-07
PCB081	2.26E-07	4.77E-07	1.02E-07	1.53E-06	3.24E-06	6.96E-07	3.81E-07	8.06E-07	1.73E-07	1.04E-07	2.21E-07	4.73E-08	1.57E-07	3.33E-07	7.14E-08
PCB105	6.92E-06	1.54E-05	2.96E-06	4.57E-05	1.02E-04	1.95E-05	1.64E-05	3.67E-05	7.03E-06	3.92E-06	8.75E-06	1.68E-06	1.23E-05	2.74E-05	5.25E-06
PCB118	6.50E-05	2.33E-04	1.61E-05	5.78E-05	2.07E-04	1.44E-05	1.09E-04	3.92E-04	2.71E-05	--	--	--	--	--	--
PCB126	1.69E-07	3.35E-07	8.22E-08	1.15E-06	2.27E-06	5.59E-07	3.23E-07	6.41E-07	1.57E-07	1.06E-07	2.10E-07	5.16E-08	5.04E-07	1.00E-06	2.46E-07
PCB169	1.75E-09	2.28E-09	1.36E-09	5.81E-10	7.57E-10	4.50E-10	1.59E-09	2.07E-09	1.23E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total PCBs	2.01E-03	8.83E-03	8.15E-04	7.89E-03	1.93E-02	4.12E-03	6.46E-02	3.71E-01	7.36E-03	1.85E-03	1.71E-02	4.38E-04	9.13E-03	2.93E-02	4.37E-03
PCDD/Fs															
Total PCDD/Fs	1.24E-05	3.21E-05	8.07E-06	1.83E-07	2.23E-06	5.65E-08	1.21E-07	1.87E-06	2.81E-08	7.51E-08	1.03E-06	2.19E-08	3.57E-08	6.77E-07	5.27E-09
Pesticides															
4,4'-DDD	2.03E-03	1.42E-02	1.07E-03	3.67E-04	2.57E-03	1.95E-04	7.06E-05	4.94E-04	3.75E-05	4.13E-05	2.89E-04	2.19E-05	1.94E-05	1.36E-04	1.03E-05
4,4'-DDT	2.68E-03	1.69E-01	1.73E-03	7.95E-05	5.00E-03	5.12E-05	1.34E-05	8.43E-04	8.65E-06	1.63E-05	1.03E-03	1.05E-05	1.71E-04	1.07E-02	1.10E-04
Total of 2,4' and 4,4'-DDE	1.86E-04	5.09E-03	1.60E-04	6.99E-05	1.93E-03	6.05E-05	1.83E-05	5.08E-04	1.59E-05	1.26E-05	3.48E-04	1.09E-05	6.45E-06	1.79E-04	5.60E-06
Total of 2,4' and 4,4'-DDD	2.76E-03	1.81E-02	1.37E-03	5.79E-04	3.70E-03	2.80E-04	1.60E-04	9.71E-04	7.36E-05	1.05E-04	6.29E-04	4.77E-05	6.72E-04	3.62E-03	2.74E-04
Total of 2,4' and 4,4'-DDT	3.17E-03	1.91E-01	1.95E-03	9.41E-05	5.65E-03	5.80E-05	2.34E-05	1.29E-03	1.32E-05	2.37E-05	1.36E-03	1.39E-05	2.12E-04	1.26E-02	1.29E-04
Total DDx	6.12E-03	2.14E-01	3.49E-03	7.43E-04	1.13E-02	3.99E-04	2.02E-04	2.77E-03	1.03E-04	1.41E-04	2.33E-03	7.25E-05	8.90E-04	1.64E-02	4.09E-04
Total Chlordanes	3.73E-05	9.54E-04	3.73E-05	8.21E-05	2.31E-03	8.21E-05	2.14E-05	7.93E-04	2.14E-05	3.02E-05	7.00E-04	3.02E-05	2.91E-05	1.27E-03	2.91E-05
γ-Hexachlorocyclohexane	8.10E-03	2.35E-02	5.54E-03	1.58E-02	4.58E-02	1.08E-02	6.97E-03	2.01E-02	4.76E-03	1.09E-02	3.10E-02	7.50E-03	2.75E-03	7.96E-03	1.88E-03
Aldrin	1.64E-05	1.57E-04	1.33E-06	1.86E-05	1.79E-04	1.51E-06	2.96E-06	2.84E-05	2.40E-07	1.99E-06	1.91E-05	1.61E-07	0.00E+00	0.00E+00	0.00E+00
Dieldrin	4.59E-05	4.93E-04	7.02E-06	2.33E-04	2.51E-03	3.57E-05	2.98E-05	3.20E-04	4.56E-06	1.28E-05	1.38E-04	1.96E-06	6.18E-06	6.64E-05	9.45E-07
PAHs															
Naphthalene	3.69E-01	5.57E-01	2.23E-01	5.11E-01	7.75E-01	3.07E-01	3.19E-01	4.85E-01	1.92E-01	2.26E-01	3.43E-01	1.36E-01	2.12E-01	3.20E-01	1.27E-01
Benzo(a)pyrene	4.59E-03	9.68E-03	1.01E-03	8.94E-03	1.89E-02	1.96E-03	3.35E-03	7.06E-03	7.34E-04	3.11E-03	6.55E-03	6.82E-04	1.24E-03	2.61E-03	2.72E-04
Total Carcinogenic PAHs	3.27E-02	8.23E-02	2.19E-02	6.48E-02	1.64E-01	4.36E-02	2.37E-02	5.93E-02	1.59E-02	1.82E-02	4.61E-02	1.18E-02	9.20E-03	2.31E-02	6.22E-03
cPAH BaPEq	5.96E-03	1.41E-02	2.04E-03	1.16E-02	2.77E-02	3.99E-03	4.34E-03	1.02E-02	1.48E-03	3.89E-03	9.12E-03	1.27E-03	1.64E-03	3.91E-03	5.74E-04
Total PAHs	1.17E+00	2.42E+00	7.96E-01	2.05E+00	4.67E+00	1.42E+00	1.12E+00	2.31E+00	7.74E-01	6.12E-01	1.26E+00	4.06E-01	4.82E-01	9.12E-01	3.10E-01
Phthalates															
Bis(2-ethylhexyl)phthalate	6.20E-04	4.88E+00	4.99E-06	3.33E-03	2.62E+01	2.68E-05	8.04E-04	6.33E+00	6.48E-06	4.95E-04	3.90E+00	3.99E-06	1.67E-04	1.31E+00	1.35E-06

Notes:

-- Analyte not sampled.
BaPEq - benzo(a)pyrene equivalents
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
RM - river mile

Table E6-8. Subsurface Sediment Advective Annual Loads.

	Study Area RM 1.9 - RM 11.8			RM 1.9 - RM 2.9			RM 3 - RM 3.9			RM 4 - RM 4.9			RM 5 - RM 5.9			RM 6 - RM 6.9		
Analyte	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**
Metals																		
Arsenic	8.92E+01	5.54E+02	1.13E+00	5.06E+00	3.13E+01	6.39E-02	9.93E+00	6.16E+01	1.25E-01	7.97E+00	4.94E+01	1.01E-01	6.49E+00	4.03E+01	8.20E-02	8.49E+00	5.27E+01	1.07E-01
Copper	1.37E+02	7.44E+04	2.74E-01	1.32E+01	7.15E+03	2.63E-02	9.67E+00	5.34E+03	1.93E-02	6.88E+00	3.71E+03	1.37E-02	4.77E+00	2.60E+03	9.53E-03	8.18E+00	4.46E+03	1.63E-02
Lead	6.30E+00	2.49E+03	2.51E-02	7.32E-01	2.89E+02	2.92E-03	6.13E-01	2.42E+02	2.44E-03	5.99E-01	2.36E+02	2.38E-03	4.16E-01	1.64E+02	1.66E-03	3.99E-01	1.58E+02	1.59E-03
Mercury	1.53E-02	1.92E-01	1.21E-03	1.69E-03	2.13E-02	1.34E-04	1.72E-03	2.17E-02	1.37E-04	1.29E-03	1.62E-02	1.03E-04	1.07E-03	1.34E-02	8.47E-05	1.63E-03	2.06E-02	1.30E-04
Butyltins																		
Tributyltin Ion	3.64E+01	1.86E+03	2.29E-02	0.00E+00	0.00E+00	0.00E+00	1.19E-01	6.06E+00	7.47E-05	1.54E-01	8.95E+00	9.63E-05	1.88E-01	1.23E+01	1.17E-04	6.54E-02	4.00E+00	4.09E-05
PCBs																		
PCB077	1.42E-04	1.04E-03	7.70E-05	9.47E-06	6.94E-05	5.14E-06	3.03E-06	2.22E-05	1.64E-06	1.11E-05	8.10E-05	6.00E-06	1.84E-06	1.35E-05	9.98E-07	5.24E-06	3.84E-05	2.84E-06
PCB081	1.81E-05	3.83E-05	8.22E-06	5.38E-07	1.14E-06	2.44E-07	1.15E-07	2.44E-07	5.24E-08	1.26E-06	2.67E-06	5.72E-07	2.74E-07	5.80E-07	1.24E-07	5.32E-07	1.13E-06	2.42E-07
PCB105	5.85E-04	1.31E-03	2.50E-04	1.65E-05	3.68E-05	7.06E-06	5.47E-06	1.22E-05	2.34E-06	1.88E-05	4.20E-05	8.05E-06	4.45E-06	9.94E-06	1.90E-06	7.37E-06	1.65E-05	3.15E-06
PCB118	1.61E-03	5.79E-03	4.01E-04	7.70E-06	2.76E-05	1.91E-06	3.42E-05	1.23E-04	8.49E-06	3.94E-05	1.41E-04	9.79E-06	3.80E-05	1.36E-04	9.43E-06	2.81E-05	1.01E-04	6.99E-06
PCB126	1.06E-05	2.11E-05	5.17E-06	3.74E-07	7.42E-07	1.82E-07	1.27E-07	2.51E-07	6.18E-08	4.67E-07	9.27E-07	2.28E-07	9.32E-08	1.85E-07	4.55E-08	2.72E-07	5.40E-07	1.33E-07
PCB169	2.70E-08	3.52E-08	2.09E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-10	3.15E-10	1.87E-10	5.12E-12	6.68E-12	3.97E-12
Total PCBs	7.80E-02	9.27E-01	2.86E-02	1.19E-02	8.31E-02	5.93E-03	1.01E-02	2.23E-01	1.28E-03	3.10E-03	5.57E-02	4.54E-04	9.09E-04	7.94E-03	2.32E-04	2.38E-03	1.57E-02	8.92E-04
PCDD/Fs																		
Total PCDD/Fs	5.60E-06	4.63E-05	2.55E-06	1.52E-07	1.62E-06	5.78E-08	1.35E-07	1.77E-06	4.08E-08	6.22E-08	4.91E-07	2.77E-08	1.59E-07	7.03E-07	8.88E-08	5.66E-07	3.19E-06	2.81E-07
Pesticides																		
4,4'-DDD	1.42E-02	9.93E-02	7.53E-03	2.94E-04	2.06E-03	1.56E-04	5.08E-04	3.56E-03	2.70E-04	6.20E-04	4.34E-03	3.29E-04	8.23E-04	5.76E-03	4.37E-04	2.53E-03	1.77E-02	1.34E-03
4,4'-DDT	5.20E-03	3.27E-01	3.35E-03	1.55E-04	9.73E-03	9.97E-05	8.47E-05	5.33E-03	5.46E-05	7.46E-04	4.69E-02	4.81E-04	6.00E-05	3.77E-03	3.87E-05	7.37E-04	4.63E-02	4.75E-04
Total of 2,4' and 4,4'-DDE	6.41E-04	1.77E-02	5.55E-04	5.83E-05	1.62E-03	5.08E-05	4.91E-05	1.37E-03	4.28E-05	4.83E-05	1.34E-03	4.19E-05	3.50E-05	9.62E-04	3.01E-05	5.96E-05	1.62E-03	5.07E-05
Total of 2,4' and 4,4'-DDD	1.73E-02	1.16E-01	8.80E-03	5.03E-04	3.17E-03	2.40E-04	6.11E-04	4.11E-03	3.11E-04	9.21E-04	5.95E-03	4.51E-04	1.20E-03	7.75E-03	5.88E-04	3.48E-03	2.28E-02	1.73E-03
Total of 2,4' and 4,4'-DDT	6.10E-03	3.68E-01	3.77E-03	1.90E-04	1.13E-02	1.16E-04	1.98E-04	1.04E-02	1.06E-04	7.64E-04	4.77E-02	4.89E-04	8.04E-05	4.68E-03	4.80E-05	7.97E-04	4.90E-02	5.02E-04
Total DDx	2.41E-02	5.01E-01	1.31E-02	7.51E-04	1.61E-02	4.07E-04	8.58E-04	1.59E-02	4.61E-04	1.73E-03	5.50E-02	9.82E-04	1.31E-03	1.34E-02	6.66E-04	4.33E-03	7.34E-02	2.28E-03
Total Chlordanes	8.17E-04	2.88E-02	8.17E-04	1.70E-05	5.61E-04	1.70E-05	5.10E-05	2.19E-03	5.10E-05	1.66E-05	5.31E-04	1.66E-05	4.44E-05	2.96E-04	4.44E-05	5.49E-05	1.11E-03	5.49E-05
γ-Hexachlorocyclohexane	5.86E-02	1.64E-01	4.03E-02	4.17E-03	1.18E-02	2.86E-03	2.51E-02	6.91E-02	1.73E-02	4.21E-03	1.21E-02	2.88E-03	3.67E-03	1.01E-02	2.53E-03	4.42E-03	1.23E-02	3.04E-03
Aldrin	8.88E-05	8.54E-04	7.20E-06	2.52E-07	2.42E-06	2.04E-08	0.00E+00	0.00E+00	0.00E+00	1.17E-06	1.13E-05	9.50E-08	1.29E-06	1.24E-05	1.05E-07	1.90E-05	1.83E-04	1.54E-06
Dieldrin	7.61E-04	8.17E-03	1.16E-04	9.48E-05	1.02E-03	1.45E-05	7.68E-05	8.25E-04	1.17E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.35E-05	1.45E-04	2.06E-06
PAHs																		
Naphthalene	3.99E+02	6.09E+02	2.38E+02	4.27E+00	6.47E+00	2.56E+00	6.33E+00	9.69E+00	3.77E+00	6.76E+00	1.02E+01	4.07E+00	5.27E+00	7.80E+00	3.23E+00	3.72E+02	5.68E+02	2.22E+02
Benzo(a)pyrene	4.72E-01	9.96E-01	1.04E-01	1.82E-02	3.84E-02	4.00E-03	2.87E-02	6.05E-02	6.29E-03	6.31E-02	1.33E-01	1.39E-02	6.21E-02	1.31E-01	1.36E-02	2.73E-01	5.75E-01	5.99E-02
Total Carcinogenic PAHs	2.48E+00	6.15E+00	1.57E+00	9.70E-02	2.46E-01	6.18E-02	1.49E-01	3.69E-01	9.44E-02	3.18E-01	8.04E-01	2.01E-01	3.45E-01	8.52E-01	2.21E-01	1.40E+00	3.44E+00	8.80E-01
cPAH BaPEq	5.74E-01	1.31E+00	1.78E-01	2.25E-02	5.23E-02	7.16E-03	3.48E-02	7.99E-02	1.08E-02	7.70E-02	1.78E-01	2.41E-02	7.62E-02	1.75E-01	2.40E-02	3.29E-01	7.48E-01	1.01E-01
Total PAHs	5.62E+02	8.83E+02	3.57E+02	1.15E+01	1.83E+01	7.89E+00	1.49E+01	2.48E+01	1.02E+01	1.59E+01	2.73E+01	1.09E+01	2.81E+01	4.92E+01	2.07E+01	4.79E+02	7.41E+02	2.98E+02
Phthalates																		
Bis(2-ethylhexyl)phthalate	4.40E-03	3.11E+01	3.54E-05	1.15E-04	9.07E-01	9.30E-07	1.76E-04	1.38E+00	1.41E-06	1.49E-04	1.17E+00	1.20E-06	3.02E-04	2.38E+00	2.43E-06	9.66E-05	7.57E-01	7.78E-07

Table E6-8. Subsurface Sediment Advective Annual Loads.

