# SCREENING AND BASELINE ECOLOGICAL RISK ASSESSMENT
# DUCK AND OTTER CREEKS
# TOLEDO AND OREGON, OHIO

**Prepared for**

**Partners for Clean Streams, Inc.**

**P.O. Box 822**

**Bowling Green, Ohio 43402**

**Prepared by**


**Tetra Tech EM Inc.**

**1 South Wacker Drive, 37th Floor**

**Chicago, Illinois  60606**


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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AOC | Area of concern |
| AVS/SEM | Acid volatile sulfides and simultaneously extractable metals |
| BERA | Baseline Ecological Risk Assessment |
| BSAF | Biota-sediment accumulation factor |
| Bss | Below sediment surface |
| BTAG | U.S. EPA Region 9 Biological Technical Assistance Group |
| BUI | Beneficial use impairments |
| COPEC | Chemicals of potential ecological concern |
| CSM | Conceptual site model |
| DDD | Dichlorodiphenyldichloroethane |
| DDE | Dichlorodiphenyldichloroethene |
| DDT | Dichlorodiphenyltrichloroethane |
| Eco-SSL | EPA's Eco-Soil Screening Level |
| ESL | EPA Region 5 Ecological Screening Levels |
| EPA | U.S. Environmental Protection Agency |
| EPC | Exposure point concentration |
| ERA | Ecological risk assessment |
| FCM | Food chain model |
| HQ | Hazard quotient |
| Kg | Kilogram |
| LOAEL | Lowest observed adverse effect levels |
| MAOC | Maumee River Area of Concern |
| mg/kg | Milligrams per kilogram |
| mg/L | Milligrams per liter |
| NOAEL | No observed adverse effects level |
| OEPA | Ohio Environmental Protection Agency |
| OSWER | Office of Solid Waste and Emergency Response |
| PAH | Polynuclear aromatic hydrocarbons |
| Partnership | The Duck and Otter Creek Partnership, Inc. |
| PCB | Polychlorinated biphenyl |
| RAGS | Risk Assessment Guidance for Superfund |
| SLERA | Screening level ecological risk assessment |
| TEC | Threshold effect concentrations |
| Tetra Tech | Tetra Tech EM Inc. |
| TM | Technical memorandum |
| TOC | Total organic carbon |
| TRV | Toxicity reference value |
| UCL | Upper confidence limit |
| USACE | U.S. Army Corps of Engineers |

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## EXECUTIVE SUMMARY

The Duck and Otter Creeks watershed in the Maumee River Area of Concern has been an urban and industrial hub on Lake Erie for over 100 years. As a result, the health of both creeks has been impacted over time. Historical impacts on the creeks have included major habitat modifications and degradation of water and sediment quality. A sediment quality assessment of Duck and Otter Creeks was completed in 1999, and the assessment report identified the potential for sediment toxicity and bioaccumulation-related risks (that is, risks related to contaminant concentrations building up in receptor tissues) to ecological receptors.

The Duck and Otter Creeks Partnership, Inc. (Partnership) has implemented a two-phase human health and ecological risk assessment study for Duck and Otter Creeks. The overall purpose of the study is "to determine whether sediment contaminants pose a significant risk to human health or the environment, and if so, to identify specific chemicals contributing to toxicity and define the spatial extent [where risks are located] of risks [to human and ecological receptors]." This document presents the results of the Tier 1 screening level ecological risk assessment (SLERA) for benthic receptors directly exposed to sediment and fish exposed to surface waters, and a Tier 2 Baseline Ecological Risk Assessment (BERA) for benthic macroinvertebrates and mammalian and avian receptors exposed indirectly to sediments in Duck and Otter Creeks.

This Tier 1 SLERA and Tier 2 BERA were conducted in accordance with the guidance for ecological risk assessments (ERA) from the Ohio Environmental Protection Agency (OEPA) (OEPA 2003a) and U.S. Environmental Protection Agency (EPA) (EPA 1997, 2001) to support decisions to be made under the Great Lakes Legacy Act. The assessment focuses primarily on the evaluation of potential impacts due to sediment contamination. It also includes a limited evaluation of the potential impacts of surface water exposure. The purpose of the BERA is to evaluate the chemicals of potential ecological concern (COPEC) identified during the SLERA using more realistic site-specific parameters and additional site-specific information.

This document was developed through a voluntary, non-regulatory process with input from many stakeholders, including state and federal government partners, businesses, industries and citizens in the watersheds. It was intended specifically for use with the EPA Great Lakes National Program Office's Great Lakes Legacy Act funding program (a voluntary program), and as such, while it follows standard guidance and protocol, it is focused on providing information necessary to allow stakeholders to determine if the creeks would benefit from or be eligible for Great Lakes Legacy Act funding. The document is intended to be used as only one part of a comprehensive assessment of the conditions and impacts to Duck and Otter Creeks. The previous reports and data sets referenced herein as well as stakeholder input should be reviewed in conjunction with this document in making decisions on any future sampling or remedial alternatives.

**Tier 1 SLERA Results**

To identify the COPECs, frequency of detection were reviewed and only compounds detected in five percent of the samples were used in the risk assessment. The following contaminants were identified as COPECs for Duck and Otter Creeks:

- Metals – Arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, selenium, and zinc
- Pesticides – Dichlorodiphenyltrichloroethane (DDT) and its metabolites, and heptachlor and its metabolites
- Polychlorinated biphenyls – Total PCBs (Aroclor 1254 and 1260).
- Polynuclear Aromatic Hydrocarbons (PAH) – 2-methlynaphthalene, acenaphthene, acenaphthlyene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perlyene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene, C1-chrysene/benzo(a)anthracene, C1-fluorenes, C1-fluoranthenes/pyrenes, C1-naphthalenes, C1-phenanthrenes/anthracenes, C2-chrysene/benzo(a)anthracene, C2-fluorenes, C2-naphthalenes, C2-phenanthrenes/anthracenes, C3-chrysene/benzo(a)anthracene, C3-fluorenes, C3-naphthalenes, C3-phenanthrenes/anthracenes, C4-chrysene/benzo(a)anthracene, C4-naphthalenes, and C4-phenanthrenes/anthracenes.

The assessment endpoints represent aspects of the ecosystem that need to be protected. Assessment endpoints for Duck and Otter Creeks are:

- Protection of benthic community
- Protection of bottom-dwelling fish community
- Protection of piscivore avian community
- Protection of piscivore mammalian community.

Measures of effect more closely reflect technical considerations in the risk assessment process; that is, measures of effect focus on both direct measures of ecological effects such as toxicity tests and indirect measures such as food-chain exposure modeling that allow for an evaluation of risk to representative receptors. The measures of effect for the Duck and Otter Creeks are:

Benthic community – Ohio EPA Specific Sediment Reference Values (OEPA 2003a) for the Huron/Erie Lake Plain were used for all metal constituents in the sediment. For pesticides and PCBs, consensus threshold effects values were used from McDonald, Ingersoll, and Berger (2000). For PAHs, sediment quality guidelines were derived following EPA guidance for PAH mixtures; these values are adjusted for site-specific total organic carbon (TOC) values (EPA 1993a and 2003). The sediment reference values and sediment quality guidelines were used to evaluate potential risk.

Fish community – Available water quality data for each creek were compared to Ohio water quality standards to assess direct impacts to fish.

Bottom-dwelling Fish community – The sediment PAH concentration was compared to values associated with deformities, eroded fins, lesions, and tumors (DELT anomalies) to assess the potential impacts to bottom dwelling fish.

To assess the potential risks to these populations, the ERA used several methods. The first compared the sediment concentrations to OEPA, EPA, and literature-developed sediment criteria. The total PAH concentrations were compared to criteria for formation of lesions in bottom-dwelling fish. On selected sediment samples from Duck and Otter Creeks, 20-day survival and growth sediment bioassays with an invertebrate midge were conducted. In addition, a food chain model (FCM) was used to estimate potential exposures to piscivorous birds and mammals. These groups were represented by the belted kingfisher and mink. To assist the risk managers and to aid in the evaluation, Duck and Otter Creeks were each divided into five equal segments or exposure areas, and exposures were estimated for each exposure area. Tables ES-1 and ES-2 summarize the identified risk associated with each exposure area of Duck Creek and Otter Creek in sediments, respectively.

**TABLE ES-1**
**SUMMARY OF POTENTIAL RISKS –**
**DUCK CREEK SEDIMENTS**

| Duck Creek Exposure Area | Benthic Aquatic Life – Probable Effect/Severe | Chemicals of Concern | Benthic Aquatic Life – Chronic | Chemicals of Concern | Lesion for Bottom-Dwelling Fish | Bioassay Percent Survival Less than Controls |
|---|---|---|---|---|---|---|
| A | Yes HQ < 4.0 | **Arsenic**, Cadmium, Lead, Zinc | Yes HQ < 12 | **Arsenic**, Cadmium, Lead, Mercury, Selenium, Zinc, 4,4'-DDD, 4,4'-DDE | Yes HQ < 193 | 2 out of 3 stations |
| B | Yes HQ < 3.8 | **Arsenic**, Lead, Zinc, Total PAH Mixture | Yes HQ < 12 | **Arsenic**, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Zinc, 4,4'-DDD, 4,4'-DDE | Yes HQ < 26 | 1 out of 2 stations |
| C | Yes HQ < 2.5 | Arsenic, **Lead**, Zinc | Yes HQ < 7.8 | Arsenic, Barium, Cadmium, Chromium, **Lead**, Mercury, Zinc, 4.4'-DDD, 4,4'-DDE | Yes HQ < 20 | 2 out of 2 stations |
| D | Yes HQ < 7.3 | Arsenic, Cadmium, Chromium, **Lead**, Mercury, Zinc, Total PAH Mixture | Yes HQ < 57 | Arsenic, Barium, Cadmium, Chromium, Lead, **Mercury**, Selenium, Zinc, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT | Yes HQ < 91 | 0 out of 2 stations |
| E | Yes HQ < 143 | Arsenic, Chromium, Lead, Zinc, Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorine, Indeno(1,2,3-cd)pyrene, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes HQ < 27 | Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Zinc, 4,4'-DDD, 4,4'-DDE, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(k)fluoranthene, Chrysene, Fluoranthene, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes HQ < 1,349 | 0 out of 2 stations |

Notes:
The maximum HQ among multiple chemicals is presented, and the chemical with the highest HQ is bolded.

DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
DDT Dichlorodiphenyltrichloroethane
HQ Hazard Quotient
PAH Polynuclear aromatic hydrocarbons

**TABLE ES-2**
**SUMMARY OF POTENTIAL RISKS –**
**OTTER CREEK SEDIMENTS**

| Otter Creek Exposure Area | Benthic Aquatic Life – Probable Effect/ Severe | Chemicals of Concern | Benthic Aquatic Life – Chronic | Chemicals of Concern | Lesion for Bottom-Dwelling Fish | Bioassay Percent Survival Less than Controls |
|---|---|---|---|---|---|---|
| A | Yes, HQ < 3.3 | Arsenic, **Chromium**, Lead, Zinc, Total PAH Mixture | Yes, HQ < 7.2 | Arsenic, Barium, Cadmium, **Chromium**, Lead, Mercury, Zinc | Yes HQ < 27 | 3 out of 4 stations |
| B | Yes, HQ < 15 | Arsenic, Chromium, Lead, Zinc, Benzo(a)anthracene, Benzo(b)fluoranthene, Chrysene, Fluoranthene, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes, HQ < 6.5 | Arsenic, Barium, Cadmium, Chromium, **Lead**, Mercury, Zinc, Total PAH Mixture | Yes HQ < 174 | 2 out of 2 stations |
| C | Yes HQ < 10 | Arsenic, Chromium, Lead, Zinc, Total PCBs, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes HQ < 6.5 | Arsenic, Barium, Cadmium, Chromium, **Lead**, Mercury, Selenium, Zinc, Total PCBs, Total PAH Mixture | Yes HQ < 87 | 2 out of 2 stations |
| D | Yes HQ < 50 | Arsenic, Cadmium, Lead, Zinc, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Phenanthrene,Pyrene, **Total PAH Mixture** | Yes HQ < 9.4 | Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Zinc, 4,4'-DDD, 4,4'-DDE, Fluoranthene, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes HQ < 402 | 2 out of 2 stations |
| E | Yes HQ < 35 | Arsenic, Lead, Zinc, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes HQ < 7.4 | Arsenic, Barium, Cadmium, Chromium, **Lead**, Mercury, Zinc, 4,4'-DDD, 4,4'-DDE, Total PCBs, Fluoranthene, Pyrene, Total PAH Mixture | Yes HQ < 401 | 2 out of 2 stations |

Notes:
The maximum HQ among multiple chemicals is presented, and the chemical with the highest HQ is bolded.

DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
HQ Hazard Quotient
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl

Duck Creek Exposure Area E exhibited the highest risk for all the methods used to assess potential exposures. This area was followed by Exposure Area D, with Exposure Areas A, B, and C exhibiting the lowest risks. The mink appeared to be the least sensitive receptor of those evaluated. The bioassay results were not consistent with the HQ values from the chemical concentrations in the sediment. The bioassay results were evaluated with potential stressors; however, no significant statistical relationship was identified to explain the observed toxicity.

Otter Creek Exposure Area D exhibited the highest risk for all the methods used to assess potential exposures. This area was followed by Exposure Area E, with Exposure Areas A, B, and C exhibiting the lowest risks. The bioassay results were a little more consistent with the HQ values from the chemical concentrations in the sediment. However, when the bioassay results were evaluated with potential stressors no significant statistical relationship was identified to explain the observed toxicity.

Historical surface water data from both creeks were reviewed to identify the maximum surface water concentration from each creek. This value was compared to the OEPA water quality standard for chronic exposure by aquatic life or EPA Region 5 Ecological Screening Levels (ESL). The comparison noted several chemicals with maximum concentrations exceeding the screening values. For Duck Creek, these chemicals include barium and vanadium. For Otter Creek, these chemicals include ammonia, cadmium, copper, cyanide, lead, mercury, and selenium.

**BERA Results**

The assessment endpoints discussed for the SLERA are the same for the BERA with one exception. Because the main objective of this risk assessment is to assist in the decision on whether Duck and Otter Creeks may qualify for funding support under the Great Lakes Legacy Act, the BERA focused on the potential risks identified with the sediments in Duck and Otter Creeks. The revised endpoints for the BERA are

- Protection of benthic community – including aquatic insects and fish
- Protection of piscivore avian community
- Protection of piscivore mammalian community.

For the BERA, the following measures were used to assess potential risks to the aquatic and related communities in and adjacent to Duck and Otter Creeks:

Benthic community – Sediment bioassays using *Chironomous tentans* were conducted with sediment samples from various portions of both creeks. These data were evaluated to determine the extent of toxicity expressed at each location. In addition, the acid volatile sulfide/simultaneously extracted metals (AVS/SEM) data were evaluated to assess the role metals in the sediments may be playing in the observed toxicity. Also, the sediment PAH concentrations and grain size analysis results were compared to the observed toxicity to determine if there is a relationship between toxicity and these parameters.

Piscivorous avian community – An FCM was used to estimate receptor doses and compare doses to appropriate toxicity reference values (TRV). A low TRV (based on no adverse effect levels) and high TRV (based on lowest adverse effect level) were used to assess potential risks to avian receptors. These TRVs represent no toxicity expected and likely toxicity expected.

The sediments are assumed sources of contaminants that will impact invertebrate and fish tissue through bioaccumulation. Due to the limited availability of high-quality, site-specific fish or invertebrate tissue concentrations, tissue concentrations need to be estimated. Biota-sediment accumulation factors (BSAF) were used to estimate tissue concentrations for fish and invertebrates. These data were used to support the food chain model for the piscivorous avian.

Piscivorous mammalian community – A food chain model was used to estimate receptor doses and compare doses to appropriate toxicity reference values.

To evaluate the available data to determine if a specific stressor or groups of stressors may be causing the observed toxicity in the bioassay tests in samples from both Duck and Otter Creeks, the available data on the chemical constituents were reviewed to identify any patterns or relationships. The AVS/SEM results as reported by the laboratory showed that the ratio of SEM to AVS in all samples tested was less than 1 for all relevant metals tested. This ratio indicates a high probability that most of the metals in the sediments may be bound to sulfides and so are not bioavailable (DiToro and other 2005).

To evaluate the potential impacts of PAHs, EPA protocols (EPA 2003) were followed to calculate toxicity units for the sediment samples – an exceedence of 1 indicates potential sediment toxicity due to the PAH compounds present. The toxicity testing results for a number of samples indicated reduced survival but toxicity units summed to less than 1, while other results indicated survival similar to the controls but the toxicity units predicted significant toxicity. This comparison did not indicate an obvious relationship. The next step in the BERA was to identify a number of potential stressors and to statistically evaluate the data to determine if they themselves or in combination with other stressors appeared a potential indicator of toxicity. The bivariate correlation did not identify any significant correlation. Neither did the correlation matrix and pairwise correlations. The step-wise regression also did not identify any likely combination of stressors that can explain the observed toxicity. Although the final step in the regression accounted for about 73 percent of the observed toxicity, often an evaluation involving a high number of stressors randomly accounts for the observed response.

A FCM was used to estimate potential exposures to piscivorous birds and mammals. These groups were represented by the belted kingfisher and mink. Table ES-3 summarizes the identified risk associated with each receptor of the Duck Creek via exposure to fish and invertebrate tissue and sediments. Lead, mercury, selenium, and zinc are the contaminants that have the greatest impact on the belted kingfisher for Duck Creek. Selenium is the contaminant that has the greatest impact on the mink for Duck Creek. The FCM model relied on estimated fish tissue and invertebrate tissue to estimate exposures and potential risks. Table ES-4 summarizes the identified risk associated with each receptor of the Otter Creek via exposure to fish and invertebrate tissue and sediments. Selenium, zinc, and total PCBs are the contaminants that have the greatest impact on the belted kingfisher for Otter Creek. Total PCBs is the contaminant that has the greatest impact on the mink for Otter Creek.

**TABLE ES-3**
**SUMMARY OF POTENTIAL RISKS –**
**DUCK CREEK BELTED KINGFISHER AND MINK**

| DUCK CREEK EXPOSURE AREA | Food Chain Model – Belted Kingfisher | Chemicals of Concern | Food Chain Model – Mink | Chemicals of Concern |
|---|---|---|---|---|
| A | Yes, Low TRV HQ<19 and High TRV HQ<6.0 | Low TRV – Arsenic, Chromium, Lead, Mercury, **Selenium**, Zinc, Total PCBs, High TRV – **Selenium**, Zinc | Yes, Low TRV HQ<11 and High TRV HQ<1.9 | Low TRV – **Arsenic**, Lead, Selenium, High TRV - **Selenium** |
| B | Yes, Low TRV HQ<17 and High TRV HQ<5.3 | Low TRV – Arsenic, Chromium, Lead, **Selenium**, Zinc, 4,4'-DDE, High TRV – **Selenium** | Yes, Low TRV HQ<7.5 and High TRV HQ<1.5 | Low TRV – **Arsenic**, Selenium, High TRV - **Selenium** |
| C | Yes, Low TRV HQ<7.0 | Low TRV – Arsenic, **Lead** | Yes, Low TRV HQ<2.5 | Low TRV – **Arsenic** |
| D | Yes, Low TRV HQ<55 and High TRV HQ<17 | Low TRV – Arsenic, Cadmium, Chromium, Lead, Mercury, **Selenium**, Zinc, 4'4-DDE, High TRV – Lead, Mercury, **Selenium**, Zinc | Yes, Low TRV HQ<23 and High TRV HQ<4.9 | Low TRV – Arsenic, Barium, Lead, **Selenium**, 4,4'-DDE, High TRV - **Selenium** |
| E | Yes, Low TRV HQ<1.7 | Low TRV –**Selenium**, Total PCBs | Yes, Low TRV HQ<7.1 | Low TRV – **High molecular weight PAHs** |

Notes:
The maximum HQ among multiple chemicals is presented, and the chemical with the highest HQ is bolded.

DDE Dichlorodiphenyldichloroethene
HQ Hazard Quotient
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl
TRV Toxicity reference value

**TABLE ES-4**
**SUMMARY OF POTENTIAL RISKS –**
**OTTER CREEK BELTED KINGFISHER AND MINK**

| **OTTER CREEK EXPOSURE AREA** | **Food Chain Model – Belted Kingfisher** | **Chemicals of Concern** | **Food Chain Model – Mink** | **Chemicals of Concern** |
|---|---|---|---|---|
| A | Yes, Low TRV HQ<11 and High TRV HQ<1.1 | Low TRV – Arsenic, Chromium, **Lead**, Mercury, Zinc, Total PCBs, High TRV - **Zinc** | Yes, Low TRV HQ<3.9 | Low TRV – **Arsenic**, Chromium, Lead |
| B | Yes, Low TRV HQ<11 and High TRV HQ<1.2 | Low TRV – Arsenic, Chromium, **Lead**, Zinc, Total PCBs, High TRV - **Zinc** | Yes, Low TRV HQ<16 | Low TRV – **Arsenic**, High molecular weight PAHs |
| C | Yes, Low TRV HQ<170 and High TRV HQ<12 | Low TRV – Arsenic, Chromium, Lead, Mercury, Selenium, Zinc, **Total PCBs**, High TRV – Selenium, **Total PCBs** | Yes, Low TRV HQ<14 and High TRV HQ<3.8 | Low TRV – Arsenic, Chromium, Lead, Selenium, **Total PCBs**, High molecular weight PAHs, High TRV –**Total PCBs** |
| D | Yes, Low TRV HQ<12 and High TRV HQ<1.1 | Low TRV – Arsenic, Chromium, **Lead**, Zinc, and Total PCBs, High TRV - **Zinc** | Yes, Low TRV HQ<9.5 | Low TRV – Arsenic, **High molecular weight PAHs** |
| E | Yes, Low TRV HQ<30 and High TRV HQ<2.1 | Low TRV – Arsenic, Chromium, Lead, Zinc, **Total PCBs**, High TRV – **Total PCBs** | Yes, Low TRV HQ<7.9 | Low TRV – Arsenic, Lead, Total PCBs, **High molecular weight PAHs** |

Notes:
The maximum HQ among multiple chemicals is presented, and the chemical with the highest HQ is bolded.

HQ Hazard Quotient
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl
TRV Toxicity reference value

## Conclusions

The results of the SLERA and BERA noted potential impacts to benthic invertebrates and terrestrial receptors through the bioassay results and the comparison of sediment concentrations to available sediment criteria.  These results are consistent with the previous studies that have identified a stressed ecological system within both Duck and Otter Creeks.

For Duck Creek, the comparison of the sediment concentrations to sediment screening values showed concentrations above those values in all exposure areas.  The bioassay results showed percent survival statistical differences in samples from Exposure Areas A, B, and C.  The Duck Creek FCM results for both the kingfisher and mink consistently identified Exposure Area D as the area with the greatest potential impact to these receptors – it had the highest HQs and the most constituents of concern; the second area of most concern noted from these results is Exposure Area A.

For Otter Creek, the comparison of the sediment concentrations to sediment screening values also showed concentrations above those values in all exposure areas.  The bioassay results showed percent survival statistical differences in samples from all exposure areas.  The Otter Creek FCM results for both the kingfisher and mink consistently identified Exposure Area C of Otter Creek as the area with the greatest potential impact to these receptors – it had the highest HQs and the most constituents of concern; the second area of most concern noted from these results is Exposure Area A.

# 1.0 INTRODUCTION

This document presents the results of the Tier 1 screening level ecological risk assessment (SLERA) for benthic receptors directly exposed to sediment and fish exposed to surface waters, and a Tier 2 Baseline Ecological Risk Assessment (BERA) for benthic macroinvertebrates and mammalian and avian receptors exposed indirectly to sediments in Duck and Otter Creeks, which are part of the Maumee River Area of Concern (MAOC), Toledo and Oregon, Ohio. This Tier 1 SLERA and Tier 2 BERA were conducted in accordance with the guidance for ecological risk assessments (ERA) from the Ohio Environmental Protection Agency (OEPA) (OEPA 2003a) and U.S. Environmental Protection Agency (EPA) (EPA 1997, 2001) to support decisions to be made under the Great Lakes Legacy Act. The assessment focuses primarily on the evaluation of potential impacts due to sediment contamination. It also includes a limited evaluation of the potential impacts of surface water exposure.

This document was developed through a voluntary, non-regulatory process with input from many stakeholders, including state and federal government partners, businesses, industries and citizens in the watersheds. It was intended specifically for use with the EPA Great Lakes National Program Office's Great Lakes Legacy Act funding program (a voluntary program), and as such, while it follows standard guidance and protocol, it is focused on providing information necessary to allow stakeholders to determine if the creeks would benefit from or be eligible for Great Lakes Legacy Act funding. The document is intended to be used as only one part of a comprehensive assessment of the conditions and impacts to Duck and Otter Creeks. The previous reports and data sets referenced herein as well as stakeholder input should be reviewed in conjunction with this document in making decisions on any future sampling or remedial alternatives.

The organization of this document is as follows:

- Remainder of Section 1.0: Overview of general approach of the ecological risk assessment for the Tier 1 Evaluation, and Tier 2 BERA.
- Section 2.0: Tier 1 SLERA Step 1: Problem Formulation and Exposure Pathway Evaluation. This section presents the site location and history, describes the environmental setting, identifies the chemicals of potential ecological concern (COPEC), and presents the conceptual site model (CSM) for Duck and Otter Creeks.
- Section 3.0: Tier 1 SLERA Step 2: Exposure Estimation and Risk Characterization Methods. This section presents the procedures to characterize the risks to benthic

ecological receptors at each exposure area of Duck and Otter Creeks. The results of this screening assessment are also presented.

- Section 4.0: Tier 2 BERA Step 3: Exposure Estimation and Risk Characterization Methods. Using a food chain model (FCM), this section presents the procedures to characterize the risks to the avian and mammalian receptors at each exposure area of Duck and Otter Creeks. This section presents the risk characterization results based on the bioassay results, chemical analysis, and the FCM assessment for each exposure area of Duck and Otter Creeks.
- Section 5.0: Uncertainty Analysis. This section presents an uncertainty analysis for the screening methods, bioassay results, and FCM methods; and potential impacts on the risk assessment results.
- Section 6.0: Conclusions. This section presents the conclusions of the ERA for each exposure area of Duck and Otter Creeks.
- Section 7.0: References. This section lists the documents used to prepare this ERA.

Figures are provided at the end of the text. Appendices are as follows:

- Appendix A contains the results of the statistical analysis of the sediment data.
- Appendix B contains the comparison of COPEC concentrations with benthic organism benchmarks.
- Appendix C contains the calculations of the hazard quotients (HQ) using the screening criteria for lesions for bottom-dwelling fish.
- Appendix D contains the bioassay results
- Appendix E contains procedures and general assumptions used in the FCM, and the calculations of the FCM for the avian and mammalian receptors using modeled tissue data.

## 1.1 TIER 1 EVALUATION

The first step in the Tier 1 evaluation is designed to help answer the question, “Are pathways present that link site contaminants to ecological receptors?” This step includes the following information:

- Environmental Setting and Ecological Characterization
- Identification of Preliminary COPECs
- Preliminary CSM
  - Stressors
  - Fate and Transport
  - Exposure Pathways
  - Preliminary Assessment and Measure of Effects.

The CSM is defined as "a written description and visual representation of the known, expected, and/or predicted relationships between the site COPECs and the ecological receptors" (EPA 1997). The identification of potentially complete exposure pathways involves an evaluation of the preliminary CSM to identify COPECs that fate and transport mechanisms and exposure routes indicate are likely to move from a source to one or more receptors.

The next step is designed to help answer the question, "Are risks to ecological receptors present at the site?" The following information is included in Step 2:

- Risk Characterization
- Uncertainty and Data Gaps Analysis.

Risks are estimated by comparing chemical concentrations directly with media-based threshold screening values. No unacceptable risks are expected where results are below the threshold values, based on no adverse effect levels. Potentially unacceptable risks are indicated for chemicals that occur at concentrations that exceed the threshold values.

## 1.2 TIER 2 BASELINE ECOLOGICAL RISK ASSESSMENT

The purpose of the BERA is to evaluate the COPECs identified during Tier 1 using more realistic site-specific parameters and additional site-specific information. The Step 3 evaluation incorporates one or more of the following steps:

- Use of site-specific information and less conservative receptor-specific assumptions such as the 95 percent upper confidence limit (95 UCL) on the arithmetic mean or arithmetic mean rather than the maximum concentration, and re-calculation of risks
- Assessment of the magnitude and frequency at which chemicals are detected
- Consideration of chemical bioavailability and the assimilation efficiency of COPECs
- Evaluation of site-specific toxicity using sediment bioassays.

If the Step 3 evaluation supports a determination of acceptable risk, no further action is warranted and the site exits the ERA process. If Step 3 supports the prediction of unacceptable risk, either the BERA process for the site continues with collection of additional site-specific information or risk management is initiated.

## 2.0 TIER 1 SLERA STEP 1: PROBLEM FORMULATION AND EXPOSURE PATHWAY EVALUATION

This section describes the problem formulation for Duck and Otter Creeks, including a brief description of the environmental setting, previous ecological investigations, ecological characterization, and CSM. The CSM describes known and potential stressors, evaluates potential exposure pathways, discusses chemical fate and transport, and identifies preliminary assessment and measure of effects. Problem formulation and exposure evaluation correspond to Step 1 of the SLERA process, as described in federal guidance (EPA 1997).

### 2.1 ENVIRONMENTAL SETTING

Duck and Otter Creeks are two small streams within the MAOC, and both are affected by point source and non-point source pollution. The creeks are located in the Toledo, Ohio metropolitan area. Otter Creek is 7 miles long, and Duck Creek is 4 miles long (Figure 1). Otter Creek flows northeasterly through portions of Toledo and Oregon, Ohio, and then empties into south Maumee Bay. Duck Creek lies west of Otter Creek and enters the mouth of the Maumee River, which empties into Maumee Bay.

The MAOC is identified as the area extending from the Bowling Green water intake at river mile 22.8 of the Maumee River, downstream to Maumee Bay, including the entire bay and nearshore waters from the Michigan state line to Crane Creek State Park in Ohio. This area includes Swan Creek, the Ottawa River (Ten Mile Creek), Duck Creek, Otter Creek, Cedar Creek, Grassy Creek, and Crane Creek.

The habitat and water quality of the MAOC have changed dramatically during the past century. The Maumee Bay watershed was once known as the Great Black Swamp, and the bay itself was considered the most prolific spawning ground in Lake Erie. Duck and Otter Creeks are comparatively small, but they have been the focus of attention on chemical contamination because their watersheds are dominated by urban and industrial development.

The Duck and Otter Creeks watershed within the MAOC has been an urban and industrial hub on Lake Erie for more than 100 years. As a result, the health of both creeks has been impaired over time. Historical impacts on the creeks have included major habitat modifications, such as rerouting and channeling the streams, and degradation of water and sediment quality. Despite significant improvements in the water quality of the creeks, contamination of sediment and surface water remains a concern. The contamination is both historical, from deposition of contaminants in the sediment as well as on-going, from point and non-point discharges.

Both creeks flow through heavily industrialized and commercial areas. In particular, the downstream-most mile of each creek passes through heavily industrialized and relatively isolated areas. Portions of Duck and Otter Creeks also flow through residential areas, and some yards open directly onto the creeks. The creeks also pass close to school yards, and Duck Creek flows through the Collins Golf Course.

The International Joint Commission determines the listing and delisting of an area of concern (AOC) based upon impairment of 14 identified beneficial uses. In 2001, the Maumee River Remedial Action Plan (RAP) determined that Duck and Otter Creeks' six of the 14 beneficial uses were "impaired." The following beneficial use impairments (BUI) are directly related to sediment and upland contamination in Duck and Otter Creeks:

- Restrictions on Fish and Wildlife Consumption (BUI #1)
- Degradation of Fish and Wildlife Populations (BUI # 3)
- Fish Tumors and Other Deformities (BUI # 4)
- Degradation of Benthos (BUI #6)
- Degradation of Aesthetics (BUI #11)
- Loss of Fish and Wildlife Habitat (BUI # 14)

## 2.2 PREVIOUS ECOLOGICAL INVESTIGATIONS

Many previous investigations at Duck and Otter Creeks have been conducted by the Ohio Environmental Protection Agency (OEPA). The OEPA studies are typically part of an evaluation of the MAOC and include overall stream quality (OEPA 1994 and 1998, 1992 to 1998, and 1995; AScI Corporation [AScI] 1997) and stream quality in the vicinity of specific disposal or industrial operations along Duck and Otter Creeks (OEPA 1997a, b, c; 1998). Secondary data are also available as a result of the following activities:

- Investigations of industrial operations along Duck and Otter Creeks (PTRL 1997a and 1997b; ENVIRON International Corporation [ENVIRON] and Mannik & Smith Group, Inc. [Mannik & Smith] 2003)

- Spill reports prepared by the City of Oregon (City of Oregon 2003; 2004a, b; 2005a, b, c)

- Investigation of a release from the City of Toledo wastewater treatment plant lime sludge ponds (City of Toledo 1988)

- Investigations of Hecklinger Pond (BEC Laboratories, Inc. [BEC] 1998, 2003, and 2004; Environmental Testing and Certification Corporation [ETC] 1989; OEPA 2003b; Toledo Testing Laboratory, Inc. [TTL] 1988; City of Toledo 1989a, b, and 1991; and Wright State University [WSU] 1991)

Previous results for sediment are briefly described below.

Sediment in Duck and Otter Creeks has been sampled at a number of locations over the past 15 years. As noted above, much of the available data are from studies or sampling efforts conducted by OEPA as part of an evaluation of the MAOC. Additional analytical data have been generated through (1) investigations of industrial operations along Duck and Otter Creeks, (2) preparation of reports on spills and releases, and (3) investigations of potential polychlorinated biphenyl (PCB) contamination in fish in Hecklinger Pond (located at the head of Duck Creek). There are two general concerns about the past investigations that provide context for this study. First, analytes and sampling locations vary, from study to study. Second, portions of the watershed — especially the southern two-thirds of Otter Creek — have been sampled only a limited number of times and have not been sampled and analyzed at all since 1994, more than 10 years ago.

Another concern is associated with some of the data collected under the Phase III – 1997 OEPA sampling program in Otter Creek. Sediment samples collected from the interface between surface water and sediment, the biologically active zone, are very useful to this evaluation. However, data collected at depths of several feet below the surface water interface (OEPA 1992 to 1998) are of limited value for assessing current risks, but would be helpful in assessing potential future exposure if sediment were to be removed as part of a rehabilitation or remediation program. Once the upper sediments are removed, deeper sediments would be exposed to receptor contact, and these risks would need to be evaluated.

The data collected in 2002 are likely the most accurate representation of sediment conditions; however, these data are from only a limited portion of Otter Creek. Thus, the sediment data available for Duck and Otter Creeks do not provide a complete understanding of current sediment conditions.

OEPA has conducted several biological surveys of the creeks to describe the aquatic communities and assess the health or biological integrity of these communities (OEPA 1986, 1993, and 1997). The results indicate that the creeks are highly stressed and do not support a strong and diverse biological community. The OEPA ratings for the creeks ranged from “very poor” to “poor” at most locations, with a few isolated locations having “marginally good” to “good” ratings. The latest OEPA survey was conducted in 1997.

Bulk sediment toxicity tests conducted on samples collected from Otter Creek in 1994 using an amphipod (*Hyalella azteca*) revealed a progressive decline in sediment quality downstream (north) of Wales Road (OEPA 1994 and 1998, 1995).

The sediment quality assessment report (ChemRisk 1999) stated that the chemical data were not consistent with the biological data, implying that chemical concentrations when compared to screening values did not support toxicity findings from the biological studies. OEPA (1999) commented that the sediment quality assessment used sediment screening values for PAHs that were based on nonconservative point estimates (such as lethal concentrations for 50 percent of the population [LC50]) rather than no observable adverse effect levels (NOAEL) or lowest observable adverse effect levels (LOAEL). The screening values used in the sediment quality assessment do not represent screening values currently used by OEPA and other agencies (OEPA 1999) to identify areas of potential concern.

The results of past studies and investigations were briefly summarized in a data gap analysis technical memorandum (TM) prepared by Tetra Tech EM Inc. (Tetra Tech 2005b). The TM identified likely chemicals of potential concern (COPC) for sediment and data gaps that currently exist at the site. The data gaps identified include:

- The majority of data available for the site are more than 10 years old. These data are of limited value because of the length of time since some were obtained. These data may provide an understanding of potential contamination in this area; however, conditions (e.g. chemical concentrations and locations) may have changed significantly since these sediment samples were collected.

- Most sediment samples were analyzed using routine analytical techniques; however, some samples were analyzed using screening analytical procedures, such as immunoassay tests. A sediment quality assessment notes a poor correlation between results from the immunoassay tests and the fixed laboratory (ChemRisk 1999). Although EPA encourages the use of field screening analytical techniques (EPA 2004), screening data must have a reasonable correlation to results from the fixed laboratory. Field screening data cannot be used for assessing potential risks because of the poor correlation.

- More current data are needed, especially in the southern portions of the watershed.

- Limited chemical data are available on the sediments that will help evaluate the bioavailability of metals and contamination by non-polar organic compounds. The collection of data for acid volatile sulfides and simultaneously extractable metals (AVS/SEM) will help evaluate whether metals are bound to sulfides and are therefore not bioavailable. In addition, collection of data on total organic carbon (TOC) will help evaluate the equilibrium relationship between non-polar organic compounds in solution and bound to the sediments and their subsequent bioavailability.

As a result of these data gaps, analysis of Duck and Otter Creek sediment samples for AVS/SEM and TOC was recommended, and both parameters were included in the current study. In addition, the current study included toxicity testing of several sediment samples using the midge species *Chironomus tentans*.

SulTRAC (a joint venture between Tetra Tech and Sullivan International Group) collected additional sediment samples at the site in April 2007 for EPA's Great Lakes National Program Office to address the data gaps identified above. The SulTRAC (2007) data provide the basis for the SLERA and BERA, since it is the most current data and samples were taken from all portions of both creeks.

## 2.3 IDENTIFICATION OF CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN (COPEC)

All detected inorganic and organic chemicals in sediments, except for essential nutrients such as iron, magnesium, potassium, and sodium, were selected for evaluation as preliminary COPECs for Duck and Otter Creeks. The preliminary COPECs were identified using sediment analytical data collected in 2007 by SulTRAC for EPA's Great Lakes National Program Office (SulTRAC 2007). Sediment samples were collected from 19 locations in Duck Creek and 27 locations in Otter Creek.

Duck Creek was divided into four approximately equal creek exposure areas, and another exposure area that comprised its Hecklinger Pond at the headwaters of Duck Creek, and Otter

Creek was divided into five exposure areas. Samples of surface sediments (the upper 6 to 12 inches) were collected at each exposure area (see Figures 2 and 3). The purpose of dividing the creeks into equal exposure areas was to assist the risk manager in identifying those areas for potential remediation, rather than assessing contamination in each creek as one unit. COPECs were identified for both creeks.

Appendix A presents the frequency of detection; minimum, mean, and maximum concentrations; and upper confidence limit (UCL) in the surface sediments. To identify the COPECs for the risk assessment, Tetra Tech reviewed the frequency of detection and used in the risk assessment only compounds detected in five percent of the samples. Tetra Tech reviewed the data to ensure that if an infrequently detected COPEC was present as a hot spot, it was included. Elimination of chemicals (primarily metals) as COPECs based on comparison to background concentrations was not employed in this assessment because site-specific background results were not available. Nonetheless, ignoring background comparisons may have retained as COPECs some inorganic chemicals present at or below background concentrations. Inclusion of these chemicals may contribute to an overestimate of exposures and risks. The following have been identified as COPECs for Duck and Otter Creeks:

- Metals – Arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, selenium, and zinc
- Pesticides – Dichlorodiphenyltrichloroethane (DDT) and its metabolites, and heptachlor and its metabolites
- Polychlorinated biphenyls – Total PCBs (Aroclor 1254 and 1260).
- Polynuclear Aromatic Hydrocarbons (PAH) – 2-methlynaphthalene, acenaphthene, acenaphthlyene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perlyene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene, C1-chrysene/benzo(a)anthracene, C1-fluorenes, C1-fluoranthenes/pyrenes, C1-naphthalenes, C1-phenanthrenes/anthracenes, C2-chrysene/benzo(a)anthracene, C2-fluorenes, C2-naphthalenes, C2-phenanthrenes/anthracenes, C3-chrysene/benzo(a)anthracene, C3-fluorenes, C3-naphthalenes, C3-phenanthrenes/anthracenes, C4-chrysene/benzo(a)anthracene, C4-naphthalenes, and C4-phenanthrenes/anthracenes.

## 2.4 CONCEPTUAL SITE MODEL

The CSM is a framework for relating ecological receptors to contaminated media. It identifies exposure pathways to be evaluated in the SLERA and provides other key information such as chemical sources, release and transport mechanisms, and the relative importance of exposure pathways to specific receptor groups. The CSM includes the following components:

- Stressors
- Fate and transport of chemicals
- Exposure pathways and routes
- Assessment and measure of effect.

The following sections briefly describe the components of the CSM for Duck and Otter Creeks, which are illustrated on Figure 4.

### 2.4.1 Stressors

Stressors can be defined as any factors that cause adverse ecological effects at a site. Chemical stressors in sediment were identified as COPECs for evaluation in this ERA using data collected by SulTRAC (2007). COPECs considered included metals, pesticides, PCBs, and PAHs. Other stressors, such as introduced species or habitat quality, were not considered in the assessment.

### 2.4.2 Fate and Transport of Chemicals

Although exposure is an elementary concept, accurately describing the movement of a chemical from its source to a site of toxic action in a receptor can be complicated. In general, an adverse exposure involves steps in which a chemical must be transported from the environmental matrix, move across several biological membranes, and concentrate in or interact with tissue to the extent that its toxic action adversely affects the organism. A chemical that can move from the environmental matrix to the tissue of a receptor is said to be bioavailable. Toxic effects observed during laboratory testing of field samples can be caused by a number of factors, including exposure to bioavailable chemicals. Interactions with sediment and aqueous matrices are considered in interpreting adverse effects associated with exposure to chemicals.

The fate and transport of chemicals associated with each exposure area of the creek determine the extent to which these stressors may affect various ecological receptors at the site. Two major factors impact the movement of organic chemicals within the sediments and their transfer to the receptors: sediment total organic carbon content and receptor lipid content. Both organic carbon and lipids have an affinity for polar organic compounds; thus, polar organic compounds are likely to bind to organic carbon in the sediments or accumulate in lipids in receptor tissue. Organic carbon may also play a role in the bioavailability of metals, by forming ligand complexes with the metals, reducing their bioavailability (DiToro and others 2005).

Potential effects of metal-contaminated sediments can be predicted by determining the SEM/AVS concentrations (Di Toro and others 1990). DiToro and others (1990) showed that AVS binds with metals in the sediments in a sulfide complex; once bound, the metals are not bioavailable and toxicity is not exhibited. The presence of AVS at a concentration that exceeds the SEM concentration indicates sufficient sulfide to bind the available metals. Moreover, organic carbon will also combine with toxic metals and render them unavailable, thereby reducing their toxicity (DiToro and others 2005).

### 2.4.3 Exposure Pathways and Routes

A chemical must be able to travel from a source to a representative receptor and must be taken up through one or more routes for an exposure pathway to be considered complete. Potential exposure pathways that result in receptor contact include exposure to sediments, surface water, and food items.

Exposure routes are the point of entry of a chemical into a receptor. For benthic organisms, these include dermal contact with interstitial water and sediment particles, contact of the gills with interstitial water, and ingestion of sediment. Exposure routes for wildlife include dermal contact and ingestion of contaminated sediment and food (Figure 4). Invertebrates exposed to chemicals in sediment may be adversely affected in a direct (lethality) manner and also accumulate chemicals to concentrations that adversely affect other characteristics, such as growth, reproduction, and emergence. Chemicals accumulated by benthic receptors may be transferred to their consumers, which include insectivores and omnivores, which in turn represent prey for carnivores. Food chain transfer, and potential bioaccumulation, may result in unacceptably high doses of chemicals to higher-trophic-level predators, even when concentrations in sediment are safe for lower-trophic-level receptors.

Potential exposure pathways are diagrammed in the CSM for Duck and Otter Creeks on Figure 4. Sediment is the predominant medium at this site that is the contaminant source for a benthic receptor or benthically-coupled receptor. The surface water exposure pathway was evaluated at this site although the assessment focuses on sediments.

The habitat structure in Duck and Otter Creeks is complex, as noted in the food web model (Figure 5). The riverine habitat offers a great number of potential niches and therefore supports a variety of species (Irvine and others 2005). The surrounding area supports a limited canopy created by the riparian vegetation and provides more secluded areas for roosting, foraging, and nesting. Birds, including the belted kingfisher, would be expected to roost in trees and feed in Duck and Otter Creeks. In addition, mammals, including mink, could be found in the areas adjacent to the creeks and derive a portion of their food from the creeks.

### 2.4.4 Assessment Endpoints

The assessment endpoints represent aspects of the ecosystem that need to be protected. EPA defines assessment endpoints as "explicit expressions of the actual environmental values (for example, ecological resources) that are to be protected" (EPA 1997). Assessment endpoints, like BUIs, are environmental characteristics that, if significantly impaired, would indicate a need for action by risk managers. Various definitions of valuable ecological resources include those without which ecosystem function would be significantly impaired; those that provide critical resources; and those perceived by humans as valuable, such as endangered species and other issues addressed by legislation. Useful assessment endpoints define both the valuable ecological entities at the site and a characteristic of the entity to protect, such as reproductive success or production per unit area.

Like BUIs, assessment endpoints are environmental characteristics that, if significantly impaired, would indicate a need for action by risk managers. Assessment Endpoints for Duck and Otter Creeks are:

- Protection of benthic community
- Protection of bottom-dwelling fish community
- Protection of piscivore avian community
- Protection of piscivore mammalian community.

### 2.4.5 Measures of Effects

EPA defines a measure of effect as "a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint and is a measure of biological effects (such as mortality, reproduction, or growth)" (EPA 1997). Measures of effect more closely reflect technical considerations in the risk assessment process; that is, measures of effect focus on both direct measures of ecological effects such as toxicity tests and indirect measures such as food-chain exposure modeling that allow for an evaluation of risk to representative receptors. Measures of effect can include measures of exposure or effect and are frequently numerical expressions of observations. Each measure of effect correlates directly with one of the defined assessment endpoints and is based on mechanisms of toxicity in the available literature. The measures of effect for the Duck and Otter Creeks are:

> Benthic community – Ohio EPA Specific Sediment Reference Values (OEPA 2003a) for the Huron/Erie Lake Plain are used for all metal constituents in the sediment. For pesticides and PCBs, consensus threshold effects values are used from McDonald, Ingersoll, and Berger (2000). For PAHs, sediment quality guidelines are derived following EPA guidance for PAH mixtures; these values are adjusted for site-specific total organic carbon (TOC) values (EPA 1993a and 2003). A mean TOC value is calculated for each creek section using data collected by SulTRAC (2007). The sediment reference values and sediment quality guidelines are used to evaluate potential risk. These values are provided in Appendix B.
>
> Fish community – Available water quality data for each creek are compared to Ohio water quality standards to assess direct impacts to fish.
>
> Bottom-dwelling Fish community – The sediment PAH concentration is compared to values associated with deformities, eroded fins, lesions, and tumors (DELT anomalies) to assess the potential impacts to bottom dwelling fish. The results for this assessment are provided in Appendix C.

## 3.0 TIER 1 SLERA STEP 2: EXPOSURE ESTIMATION AND RISK CHARACTERIZATION METHODS

A SLERA proceeds to Step 2 when complete exposure pathways for ecologically relevant ecosystems or receptors have been identified in Step 1—as occurred in the Duck and Otter Creeks. This section describes the screening-level exposure estimate and risk characterization procedures for evaluating risk to benthic invertebrates and wildlife from exposure to contaminants in sediments of the Duck and Otter Creeks.

### 3.1 METHODOLOGY FOR EVALUATING EFFECTS ON BENTHIC INVERTEBRATES

The evaluation of risk to benthic invertebrates focused on maintaining sufficient rates of survival and growth to protect invertebrate populations in sediment. The CSM presented in Section 2.4 identifies a potentially complete exposure pathway from contaminated sediments to invertebrates in sediments via direct contact and ingestion. Sediments provide habitat for a wide variety of benthic organisms, as well as juvenile forms of pelagic organisms. The organisms in sediments are in constant contact with the sediments, and therefore, the contaminants adsorbed to the sediment particles and dissolved in the pore water. *Guidance for Conducting Ecological Risk Assessment* developed by OEPA (2003a) contains sediment reference values (SRV) for metals to identify potential impacts on benthic organisms. These values were developed to identify representative background concentrations for lotic water bodies (OEPA 2003a). Tetra Tech compared the SRV to toxicity-based screening values to reflect a no observed adverse effect level (NOAEL) reported by MacDonald Ingersol, and Berger (2000) as a consensus threshold effect concentration (TEC). (The TEC values have been recommended by EPA Great Lakes National Program Office as sediment screening values.) The TEC were compared to the regionally specific SRV and found to be similar (See Appendix B). Therefore, the SRVs were used to screen for potential risk based on threshold effects. To provide further insight on the potential risks associated with sediment contaminants, Tetra Tech also included the screening values that were based on probable effect concentration (PEC) as indentified by MacDonald Ingersol, and Berger (2000) in the tables in Appendix B.

For the organic constituents, Tetra Tech relied on several sources for criteria. For PAH compounds, Tetra Tech followed the procedures outlined in *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks for the Protection of Benthic Organisms: PAH Mixtures* (EPA 2003) and calculated a screening value for assuming one toxicity unit for the individual PAH compound using the average total organic carbon (TOC) concentration for each creek exposure area (Appendix B). As was done for the metals, Tetra Tech also identified PEC values for PAHs (MacDonald Ingersol, and Berger 2000). For pesticides, Tetra Tech used the TECs and PECs from MacDonald, Ingersol, and Berger (2000) based on a 1 percent TOC concentration in the sediments, and adjusted these values to reflect the TOC values present in Duck and Otter Creeks. To determine the overall potential risk posed by a particular contaminant concentration, the concentration of the contaminant in sediment was compared to sediment criteria for the protection of aquatic life identified from these various sources.

The SLERA used an exposure point concentration (EPC) as defined as the lesser of the 95% upper confidence limit (UCL) and the maximum detected concentration of each COPEC detected in the sediment at the site.

Chemicals that posed potential risk to invertebrates were identified based on comparison of the EPC concentrations in sediment with toxicity criteria values listed in Appendix B. A HQ, the ratio of the sediment concentration to the sediment criteria, was determined for each COPEC; the complete results are presented in Appendix B.

### 3.2 SCREENING FOR LESIONS IN BOTTOM-DWELLING FISH

Horness and others (1998) proposed sediment quality thresholds for PAHs corresponding to the incidence of liver lesions in English sole (*Pleuronectes vetulus*). The thresholds were developed using hockey stick regression analysis on data developed as part of the National Oceanic and Atmospheric Administration's National Benthic Surveillance Project. The following seven lesion threshold values for total PAH concentration were developed:

- Neoplasm threshold = 2,800 micrograms per kilogram (µg/kg)
- Foci of cellular alteration threshold = 54 µg/kg
- Specific degenerative/necrotic (SDN) lesions threshold = 940 µg/kg
- SDN comprised largely of megalocytic hepatosis threshold = 930 µg/kg
- SDN comprised largely of nuclear pleomorphism threshold = 930 µg/kg
- Proliferative lesions threshold = 230 µg/kg
- Any lesion threshold = 620 µg/kg.

Horness and others (1998) did not specify which PAH compounds comprised total PAH. Therefore, for this analysis, total PAH was based on the sum of the following EPA priority pollutant PAHs.

- 2-Methylnaphthalene
- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Naphthalene
- Phenanthrene
- Pyrene

The total PAH concentration, which was determined for each creek exposure area, was based on the sum of the EPC concentrations for each PAH compound identified earlier for the invertebrate and wildlife assessments. If a specific compound was not detected in any of the samples, it was not included in calculating the total PAH concentration. A HQ, the ratio of the sediment total PAH concentration to the sediment threshold values, was determined for each COPEC; the values are found in Appendix C.

## 3.3 SCREENING FOR SURFACE WATER

The surface water data available for both Duck and Otter Creeks were reviewed and the maximum concentration of each constituent reported for each creek was identified. These concentrations were compared to the Ohio Water Quality Standards for the chronic protection of aquatic life (Ohio Administrative Code 3745-01), or if no Ohio value was available, the EPA Region 5 Ecological Screening Levels (EPA 2003) were used.

## 3.4 RESULTS FOR THE SEDIMENT SCREENING

Risks to invertebrates and lesions to fish were screened for each exposure area of the Duck and Otter Creeks based on comparison of site COPEC concentrations with benchmarks and criteria. In addition, the potential for bottom-dwelling fish to develop lesions was screened based on comparisons to thresholds. A HQ for the results of the criteria comparison was calculated by dividing the COPEC EPC concentration in the sediment (units are milligrams per kilogram [mg/kg] for metals and µg/kg for all other constituents) by the benchmark. These results are discussed in Sections 3.4 and 3.5. The comparisons of the sediment concentrations to the various criteria are presented in Appendix B. HQ calculations for the comparison of the total PAH concentrations with the screening criteria for lesions in bottom-dwelling fish are presented in Appendix C.

Only those chemicals with a HQ greater than 1 are reported in this section.

### 3.4.1 Duck Creek

This section presents the results of the SLERA for Duck Creek. Risk to each receptor group is described, and a summary of risk for each exposure area of the creek is provided.

#### 3.4.1.1 Exposure Area A – Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

For the sediment samples from Exposure Area A of the Duck Creek, arsenic, cadmium, lead, and zinc exceeded the probable effect criteria/severe effect levels. Various concentrations of metals and pesticides, including barium, mercury, selenium, 4,4'-dichlorodiphenyldichloroethane (DDD), and 4,4'-dichlorodiphenyldichloroethene (DDE), exceeded the lowest effect levels (chronic criterion) (Table 1).

**TABLE 1**
**BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – DUCK CREEK EXPOSURE AREA A**

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **4.0** | **12.0** |
| Barium | NA | **2.5** |
| Cadmium | **1.0** | **5.2** |
| Lead | **2.7** | **8.6** |
| Mercury | 0.4 | **3.1** |
| Selenium | NA | **7.1** |
| Zinc | **2.0** | **4.9** |
| 4,4'-DDD | 0.3 | **3.2** |
| 4,4'-DDE | 0.3 | **2.2** |

Notes:
Value in bold text indicates hazard quotient greater than 1
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
NA No criteria available

A summary of the screening results for lesions in bottom-dwelling fish is presented in Table 2. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

**TABLE 2**

**LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – DUCK CREEK EXPOSURE AREA A**

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | Neoplasm Lesions | FCA lesions | SDN-N Lesions | SDN-MH/NP Lesions | Proliferative Lesions | Any Lesions |
| Sediment | **42.6** | **2,210.7** | **127.0** | **128.4** | **519.0** | **192.5** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

### 3.4.1.2 Exposure Area B – Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

For the sediment samples from Exposure Area B of the Duck Creek, arsenic, lead, zinc, and the total PAH mixtures exceeded the probable effect criteria/severe effect levels. Various contaminants, including barium, cadmium, chromium, mercury, selenium, 4,4'-DDD, and 4,4'-DDE, exceeded the benthic aquatic life chronic toxicity criteria/lowest effect levels (Table 3).

**TABLE 3**

**BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – DUCK CREEK EXPOSURE AREA B**

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **3.7** | **11.2** |
| Barium | NA | **3.0** |
| Cadmium | 0.1 | **4.7** |
| Chromium | 0.7 | **1.5** |
| Lead | **2.4** | **7.7** |
| Mercury | 0.2 | **1.8** |
| Selenium | NA | **7.1** |
| Zinc | **1.7** | **4.0** |
| 4,4'-DDD | 0.4 | **4.4** |
| 4,4'-DDE | 0.5 | **4.0** |
| Total PAH Mixtures | **1.4** | 0.2 |

Notes:
Value in bold text indicates hazard quotient greater than 1.
NA No criteria available
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
PAH Polynuclear aromatic hydrocarbons

A summary of the screening results for lesions in bottom-dwelling fish in Duck Creek Exposure Area B is presented in Table 4. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

**TABLE 4**
**LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – DUCK CREEK EXPOSURE AREA B**

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | **Neoplasm Lesions** | **FCA Lesions** | **SDN-N Lesions** | **SDN-MH/NP Lesions** | **Proliferative Lesions** | **Any Lesions** |
| Surface | **5.7** | **295.3** | **17.0** | **17.1** | **69.3** | **25.7** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

#### 3.4.1.3 Exposure Area C – Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

For the sediment samples from Exposure Area C of the Duck Creek, arsenic, lead, and zinc exceeded the probable effect criteria/severe effect levels.. Various contaminants, including barium, cadmium, chromium, mercury, 4,4'-DDD, and 4,4'-DDE, exceeded the benthic aquatic life chronic toxicity criteria/lowest effect levels (Table 5).

**TABLE 5**
**BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – DUCK CREEK EXPOSURE AREA C**

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **2.0** | **5.9** |
| Barium | NA | **3.1** |
| Cadmium | 0.7 | **3.8** |
| Chromium | 0.7 | **1.5** |
| Lead | **2.4** | **7.7** |
| Mercury | 0.2 | **1.8** |
| Zinc | **1.4** | **3.4** |
| 4,4'-DDD | 0.2 | **2.6** |
| 4,4'-DDE | 0.4 | **3.1** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA No criteria available
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene

A summary of the screening results for lesions in bottom-dwelling fish in Duck Creek Exposure Area C is presented in Table 6. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

**TABLE 6**
**LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – DUCK CREEK EXPOSURE AREA C**

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | **Neoplasm Lesions** | **FCA Lesions** | **SDN-N Lesions** | **SDN-MH/NP Lesions** | **Proliferative Lesions** | **Any Lesions** |
| Sediment | **4.3** | **225.2** | **12.9** | **13.1** | **52.9** | **19.6** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

### 3.4.1.4 Exposure Area D – Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

Arsenic, cadmium, chromium, lead, mercury, zinc, and total PAH mixtures exceeded the corresponding probable effect criteria/severe effect levels for the sediment samples from Exposure Area D for the Duck Creek, and additional metals such as barium and selenium and pesticides 4,4’-DDD, 4,4’-DDE, and 4,4’-dichlorodiphenyltrichloroethane (DDT), exceeded the corresponding benthic aquatic life chronic toxicity criteria/lowest effect levels (Table 7).

## TABLE 7

## BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – DUCK CREEK EXPOSURE AREA D

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **4.2** | **12.7** |
| Barium | NA | **10.2** |
| Cadmium | **3.2** | **16.8** |
| Chromium | **1.7** | **3.7** |
| Lead | **7.3** | **23.0** |
| Mercury | **6.4** | **56.8** |
| Selenium | NA | **21.7** |
| Zinc | **5.0** | **12.0** |
| 4,4'-DDD | 0.6 | **7.2** |
| 4,4'-DDE | 0.9 | **8.1** |
| 4,4'-DDT | 0.1 | **1.1** |
| Total PAH Mixtures | **3.8** | 0.7 |

Notes:
Value in bold text indicates hazard quotient greater than one.
NA No criteria available
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
DDT Dichlorodiphenyltrichloroethane
PAH Polynuclear aromatic hydrocarbons

A summary of the screening results for lesions in bottom-dwelling fish in the Duck Creek Exposure Area D is presented in Table 8. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

## TABLE 8

## LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – DUCK CREEK EXPOSURE AREA D

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | Neoplasm Lesions | FCA Lesions | SDN-N Lesions | SDN-MH/NP Lesions | Proliferative Lesions | Any Lesions |
| Sediment | **20.1** | **1,043.3** | **59.9** | **60.6** | **244.9** | **90.9** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

#### 3.4.1.5 Exposure Area E – Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

Arsenic, chromium, lead, zinc, and various PAHs, including acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, and the total PAH mixtures, exceeded the corresponding benthic aquatic life probable effect criteria/severe effect levels in the sediment samples from Exposure Area E of the Duck Creek. Additional metals such as barium, cadmium, and selenium and pesticides 4,4'-DDD and 4,4'-DDE exceeded the corresponding benthic aquatic life chronic toxicity criteria/lowest effect levels (Table 9).

**TABLE 9**

**BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – DUCK CREEK EXPOSURE AREA E**

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **3.8** | **11.3** |
| Barium | NA | **2.5** |
| Cadmium | 0.7 | **3.6** |
| Chromium | **1.1** | **2.4** |
| Lead | **2.6** | **8.4** |
| Selenium | NA | **13.4** |
| Zinc | **1.6** | **4.0** |
| 4,4'-DDD | 0.3 | **3.1** |
| 4,4'-DDE | 0.2 | **1.5** |
| Acenaphthene | **1.6** | 0.3 |
| Anthracene | **8.8** | **1.3** |
| Benzo(a)anthracene | **15.6** | **1.9** |
| Benzo(a)pyrene | **13.1** | **2.0** |
| Benzo(b)fluoranthene | **15.9** | **2.4** |
| Benzo(k)fluoranthene | **6.1** | **1.1** |
| Chrysene | **12.2** | **1.4** |
| Dibenzo(a,h)anthracene | **1.6** | 0.3 |
| Fluoranthene | **21.7** | **7.0** |
| Fluorene | **3.7** | 0.4 |
| Indeno(1,2,3-cd)pyrene | **5.2** | 0.7 |
| Phenanthrene | **13.5** | **2.6** |
| Pyrene | **22.7** | **5.0** |
| Total PAH Mixtures | **143** | **26.4** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA No criteria available
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
PAH Polynuclear aromatic hydrocarbons

A summary of the screening results for lesions in bottom-dwelling fish in Duck Creek Exposure Area E is presented in Table 10. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

**TABLE 10**
**LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – DUCK CREEK EXPOSURE AREA E**

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | **Neoplasm Lesions** | **FCA Lesions** | **SDN-N Lesions** | **SDN-MH/NP Lesions** | **Proliferative Lesions** | **Any Lesions** |
| Sediment | **298.5** | **15,480.1** | **889.3** | **898.8** | **3,634.5** | **1,348.3** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

### 3.4.2 Otter Creek

This section presents the results of the SLERA for Otter Creek. Risk to each receptor group is described, and a summary of risk for each exposure area of the creek is provided.

#### 3.4.2.1 Exposure Area A - Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

Arsenic, chromium, lead, zinc, and the total PAH mixtures exceeded the corresponding benthic aquatic life probable effect criteria/severe effect levels in the sediment samples from Exposure Area A of Otter Creek, and additional metals such as barium, cadmium, and mercury exceeded the corresponding benthic aquatic life chronic toxicity criteria/lowest effect levels (Table 11).

**TABLE 11**

**BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – OTTER CREEK EXPOSURE AREA A**

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **1.2** | **3.5** |
| Barium | NA | **1.8** |
| Cadmium | 0.5 | **2.5** |
| Chromium | **3.3** | **7.1** |
| Lead | **2.2** | **7.1** |
| Mercury | 0.3 | **2.8** |
| Zinc | **2.2** | **5.2** |
| Total PAH Mixtures | **2.6** | 0.5 |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA No criteria available
PAH Polynuclear aromatic hydrocarbons

A summary of the screening results for lesions in bottom-dwelling fish in Otter Creek Exposure Area A is presented in Table 12. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

**TABLE 12**

**LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – OTTER CREEK EXPOSURE AREA A**

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | Neoplasm Lesions | FCA Lesions | SDN-N Lesions | SDN-MH/NP Lesions | Proliferative Lesions | Any Lesions |
| Sediment | **5.9** | **305.5** | **17.6** | **17.7** | **71.7** | **26.6** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

### 3.4.2.2 Exposure Area B - Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

Arsenic, chromium, lead, zinc, and various PAHs, including benzo(a)anthracene, benzo(b)fluoranthene, chrysene, fluoranthene, phenanthrene, pyrene, and the total PAH mixtures, exceeded the corresponding benthic aquatic life probable effect criteria/severe effect levels in the sediment samples from Exposure Area B of the Otter Creek, and additional metals such as barium, cadmium, and mercury exceeded the corresponding benthic aquatic life chronic toxicity criteria/lowest effect levels (Table 13).

**TABLE 13**
**BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – OTTER CREEK EXPOSURE AREA B**

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **1.4** | **4.3** |
| Barium | NA | **1.2** |
| Cadmium | 0.5 | **2.3** |
| Chromium | **1.7** | **3.8** |
| Lead | **2.1** | **6.5** |
| Mercury | 0.3 | **2.7** |
| Zinc | **2.3** | **5.5** |
| Benzo(a)anthracene | **1.9** | 0.2 |
| Benzo(b)fluoranthene | **1.7** | 0.3 |
| Chrysene | **1.7** | 0.2 |
| Fluoranthene | **1.9** | 0.6 |
| Phenanthrene | **2.0** | 0.4 |
| Pyrene | **2.0** | 0.4 |
| Total PAH Mixtures | **14.7** | **2.6** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA No criteria available
PAH Polynuclear aromatic hydrocarbons

A summary of the screening results for lesions in bottom-dwelling fish in the Otter Creek Exposure Area B is presented in Table 14. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

**TABLE 14**

**LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – OTTER CREEK EXPOSURE AREA B**

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | **Neoplasm Lesions** | **FCA Lesions** | **SDN-N Lesions** | **SDN-MH/NP Lesions** | **Proliferative Lesions** | **Any Lesions** |
| Sediment | **38.4** | **1,993.4** | **114.5** | **115.7** | **468.0** | **173.6** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

### 3.4.2.3 Exposure Area C – Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

Arsenic, chromium, lead, zinc, total PCBs, and various PAHs, including phenanthrene, pyrene, and the total PAH mixtures, exceeded the corresponding benthic aquatic life probable effect criteria/severe effect levels in the sediment samples from Exposure Area C of Otter Creek, and additional metals such as barium, cadmium, mercury, and selenium exceeded the corresponding benthic aquatic life chronic toxicity criteria/lowest effect levels (Table 15).