	RM 7 - RM 7.9			RM 8 - RM 8.9			RM 9 - RM 9.9			RM 10 - RM 10.9			RM 11 - RM 11.8		
Analyte	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**	**Primary Loading Estimate (kg/yr)**	**Upper Loading Estimate (kg/yr)**	**Lower Loading Estimate (kg/yr)**
Metals															
Arsenic	1.26E+01	7.83E+01	1.60E-01	1.98E+01	1.23E+02	2.50E-01	8.10E+00	5.02E+01	1.02E-01	6.72E+00	4.17E+01	8.49E-02	4.02E+00	2.52E+01	5.07E-02
Copper	1.58E+01	8.60E+03	3.15E-02	5.95E+01	3.19E+04	1.19E-01	8.52E+00	4.63E+03	1.70E-02	8.55E+00	4.74E+03	1.71E-02	2.25E+00	1.31E+03	4.50E-03
Lead	6.19E-01	2.44E+02	2.46E-03	1.76E+00	6.95E+02	7.02E-03	3.71E-01	1.47E+02	1.48E-03	6.18E-01	2.44E+02	2.46E-03	1.70E-01	6.75E+01	6.78E-04
Mercury	1.48E-03	1.87E-02	1.18E-04	4.37E-03	5.50E-02	3.47E-04	8.64E-04	1.09E-02	6.86E-05	9.04E-04	1.14E-02	7.18E-05	2.34E-04	2.94E-03	1.86E-05
Butyltins															
Tributyltin Ion	2.64E+00	1.55E+02	1.65E-03	3.31E+01	1.66E+03	2.09E-02	8.85E-02	5.60E+00	5.53E-05	1.56E-02	1.06E+00	9.76E-06	0.00E+00	0.00E+00	0.00E+00
PCBs															
PCB077	6.13E-06	4.49E-05	3.33E-06	9.10E-05	6.67E-04	4.94E-05	9.43E-06	6.91E-05	5.12E-06	4.67E-06	3.42E-05	2.53E-06	0.00E+00	0.00E+00	0.00E+00
PCB081	9.29E-07	1.96E-06	4.22E-07	1.13E-05	2.39E-05	5.13E-06	1.98E-06	4.18E-06	8.98E-07	1.19E-06	2.51E-06	5.39E-07	0.00E+00	0.00E+00	0.00E+00
PCB105	1.51E-05	3.37E-05	6.46E-06	4.09E-04	9.13E-04	1.75E-04	6.01E-05	1.34E-04	2.57E-05	4.83E-05	1.08E-04	2.06E-05	0.00E+00	0.00E+00	0.00E+00
PCB118	2.16E-05	7.75E-05	5.36E-06	1.07E-03	3.84E-03	2.66E-04	3.75E-04	1.34E-03	9.30E-05	--	--	--	--	--	--
PCB126	3.33E-07	6.61E-07	1.63E-07	6.99E-06	1.39E-05	3.41E-06	1.02E-06	2.02E-06	4.97E-07	9.08E-07	1.80E-06	4.43E-07	2.88E-08	5.72E-08	1.41E-08
PCB169	2.72E-10	3.54E-10	2.10E-10	2.12E-08	2.77E-08	1.65E-08	4.64E-09	6.06E-09	3.60E-09	5.57E-10	7.26E-10	4.31E-10	0.00E+00	0.00E+00	0.00E+00
Total PCBs	4.29E-03	5.00E-02	1.64E-03	2.97E-02	1.05E-01	1.60E-02	1.32E-03	3.01E-03	5.75E-04	7.06E-03	1.50E-01	1.01E-03	7.23E-03	2.33E-01	5.61E-04
PCDD/Fs															
Total PCDD/Fs	4.22E-06	3.26E-05	2.01E-06	2.64E-07	5.07E-06	3.44E-08	2.20E-08	3.94E-07	3.78E-09	2.41E-08	4.72E-07	2.55E-09	1.58E-11	7.89E-11	8.19E-12
Pesticides															
4,4'-DDD	7.52E-03	5.27E-02	3.99E-03	1.55E-03	1.08E-02	8.21E-04	7.18E-05	5.03E-04	3.81E-05	1.11E-04	7.76E-04	5.88E-05	1.60E-04	1.12E-03	8.50E-05
4,4'-DDT	2.86E-03	1.80E-01	1.84E-03	4.48E-04	2.82E-02	2.89E-04	1.29E-05	8.14E-04	8.34E-06	7.24E-05	4.55E-03	4.67E-05	2.65E-05	1.67E-03	1.71E-05
Total of 2,4' and 4,4'-DDE	1.18E-04	3.24E-03	1.02E-04	2.29E-04	6.37E-03	2.00E-04	1.72E-05	4.79E-04	1.50E-05	1.64E-05	4.57E-04	1.43E-05	9.29E-06	2.59E-04	8.11E-06
Total of 2,4' and 4,4'-DDD	7.98E-03	5.51E-02	4.18E-03	2.08E-03	1.37E-02	1.04E-03	1.17E-04	7.44E-04	5.64E-05	2.18E-04	1.35E-03	1.02E-04	2.27E-04	1.48E-03	1.12E-04
Total of 2,4' and 4,4'-DDT	2.94E-03	1.84E-01	1.88E-03	8.67E-04	4.69E-02	4.81E-04	2.45E-05	1.33E-03	1.36E-05	1.75E-04	9.15E-03	9.38E-05	6.59E-05	3.43E-03	3.52E-05
Total DDx	1.10E-02	2.42E-01	6.16E-03	3.18E-03	6.70E-02	1.72E-03	1.59E-04	2.55E-03	8.50E-05	4.10E-04	1.10E-02	2.10E-04	3.02E-04	5.17E-03	1.55E-04
Total Chlordanes	1.41E-04	4.27E-03	1.41E-04	4.26E-04	1.72E-02	4.26E-04	1.21E-05	3.73E-04	1.21E-05	3.07E-05	1.28E-03	3.07E-05	2.30E-05	1.01E-03	2.30E-05
γ-Hexachlorocyclohexane	5.30E-03	1.54E-02	3.62E-03	9.81E-03	2.79E-02	6.72E-03	1.02E-03	2.98E-03	6.95E-04	4.46E-05	1.30E-04	3.05E-05	8.19E-04	2.39E-03	5.59E-04
Aldrin	3.43E-05	3.30E-04	2.78E-06	2.82E-05	2.71E-04	2.29E-06	2.28E-07	2.20E-06	1.85E-08	1.73E-06	1.67E-05	1.40E-07	2.57E-06	2.48E-05	2.09E-07
Dieldrin	1.09E-04	1.17E-03	1.67E-05	8.54E-05	9.15E-04	1.31E-05	1.81E-05	1.94E-04	2.76E-06	2.65E-06	2.84E-05	4.04E-07	3.61E-04	3.87E-03	5.51E-05
PAHs															
Naphthalene	2.16E+00	3.29E+00	1.30E+00	1.28E+00	1.94E+00	7.70E-01	3.35E-01	5.11E-01	2.01E-01	2.37E-01	3.61E-01	1.42E-01	4.34E-01	6.62E-01	2.59E-01
Benzo(a)pyrene	9.81E-03	2.07E-02	2.15E-03	1.10E-02	2.33E-02	2.42E-03	1.84E-03	3.88E-03	4.04E-04	3.07E-03	6.48E-03	6.74E-04	1.37E-03	2.90E-03	3.02E-04
Total Carcinogenic PAHs	6.57E-02	1.63E-01	4.36E-02	7.02E-02	1.79E-01	4.62E-02	1.29E-02	3.24E-02	8.62E-03	1.75E-02	4.38E-02	1.12E-02	7.41E-03	1.82E-02	4.67E-03
cPAH BaPEq	1.26E-02	2.94E-02	4.19E-03	1.43E-02	3.36E-02	4.84E-03	2.39E-03	5.63E-03	8.14E-04	3.85E-03	8.93E-03	1.25E-03	1.70E-03	3.86E-03	5.34E-04
Total PAHs	6.31E+00	1.07E+01	4.54E+00	4.43E+00	8.01E+00	3.10E+00	8.40E-01	1.49E+00	5.73E-01	6.91E-01	1.29E+00	4.71E-01	8.13E-01	1.31E+00	5.26E-01
Phthalates															
Bis(2-ethylhexyl)phthalate	1.88E-04	1.48E+00	1.51E-06	2.57E-03	1.67E+01	2.07E-05	6.13E-05	4.84E-01	4.94E-07	6.93E-04	5.48E+00	5.59E-06	5.28E-05	4.15E-01	4.26E-07

Notes:

-- Analyte not sampled.
BaPEq - benzo(a)pyrene equivalents
DDx - 2,4'- and 4,4'-DDD, DDE, and DDT
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
RM - river mile

Table E7-1. Summary of Available Bank Chemistry Data.

Site	River Mile	Database Task Code	Chemicals Detected - SCRA Database	Erodable Bank (per Map E7-1)	Metals	Butyltins	Petroleum Hydrocarbons	PAHs	PCBs	Pesticides	SVOCs	VOCs	Other
AAC/Marine Finance	5.7, 5.9	WLCMFH00	Yes	Yes - unclassified fill (south)	X	X	X	X					
Anchor Park	9.2	WLCOFJ02	Yes	Maybe - unclassified fill and beach	X		X	X	X		X		
ARCO	4.9	WLCARI99, WLCBPE06	Yes	No - seawall	X		X	X			X		
Arkema	7-7.2	WLRELF99	Yes	Maybe - beach	X	X	X		X	X		X	X
ATC Leasing Company	8.8	HHRAbeach1, 08B032	Yes	No - vegetated riprap	X			X	X		X		
Becker Land LLC	9.1	HHRAbeach1, 09B028	Yes	Maybe - beach	X		X	X	X	X	X		
City of Portland, Head of Swan Is. Lagoon	9.2	HHRAbeach1, 09B024	Yes	Maybe - beach	X			X			X		
ExxonMobil	5.1	WLCEMH04	No	No - vegetated riprap									
Gunderson	8.8-9.2	WLCGNG03, WLCOFH02	Yes	Yes - some areas of unclassified fill	X	X	X	X	X	X	X	X	
Kinder Morgan	4.2	WLCGXB02	Yes	Maybe - beach and non-vegetated riprap			X	X				X	
Evraz Oregon Steel Mills	2-2.5	WLCOSJ00	Yes	Maybe - unclassified fill and beach	X			X	X		X		
Owens-Corning	3.9	HHRAbeach1, 03B033	Yes	Maybe - beach	X			X			X		
PGE	3.4	HHRAbeach1, 03B031	Yes	Maybe - beach	X			X			X		
Port of Portland, Rivergate	3.3	HHRAbeach1, 03B030	Yes	Maybe - beach	X			X			X		
Port of Portland, Terminal 4 (Auto Storage)	5.1	WLCOFJ02	Yes	No - bioengineered bank and vegetated riprap	X		X	X	X	X	X		
Port of Portland/Swan Island (river side)	9.4	HHRAbeach1, 09B026; WLCOFJ02	Yes	Maybe - beach	X			X			X		
RK Storage	4.4	WLCOFJ02	Yes	Maybe - beach	X		X	X	X		X		
Steel Hammer Properties LLC/Crawford Street Corp.	6.2	HHRAbeach1, 06B030	Yes	Maybe - beach	X			X	X		X		

Table E7-1. Summary of Available Bank Chemistry Data.

Site	River Mile	Database Task Code	Chemicals Detected - SCRA Database	Erodable Bank (per Map E7-1)	Metals	Butyltins	Petroleum Hydrocarbons	PAHs	PCBs	Pesticides	SVOCs	VOCs	Other
Sulzer Bingham Pumps	10.4	WLCSPL03	Yes	No - pilings	X		X	X					
Triangle Park	7.3, 7.4	WLCOFJ02	Yes	Yes - some beach and unclassifed fill	X		X	X	X	X	X		
McCormick & Baxter	6.9	WLCMBJ99	Yes	No - vegetated riprap	X			X			X		PCDD/Fs
Willamette Cove	6.5	HHRAbeach1, 06B026; WLCOFJ02	Yes	No - vegetated riprap	X			X			X		
Willbridge Terminal	7.8	WLRWTF98	No	Maybe - beach									

Notes:

Information contained in this table was taken from the SCRA database with the following selection criteria:

Date: all information since 1/1/97
Data quality: all data quality categories to distinguish presence/absence
Elevation: >+11 - <+22 ft NAVD
Soil or sediment sample depth from surface: 0-40 cm

PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCDD/Fs - dioxins/furans
SCRA - site characterization and risk assessment
SVOC - semivolatile organic compound
VOC - volatile organic compound

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LWG
LOWER WILLAMETTE GROUP

PORTLAND HARBOR RI/FS

REMEDIAL INVESTIGATION REPORT

APPENDIX E, ATTACHMENT E-1
STORMWATER LOADING PRELIMINARY DATA ANALYSIS STEPS

DRAFT

Privileged and Confidential:
Work Product Prepared in Anticipation of Litigation.

October 27, 2009

ATTACHMENT E-1 – STORMWATER LOADING PRELIMINARY DATA ANALYSIS STEPS

This document provides a summary of the detailed data analysis steps undertaken as a part of the stormwater loading calculations.

The steps described below were initially presented in the Stormwater Loading Methods Report (Anchor 2008) and have been refined through discussions and recommendations from EPA and the Stormwater Technical Team. Most recently, these steps were discussed by the Stormwater Technical Team and EPA during the Stormwater Loading Check-in Meeting on February 27, 2009. Additional comments were provided by EPA on April 29, 2009. This document is consistent with decisions discussed during the Check-in Meeting as well as written comments and recommendations provided by EPA thereafter.

1.0 EVALUATION OF LABORATORY REPLICATES AND FIELD DUPLICATES

For individual chemicals and sums, the process explained in the attached flow chart, Figure 1-1, which is generally consistent with EPA comments and method agreements, was used to further evaluate duplicate outliers in stormwater. Table 1-1 lists all duplicates with Relative Percent Difference (RPD) values exceeding the levels presented in Table 4.2 of the Portland Harbor RI/FS Round 2 QAPP Round 3A Stormwater Sampling (Integral 2007). Since no RPD limit was specified for PCBs, the screening level RPD for phthalates, pesticides, and PAHs was used, which is 30 percent for stormwater.

Detailed evaluation regarding how to handle replicate/duplicates is presented in Table 1-1. Table 1-1 also presents the rationale for the recommended replicate/duplicate handling following the decision process shown in Figure 1-1.

For this preliminary screening process, all non-detect results were included at one half the detection limit.

The screening resulted in 80 parent and replicate/duplicate pairings out of approximately 500 total pairings having an RPD greater than the screening factor and therefore retained for further evaluation as presented in Figure 1-1. Through the additional analysis, 24 parent and replicate/duplicate pairings were subjected to some kind of "segregation" evaluation, which is approximately 5 percent. In other words, in 95 percent of the cases, replicates or duplicates were averaged per standard RI database rules.

Additionally, out of the 24 pairs summarized in the attached Table 1-1, eight of these pairs are from OF-18, which is a multiple land use site. Data from multiple land use sites were collected with the intent to perform an uncertainty analysis and are not used directly in any loading calculations. Therefore, these samples are not further discussed here, but are included in Table 1-1 for reference and are discussed further in Section E3.7.2.

Out of the remaining 16 cases, only one pair was completely segregated (removed) from the stormwater loading working database. In the other 15 cases, either the parent or the replicate/duplicate was segregated and the other half of the pair was retained in the working database.

Due to the limited data set for sediment traps, all sediment trap duplicates were averaged with parent samples.

2.0 RECLASSIFICATION ANALYSIS

The *a-priori* non-representative locations and chemicals are shown below in Table 2-1.

Table 2-1. Chemicals and Sites for Further Analysis

Outfall #	Facility/Location	Non-Representative Chemicals for Further Analysis
WR-22	OSM	PCBs, PAHs, metals
WR-123	Schnitzer International Slip	PCBs, phthalates, metals
WR-384	Schnitzer - Riverside	Metals, PCBs
WR-107	GASCO	PAHs
WR-96	Arkema	Pesticides
WR-14	Chevron - Transportation	PAHs
WR-161	Portland Shipyard	PAHs, phthalates, metals, PCBs
WR-4	Sulzer Pump	PAHs, metals, PCBs
WR-145	Gunderson	PCBs, PAHs, phthalates, metals
WR-147/148	Gunderson (former Schnitzer)	Phthalates, metals, PCBs, PAHs
Within OF-17	GE	PCBs
WR-183/Basin R	Terminal 4 - Slip 1	PAHs, TOC
WR-181/Basin Q	Terminal 4 - Slip 1	Metals, PAHs, TOC
WR-177/Basin M	Terminal 4 - Slip 1	Metals, PAHs
WR-169/BasinD	Terminal 4	Metals, PAHs
WR-20/Basin L	Terminal 4 - Wheeler Bay	PAHs
OF-22B	City –Doane Lake Industrial Area	Pesticides, Metals
WR-510	St. Johns Bridge/Highway 30	PCBs, others (bridge repaving activity)

For individual chemicals and sums, the process explained in the attached flow chart, Figure 2-1, was used to evaluate the classification of data. Figure 2-1 is generally consistent with EPA comments and method agreements for this evaluation. Sites with both Heavy Industrial and Light Industrial land use types were evaluated. There were no sites in the Residential and Open Space land uses identified for further analysis; therefore, the reclassification analysis does not address these land uses.