**TABLE 15**

**BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – OTTER CREEK EXPOSURE AREA C**

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **1.9** | **5.7** |
| Barium | NA | **1.3** |
| Cadmium | 0.4 | **2.0** |
| Chromium | **2.7** | **5.9** |
| Lead | **2.0** | **6.5** |
| Mercury | 0.4 | **3.6** |
| Selenium | NA | **2.6** |
| Zinc | **1.1** | **2.7** |
| Total PCBs | **3.8** | **5.7** |
| Phenanthrene | **2.4** | 0.5 |
| Pyrene | **1.6** | 0.4 |
| Total PAH Mixtures | **10.0** | **1.8** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA No criteria available
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl

A summary of the screening results for lesions in bottom-dwelling fish in the Otter Creek Exposure Area C is presented in Table 16. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

**TABLE 16**
**LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – OTTER CREEK EXPOSURE AREA C**

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | **Neoplasm Lesions** | **FCA Lesions** | **SDN-N Lesions** | **SDN-MH/NP Lesions** | **Proliferative Lesions** | **Any Lesions** |
| Sediment | **19.1** | **991.7** | **57.0** | **57.6** | **232.8** | **86.4** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

#### 3.4.2.4 Exposure Area D – Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

Arsenic, chromium, lead, zinc, and various PAHs, including anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, and the total PAH mixtures, exceeded the corresponding benthic aquatic life probable effect criteria/severe effect levels in the sediment samples from Exposure Area D of Otter Creek. Additional metals such as barium, cadmium, and mercury, and the pesticides 4,4’-DDD and 4,4’-DDE exceeded the corresponding benthic aquatic life chronic toxicity criteria/lowest effect levels (Table 17).

## TABLE 17

## BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – OTTER CREEK EXPOSURE AREA D

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **2.0** | **6.0** |
| Barium | NA | **1.2** |
| Cadmium | 0.5 | **2.5** |
| Chromium | **1.0** | **2.1** |
| Lead | **2.3** | **7.4** |
| Mercury | 0.1 | **1.3** |
| Zinc | **2.1** | **5.0** |
| 4,4’-DDD | 0.2 | **2.0** |
| 4,4’-DDE | 0.2 | **1.8** |
| Anthracene | **1.6** | 0.2 |
| Benzo(a)anthracene | **4.8** | 0.6 |
| Benzo(a)pyrene | **3.7** | 0.6 |
| Benzo(b)fluoranthene | **4.6** | 0.7 |
| Benzo(k)fluoranthene | **1.5** | 0.3 |
| Chrysene | **4.8** | 0.6 |
| Fluoranthene | **8.1** | **2.6** |
| Fluorene | **1.2** | 0.1 |
| Indeno(1,2,3-cd)pyrene | **3.3** | 0.4 |
| Phenanthrene | **6.1** | **1.2** |
| Pyrene | **8.0** | **1.7** |
| Total PAH Mixtures | **49.6** | **9.3** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA No criteria available
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
PAH Polynuclear aromatic hydrocarbons

A summary of the screening results for lesions in bottom-dwelling fish in the Otter Creek Exposure Area D is presented in Table 18. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

## TABLE 18

## LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – OTTER CREEK EXPOSURE AREA D

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | **Neoplasm Lesions** | **FCA Lesions** | **SDN-N Lesions** | **SDN-MH/NP Lesions** | **Proliferative Lesions** | **Any Lesions** |
| Sediment | **88.9** | **4,612.1** | **265.0** | **267.8** | **1,082.8** | **401.7** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

#### 3.4.2.5 Exposure Area E - Results of Benthic Aquatic Life Criteria Comparison and Lesions in Bottom-dwelling Fish Screening Results

Arsenic, lead, zinc, and various PAHs, including anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, and the total PAH mixtures, exceeded the corresponding benthic aquatic life probable effect criteria/severe effect levels in the sediment samples from Exposure Area E of Otter Creek. Additional metals such as barium, cadmium, chromium, and mercury, and the pesticides 4,4’-DDD and 4,4’-DDE, and total PCBs exceeded the corresponding benthic aquatic life chronic toxicity criteria/lowest effect levels (Table 19).

A summary of the screening results for lesions in bottom-dwelling fish in the Otter Creek Exposure Area E is presented in Table 20. The sediment concentrations were above all available screening criteria, indicating a potential impact on bottom-dwelling fish.

**TABLE 19**
**BENTHIC AQUATIC LIFE HAZARD QUOTIENTS FOR THE SEDIMENT – OTTER CREEK EXPOSURE AREA E**

| Chemical | Benthic Aquatic Life Probable Effect Criteria | Benthic Aquatic Life Chronic Criteria |
|---|---|---|
| Arsenic | **1.6** | **4.6** |
| Barium | NA | **1.1** |
| Cadmium | 0.5 | **2.5** |
| Chromium | 0.7 | **1.5** |
| Lead | **2.3** | **7.4** |
| Mercury | 0.2 | **1.4** |
| Zinc | **1.2** | **2.8** |
| 4,4’-DDD | 0.1 | **1.4** |
| 4,4’-DDE | 0.1 | **1.3** |
| Total PCBs | 0.7 | **1.0** |
| Anthracene | **1.1** | 0.2 |
| Benzo(a)anthracene | **3.3** | 0.4 |
| Benzo(a)pyrene | **2.6** | 0.4 |
| Benzo(b)fluoranthene | **3.3** | 0.5 |
| Benzo(k)fluoranthene | **1.0** | 0.2 |
| Chrysene | **3.4** | 0.4 |
| Fluoranthene | **5.7** | **1.8** |
| Indeno(1,2,3-cd)pyrene | **2.3** | 0.3 |
| Phenanthrene | **4.3** | 0.8 |
| Pyrene | **5.6** | **1.2** |
| Total PAH Mixtures | **34.7** | **6.5** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA No criteria available
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl

**TABLE 20**

**LESION SCREENING HAZARD QUOTIENTS FOR PAH CONCENTRATIONS IN SEDIMENT – OTTER CREEK EXPOSURE AREA E**

| | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|
| | Neoplasm Lesions | FCA Lesions | SDN-N Lesions | SDN-MH/NP Lesions | Proliferative Lesions | Any Lesions |
| Sediment | **88.7** | **4,601.1** | **264.3** | **267.2** | **1,080.3** | **400.7** |

Notes:
Value in bold text indicates hazard quotient greater than 1
FCA Foci of cellular alteration
PAH Polynuclear aromatic hydrocarbon
SDN-N Specific degenerative/necrotic
SDN-MH/NP Specific degenerative/megalocytic hepatosis or nuclear pleomorphism

## 3.5 RESULTS FOR THE SURFACE WATER SCREENING

Tetra Tech reviewed the historical surface water data from both creeks and identified the maximum surface water concentration from each creek. This value was compared to the OEPA water quality standard for chronic exposure by aquatic life or EPA Region 5 Ecological Screening Levels (ESL). The results are presented in Tables 21 and 22. The comparison notes several chemicals with maximum concentrations exceeding the screening values. For Duck Creek, these chemicals include barium and vanadium. For Otter Creek, these chemicals include ammonia, cadmium, copper, cyanide, lead, mercury, and selenium.

**TABLE 21**
**COMPARISON OF MAXIMUM SURFACE WATER CONCENTRATIONS TO WATER QUALITY STANDARDS OR SCREENING LEVELS**
**DUCK CREEK**

| Chemical | Maximum Concentration | Exposure Area | Data Source | Ohio Water Quality Standard | EPA Region 5 Ecological Screening Levels (ESL) | Exceeds Standard/ ESL |
|---|---|---|---|---|---|---|
| **Inorganics** | mg/L | | | mg/L | mg/L | |
| Ammonia | 0.5 | Area C | a | 0.6 | | No |
| Barium | 0.249 | Area B | b | NA | 0.22 | Yes |
| Manganese | 0.153 | Area B | b | NA | NA | -- |
| Vanadium | 0.019 | Area B | b | NA | 0.012 | Yes |
| Zinc | 0.13 | Area D | a | 0.3 | | No |
| | | | | | | |
| **Organics** | μg/L | | | μg/L | μg/L | |
| Acetone | 11.4 | Area B | c | NA | 1700 | No |
| Trichlorofluoromethane | 2 | Area B, C, D, E | a | NA | NA | -- |

Notes:
mg/L Milligrams per liter
μg/L Micrograms per liter

Sources: Ohio Water Quality Standards – Ohio Administrative Code 3745-01,assumed a water hardness of 300 mg/L as calcium carbonate.
EPA Region 5 ESLs (EPA 2003)
a SECOR International, Inc. (SECOR). 2005. Spreadsheet Presenting Analytical Data for Surface Water and Sediment Samples for Duck Creek, Otter Creek, and the Maumee River. Samples Collected by SECOR for the Chevron USA Inc. Toledo Refinery, 2935 Front Street, Toledo, Ohio.
b Quality Specialists & Environmental Analysts, Inc. (QSEA). 1996. "Data Validation Report, Sample Delivery Groups CS001S, CS010W, 201SED, and CS310S, Maumee RAP Project, Consaul Street Location." Prepared June 1996; revised September 1996.
c BEC Laboratories. 2003. Analytical Results for Surface Water Samples Collected from Duck Creek on October 15, 2003.

**TABLE 22**
**COMPARISON OF MAXIMUM SURFACE WATER CONCENTRATIONS TO WATER QUALITY STANDARDS OR SCREENING LEVELS**
**OTTER CREEK**

| Chemical | Maximum Concentration | Exposure Area | Data Source | Ohio Water Quality Standard | EPA Region 5 Ecological Screening Levels (ESL) | Exceeds Standard/ ESL |
|---|---|---|---|---|---|---|
| **Inorganics** | mg/L | | | mg/L | mg/L | |
| Ammonia | 3.02 | Area B | a | 0.6 | | Yes |
| Antimony | 0.012 | Area D | b | NA | 0.08 | No |
| Arsenic | 0.033 | Area A,B | c | 0.15 | | No |
| Barium | 0.088 | Area D | b | NA | 0.22 | No |
| Beryllium | 0.0012 | Area C | c | NA | 0.0036 | No |
| Cadmium | 0.013 | Area B | a | 0.0058 | | Yes |
| Chromium | 0.0805 | Area B | a | 0.210 | | No |
| Copper | 0.055 | Area B | a | 0.024 | | Yes |
| Cyanide | 0.018 | Area C | c | 0.0052 | | Yes |
| Lead | 0.32 | Area B | a | 0.026 | | Yes |
| Mercury | 0.0217 | Area B | a | 0.00091 | | Yes |
| Nickel | 0.055 | Area B | a | 0.130 | | No |
| Selenium | 0.07 | Area D | b | 0.005 | | Yes |
| Zinc | 0.198 | Area B | a | 0.3 | | No |
| | | | | | | |
| **Organics** | μg/L | | | μg/L | μg/L | |
| 2,4-D | 1.395 | Area D | b | NA | 220 | No |
| Chloroform | 2.9 | Area A | c | NA | 140 | No |
| Ethylbenzene | 1 | Area C | d | NA | 14 | No |
| m&p Xylenes | 6 | Area C | d | NA | 27 | No |

Notes:
mg/L Milligrams per liter
μg/L Micrograms per liter

Sources: Ohio Water Quality Standards – Ohio Administrative Code 3745-01 assumed a water hardness of 300 mg/L as calcium carbonate.
EPA Region 5 ESLs (EPA 2003)
a City of Toledo (1992to 2002) Stream sampling data from 1992 to 2002.
b ENVIRON International Corporation (ENVIRON) and The Mannik & Smith Group, Inc. (Mannik & Smith). 2003. "Resource Conservation and Recovery Act Facility Investigation (RFI) Phase I Report and Phase II Work Plan, Envirosafe Services of Ohio, Inc., Otter Creek Road Facility, Oregon, Ohio." July.
c Ohio Environmental Protection Agency (OEPA). 1992 to 1998. Analytical Results for Phases I through III of Sediment and Surface Water Sampling in the Maumee River Area of Concern, Including Duck and Otter Creeks. Northwest District Office, Division of Surface Water.
d SECOR International, Inc. (SECOR). 2005. Spreadsheet Presenting Analytical Data for Surface Water and Sediment Samples for Duck Creek, Otter Creek, and the Maumee River. Samples Collected by SECOR for the Chevron USA Inc. Toledo Refinery, 2935 Front Street, Toledo, Ohio.

## 4.0 BASELINE ECOLOGICAL ASSESSMENT

The approach used for the BERA of Duck and Otter Creeks followed an established framework and guidelines for assessing ecological risks. Specifically, the EPA guidance for ecological risk assessment (EPA 1997) established an eight-step process for assessing ecological risk. The first two steps constitute the screening level evaluation with the goals of determining if the site poses no or negligible ecological risk, and identifying which contaminants and exposure pathways require further evaluation. The results of the SLERA noted potential unacceptable risks for sediments and surface water. Steps 3 through 7 detail the development of a BERA. Step 8 discusses risk management and will not be addressed as part of this BERA report. However, the scope for this report did not follow these linear steps, but rather combined a number of steps to efficiently assess the potential risk at the site. The BERA evaluates the COPECs identified in the SLERA with more site-specific information, and expands on potential ecological concerns.

### 4.1 ASSESSMENT ENDPOINTS AND MEASURES OF EFFECTS

The assessment endpoints discussed in Section 2.4.4 are the same for the BERA with one exception. Because the main objective of this risk assessment is to assist in the decision on whether Duck and Otter Creeks may qualify for funding support under the Great Lakes Legacy Act, the BERA will focus on the potential risks identified with the sediments in Duck and Otter Creeks. The revised endpoints for the BERA are

- Protection of benthic community – including aquatic insects and fish
- Protection of piscivore avian community
- Protection of piscivore mammalian community.

For the baseline risk assessment, the following measures are used to assess potential risks to the aquatic and related communities in and adjacent to Duck and Otter Creeks:

> Benthic community – Sediment bioassays using *Chironomous tentans* were conducted with sediment samples from various portions of both creeks. These data are evaluated to determine the extent of toxicity expressed at each location. In addition, Tetra Tech evaluated the AVS/SEM data to assess the role metals in the sediments may be playing in the observed toxicity. Also, the sediment PAH concentrations and grain size analysis

results are compared to the observed toxicity to determine if there is a relationship between toxicity and these parameters.

Piscivorous avian community – A food chain model is used to estimate receptor doses and compare doses to appropriate toxicity reference values (TRV). Tetra Tech used a low TRV (based on no adverse effect levels) and high TRV (based on lowest adverse effect level) to assess potential risks to avian receptors. These TRVs represent no toxicity expected and likely toxicity expected. TRV values for the identified COPECs are also presented in Appendix E.

The sediments are assumed sources of contaminants that will impact invertebrate and fish tissue through bioaccumulation. Due to the limited availability of high-quality, site-specific fish or invertebrate tissue concentrations, tissue concentrations need to be estimated. Biota-sediment accumulation factors (BSAF) are used to estimate tissue concentrations for fish and invertebrates. These data are used to support the food chain model for the piscivorous avian.

Piscivorous mammalian community – A food chain model is used to estimate receptor doses and compare doses to appropriate toxicity reference values (TRV). Tetra Tech used a low TRV (based on no adverse effect levels) and high TRV (based on lowest adverse effect level) to assess potential risks to avian receptors. These TRVs represent no toxicity expected and likely toxicity expected, respectively. TRV values for the identified COPECs are also presented in Appendix E.

The sediments are assumed sources of contaminants that will impact invertebrate and fish tissue through bioaccumulation. Due to the limited availability of high-quality, site-specific fish or invertebrate tissue concentrations, tissue concentrations need to be estimated. Biota-sediment accumulation factors (BSAF) are used to estimate tissue concentrations for fish and invertebrates. These data are used to support the food chain model for the piscivorous mammalian.

The risk characterization used both low and high TRVs to assess toxicity to piscivorous wildlife. If low TRVs were used exclusively, actual risks may be overestimated; conversely, if only high TRVs were used, risks may be underestimated. Therefore, the use of both values provides risk managers with an understanding of the potential range of risks associated with the contamination in the sediments.

## 4.2 CHARACTERIZATION OF ECOLOGICAL EFFECTS

To evaluate the potential risks for ecological receptors exposed to sediments, the BERA further evaluated the benthic community and the terrestrial community that feed on fish and benthic invertebrates from the creeks. To evaluate potential impacts to the benthic community, sediment samples were collected and were used in toxicity testing with a benthic invertebrate (*Chironomus tentans*). In addition, the sediments used in the toxicity testing were analyzed for the full scan of

PAHs, acid volatile sulfides, simultaneously extracted metals, particle size analysis, total organic carbon, and oil and grease to support the evaluation of the toxicity results. To evaluate the potential risks from sediment exposure for the potential terrestrial receptors, a food chain model was used to estimate potential exposure to receptors that feed on fish and invertebrates from the creeks. Although the SLERA noted potential risks to bottom-feeding fish through the formation of lesions, the BERA did not evaluate this potential risk further. No survey of the fish in Duck and Otter Creeks has been conducted to field-verify whether the fish are impacted. Also, the lesion threshold values are based on a sole, which is in intimate dermal contact with the sediments, therefore, probably overestimated risks.

The following sections describe the toxicity testing and results (Section 4.2.1) and food chain model methods and results (Section 4.2.2) for both Duck and Otter Creeks.

### 4.2.1 Toxicity Testing

If the SLERA notes potential risks to invertebrates and wildlife based on exceeding various criteria, the next step is to conduct a more detailed evaluation of the potential risks by using additional site-specific exposure information and characterizing risks again. The more detailed evaluation was performed to provide a better understanding of the potential risks to benthic organism through a toxicity test. SulTRAC (2007) obtained sediment samples from "master stations" within Duck and Otter Creeks. These sediment samples were subjected to 20-day survival and growth toxicity testing with the freshwater invertebrate midge (*Chironomus tentans*). The toxicity test evaluated the mortality (reported as percent survival); for sediments with survival values not different from the control tests, organisms were evaluated for growth by measuring weight of the organisms (reported as dry weight). The results from each "master station" were statistically compared to controls. The results for Duck and Otter Creeks are presented below.

#### 4.2.1.1 Toxicity Testing for Duck Creek

Seven sediment samples were collected from Duck Creek and were used in toxicity testing to evaluate whether sediment may represent a significant threat to benthic invertebrates. The toxicity tests were evaluated for percent survival, and any that did not detect a difference in survival (compared to a control sample) were evaluated for effect on growth by measuring the dry weight of the surviving organisms. The results of the toxicity testing are provided in SulTRAC (2007) and are summarized in Table 23.

In Exposure Area A of Duck Creek, survival rates for two samples (DC-01 and DC-05) were significantly lower than the control; the survival rate did not differ from the control for one sample (DC-03). The evaluation of potential impacts on growth for this sediment sample (DC-03) did not indicate a significant difference from the control. Survival rates for the samples from

**TABLE 23**
**SUMMARY OF TOXICITY TESTING –**
**DUCK CREEK**

| Exposure Area/ Sample Location | Mean Percent Survival | Mean Percent Survival Statistically Different from Controls | Mean Dry Weight (grams) | Mean Dry Weight Statistically Different from Controls |
|---|---|---|---|---|
| **Control** | 91.7 | NA | 1.3304 | NA |
| **Duck Creek Exposure Area A** | | | | |
| DC-01 | 43.3 | Yes | NA | NA |
| DC-03 | 85 | No | 1.509 | No |
| DC-05 | 40 | Yes | NA | NA |
| **Duck Creek Exposure Area B** | | | | |
| DC-05 | 40 | Yes | NA | NA |
| DC-08 | 45 | Yes | NA | NA |
| **Duck Creek Exposure Area C** | | | | |
| DC-08 | 45 | Yes | NA | NA |
| DC-10 | 83 | No | 1.5511 | No |
| **Duck Creek Exposure Area D** | | | | |
| DC-10 | 83 | No | 1.5511 | No |
| DC-13 | 90 | No | 1.336 | No |
| **Duck Creek Exposure Area E** | | | | |
| DC-13 | 90 | No | 1.336 | No |
| DC-14 | 86.7 | No | 1.474 | No |

Notes:

NA Not applicable

Exposure Area B (DC-05 and DC-08) both were significantly lower than the control. In Exposure Area C, the survival rate for one sample (DC-08) was significantly lower than the control, while it did not differ for one sample (DC-10). The evaluation of potential impacts on growth for sediment sample DC-010 did not indicate a significant difference from the control. Survival rates for the samples from Exposure Areas D (DC-10 and DC-13) and E (DC-13 and DC-14) were similar to the control. These sediment samples (DC-10, DC-13, and DC-14) were also evaluated for their potential impacts on growth, and no significant difference from the control was observed.

#### 4.2.1.2 Toxicity Testing for Otter Creek

Nine sediment samples were collected from Otter Creek and were used for toxicity testing to evaluate whether the sediment may represent a significant threat to potential receptor sediment organisms. The toxicity tests were evaluated for percent survival, and any that did not detect a difference in survival (compared to a control sample) were evaluated for effect on growth. The results of the toxicity testing are provided in SulTRAC (2007) and are summarized in Table 24.

**TABLE 24**
**SUMMARY OF TOXICITY TESTING –**
**OTTER CREEK**

| Exposure Area/ Sample Location | Mean Percent Survival | Mean Percent Survival Statistically Different from Controls | Mean Dry Weight (grams) | Mean Dry Weight Statistically Different from Controls |
|---|---|---|---|---|
| **Control** | 91.7 | NA | 1.3304 | NA |
| **Otter Creek Exposure Area A** | | | | |
| OC-01 | 60 | No | 2.3783 | No |
| OC-03 | 48.3 | Yes | NA | NA |
| OC-05 | 16.7 | Yes | NA | NA |
| OC-07 | 16.7 | Yes | NA | NA |
| **Otter Creek Exposure Area B** | | | | |
| OC-07 | 16.7 | Yes | NA | NA |
| OC-11 | 43.3 | Yes | NA | NA |
| **Otter Creek Exposure Area C** | | | | |
| OC-11 | 43.3 | Yes | NA | NA |
| OC-14 | 51.7 | Yes | NA | NA |
| **Otter Creek Exposure Area D** | | | | |
| OC-19 | 53.3 | Yes | NA | NA |
| OC-22 | 30 | Yes | NA | NA |
| **Otter Creek Exposure Area E** | | | | |
| OC-22 | 30 | Yes | NA | NA |
| OC-26 | 35 | Yes | NA | NA |

Notes:

NA Not applicable

In Exposure Area A of Otter Creek, survival rates for three samples (OC-03, OC-05, and OC-07) were significantly lower than the control, while survival for one sample (OC-01) did not differ. The evaluation of potential impacts on growth for this sediment sample (OC-01) did not indicate a significant difference from the control. Survival rates for the samples from Area B (OC-07 and OC-11) both were significantly lower than the control. In Exposure Area C, survival rates for both samples (OC -11 and OC-14) were significantly lower than the control. Survival rates for the samples from Exposure Area D (OC-19 and OC-22) both were significantly lower than the control, and survival rates in exposure Exposure Area E (OC-22 and OC-26) were significantly lower than the control.

There was one issue noted with the bioassay results. The tests were conducted with two water replacements per day, rather than aeration. This approach may cause additional agitation of the sediments and increase the physical stress levels to the organisms.

#### 4.2.2 Evaluation of Potential Stressors

The next step is to evaluate the available data to determine if a specific stressor or groups of stressors may be causing the observed toxicity in both Duck and Otter Creeks. This was done by first reviewing the available data on the chemical constituents in both creeks to identify any patterns or relationships. The results from the SLERA identified two classes of contaminants that may be the source of the toxicity: metals and PAHs. To assess the potential impact of metals on the observed toxicity, the AVS and SEM data for both creeks as reported by SulTRAC (2007) were evaluated. The AVS and SEM results as reported by the laboratory showed that the ratio of SEM to AVS in all samples tested was less than 1 for all relevant metals tested (see Appendix D – Table D-1). This ratio indicates a high probability that most of the metals in the sediments may be bound to sulfides and so are not bioavailable (DiToro and other 2005).

To evaluate the potential impacts of PAHs, Tetra Tech followed the protocols outlined by EPA (EPA 2003). The objective of this analysis is to determine if the sum of the toxicity units for all PAH compounds in the sample tested exceeds 1. Exceedance of 1 indicates potential sediment toxicity due to the PAH compounds present. The results presented in Appendix D – Table D-2 indicate that some samples show survival less than the control samples, the toxicity units exceed 1. However, the toxicity testing results for a number of samples indicated reduced survival but toxicity units summed to less than 1, while other results indicated survival similar to the controls but the toxicity units predicted significant toxicity. This comparison did not indicate an obvious relationship.

The next step in the evaluation was to identify a number of potential stressors and to statistically evaluate the data to determine if they themselves or in combination with other stressors appeared a potential indicator of toxicity. Tetra Tech used the following potential stressors for this analysis: AVS/SEM data, PAH toxicity units, PCB/pesticide threshold hazard quotients, percent sediment silt and clay, sulfide concentration, oil and grease results, percent dry weight, and total organic carbon content. The values used in the analysis are presented in Appendix D – Table D-4. The following techniques of statistical analysis were used to seek a causal relationship that could account for the observed sediment toxicity; the SAS statistical package was used to perform this analysis.

1. Bivariate correlation matrix for the response variable (percent survival) and the seven independent variables.

2. Correlation matrix and pairwise correlations.

3. Stepwise regression output for the best multiple regression model that included all seven independent variables.

The results are presented in Appendix D. The bivariate correlation did not identify any significant correlation. Neither did the correlation matrix and pairwise correlations. The step-wise regression also did not identify any likely combination of stressors that can explain the observed toxicity. Although the final step in the regression accounted for about 73 percent of the observed toxicity, often an evaluation involving a high number of stressors randomly accounts for the observed response.

## 4.3 METHODOLOGY FOR EVALUATING EFFECTS ON BIRDS AND MAMMALS

If the SLERA notes potential risks to invertebrates and wildlife based on exceedances of various criteria, the next step is to conduct a more detailed evaluation of the potential risks by using additional site-specific exposure information and characterizing risks again. The more detailed evaluation was performed to provide a better understanding of the potential risks to piscivorous wildlife. The evaluation of risks to birds and mammals was based on the selected assessment and measure of effects identified in Section 2.4.5. FCMs were used to assess exposure of birds and mammals to chemicals ingested in food or incidentally during other activities, especially chemicals that bioaccumulate (Pascoe, Blanchet, and Linder 1996). The following sections describe the models used to estimate ingested doses of site COPECs for birds and mammals, referencing literature information to estimate prey concentrations. Resulting potential risks were determined using this information.

Tetra Tech followed EPA's ecological risk assessment guidance (EPA 1997) and assessed the potential risks using a FCM. As was noted earlier (Section 2.4), the CSM identified several receptors that could be impacted by sediment contamination, including invertebrates, mammals, fish, and birds. The FCM is the other measure of exposure used in this assessment to determine whether exposures to contaminants at the Duck and Otter Creeks exceed toxicity reference values for higher trophic level ecological receptors in or adjacent to the creeks.

The biological survey information identified a number of higher trophic level organisms known to inhabit the Duck and Otter Creeks. In order to gain a better understanding of potential impacts from the sediment, both piscivorous birds and piscivorous mammals were evaluated. These feeding guilds are assumed to obtain more than half of their food from aquatic sources in the creeks. The belted kingfisher (*Ceryle alcyon)* was selected to represent the avian piscivorous guild. The mink (*Mustela vison)* was selected to represent the piscivorous mammal. The belted kingfisher and mink are only representative species and may not be specific to this watershed but were selected for the substantial research and data known about each species and similarity to known species in this watershed. The remainder of this section describes the FCM, the TRVs, and the interpretation of HQ results.

### 4.3.1 Quantitative Evaluation of Risk Using a Food Chain Model

FCMs for birds and mammals assumed that exposure to a COPEC is primarily through ingestion of contaminated sediment and prey. Exposure was assessed within the context of the following linear foodchains to evaluate potential ecological effects on birds and mammals that consume benthic invertebrates and fish:

- Sediments → Invertebrates and Fish → Belted Kingfisher
- Sediments → Invertebrates and Fish → Mink

The FCM estimated the mass of a COPEC internalized daily by each receptor per kilogram of body weight per day (the daily COPEC dosage). Estimates of exposure were generally based on knowledge of the spatial (within the creek or creek exposure area) and temporal distribution (assuming year-round exposure) of both COPECs and receptors, and on specific natural and life history characteristics that influence exposure to COPECs. The parameters used in estimating total daily doses to birds and mammals are provided in Tables 25 and 26 for the representative receptors selected—belted kingfisher and mink.

FCMs used results for surface sediment samples collected from 0 to 1 foot below sediment surface (bss) from each exposure area of the Duck and Otter Creeks to estimate doses to avian and mammalian receptors. The exposure point concentrations were calculated , using ProUCL 4.0 (EPA 2007) and represent the 95 percent upper confidence level about the mean.

The procedure used to calculate the EPC concentrations are provided in Appendix A.

EPC COPEC doses were calculated for the belted kingfisher and mink using average values for exposure parameters such as body weight and ingestion rates and EPC sediment concentrations. These doses were then compared with high and low TRVs to estimate the potential adverse biological effects on the receptor. The risk to each representative species was characterized using a HQ approach based on this comparison. Appendix E provides the FCM results for the belted kingfisher and mink receptors.

## TABLE 25

## DOSE PARAMETERS FOR THE BELTED KINGFISHER (CERYLE ALCYON)

**Draft Ecological Risk Assessment,**
**Duck and Otter Creeks, Toledo and Oregon, Ohio**

| Parameter | Average Adult | Units | Reference/Notes |
|---|---|---|---|
| Ingestion Rate$_{food}$ | 8.42E-02 | kg/day | Calculated with body weight of 147 grams using the equation for the food requirement for intake of fresh matter for carnivorous birds (food ingestion rate = [3.048[BW(grams)]^0.665]/1000) (Nagy 2001). |
| Ingestion Rate$_{fish}$ | 5.01E-02 | kg/day | Based on 60 percent of food ingestion rate. |
| Ingestion Rate$_{invertebrate}$ | 3.33E-02 | kg/day | Based on 40 percent of food ingestion rate. |
| Ingestion Rate$_{sediment}$ | 5.89E-04 | kg/day | 0.7 percent of total ingestion rate, based on the bald eagle (Pascoe, Blanchet, and Linder 1996). |
| Sediment Concentrations | Mean Concentration | mg/kg | Based on use of the 95 percent UCL about the mean concentration of each chemical in sediment collected from the site (0-1 bss) per EPA baseline ERA guidance (EPA 1997). |
| Food Concentrations | Food Chain Model | mg/kg | Estimated using uptake models referencing concentrations at the site or by multiplying concentrations in sediment in the creek by BSAFs for aquatic invertebrates and fish. |
| Diet Composition | 60%<br>40%<br>0.7% | Fish<br>Invertebrates<br>Sediment | Food will consist of 60 percent fish and 40 percent invertebrates because the belted kingfisher was selected as representative species for carnivorous birds (Alexander 1977 as cited in EPA 1993). |
| Foraging Range | 1.5 | km | Territory size is approximately 1.5 km of shoreline (Brooks and Davis 1987 as cited in EPA 1993b). |
| Site Use Factor | site-specific | Unitless | Based on creek exposure area length divided by foraging range (EPA 1997). |
| Body Weight | 1.47E-01 | kg | Mean body weight of adults from the eastern United States (Brooks and Davis 1987 as cited in EPA 1993). |

**Notes:**

| | |
|---|---|
| BSAF | Biota-sediment accumulation factor |
| bss | Below sediment surface |
| BW | Body weight |
| EPA | U.S. Environmental Protection Agency |
| ERA | Ecological Risk Assessment |
| kg | Kilogram |
| kg/day | Kilograms per day |
| km | Kilometer |
| mg | Milligram |
| mg/kg | Milligrams per kilogram |
| UCL | Upper confidence limit |

**References:**


Nagy, K.A. 2001. "Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds." *Nutrition Abstracts and Reviews*, Series B, 71(10): 2R-12R.

Pascoe, G.A., R.J. Blanchet, and G. Linder. 1996. "Food Chain Analysis of Exposures and Risks to Wildlife at a Metals-Contaminated Wetland." *Archives of Environmental Contamination and Toxicology*, 30:306-318.

U.S. Environmental Protection Agency (EPA). 1993. *Wildlife Exposure Factors Handbook.* December.

EPA. 1997. *Ecological Risk Assessment Guidance for Superfund (RAGS): Process for Designing and Conducting Ecological Risk Assessments*. Interim Final. Office of Solid Waste and Emergency Response (OSWER). EPA-540-R-97-006. June.

## TABLE 26

## DOSE PARAMETERS FOR THE MINK (MUSTELA VISION)
## Draft Ecological Risk Assessment,
## Duck and Otter Creeks, Toledo and Oregon, Ohio

| Parameter | Average Adult | Units | Reference/Notes |
|---|---|---|---|
| Ingestion Rate$_{food}$ | 1.66E-01 | kg/day | Calculated with body weight of 1000 grams using the equation for the food requirement for intake of fresh matter for carnivores (food ingestion rate = [0.794[BW(grams)]^0.773]/1000) (Nagy 2001). |
| Ingestion Rate$_{fish}$ | 1.41E-01 | kg/day | Based on 85 percent of food ingestion rate (Alexander 1977 as cited in EPA 1993). |
| Ingestion Rate$_{invertebrate}$ | 8.28E-03 | kg/day | Based on 5 percent of food ingestion rate (Alexander 1977 as cited in EPA 1993). |
| Ingestion Rate$_{sediment}$ | 1.66E-04 | kg/day | Sediment ingestion expected to be negligible (Sample and Suter 1999). |
| Sediment Concentrations | Mean Concentration | mg/kg | Based on use of the 95 percent UCL about the mean concentration of each chemical in sediment collected from the site (0-1 bss) per EPA baseline ERA guidance (EPA 1997). |
| Food Concentrations | Food Chain Model | mg/kg | Food concentrations were estimated using uptake models using concentrations at the site or by multiplying concentrations in sediment in the creek by BSAFs for aquatic invertebrates and fish. |
| Diet Composition | 85%<br>5%<br>0.1% | Fish<br>Invertebrates<br>Sediment | Food will consist of 85 percent fish and 5 percent invertebrates because the mink was selected as representative species for piscivorous mammal. It was assumed that 10 percent of the diet was not aquatic-based and would include small mammals, birds, and vegetation. |
| Foraging Range | 2.24E+00 | km | Based on kilometers of stream, mean of means, adult, both sexes EPA (1993) as cited in OEPA (2003). |
| Site Use Factor | site-specific | Unitless | Based on creek exposure area length divided by foraging range (EPA 1997) |
| Body Weight | 1.00E+00 | kg | Average body weight from Sample and Suter (1999). |

**Notes:**

| | |
|---|---|
| BSAF | Biota-sediment accumulation factor |
| bss | Below sediment surface |
| EPA | U.S. Environmental Protection Agency |
| ERA | Ecological Risk Assessment |
| kg | Kilogram |
| kg/day | Kilograms per day |
| km | Kilometer |
| mg | Milligram |
| mg/kg | Milligrams per kilogram |
| UCL | Upper confidence limit |

**References:**


OEPA. 2003. *Guidance for Conducting Ecological Risk Assessment*. Department of Emergency and Remedial Response. DERR-00-RR-031. February

Nagy, K.A. 2001. "Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds." *Nutrition Abstracts and Reviews*, Series B, 71(10): 2R-12R.

U.S. Environmental Protection Agency (EPA). 1993. *Wildlife Exposure Factors Handbook*. December.

EPA. 1997. *Ecological Risk Assessment Guidance for Superfund (RAGS): Process for Designing and Conducting Ecological Risk Assessments*. Interim Final. Office of Solid Waste and Emergency Response (OSWER). EPA-540-R-97-006. June.

Sample, B.E. and G.W. Suter II. 1999. "Ecological Risk Assessment in a Large River-Reservoir: 4. Piscivorous Wildlife." *Environ. Toxicol. Chem.*,. 18(4):610-620.

The total exposure from ingestion for each receptor of concern was calculated as the sum of the dietary exposure estimates. The following generic equation was adapted for each representative receptor:

$$Dose_{total} = \frac{([IR_{prey} \times C_{prey}] + [IR_{sedi} \times C_{sed}]) \times SUF}{BW} \qquad (1)$$

where:

| | | |
|---|---|---|
| $Dose_{total}$ | = | Estimated dose from ingestion (milligrams per kilogram body weight-day [mg/kg/day]) |
| $IR_{prey}$ | = | Ingestion rate of prey (kilograms per day [kg/day] wet weight) |
| $C_{prey}$ | = | Concentration in wet weight of COPEC in prey (mg/kg) |
| $IR_{sed}$ | = | Ingestion rate of sediment (kg/day) |
| $C_{sed}$ | = | Concentration in dry weight of COPEC in sediment (mg/kg) |
| SUF | = | Site use factor (unitless) |
| BW | = | Adult body weight (kilogram) |

These risk estimates ensure that the assessment does not indicate little or no risk when a risk actually exists; therefore, conservative assumptions were used in this analysis in the absence of site- or species-specific data.

***Bioaccumulation Factors***

No site-specific prey data are available for use in the dose calculation described above for macroinvertebrates. However, metals data are available from a study on the Buffalo River within the Lake Erie basin for metals and PCBs (U.S. Army Corps of Engineers [USACE] 2003); this information was used to calculate BSAFs. The BSAFs calculated using the Lake Erie basin data for metals were based on sediment concentrations reported as dry weight and organism concentration based on wet weight. For the PCBs, sediment PCB and TOC concentrations were reported in dry weight and organism PCB and lipid concentrations were reported in wet weight, which will result in a unitless BSAF. Therefore, BSAFs for invertebrates and fish, except for metals and PCBs, were obtained from various literature sources (USACE 2006; Tracey and Hanson 1996). The BSAFs used for calculating prey concentrations are provided in Appendix E, Table E-3. It should be noted that there is a higher level of uncertainty with sediment BSAFs that are not site specific. The level of uncertainty for BSAFs for fish is higher than for invertebrates, since fish are likely to move over wider areas and exposure mechanisms are not as direct as benthic invertebrates in constant contact with the sediment.

For the metal constituents, the BSAF was multiplied by the concentration in the sediment to estimate the COPEC concentration in prey as represented in the following equation.

$$C_t = BSAF \times C_s \tag{2}$$

Where:

| | | |
|---|---|---|
| BSAF | = | Biota-sediment accumulation factor (unitless) |
| $C_t$ | = | Concentration in the organism – wet weight (mg/kg) |
| $C_s$ | = | COPEC concentration in sediment – dry weight (mg/kg) |

The BSAFs for the organic constituents are calculated taking into account the sediment organic carbon content and the organism's lipid content as represented by the following equation:

$$BSAF = (C_t / F_l)/(C_s / F_{oc}) \tag{3}$$

This equation is rearranged to calculate tissue concentration ($C_t$) from a BSAF:

$$C_t = (BSAF \times (C_s / F_{oc})) \times F_l \tag{4}$$

Where:

| | | |
|---|---|---|
| BSAF | = | Biota-sediment accumulation factor (unitless) |
| $C_t$ | = | Concentration in the organism (mg/kg) |
| $F_l$ | = | Lipid fraction in tissue (percent) |
| $C_s$ | = | COPEC concentration in sediment (mg/kg) |
| $F_{oc}$ | = | Organic carbon fraction in the sediment (percent) |

Site-specific organic carbon data were used to calculate the organism tissue concentration. The mean TOC value was used for this calculation (see Appendix A). The lipid fractions used in the calculations were 5.3 percent for fish and 2.5 percent for invertebrates (USACE 2006).

### 4.3.2 Toxicity Reference Values

TRVs used in the FCMs were primarily from the EPA's Eco-Soil Screening Level (Eco-SSL) documents (EPA 2005, 2007, 2008); and U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (EPA 2002). Each TRV represents a critical exposure level from a toxicological study and is supported by a data set of toxicological exposures and effects. A low TRV is a conservative value consistent with a chronic no observed adverse effects level (NOAEL). Values from EPA's Eco-SSL documents were considered low TRVs. A high TRV represents a mid-range effects level for a

COPEC at which the endpoint of toxicity is ecologically relevant. A high TRV is a value consistent with a chronic lowest observed adverse effects level (LOAEL). For PAH compounds, the TRVs were available for two general classes of compounds—High Molecular Weight PAHs and Low Molecular Weight PAHs (EPA 2008). The COPEC-specific low and high TRVs are provided in Appendix E, Table E-4. TRVs were derived separately for birds and mammals using available toxicological literature. Consistent with EPA Region 5 policy, the TRVs were not adjusted based on body scaling or allometric conversion.

### 4.3.3 Hazard Quotient Approach

COPEC doses were calculated for the belted kingfisher and mink using average values for exposure parameters such as body weight and ingestion rate and EPC sediment concentrations. By calculating both a $HQ_{(dose/high\ TRV)}$ and $HQ_{(dose/low\ TRV)}$ for sediment concentrations, a risk manager can more definitively assess risk to the typical individual in the overall population.

The interpretation of each HQ is summarized on Table 27:

**TABLE27**
**HAZARD QUOTIENT (HQ) INTERPRETATION**

| HQ = Dose/TRV | Low TRV | High TRV | Between Low and High TRV |
|---|---|---|---|
| | $HQ_{(dose/low\ TRV)}$ <1 indicates little or no risk to average receptor | $HQ_{(dose/high\ TRV)}$ > 1 indicates potential significant risk to average receptor | Between $HQ_{(dose/high\ TRV)}$ < 1 and $HQ_{(dose/low\ TRV)}$ > 1 indicates potential for risk to average receptor. However, the magnitude of the potential risk is uncertain. |

Notes:
HQ Hazard quotient
TRV Toxicity reference value

### 4.3.4 Toxicological Effects on Birds and Mammals and Interpretation of Hazard Quotient

Daily dose estimates were compared with high and low TRVs to estimate the potential adverse biological effects on each receptor. The risk to representative receptors was characterized based on this comparison, which was conducted consistent with EPA's HQ methodology (EPA 1986), as follows:

$$HQ = \frac{Dose}{TRV} = \frac{(mg / kg - day)}{(mg / kg - day)}$$

Where:

| | | |
|---|---|---|
| HQ | = | Hazard quotient (unitless) |
| Dose | = | COPEC-, receptor-, and site-specific daily dose estimate |
| TRV | = | COPEC- and receptor-specific toxicity reference value |

Because of the differences in the degree of conservatism in TRVs selected for various COPECs and receptors, the resulting HQ values are not compared or added together among COPECs or receptors; instead, these are considered individually (U.S. Department of the Navy [Navy] 1999).

As described in Section 2.2, chemicals (primarily metals) were not eliminated as COPECs based on comparison to background concentrations; this step was not employed in this BERA based on the absence of site-specific background results. Nonetheless, by ignoring background comparisons, some inorganic chemicals present at or below background concentrations may have been retained as COPECs. Inclusion of these chemicals may contribute to an overestimate of exposures, risks, and hazards.

## 4.4 FOOD CHAIN MODEL RESULTS

The evaluation of risk to ecological receptors focused on selected assessment endpoints identified in Section 4.1. The potential risks for the representative bird (belted kingfisher) and mammal (mink) were evaluated based on the site-specific fish and invertebrate concentrations to represent the Duck and Otter Creeks. The risk for the belted kingfisher and mink are based on modeled doses and comparison to TRVs. A HQ for the results of the FCM was calculated by dividing the chemical dose in the sediment (in mg/kg) by the benchmark. This section presents the results of the FCM using the fish tissue and invertebrate results for each exposure area of the creeks. An estimated daily ingested dose for each COPEC was calculated for the belted kingfisher and mink based on life history and foraging habits. One exposure concentration was used in the FCM—EPC value. Dose and HQ calculations are presented in their entirety in Appendix E. Only those chemicals with a HQ greater than 1 are reported in this section.

#### 4.4.1 Belted Kingfisher – Duck Creek

HQs greater than 1 based on the EPC concentrations for sediments using the low TRV are provided in Table 28. The COPECs that are the most significant risk drivers are arsenic, lead, mercury, and selenium. Cadmium, chromium, mercury, zinc, total PCBs, and 4,4'-DDE also have HQs greater than 1. Based on the approach for interpreting the HQs (Table 27), these results indicate a potential impact on the belted kingfisher due to arsenic, lead, mercury, selenium, and zinc in the fish and invertebrate tissues, and sediments.

**TABLE 28**
**HAZARD QUOTIENTS GREATER THAN 1 FOR BELTED KINGFISHER**
**DUCK CREEK – LOW TRV**

| Chemical | Exposure Area A | Exposure Area B | Exposure Area C | Exposure Area D | Exposure Area E |
|---|---|---|---|---|---|
| Arsenic | **6.5** | **5.4** | **1.8** | **6.6** | 1.0 |
| Cadmium | 0.3 | 0.3 | 0.1 | **1.0** | 0.04 |
| Chromium | **1.3** | **1.1** | 0.7 | **2.9** | 0.3 |
| Lead | **14** | **11** | **7.0** | **35** | **2.1** |
| Mercury | **1.1** | 0.6 | 0.4 | **20** | 0.05 |
| Selenium | **19** | **17** | NA | **55** | **5.5** |
| Zinc | **2.2** | **1.6** | 0.9 | **5.2** | 0.3 |
| Total PCBs | **3.6** | 1.0 | NA | NA | 0.9 |
| 4,4'-DDE | 0.8 | **1.2** | 0.6 | **2.6** | 0.08 |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA Not applicable
DDE Dichlorodiphenyldichloroethene
PCB Polychlorinated biphenyl
TRV Toxicity reference value

HQs greater than 1 based on the EPC concentrations for sediments using the high TRV are provided in Table 29. The COPECs with HQs greater than 1 were lead, mercury, selenium, and zinc, indicating a likely impact on belted kingfisher due to the COPECs in the fish and invertebrate tissue, and sediment in the Duck Creek.

**TABLE 29**
**HAZARD QUOTIENTS GREATER THAN 1 FOR BELTED KINGFISHER**
**DUCK CREEK – HIGH TRV**

| Chemical | Exposure Area A | Exposure Area B | Exposure Area C | Exposure Area D | Exposure Area E |
|---|---|---|---|---|---|
| Lead | 0.5 | 0.4 | 0.3 | **1.3** | 0.08 |
| Mercury | 0.3 | 0.1 | 0.08 | **4.4** | 0.01 |
| Selenium | **6.0** | **5.3** | NA | **17** | **1.7** |
| Zinc | **1.1** | 0.8 | 0.4 | **2.5** | 0.3 |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA Not applicable
TRV Toxicity reference value

### 4.4.2 Mink – Duck Creek

HQs greater than 1 based on the EPC concentrations for sediments using the low TRV are provided in Table 30. The COPECs that are the most significant risk drivers are arsenic and selenium. HQs for barium, lead, and 4,4’-DDE are slightly above 1. These results indicate a potential impact to the mink due mainly to arsenic and selenium in the fish and invertebrate tissues, and sediment of Duck Creek.

**TABLE 30**
**HAZARD QUOTIENTS GREATER THAN 1 FOR MINK**
**DUCK CREEK – LOW TRV**

| Chemical | Exposure Area A | Exposure Area B | Exposure Area C | Exposure Area D | Exposure Area E |
|---|---|---|---|---|---|
| Arsenic | **10** | **7.5** | **2.5** | **9.2** | **1.3** |
| Barium | 0.5 | 0.5 | 0.3 | **1.9** | 0.07 |
| Lead | **1.0** | 0.7 | 0.5 | **2.3** | 0.1 |
| Selenium | **8.9** | **6.9** | NA | **23** | **2.3** |
| 4,4’-DDE | 0.4 | 0.5 | 0.2 | **1.1** | 0.03 |
| High Molecular Weight PAHs | 0.6 | 0.2 | 0.4 | 0.6 | **7.1** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA Not applicable
DDE Dichlorodiphenyldichloroethene
PAH Polycyclic aromatic hydrocarbons
TRV Toxicity reference value

HQs greater than 1 based on the EPC concentrations for sediments using the high TRV are provided in Table 31. The COPEC with a HQ greater than 1 was selenium, indicating a likely impact on mink due to selenium in the fish and invertebrate tissue, and sediment in the Duck Creek.

**TABLE 31**
**HAZARD QUOTIENTS GREATER THAN 1 FOR MINK**
**DUCK CREEK – HIGH TRV**

| Chemical | Exposure Area A | Exposure Area B | Exposure Area C | Exposure Area D | Exposure Area E |
|---|---|---|---|---|---|
| Selenium | **1.9** | **1.5** | NA | **4.9** | 0.5 |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA Not applicable
TRV Toxicity reference value
.

The FCM results for both the kingfisher and mink consistently identified Exposure Area D of Duck Creek as the area with the greatest potential impact to these receptors – it had the highest HQs and the most constituents of concern. The second area of concern noted from these results is Exposure Area A.

### 4.4.3 Belted Kingfisher – Otter Creek

HQs greater than 1 based on the EPC concentrations for sediments using the low TRV are provided in Table 32. The COPECs that are the most significant risk drivers are lead and total PCBs. Arsenic, chromium, mercury, selenium, and zinc also have HQs greater than 1. Based on the approach for interpreting the HQs (Table 27), these results indicate a potential impact on the belted kingfisher due to lead and total PCBs in the fish and invertebrate tissues, and sediments of Otter Creek.

**TABLE 32**
**HAZARD QUOTIENTS GREATER THAN 1 FOR BELTED KINGFISHER**
**OTTER CREEK – LOW TRV**

| Chemical | Exposure Area A | Exposure Area B | Exposure Area C | Exposure Area D | Exposure Area E |
|---|---|---|---|---|---|
| Arsenic | **1.9** | **2.3** | **3.1** | **3.2** | **2.5** |
| Chromium | **5.7** | **3.0** | **4.8** | **1.7** | **1.2** |
| Lead | **11** | **11** | **11** | **12** | **12** |
| Mercury | **1.0** | 1.0 | **1.3** | 0.5 | 0.5 |
| Selenium | NA | NA | **6.2** | NA | NA |
| Zinc | **2.4** | **2.5** | **1.2** | **2.2** | **1.3** |
| Total PCBs | **5.6** | **2.8** | **170** | **4.0** | **30** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA Not applicable
PCB Polychlorinated biphenyl
TRV Toxicity reference value

HQs greater than 1 based on the EPC concentrations for sediments using the high TRV are provided in Table 33. The COPECs with HQs greater than 1 were zinc for Exposure Areas A, B, and D of Otter Creek, selenium for Exposure Area C of Otter Creek, and total PCBs for Exposure Areas C and E of Otter Creek, indicating a likely impact on belted kingfisher due to the COPECs in the fish and invertebrate tissue, and sediment.

**TABLE 33**
**HAZARD QUOTIENTS GREATER THAN 1 FOR BELTED KINGFISHER**
**OTTER CREEK – HIGH TRV**

| Chemical | Exposure Area A | Exposure Area B | Exposure Area C | Exposure Area D | Exposure Area E |
|---|---|---|---|---|---|
| Selenium | NA | NA | **2.0** | NA | NA |
| Zinc | **1.1** | **1.2** | 0.6 | **1.1** | 0.6 |
| Total PCBs | 0.4 | 0.2 | **12** | 0.3 | **2.1** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA Not applicable
PCB Polychlorinated biphenyl
TRV Toxicity reference value

### 4.4.4 Mink – Otter Creek

HQs greater than 1 based on the EPC concentrations for sediments using the low TRV are provided in Table 34. The COPECs that are the most significant risk drivers are arsenic and high molecular weight PAHs. Chromium, lead, selenium, and total PCBs have HQs greater than 1 for various exposure areas of Otter Creek. These results indicate that a potential impact to the mink is due mainly to arsenic and high molecular weight PAHs in the fish and invertebrate tissues, and sediment of Otter Creek.

**TABLE 34**
**HAZARD QUOTIENTS GREATER THAN 1 FOR MINK**
**OTTER CREEK - LOW TRV**

| **Chemical** | **Exposure Area A** | **Exposure Area B** | **Exposure Area C** | **Exposure Area D** | **Exposure Area E** |
|---|---|---|---|---|---|
| Arsenic | **3.9** | **3.2** | **6.4** | **5.7** | **5.2** |
| Chromium | **1.8** | 0.6 | **1.5** | 0.4 | 0.4 |
| Lead | **1.1** | 0.7 | **1.0** | 1.0 | **1.2** |
| Selenium | NA | NA | **3.8** | NA | NA |
| Total PCBs | 0.5 | 0.2 | **14** | 0.3 | **2.4** |
| High Molecular Weight PAHs | 0.53 | **2.2** | **1.5** | **9.5** | **7.9** |

Notes:
Value in bold text indicates hazard quotient greater than 1
NA Not applicable
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl
TRV Toxicity reference value

HQs greater than 1 based on the EPC concentrations for sediments using the high TRV are provided in Table 35. The COPECs with HQs greater than 1 were total PCBs for Exposure Area C of Otter Creek and high molecular weight PAHs for Exposure Area D of Otter Creek, indicating a likely impact on mink due to the COPECs in the fish and invertebrate tissue, and sediment.

**TABLE 35**
**HAZARD QUOTIENTS GREATER THAN 1 FOR MINK**
**OTTER CREEK – HIGH TRV**

| **Chemical** | **Exposure Area A** | **Exposure Area B** | **Exposure Area C** | **Exposure Area D** | **Exposure Area E** |
|---|---|---|---|---|---|
| Total PCBs | 0.1 | 0.04 | **3.8** | 0.08 | 0.7 |

Notes:
Value in bold text indicates hazard quotient greater than 1
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl
TRV Toxicity reference value

The FCM results for both the kingfisher and mink consistently identified Exposure Area C of Otter Creek as the area with the greatest potential impact to these receptors – it had the highest HQs and the most constituents of concern. The second area of concern noted from these results is Exposure Area A.

## 5.0 5UNCERTAINTY ANALYSIS

Uncertainty plays an important role in risk-based decision-making and is therefore incorporated explicitly into the risk characterization process. Identifying known sources of uncertainty is a critical component of a SLERA and BERA because conservative default assumptions incorporated into the ERA protocols are associated with substantial uncertainty. By evaluating uncertainties, potential errors are made more explicit in the risk management process (Suter 1993).

Three sources of uncertainty in ERAs are described in Suter (1993):

1. Mistakes in execution of the assessment (errors such as incorrect measurements, data recording errors, and computational errors).

2. Imperfect knowledge of factors that could be known (ignorance about some aspect of the ecosystem that may be relevant, such as assumptions used in dose models, practical constraints on the ability to measure everything, and lack of knowledge on toxicological effects of all COPECs on all species).

3. Inherent randomness of the world (stochasticity in physical or biological processes that may affect assumptions or actual risk such as variation in population parameters or rainfall patterns).

As discussed in earlier sections, the ERA process is based on a number of assumptions and extrapolations to evaluate potential risk to ecological receptors. The assumptions in the ERA are intentionally conservative and result in overestimates of site-specific risk to ensure that no COPECs that pose actual risk are eliminated from the ERA. The following subsections discuss major uncertainties and conservative assumptions used in this ERA.

### 5.1 ANALYTICAL DATA

Limited data collected from the Duck Creek and Otter Creek exposure areas were used to evaluate conditions of each exposure area; all concentrations measured are therefore only estimates of concentrations that may occur at the creeks exposure areas (with associated error). Estimates of COPEC concentrations in media were based on samples collected from limited areas within each exposure area, but were used to characterize conditions throughout the exposure area. It was assumed that the EPC concentrations in sediment represented the entire exposure area. This method creates bias in the data toward the more disturbed or affected environments at the site and is likely to overestimate COPEC exposure concentrations. Given the uncertainties associated with sampling in large areas, the sample size of data was adequate to characterize each exposure area. The use of the EPC COPEC concentrations in the FCM attempted to provide an understanding of the potential upper and central range of potential concentrations.

To determine potential exposure point concentrations, Duck Creek and Otter Creek were both divided into five exposure areas. The division was based on visual evaluations of each creek to divide them into generally equal exposure areas. Dividing the creeks into segments opens up the possibility that a hot spot of contamination could influence the estimated exposure concentration. This could either underestimate or overestimate an exposure concentration.

Bulk sediment concentrations may not necessarily relate to exposure concentrations for benthic insects. There are a number of factors that influence the actual exposure concentrations for the benthic insects. It has been well documented that sediment pore water concentrations are a better indicator of toxicity than bulk chemical analysis. The use of AVS/SEM data that provides an understanding of the bioavailability of metals in the sediments and direct bioassays of the sediment reduced the uncertainty associated with the analysis of toxicity based solely on bulk chemical analysis.

There are uncertainties associated with sediment toxicity bioassay tests. The tests were conducted with two water replacements per day, rather than aeration. This approach may cause additional agitation of the sediments and increase the physical stress levels to the organisms. This issue may lead to an overestimation of the sediment toxicity.

## 5.2 USE OF SCREENING VALUES

Comparisons of site-specific EPC concentrations to generic screening values established by OEPA (2003a), EPA (2003), and other sources were used as indicators of potential adverse effects. Bulk chemistry results from each exposure area likely overestimate the bioavailable fraction. In addition, screening values were not developed using site-specific taxa and may rely on data from tolerant benthic species, such as midges and worms. The use of these values may overestimate potential toxicity. As discussed in previous sections, a number of COPECs could not be evaluated because screening values were not available. Development of toxicity benchmarks is often precluded by lack of relevant toxicological literature. The risk to invertebrates and wildlife from these compounds is therefore underestimated.

## 5.3 UNCERTAINTIES ASSOCIATED WITH THE FOOD-CHAIN MODEL

The following discussion highlights uncertainties associated with the food-chain model used to evaluate risk to birds and mammals in Section 4. The overall effect of these uncertainties and conservative assumptions cannot be quantitatively calculated without site-specific information.

### 5.3.1 Tissue Residue Data

No site-specific tissue residue data for metals, total PCBs, and PAH compounds were available for these sites, so site-specfic BSAFs could not be estimated. This ERA relied on BSAFs reported in the literature, although some values were available from other Lake Erie tributaries. This approach is generally associated with much more uncertainty than when site-specific concentrations in prey tissue are used to develop BSAFs. In particular, estimates of concentration in prey based on literature values may not reflect assimilation and depuration of COPECs in the same way as laboratory time-averaged tissue concentrations studies. The level of uncertainty for BSAFs for fish is higher than for invertebrates, since fish are likely to move over wider areas and exposure mechanisms are not as direct as benthic invertebrates which are in constant contact with the sediment. Concentrations in prey may be either overestimated or underestimated because conditions at the site are likely different from conditions under which the other data were collected. Literature generally indicates modeling overestimates tissue concentrations.

### 5.3.2 Dietary Composition

The diet of each receptor was assumed to consist of a specific percent of an aquatic-based food type, which is not necessarily an accurate reflection of a site-specific diet. This simplification of dietary composition may result in an overestimate or underestimate of risk.

### 5.3.3 Bioavailability

All COPECs were conservatively assumed 100-percent bioavailable for all receptors in the food chain model. As was noted with the AVS/SEM results, metals bioavailability via direct exposure to the sediments may be limited and may also limit metal uptake by invertebrates prey. Two major factors impact the movement of organic chemicals within the sediments and their transfer to the receptors: sediment total organic carbon content and receptor lipid content. Both organic carbon and lipids have an affinity for polar organic compounds, these compounds are likely to bind to organic carbon in the sediments, or accumulate in lipids in receptor tissue. Organic carbon may also play a role in the bioavailability of metals, by forming ligand complexes with the metals, reducing their bioavailability (DiToro 2005). Depending on the COPEC and receptor, however, bioavailability may be significantly less than 100 percent. This conservative estimate of bioavailability results in an overestimate of the associated risk.

### 5.3.4 Body Weight and Ingestion Rates

The range of reported body weights and ingestion rates for wildlife varies significantly in the literature (EPA 1993). These values may not reflect the true attributes of these receptors at Duck and Otter Creeks. The risk may be either overestimated or underestimated, depending on the difference between actual values and literature values.

### 5.3.5 Spatial Distribution

As noted earlier, Duck and Otter Creeks were divided into five exposure areas to assist in the evaluation of the spatial distribution of potential risk. The assumption that more mobile organisms, such as the fish, bird, or mammal, would be exposed throughout their lifetimes to contaminants in only one exposure area is likely an over simplification of the actual exposure. The associated estimated risks are also likely to overestimate actual risks.

### 5.3.6 Development of Toxicity Reference Values

TRVs used in risk calculations were derived from literature studies. These studies were not conducted on the specific receptors used in this assessment. The effect of this uncertainty cannot be estimated; it could result in either an overestimate or underestimate of risk.

### 5.3.7 COPECs without Toxicity Reference Values

The comparison of estimated doses to TRVs was used as an indicator of potential adverse effects on birds and mammals. As discussed in previous sections, a number of COPECs could not be evaluated when TRVs were not available. TRVs cannot be derived for chemicals that lack sufficient published toxicological data. The risk to birds and mammals from these compounds is therefore unknown.

### 5.3.8 Interspecies Extrapolation

The use of receptor species as surrogates for other related or ecologically similar taxa is supported by current guidance (EPA 1992a, b); however, this type of analysis does not account for differences among taxa. In addition, uncertainty exists in assessments of risk to whole communities based on the detailed analysis of relatively few taxa, which may result in an overestimate or underestimate of risk. The evaluation of DELT relied on data developed from observations with English sole, and this species is not present in the Duck and Otter Creeks. Uncertainties are associated with interspecies extrapolation: it is not known if the species in the Duck and Otter Creeks are susceptible to DELTs from PAHs at the same rate as the test species. In addition, the screening criteria were based on total PAHs, not specific PAHs, and the mixture of PAHs in Duck and Otter Creek sediments is likely to differ from those used to develop the criteria. So it is not clear how the Duck and Otter Creeks species will be impacted by a different PAH mixture, since the mixture from the original study was not known.

### 5.3.9 Individual and Population Variation

Individuals within a population vary in a number of life history and behavioral traits. The dose model focused on adults and may not accurately represent ingestion of COPECs by juvenile stages that may feed in a different manner. The risk may be overestimated or underestimated depending on the behavior and proportion of juveniles among the population.

# 6.0 CONCLUSIONS AND RECOMMENDATIONS

The ERA's objective was to identify those populations that may be exposed to sediment contamination in the Duck and Otter Creeks, and whether that exposure could result in unacceptable risk to the ecological receptors of the Duck and Otter Creeks. The ERA identified a number of potential receptors to the contaminated sediments—benthic invertebrates, benthic-coupled fish, and piscivorous birds and mammals. To assess the potential risks to these populations, the ERA used several methods. The first compared the sediment concentrations to OEPA, EPA, and literature-developed sediment criteria. The total PAH concentrations were compared to criteria for formation of lesions in bottom-dwelling fish. On selected sediment samples from Duck and Otter Creeks, 20-day survival and growth sediment bioassays with an invertebrate midge were conducted. To assess the potential impact of metals on the observed toxicity, the AVS and SEM data for both creeks as reported by SulTRAC (2007) were also evaluated. In addition, a FCM was used to estimate potential exposures to piscivorous birds and mammals. These groups were represented by the belted kingfisher and mink. To assist the risk managers and to aid in the evaluation, Duck and Otter Creeks were each divided into five equal exposure areas, and exposures were estimated for each exposure area. Tables 36 and 37 summarize the identified risk associated with each exposure area of Duck Creek and Otter Creek in sediments, respectively.

Duck Creek Exposure Area E exhibited the highest risk for all the methods used to assess potential exposures. This area was followed by Exposure Area D, with Exposure Areas A, B, and C exhibiting the lowest risks. The potential for the formation of lesions in bottom dwelling fish was significant at all locations based on the screening criteria used. Although the site ranking was not consistent with the bulk chemical concentration screening after Exposure Area E, with Exposure Areas A, D, B, and C exhibiting lower lesion formation risk. The mink appeared to be the least sensitive receptor of those evaluated with the food chain model. The AVS/SEM results as reported by the laboratory showed that the ratio of SEM to AVS in all samples tested was less than 1 for all relevant metals tested. This ratio indicates a high probability that most of the metals in the sediments may be bound to sulfides and therefore not bioavailable (DiToro and others 2005), so the sediment risks associated with metals are expected to be limited. The bioassay results were not consistent with the HQ values from the chemical concentrations in the sediment. The bioassay results were evaluated with potential stressors; however, no significant statistical relationship was identified to explain the observed toxicity.

**TABLE 36**
**SUMMARY OF POTENTIAL RISKS –**
**DUCK CREEK SEDIMENTS**

| Duck Creek Exposure Area | Benthic Aquatic Life – Probable Effect/Severe | Chemicals of Concern | Benthic Aquatic Life – Chronic | Chemicals of Concern | Lesion for Bottom-Dwelling Fish | Bioassay Percent Survival Less than Controls |
|---|---|---|---|---|---|---|
| A | Yes HQ < 4.0 | **Arsenic**, Cadmium, Lead, Zinc | Yes HQ < 12 | **Arsenic**, Cadmium, Lead, Mercury, Selenium, Zinc, 4,4'-DDD, 4,4'-DDE | Yes HQ < 193 | 2 out of 3 stations |
| B | Yes HQ < 3.8 | **Arsenic**, Lead, Zinc, Total PAH Mixture | Yes HQ < 12 | **Arsenic**, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Zinc, 4,4'-DDD, 4,4'-DDE | Yes HQ < 26 | 1 out of 2 stations |
| C | Yes HQ < 2.5 | Arsenic, **Lead**, Zinc | Yes HQ < 7.8 | Arsenic, Barium, Cadmium, Chromium, **Lead**, Mercury, Zinc, 4.4'-DDD, 4,4'-DDE | Yes HQ < 20 | 2 out of 2 stations |
| D | Yes HQ < 7.3 | Arsenic, Cadmium, Chromium, **Lead**, Mercury, Zinc, Total PAH Mixture | Yes HQ < 57 | Arsenic, Barium, Cadmium, Chromium, Lead, **Mercury**, Selenium, Zinc, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT | Yes HQ < 91 | 0 out of 2 stations |

Notes:
The maximum HQ among multiple chemicals is presented, and the chemical with the highest HQ is bolded.

DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
DDT Dichlorodiphenyltrichloroethane
HQ Hazard Quotient
PAH Polynuclear aromatic hydrocarbons

**TABLE 37**
**SUMMARY OF POTENTIAL RISKS –**
**OTTER CREEK SEDIMENTS**

| **Otter Creek Exposure Area** | **Benthic Aquatic Life – Probable Effect/ Severe** | **Chemicals of Concern** | **Benthic Aquatic Life – Chronic** | **Chemicals of Concern** | **Lesion for Bottom-Dwelling Fish** | **Bioassay Percent Survival Less than Controls** |
|---|---|---|---|---|---|---|
| A | Yes, HQ < 3.3 | Arsenic, **Chromium**, Lead, Zinc, Total PAH Mixture | Yes, HQ < 7.2 | Arsenic, Barium, Cadmium, **Chromium**, Lead, Mercury, Zinc | Yes HQ < 27 | 3 out of 4 stations |
| B | Yes, HQ < 15 | Arsenic, Chromium, Lead, Zinc, Benzo(a)anthracene, Benzo(b)fluoranthene, Chrysene, Fluoranthene, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes, HQ < 6.5 | Arsenic, Barium, Cadmium, Chromium, **Lead**, Mercury, Zinc, Total PAH Mixture | Yes HQ < 174 | 2 out of 2 stations |
| C | Yes HQ < 10 | Arsenic, Chromium, Lead, Zinc, Total PCBs, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes HQ < 6.5 | Arsenic, Barium, Cadmium, Chromium, **Lead**, Mercury, Selenium, Zinc, Total PCBs, Total PAH Mixture | Yes HQ < 87 | 2 out of 2 stations |
| D | Yes HQ < 50 | Arsenic, Cadmium, Lead, Zinc, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Phenanthrene,Pyrene, **Total PAH Mixture** | Yes HQ < 9.4 | Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Zinc, 4,4'-DDD, 4,4'-DDE, Fluoranthene, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes HQ < 402 | 2 out of 2 stations |
| E | Yes HQ < 35 | Arsenic, Lead, Zinc, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, Pyrene, **Total PAH Mixture** | Yes HQ < 7.4 | Arsenic, Barium, Cadmium, Chromium, **Lead**, Mercury, Zinc, 4,4'-DDD, 4,4'-DDE, Total PCBs, Fluoranthene, Pyrene, Total PAH Mixture | Yes HQ < 401 | 2 out of 2 stations |

Notes:
The maximum HQ among multiple chemicals is presented, and the chemical with the highest HQ is bolded.

DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
HQ Hazard Quotient
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl

Otter Creek Exposure Area D exhibited the highest risk for all the methods used to assess potential exposures.  This area was followed by Exposure Area E, with Exposure Areas A, B, and C exhibiting the lowest risks.  The potential for the formation of lesions in bottom dwelling fish was significant at all locations based on the screening criteria used.  Although the site ranking was not consistent with the bulk chemical concentration screening after Exposure Area E, with Exposure Areas B, C, and A exhibiting lower lesion formation risk.  The mink appeared to be the least sensitive receptor of avian and mammalian receptors evaluated with the food chain model. The bioassay results were a little more consistent with the HQ values from the chemical concentrations in the sediment.  However, when the bioassay results were evaluated with potential stressors no significant statistical relationship was identified to explain the observed toxicity.

A FCM was used to estimate potential exposures to piscivorous birds and mammals.  These groups were represented by the belted kingfisher and mink.  Table 38 summarizes the identified risk associated with each receptor of the Duck Creek via exposure to fish and invertebrate tissue and sediments.  Lead, mercury, selenium, and zinc are the contaminants that have the greatest impact on the belted kingfisher for Duck Creek.  Selenium is the contaminant that has the greatest impact on the mink for Duck Creek.  The FCM model relied on estimated fish tissue and invertebrate tissue to estimate exposures and potential risks.  Table 39 summarizes the identified risk associated with each receptor of the Otter Creek via exposure to fish and invertebrate tissue and sediments.  Selenium, zinc, and total PCBs are the contaminants that have the greatest impact on the belted kingfisher for Otter Creek.  Total PCBs and high molecular weight PAHs are the contaminants that have the greatest impact on the mink for Otter Creek.

OEPA has conducted several biological surveys of the creeks to describe the aquatic communities and assess the health or biological integrity of these communities (OEPA 1986, 1993, and 1997).  The results indicate that the creeks are highly stressed and do not support a strong and diverse biological community.  Bulk sediment toxicity tests conducted on samples collected from Otter Creek in 1994 using an amphipod (*Hyalella azteca*) revealed a progressive decline in sediment quality downstream (north) of Wales Road (OEPA 1994 and 1998, 1995).

**TABLE 38**
**SUMMARY OF POTENTIAL RISKS –**
**DUCK CREEK BELTED KINGFISHER AND MINK**

| DUCK CREEK EXPOSURE AREA | Food Chain Model – Belted Kingfisher | Chemicals of Concern | Food Chain Model – Mink | Chemicals of Concern |
|---|---|---|---|---|
| A | Yes, Low TRV HQ<19 and High TRV HQ<6.0 | Low TRV – Arsenic, Chromium, Lead, Mercury, **Selenium**, Zinc, Total PCBs, High TRV – **Selenium**, Zinc | Yes, Low TRV HQ<11 and High TRV HQ<1.9 | Low TRV – **Arsenic**, Lead, Selenium, High TRV - **Selenium** |
| B | Yes, Low TRV HQ<17 and High TRV HQ<5.3 | Low TRV – Arsenic, Chromium, Lead, **Selenium**, Zinc, 4,4’-DDE, High TRV – **Selenium** | Yes, Low TRV HQ<7.5 and High TRV HQ<1.5 | Low TRV – **Arsenic**, Selenium, High TRV - **Selenium** |
| C | Yes, Low TRV HQ<7.0 | Low TRV – Arsenic, **Lead** | Yes, Low TRV HQ<2.5 | Low TRV – **Arsenic** |
| D | Yes, Low TRV HQ<55 and High TRV HQ<17 | Low TRV – Arsenic, Cadmium, Chromium, Lead, Mercury, **Selenium**, Zinc, 4’4-DDE, High TRV – Lead, Mercury, **Selenium**, Zinc | Yes, Low TRV HQ<23 and High TRV HQ<4.9 | Low TRV – Arsenic, Barium, Lead, **Selenium**, 4,4’-DDE, High TRV - **Selenium** |
| E | Yes, Low TRV HQ<1.7 | Low TRV – **Selenium**, Total PCBs | Yes, Low TRV HQ<7.1 | Low TRV – **High molecular weight PAHs** |

Notes:
The maximum HQ among multiple chemicals is presented, and the chemical with the highest HQ is bolded.

DDE Dichlorodiphenyldichloroethene
HQ Hazard Quotient
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl
TRV Toxicity reference value

**TABLE 39**
**SUMMARY OF POTENTIAL RISKS –**
**OTTER CREEK BELTED KINGFISHER AND MINK**

| OTTER CREEK EXPOSURE AREA | Food Chain Model – Belted Kingfisher | Chemicals of Concern | Food Chain Model – Mink | Chemicals of Concern |
|---|---|---|---|---|
| A | Yes, Low TRV HQ<11 and High TRV HQ<1.1 | Low TRV – Arsenic, Chromium, **Lead**, Mercury, Zinc, Total PCBs, High TRV - **Zinc** | Yes, Low TRV HQ<3.9 | Low TRV – **Arsenic**, Chromium, Lead |
| B | Yes, Low TRV HQ<11 and High TRV HQ<1.2 | Low TRV – Arsenic, Chromium, **Lead**, Zinc, Total PCBs, High TRV - **Zinc** | Yes, Low TRV HQ<16 | Low TRV – **Arsenic**, High molecular weight PAHs |
| C | Yes, Low TRV HQ<170 and High TRV HQ<12 | Low TRV – Arsenic, Chromium, Lead, Mercury, Selenium, Zinc, **Total PCBs**, High TRV – Selenium, **Total PCBs** | Yes, Low TRV HQ<14 and High TRV HQ<3.8 | Low TRV – Arsenic, Chromium, Lead, Selenium, **Total PCBs**, High molecular weight PAHs, High TRV – **Total PCBs** |
| D | Yes, Low TRV HQ<12 and High TRV HQ<1.1 | Low TRV – Arsenic, Chromium, **Lead**, Zinc, and Total PCBs, High TRV - **Zinc** | Yes, Low TRV HQ<9.5 | Low TRV – Arsenic, **High molecular weight PAHs** |
| E | Yes, Low TRV HQ<30 and High TRV HQ<2.1 | Low TRV – Arsenic, Chromium, Lead, Zinc, **Total PCBs**, High TRV – **Total PCBs** | Yes, Low TRV HQ<7.9 | Low TRV – Arsenic, Lead, Total PCBs, **High molecular weight PAHs** |

Notes:
The maximum HQ among multiple chemicals is presented, and the chemical with the highest HQ is bolded.

HQ Hazard Quotient
PAH Polynuclear aromatic hydrocarbons
PCB Polychlorinated biphenyl
TRV Toxicity reference value

The results of the SLERA and BERA noted potential impacts to benthic invertebrates and terrestrial receptors through the bioassay results and the comparison of sediment concentrations to available sediment criteria. These results are consistent with the previous studies that have identified a stressed ecological system within both Duck and Otter Creeks.

For Duck Creek, the comparison of the sediment concentrations to sediment screening values showed concentrations above those values in all exposure areas. The bioassay results showed percent survival statistical differences in samples from Exposure Areas A, B, and C. The Duck Creek FCM results for both the kingfisher and mink consistently identified Exposure Area D as the area with the greatest potential impact to these receptors – it had the highest HQs and the most constituents of concern; the second area of most concern noted from these results is Exposure Area A.

For Otter Creek, the comparison of the sediment concentrations to sediment screening values also showed concentrations above those values in all exposure areas. The bioassay results showed percent survival statistical differences in samples from all exposure areas. The Otter Creek FCM results for both the kingfisher and mink consistently identified Exposure Area C of Otter Creek as the area with the greatest potential impact to these receptors – it had the highest HQs and the most constituents of concern; the second area of most concern noted from these results is Exposure Area A.

**Recommendations**

As noted above, the weight of evidence provided in this assessment has identified potential risks associated with exposure to sediments in Duck and Otter Creeks to benthic receptors and to terrestrial receptors that may use the creeks as potential food sources. The bioassay data and the subsequent analysis of potential stressors did not identify a clear stressor or groups of stressors that may be the major influence on the expressed toxicity. Additional studies of the sediments may provide a better insight into the contaminants that may be driving the expressed toxicity. EPA (2003) has noted that pore water is the controlling factor for sediment toxicity. Obtaining sediment pore water samples and analyzing them for metals, PAHs, and pesticides may provide a better understanding of which constituent may be the cause for the observed toxicity. Another constituent that was not measured in any of the sediment samples that may have an impact on the observed toxicity is ammonia. Sampling the sediment for this constituent would add to a better understanding of potential causes for the observed toxicity.

Performing site-specific sediment bioaccumulation tests with invertebrates would further refine the BSAFs that were used in this assessment. This information would provide a better understanding of the movement of contaminants from sediments through the food chain. In addition, the collection of fish tissue from each creek to determine the contaminant body burden would also reduce the uncertainty associated with the food chain modeling assessment.

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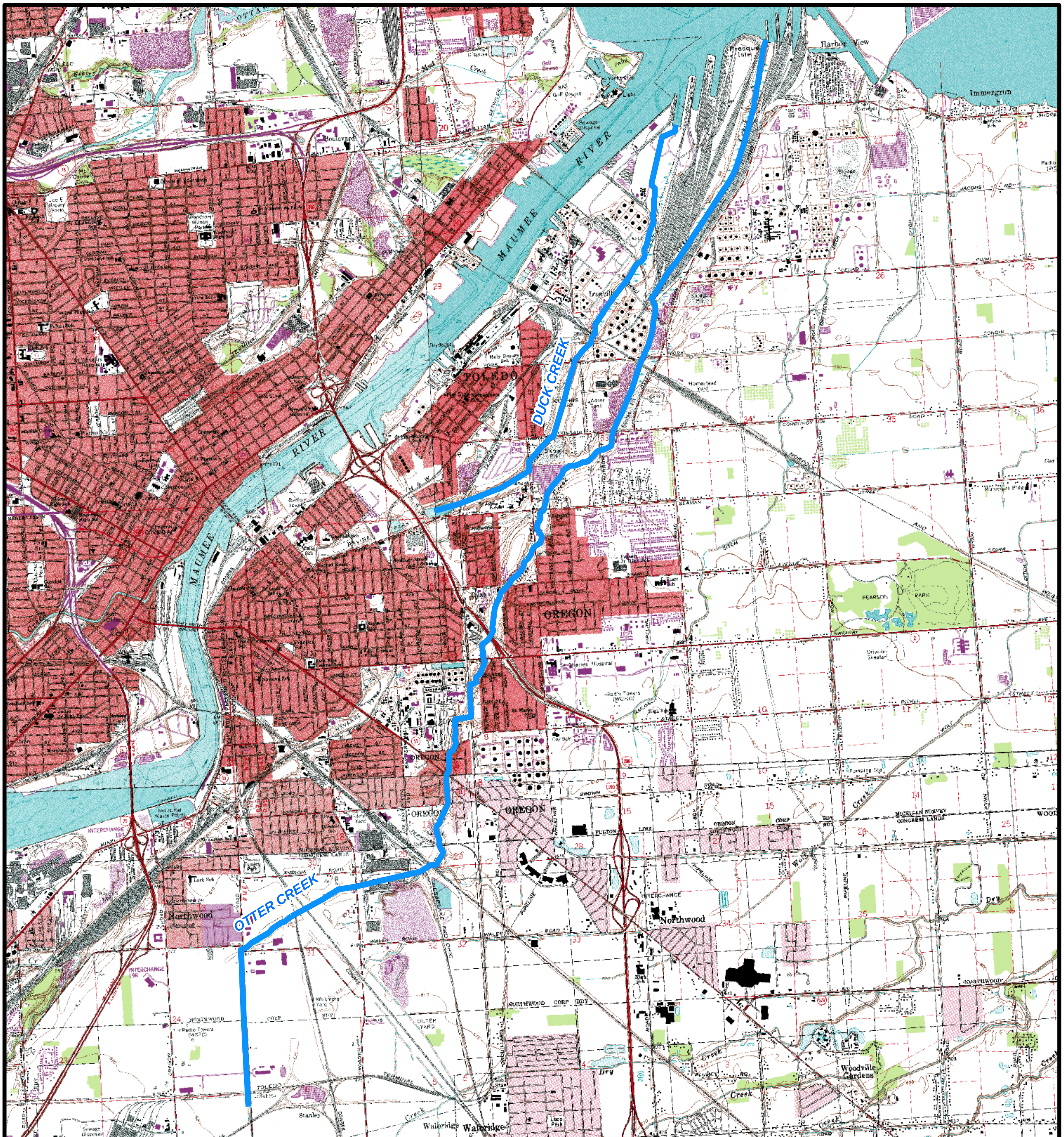
# FIGURES




SITE LOCATION


SOURCE: MODIFIED FROM USGS, OREGON, OHIO, QUADRANGLE, 1977; TOLEDO, OHIO-MICHIGAN, QUADRANGLE, 1980; ROSSFORD, OHIO, QUADRANGLE, 1988; AND WALBRIDGE, OHIO, QUADRANGLE, 1994

N
W E
S

0 2,500 5,000 Feet

DUCK AND OTTER CREEKS
TOLEDO AND OREGON, OHIO

FIGURE 1
SITE LOCATION MAP

Tetra Tech EM Inc.

2005-04-19 s:\cadd\p\3269\04\docp1.mxd TTEMI-NV joel.peters


SOURCE: MODIFIED FROM LUCAS COUNTY REAL ESTATE DIVISION, 2000, MANNICK AND SMITH, 2003, AND USDA, 2006.

N W E S

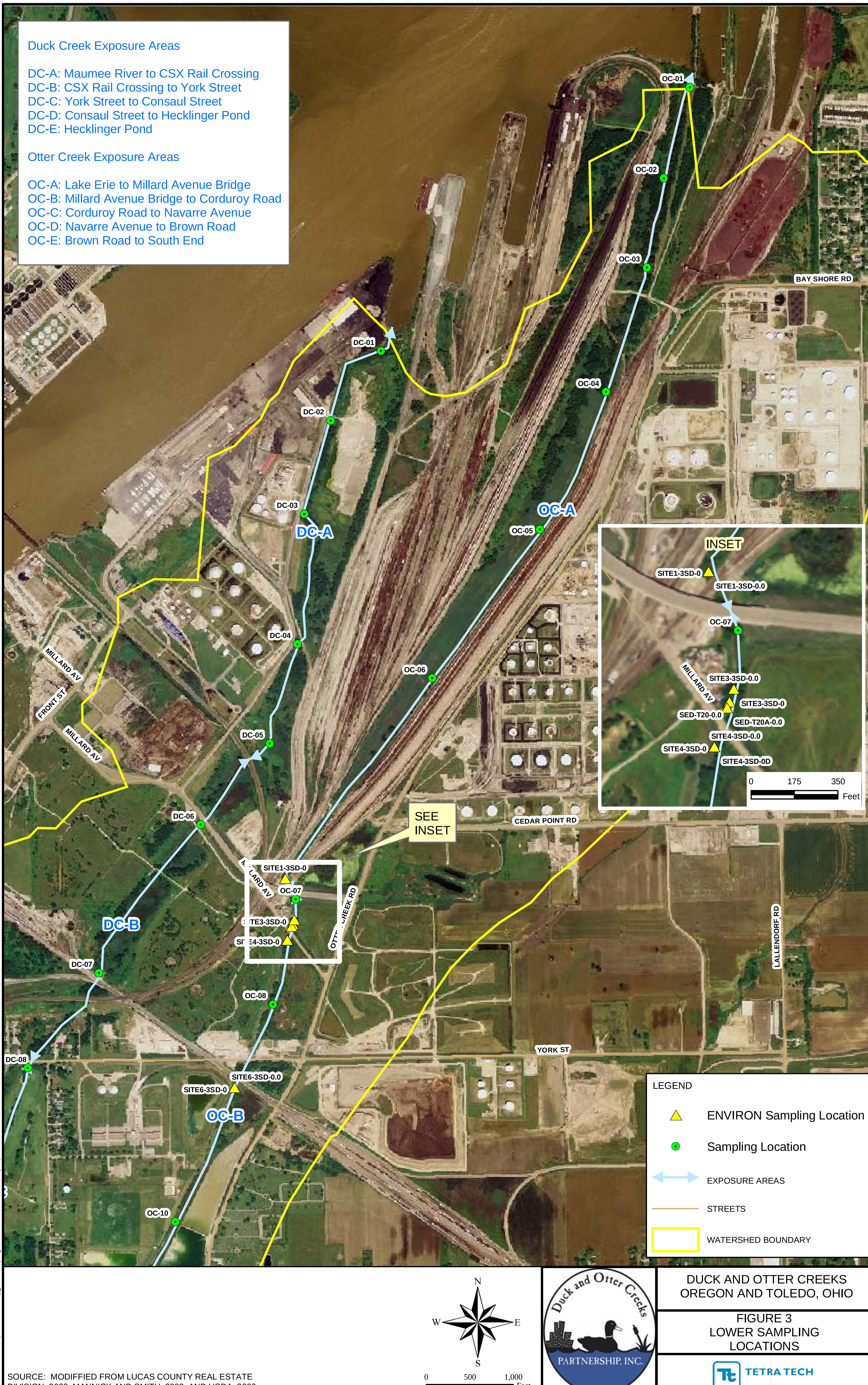
0 750 1,500 Feet

Duck and Otter Creeks PARTNERSHIP, INC.

DUCK AND OTTER CREEKS
OREGON AND TOLEDO, OHIO

FIGURE 2
UPPER SAMPLING LOCATIONS

TETRA TECH




SOURCE: MODIFIED FROM LUCAS COUNTY REAL ESTATE DIVISION, 2000, MANNICK AND SMITH, 2003, AND USDA, 2006.

DUCK AND OTTER CREEKS
OREGON AND TOLEDO, OHIO

FIGURE 3
LOWER SAMPLING LOCATIONS

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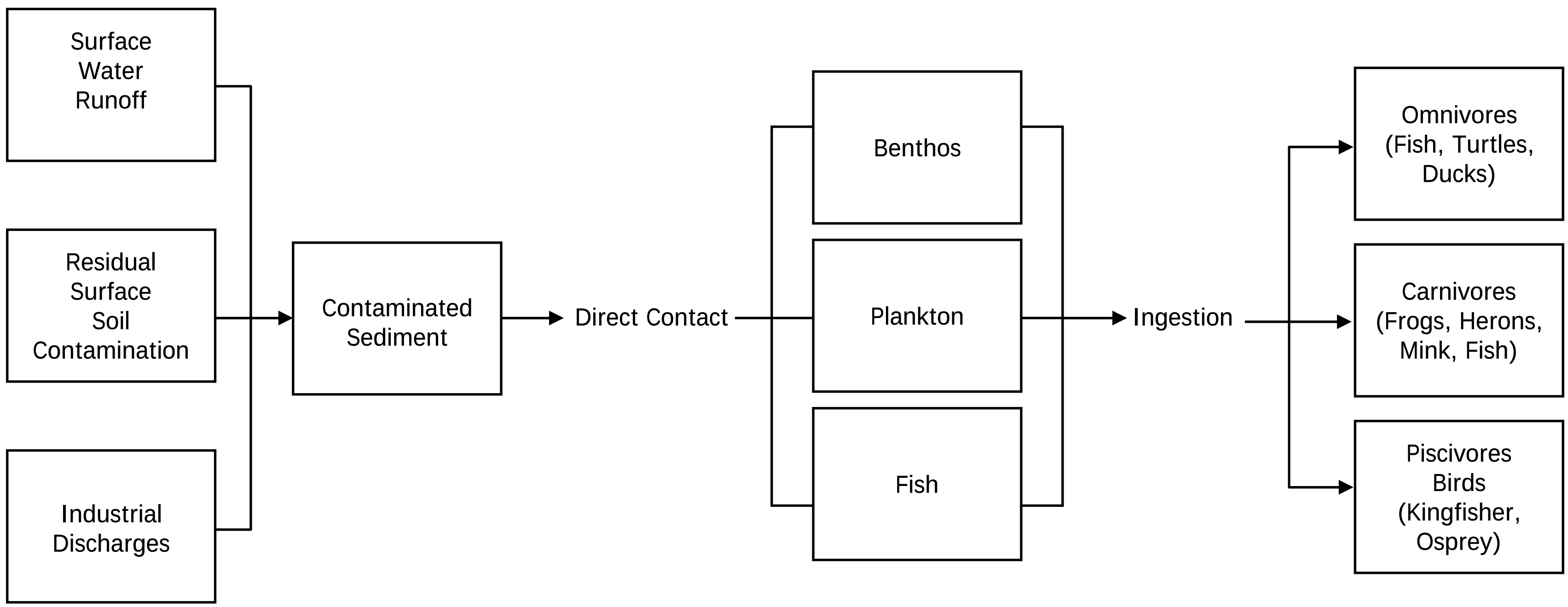
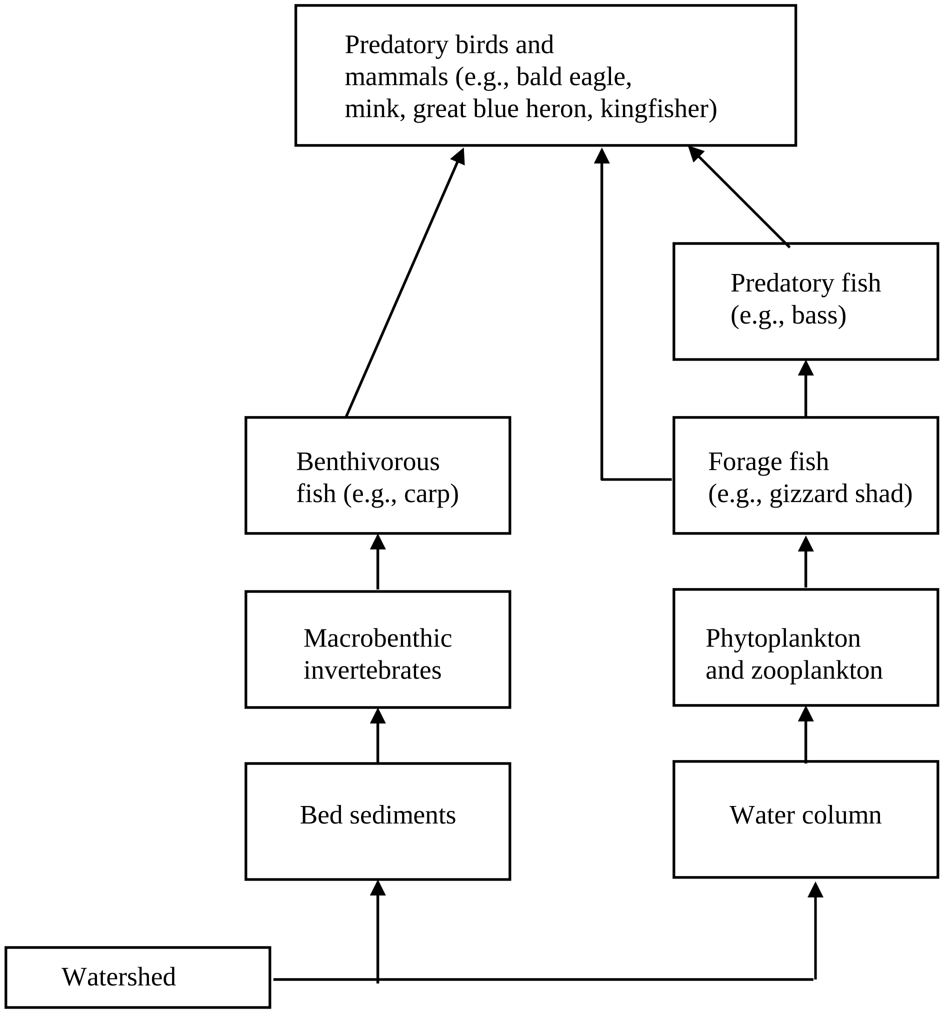



**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

**Figure 4**
**Ecological Conceptual Site Model**

TETRA TECH, INC.

Date: 0710/08 Drawn By: S.D. White Project No. 103P0241




**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

**Figure 5**
**Aquatic Food Wed**

TETRA TECH, INC.

Date: 01/10/07 Drawn By: S.D. White Project No. G9021.009.07

# APPENDIX A

# STATISTICAL ANALYSIS OF THE SEDIMENT DATA

## APPENDIX A

## STATISICIAL ANALYSIS OF THE SEDIMENT DATA FROM THE DUCK AND OTTER CREEKS

Statistical analysis of sediment data from Buffalo River, including the calculation of EPC, followed methods recommended in EPA guidance (EPA 2007), as well as both standard texts on environmental statistics (Gilbert 1987) and more specialized sources dealing with the treatment of censored (nondetect) data (Helsel 2005).

Method selection was initially based on the sample size and detection frequency for chemicals in individual data sets (i.e., surface sediment from individual exposure areas of the creeks and for all exposure areas combined). For chemicals where 100 percent of the measurements were detections, the methods followed recommendations in EPA's User's Guide for the ProUCL (Version 4.0) statistical software package (EPA 2007). For chemicals with one or more censored measurements, methods were selected following recommendations in EPA (2007). All of the censored data methods recommend in EPA (2007) are based on the Kaplan-Meier product limit estimator, which has also been strongly advocated in mainstream sources from the technical literature in environmental statistics (see Helsel 2005 for a review).

The steps followed for the analysis of Duck and Otter Creeks sediment are summarized below:

1) Detection frequencies were calculated for chemicals in individual data sets, and chemicals with no detected measurements were excluded from analysis. For chemicals with fewer than 5 detected measurements, the 95UCL defaulted to the maximum detected concentration.

2) Censored measurements in each data set that exceeded the maximum detected concentration were removed. The number of censored measurements excluded from analysis was reported in summary tables.

3) Formal goodness-of-fit (GOF) tests were used to determine the underlying distribution for each chemical. The Shapiro-Wilk W test was used for normal and lognormal distributions, and the Cramer von Mises $W^2$ test was used for gamma distributions. GOF tests were only used for chemicals with at least 5 detected measurements. For chemicals with censored measurements, testing was only conducted using the detected data. Distributions for chemicals not following a normal, lognormal, or gamma distribution, or having fewer than 5 detected measurements, were listed as nonparametric. All GOF tests were evaluated at the 0.05 (5 percent) significance level.

4) For chemicals with detection frequencies of 100 percent, methods were selected following recommendations in ProUCL 4.0 (EPA 2007). In EPA (2007), methods are selected based on the relative sample-size and degree of skewness for each chemical distribution. The specific decision rules used to select the optimal method for calculating the 95UCL for normal, lognormal, gamma, and nonparametric distributions are provided in EPA (2007).

5) For chemicals with one or more censored measurements, methods were selected following the recommendations in EPA (2007). All methods following EPA (2007) used the Kaplan-Meier product limit estimator to calculate the mean. Confidence limits for the 95UCL were then estimated using one of the following methods: (a) Student's t cutoff, (b) Chebyshev theorem, (c) percentile bootstrap, or (d) bias corrected accelerated (BCa) bootstrap.