As agreed by the Stormwater Technical Team and EPA, St. Johns Bridge data will be examined as part of a separate process and is not included in the RI data set.

Per Figure 2-1, the evaluation process generally followed two broad steps. The first step assessed whether representative locations should remain representative or become non-representative, and the second step assessed whether non-representative sites were better categorized as representative. The results are summarized in Tables 2-2a–f, which provides the decisions made for Step 1 and Step 2 and the resulting recommended final categorization.

Note that each chemical within each chemical group was evaluated separately to determine final categorizations, with the exception of PCBs. For PCBs, sites were classified as representative or non-representative on the basis of the entire set of congeners and total PCBs, and therefore a site could not be non-representative for one congener and representative for another congener.

3.0 CALCULATION OF LOADS

For later purposes of fate and transport modeling, a full range of potentially useful summary statistics including central tendencies and confidence limits will be generated such that evaluations of various types of loading estimate scenarios and modeling sensitivity analyses can be supported. The intent is to use various estimates of stormwater loads to assess the river modeling calibration and determine those chemicals for which large changes in assumed stormwater loads are relatively minor as compared to overall river loads.

For the RI Report, loads were estimated as a product of the calculated concentration estimates and the flow rate from the 50th percentile flow year. The annual mass loads were generated by adding the loading contributions from each land use and non-representative site for each Fate and Transport Model segment:

> Annual stormwater chemical load (kg/yr) = heavy industrial stormwater chemical load (kg/yr) + light industrial stormwater chemical load (kg/yr) + residential stormwater chemical load (kg/yr) + parks/open space stormwater chemical load (kg/yr) + major transportation stormwater chemical load (kg/yr) + "non-representative" site stormwater chemical load (kg/yr)

To express the uncertainty in these estimates, a range of loading rates was calculated for each IC, including the geometric mean, basin-weighted mean, 5th percentile, and 95th percentile, in order to show a representative range of concentrations. A full range of statistics, as discussed above, will be presented in later documents' discussion of the Fate and Transport Model.

3.1 COMPOSITE WATER

3.1.1 Minimum Sample Size Requirements

Summary statistics generated were often based on data sets with few observations and/or detected values. Hypothesis testing (i.e., goodness-of-fit), interpolation (i.e., Regression on Order Statistics [ROS]), and estimation (i.e., upper confidence limits [UCL]) methods used to generate summary statistics may not be appropriate or reliable due to the uncertainty in the representativeness of the data set for the population of interest. In addition, ProUCL has incorporated minimum sample size requirements into the statistical routines and may not provide such statistics or test results for small data sets. As such, the following decision rules, based on both statistical principles and recommendations provided in the ProUCL Version 4.0 Technical Guide and User Guide (EPA 2007) and practical limits of the ProUCL software, were used to determine whether specific test results or statistics would be calculated and presented in summary statistics. The decision rules are as follows:

- For analyte/matrix/land-use combinations with 5<=N<8, advanced summary statistics were generated and presented but should be interpreted with caution due to the limited number of samples.
- For analyte/matrix/land-use combinations with 5<=N<10, bootstrap methods for estimating UCL were avoided due to uncertainties in the bootstrapping operation with low sample numbers; ProUCL recommends a minimum of 10 to 15 samples for bootstrapping operations.
- For analyte/matrix/land-use combinations with less than four detected observations, goodness-of-fit (GOF), ROS, and bootstrap operations are unreliable and were not used. ProUCL will not generate GOF, ROS-based summary statistics, Kaplan-Meier and bootstrap estimates for this scenario.

3.1.2 Summarize Unweighted Composite Water Data

Summary statistics on unweighted data were calculated by land use and are presented in Table E3-2.

3.1.2.1 Summary Statistics for Data Averaged by Site, and Then Pooled by Chemical and Land Use

1. The lognormal ROS method was used to impute non-detect values using the pooled data set. Estimation of non-detects was necessary in this step in order to estimate the averages by site, because sample numbers or detected sample numbers were too small on a per-site basis to use other techniques (i.e., ROS or Kaplan-Meier) to interpolate non-detects or estimate averages for each basin. A lognormal distribution was used in the ROS estimates for the following reasons: 1) the normal ROS estimation method frequently imputes negative values for non-detects, which is not possible, and 2) environmental data frequently assumes a lognormal distribution; there is an underlying assumption of lognormality for these stormwater data. In cases where the ROS method was unreliable due to a limited number of samples or limited detected samples as described in Section 3.1, half the detection limit was substituted for non-detect values.
2. The data were averaged by site, in order to come up with one value for each sample location.
    a. ProUCL was used to generate summary statistics on the averaged by site data consistent with recommendations for such statistics provided in the ProUCL Version 4.0 Technical Guide and User Guide (USEPA 2007). Statistics of interest for the RI Report include geomean, and the 5th and 95th percentiles.

3.1.3 Summarize Weighted Composite Water Data

Summary statistics on data averaged by site and weighted using a unit flow factor are also presented in Table E3-2 in the column labeled "Basin Weighted Mean Concentration." The steps for this calculation were as follows:

1. Using the same data set created above with substituted values and data averaged by site, the data were weighted using the following method:

   $C_{weighted} = C \times W \times N$, where

   C = the average concentration from each sample location

   W = weighting factor, a unitless factor for each sample location based on its runoff volume divided by the sum of all volumes for all locations

   N = the number of sample locations in a land use category

2. Microsoft Access was used to calculate the mean concentration for each land use.

3.1.4 Summary Statistics for Non-Representative Sites

1. Since it was not possible to use ROS or Kaplan-Meier to calculate means for each individual sample location due to limited samples and non-detects, half the detection limit was substituted for non-detects.
2. The mean value for each non-representative site is presented in Table E3-2. Note that since only one value exists for each site after averaging the data by site, only one value is presented.

3.2 SEDIMENT TRAP DATA

Sediment trap data were collected during both Rounds 3A and 3B Stormwater Sampling. The purpose of Round 3B sampling was to fill data gaps where data were not collected in the first round. However, there are a few instances where the same analyte was measured at the same location in both Round 3A and 3B. This occurred if a limited sample mass collected during Round 3A led to elevated detection limits. Thus, it could be expected that some non-detect values occurred in Round 3A due to limited sample mass. In this case, the analytes were measured again in Round 3B if sufficient sediment was available.

There were sixteen instances where there was a non-detect sample collected for a particular analyte during both Round 3A and Round 3B. In most cases, the non-detect value in Round 3A and 3B were similar. However, in the case of three pesticide samples collected at OF-49, the non-detect values in Round 3A were ten times greater than the non-detect samples collected in Round 3B. In the case of these three samples, the high non-detect samples collected in Round 3A were segregated.

In all other cases, samples for sediment traps were averaged prior to calculation of any statistics. It should be noted that this procedure differs from the treatment of the composite water samples. For sediment traps, if two detected samples exist for a particular sampling location, then samples were averaged. If there was one non-detect and one detect sample, then the detect sample was retained, and the non-detect sample

was segregated. If both samples were non-detect, then the samples were averaged and the non-detect qualifier remained except in the three cases discussed above.

3.2.1 Step 1 – Summary Statistics for Sediment Trap Data for Representative Land Use Sampling Locations

The process for calculating unweighted statistics on the data is explained below.

1. After averaging of samples by location, data for each land use were reformatted to meet ProUCL requirements. Records identified as non-representative were treated as independent data sets on a chemical- and location-specific basis and are discussed below. Statistics were only calculated to the extent practical in accordance with ProUCL guidance due to the small data set associated with each.
2. ProUCL was used to conduct graphical and statistical (i.e., GOF) tests to determine the underlying data distribution (or lack thereof) for each analyte and land use.
3. ProUCL was used to generate summary statistics for each land use consistent with recommendations for such statistics provided in the ProUCL Version 4.0 Technical Guide and User Guide (USEPA 2007). Statistics of interest include the geomean and the 5th and 95th percentiles.
4. After calculating statistics, the chemical solids loading rate (a concentration in terms of mass per volume water) similar to that obtained via stormwater was calculated and is presented in Table E3-2. The measured sediment concentration statistics (Cs in µg/kg) were multiplied by a central tendency (i.e., geometric mean) of the total suspended solids concentration (TSS in kg/L) measured in composite water for a particular land use to get a concentration in terms of (µg/L)

3.2.2 Step 2 – Summary Statistics for Weighted Sediment Trap Data for Representative Land Use Sampling Locations

The process for calculating weighted statistics on the data is as follows:

1. Using the sediment trap data set with samples averaged by site as discussed above, the lognormal ROS method was used to impute non-detect values. A lognormal distribution was used in the ROS estimates for the following reasons: 1) the normal ROS estimation method frequently imputes negative values for non-detects, which is not possible, and 2) environmental data frequently assumes a lognormal distribution; there is an underlying assumption of lognormality for these stormwater data. In cases where the ROS method was unreliable due to limited samples or limited detected samples as described in Section 3.1, half the detection limit was substituted for non-detects.
2. The data were weighted using the following method:

   $C_{weighted} = C \times W \times N$, where:

C = the average concentration from each sample location

W = weighting factor, a unitless factor for each sample location based on its runoff volume divided by the sum of all volumes for all locations

N = the number of sample locations in a land use category

3. ProUCL was used to generate summary statistics on the weighted data consistent with recommendations for such statistics provided in the ProUCL Version 4.0 Technical Guide and User Guide (USEPA 2007). Statistics of interest include the geomean, 5th and 95th percentiles.
4. After calculating statistics, the chemical solids loading rate was calculated exactly as described above for unweighted data and are presented in Table E3-2.

3.2.3 Step 3 – Sediment Trap Data for Non-Representative Land Use Sampling Locations

1. There is generally only one data point for each non-representative sampling location, so statistical methods cannot be used to calculate substitution values for non-detects. Therefore, half the detection limit was substituted for non-detects.
2. There is generally only one data point for each sampling location and chemical so no statistics were calculated.
3. The chemical solids loading rate (concentration in water terms) was then calculated from the single value available at each site in the same manner as noted for representative data above and these values are presented in Table E3-2.

REFERENCES

Anchor Environmental, L.L.C. (Anchor). 2008. Stormwater Loading Calculation Methods. Prepared for the Lower Willamette Group, Portland, OR. Anchor, Seattle, WA.

Integral. 2007. Round 2 Quality Assurance Project Plan Addendum 8: Round 3A Stormwater Sampling. Prepared for the Lower Willamette Group, Portland, OR. Anchor, Seattle, WA. March 1.

USEPA. 2007. ProUCL Version 4.0 Technical Guide. EPA/600/R-07/041. April.

Decision 1

Compute relative percent difference (RPD) for each Parent/duplicate and Parent/replicate data pair.

$$RPD = 100\frac{[X_1 - X_2]}{\frac{[X_1 + X_2]}{2}}$$

where:

X_1 = concentration in Parent sample;

X_2 = concentration in field duplicate or lab replicate; and

Is RPD is greater than the levels presented in Table 4.2 of the *Portland Harbor RI/FS Round 2 QAPP Round 3A Stormwater Sampling*, January 19, 2007?

Yes

Decision 2

Conduct further investigation to identify any potential reasons for divergence through discussions with field and lab staff and review of pertinent notes. If a substantial reason (e.g., information that field or lab procedures likely impacted results) exists for divergence, use best professional judgment to determine if a data pair or individual data point should be segregated from the data set. Is there a substantial reason for divergence?

Yes

Decision 3

Compare data pair to other samples in the corresponding land use category. Are data points within the range of land use samples?

Yes

Segregate both samples because they are different but there is no way to determine which one is more correct.

No

Segregate both samples, because they are both outside the range.

One data point is outside of the range

Segregate the sample that is outside of the range; retain the sample that is within the range.

Possibly / No

Decision 3

Compare data pair to other samples in the corresponding land use category. Are data points within the range of land use samples?

Yes

Average the two samples because both samples are assumed to be equally correct.

No

One data point is outside of the range

Retain the sample that is within the range and apply **Decision 4** to the sample outside of the range.

Decision 4

Is one or both of the samples less than twice the method reporting limit (MRL)?

If sum or total is non-detect, highest detection limit will be used for MRL.

Yes

Average the two samples because concentrations are expected to vary more near the MRL.

No

Segregate both samples.

Note: Sums and totals were examined on a total basis; individual compounds which comprise the sum or total were not evaluated.

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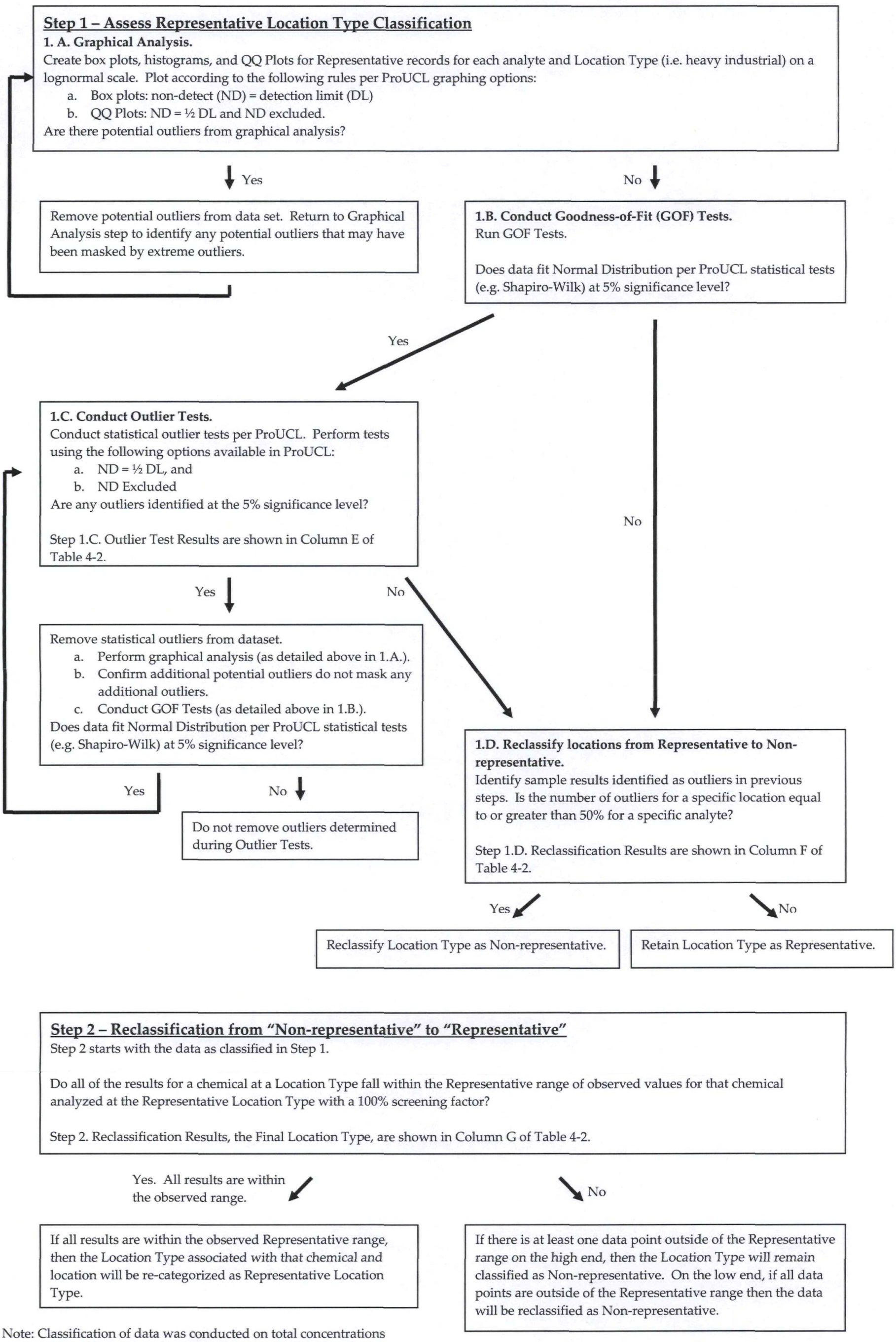
Figure 1-1

Portland Harbor RI/FS

Draft Remedial Investigation Report

Replicate/Duplicate Outlier Analysis Flow Chart



Note: Classification of data was conducted on total concentrations and dissolved concentrations follow total classifications.