It should be noted that following EPA (2007), the estimated 95UCL will not provide 95 percent coverage for the mean in all cases. For this reason, EPA (2007) suggests using estimates for the 97.5UCL or 99UCL to assure that the coverage is at least 95 percent. Cases where the 97.5UCL or 99UCL is more appropriate are identified in EPA (2007)

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# TABLE A-1
# SEDIMENT-SPECIFIC SUMMARY STATISTICS FOR DUCK CREEK
# ECOLOGICAL RISK ASSESSMENT
# DUCK AND OTTER CREEKS
# TOLEDO AND OREGON, OHIO

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Number of High Censored Results[b] | Censored Data | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | | Min | Max | Min | Max | Mean | 95UCL | UCL Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | N | 9 | 19 | 47 | 6 | 5.15E+02 | 2.88E+03 | 1.26E+02 | 1.05E+03 | 4.44E+02 | 5.76E+02 | (12) | 5.76E+02 |
| 4,4'-DDD | µg/kg | G | 19 | 19 | 100 | 0 | N/A | N/A | 7.64E+00 | 3.88E+02 | 1.12E+02 | 1.17E+02 | (10) | 1.17E+02 |
| 4,4'-DDE | µg/kg | G | 19 | 19 | 100 | 0 | N/A | N/A | 4.40E+00 | 2.85E+02 | 6.56E+01 | 6.89E+01 | (10) | 6.89E+01 |
| 4,4'-DDT | µg/kg | N | 8 | 19 | 42 | 0 | 4.83E+00 | 1.21E+01 | 3.13E+00 | 5.02E+01 | 1.25E+01 | 1.85E+01 | (12) | 1.85E+01 |
| Acenaphthene | µg/kg | N/A | 3 | 19 | 16 | 0 | 4.47E+02 | 2.88E+03 | 2.30E+02 | 5.85E+03 | N/A | N/A | (1) | 5.85E+03 |
| Acenaphthylene | µg/kg | N/A | 1 | 19 | 5 | 13 | 4.47E+02 | 2.88E+03 | 8.16E+02 | 8.16E+02 | N/A | N/A | (1) | 8.16E+02 |
| Anthracene | µg/kg | NP | 10 | 19 | 53 | 0 | 5.15E+02 | 2.88E+03 | 7.60E+01 | 3.24E+04 | 2.00E+03 | 1.93E+04 | (15) | 1.93E+04 |
| Arsenic | mg/kg | N | 19 | 19 | 100 | 0 | N/A | N/A | 5.48E+00 | 1.40E+02 | 7.34E+01 | 8.97E+01 | (2) | 8.97E+01 |
| Barium | mg/kg | G | 19 | 19 | 100 | 0 | N/A | N/A | 6.84E+01 | 2.15E+03 | 4.54E+02 | 6.39E+02 | (10) | 6.39E+02 |
| Benzo(a)anthracene | µg/kg | NP | 18 | 19 | 95 | 0 | 2.88E+03 | 2.88E+03 | 7.12E+01 | 8.72E+04 | 5.47E+03 | 5.08E+04 | (15) | 5.08E+04 |
| Benzo(a)pyrene | µg/kg | NP | 18 | 19 | 95 | 0 | 2.88E+03 | 2.88E+03 | 7.12E+01 | 8.25E+04 | 5.17E+03 | 4.81E+04 | (15) | 4.81E+04 |
| Benzo(b)fluoranthene | µg/kg | NP | 19 | 19 | 100 | 0 | N/A | N/A | 1.05E+02 | 1.07E+05 | 6.93E+03 | 6.24E+04 | (6) | 6.24E+04 |
| Benzo(k)fluoranthene | µg/kg | NP | 16 | 19 | 84 | 0 | 5.15E+02 | 2.88E+03 | 7.17E+01 | 3.86E+04 | 2.53E+03 | 1.51E+04 | (14) | 1.51E+04 |
| Cadmium | mg/kg | G | 19 | 19 | 100 | 0 | N/A | N/A | 3.70E-01 | 1.61E+01 | 3.21E+00 | 4.75E+00 | (10) | 4.75E+00 |
| Chromium | mg/kg | G | 19 | 19 | 100 | 0 | N/A | N/A | 1.59E+01 | 1.90E+02 | 6.65E+01 | 8.75E+01 | (10) | 8.75E+01 |
| Chrysene | µg/kg | NP | 18 | 19 | 95 | 0 | 2.88E+03 | 2.88E+03 | 8.98E+01 | 8.09E+04 | 5.28E+03 | 3.16E+04 | (14) | 3.16E+04 |
| Dibenz(a,h)anthracene | µg/kg | NP | 10 | 19 | 53 | 0 | 5.15E+02 | 2.88E+03 | 7.07E+01 | 9.74E+03 | 6.83E+02 | 3.92E+03 | (14) | 3.92E+03 |
| Fluoranthene | µg/kg | NP | 19 | 19 | 100 | 0 | N/A | N/A | 1.82E+02 | 1.90E+05 | 1.20E+04 | 1.11E+05 | (6) | 1.11E+05 |
| Fluorene | µg/kg | NP | 9 | 19 | 47 | 0 | 5.15E+02 | 2.88E+03 | 7.28E+01 | 8.72E+03 | 6.46E+02 | 1.53E+03 | (17) | 1.53E+03 |
| Heptachlor | µg/kg | N/A | 1 | 19 | 5 | 18 | 4.83E+00 | 2.24E+01 | 3.92E+00 | 3.92E+00 | N/A | N/A | (1) | 3.92E+00 |
| Heptachlor epoxide | µg/kg | NP | 4 | 19 | 21 | 2 | 5.21E+00 | 2.24E+01 | 7.86E+00 | 1.47E+01 | 8.61E+00 | 9.50E+00 | (12) | 9.50E+00 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NP | 16 | 19 | 84 | 0 | 5.15E+02 | 2.88E+03 | 1.03E+02 | 3.29E+04 | 2.20E+03 | 1.29E+04 | (14) | 1.29E+04 |
| Lead | mg/kg | G | 19 | 19 | 100 | 0 | N/A | N/A | 6.85E+01 | 1.08E+03 | 2.82E+02 | 3.76E+02 | (10) | 3.76E+02 |
| Mercury | mg/kg | NP | 16 | 19 | 84 | 0 | 2.00E-02 | 4.00E-02 | 5.00E-02 | 6.82E+00 | 4.95E-01 | 2.70E+00 | (14) | 2.70E+00 |
| Naphthalene | µg/kg | G | 9 | 19 | 47 | 2 | 5.15E+02 | 2.88E+03 | 1.31E+02 | 1.93E+03 | 5.69E+02 | 7.75E+02 | (12) | 7.75E+02 |
| PCB-1254 | µg/kg | N | 10 | 19 | 53 | 2 | 1.04E+02 | 4.49E+02 | 1.10E+02 | 2.59E+02 | 1.60E+02 | 1.83E+02 | (12) | 1.83E+02 |
| PCB-1260 | µg/kg | N/A | 3 | 19 | 16 | 2 | 1.25E+02 | 5.38E+02 | 1.37E+02 | 2.95E+02 | N/A | N/A | (1) | 2.95E+02 |
| Phenanthrene | µg/kg | NP | 18 | 19 | 95 | 0 | 2.88E+03 | 2.88E+03 | 6.30E+01 | 6.84E+04 | 4.55E+03 | 2.68E+04 | (14) | 2.68E+04 |
| Pyrene | µg/kg | NP | 19 | 19 | 100 | 0 | N/A | N/A | 1.41E+02 | 1.50E+05 | 9.51E+03 | 8.73E+04 | (6) | 8.73E+04 |
| Selenium | mg/kg | N | 13 | 19 | 68 | 0 | 2.21E+00 | 7.44E+00 | 3.26E+00 | 3.04E+01 | 9.15E+00 | 1.22E+01 | (12) | 1.22E+01 |
| Zinc | mg/kg | G | 19 | 19 | 100 | 0 | N/A | N/A | 1.09E+02 | 2.28E+03 | 5.70E+02 | 8.05E+02 | (10) | 8.05E+02 |

**TABLE A-1**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS FOR DUCK CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

**Notes:**

| | |
|---|---|
| BCa | Bias-corrected accelerated |
| EPC | Exposure point concentration. The lesser of the 95UCL and the maximum detected result |
| KM | Kaplan-Meier product limit estimator |
| N/A | Not applicable, no estimate provided because there were fewer than 4 detected result |
| Max | Maximum result |
| Min | Minimum result |
| MVUE | Minimum variance unbiased estimate |
| mg/kg | Milligrams per kilogram |
| µg/kg | Micrograms per kilogram |
| 95UCL | One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL |
| a | Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations |
| | <u>Distribution Codes</u>: G= gamma, L= lognormal, N= normal, NP= nonparametric |
| b | Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL and EPC, but were included in the reported sample size and range for censored data |
| c | The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results. |
| d | All methods follow EPA (2002, 2007). |
| | <u>Method (Statistic) Codes are defined as follows</u>: |
| (1) | Maximum detected result |
| (2) | 95 percent UCL calculated using Student's *t* distribution |
| (3) | 95 percent UCL calculated using Land's H statistic |
| (4), (5), (6) | 95, 97.5, or 99 percent UCL, respectively, calculated using the nonparametric Chebyshev method |
| (7), (8), (9) | 95, 97.5, or 99 percent UCL, respectively, calculated using the MVUE Chebyshev method |
| (10) | 95 percent UCL calculated using the approximate gamma method |
| (11) | 95 percent UCL calculated using the adjusted gamma method |
| (12) | 95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL |
| (13), (14), (15) | 95, 97.5, or 99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL |
| (16) | 95 percent UCL calculated using the KM mean and a percentile bootstrap to estimate the UCL |
| (17) | 95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL |

**References**


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**TABLE A-2**
**SEDIMENT-SPECIFIC STATISTICS FOR OTTER CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Number of High Censored Results[b] | Censored Data | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | | Min | Max | Min | Max | Mean | 95UCL | UCL Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | G | 18 | 27 | 67 | 1 | 5.39E+02 | 1.25E+03 | 9.48E+01 | 1.06E+03 | 3.40E+02 | 4.28E+02 | (16) | 4.28E+02 |
| 4,4'-DDD | µg/kg | N | 23 | 27 | 85 | 0 | 4.85E+00 | 5.86E+00 | 3.63E+00 | 3.58E+01 | 1.43E+01 | 1.71E+01 | (12) | 1.71E+01 |
| 4,4'-DDE | µg/kg | N | 24 | 27 | 89 | 0 | 4.85E+00 | 5.86E+00 | 2.37E+00 | 2.09E+01 | 8.97E+00 | 1.07E+01 | (12) | 1.07E+01 |
| Acenaphthene | µg/kg | N | 9 | 33 | 27 | 0 | 1.60E+00 | 1.00E+03 | 6.28E+01 | 1.63E+03 | 2.77E+02 | 4.11E+02 | (12) | 4.11E+02 |
| Acenaphthylene | µg/kg | NP | 4 | 33 | 12 | 24 | 1.50E+00 | 1.25E+03 | 5.75E+01 | 2.35E+02 | 9.92E+01 | 2.07E+02 | (16) | 2.07E+02 |
| Anthracene | µg/kg | NP | 29 | 33 | 88 | 0 | 1.60E+00 | 2.10E+01 | 1.09E+02 | 4.84E+03 | 6.89E+02 | 1.91E+03 | (14) | 1.91E+03 |
| Arsenic | mg/kg | N | 27 | 27 | 100 | 0 | N/A | N/A | 6.67E+00 | 8.35E+01 | 3.94E+01 | 4.51E+01 | (2) | 4.51E+01 |
| Barium | mg/kg | N | 27 | 27 | 100 | 0 | N/A | N/A | 6.24E+01 | 3.85E+02 | 2.11E+02 | 2.41E+02 | (2) | 2.41E+02 |
| Benzo(a)anthracene | µg/kg | NP | 30 | 33 | 91 | 0 | 1.20E+00 | 1.50E+01 | 5.80E+01 | 1.84E+04 | 2.20E+03 | 6.25E+03 | (14) | 6.25E+03 |
| Benzo(a)pyrene | µg/kg | LN | 30 | 33 | 91 | 0 | 1.60E+00 | 6.70E+00 | 2.94E+02 | 2.00E+04 | 2.26E+03 | 5.10E+03 | (13) | 5.10E+03 |
| Benzo(b)fluoranthene | µg/kg | LN | 31 | 33 | 94 | 0 | 1.50E+00 | 6.20E+00 | 9.10E+01 | 2.47E+04 | 3.32E+03 | 8.62E+03 | (14) | 8.62E+03 |
| Benzo(g,h,i)perylene | µg/kg | N/A | 3 | 6 | 50 | 0 | 1.60E+00 | 6.70E+00 | 6.40E+02 | 1.40E+03 | N/A | N/A | (1) | 1.40E+03 |
| Benzo(k)fluoranthene | µg/kg | G | 30 | 33 | 91 | 0 | 2.10E+00 | 8.80E+00 | 1.42E+02 | 7.88E+03 | 1.10E+03 | 2.24E+03 | (13) | 2.24E+03 |
| Cadmium | mg/kg | N | 27 | 27 | 100 | 0 | N/A | N/A | 5.10E-01 | 2.67E+00 | 1.51E+00 | 1.71E+00 | (2) | 1.71E+00 |
| Chromium | mg/kg | N | 27 | 27 | 100 | 0 | N/A | N/A | 2.84E+01 | 3.99E+02 | 1.59E+02 | 1.93E+02 | (2) | 1.93E+02 |
| Chrysene | µg/kg | NP | 32 | 33 | 97 | 0 | 1.10E+00 | 1.10E+00 | 6.80E+01 | 2.29E+04 | 3.02E+03 | 7.82E+03 | (14) | 7.82E+03 |
| Dibenz(a,h)anthracene | µg/kg | NP | 24 | 33 | 73 | 0 | 1.60E+00 | 7.26E+02 | 8.92E+01 | 4.53E+03 | 4.23E+02 | 1.32E+03 | (14) | 1.32E+03 |
| Fluoranthene | µg/kg | LN | 33 | 34 | 97 | 0 | 1.50E+00 | 1.50E+00 | 1.10E+02 | 5.18E+04 | 5.36E+03 | 1.57E+04 | (14) | 1.57E+04 |
| Fluorene | µg/kg | NP | 25 | 33 | 76 | 0 | 1.50E+00 | 8.46E+02 | 7.99E+01 | 2.39E+03 | 3.52E+02 | 5.09E+02 | (17) | 5.09E+02 |
| Indeno(1,2,3-cd)pyrene | µg/kg | LN | 30 | 33 | 91 | 0 | 1.90E+00 | 7.50E+00 | 1.11E+02 | 1.77E+04 | 1.46E+03 | 4.87E+03 | (14) | 4.87E+03 |
| Lead | mg/kg | N | 27 | 27 | 100 | 0 | N/A | N/A | 6.67E+01 | 3.97E+02 | 2.15E+02 | 2.45E+02 | (2) | 2.45E+02 |
| Mercury | mg/kg | G | 25 | 27 | 93 | 0 | 6.00E-02 | 8.00E-02 | 7.00E-02 | 7.70E-01 | 2.10E-01 | 2.59E-01 | (17) | 2.59E-01 |
| Naphthalene | µg/kg | G | 19 | 34 | 56 | 0 | 2.00E+00 | 8.46E+02 | 1.09E+02 | 1.45E+03 | 2.91E+02 | 3.74E+02 | (12) | 3.74E+02 |
| PCB-1254 | µg/kg | NP | 25 | 27 | 93 | 0 | 1.17E+02 | 1.23E+02 | 6.18E+01 | 1.13E+04 | 7.21E+02 | 3.32E+03 | (14) | 3.32E+03 |
| Phenanthrene | µg/kg | NP | 33 | 34 | 97 | 0 | 2.50E+00 | 2.50E+00 | 4.80E+01 | 2.63E+04 | 2.99E+03 | 8.84E+03 | (14) | 8.84E+03 |
| Pyrene | µg/kg | LN | 33 | 34 | 97 | 0 | 1.40E+00 | 1.40E+00 | 1.20E+02 | 4.48E+04 | 5.20E+03 | 1.44E+04 | (14) | 1.44E+04 |
| Pyridine | µg/kg | N/A | 1 | 7 | 14 | 1 | 2.10E+01 | 2.70E+02 | 2.40E+02 | 2.40E+02 | N/A | N/A | (1) | 2.40E+02 |
| Selenium | mg/kg | NP | 4 | 27 | 15 | 0 | 2.06E+00 | 7.24E+00 | 2.67E+00 | 3.65E+00 | 2.78E+00 | 2.89E+00 | (12) | 2.89E+00 |
| Zinc | mg/kg | G | 27 | 27 | 100 | 0 | N/A | N/A | 9.50E+01 | 1.04E+03 | 4.10E+02 | 4.93E+02 | (10) | 4.93E+02 |
| bis(2-Ethylhexyl)phthalate | µg/kg | NP | 4 | 6 | 67 | 0 | 2.20E+01 | 2.40E+01 | 1.20E+02 | 1.10E+03 | 4.17E+02 | 6.38E+02 | (17) | 6.38E+02 |

**TABLE A-2**
**SEDIMENT-SPECIFIC STATISTICS FOR OTTER CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

**Notes:**

| | |
|---|---|
| BCa | Bias-corrected accelerated |
| EPC | Exposure point concentration. The lesser of the 95UCL and the maximum detected result. |
| KM | Kaplan-Meier product limit estimator |
| N/A | Not applicable, no estimate provided because there were fewer than 4 detected results |
| Max | Maximum result |
| Min | Minimum result |
| MVUE | Minimum variance unbiased estimate |
| mg/kg | Milligrams per kilogram |
| µg/kg | Micrograms per kilogram |
| 95UCL | One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL. |
| a | Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations. |
| | <u>Distribution Codes</u>: G= gamma, L= lognormal, N= normal, NP= nonparametric |
| b | Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data. |
| c | The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results. |
| d | All methods follow EPA (2002, 2007). |
| | <u>Method (Statistic) Codes are defined as follows</u>: |
| (1) | Maximum detected result |
| (2) | 95 percent UCL calculated using Student's *t* distribution |
| (3) | 95 percent UCL calculated using Land's H statistic |
| (4), (5), (6) | 95, 97.5, or 99 percent UCL, respectively, calculated using the nonparametric Chebyshev method |
| (7), (8), (9) | 95, 97.5, or 99 percent UCL, respectively, calculated using the MVUE Chebyshev method |
| (10) | 95 percent UCL calculated using the approximate gamma method |
| (11) | 95 percent UCL calculated using the adjusted gamma method |
| (12) | 95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL |
| (13), (14), (15) | 95, 97.5, or 99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL |
| (16) | 95 percent UCL calculated using the KM mean and a percentile bootstrap to estimate the UCL |
| (17) | 95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL |

**References**


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U.S. Environmental Protection Agency (EPA). 2007. “ProUCL Version 4.0 Technical Guide.” Prepared by A. Singh and A.K. Singh. EPA/600/R-07/041. April.

**TABLE A-3**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF DUCK CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Stream Reach | Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Number of High Censored Results[b] | Censored Data | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Detected | Total | | | Min | Max | Min | Max | Mean | 95UCL | UCL Method[d] | EI |
| DC-A | 2-Methylnaphthalene | µg/kg | NP | 4 | 5 | 80 | 1 | 1.38E+03 | 1.38E+03 | 1.26E+02 | 5.90E+02 | 4.39E+02 | 9.03E+02 | (4) | 5.90 |
| | 4,4'-DDD | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 2.18E+01 | 1.36E+02 | 8.20E+01 | 1.62E+02 | (4) | 1.36 |
| | 4,4'-DDE | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.07E+01 | 6.22E+01 | 3.97E+01 | 7.64E+01 | (4) | 6.22 |
| | 4,4'-DDT | µg/kg | N/A | 1 | 5 | 20 | 0 | 4.83E+00 | 1.06E+01 | 1.91E+01 | 1.91E+01 | N/A | N/A | (1) | 1.91 |
| | Anthracene | µg/kg | N/A | 2 | 5 | 40 | 3 | 1.27E+03 | 1.38E+03 | 7.60E+01 | 1.12E+02 | N/A | N/A | (1) | 1.12 |
| | Arsenic | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.48E+00 | 1.32E+02 | 6.64E+01 | 2.90E+02 | (6) | 1.32 |
| | Barium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 9.49E+01 | 5.26E+02 | 3.32E+02 | 7.27E+02 | (4) | 5.26 |
| | Benzo(a)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 2.18E+02 | 5.17E+02 | 3.53E+02 | 4.66E+02 | (2) | 4.66 |
| | Benzo(a)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.83E+02 | 4.49E+02 | 2.68E+02 | 3.75E+02 | (2) | 3.75 |
| | Benzo(b)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 2.51E+02 | 6.58E+02 | 4.60E+02 | 6.10E+02 | (2) | 6.10 |
| | Benzo(k)fluoranthene | µg/kg | NP | 4 | 5 | 80 | 1 | 1.38E+03 | 1.38E+03 | 7.34E+01 | 2.17E+02 | 1.64E+02 | 3.10E+02 | (4) | 2.17 |
| | Cadmium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 4.90E-01 | 5.00E+00 | 3.08E+00 | 1.30E+01 | (6) | 5.00 |
| | Chromium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.59E+01 | 8.19E+01 | 5.55E+01 | 1.17E+02 | (4) | 8.19 |
| | Chrysene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 3.10E+02 | 8.28E+02 | 5.11E+02 | 6.97E+02 | (2) | 6.97 |
| | Dibenz(a,h)anthracene | µg/kg | N/A | 3 | 5 | 60 | 2 | 1.27E+03 | 1.38E+03 | 7.07E+01 | 1.49E+02 | N/A | N/A | (1) | 1.49 |
| | Fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 3.07E+02 | 1.08E+03 | 8.11E+02 | 1.40E+03 | (4) | 1.08 |
| | Fluorene | µg/kg | N/A | 2 | 5 | 40 | 3 | 1.27E+03 | 1.38E+03 | 7.28E+01 | 8.59E+01 | N/A | N/A | (1) | 8.59 |
| | Heptachlor | µg/kg | N/A | 1 | 5 | 20 | 4 | 4.83E+00 | 1.06E+01 | 3.92E+00 | 3.92E+00 | N/A | N/A | (1) | 3.92 |
| | Heptachlor epoxide | µg/kg | NP | 4 | 5 | 80 | 0 | 5.21E+00 | 5.21E+00 | 7.86E+00 | 1.47E+01 | 1.01E+01 | 1.29E+01 | (12) | 1.29 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.03E+02 | 2.61E+02 | 1.74E+02 | 2.35E+02 | (2) | 2.35 |
| | Lead | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 8.36E+01 | 4.02E+02 | 2.36E+02 | 4.98E+02 | (4) | 4.02 |
| | Mercury | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.00E-02 | 3.70E-01 | 2.06E-01 | 4.29E-01 | (4) | 3.70 |
| | Naphthalene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.31E+02 | 6.94E+02 | 4.82E+02 | 9.42E+02 | (4) | 6.94 |
| | PCB-1254 | µg/kg | NP | 4 | 5 | 80 | 0 | 1.04E+02 | 1.04E+02 | 1.41E+02 | 1.93E+02 | 1.62E+02 | 1.87E+02 | (12) | 1.87 |
| | PCB-1260 | µg/kg | N/A | 2 | 5 | 40 | 0 | 1.25E+02 | 2.53E+02 | 1.37E+02 | 2.95E+02 | N/A | N/A | (1) | 2.95 |
| | Phenanthrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 3.22E+02 | 8.33E+02 | 5.48E+02 | 7.24E+02 | (2) | 7.24 |
| | Pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 4.14E+02 | 1.08E+03 | 7.42E+02 | 9.84E+02 | (2) | 9.84 |
| | Selenium | mg/kg | NP | 3 | 5 | 60 | 0 | 2.21E+00 | 2.45E+00 | 5.56E+00 | 9.97E+00 | N/A | N/A | (1) | 9.97 |
| | Zinc | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.21E+02 | 9.36E+02 | 5.81E+02 | 2.40E+03 | (6) | 9.36 |

**TABLE A-3**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF DUCK CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC-B | 2-Methylnaphthalene | µg/kg | N/A | 3 | 4 | 75 | 1 | 2.25E+03 | 2.25E+03 | 2.97E+02 | 6.08E+02 | N/A | N/A | (1) | 6.08 |
| | 4,4'-DDD | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 1.36E+02 | 2.22E+02 | 1.65E+02 | 2.11E+02 | (2) | 2.11 |
| | 4,4'-DDE | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 5.66E+01 | 1.36E+02 | 8.25E+01 | 1.25E+02 | (2) | 1.25 |
| | 4,4'-DDT | µg/kg | N/A | 1 | 4 | 25 | 0 | 8.88E+00 | 1.21E+01 | 3.72E+01 | 3.72E+01 | N/A | N/A | (1) | 3.72 |
| | Acenaphthene | µg/kg | N/A | 1 | 4 | 25 | 3 | 1.24E+03 | 2.25E+03 | 2.30E+02 | 2.30E+02 | N/A | N/A | (1) | 2.30 |
| | Anthracene | µg/kg | N/A | 2 | 4 | 50 | 2 | 1.27E+03 | 2.25E+03 | 2.97E+02 | 3.74E+02 | N/A | N/A | (1) | 3.74 |
| | Arsenic | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 4.22E+01 | 1.32E+02 | 7.79E+01 | 1.23E+02 | (2) | 1.23 |
| | Barium | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 3.43E+02 | 6.51E+02 | 4.78E+02 | 6.28E+02 | (2) | 6.28 |
| | Benzo(a)anthracene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 3.10E+02 | 1.30E+03 | 8.85E+02 | 1.87E+03 | (4) | 1.30 |
| | Benzo(a)pyrene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 2.01E+02 | 1.05E+03 | 7.38E+02 | 1.62E+03 | (4) | 1.05 |
| | Benzo(b)fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 4.07E+02 | 1.81E+03 | 1.28E+03 | 2.62E+03 | (4) | 1.81 |
| | Benzo(k)fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 1.55E+02 | 6.06E+02 | 4.45E+02 | 9.06E+02 | (4) | 6.06 |
| | Cadmium | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 2.35E+00 | 4.49E+00 | 3.51E+00 | 4.54E+00 | (2) | 4.49 |
| | Chromium | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 6.60E+01 | 7.62E+01 | 7.22E+01 | 7.74E+01 | (2) | 7.62 |
| | Chrysene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 4.30E+02 | 1.56E+03 | 1.16E+03 | 2.30E+03 | (4) | 1.56 |
| | Dibenz(a,h)anthracene | µg/kg | N/A | 2 | 4 | 50 | 2 | 1.27E+03 | 2.25E+03 | 1.63E+02 | 1.69E+02 | N/A | N/A | (1) | 1.69 |
| | Fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 7.71E+02 | 2.81E+03 | 2.18E+03 | 4.24E+03 | (4) | 2.81 |
| | Fluorene | µg/kg | N/A | 2 | 4 | 50 | 2 | 1.27E+03 | 2.25E+03 | 1.78E+02 | 2.34E+02 | N/A | N/A | (1) | 2.34 |
| | Heptachlor epoxide | µg/kg | N/A | 1 | 4 | 25 | 1 | 8.88E+00 | 1.59E+01 | 1.47E+01 | 1.47E+01 | N/A | N/A | (1) | 1.47 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 1.35E+02 | 6.27E+02 | 4.35E+02 | 8.93E+02 | (4) | 6.27 |
| | Lead | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 2.40E+02 | 3.63E+02 | 3.01E+02 | 3.60E+02 | (2) | 3.60 |
| | Mercury | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 1.30E-01 | 2.10E-01 | 1.78E-01 | 2.18E-01 | (2) | 2.10 |
| | Naphthalene | µg/kg | N/A | 3 | 4 | 75 | 1 | 2.25E+03 | 2.25E+03 | 6.55E+02 | 9.28E+02 | N/A | N/A | (1) | 9.28 |
| | PCB-1254 | µg/kg | N/A | 3 | 4 | 75 | 1 | 3.17E+02 | 3.17E+02 | 1.10E+02 | 1.64E+02 | N/A | N/A | (1) | 1.64 |
| | Phenanthrene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 5.14E+02 | 1.38E+03 | 1.10E+03 | 1.57E+03 | (2) | 1.38 |
| | Pyrene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 5.93E+02 | 2.26E+03 | 1.72E+03 | 3.43E+03 | (4) | 2.26 |
| | Selenium | mg/kg | NP | 3 | 4 | 75 | 0 | 7.44E+00 | 7.44E+00 | 6.07E+00 | 9.97E+00 | N/A | N/A | (1) | 9.97 |
| | Zinc | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 4.75E+02 | 7.62E+02 | 6.44E+02 | 7.87E+02 | (2) | 7.62 |

**TABLE A-3**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF DUCK CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC-C | 4,4'-DDD | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 7.83E+01 | 1.76E+02 | N/A | N/A | (1) | 1.76 |
| | 4,4'-DDE | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 6.10E+01 | 1.36E+02 | N/A | N/A | (1) | 1.36 |
| | 4,4'-DDT | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 1.67E+01 | 3.72E+01 | N/A | N/A | (1) | 3.72 |
| | Anthracene | µg/kg | N/A | 2 | 3 | 67 | 1 | 2.25E+03 | 2.25E+03 | 2.14E+02 | 2.75E+02 | N/A | N/A | (1) | 2.75 |
| | Arsenic | mg/kg | NP | 3 | 3 | 100 | 0 | N/A | N/A | 2.95E+01 | 6.51E+01 | N/A | N/A | (1) | 6.51 |
| | Barium | mg/kg | NP | 3 | 3 | 100 | 0 | N/A | N/A | 2.95E+02 | 6.51E+02 | N/A | N/A | (1) | 6.51 |
| | Benzo(a)anthracene | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 6.35E+02 | 9.18E+02 | N/A | N/A | (1) | 9.18 |
| | Benzo(a)pyrene | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 5.86E+02 | 8.98E+02 | N/A | N/A | (1) | 8.98 |
| | Benzo(b)fluoranthene | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 1.10E+03 | 1.48E+03 | N/A | N/A | (1) | 1.48 |
| | Benzo(k)fluoranthene | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 3.94E+02 | 5.19E+02 | N/A | N/A | (1) | 5.19 |
| | Cadmium | mg/kg | NP | 3 | 3 | 100 | 0 | N/A | N/A | 1.66E+00 | 3.67E+00 | N/A | N/A | (1) | 3.67 |
| | Chromium | mg/kg | NP | 3 | 3 | 100 | 0 | N/A | N/A | 3.86E+01 | 7.44E+01 | N/A | N/A | (1) | 7.44 |
| | Chrysene | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 9.49E+02 | 1.24E+03 | N/A | N/A | (1) | 1.24 |
| | Dibenz(a,h)anthracene | µg/kg | N/A | 2 | 3 | 67 | 1 | 2.25E+03 | 2.25E+03 | 9.07E+01 | 1.36E+02 | N/A | N/A | (1) | 1.36 |
| | Fluoranthene | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 2.23E+03 | 2.76E+03 | N/A | N/A | (1) | 2.76 |
| | Fluorene | µg/kg | N/A | 2 | 3 | 67 | 1 | 2.25E+03 | 2.25E+03 | 1.32E+02 | 1.36E+02 | N/A | N/A | (1) | 1.36 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 3.96E+02 | 5.47E+02 | N/A | N/A | (1) | 5.47 |
| | Lead | mg/kg | NP | 3 | 3 | 100 | 0 | N/A | N/A | 1.73E+02 | 3.63E+02 | N/A | N/A | (1) | 3.63 |
| | Mercury | mg/kg | NP | 3 | 3 | 100 | 0 | N/A | N/A | 1.20E-01 | 2.10E-01 | N/A | N/A | (1) | 2.10 |
| | Phenanthrene | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 1.10E+03 | 1.25E+03 | N/A | N/A | (1) | 1.25 |
| | Pyrene | µg/kg | N/A | 3 | 3 | 100 | 0 | N/A | N/A | 1.64E+03 | 2.00E+03 | N/A | N/A | (1) | 2.00 |
| | Selenium | mg/kg | NP | 0 | 3 | 0 | 0 | 3.86E+00 | 7.44E+00 | N/A | N/A | N/A | N/A | (1) | N |
| | Zinc | mg/kg | NP | 3 | 3 | 100 | 0 | N/A | N/A | 2.95E+02 | 6.51E+02 | N/A | N/A | (1) | 6.51 |
| DC-D | 2-Methylnaphthalene | µg/kg | N/A | 2 | 4 | 50 | 2 | 7.19E+02 | 2.88E+03 | 2.79E+02 | 3.42E+02 | N/A | N/A | (1) | 3.42 |
| | 4,4'-DDD | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 7.83E+01 | 3.88E+02 | 2.20E+02 | 5.24E+02 | (4) | 3.88 |
| | 4,4'-DDE | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 6.10E+01 | 2.85E+02 | 1.55E+02 | 3.89E+02 | (4) | 2.85 |
| | 4,4'-DDT | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 1.70E+01 | 5.02E+01 | 3.17E+01 | 4.86E+01 | (2) | 4.86 |
| | Acenaphthene | µg/kg | N/A | 1 | 4 | 25 | 3 | 7.19E+02 | 2.88E+03 | 3.94E+02 | 3.94E+02 | N/A | N/A | (1) | 3.94 |
| | Anthracene | µg/kg | N/A | 2 | 4 | 50 | 1 | 1.41E+03 | 2.88E+03 | 2.14E+02 | 1.54E+03 | N/A | N/A | (1) | 1.54 |
| | Arsenic | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 2.29E+01 | 1.40E+02 | 6.87E+01 | 1.87E+02 | (4) | 1.40 |
| | Barium | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 1.59E+02 | 2.15E+03 | 8.14E+02 | 5.37E+03 | (6) | 2.15 |
| | Benzo(a)anthracene | µg/kg | N/A | 3 | 4 | 75 | 0 | 2.88E+03 | 2.88E+03 | 4.59E+02 | 5.30E+03 | N/A | N/A | (1) | 5.30 |
| | Benzo(a)pyrene | µg/kg | N/A | 3 | 4 | 75 | 0 | 2.88E+03 | 2.88E+03 | 4.28E+02 | 5.40E+03 | N/A | N/A | (1) | 5.40 |
| | Benzo(b)fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 3.06E+02 | 7.65E+03 | 2.48E+03 | 1.97E+04 | (6) | 7.65 |
| | Benzo(k)fluoranthene | µg/kg | N/A | 3 | 4 | 75 | 1 | 2.88E+03 | 2.88E+03 | 2.93E+02 | 2.63E+03 | N/A | N/A | (1) | 2.63 |
| | Cadmium | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 8.80E-01 | 1.61E+01 | 5.50E+00 | 4.10E+01 | (6) | 1.61 |
| | Chromium | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 3.35E+01 | 1.90E+02 | 8.18E+01 | 2.42E+02 | (4) | 1.90 |
| | Chrysene | µg/kg | N/A | 3 | 4 | 75 | 0 | 2.88E+03 | 2.88E+03 | 6.93E+02 | 5.10E+03 | N/A | N/A | (1) | 5.10 |
| | Dibenz(a,h)anthracene | µg/kg | N/A | 2 | 4 | 50 | 2 | 1.41E+03 | 2.88E+03 | 9.07E+01 | 6.59E+02 | N/A | N/A | (1) | 6.59 |
| | Fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 4.73E+02 | 1.08E+04 | 3.73E+03 | 2.75E+04 | (6) | 1.08 |
| | Fluorene | µg/kg | N/A | 3 | 4 | 75 | 1 | 2.88E+03 | 2.88E+03 | 1.32E+02 | 6.19E+02 | N/A | N/A | (1) | 6.19 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | N/A | 3 | 4 | 75 | 1 | 2.88E+03 | 2.88E+03 | 2.70E+02 | 2.35E+03 | N/A | N/A | (1) | 2.35 |
| | Lead | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 1.08E+02 | 1.08E+03 | 4.09E+02 | 1.39E+03 | (4) | 1.08 |
| | Mercury | mg/kg | NP | 3 | 4 | 75 | 0 | 3.00E-02 | 3.00E-02 | 1.20E-01 | 6.82E+00 | N/A | N/A | (1) | 6.82 |
| | Naphthalene | µg/kg | N/A | 1 | 4 | 25 | 3 | 7.19E+02 | 2.88E+03 | 2.53E+02 | 2.53E+02 | N/A | N/A | (1) | 2.53 |
| | Phenanthrene | µg/kg | N/A | 3 | 4 | 75 | 0 | 2.88E+03 | 2.88E+03 | 1.10E+03 | 4.31E+03 | N/A | N/A | (1) | 4.31 |
| | Pyrene | µg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 3.17E+02 | 8.99E+03 | 3.01E+03 | 2.30E+04 | (6) | 8.99 |
| | Selenium | mg/kg | NP | 2 | 4 | 50 | 0 | 2.82E+00 | 3.86E+00 | 7.19E+00 | 3.04E+01 | N/A | N/A | (1) | 3.04 |
| | Zinc | mg/kg | NP | 4 | 4 | 100 | 0 | N/A | N/A | 1.43E+02 | 2.28E+03 | 7.99E+02 | 5.75E+03 | (6) | 2.28 |

**TABLE A-3**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF DUCK CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2-Methylnaphthalene | µg/kg | N/A | 1 | 6 | 17 | 3 | 5.15E+02 | 1.27E+03 | 1.05E+03 | 1.05E+03 | N/A | N/A | (1) | 1.05 |
| | 4,4'-DDD | µg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 7.64E+00 | 7.07E+01 | 2.36E+01 | 6.57E+01 | (4) | 6.57 |
| | 4,4'-DDE | µg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 4.40E+00 | 1.99E+01 | 1.46E+01 | 2.68E+01 | (4) | 1.99 |
| | 4,4'-DDT | µg/kg | N/A | 1 | 6 | 17 | 5 | 5.39E+00 | 1.12E+01 | 3.13E+00 | 3.13E+00 | N/A | N/A | (1) | 3.13 |
| | Acenaphthene | µg/kg | N/A | 1 | 6 | 17 | 0 | 5.15E+02 | 1.27E+03 | 5.85E+03 | 5.85E+03 | N/A | N/A | (1) | 5.85 |
| | Acenaphthylene | µg/kg | N/A | 1 | 6 | 17 | 3 | 5.15E+02 | 1.27E+03 | 8.16E+02 | 8.16E+02 | N/A | N/A | (1) | 8.16 |
| | Anthracene | µg/kg | N/A | 3 | 6 | 50 | 0 | 5.15E+02 | 1.27E+03 | 1.71E+02 | 3.24E+04 | N/A | N/A | (1) | 3.24 |
| | Arsenic | mg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 5.21E+01 | 1.29E+02 | 9.45E+01 | 1.24E+02 | (2) | 1.24 |
| | Barium | mg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 6.84E+01 | 5.14E+02 | 3.24E+02 | 6.78E+02 | (4) | 5.14 |
| | Benzo(a)anthracene | µg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 7.12E+01 | 8.72E+04 | 1.52E+04 | 7.10E+04 | (9) | 7.10 |
| | Benzo(a)pyrene | µg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 7.12E+01 | 8.25E+04 | 1.44E+04 | 1.50E+05 | (6) | 8.25 |
| | Benzo(b)fluoranthene | µg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 1.05E+02 | 1.07E+05 | 1.89E+04 | 1.00E+05 | (9) | 1.00 |
| | Benzo(k)fluoranthene | µg/kg | NP | 5 | 6 | 83 | 0 | 5.15E+02 | 5.15E+02 | 7.17E+01 | 3.86E+04 | 6.80E+03 | 7.14E+04 | (15) | 3.86 |
| | Cadmium | mg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 3.70E-01 | 3.42E+00 | 1.98E+00 | 7.97E+00 | (6) | 3.42 |
| DC-E | Chromium | mg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 1.91E+01 | 1.21E+02 | 6.70E+01 | 1.52E+02 | (4) | 1.21 |
| | Chrysene | µg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 8.98E+01 | 8.09E+04 | 1.41E+04 | 6.86E+04 | (9) | 6.86 |
| | Dibenz(a,h)anthracene | µg/kg | N/A | 2 | 6 | 33 | 0 | 5.15E+02 | 1.27E+03 | 2.08E+02 | 9.74E+03 | N/A | N/A | (1) | 9.74 |
| | Fluoranthene | µg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 1.82E+02 | 1.90E+05 | 3.32E+04 | 1.63E+05 | (9) | 1.63 |
| | Fluorene | µg/kg | N/A | 1 | 6 | 17 | 0 | 5.15E+02 | 1.27E+03 | 8.72E+03 | 8.72E+03 | N/A | N/A | (1) | 8.72 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | NP | 4 | 6 | 67 | 0 | 5.15E+02 | 5.78E+02 | 4.06E+02 | 3.29E+04 | 5.92E+03 | 6.25E+04 | (15) | 3.29 |
| | Lead | mg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 6.85E+01 | 3.93E+02 | 2.42E+02 | 4.95E+02 | (4) | 3.93 |
| | Mercury | mg/kg | NP | 4 | 6 | 67 | 0 | 2.00E-02 | 4.00E-02 | 8.00E-02 | 1.20E-01 | 9.67E-02 | 1.13E-01 | (12) | 1.13 |
| | Naphthalene | µg/kg | N/A | 1 | 6 | 17 | 0 | 5.15E+02 | 1.27E+03 | 1.93E+03 | 1.93E+03 | N/A | N/A | (1) | 1.93 |
| | PCB-1254 | µg/kg | NP | 4 | 6 | 67 | 0 | 1.08E+02 | 1.22E+02 | 1.95E+02 | 2.59E+02 | 2.18E+02 | 2.42E+02 | (12) | 2.42 |
| | PCB-1260 | µg/kg | N/A | 1 | 6 | 17 | 4 | 1.29E+02 | 2.68E+02 | 1.45E+02 | 1.45E+02 | N/A | N/A | (1) | 1.45 |
| | Phenanthrene | µg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 6.30E+01 | 6.84E+04 | 1.18E+04 | 1.24E+05 | (6) | 6.84 |
| | Pyrene | µg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 1.41E+02 | 1.50E+05 | 2.61E+04 | 2.73E+05 | (6) | 1.50 |
| | Selenium | mg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 3.26E+00 | 1.87E+01 | 1.28E+01 | 2.52E+01 | (4) | 1.87 |
| | Zinc | mg/kg | NP | 6 | 6 | 100 | 0 | N/A | N/A | 1.09E+02 | 7.54E+02 | 4.31E+02 | 9.66E+02 | (4) | 7.54 |

**TABLE A-3**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF DUCK CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

**Notes:**

| | |
|---|---|
| BCa | Bias-corrected accelerated |
| EPC | Exposure point concentration. The lesser of the 95UCL and the maximum detected result. |
| KM | Kaplan-Meier product limit estimator |
| N/A | Not applicable, no estimate provided because there were fewer than 4 detected results |
| Max | Maximum result |
| Min | Minimum result |
| MVUE | Minimum variance unbiased estimate |
| mg/kg | Milligrams per kilogram |
| µg/kg | Micrograms per kilogram |
| 95UCL | One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL. |
| a | Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations. |
| | Distribution Codes: G= gamma, L= lognormal, N= normal, NP= nonparametric |
| b | Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data. |
| c | The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results. |
| d | All methods follow EPA (2002, 2007). |
| | Method (Statistic) Codes are defined as follows: |
| (1) | Maximum detected result |
| (2) | 95 percent UCL calculated using Student's *t* distribution |
| (3) | 95 percent UCL calculated using Land's H statistic |
| (4), (5), (6) | 95, 97.5, or 99 percent UCL, respectively, calculated using the nonparametric Chebyshev method |
| (7), (8), (9) | 95, 97.5, or 99 percent UCL, respectively, calculated using the MVUE Chebyshev method |
| (10) | 95 percent UCL calculated using the approximate gamma method |
| (11) | 95 percent UCL calculated using the adjusted gamma method |
| (12) | 95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL |
| (13), (14), (15) | 95, 97.5, or 99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL |
| (16) | 95 percent UCL calculated using the KM mean and a percentile bootstrap to estimate the UCL |
| (17) | 95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL |

**References**

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**TABLE A-4**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF OTTER CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Stream Reach | Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Number of High Censored Results[b] | Censored Data | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Detected | Total | | | Min | Max | Min | Max | Mean | 95UCL | UCL Method[d] | E |
| OC-A | 2-Methylnaphthalene | µg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 1.28E+02 | 1.06E+03 | 5.19E+02 | 1.08E+03 | (4) | 1.0 |
| | 4,4'-DDD | µg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 1.09E+01 | 2.74E+01 | 1.88E+01 | 2.37E+01 | (2) | 2.3 |
| | 4,4'-DDE | µg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 9.38E+00 | 1.78E+01 | 1.35E+01 | 1.63E+01 | (2) | 1.6 |
| | Anthracene | µg/kg | NP | 7 | 8 | 88 | 0 | 6.70E+00 | 6.70E+00 | 1.42E+02 | 3.36E+02 | 2.27E+02 | 2.81E+02 | (12) | 2.8 |
| | Arsenic | mg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 1.29E+01 | 4.31E+01 | 3.12E+01 | 3.83E+01 | (2) | 3.8 |
| | Barium | mg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 8.66E+01 | 3.85E+02 | 2.77E+02 | 4.44E+02 | (4) | 3.8 |
| | Benzo(a)anthracene | µg/kg | NP | 7 | 8 | 88 | 0 | 4.90E+00 | 4.90E+00 | 3.05E+02 | 1.12E+03 | 6.92E+02 | 8.79E+02 | (12) | 8.7 |
| | Benzo(a)pyrene | µg/kg | NP | 7 | 8 | 88 | 0 | 6.70E+00 | 6.70E+00 | 2.94E+02 | 1.21E+03 | 7.47E+02 | 9.84E+02 | (12) | 9.8 |
| | Benzo(b)fluoranthene | µg/kg | NP | 7 | 8 | 88 | 0 | 6.20E+00 | 6.20E+00 | 4.27E+02 | 2.27E+03 | 1.30E+03 | 2.43E+03 | (13) | 2.2 |
| | Benzo(k)fluoranthene | µg/kg | NP | 7 | 8 | 88 | 0 | 8.80E+00 | 8.80E+00 | 1.51E+02 | 7.45E+02 | 3.65E+02 | 6.84E+02 | (13) | 6.8 |
| | Cadmium | mg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 9.00E-01 | 2.67E+00 | 1.94E+00 | 2.41E+00 | (2) | 2.4 |
| | Chromium | mg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 5.62E+01 | 3.85E+02 | 2.01E+02 | 3.63E+02 | (4) | 3.6 |
| | Chrysene | µg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 1.50E+02 | 2.50E+03 | 1.40E+03 | 1.91E+03 | (2) | 1.9 |
| | Dibenz(a,h)anthracene | µg/kg | NP | 6 | 8 | 75 | 1 | 6.70E+00 | 6.28E+02 | 1.07E+02 | 2.19E+02 | 1.46E+02 | 1.76E+02 | (12) | 1.7 |
| | Fluoranthene | µg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 1.90E+02 | 2.94E+03 | 1.44E+03 | 2.03E+03 | (2) | 2.0 |
| | Fluorene | µg/kg | NP | 7 | 8 | 88 | 0 | 6.20E+00 | 6.20E+00 | 1.23E+02 | 3.03E+02 | 1.81E+02 | 2.28E+02 | (12) | 2.2 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | NP | 7 | 8 | 88 | 0 | 7.50E+00 | 7.50E+00 | 1.11E+02 | 7.11E+02 | 3.07E+02 | 6.04E+02 | (13) | 6.0 |
| | Lead | mg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 8.97E+01 | 3.50E+02 | 2.65E+02 | 3.32E+02 | (2) | 3.3 |
| | Mercury | mg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 1.00E-01 | 3.50E-01 | 2.70E-01 | 3.32E-01 | (2) | 3.3 |
| | Naphthalene | µg/kg | NP | 6 | 8 | 75 | 1 | 8.30E+00 | 6.62E+02 | 1.62E+02 | 5.62E+02 | 3.26E+02 | 4.40E+02 | (17) | 4.4 |
| | PCB-1254 | µg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 1.72E+02 | 4.84E+02 | 3.66E+02 | 4.55E+02 | (2) | 4.5 |
| | Phenanthrene | µg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 1.10E+02 | 1.45E+03 | 8.92E+02 | 1.18E+03 | (2) | 1.1 |
| | Pyrene | µg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 2.20E+02 | 2.70E+03 | 1.71E+03 | 2.26E+03 | (2) | 2.2 |
| | Selenium | mg/kg | NP | 0 | 7 | 0 | 0 | 2.43E+00 | 7.24E+00 | N/A | N/A | N/A | N/A | (1) | [illegible] |
| | Zinc | mg/kg | NP | 7 | 7 | 100 | 0 | N/A | N/A | 1.49E+02 | 1.04E+03 | 5.21E+02 | 9.92E+02 | (4) | 9.9 |
| | bis(2-Ethylhexyl)phthalate | µg/kg | N/A | 1 | 1 | 100 | 0 | N/A | N/A | 1.20E+02 | 1.20E+02 | N/A | N/A | (1) | 1.2 |

**TABLE A-4**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF OTTER CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OC-B | 2-Methylnaphthalene | µg/kg | N/A | 3 | 5 | 60 | 2 | N/A | N/A | 1.28E+02 | 3.51E+02 | N/A | N/A | (1) | 3.5 |
| | 4,4'-DDD | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.32E+01 | 1.80E+01 | 1.56E+01 | 1.72E+01 | (2) | 1.7 |
| | 4,4'-DDE | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 4.73E+00 | 1.02E+01 | 8.60E+00 | 1.08E+01 | (2) | 1.0 |
| | Acenaphthene | µg/kg | N/A | 2 | 10 | 20 | 0 | 1.60E+00 | 7.51E+02 | 6.28E+01 | 1.33E+03 | N/A | N/A | (1) | 1.3 |
| | Acenaphthylene | µg/kg | N/A | 1 | 10 | 10 | 5 | 1.50E+00 | 7.51E+02 | 5.75E+01 | 5.75E+01 | N/A | N/A | (1) | 5.7 |
| | Anthracene | µg/kg | NP | 7 | 10 | 70 | 0 | 1.60E+00 | 2.10E+01 | 2.08E+02 | 3.80E+03 | 6.17E+02 | 9.95E+02 | (17) | 9.9 |
| | Arsenic | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 2.25E+01 | 5.25E+01 | 3.60E+01 | 4.71E+01 | (2) | 4.7 |
| | Barium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.27E+02 | 2.84E+02 | 1.94E+02 | 2.53E+02 | (2) | 2.5 |
| | Benzo(a)anthracene | µg/kg | LN | 8 | 10 | 80 | 0 | 1.20E+00 | 1.50E+01 | 5.80E+01 | 1.09E+04 | 1.79E+03 | 8.31E+03 | (14) | 8.3 |
| | Benzo(a)pyrene | µg/kg | G | 8 | 10 | 80 | 0 | 1.60E+00 | 1.70E+00 | 6.10E+02 | 7.86E+03 | 1.78E+03 | 2.79E+03 | (17) | 2.7 |
| | Benzo(b)fluoranthene | µg/kg | G | 9 | 10 | 90 | 0 | 1.50E+00 | 1.50E+00 | 9.10E+01 | 1.40E+04 | 2.84E+03 | 8.56E+03 | (13) | 8.5 |
| | Benzo(g,h,i)perylene | µg/kg | N/A | 3 | 5 | 60 | 0 | 1.60E+00 | 1.70E+00 | 6.40E+02 | 1.40E+03 | N/A | N/A | (1) | 1.4 |
| | Benzo(k)fluoranthene | µg/kg | G | 8 | 10 | 80 | 0 | 2.10E+00 | 2.20E+00 | 3.97E+02 | 3.63E+03 | 1.09E+03 | 1.61E+03 | (16) | 1.6 |
| | Cadmium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 8.70E-01 | 2.60E+00 | 1.54E+00 | 2.22E+00 | (2) | 2.2 |
| | Chromium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 8.98E+01 | 2.20E+02 | 1.44E+02 | 1.91E+02 | (2) | 1.9 |
| | Chrysene | µg/kg | G | 9 | 10 | 90 | 0 | 1.10E+00 | 1.10E+00 | 6.80E+01 | 1.24E+04 | 2.47E+03 | 7.48E+03 | (13) | 7.4 |
| | Dibenz(a,h)anthracene | µg/kg | NP | 5 | 10 | 50 | 0 | 1.60E+00 | 2.10E+01 | 9.45E+01 | 9.51E+02 | 2.01E+02 | 3.67E+02 | (16) | 3.6 |
| | Fluoranthene | µg/kg | G | 10 | 11 | 91 | 0 | 1.50E+00 | 1.50E+00 | 1.10E+02 | 1.80E+04 | 3.57E+03 | 1.03E+04 | (13) | 1.0 |
| | Fluorene | µg/kg | NP | 7 | 10 | 70 | 0 | 1.50E+00 | 1.90E+01 | 7.99E+01 | 1.50E+03 | 2.44E+02 | 1.14E+03 | (14) | 1.1 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | N | 8 | 10 | 80 | 0 | 1.90E+00 | 2.00E+00 | 2.99E+02 | 2.11E+03 | 7.30E+02 | 1.07E+03 | (12) | 1.0 |
| | Lead | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.65E+02 | 3.21E+02 | 2.37E+02 | 3.05E+02 | (2) | 3.0 |
| | Mercury | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 2.00E-01 | 3.50E-01 | 2.66E-01 | 3.22E-01 | (2) | 3.2 |
| | Naphthalene | µg/kg | N/A | 2 | 11 | 18 | 3 | 2.00E+00 | 7.51E+02 | 1.76E+02 | 3.11E+02 | N/A | N/A | (1) | 3.1 |
| | PCB-1254 | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 8.13E+01 | 2.47E+02 | 1.77E+02 | 2.49E+02 | (2) | 2.4 |
| | Phenanthrene | µg/kg | G | 10 | 11 | 91 | 0 | 2.50E+00 | 2.50E+00 | 4.80E+01 | 1.31E+04 | 1.94E+03 | 6.89E+03 | (13) | 6.8 |
| | Pyrene | µg/kg | G | 10 | 11 | 91 | 0 | 1.40E+00 | 1.40E+00 | 1.20E+02 | 1.74E+04 | 3.34E+03 | 9.79E+03 | (13) | 9.7 |
| | Pyridine | µg/kg | N/A | 1 | 6 | 17 | 1 | 2.10E+01 | 2.70E+02 | 2.40E+02 | 2.40E+02 | N/A | N/A | (1) | 2.4 |
| | Selenium | mg/kg | NP | 0 | 5 | 0 | 0 | 2.40E+00 | 6.41E+00 | N/A | N/A | N/A | N/A | (1) | [illegible] |
| | Zinc | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 2.40E+02 | 1.04E+03 | 4.96E+02 | 1.17E+03 | (4) | 1.0 |
| | bis(2-Ethylhexyl)phthalate | µg/kg | N/A | 3 | 5 | 60 | 0 | 2.20E+01 | 2.40E+01 | 4.70E+02 | 1.10E+03 | N/A | N/A | (1) | 1.1 |

**TABLE A-4**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF OTTER CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OC-C | 2-Methylnaphthalene | µg/kg | NP | 5 | 8 | 62 | 3 | N/A | N/A | 9.48E+01 | 5.11E+02 | 3.04E+02 | 4.01E+02 | (17) | 4.0 |
| | 4,4'-DDD | µg/kg | NP | 7 | 8 | 88 | 0 | 5.38E+00 | 5.38E+00 | 1.10E+01 | 2.79E+01 | 1.50E+01 | 1.87E+01 | (12) | 1.8 |
| | 4,4'-DDE | µg/kg | NP | 7 | 8 | 88 | 0 | 5.38E+00 | 5.38E+00 | 4.39E+00 | 1.55E+01 | 7.45E+00 | 9.95E+00 | (12) | 9.9 |
| | Acenaphthene | µg/kg | NP | 4 | 9 | 44 | 0 | 8.40E+00 | 7.51E+02 | 1.21E+02 | 1.15E+03 | 3.94E+02 | 8.18E+02 | (16) | 8.1 |
| | Acenaphthylene | µg/kg | N/A | 2 | 9 | 22 | 6 | 7.80E+00 | 1.08E+03 | 1.10E+02 | 2.35E+02 | N/A | N/A | (1) | 2.3 |
| | Anthracene | µg/kg | NP | 9 | 9 | 100 | 0 | N/A | N/A | 2.40E+02 | 2.60E+03 | 8.63E+02 | 2.18E+03 | (4) | 2.1 |
| | Arsenic | mg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 3.58E+01 | 8.35E+01 | 5.35E+01 | 6.30E+01 | (2) | 6.3 |
| | Barium | mg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 1.29E+02 | 3.36E+02 | 2.30E+02 | 2.80E+02 | (2) | 2.8 |
| | Benzo(a)anthracene | µg/kg | G | 9 | 9 | 100 | 0 | N/A | N/A | 8.91E+02 | 7.13E+03 | 2.44E+03 | 3.98E+03 | (10) | 3.9 |
| | Benzo(a)pyrene | µg/kg | G | 9 | 9 | 100 | 0 | N/A | N/A | 9.83E+02 | 7.22E+03 | 2.51E+03 | 3.85E+03 | (10) | 3.8 |
| | Benzo(b)fluoranthene | µg/kg | G | 9 | 9 | 100 | 0 | N/A | N/A | 2.15E+03 | 9.52E+03 | 3.82E+03 | 5.33E+03 | (10) | 5.3 |
| | Benzo(g,h,i)perylene | µg/kg | N/A | 1 | 1 | 100 | 0 | N/A | N/A | 1.40E+03 | 1.40E+03 | N/A | N/A | (1) | 1.4 |
| | Benzo(k)fluoranthene | µg/kg | G | 9 | 9 | 100 | 0 | N/A | N/A | 6.95E+02 | 3.09E+03 | 1.35E+03 | 1.89E+03 | (10) | 1.8 |
| | Cadmium | mg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 1.06E+00 | 2.60E+00 | 1.61E+00 | 1.93E+00 | (2) | 1.9 |
| | Chromium | mg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 1.53E+02 | 3.99E+02 | 2.44E+02 | 3.01E+02 | (2) | 3.0 |
| | Chrysene | µg/kg | G | 9 | 9 | 100 | 0 | N/A | N/A | 1.57E+03 | 8.81E+03 | 3.38E+03 | 4.97E+03 | (10) | 4.9 |
| | Dibenz(a,h)anthracene | µg/kg | NP | 6 | 9 | 67 | 0 | 8.40E+00 | 7.26E+02 | 8.92E+01 | 1.81E+03 | 4.61E+02 | 1.68E+03 | (14) | 1.6 |
| | Fluoranthene | µg/kg | G | 9 | 9 | 100 | 0 | N/A | N/A | 2.69E+03 | 1.91E+04 | 6.09E+03 | 9.77E+03 | (10) | 9.7 |
| | Fluorene | µg/kg | LN | 8 | 9 | 89 | 0 | 5.32E+02 | 5.32E+02 | 8.90E+01 | 1.50E+03 | 4.07E+02 | 1.43E+03 | (14) | 1.4 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | G | 9 | 9 | 100 | 0 | N/A | N/A | 2.45E+02 | 5.58E+03 | 1.63E+03 | 3.04E+03 | (10) | 3.0 |
| | Lead | mg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 1.91E+02 | 3.97E+02 | 2.57E+02 | 3.04E+02 | (2) | 3.0 |
| | Mercury | mg/kg | G | 8 | 8 | 100 | 0 | N/A | N/A | 1.10E-01 | 7.70E-01 | 2.59E-01 | 4.26E-01 | (10) | 4.2 |
| | Naphthalene | µg/kg | NP | 6 | 9 | 67 | 0 | 1.00E+01 | 7.51E+02 | 1.09E+02 | 1.45E+03 | 3.98E+02 | 6.62E+02 | (17) | 6.6 |
| | PCB-1254 | µg/kg | NP | 7 | 8 | 88 | 0 | 1.23E+02 | 1.23E+02 | 1.51E+02 | 1.13E+04 | 1.62E+03 | 1.55E+04 | (15) | 1.1 |
| | Phenanthrene | µg/kg | LN | 9 | 9 | 100 | 0 | N/A | N/A | 6.68E+02 | 1.36E+04 | 3.14E+03 | 9.03E+03 | (3) | 9.0 |
| | Pyrene | µg/kg | G | 9 | 9 | 100 | 0 | N/A | N/A | 2.33E+03 | 1.78E+04 | 6.61E+03 | 1.11E+04 | (10) | 1.1 |
| | Selenium | mg/kg | NP | 4 | 8 | 50 | 0 | 2.44E+00 | 5.10E+00 | 2.67E+00 | 3.65E+00 | 2.97E+00 | 3.29E+00 | (12) | 3.2 |
| | Zinc | mg/kg | N | 8 | 8 | 100 | 0 | N/A | N/A | 2.81E+02 | 6.35E+02 | 4.32E+02 | 5.15E+02 | (2) | 5.1 |
| | bis(2-Ethylhexyl)phthalate | µg/kg | N/A | 1 | 1 | 100 | 0 | N/A | N/A | 1.10E+03 | 1.10E+03 | N/A | N/A | (1) | 1.1 |

**TABLE A-4**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF OTTER CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OC-D | 2-Methylnaphthalene | µg/kg | N/A | 2 | 5 | 40 | 3 | N/A | N/A | 1.41E+02 | 1.57E+02 | N/A | N/A | (1) | 1.57 |
| | 4,4'-DDD | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.47E+00 | 3.58E+01 | 1.64E+01 | 4.16E+01 | (4) | 3.58 |
| | 4,4'-DDE | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.19E+00 | 2.09E+01 | 1.07E+01 | 2.36E+01 | (4) | 2.09 |
| | Acenaphthene | µg/kg | N/A | 3 | 5 | 60 | 0 | 6.92E+02 | 8.46E+02 | 1.80E+02 | 1.63E+03 | N/A | N/A | (1) | 1.63 |
| | Acenaphthylene | µg/kg | N/A | 1 | 5 | 20 | 4 | N/A | N/A | 2.03E+02 | 2.03E+02 | N/A | N/A | (1) | 2.03 |
| | Anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.23E+02 | 4.84E+03 | 1.46E+03 | 1.04E+04 | (6) | 4.84 |
| | Arsenic | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.74E+01 | 6.57E+01 | 4.44E+01 | 8.12E+01 | (4) | 6.57 |
| | Barium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 9.42E+01 | 3.18E+02 | 1.69E+02 | 2.52E+02 | (2) | 2.52 |
| | Benzo(a)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.98E+02 | 1.84E+04 | 5.64E+03 | 3.93E+04 | (6) | 1.84 |
| | Benzo(a)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 7.73E+02 | 2.00E+04 | 6.14E+03 | 4.24E+04 | (6) | 2.00 |
| | Benzo(b)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.32E+03 | 2.47E+04 | 8.05E+03 | 5.23E+04 | (6) | 2.47 |
| | Benzo(k)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 4.25E+02 | 7.88E+03 | 2.58E+03 | 1.66E+04 | (6) | 7.88 |
| | Cadmium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.30E-01 | 2.39E+00 | 1.34E+00 | 2.67E+00 | (4) | 2.39 |
| | Chromium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.66E+01 | 1.06E+02 | 8.80E+01 | 1.08E+02 | (2) | 1.06 |
| | Chrysene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 9.69E+02 | 2.29E+04 | 7.06E+03 | 4.83E+04 | (6) | 2.29 |
| | Dibenz(a,h)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.36E+02 | 4.53E+03 | 1.29E+03 | 9.51E+03 | (6) | 4.53 |
| | Fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.90E+03 | 5.18E+04 | 1.59E+04 | 1.11E+05 | (6) | 5.18 |
| | Fluorene | µg/kg | N/A | 3 | 5 | 60 | 0 | 6.92E+02 | 8.46E+02 | 2.31E+02 | 2.39E+03 | N/A | N/A | (1) | 2.39 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.17E+02 | 1.77E+04 | 4.89E+03 | 3.73E+04 | (6) | 1.77 |
| | Lead | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 6.97E+01 | 3.48E+02 | 1.87E+02 | 3.99E+02 | (4) | 3.48 |
| | Mercury | mg/kg | NP | 3 | 5 | 60 | 0 | 6.00E-02 | 8.00E-02 | 1.10E-01 | 1.50E-01 | N/A | N/A | (1) | 1.5 |
| | Naphthalene | µg/kg | N/A | 3 | 5 | 60 | 1 | 6.92E+02 | 8.46E+02 | 2.65E+02 | 8.24E+02 | N/A | N/A | (1) | 8.24 |
| | PCB-1254 | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.45E+02 | 2.57E+02 | 1.85E+02 | 2.27E+02 | (2) | 2.27 |
| | Phenanthrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 6.45E+02 | 2.63E+04 | 8.47E+03 | 5.78E+04 | (6) | 2.63 |
| | Pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.54E+03 | 4.48E+04 | 1.39E+04 | 9.60E+04 | (6) | 4.48 |
| | Selenium | mg/kg | NP | 0 | 5 | 0 | 0 | 2.06E+00 | 5.22E+00 | N/A | N/A | N/A | N/A | (1) | [illegible] |
| | Zinc | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.68E+02 | 9.45E+02 | 4.74E+02 | 1.06E+03 | (4) | 9.45 |
| OC-E | 2-Methylnaphthalene | µg/kg | N/A | 2 | 5 | 40 | 3 | N/A | N/A | 1.90E+02 | 3.25E+02 | N/A | N/A | (1) | 3.25 |
| | 4,4'-DDD | µg/kg | N/A | 2 | 5 | 40 | 0 | 4.85E+00 | 5.86E+00 | 3.63E+00 | 3.58E+01 | N/A | N/A | (1) | 3.58 |
| | 4,4'-DDE | µg/kg | N/A | 3 | 5 | 60 | 0 | 4.85E+00 | 5.86E+00 | 2.37E+00 | 2.09E+01 | N/A | N/A | (1) | 2.09 |
| | Acenaphthene | µg/kg | N/A | 1 | 5 | 20 | 0 | 5.09E+02 | 6.55E+02 | 1.63E+03 | 1.63E+03 | N/A | N/A | (1) | 1.63 |
| | Anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.09E+02 | 4.84E+03 | 1.13E+03 | 1.04E+04 | (6) | 4.84 |
| | Arsenic | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 6.67E+00 | 5.10E+01 | 2.49E+01 | 5.68E+01 | (4) | 5.10 |
| | Barium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 6.24E+01 | 2.21E+02 | 1.52E+02 | 2.80E+02 | (4) | 2.2 |
| | Benzo(a)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 3.75E+02 | 1.84E+04 | 4.30E+03 | 3.94E+04 | (6) | 1.84 |
| | Benzo(a)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 3.64E+02 | 2.00E+04 | 4.62E+03 | 4.29E+04 | (6) | 2.00 |
| | Benzo(b)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.21E+02 | 2.47E+04 | 5.90E+03 | 5.28E+04 | (6) | 2.47 |
| | Benzo(k)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.42E+02 | 7.88E+03 | 1.89E+03 | 1.68E+04 | (6) | 7.88 |
| | Cadmium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.10E-01 | 2.39E+00 | 1.33E+00 | 2.75E+00 | (4) | 2.39 |
| | Chromium | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 2.84E+01 | 9.81E+01 | 4.95E+01 | 7.61E+01 | (2) | 7.6 |
| | Chrysene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 4.78E+02 | 2.29E+04 | 5.49E+03 | 4.89E+04 | (6) | 2.29 |
| | Dibenz(a,h)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 1.47E+02 | 4.53E+03 | 1.06E+03 | 9.69E+03 | (6) | 4.53 |
| | Fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 8.69E+02 | 5.18E+04 | 1.20E+04 | 1.11E+05 | (6) | 5.18 |
| | Fluorene | µg/kg | NP | 4 | 5 | 80 | 0 | 6.41E+02 | 6.41E+02 | 1.13E+02 | 2.39E+03 | 5.87E+02 | 3.49E+03 | (14) | 2.39 |
| | Indeno(1,2,3-cd)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 3.82E+02 | 1.77E+04 | 3.99E+03 | 3.81E+04 | (6) | 1.77 |
| | Lead | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 6.67E+01 | 3.48E+02 | 1.48E+02 | 3.73E+02 | (4) | 3.48 |
| | Mercury | mg/kg | NP | 4 | 5 | 80 | 0 | 8.00E-02 | 8.00E-02 | 7.00E-02 | 2.10E-01 | 1.10E-01 | 1.69E-01 | (12) | 1.6 |
| | Naphthalene | µg/kg | N/A | 3 | 5 | 60 | 2 | N/A | N/A | 1.36E+02 | 2.65E+02 | N/A | N/A | (1) | 2.65 |
| | PCB-1254 | µg/kg | NP | 4 | 5 | 80 | 0 | 1.17E+02 | 1.17E+02 | 6.18E+01 | 2.42E+03 | 5.73E+02 | 5.32E+03 | (15) | 2.42 |
| | Phenanthrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 5.71E+02 | 2.63E+04 | 6.07E+03 | 5.65E+04 | (6) | 2.63 |
| | Pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 8.74E+02 | 4.48E+04 | 1.04E+04 | 9.61E+04 | (6) | 4.48 |
| | Selenium | mg/kg | NP | 0 | 5 | 0 | 0 | 2.27E+00 | 5.22E+00 | N/A | N/A | N/A | N/A | (1) | [illegible] |
| | Zinc | mg/kg | NP | 5 | 5 | 100 | 0 | N/A | N/A | 9.50E+01 | 5.38E+02 | 2.67E+02 | 5.94E+02 | (4) | 5.38 |

**TABLE A-4**
**SEDIMENT-SPECIFIC SUMMARY STATISTICS AND EXPOSURE POINT CONCENTRATIONS FOR INDIVIDUAL REACHES OF OTTER CREEK**
**ECOLOGICAL RISK ASSESSMENT**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

**Notes:**

| | |
|---|---|
| BCa | Bias-corrected accelerated |
| EPC | Exposure point concentration. The lesser of the 95UCL and the maximum detected result. |
| KM | Kaplan-Meier product limit estimator |
| N/A | Not applicable, no estimate provided because there were fewer than 4 detected results |
| Max | Maximum result |
| Min | Minimum result |
| MVUE | Minimum variance unbiased estimate |
| mg/kg | Milligrams per kilogram |
| µg/kg | Micrograms per kilogram |
| 95UCL | One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL. |
| a | Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations. |
| | <u>Distribution Codes</u>: G= gamma, L= lognormal, N= normal, NP= nonparametric |
| b | Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data. |
| c | The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results. |
| d | All methods follow EPA (2002, 2007). |
| | <u>Method (Statistic) Codes are defined as follows</u>: |
| (1) | Maximum detected result |
| (2) | 95 percent UCL calculated using Student's *t* distribution |
| (3) | 95 percent UCL calculated using Land's H statistic |
| (4), (5), (6) | 95, 97.5, or 99 percent UCL, respectively, calculated using the nonparametric Chebyshev method |
| (7), (8), (9) | 95, 97.5, or 99 percent UCL, respectively, calculated using the MVUE Chebyshev method |
| (10) | 95 percent UCL calculated using the approximate gamma method |
| (11) | 95 percent UCL calculated using the adjusted gamma method |
| (12) | 95 percent UCL calculated using the KM mean and Student's t cutoff for the UCL |
| (13), (14), (15) | 95, 97.5, or 99 percent UCL, respectively, calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL |
| (16) | 95 percent UCL calculated using the KM mean and a percentile bootstrap to estimate the UCL |
| (17) | 95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL |

**References**


U.S. Environmental Protection Agency (EPA). 2002. “Calculating exposure point concentrations at hazardous waste sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

U.S. Environmental Protection Agency (EPA). 2007. “ProUCL Version 4.0 Technical Guide.” Prepared by A. Singh and A.K. Singh. EPA/600/R-07/041. April.