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Figure 2-1
Portland Harbor RI/FS
Draft Remedial Investigation Report
Reclassification Analysis Flow Chart

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

															Decision 1		Decision 2		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	RPD	Decision 1 - RPD > QAPP RPD?	Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB077	NA	118		86.6		pg/L	0.31	YES	A, E - 105% full, clear with trace sediment in bottom. B,C, D - 105% full, cloudier with more sediment than A.	--	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							PCB_Congeners	PCB126	NA	17	J	7.65	U	pg/L	0.76	YES	A, E - 105% full, clear with trace sediment in bottom. B,C, D - 105% full, cloudier with more sediment than A.	--	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							PCB_Congeners	PCB081	NA	9.12	J	3.86	J	pg/L	0.81	YES	A, E - 105% full, clear with trace sediment in bottom. B,C, D - 105% full, cloudier with more sediment than A.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	1.7	J	0.034	J	pg/L	0.96	YES	A, E - 105% full, clear with trace sediment in bottom. B,C, D - 105% full, cloudier with more sediment than A.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	5/3/07	LW3-STW-CW20-OF22B	Pesticides	Sum DDE	NA	0.018	J	0.049	J	µg/L	0.46	YES	A - slightly black flocculents in bottom. B-C - clear with earthworm/snails. D-F -cloudy, sediment. G- slightly Cloudy.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							Pesticides	Sum DDT	NA	0.071	U	0.01	NJ	µg/L	0.75	YES	A - slightly black flocculents in bottom. B-C - clear with earthworm/snails. D-F -cloudy, sediment. G- slightly Cloudy.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

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River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	RPD	Decision 1 - RPD > QAPP RPD?	Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Dieldrin	NA	0.19		0.089		µg/L	0.72	YES	Sediment, worm, and snail present in stormwater composite sample	--	NO
							Pesticides	4,4'-DDD	NA	0.079	NJ	0.026	NJ	µg/L	1.01	YES	Sediment, worm, and snail present in stormwater composite sample	--	NO
							Pesticides	Sum DDD	NA	0.079	J	0.026	J	µg/L	0.504761905	YES	Sediment, worm, and snail present in stormwater composite sample	N/A	NO
							Pesticides	Total DDTs	NA	0.14	J	0.071	J	µg/L	0.327014218	YES	Sediment, worm, and snail present in stormwater composite sample	N/A	NO
Upper Study Area 1	Albina - UPRR	Heavy Industrial	FD	WR218	11/29/07	LW3-STW2-CW20-WR218	Metals	Arsenic	total	0.7		1.05		µg/L	0.40	YES	100% full, cloudy, grayish, some sediment.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of arsenic is more than 50%.
							Metals	Arsenic	total	0.72		1.05		µg/L	0.37	YES	100% full, cloudy, grayish, some sediment.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of arsenic is more than 50%.
Upper Study Area	Highway 30	Transportation	LR	H30B	1/30/08	LW3-STW2-CW50-H30B	Metals	Mercury	dissolved	0.03	J	0.015	U	µg/L	0.67	YES	Slight "oil sheen" in some samples.	--	NO. Oil sheen should not affect dissolved mercury concentration.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

															Decision 1		Decision 2		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	RPD	Decision 1 - RPD > QAPP RPD?	Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PAHs	Benzo(a)pyrene	NA	0.1		0.14		µg/L	0.33	YES	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. Benzo(a)pyrene is hydrophobic, so sediment in one sample and not the other could affect concentrations.
							Metals	Chromium	total	7.32		11.5		µg/L	0.44	YES	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of chromium is more than 50%.
							PCB_Congeners	PCB081	NA	16.9	J	8.6	U	pg/L	0.65	YES	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
							PCB_Congeners	PCB077	NA	246		573		pg/L	0.80	YES	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
							PCB_Congeners	PCB105	NA	1290		7620		pg/L	1.42	YES	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
							PCB_Congeners	PCB106 & 118	NA	3190		19100		pg/L	1.43	YES	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
							Metals	Arsenic	total	1.36		1.67		µg/L	0.20	YES	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of arsenic is more than 50%.
							Metals	Lead	total	44.7		76.3		µg/L	0.52	YES	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of lead is more than 50%.
							PCB_Congeners	PCB126	NA	24.8		110		pg/L	1.26	YES	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
							PCB_Congeners	PCB 156&157	NA	525		3200		pg/L	0.72	YES	Some sediment present.	N/A	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
							PCB_Congeners	Total PCB Congeners	NA	125000	J	503000		pg/L	0.601910828	YES	Some sediment present.	N/A	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
							PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	2.6	J	11.4		pg/L	0.628571429	YES	Some sediment present.	N/A	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

															Decision 1		Decision 2		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	RPD	Decision 1 - RPD > QAPP RPD?	Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	PCB077	NA	3.92	J	1.865	U	pg/L	0.71	YES	Water is nearly clear with very little suspended material.	--	NO
							PCB_Congeners	PCB106 & 118	NA	47.3		15.4	U	pg/L	1.02	YES	Water is nearly clear with very little suspended material.	--	NO
							PCB_Congeners	Total PCB Congeners	NA	208	J	80.8	J	pg/L	0.440443213	YES	Water is nearly clear with very little suspended material.	N/A	NO
							PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	0.00096	J	0.00046	J	pg/L	0.352112676	YES	Water is nearly clear with very little suspended material.	N/A	NO
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF19	4/9/07	LW3-STW-CW20-OF19	Metals	Mercury	total	0.03	J	0.015	U	µg/L	0.67	YES	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminated by a mineral oil spill upstream of the sample.	--	NO

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

															Decision 1		Decision 2		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	RPD	Decision 1 - RPD > QAPP RPD?	Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB077	NA	78	J	39.7	J	pg/L	0.65	YES	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminated by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							PCB_Congeners	PCB106 & 118	NA	32000	J	317	J	pg/L	1.96	YES	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminated by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							PCB_Congeners	PCB126	NA	62.4	J	5.6	UJ	pg/L	1.67	YES	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminated by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							PCB_Congeners	PCB105	NA	10200	J	105	J	pg/L	1.96	YES	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminated by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							PCB_Congeners	PCB 156&157	NA	2530	J	38	J	pg/L	0.97	YES	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminated by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							PCB_Congeners	Total PCB Congeners	NA	371000	J	17800	J	pg/L	0.908436214	YES	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminated by a mineral oil spill upstream of the sample.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
							PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	6.7	J	0.009	J	pg/L	0.997317037	YES	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminated by a mineral oil spill upstream of the sample.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

															Decision 1		Decision 2		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	RPD	Decision 1 - RPD > QAPP RPD?	Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/18/07	LW3-STW-CW30-OFM1	Metals	Lead	total	10.2	J	21.4	J	µg/L	0.71	YES	A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO. Slight sediment is not expected to impact the sample concentrations.
							PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	0.011	none	1.1	J	pg/L	0.98019802		A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	N/A	
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Nickel	total	2.2		1.71		µg/L	0.25	YES	A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	--	POSSIBLY. No dissolved information available for this date, but in other nickel samples at OFM2 the particulate fraction was more than 50% so sediment may have affected sample.
							Metals	Chromium	total	2		1.53		µg/L	0.27	YES	A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	--	POSSIBLY. No dissolved information available for this date, but in other chromium samples at OFM2 the particulate fraction was more than 50% so sediment may have affected sample.
							Metals	Arsenic	total	1.75		1.22		µg/L	0.36	YES	A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	--	POSSIBLY. No dissolved information available for this date, but in other arsenic samples at OFM2 the particulate fraction was more than 50% so sediment may have affected sample.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	5/3/07	LW3-STW-CW40-OFM2	PCB_Congeners	PCB 156&157	NA	10	J	43.2	J	pg/L	0.62	YES	A - opaque orange, trace orange silt on bottom, trace pollen. B-H -clear-orange, trace sand and silt on base, trace pollen, clears in D, cloudy again in E-H.	N/A	NO
								Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	0.66	J	0.0074	J	pg/L	0.977824393	YES		N/A	NO
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	10/19/07	WLCGED07MH2SW101907U	PCB_Congeners	PCB081	NA	9.98	NJ	6.68	NJ	pg/L	0.40	YES	No field data regarding visible observations of sample available.	Analyte did not meet all identification criteria.	NO
							Metals	Nickel	total	3.84	J	6.55	J	µg/L	0.52	YES		Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

															Decision 1		Decision 2		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	RPD	Decision 1 - RPD > QAPP RPD?	Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	11/13/07	WLCGED07MH2SW111307F	Metals	Nickel	dissolved	1.65	J	1.27	J	µg/L	0.26	YES	No field data regarding visible observations of sample available.	Matrix spike recovery exceedance, replicate precision, or internal standard performance. Also, dissolved concentration is higher than total concentration in both cases.	YES. Dissolved concentration should not be more than total concentration.
							PCB_Congeners	PCB081	NA	4.1	NJ	1.78	U	pg/L	0.79	YES		--	NO
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	PAHs	Naphthalene	dissolved	0.014	J	0.019	J	µg/L	0.30	YES	No field data regarding visible observations of sample available.	Surrogate spike recovery exceedance.	NO
							PAHs	Benzo(a)pyrene	dissolved	0.018	J	0.03	J	µg/L	0.50	YES		Surrogate spike recovery exceedance.	NO
							Metals	Lead	dissolved	2.69	J	0.843	J	µg/L	1.05	YES		Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	11/16/07	WLCT4C07BsnD071116	PCB_Congeners	PCB156&157	Total	54.9	J	9	J	pg/L	0.72	YES	No field data regarding visible observations of sample available.	–	NO
							Phthalates	Bis(2-ethylhexyl) phthalate	total	1.8		1.1		µg/L	0.48	YES		–	NO

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River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	RPD	Decision 1 - RPD > QAPP RPD?	Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Metals	Chromium	total	4.65	J	6.38	J	µg/L	0.31	YES	No field data regarding visible observations of sample available.	Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO
							Metals	Nickel	total	4.04	J	7.95	J	µg/L	0.65	YES		Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO
							Metals	Arsenic	total	0.339	J	0.469	J	µg/L	0.32	YES		Matrix spike recovery exceedance, replicate precision, or internal standard performance	NO
							Metals	Lead	total	13.7	J	19.2	J	µg/L	0.33	YES		Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO
							Metals	Mercury	total	0.03	J	0.01	U	µg/L	1.00	YES		Qualified because the value is between the MDL and MRL.	NO
							Pesticides	4,4'-DDT	total	0.015	J	0.0011	UJ	µg/L	1.73	YES		Continuing calibration blank exceedances.	NO
							Pesticides	Sum DDT	total	0.0027	UJ	0.015	UJ	µg/L	0.694915254	YES		N/A	NO
							Pesticides	Total DDTs	total	0.0054	J	0.015	J	µg/L	0.470588235	YES		N/A	NO
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR071116	Metals	Copper	total	8.94		11.5		µg/L	0.25	YES	No field data regarding visible observations of sample available.	–	NO
							Metals	Nickel	total	1.63		2.13		µg/L	0.27	YES		–	NO
							Metals	Chromium	total	0.88		1.86		µg/L	0.72	YES		–	NO
							Metals	Lead	total	7.04		13.8		µg/L	0.65	YES		–	NO
							PAHs	Total Carcinogenic PAHs	total	0.0031		0.046		pg/L	0.873727088	YES		N/A	NO
							PAHs	Total PAHs	total	0.26		0.54		pg/L	0.35	YES		N/A	NO

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															Decision 1		Decision 2		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	RPD	Decision 1 - RPD > QAPP RPD?	Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07Bsn T070503	PCB_Congeners	PCB077	total	154	J	1240	J	pg/L	1.56	YES	No field data regarding visible observations of sample available.	Surrogate spike recovery exceedance.	NO
							PCB_Congeners	PCB105	total	707	J	6570	J	pg/L	1.61	YES		Surrogate spike recovery exceedance.	NO
							PCB_Congeners	PCB106 & 118	total	1600	J	15700	J	pg/L	1.63	YES		Surrogate spike recovery exceedance.	NO
							PCB_Congeners	PCB126	total	17.9	J	136	J	pg/L	1.53	YES		Surrogate spike recovery exceedance.	NO
							PCB_Congeners	PCB 156&157	total	260		2730		pg/L	0.83	YES		N/A	NO
							PCB_Congeners	Total PCB Congeners	total	52500	J	594000	J	pg/L	0.837587007	YES		N/A	NO
							PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	1.8	J	14.1	J	pg/L	0.773584906	YES		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07Bsn T070407	Pesticides	Sum DDD	total	0.0053	J	0.00049	U	µg/L	0.83	YES	No field data regarding visible observations of sample available.	N/A	NO
							Pesticides	Total DDTs	total	0.0071	J	0.0024	UJ	µg/L	0.49	YES		N/A	NO
							Pesticides	Total Chlordane	total	0.0052	J	0.0012	J	µg/L	0.625	YES		N/A	NO
Lower ISA	Basin M Terminal 4 WR-177	Heavy Industrial	FD	Basin M	5/3/07	WLCT4C07Bsn M070503	Pesticides	Sum DDT	total	0.0019	J	0.012	J	µg/L	0.726618705	YES	No field data regarding visible observations of sample available.	N/A	NO
							Pesticides	Total DDTs	total	0.0048	J	0.014	J	µg/L	0.489361702	YES		N/A	NO

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

							Decision 3		Decision 4		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	Both samples within range.	YES	10	NO	Average the two samples.
							Both samples within range. Also note that the detection limit for the Parent sample is 15.3 (shown at half the detection limit for calculating RPD) , which is very close to the FD value of 17.	YES	10	YES	Average the two samples.
							Parent sample within range, FD within higher part of range.	YES	10	YES	Average the two samples.
							Both samples are within range.	YES	N/A	N/A	Average the two samples.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	5/3/07	LW3-STW-CW20-OF22B	Both samples are within range.	YES	0.0005	NO	Average the two samples.
							The FD is higher than the range, but it is a non-detect.	NO	0.0005	NO	Segregate the FD, keep the parent.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

							Decision 3		Decision 4		
River Reach	**Site**	**Land Use**	**Sample Type**	**Location Name**	**Sample Date**	**Parent Sample Code**	**Within Range of Land Use?**	**Decision 3 - Are samples within land use range?**	**MRL**	**Decision 4 - < 2X MRL?**	**FINAL RECOMMENDATION**
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Yes, within range of other samples from OF22B (Unique for Pesticides).	YES	0.0005	NO	Average the two samples.
							The Parent sample is barely below the range of the other three samples from OF22B (Unique for Pesticides) and the FD is within the range. Entire range of samples spans between 0.02 and 0.16.	YES	0.0005	NO	Average the two samples.
							The Parent sample is barely below the range of the other three samples from OF22B (Unique for Pesticides) and the FD is within the range.	YES	0.0005	NO	Average the two samples.
							Both samples are within range.	YES	0.0005	NO	Average the two samples.
Upper Study Area 1	Albina - UPRR	Heavy Industrial	FD	WR218	11/29/07	LW3-STW2-CW20-WR218	Both samples within range.	YES	0.05	NO	Average the two samples.
							Both samples within range.	YES	0.05	NO	Average the two samples.
Upper Study Area	Highway 30	Transportation	LR	H30B	1/30/08	LW3-STW2-CW50-H30B	YES (only three other samples). Also note that the detection limit for the Parent sample was 0.03 which matches the LR, but is shown here at half the detection limit for calculating RPD.	YES	0.2	YES	Average the two samples.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

							Decision 3		Decision 4		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	No, the Parent sample is above the range of the other samples, and the FD is within the higher part of the range for OF18. However, the entire range of all samples only spans between 0.03 and 0.14.	NO	0.02	NO	Segregate the Parent sample, keep FD.
							YES, both samples are within range (only four other samples).	YES	0.2	NO	Average the two samples.
							No. These two samples are both higher than the other samples from OF18. However, the entire range of samples only spans between 2 and 16.8 and one of the samples is a non-detect. Also note that the detection limit for the Parent sample is 15.2 (shown at half the detection limit for calculating RPD), which is very close to the FD value of 16.9.	NO	10	YES	Average the two samples.
							The FD is within the range, the Parent sample is outside of the range of the other OF18 samples. The entire range of samples spans between 150 and 600.	NO	10	NO	Segregate Parent sample, keep FD.
							The FD is very close to the higher part of the range, the Parent sample is outside of the range of other OF18 samples. The entire range of samples spans between 100 and 8000.	NO	10	NO	Segregate Parent sample, keep FD.
							The FD is within the range, the Parent sample is outside of the range of other OF18 samples. The entire range of samples spans between 500 and 19100.	NO	10	NO	Segregate Parent sample, keep FD.
							Yes, they are both within the range.	YES	0.05	NO	Average the two samples.
							The FD is within the range, the Parent sample is outside of the range of other OF18 samples. The entire range of samples spans between 8 and 80.	NO	0.02	NO	Segregate Parent sample, keep FD.
							The FD is within the range, the Parent sample is outside of the range of other OF18 samples. The entire range of samples spans between 5 and 100.	NO	10	NO	Segregate Parent sample, keep FD.
							Both samples are higher than the other two samples from OF18.	NO	10	NO	Segregate both samples
							Both samples are higher than the other two samples from OF18.	NO	10	NO	Segregate both samples
							The FD is within the range, the Parent is outside of the range of the other OF18 samples. The entire range of samples spans between 2.5 and 2.6	NO	N/A	N/A	Segregate Parent sample, keep FD.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

							Decision 3		Decision 4		
River Reach	**Site**	**Land Use**	**Sample Type**	**Location Name**	**Sample Date**	**Parent Sample Code**	**Within Range of Land Use?**	**Decision 3 - Are samples within land use range?**	**MRL**	**Decision 4 - < 2X MRL?**	**FINAL RECOMMENDATION**
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	Parent sample is lower than range, FD is higher than range. Also, note that the detection limit for the Parent sample is 3.73 (shown at half the detection limit for calculating RPD) , which is very close to the FD value of 3.92.	NO	10	YES	Average the two samples.
							Parent sample is within range, FD is slightly higher, but only three other samples. Also note that the detection limit for the Parent sample is 30.8 (shown at half the detection limit for calculating RPD) , which is very close to the FD value of 47.3.	YES	10	YES	BPJ. Average the two samples.
							Only one other sample.	N/A	NO	NO	BPJ. Average the two samples.
							Only one other sample.	N/A	N/A	N/A	BPJ. Average the two samples.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF19	4/9/07	LW3-STW-CW20-OF19	FD is within range, Parent sample is within lower part of range. Also note that the detection limit for the Parent sample was 0.03 which matches the FD, but is shown here at 1/2 detection limit for calculating RPD.	YES	0.2	YES	Average the two samples.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

							Decision 3		Decision 4		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	Parent sample is within Interquartile Range, LR is in higher part of range.	YES	10	NO	Average the two samples.
							Parent sample is within range, LR is much higher than range.	NO	10	NO	Segregate the LR, keep Parent.
							Parent sample is within range, LR is much higher than range.	NO	10	YES	Average the two samples.
							Parent sample is within range, LR is much higher than range.	NO	10	NO	Segregate the LR, keep Parent.
							Parent sample is within range, LR is much higher than range.	NO	10	NO	Segregate the LR, keep Parent.
							Parent sample is within range, LR is much higher than range.	NO	10	NO	Segregate the LR, keep Parent.
							Parent sample is within range, LR is much higher than range.	NO	N/A	N/A	Segregate the LR, keep Parent.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Decision 3		Decision 4		FINAL RECOMMENDATION
							Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/18/07	LW3-STW-CW30-OFM1	Parent sample within higher part of range, LR within Interquartile Range.	YES	0.02	NO	Average the two samples.
							Both samples are within range.	YES	N/A	N/A	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Both samples within range.	YES	0.2	NO	Average the two samples.
							Parent sample within lower part of range, FD within range.	YES	0.2	NO	Average the two samples.
							Both samples within higher part of range.	YES	0.05	NO	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	5/3/07	LW3-STW-CW40-OFM2	Both samples are within range.	YES	10	YES	Average the two samples.
							Both samples are within range.	YES	N/A	N/A	Average the two samples.
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	10/19/07	WLCGED07MH2SW101907U	Yes, both samples are within the range of other MH2 samples.	YES	10	YES	Average the two samples.
							FD within range, Parent sample within higher part of range.	YES	0.2	NO	Average the two samples.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

							Decision 3		Decision 4		
River Reach	**Site**	**Land Use**	**Sample Type**	**Location Name**	**Sample Date**	**Parent Sample Code**	**Within Range of Land Use?**	**Decision 3 - Are samples within land use range?**	**MRL**	**Decision 4 - < 2X MRL?**	**FINAL RECOMMENDATION**
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	11/13/07	WLCGED07MH2SW111307F	Both samples within range.	YES	0.2	NO	Segregate the two samples.
							Yes, both samples are within the range of other MH2 samples (Unique for PCBs). Also note that the detection limit for the Parent sample is 3.56 (shown at half the detection limit for calculating RPD) , which is very close to the FD value of 4.1.	YES	10	YES	Average the two samples.
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	No, both samples lower than range, but only two other samples (Unique for PAHs). The entire range spans between 0.010 and 0.035.	NO	0.02	YES	Average the two samples.
							FD is within range, Parent sample higher than range, but only two other samples (Unique for PAHs). The entire range spans between 0.01 and 0.03.	NO	0.02	YES	Average the two samples.
							Both samples higher than range, but only three other samples (Unique for metals). The entire range spans between 0.16 and 2.8. Also, the total lead in both samples were the two highest total lead concentrations for this sample location (around 40).	NO	0.02	NO	BPJ. Average the two samples.
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	11/16/07	WLCT4C07BsnD071116	Both samples within range.	YES	10	YES	Average the two samples.
							Parent sample within lower part of range, FD within range.	YES	0.5	NO	Average the two samples.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

							Decision 3		Decision 4		
River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals).	N/A	0.2	NO	BPJ. Average the two samples.
							Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals).	N/A	0.2	NO	BPJ. Average the two samples.
							Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals).	N/A	0.05	NO	BPJ. Average the two samples.
							Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals).	N/A	0.02	NO	BPJ. Average the two samples.
							Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals). Additionally, one of the samples is a non-detect. Also note that the detection limit for the Parent sample is 0.02 (shown at half the detection limit for calculating RPD), which is very close to the FD value of 0.03.	N/A	0.2	NO	BPJ. Average the two samples.
							Parent sample within lower part of range, FD barely higher than range. Also, one of the samples is a non-detect.	YES	0.0005	NO	BPJ. Average the two samples.
							Both samples are within range.	YES	0.0005	NO	Average the two samples.
							Both samples are within range.	YES	0.0005	NO	Average the two samples.
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR071116	Both samples within lower part of range.	YES	0.1	NO	Average the two samples.
							Both samples within lower part of range.	YES	0.2	NO	Average the two samples.
							Parent sample within Interquartile Range, FD within lower part of range.	YES	0.2	NO	Average the two samples.
							Both samples within Interquartile Range.	YES	0.02	NO	Average the two samples.
							Both samples are within range.	YES	N/A	N/A	Average the two samples.
							Both samples are within range.	YES	0.02	NO	Average the two samples.

Table 1-1. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	Parent Sample Code	Decision 3		Decision 4		FINAL RECOMMENDATION
							Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07Bsn T070503	Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
							Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
							Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
							Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
							Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
							Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
							Parent sample is higher than range, FD is within higher part of range.	NO	N/A	N/A	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07Bsn T070407	Parent sample is lower than range but is non detect, FD is within range.	NO	0.0005	NO	BPJ. Average the two samples.
							Both samples are within range.	YES	0.0005	NO	Average the two samples.
							Parent sample is barely outside of range on low end but only two other samples. FD is outside of range.	NO	0.0005	NO	BPJ. Average the two samples.
Lower ISA	Basin M Terminal 4 WR-177	Heavy Industrial	FD	Basin M	5/3/07	WLCT4C07Bsn M070503	Both samples are within range.	YES	0.0005	NO	Average the two samples.
							Both samples are within range.	YES	0.0005	NO	Average the two samples.

Table 2-2a. Reclassification Summary for PAHs.

Outfall(s)	Facility or Location	A priori Classification	Benzo(a)pyrene			Naphthalene		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
WR-107	GASCO	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-14	Chevron - Transportation	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative	Representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative		Representative	Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative		Representative	Representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Non-representative	Non-representative	Non-representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative	Representative		Representative
Light Industrial								
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report

Table 2-2a. Reclassification Summary for PAHs.

Outfall(s)	Facility or Location	A priori Classification	Total cPAHs PaBEq			Total PAHs		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
WR-107	GASCO	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-14	Chevron - Transportation	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative	Representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative		Representative	Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-22	OSM	Non-representative		Representative	Representative		Representative	Representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative	Representative		Representative
Light Industrial								
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative

Notes:

T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination

iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report

Table 2-2b. Reclassification Summary for PCBs

Outfall(s)	Facility or Location	A priori Classification	PCB 077		PCB 081		PCB 105		PCB 106 + 118		PCB 126	
			Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Heavy Industrial												
Manhole 2	GE Decommissioning	Non-representative		Representative		Representative		Representative		Representative		Representative
WR-123	Schnitzer International Slip	Non-representative		Representative		Representative		Representative		Representative		Representative
WR-142/145	Gunderson	Non-representative		Representative		Representative		Representative		Representative		Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative		Representative		Representative		Representative		Representative
WR-161	Portland Shipyard	Non-representative		Representative		Representative		Representative		Representative		Representative
WR-22	OSM	Non-representative		Representative		Representative		Representative		Representative		Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative		Non-representative		Non-representative		Non-representative		Non-representative
WR-4	Sulzer Pump	Non-representative		Representative		Representative		Representative		Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative		Representative		Representative		Representative	
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative	
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative	
WR-107	GASCO	Representative	Representative		Representative		Representative		Representative		Representative	
WR-14	Chevron - Transportation	Representative	Representative		Representative		Representative		Representative		Representative	
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative		Representative		Representative	
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative		Representative		Representative	
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative		Representative		Representative	
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Non-Representative[1]		Representative		Representative		Representative	
WR-218	UPRR Albina	Representative	Representative		Representative		Representative		Representative		Representative	
WR-67	Siltronic	Representative	Representative		Representative		Representative		Representative		Representative	
WR-96	Arkema	Representative	Representative		Representative		Representative		Representative		Representative	
Light Industrial												
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative	
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative	
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative	
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative		Representative		Representative		Representative	

Notes:

T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination

iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report

Site specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

1. For Basin L, two out of four samples are Non-representative for PCB 081, however that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.
2. For WR-147, some of the samples for PCB 156+157 are outside of the representative range. However, that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

Table 2-2b. Reclassification Summary for PCBs

Outfall(s)	Facility or Location	A priori Classification	PCB 156+157		PCB 169		Total PCBs		Total PCBs TEQ		All PCBs
			Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Final
Heavy Industrial											
Manhole 2	GE Decommissioning	Non-representative		Representative		Representative		Representative		Representative	Representative
WR-123	Schnitzer International Slip	Non-representative		Representative		Representative		Representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative		Representative		Representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative		Non-Representative[2]		Representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative		Representative		Representative		Representative	Representative
WR-22	OSM	Non-representative		Representative		Representative		Representative		Representative	Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative		Non-representative		Non-representative		Non-representative	Non-representative
WR-4	Sulzer Pump	Non-representative		Representative		Representative		Representative		Representative	Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative		Representative		Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative
WR-107	GASCO	Representative	Representative		Representative		Representative		Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative		Representative		Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative		Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative		Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative		Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative		Representative		Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative		Representative		Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative		Representative		Representative		Representative
WR-96	Arkema	Representative	Representative		Representative		Representative		Representative		Representative
Light Industrial											
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative		Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative		Representative		Representative		Representative

Notes:

T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination

iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report

Site specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

1. For Basin L, two out of four samples are Non-representative for PCB 081, however that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.
2. For WR-147, some of the samples for PCB 156+157 are outside of the representative range. However, that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

Table 2-2c. Reclassification Summary for Phthalates

Outfall(s)	Facility or Location	A priori Classification	Bis(2-ethylhexyl) phthalate		
			Step 1	Step 2	Final
Heavy Industrial					
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Non-representative	Non-representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	NSC		NSC
OF-22B	City - Doane Lake Industrial Area	Representative	NSC		NSC
WR-107	GASCO	Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Non-representative	Non-representative	Non-representative
WR-218	UPRR Albina	Representative	Representative		Representative
WR-22	OSM	Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	NSC		NSC
WR-67	Siltronic	Representative	NSC		NSC
WR-96	Arkema	Representative	Representative		Representative
Light Industrial					
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	NSC		NSC
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 2-2d. Reclassification Summary for Metals

Outfall(s)	Facility or Location	A priori Classification	Arsenic			Chromium			Copper		
			Step 1	Step 2	Final	Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial											
OF-22B	City - Doane Lake Industrial Area	Non-representative		Representative	Representative		Representative	Representative		Representative	Representative
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative		Non-representative	Non-representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative	Representative		Representative	Representative		Non-representative	Non-representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative		Representative	Representative		Non-representative	Non-representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative		Representative	Representative		Non-representative	Non-representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative		Non-representative	Non-representative		Representative	Representative
WR-384	Schnitzer - Riverside	Non-representative		Representative	Representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Non-representative	Non-representative	Non-representative	Representative		Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Non-representative	Non-representative	Non-representative	Representative		Representative	Representative		Representative
Light Industrial											
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative		Representative

Notes:

T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

Table 2-2d. Reclassification Summary for Metals

Outfall(s)	Facility or Location	A priori Classification	Lead			Mercury		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
OF-22B	City - Doane Lake Industrial Area	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative	Representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative		Representative	Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative		Representative	Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative	Non-representative	Non-representative	Non-representative
Light Industrial								
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

Table 2-2d. Reclassification Summary for Metals

Outfall(s)	Facility or Location	A priori Classification	Nickel			Zinc		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
OF-22B	City - Doane Lake Industrial Area	Non-representative		Representative	Representative		Representative	Representative
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative	Representative		Non-representative	Non-representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative		Non-representative	Non-representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative		Representative	Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative	Representative		Representative
Light Industrial								
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

Table 2-2e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	A priori Classification	4,4'-DDD			4,4'-DDT			Aldrin		
			Step 1	Step 2	Final	Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial											
OF-22B	City - Doane Lake Industrial Area	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-96	Arkema	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	NSC		NSC	NSC		NSC	NSC		NSC
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	NSC		NSC	NSC		NSC	NSC		NSC
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-142/145	Gunderson	Representative	NSC		NSC	NSC		NSC	NSC		NSC
WR-147	Gunderson (former Schnitzer)	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-161	Portland Shipyard	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-22	OSM	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	NSC		NSC	NSC		NSC	NSC		NSC
WR-67	Siltronic	Representative	NSC		NSC	NSC		NSC	NSC		NSC
Light Industrial											
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	NSC		NSC	NSC		NSC	NSC		NSC

Notes:

T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report

NSC - No samples collected

Table 2-2e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	Dieldrin			gamma-Hexachlorocyclohexane			Hexachlorobenzene		
		Step 1	Step 2	Final	Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial										
OF-22B	City - Doane Lake Industrial Area		Non-representative	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-96	Arkema		Non-representative	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	NSC		NSC	NSC		NSC	NSC		NSC
OF-16	City - Heavy Industrial	Representative		Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	NSC		NSC	NSC		NSC	NSC		NSC
WR-107	GASCO	Representative		Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative		Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative		Representative	Representative		Representative	Representative		Representative
WR-142/145	Gunderson	NSC		NSC	NSC		NSC	NSC		NSC
WR-147	Gunderson (former Schnitzer)	Representative		Representative	Representative		Representative	Representative		Representative
WR-161	Portland Shipyard	Representative		Representative	Representative		Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative		Representative	Representative		Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative		Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative		Representative	Representative		Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative		Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative		Representative	Representative		Representative	Representative		Representative
WR-22	OSM	Representative		Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative		Representative	Representative		Representative	Representative		Representative
WR-4	Sulzer Pump	NSC		NSC	NSC		NSC	NSC		NSC
WR-67	Siltronic	NSC		NSC	NSC		NSC	NSC		NSC
Light Industrial										
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative		Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative		Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative		Representative	Representative		Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	NSC		NSC	NSC		NSC	NSC		NSC

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 2-2e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	Total Chlordanes			Sum DDD			Sum DDE		
		Step 1	Step 2	Final	Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial										
OF-22B	City - Doane Lake Industrial Area		Non-representative	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-96	Arkema		Non-representative	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
Manhole 2	GE Decommissioning	NSC		NSC	NSC		NSC	NSC		NSC
OF-16	City - Heavy Industrial	Representative		Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	NSC		NSC	NSC		NSC	NSC		NSC
WR-107	GASCO	Representative		Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative		Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative		Representative	Representative		Representative	Representative		Representative
WR-142/145	Gunderson	NSC		NSC	NSC		NSC	NSC		NSC
WR-147	Gunderson (former Schnitzer)	Non-representative	Non-representative	Non-representative	Representative		Representative	Representative		Representative
WR-161	Portland Shipyard	Representative		Representative	Representative		Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative		Representative	Representative		Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative		Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative		Representative	Representative		Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative		Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative		Representative	Representative		Representative	Representative		Representative
WR-22	OSM	Representative		Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative		Representative	Representative		Representative	Representative		Representative
WR-4	Sulzer Pump	NSC		NSC	NSC		NSC	NSC		NSC
WR-67	Siltronic	NSC		NSC	NSC		NSC	NSC		NSC
Light Industrial										
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative		Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative		Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative		Representative	Representative		Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	NSC		NSC	NSC		NSC	NSC		NSC

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 2-2e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	Sum DDT			Total DDXs		
		Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial							
OF-22B	City - Doane Lake Industrial Area		Non-representative	Non-representative		Non-representative	Non-representative
WR-96	Arkema		Non-representative	Non-representative		Non-representative	Non-representative
Manhole 2	GE Decommissioning	NSC		NSC	NSC		NSC
OF-16	City - Heavy Industrial	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	NSC		NSC	NSC		NSC
WR-107	GASCO	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative		Representative	Representative		Representative
WR-142/145	Gunderson	NSC		NSC	NSC		NSC
WR-147	Gunderson (former Schnitzer)	Representative		Representative	Representative		Representative
WR-161	Portland Shipyard	Representative		Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative		Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative		Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative		Representative	Representative		Representative
WR-22	OSM	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative		Representative	Representative		Representative
WR-4	Sulzer Pump	NSC		NSC	NSC		NSC
WR-67	Siltronic	NSC		NSC	NSC		NSC
Light Industrial							
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative		Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	NSC		NSC	NSC		NSC

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 2-2f. Reclassification Summary for Total Organic Carbon.

Outfall(s)	Facility or Location	A priori Classification	Total Organic Carbon		
			Step 1	Step 2	Final
Heavy Industrial					
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative
WR-142/145	Gunderson	Representative	Representative		Representative
WR-147	Gunderson (former Schnitzer)	Representative	Representative		Representative
WR-161	Portland Shipyard	Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative
WR-22	OSM	Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative
Light Industrial					
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative

Notes:
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
NSC - No samples collected

LWG
LOWER WILLAMETTE GROUP

PORTLAND HARBOR RI/FS

REMEDIAL INVESTIGATION REPORT

APPENDIX E, ATTACHMENT E-2
MEMORANDUM ON PORTLAND HARBOR STORMWATER RUNOFF MODELING (CITY OF PORTLAND 2008)

DRAFT

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.

October 27, 2009

CITY OF PORTLAND
ENVIRONMENTAL SERVICES
Systems Analysis
Spatial Analysis and Modeling

Memorandum

To: Carl Stivers – Anchor Environmental

From: Mark Liebe, BES - Systems Analysis

Reviewed By: Binhong Wu, BES
Dawn Sanders, BES

Date: September 9, 2008

Project: Portland Harbor Superfund

Subject: Portland Harbor Stormwater Runoff Modeling

Table of Contents

Objective 2
Background 2
Evaluation Area 2
Rainfall Data 4
Analysis Methods 4
Interpolation of Rainfall Data 4
Rainfall Runoff Calculations 5
GRID Model 6
Model Boundary Refinements for Hybrid Model Segment Estimates 8
Drainage Area Runoff Calculations 9
Analysis Results 14
Detailed runoff results database 14
Summary results spreadsheet 15
RunoffAreaProportion tab 15
RunoffAreaProportionbyFTONLY tab 16
AreaPercentSummary tab 16
Assumptions and Limitations of Analysis 16
References 17

Tables

Table 1: Total average rainfall amounts for rainfall periods 5
Table 2: Modeled Land Use Designations Based on Zoning Codes 7
Table 3: Acres and overall percent impervious area for land use types in the LWG area 8
Table 4: Detailed GRID runoff results database schema. 14
Table 5: Sample data from the runoff results database (from query Results_Liters) 15
Table 6: Sample of summary data from RunoffAreaProportion tab 15
Table 7: Sample of summary data from RunoffAreaProportionbyFTONLY tab 16
Table 8: Sample of summary data from AreaPercentSummarytab 16

Figures

Figure 1: Hybrid Model Segment Areas, GRID model area, and HYDRA rain gages 3
Figure 2: Virtual raingage conceptual diagram. 5
Figure 3: Segment Drainage Areas, Unique Sites, Hybrid Model River Segments, and Virtual Rain gage Grid. 10
Figure 4: LWG Generalized Zoning used in the GRID Model 11
Figure 5: Vacant Land and Transportation Layer inputs to the GRID Model 12
Figure 6: Mapped Impervious Area used in the GRID Model Runoff Analysis 13

Objective

The City of Portland's Bureau of Environmental Services (BES) estimated monthly stormwater runoff volumes to the Portland Harbor area. The purpose of this analysis is to provide runoff volumes that could be used to estimate stormwater loading to the river during the periods being evaluated by the Lower Willamette Group (LWG) in-river Hybrid Model, an in-river fate and transport model. This memorandum provides a description of the modeling conducted, including the monitoring data used, the analysis methods, and the data transmittals of the results.

Background

The Systems Analysis Section of BES was requested by the LWG to calculate monthly runoff volumes for the Portland Harbor drainage area. This work built off modeling conducted for the Oregon Department of Environmental Quality (DEQ) in 2006, where flow and total suspended solids (TSS) estimates for stormwater were estimated as input to DEQ's Fate and Transport model (BES, Oct. 2006).

Stormwater runoff volumes were estimated for the upland areas that drain to each Hybrid model river segment. Runoff for areas that may have unique pollutant loading rates were also estimated, in addition to the segment drainages.

This Background section provides a description of the area evaluated and the precipitation data used in this analysis.

Evaluation Area

The Portland Harbor area being modeled by the LWG Hybrid model extends from river miles 1.0 and 11.8. The Hybrid model divides the river into 44 river cells, with individual cells along the right and left banks and central channel for approximately each river mile. Separate cells represent Swan Island Lagoon and a portion of the Multnomah Channel. These river segments were provided to BES as a GIS layer by Anchor Environmental.

Based on the in-water extent, BES estimated the extent of upland area that drained stormwater to the river. The upland area that drains to the in-water Hybrid model river extent is approximately 19 square miles, as shown in Figure 1. For the purposes of this memorandum, the upland area that corresponds with each of the Hybrid Model river segments are referred to as segment drainage areas.

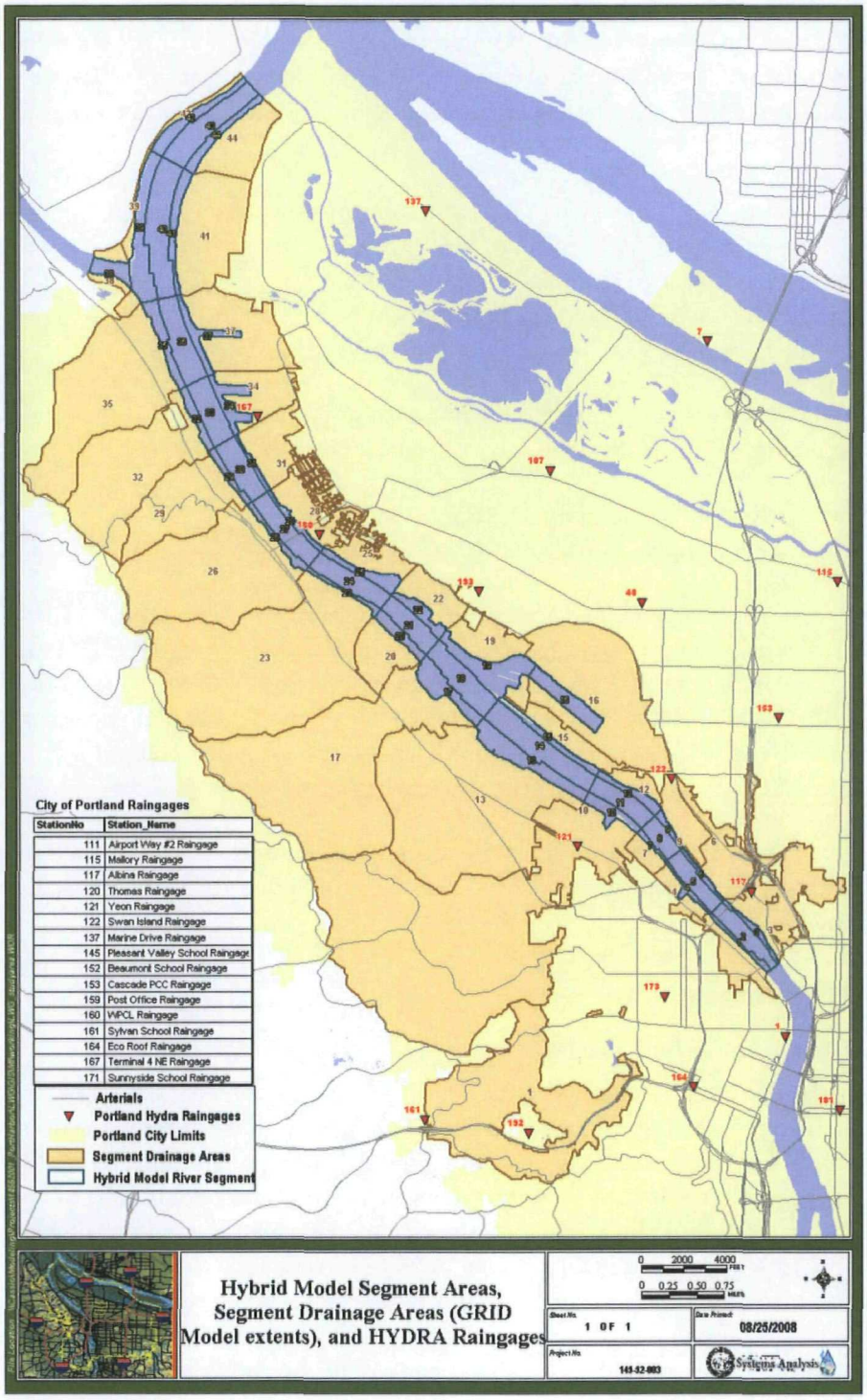

Figure 1: Hybrid Model Segment Areas, GRID model area, and HYDRA rain gages

Rainfall Data

BES was requested to estimate monthly runoff volumes for five "typical" rainfall years (all starting September 1 of the year noted and ending August 31 of the following year). These years were selected to match the years planned to be run using the Hybrid Model during the Portland Harbor RI/FS process (LWG, 2008):

- 5th Percentile Flow Year 2000 – mean flow 454 cubic meters per second (m^3/sec)
- 25th Percentile Flow Year 1990 – mean flow 801 m^3/sec
- 50th Percentile Flow Year 2002 – mean flow 863 m^3/sec
- 75th Percentile Flow Year 2005 - mean flow 1,099 m^3/sec
- 95th Percentile Flow Year 1996 – mean flow 1,522 m^3/sec

Runoff volume estimates were also requested for two additional rainfall periods that are to be used in calibration and validation of the Hybrid model:

- September 1, 2004 through January 31, 2006 (17 months)
- September 1, 2006 through January 31, 2008 (17 months)

The rainfall data was extracted from the City's rainfall monitoring system, called HYDRA (available on USGS website http://or.water.usgs.gov/non-usgs/bes/raingage_info/clickmap.html). Portland first started recording rainfall data in 1976 with the installation of BES's HYdrologic Data Retrieval and Alarm (HYDRA) network. The HYDRA system is composed of approximately 40 rain gages, a portion of which were used for this analysis, and as shown in Figure 1. These data are contained in the transmittal spreadsheet RAINFALLCOMPILATION.xls.

Some data from the HYDRA system for some rain gages is not continuous for certain time periods needed for the analysis. An interpolation method was used to fill in the missing data. This method is described in the next section.

Analysis Methods

Interpolation of Rainfall Data

Using the rainfall data from the discrete HYDRA rain gage stations, "virtual" rain gages were created at a finer grid spacing than the existing reengage locations to better simulate storm patterns across the study area. A virtual reengage is a theoretical reengage that interpolates the rainfall at a point based on actual data surrounding the point (see Figure 2). Survey quarter sections were used as the basis for the virtual reengage grid. The basic formula for calculating the virtual reengage rainfall intensity uses the weighted average of the three closest actual rain gage's data for any one time interval. The weight is based on the squared distances of the rain gages from the center of a quarter section (see Equation 1). Once a subcatchment is defined based on topography and area drainage, the quarter section virtual rain gage nearest to the subcatchment's centroid can be assigned to it during runoff simulations.

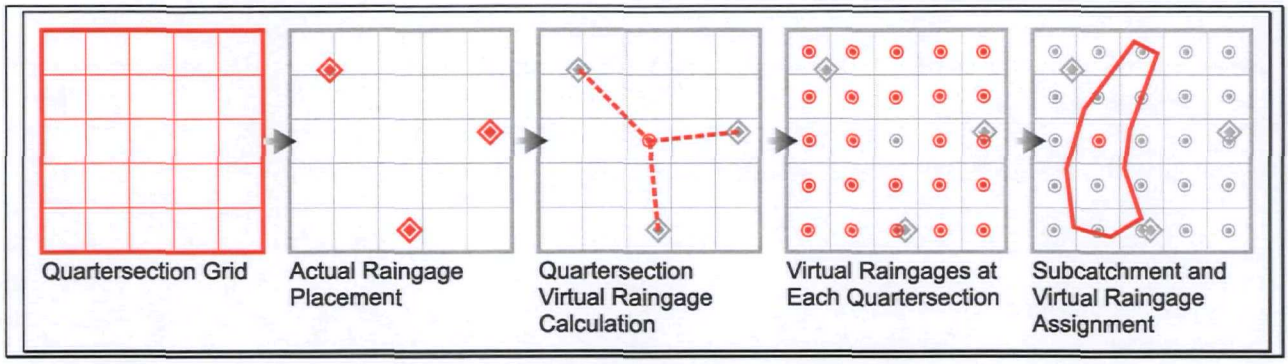

Figure 2: Virtual raingage conceptual diagram.

$$Rain_X = \left(\frac{Rain_A}{Dist^2_{X-A}} + \frac{Rain_B}{Dist^2_{X-B}} + \frac{Rain_C}{Dist^2_{X-C}} \right) \times \left(\frac{1}{\frac{1}{Dist^2_{X-A}} + \frac{1}{Dist^2_{X-B}} + \frac{1}{Dist^2_{X-B}}} \right)$$

Equation 1: Reciprocal distance squared method for virtual raingage analysis.

144 quarter sections were used as virtual rain gage areas for the Portland Harbor area, which are shown in Figure 3. These quarter sections are contained in the transmittal GIS database feature class LWG_VIRTUALGAGES.

A summary of the total average rainfall for each for each of the requested rainfall periods is shown in Table 1. The rainfall for each month was averaged across all virtual raingage areas, and those averages were then totaled for each rainfall period.

Table 1: Total average rainfall amounts for rainfall periods.

Period	Total Average Rainfall (in)	Start Date	End Date
1	36.0	9/1/1990	8/31/1991
2	58.6	9/1/1996	8/31/1997
3	24.6	9/1/2000	8/31/2001
4	34.6	9/1/2002	8/31/2003
5	42.7	9/1/2005	8/31/2006
6	47.6	9/1/2004	1/31/2006
7	44.6	9/1/2006	1/31/2008

Rainfall Runoff Calculations

The runoff calculations used for the LWG analysis use two primary components: a runoff coefficient and the actual runoff volume. This method was requested since monthly total volumes were desired. Other methods are available for calculating runoff within the GRID model, but they are more related to storm event-specific runoff estimates.

Runoff coefficient is the overall ratio of stormwater runoff to rainfall and is proportional to the percentage of impervious surface area within a basin. This estimate of the runoff coefficient for each land use type on the following equation:

$$R = 0.05 + 0.009 * IMP$$

Where:

R = runoff coefficient

IMP = impervious area in the basin (%)

The runoff volume is calculated using the following:

$$V = 1.027902E+05 * P * R * A$$

Where:

V = estimated stormwater runoff volume from the drainage basin (liters)

P = total monthly precipitation (inches)

R = runoff coefficient for the drainage basin (dimensionless)

A = area of the drainage basin (acres)

1.027902E+05 = unit conversion factor[1]

GRID Model

A BES model, called the GRID model (BES, 2004), was used to estimate the monthly stormwater runoff volumes for the segment drainage areas defined by the LWG Hybrid Model river segments (shown in Figure 1) The GRID model and the specific inputs used for the analysis are discussed below.

Basic model description

The GRID model is a GIS-based reconnaissance-level pollutant-loading model. For the purposes of this modeling task, the GRID model was used only for calculation of stormwater runoff volumes. The model uses an array of grid cells into which detailed GIS and other spatial data are compiled. The grid size used in the model is 100-foot by 100-foot. The data compiled for each grid cell includes precipitation, pervious/impervious area, and zoning area (or actual land use) for each grid cell. With these data, a set of runoff equations including the equations presented in previous sections, are applied that calculates runoff for each grid cell. More details on the GRID model are provided in the BES Oct 2006 memorandum. The GRID model cells as well as the input data for each cell are contained in the transmittal GIS database feature class LWGGrd100ft.

[1] 43560 ft^2/acre * 1 ft/12 inches * 28.31685 liters/cubic foot

Land use, vacant lands, and major transportation

Generalized land use zoning types were used in the GRID model to aggregate estimated runoff volumes from various land surfaces, and are shown in Figure 4. The land use areas are combined into generalized zoning codes listed in the figure legend per Table 2 (LWG, May 2008). For the purposes of this analysis, it should be understood that the data actually represent zoning and not actual land use except for major transportation and vacant lands (see below). Zoning is not equivalent to actual land use in many cases, but zoning is the most comprehensive data available for the purposes of modeling, and is the best representation of land use available.

Table 2: Modeled Land Use Designations Based on Zoning Codes

General Land Use Code	Detailed Zoning Codes	Zoning Description[1]	Notes
IND (Heavy Industrial)	IH	Heavy Industrial	
LIND (Light Industrial)	IG2 EG1 EG2 EX IG1	General Industrial 2 General Employment 1 General Employment 2 Central Employment General Industrial 1	
TRANS (Major Transportation)	--	Not a zoned area.	This will be State Highways and Freeways derived as an overlay to the zoning layer
RES/COM (Residential and Commercial)	R10 R7 R5 R3 R2.5 R2 R1 RX RH IR CG CN1 CN2 CS CM CO1 CX CO2	Residential 10,000 sq. ft. lots Residential 7,000 sq. ft. lots Residential 5,000 sq. ft. lots Residential 3,000 sq. ft. lots Residential 2,500 sq. ft. lots Residential 2,000 sq. ft. lots Residential 1,000 sq. ft. lots Central Residential High Density Residential Institutional Residential General Commercial Neighborhood Commercial 1 Neighborhood Commercial Storefront Commercial Mixed Commercial/Residential Office Commercial 1 Central Commercial Office Commercial 2	Sparse residential and commercial land use within Portland Harbor area but all zoning codes are included in case any of these are within the segment drainage areas.
POS (Parks and Open Space)	OS RF R20 RUR	Open Space Residential Farming Residential 20,000 sq. ft. lots Rural (Mult Co. zoning code)	Includes very low density residential located above Forest Park. This type of land use included in Open Space monitoring station. Also includes Vacant Land that is undeveloped and functions as Open Space.

[1]Portland Code Title 33 descriptions of land use zoning at http://www.portlandonline.com/auditor/index.cfm?c=28197

Two actual land use types were included in the GRID model and treated as overlays: vacant lands and major transportation. These are described in Appendix C of the LWG's *Stormwater Loading Calculations Methods* (LWG, May 2008). Both the vacant lands and major transportation overlays are shown in Figure 5

Statistics for the entire study area for acreage and percent impervious of the modeled land use categories are shown in Table 3.

Table 3: Acres and overall percent impervious area for land use types in the LWG area.

Zoning type	Open Space/ Vacant	Heavy Industrial	Light Industrial	Residential/ Commercial	Major Transportation	Total
Acres[1]	7,021	3,083	952	922	255	12,232
Percent Impervious[2]	2%	56%	73%	28%	59%	24%

[1]Derived from independent GIS analysis of zoning data used in the GRID model.
[2]Derived from BES GIS analysis using zoning and mapped impervious area.

Explicitly mapped impervious area

Per LWG's request, runoff volumes were estimated using the explicit form of runoff estimation available in the GRID model. This explicit form uses mapped impervious area as the basis for runoff estimation, in order to provide a more accurate depiction of the relative spatial distribution of runoff between Drainage Segments. The GRID model was modified to use explicitly mapped impervious areas. These mapped impervious areas are derived from a GIS layer maintained by BES for combined sewer modeling and other data collection efforts. These data were compiled into a GIS layer specifically for this modeling effort. Since runoff was to be calculated separately for potentially Unique sites or basins, the City's Industrial Stormwater staff reviewed and modified, as appropriate, impervious areas for these sites. The City also conducted limited quality assurance at other locations within the study area, based on their site knowledge. The mapped impervious areas are shown in Figure 6.

Model Boundary Refinements for Hybrid Model Segment Estimates

BES developed flow and TSS estimates for stormwater for the Oregon DEQ as input to their Fate and Transport model (BES, Oct. 2006) which required delineation of upland segment drainage areas that drained to each river segment, and which included both natural and manmade conveyances. This original delineation was updated to extend further upstream and downstream, to align with the Hybrid Model extent, and minor adjustments made to the segment boundaries. Upland areas draining to each river segment were delineated using City and non-City conveyance system information mapped in the City's GIS system, site-specific information available from the BES Industrial Stormwater group, and topography. These delineations were aligned with the LWG Hybrid river segments, as shown in Figure 1.

A "Unique Sites" GIS layer was provided to BES by Anchor Environmental for areas that needed to have flow estimated separately from the overall segment drainage areas.

The segment drainage area boundaries were divided up by both virtual rain gage area and unique site boundaries. The resulting divisions resulted in 353 subareas within the PH study area, each uniquely identified by various combinations of Hybrid river segment, Unique Site ID, and virtual rain gage number. These combinations are contained in three distinct fields in the results database and then rolled up by segment drainage area and Unique Site ID in the summary spreadsheets, to help identify specific areas and to link the results to a GIS layer which BES created to show each of the individual divided polygons that was used to aggregate the results of the GRID analysis.

The original GIS layer that was used to apportion the GRID model cells into the distinct subareas is contained in the transmittal personal geodatabase in the feature class LWG_ANALYSIS_AREAS.

Drainage Area Runoff Calculations

Runoff volumes were calculated for each of the approximately 77,000 cells in the LWG GRID model, and then accumulated into the 353 individual subareas discussed previously. This subgrouping allows for separate calculation of loading for these areas, and also allow for the separation of those Unique Sites that overlap the original segment drainage areas. Both the segment drainage areas and the Unique Sites are shown in Figure 3.

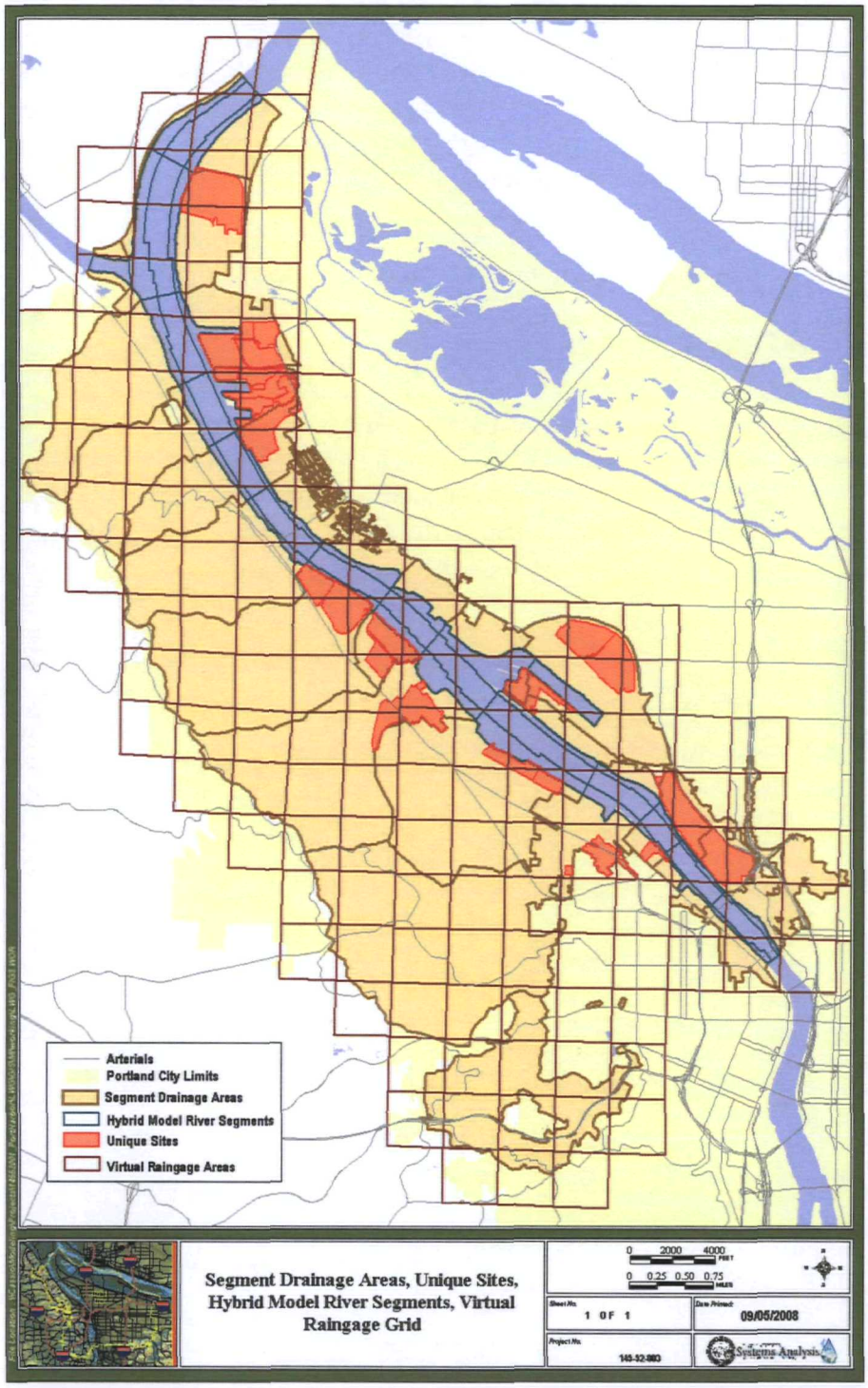

Figure 3: Segment Drainage Areas, Unique Sites, Hybrid Model River Segments, and Virtual Rain gage Grid.

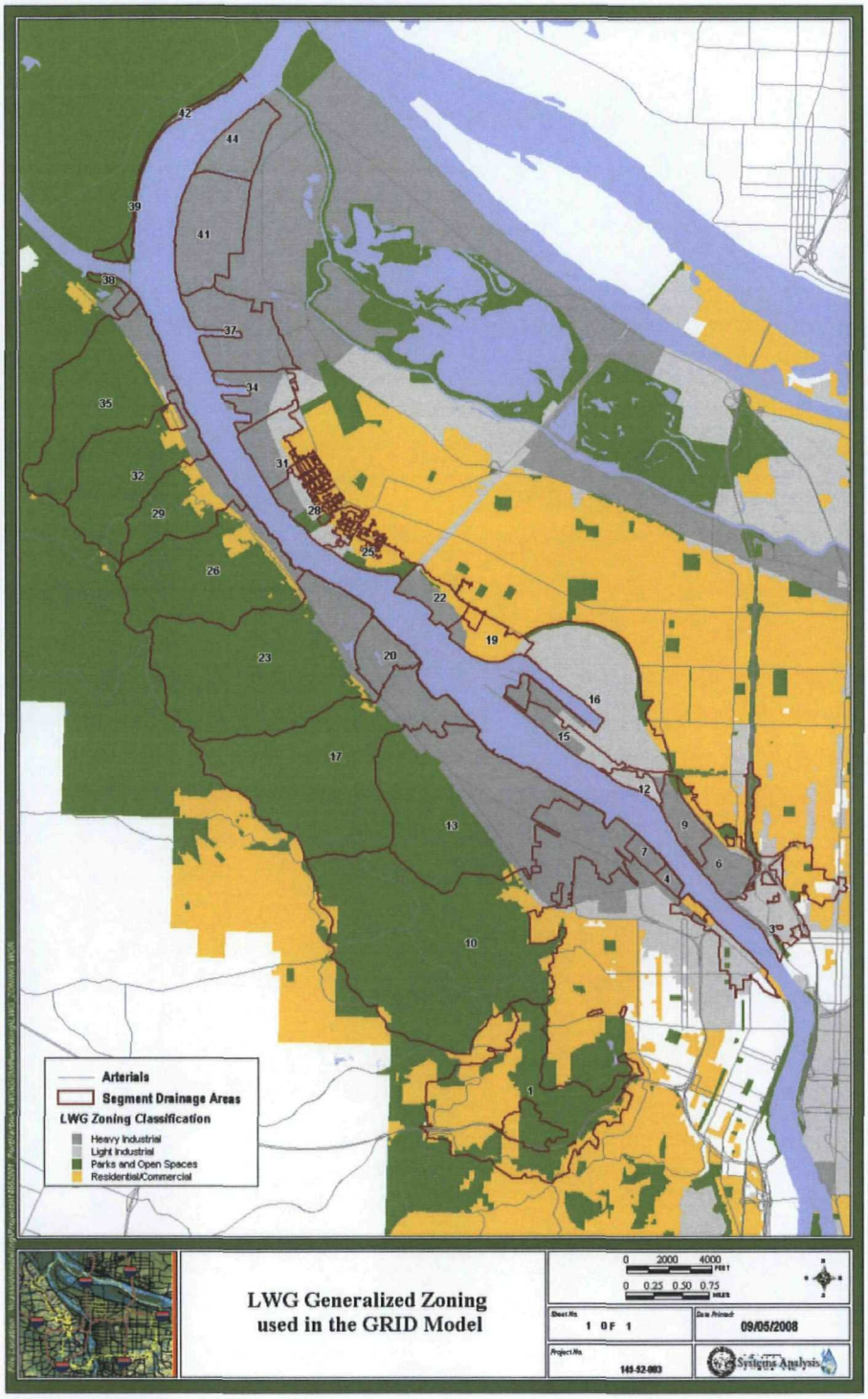

Figure 4: LWG Generalized Zoning used in the GRID Model

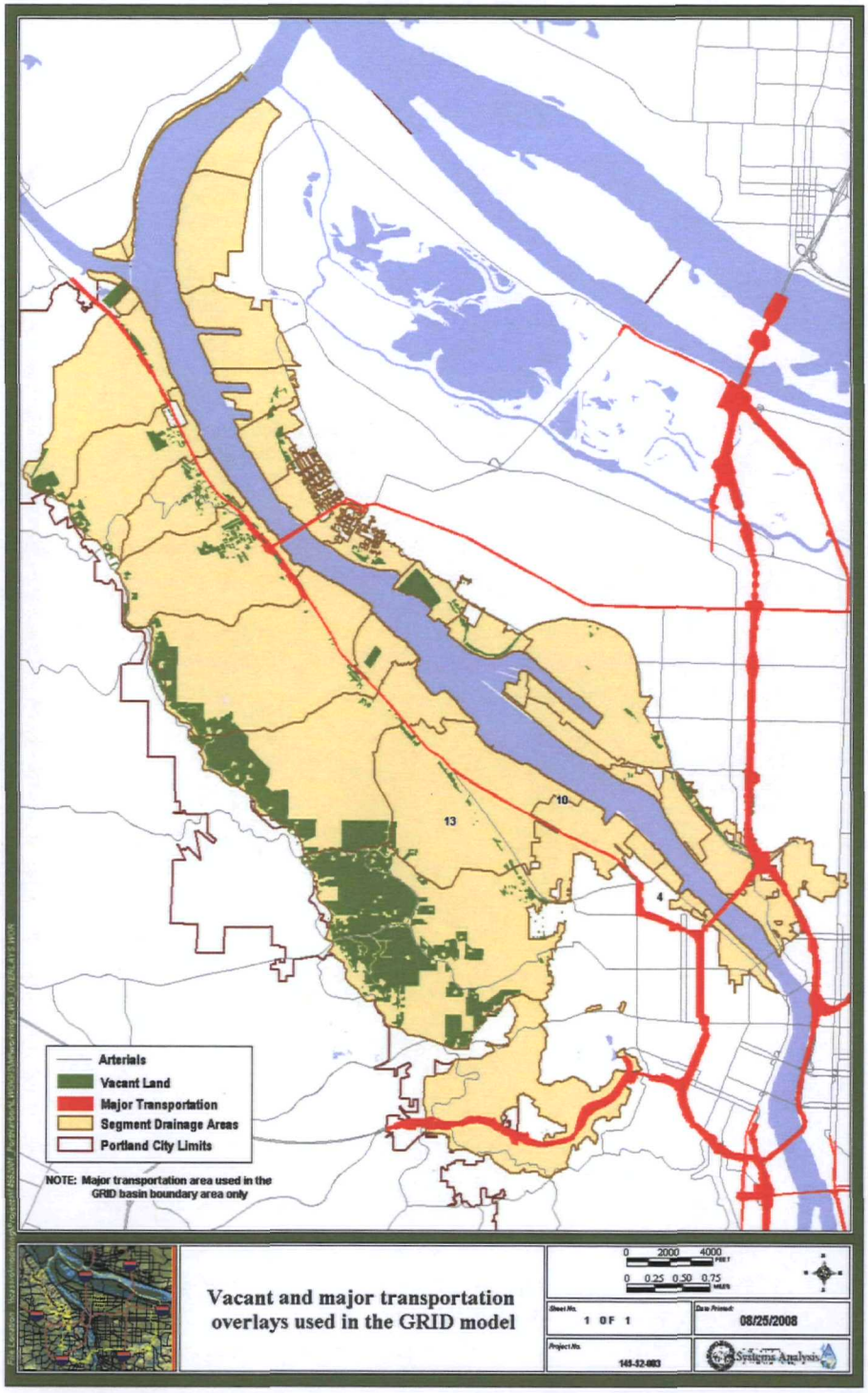

Figure 5: Vacant Land and Transportation Layer inputs to the GRID Model.

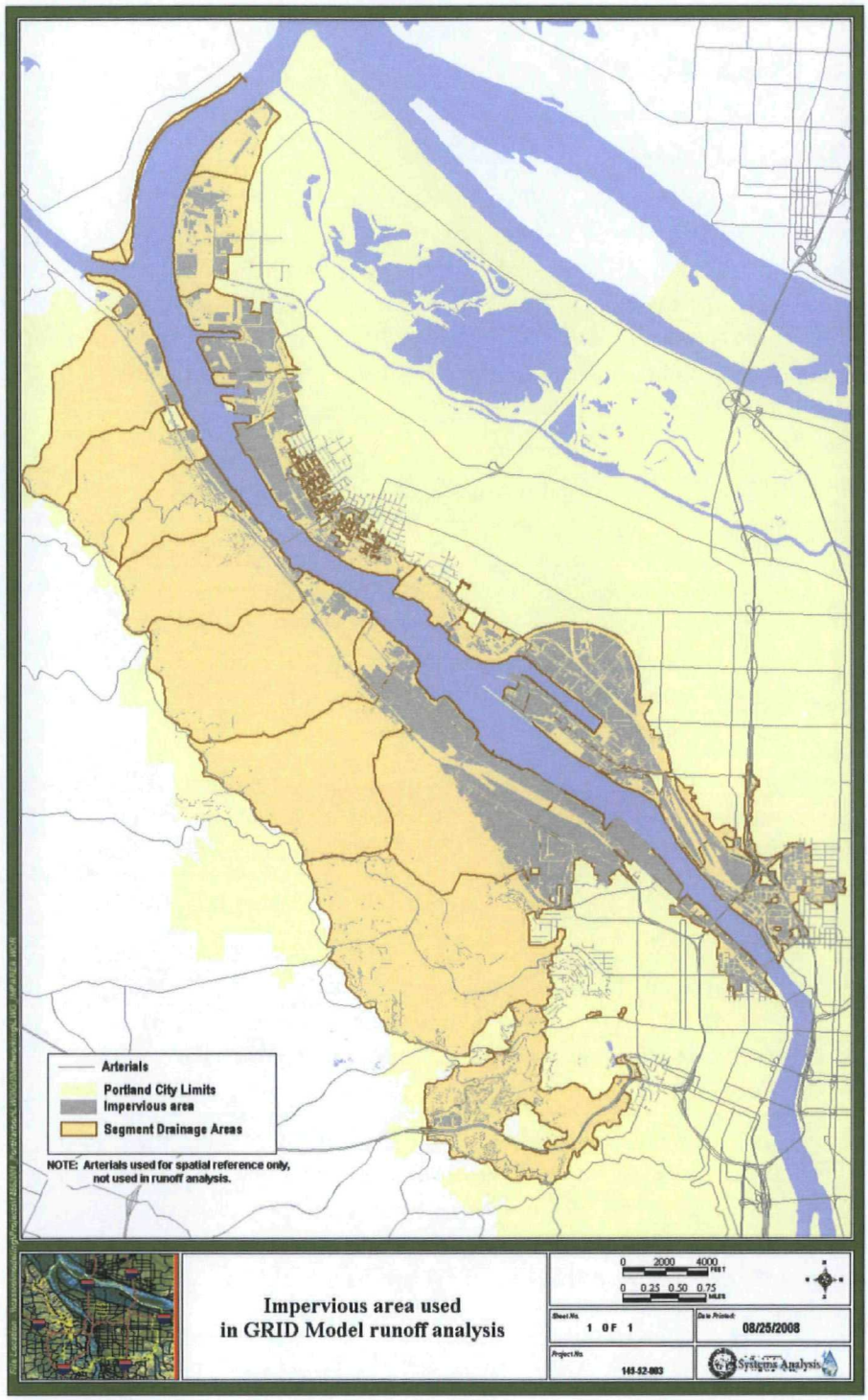

Figure 6: Mapped Impervious Area used in the GRID Model Runoff Analysis

Analysis Results

Detailed runoff results database

Detailed runoff volume results from the GRID model are contained in the results database. This is in Microsoft Access format, and also accompanies the GIS data in ESRI personal geodatabase format in the same database file. The data table containing the results is named RESULTS, which consists of the schema shown in Table 4. The results database is used for multiple projects, and as such the naming conventions on data fields is not completely consistent with conventions used in the LWG work. The LWG naming conventions are shown in the descriptions for each data field listed below from the GRID model results database structure.

Table 4: Detailed GRID runoff results database schema.

Field name	Description	Field type
Description	Unique identifier assigned to each GRID cell. Similar to the Column/row syntax of Excel spreadsheets. Same description may be found in multiple records, depending on if GRID cell is divided across multiple Hybrid model drainage areas, Unique Sites, and Virtual Rain gages.	Character
Area	Hybrid model drainage area ID within which individual GRID cell runoff volumes are calculated. These correspond to the individual Hybrid model segment areas to which each drainage area drains.	Character
Subarea	Unique Site ID, if applicable. Unique Sites and their ID's were provided by the LWG.	Character
VRG	Virtual rain gage ID. As shown in Figure 3, the study area was divided up into 144 individual virtual rain gage areas. Each area/subarea combination could have several records, each with its own VRG ID.	Integer
Timeperiod	A compound value indicating the YEAR and MONTH of the runoff volume results. The syntax of this field is YYYYMM, where YYYY is the period year and MM is a two digit number representing the month. This field contains redundant information to that contained in the Year and Month fields, but is used as an aid in querying the database.	Integer
Year	Individual field containing the year of the rainfall period for the GRID runoff analysis. Same year as indicated in the Timeperiod field.	Integer
Month	Month of the runoff analysis period. Corresponds to the time periods provided to BES for runoff analysis. Same month as indicated in the Timeperiod field.	Integer

Field name	Description	Field type
Runoff	Value (in cubic feet) of estimated GRID cell runoff.[1]	Double

[1]Database queries developed to convert runoff automatically to liters

An example subset from the results database is shown in Table 5. In this example, two monthly runoff results for GRID cell KH170 are shown, both for March 1992. The first record is for the portion of GRID cell KH170 that overlaps the segment drainage area FT41 and which also overlaps Unique Site WR-22. The total runoff for that portion of the GRID cell for that time period is 33 liters. The second record is for the portion of the same GRID cell that overlaps only the segment drainage area boundary and does not intersect the Unique Site WR-22. The total runoff for that portion of the GRID cell for the same time period is 910 liters. As the results are contained in a database, various summations can be performed by either GRID CELL, Area, SubArea, Area/Subarea combination, Time period, Year, Month, and so on.

Table 5: Sample data from the runoff results database (from query Results_Liters)

Description	Area	Subarea	VRG	Timeperiod	Year	Month	Runoff_L
KH170	FT41	WR-22	1618	199203	1992	3	33
KH170	FT41		1618	199203	1992	3	910

There are additional queries contained in the results database that perform various summations and roll-ups, some of which were used to create the summary tables in the summary spreadsheet.

Summary results spreadsheet

Summary results from the runoff analysis have been compiled into a spreadsheet containing the total runoff volumes (in liters) for each segment drainage area, Unique Site, and time period. Three tabs are present in the summary spreadsheet. The following section discusses the content of each tab. Where appropriate, each tab contains data filters which allow for the selection and filtering of various combinations of area and time period, depending on the contents of the tab.

RunoffAreaProportion tab

This tab in the runoff summary spreadsheet presents the accumulated monthly runoff values (in liters) from the GRID model, grouped by segment drainage area, Unique Site (if present), time period, and generalized land use type. A sample of data from this data summary is shown in Table 6.

Table 6: Sample of summary data from RunoffAreaProportion tab

Area	Subarea	Year	Month	PERIOD	POS_ROL	TRA_ROL	LIN_ROL	HIN_ROL	RES_ROL	TOT_ROL
FT01		1990	9	1	2,055,621	1,534,144	1,663,541	95,104	4,281,522	9,629,932
FT01		1990	10	1	26,188,105	18,028,071	21,583,880	1,432,312	52,438,310	119,670,677
FT01		1990	11	1	18,205,551	12,156,746	15,857,099	1,099,146	35,644,100	82,962,642
FT01		1990	12	1	16,837,976	11,295,199	15,281,580	1,035,238	31,985,246	76,435,240

Data filters are set up for the Area, Subarea, Year, Month, and Period fields of this tab. The runoff columns each contain either the total runoff (in liters) for the month of interest for the area/subarea/year/month combination, or the total runoff associated with each individual land use type (POS, TRA, LIN, HIN, or RES).

RunoffAreaProportionbyFTONLY tab

This tab in the runoff summary spreadsheet presents the accumulated monthly runoff values (in liters) from the GRID model for segment drainage areas only, without the partitioning by Unique Site as was done in the first spreadsheet tab. A sample of data from this data summary is shown in Table 7.

Table 7: Sample of summary data from RunoffAreaProportionbyFTONLY tab

Area	Year	Month	PERIOD	POS_ROL	TRA_ROL	LIN_ROL	HIN_ROL	RES_ROL	TOT_ROL
FT01	1990	9	1	2,055,621	1,534,144	1,663,541	95,104	4,281,522	9,629,932
FT01	1990	10	1	26,188,105	18,028,071	21,583,880	1,432,312	52,438,310	119,670,677
FT01	1990	11	1	18,205,551	12,156,746	15,857,099	1,099,146	35,644,100	82,962,642
FT01	1990	12	1	16,837,976	11,295,199	15,281,580	1,035,238	31,985,246	76,435,240

Data filters are set up for the Area, Year, Month, and Period fields of this tab. The runoff columns each contain either the total runoff (in liters) for the month of interest for the area, or the total runoff associated with each individual land use type (POS, TRA, LIN, HIN, or RES).

AreaPercentSummary tab

This tab in the runoff summary spreadsheet presents the percent impervious statistics for each Area/Subarea, broken down by generalized land use. As percent impervious was not varied through time, the values are the result of the impervious areas shown in Figure 6 accumulated for each Area/Subarea combination. A sample of data from this summary is shown in Table 8.

Table 8: Sample of summary data from AreaPercentSummarytab

AREA	SubArea	IMP_AVG	POS_AVG	TRA_AVG	LIN_AVG	HIN_AVG	RES_AVG
FT01		28.5%	41.7%	8.4%	8.2%	0.4%	41.4%
FT03		81.5%	4.4%	22.6%	38.1%	6.0%	28.9%
FT04		75.9%	0.0%	0.0%	11.6%	59.7%	28.7%
FT06		46.1%	20.8%	5.1%	3.0%	61.2%	10.0%
FT07		91.7%	0.0%	0.0%	0.0%	100.0%	0.0%
FT07	WR-4	84.8%	0.0%	0.0%	0.0%	100.0%	0.0%

The field IMP_AVG is the average percent impervious value for the entire area, while all the other percent fields shown are the percent of the total impervious area contained in that Area/SubArea combination. In the example shown, Area FT01 shows a total percent imperviousness for 28.5 percent, while 8.2% of the total area is composed of land designated with the major transportation (TRA) zoning code. Industrial lands make up 0.4 percent of the total area in Area FT01. Area FT07 shows a total of 91.7 overall percent imperviousness, of which 100 percent of that area is heavy industrial (HIN). In contrast, the portion of that portion of Area FT07 which lies within Unique Site WR-4 has an overall percent imperviousness of 84.8 percent, which is also comprised of 100 percent heavy industrial (HIN) zoned land.

Assumptions and Limitations of Analysis

Every effort was made to include the best available information for this runoff analysis, and though the GRID model breaks the study area up into many hundreds of thousands of discrete areas, the analysis

methods are still quite simplified. Some of the limitations of the GRID model analysis methods used here are:

- Rainfall abstractions are only accounted for with the simplified runoff coefficient discussed previously.
- No calibration was done for this modeling effort.
- There are known dropouts in the rainfall records and the next nearest available rain gages were used in their place where needed. The method used to estimate rainfall (virtual rain gages) compensated for these missing data by interpolating rainfall from available rain gage data, as described in the rainfall analysis section.
- Land use zoning was used to estimate actual land use. While the zoning is the comprehensive information available to estimate land use, actual land use may vary in some areas. The overlay of current vacant land in Forest Park and other undeveloped areas was used to make the zoning layer more accurate.
- Impervious area was based on existing GIS information which has not been checked at the tax lot scale. It was deemed that for the scale of segment drainage areas, the accuracy of this layer was sufficient but because the Unique Sites are a smaller scale, these areas were reviewed and corrected at the tax lot scale.
- Land use and impervious area GIS layers used to estimate runoff contributions are based on current conditions. Land use and impervious area changes would not be expected to be significantly different over the modeled time periods at the scale of the segment drainage areas but may be significant at the Unique Site scale. Therefore, it should be assumed that there is more uncertainty in runoff estimates at the Unique Sites over time.

References

Bureau of Environmental Services, June 2004. *Generalized documentation of the BES Simplified Watershed Yield Model (SWYM) – alias BES GRID Model*Oregon.

Bureau of Environmental Services, June 2007. *Sewer and Drainage Facilities Design Manual.*

Bureau of Environmental Services, Oct. 2006. *Various TSS analyses and comparisons - Portland Harbor and Willamette mainstem.* Technical Memorandum

LWG, May 2008. *Stormwater Loading Calculations Methods.* Prepared by Anchor Environmental.

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REMEDIAL INVESTIGATION REPORT

APPENDIX E, ATTACHMENT E-3
DATA TABLE OF UPLAND SOILS CHEMISTRY (ON CD)

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REMEDIAL INVESTIGATION REPORT

APPENDIX F
BASELINE ECOLOGICAL RISK ASSESSMENT (ON CD)

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REMEDIAL INVESTIGATION REPORT

APPENDIX G
BASELINE HUMAN HEALTH RISK ASSESSMENT (ON CD)

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