**TABLE A-5**
**SEDIMENT SAMPLING LOCATION COORDINATES**
**DUCK AND OTTER CREEKS,**
**TOLEDO AND OREGON, OHIO**

| Sample ID | Easting* (X) | Northing* (Y) | Longitude | Latitude |
|---|---|---|---|---|
| DC-01 | 1704636.144 | 738068.6415 | -83.46605595 | 41.68845816 |
| DC-02 | 1704057.046 | 737268.499 | -83.46814345 | 41.68624485 |
| DC-03 | 1703753.912 | 736194.2966 | -83.46920945 | 41.68328786 |
| DC-04 | 1703676.644 | 734701.3597 | -83.46943155 | 41.67918868 |
| DC-05 | 1703357.26 | 733559.9514 | -83.47055412 | 41.67604676 |
| DC-06 | 1702569.212 | 732626.117 | -83.47340038 | 41.67346008 |
| DC-07 | 1701399.582 | 730926.119 | -83.47761153 | 41.66875915 |
| DC-08 | 1700584.989 | 729833.6422 | -83.48054781 | 41.66573614 |
| DC-09 | 1700199.373 | 728619.8967 | -83.481909 | 41.66239354 |
| DC-10 | 1699711.065 | 727264.5836 | -83.48363999 | 41.65865926 |
| DC-11 | 1698759.246 | 726229.9713 | -83.48708005 | 41.65579062 |
| DC-12 | 1697676.731 | 725281.6392 | -83.49100159 | 41.65315456 |
| DC-13 | 1696087.292 | 724928.7954 | -83.49680244 | 41.65213659 |
| DC-14 | 1695962.434 | 724879.4219 | -83.49725721 | 41.65199719 |
| DC-15 | 1694972.637 | 724857.7715 | -83.5008778 | 41.65190666 |
| DC-16 | 1695757.664 | 724837.3469 | -83.49800467 | 41.6518753 |
| DC-17 | 1695445.607 | 724773.2731 | -83.49914374 | 41.65168967 |
| DC-18 | 1695074.753 | 724663.0053 | -83.500496 | 41.65137541 |
| DC-19 | 1695213.512 | 724495.8142 | -83.4999813 | 41.65092098 |
| OC-01 | 1708179.194 | 741098.8669 | -83.45320646 | 41.69688046 |
| OC-01a | 1708015.396 | 740594.4283 | -83.45378598 | 41.69549131 |
| OC-02 | 1707878.575 | 740054.3199 | -83.45426529 | 41.69400507 |
| OC-02a | 1707760.409 | 739465.3858 | -83.45467432 | 41.69238541 |
| OC-03 | 1707684.147 | 739028.0324 | -83.45493599 | 41.69118297 |
| OC-03a | 1707469.941 | 738329.0131 | -83.45569216 | 41.68925833 |
| OC-04 | 1707217.99 | 737596.8509 | -83.45658514 | 41.6872416 |
| OC-04a | 1706844.417 | 736567.3872 | -83.45791133 | 41.68440537 |
| OC-05 | 1706458.335 | 736016.4866 | -83.45930247 | 41.68288198 |
| OC-05a | 1705883.546 | 735224.206 | -83.46137456 | 41.68069048 |
| OC-06 | 1705224.362 | 734309.6174 | -83.46375047 | 41.67816076 |
| OC-07 | 1703654.168 | 731771.6351 | -83.46939462 | 41.67114843 |
| OC-08 | 1703394.292 | 730565.5688 | -83.47029663 | 41.66783088 |
| OC-09 | 1702828.28 | 729271.6384 | -83.47231529 | 41.66426284 |
| OC-10 | 1702275.389 | 728066.0593 | -83.47428933 | 41.66093762 |
| OC-11 | 1701851.211 | 727191.1276 | -83.47580572 | 41.65852366 |
| OC-12 | 1700792.427 | 726209.4252 | -83.47963968 | 41.65579714 |
| OC-13 | 1699877.244 | 725689.9419 | -83.48296696 | 41.65434334 |
| OC-14 | 1699141.189 | 724482.9904 | -83.48561026 | 41.65100848 |
| OC-15 | 1698900.132 | 723283.0943 | -83.48644257 | 41.6477083 |
| OC-16 | 1698201.582 | 722303.9498 | -83.48895767 | 41.64499966 |
| OC-17 | 1697109.064 | 720222.671 | -83.4928679 | 41.63925423 |
| OC-18 | 1696720.153 | 719781.5401 | -83.49427219 | 41.63803153 |
| OC-19 | 1696196.886 | 718222.3806 | -83.49612118 | 41.63373655 |
| OC-20 | 1695567.053 | 716537.1888 | -83.49835443 | 41.62909233 |
| OC-21 | 1695150.083 | 714917.4445 | -83.4998116 | 41.62463436 |
| OC-21a | 1695165.178 | 715050.2524 | -83.49976196 | 41.62499929 |
| OC-22 | 1695151.782 | 714045.5656 | -83.49976883 | 41.62224183 |
| OC-23 | 1694783.517 | 712633.1483 | -83.50105635 | 41.6183543 |
| OC-24 | 1691594.055 | 711156.6436 | -83.51265735 | 41.61420146 |
| OC-25 | 1689090.481 | 710087.8695 | -83.52176641 | 41.61118841 |
| OC-26 | 1687541.178 | 709102.107 | -83.52738903 | 41.60843335 |

**Note:**
* = The coordinate system used is NAD83 Ohio State Plane Feet North

# TABLE A-6
# SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES
# DUCK AND OTTER CREEKS
# TOLEDO, OHIO

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S01-DC-01 4/02/07 | S02-DC-02 4/02/07 | S03-DC-03 4/02/07 | S04-DC-04 4/02/07 | S05-DC-05 4/03/07 | S06-DC-06 4/03/07 | | |
| Aldrin | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 0.029 | NE |
| Alpha-BHC | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 0.09 | NE |
| Beta-BHC | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 0.32 | NE |
| Gamma-BHC | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 0.44 | 0.00237 |
| Delta-BHC | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 0.09 | NE |
| Alpha-Chlordane | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 1.6 | 0.00324 |
| Gamma-Chlordane | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 1.6 | 0.00324 |
| 4,4'-DDD | *0.089* | *0.0721* | *0.0218* | *0.0912* | *0.136* | *0.161* | 2.4 | 0.00488 |
| 4,4'-DDE | *0.0473* | *0.0367* | *0.0107* | *0.0417* | *0.0622* | *0.0566* | 1.7 | 0.00316 |
| 4,4'-DDT | 0.00483 U | 0.0102 U | *0.0191* | 0.0106 U | 0.0104 U | 0.00888 U | 1.7 | 0.00416 |
| Dieldrin | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 0.03 | 0.0019 |
| Endosulfan I | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 370 | NE |
| Endosulfan II | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 370 | NE |
| Endosulfan Sulfate | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 370 | NE |
| Endrin | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 18 | 0.00222 |
| Endrin Aldehyde | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 18 | NE |
| Endrin Ketone | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 18 | NE |
| Heptachlor | 0.00483 U | 0.0102 U | 0.00392 J | 0.0106 U | 0.0104 U | 0.00888 U | 0.11 | NE |
| Heptachlor Epoxide | *0.0109* | *0.00786* | 0.00521 U | *0.00907 J* | *0.0147* | 0.00888 U | 0.053 | 0.00247 |
| Methoxychlor | 0.00483 U | 0.0102 U | 0.00521 U | 0.0106 U | 0.0104 U | 0.00888 U | 310 | NE |

**TABLE A-6**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S07-DC-07 4/02/07 | S08-DC-08 4/02/07 | S09-DC-09 4/02/07 | S10-DC-10 4/0307 | S11-DC-11 4/03/07 | S12-DC-12 4/03/07 | | |
| Aldrin | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 0.029 | NE |
| Alpha-BHC | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 0.09 | NE |
| Beta-BHC | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 0.32 | NE |
| Gamma-BHC | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 0.44 | 0.00237 |
| Delta-BHC | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 0.09 | NE |
| Alpha-Chlordane | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 1.6 | 0.00324 |
| Gamma-Chlordane | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 1.6 | 0.00324 |
| 4,4'-DDD | *0.222* | *0.14* | *0.176* | *0.0783* | *0.388 H* | *0.277* | 2.4 | 0.00488 |
| 4,4'-DDE | *0.0752* | *0.136* | *0.0727* | *0.061* | *0.201 H* | *0.285* | 1.7 | 0.00316 |
| 4,4'-DDT | 0.0121 U | *0.0372* | *0.0167* | *0.017* | *0.0502 H* | *0.0248* | 1.7 | 0.00416 |
| Dieldrin | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 0.03 | 0.0019 |
| Endosulfan I | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 370 | NE |
| Endosulfan II | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 370 | NE |
| Endosulfan Sulfate | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 370 | NE |
| Endrin | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 18 | 0.00222 |
| Endrin Aldehyde | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 18 | NE |
| Endrin Ketone | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 18 | NE |
| Heptachlor | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 0.11 | NE |
| Heptachlor Epoxide | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 0.053 | 0.00247 |
| Methoxychlor | 0.0121 U | 0.0159 U | 0.01 U | 0.00801 U | 0.0121 U, H | 0.0224 U | 310 | 0.00141 |

**TABLE A-6**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S13-DC-13 4/04/07 | S14-DC-14 4/04/07 | S15-DC-15 4/04/07 | S16-DC-16 4/02/07 | S17-DC-17 4/02/07 | S18-DC-18 4/02/07 | | |
| Aldrin | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 0.029 | NE |
| Alpha-BHC | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 0.09 | NE |
| Beta-BHC | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 0.32 | NE |
| Gamma-BHC | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 0.44 | 0.00237 |
| Delta-BHC | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 0.09 | NE |
| Alpha-Chlordane | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 1.6 | 0.00324 |
| Gamma-Chlordane | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 1.6 | 0.00324 |
| 4,4'-DDD | *0.136* | *0.0707* | *0.00787* | *0.0179* | *0.0198* | *0.0174* | 2.4 | 0.00488 |
| 4,4'-DDE | *0.0727* | *0.0175* | *0.00723* | *0.0194* | *0.0199* | *0.019* | 1.7 | 0.00316 |
| 4,4'-DDT | *0.0349* | 0.00954 U | 0.00313 J | 0.0112 U | 0.0109 U | 0.0104 U | 1.7 | 0.00416 |
| Dieldrin | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 0.03 | 0.0019 |
| Endosulfan I | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 370 | NE |
| Endosulfan II | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 370 | NE |
| Endosulfan Sulfate | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 370 | NE |
| Endrin | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 18 | 0.00222 |
| Endrin Aldehyde | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 18 | NE |
| Endrin Ketone | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 18 | NE |
| Heptachlor | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 0.11 | NE |
| Heptachlor Epoxide | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 0.053 | 0.00247 |
| Methoxychlor | 0.00616 U | 0.00954 U | 0.00609 U | 0.0112 U | 0.0109 U | 0.0104 U | 310 | 0.00141 |

**TABLE A-6**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S19-DC-19 4/04/07 | S20-OC-01 4/02/07 | S21-OC-02 4/02/07 | S22-OC-03 4/02/07 | S23-OC-04 4/02/07 | S24-OC-05 4/02/07 | | |
| Aldrin | 0.00539 U | 0.0541 U, MS, LS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 0.029 | NE |
| Alpha-BHC | 0.00539 U | 0.0541 U, MS, LS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 0.09 | NE |
| Beta-BHC | 0.00539 U | 0.0541 U, MS, LS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 0.32 | NE |
| Gamma-BHC | 0.00539 U | 0.0541 U, MS, LS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 0.44 | 0.00237 |
| Delta-BHC | 0.00539 U | 0.0541 U, MS, LS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 0.09 | NE |
| Alpha-Chlordane | 0.00539 U | 0.0541 U, MS, LS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 1.6 | 0.00324 |
| Gamma-Chlordane | 0.00539 U | 0.0541 U, MS, LS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 1.6 | 0.00324 |
| 4,4'-DDD | *0.00764* | *0.0116 M, MS, LC* | *0.0252 LS, LC* | *0.0274 LS, LC* | *0.0152 LS, LC* | *0.0233 LS, LC* | 2.4 | 0.00488 |
| 4,4'-DDE | *0.0044 J* | *0.00938 M, MS, LC* | *0.0178 LS, LC* | *0.0174 LS, LC* | *0.0138 LS, LC* | *0.0163 LS, LC* | 1.7 | 0.00316 |
| 4,4'-DDT | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 1.7 | 0.00416 |
| Dieldrin | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 0.03 | 0.0019 |
| Endosulfan I | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 370 | NE |
| Endosulfan II | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 370 | NE |
| Endosulfan Sulfate | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 370 | NE |
| Endrin | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 18 | 0.00222 |
| Endrin Aldehyde | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 18 | NE |
| Endrin Ketone | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 18 | NE |
| Heptachlor | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 0.11 | NE |
| Heptachlor Epoxide | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 0.053 | 0.00247 |
| Methoxychlor | 0.00539 U | 0.0541 U, M, MS, LC | 0.00743 U, LS, LC | 0.00958 U, LS, LC | 0.00798 U, LS, LC | 0.00848 U, LS, LC | 310 | 0.00141 |

**TABLE A-6**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S25-OC-06 4/02/07 | S26-OC-07 4/03/07 | S27-OC-08 4/03/07 | S28-OC-09 4/04/07 | S29-OC-10 4/04/07 | S30-OC-11 4/03/07 | | |
| Aldrin | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 0.029 | NE |
| Alpha-BHC | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 0.09 | NE |
| Beta-BHC | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 0.32 | NE |
| Gamma-BHC | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 0.44 | 0.00237 |
| Delta-BHC | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 0.09 | NE |
| Alpha-Chlordane | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 1.6 | 0.00324 |
| Gamma-Chlordane | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 1.6 | 0.00324 |
| 4,4'-DDD | *0.0109 LS, LC* | *0.18 LS, LC* | *0.0157 LS, LC* | *0.0132 LS, LC* | *0.0153 LS, LC* | *0.0158 LS, LC* | 2.4 | 0.00488 |
| 4,4'-DDE | *0.00972 LS, LC* | *0.00992 LS, LC* | *0.00843 LS, LC* | *0.00473 LS, LC* | *0.0102 LS, LC* | *0.00971 LS, LC* | 1.7 | 0.00316 |
| 4,4'-DDT | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 1.7 | 0.00416 |
| Dieldrin | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 0.03 | 0.0019 |
| Endosulfan I | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 370 | NE |
| Endosulfan II | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 370 | NE |
| Endosulfan Sulfate | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 370 | NE |
| Endrin | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 18 | 0.00222 |
| Endrin Aldehyde | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 18 | NE |
| Endrin Ketone | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 18 | NE |
| Heptachlor | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 0.11 | NE |
| Heptachlor Epoxide | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 0.053 | 0.00247 |
| Methoxychlor | 0.0071 U, LS, LC | 0.00695 U, LS, LC | 0.006 U, LS, LC | 0.00521 U, LS, LC | 0.00576 U, LC | 0.00766 U, LC | 310 | 0.00141 |

**TABLE A-6**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S31-OC-12 4/03/07 | S32-OC-13 4/03/07 | S33-OC-14 4/03/07 | S34-OC-15 4/03/07 | S35-OC-16 4/03/07 | S36-OC-17 4/03/07 | | |
| Aldrin | 0.006 U, LC | 0.00487 U, LS, LC | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 0.029 | NE |
| Alpha-BHC | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 0.09 | NE |
| Beta-BHC | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 0.32 | NE |
| Gamma-BHC | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 0.44 | 0.00237 |
| Delta-BHC | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 0.09 | NE |
| Alpha-Chlordane | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 1.6 | 0.00324 |
| Gamma-Chlordane | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 1.6 | 0.00324 |
| 4,4'-DDD | *0.0133 LS, LC* | *0.0141 LS* | *0.0125 LS* | *0.011* | 0.00538 U | *0.0279* | 2.4 | 0.00488 |
| 4,4'-DDE | *0.00608 LS, LC* | *0.00615 LS* | *0.00573 LS* | *0.00439 J* | 0.00538 U | *0.0155* | 1.7 | 0.00316 |
| 4,4'-DDT | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 1.7 | 0.00416 |
| Dieldrin | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 0.03 | 0.0019 |
| Endosulfan I | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 370 | NE |
| Endosulfan II | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 370 | NE |
| Endosulfan Sulfate | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 370 | NE |
| Endrin | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 18 | 0.00222 |
| Endrin Aldehyde | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 18 | NE |
| Endrin Ketone | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 18 | NE |
| Heptachlor | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 0.11 | NE |
| Heptachlor Epoxide | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 0.053 | 0.00247 |
| Methoxychlor | 0.006 U, LC | 0.00487 U, LS | 0.00537 U, LS | 0.00617 U | 0.00538 U | 0.00502 U | 310 | 0.00141 |

**TABLE A-6**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S37-OC-18 4/03/07 | S38-OC-19 4/03/07 | S39-OC-20 4/03/07 | S40-OC-21 4/03/07 | S41-OC-21A 4/04/07 | S42-OC-22 4/03/07 | | |
| Aldrin | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 0.029 | NE |
| Alpha-BHC | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 0.09 | NE |
| Beta-BHC | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 0.32 | NE |
| Gamma-BHC | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 0.44 | 0.00237 |
| Delta-BHC | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 0.09 | NE |
| Alpha-Chlordane | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 1.6 | 0.00324 |
| Gamma-Chlordane | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 1.6 | 0.00324 |
| 4,4'-DDD | *0.0146* | *0.0101* | *0.0233* | *0.00708 J* | *0.00547* | 0.00358 | 2.4 | 0.00488 |
| 4,4'-DDE | *0.00765* | *0.00666* | *0.0139* | *0.0066 J* | *0.00519 J* | *0.0209* | 1.7 | 0.00316 |
| 4,4'-DDT | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 1.7 | 0.00416 |
| Dieldrin | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 0.03 | 0.0019 |
| Endosulfan I | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 370 | NE |
| Endosulfan II | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 370 | NE |
| Endosulfan Sulfate | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 370 | NE |
| Endrin | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 18 | 0.00222 |
| Endrin Aldehyde | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 18 | NE |
| Endrin Ketone | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 18 | NE |
| Heptachlor | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 0.11 | NE |
| Heptachlor Epoxide | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 0.053 | 0.00247 |
| Methoxychlor | 0.00529 U | 0.00427 U | 0.00447 U, LS | 0.00718 U | 0.00539 U | 0.00485 U | 310 | 0.00141 |

**TABLE A-6**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PESTICIDES**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S43-OC-23 4/03/07 | S44-OC-24 4/03/07 | S45-OC-25 4/03/07 | S46-OC-26 4/03/07 | S47-ER-EK-01 4/04/07 (milligrams per liter) | S48-ER-SH-02 4/04/07 (milligrams per liter) | | |
| Aldrin | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0366 U | 0.0337 U | 0.029 | NE |
| Alpha-BHC | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0366 U | 0.0337 U | 0.09 | NE |
| Beta-BHC | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0366 U | 0.0337 U | 0.32 | NE |
| Gamma-BHC | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0336 U | 0.0337 U | 0.44 | 0.00237 |
| Delta-BHC | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0336 U | 0.0337 U | 0.09 | NE |
| Alpha-Chlordane | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0732 U | 0.0674 U | 1.6 | 0.00324 |
| Gamma-Chlordane | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0732 U | 0.0674 U | 1.6 | 0.00324 |
| 4,4'-DDD | 0.00485 U | 0.00363 J | 0.00586 U | 0.00529 U | 0.0732 U | 0.0674 U | 2.4 | 0.00488 |
| 4,4'-DDE | 0.00485 U | 0.00247 J | 0.00586 U | 0.00237 J | 0.0366 U | 0.0337 U | 1.7 | 0.00316 |
| 4,4'-DDT | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.11 U | 0.101 U | 1.7 | 0.00416 |
| Dieldrin | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0366 U | 0.0337 U | 0.03 | 0.0019 |
| Endosulfan I | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.07332 U | 0.0674 U | 370 | NE |
| Endosulfan II | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0366 U | 0.0337 U | 370 | NE |
| Endosulfan Sulfate | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0732 U | 0.0674 U | 370 | NE |
| Endrin | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0366 U | 0.0337 U | 18 | 0.00222 |
| Endrin Aldehyde | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0366 U | 0.0337 U | 18 | NE |
| Endrin Ketone | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0732 U | 0.0674 U | 18 | NE |
| Heptachlor | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0336 U | 0.0337 U | 0.11 | NE |
| Heptachlor Epoxide | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.0366 U | 0.0337 U | 0.053 | 0.00247 |
| Methoxychlor | 0.00485 U | 0.00462 U | 0.00586 U | 0.00529 U | 0.146 U | 0.0135 U | 310 | 0.00141 |

Notes:

[a] Human health reference limits taken from EPA Region 9 preliminary remediation goals (PRG) for residential soil exposure (EPA 2004c)

[b] Ecological reference limits were provided by EPA GLNPO (MacDonald and others 2000).

H = Estimated value. Holding time exceeded.
J = Estimated value. Greater than detection limit, but less than reporting limit.
LC = Estimated value. Lab control recoveries exceed upper or lower control limits.
LS = Estimated value. Batch quality control for laboratory surrogate exceeds upper or lower control limits.
M = Estimated value. Associated matrix spike/matrix spike duplicate recoveries exceed the upper or lower control limits.
MS = Estimated value. Relative percent difference between matrix spike/matrix spike duplicate exceeded specified criteria.
NE = Not established
U = Analyte not detected at or above reporting limit

**Bold** values exceed human health reference limits
*Italicized* values exceed ecological reference limits
All values are expressed in milligrams per kilogram unless otherwise noted

**TABLE A-7**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S01-DC-01 4/02/07 | S02-DC-02 4/02/07 | S03-DC-03 4/02/07 | S04-DC-04 4/02/07 | S05-DC-05 4/03/07 | S06-DC-06 4/03/07 | | |
| Aroclor 1016 | 0.145 U | 0.306 U | 0.156 U | 0.317 U | 0.312 U | 0.266 U | 3.90 | NE |
| Aroclor 1221 | 0.0966 U | 0.204 U | 0.104 U | 0.211 U | 0.208 U | 0.178 U | 3.90 | NE |
| Aroclor 1232 | 0.0966 U | 0.204 U | 0.104 U | 0.211 U | 0.208 U | 0.178 U | 3.90 | NE |
| Aroclor 1242 | 0.0966 U | 0.204 U | 0.104 U | 0.211 U | 0.208 U | 0.178 U | 0.22 | NE |
| Aroclor 1248 | 0.0966 U | 0.204 U | 0.104 U | 0.211 U | 0.208 U | 0.178 U | 0.22 | NE |
| Aroclor 1254 | 0.193 | 0.141 J | 0.104 U | 0.186 J | 0.15 J | 0.11 J | 0.22 | NE |
| Aroclor 1260 | **0.295** | 0.137 J | 0.125 U | 0.253 U | 0.25 U | 0.213 U | 0.22 | NE |
| Total PCBs[c] | *0.488* | *0.278* | U | *0.186* | *0.15* | *0.11* | NE | 0.0598 |

# TABLE A-7
# SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs
# DUCK AND OTTER CREEKS
# TOLEDO, OHIO

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S07-DC-07 4/02/07 | S08-DC-08 4/02/07 | S09-DC-09 4/02/07 | S10-DC-10 4/0307 | S11-DC-11 4/03/07 | S12-DC-12 4/03/07 | | |
| Aroclor 1016 | 0.362 U | 0.476 U | 0.3 U | 0.24 U | 0.363 U, H | 0.673 U | 3.90 | NE |
| Aroclor 1221 | 0.242 U | 0.317 U | 0.2 U | 0.16 U | 0.242 U, H | 0.449 U | 3.90 | NE |
| Aroclor 1232 | 0.242 U | 0.317 U | 0.2 U | 0.16 U | 0.242 U, H | 0.449 U | 3.90 | NE |
| Aroclor 1242 | 0.242 U | 0.317 U | 0.2 U | 0.16 U | 0.242 U, H | 0.449 U | 0.22 | NE |
| Aroclor 1248 | 0.242 U | 0.317 U | 0.2 U | 0.16 U | 0.242 U, H | 0.449 U | 0.22 | NE |
| Aroclor 1254 | 0.164 J | 0.317 U | 0.2 U | 0.16 U | 0.242 U, H | 0.449 U | 0.22 | NE |
| Aroclor 1260 | 0.29 U | 0.381 U | 0.24 U | 0.192 U | 0.291 U, H | 0.538 U | 0.22 | NE |
| Total PCBs[c] | *0.164* | U | U | U | U | U | NE | 0.0598 |

**TABLE A-7**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S13-DC-13 4/04/07 | S14-DC-14 4/04/07 | S15-DC-15 4/04/07 | S16-DC-16 4/02/07 | S17-DC-17 4/02/07 | S18-DC-18 4/02/07 | | |
| Aroclor 1016 | 0.185 U | 0.286 U | 0.183 U | 0.335 U | 0.327 U | 0.312 U | 3.90 | NE |
| Aroclor 1221 | 0.123 U | 0.191 U | 0.122 U | 0.223 U | 0.218 U | 0.208 U | 3.90 | NE |
| Aroclor 1232 | 0.123 U | 0.191 U | 0.122 U | 0.223 U | 0.218 U | 0.208 U | 3.90 | NE |
| Aroclor 1242 | 0.123 U | 0.191 U | 0.122 U | 0.223 U | 0.218 U | 0.208 U | 0.22 | NE |
| Aroclor 1248 | 0.123 U | 0.191 U | 0.122 U | 0.223 U | 0.218 U | 0.208 U | 0.22 | NE |
| Aroclor 1254 | 0.123 U | 0.195 | 0.122 U | **0.259** | **0.231** | **0.235** | 0.22 | NE |
| Aroclor 1260 | 0.148 U | 0.145 J | 0.146 U | 0.268 U | 0.262 U | 0.249 U | 0.22 | NE |
| Total PCBs[c] | U | *0.34* | U | *0.259* | *0.231* | *0.235* | NE | 0.0598 |

**TABLE A-7**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S19-DC-19 4/04/07 | S20-OC-01 4/02/07 | S21-OC-02 4/02/07 | S22-OC-03 4/02/07 | S23-OC-04 4/02/07 | S24-OC-05 4/02/07 | | |
| Aroclor 1016 | 0.162 U | 0.162 U | 0.223 U | 0.287 U | 0.239 U | 0.254 U | 3.90 | NE |
| Aroclor 1221 | 0.108 U | 0.108 U | 0.149 U | 0.192 U | 0.16 U | 0.17 U | 3.90 | NE |
| Aroclor 1232 | 0.108 U | 0.108 U | 0.149 U | 0.192 U | 0.16 U | 0.17 U | 3.90 | NE |
| Aroclor 1242 | 0.108 U | 0.108 U | 0.149 U | 0.192 U | 0.16 U | 0.17 U | 0.22 | NE |
| Aroclor 1248 | 0.108 U | 0.108 U | 0.149 U | 0.192 U | 0.16 U | 0.17 U | 0.22 | NE |
| Aroclor 1254 | 0.108 U | 0.172 | **0.484** | **0.468** | **0.458** | **0.332** | 0.22 | NE |
| Aroclor 1260 | 0.129 U | 0.13 U | 0.178 U | 0.23 U | 0.192 U | 0.204 U | 0.22 | NE |
| Total PCBs[c] | U | *0.172* | *0.484* | *0.468* | *0.458* | *0.332* | NE | 0.0598 |

**TABLE A-7**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S25-OC-06 4/02/07 | S26-OC-07 4/03/07 | S27-OC-08 4/03/07 | S28-OC-09 4/04/07 | S29-OC-10 4/04/07 | S30-OC-11 4/03/07 | | |
| Aroclor 1016 | 0.213 U | 0.209 U | 0.18 U | 0.156 U | 0.173 U | 0.23 U | 3.90 | NE |
| Aroclor 1221 | 0.142 U | 0.139 U | 0.12 U | 0.104 U | 0.115 U | 0.153 U | 3.90 | NE |
| Aroclor 1232 | 0.142 U | 0.139 U | 0.12 U | 0.104 U | 0.115 U | 0.153 U | 3.90 | NE |
| Aroclor 1242 | 0.142 U | 0.139 U | 0.12 U | 0.104 U | 0.115 U | 0.153 U | 0.22 | NE |
| Aroclor 1248 | 0.142 U | 0.139 U | 0.12 U | 0.104 U | 0.115 U | 0.153 U | 0.22 | NE |
| Aroclor 1254 | **0.403** | **0.242** | 0.201 | 0.0813 J | 0.116 | **0.247** | 0.22 | NE |
| Aroclor 1260 | 0.17 U | 0.167 U | 0.144 U | 0.125 U | 0.138 U | 0.184 U | 0.22 | NE |
| Total PCBs[c] | *0.403* | *0.242* | *0.201* | *0.0813* | *0.116* | *0.247* | NE | 0.0598 |

**TABLE A-7**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S31-OC-12 4/03/07 | S32-OC-13 4/03/07 | S33-OC-14 4/03/07 | S34-OC-15 4/03/07 | S35-OC-16 4/03/07 | S36-OC-17 4/03/07 | | |
| Aroclor 1016 | 0.18 U | 0.146 U | 0.163 U | 0.185 U | 0.161 U | 0.151 U | 3.90 | NE |
| Aroclor 1221 | 0.12 U | 0.0974 U | 0.109 U | 0.123 U | 0.108 U | 0.1 U | 3.90 | NE |
| Aroclor 1232 | 0.12 U | 0.0974 U | 0.109 U | 0.123 U | 0.108 U | 0.1 U | 3.90 | NE |
| Aroclor 1242 | 0.12 U | 0.0974 U | 0.109 U | 0.123 U | 0.108 U | 0.1 U | 0.22 | NE |
| Aroclor 1248 | 0.12 U | 0.0974 U | 0.109 U | 0.123 U | 0.108 U | 0.1 U | 0.22 | NE |
| Aroclor 1254 | 0.184 | 0.188 | 0.151 | 0.123 U | **11.3** | **0.524** | 0.22 | NE |
| Aroclor 1260 | 0.144 U | 0.117 U | 0.13 U | 0.148 U | 0.129 U | 0.121 U | 0.22 | NE |
| Total PCBs[c] | *0.184* | *0.188* | *0.151* | U | *11.3* | *0.524* | NE | 0.0598 |

**TABLE A-7**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S37-OC-18 4/03/07 | S38-OC-19 4/03/07 | S39-OC-20 4/03/07 | S40-OC-21 4/03/07 | S41-OC-21A 4/04/07 | S42-OC-22 4/03/07 | | |
| Aroclor 1016 | 0.159 U | 0.128 U | 0.134 U | 0.215 U | 0.162 U | 0.146 U | 3.90 | NE |
| Aroclor 1221 | 0.106 U | 0.0855 U | 0.0895 U | 0.144 U | 0.108 U | 0.0971 U | 3.90 | NE |
| Aroclor 1232 | 0.106 U | 0.0855 U | 0.0895 U | 0.144 U | 0.108 U | 0.0971 U | 3.90 | NE |
| Aroclor 1242 | 0.106 U | 0.0855 U | 0.0895 U | 0.144 U | 0.108 U | 0.0971 U | 0.22 | NE |
| Aroclor 1248 | 0.106 U | 0.0855 U | 0.0895 U | 0.144 U | 0.108 U | 0.0971 U | 0.22 | NE |
| Aroclor 1254 | 0.179 | 0.145 | **0.257** | 0.197 | 0.166 | 0.161 | 0.22 | NE |
| Aroclor 1260 | 0.127 U | 0.103 U | 0.107 U | 0.172 U | 0.129 U | 0.116 U | 0.22 | NE |
| Total PCBs[c] | *0.179* | *0.145* | *0.257* | *0.197* | *0.166* | *0.161* | NE | 0.0598 |

**TABLE A-7**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PCBs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S43-OC-23 4/03/07 | S44-OC-24 4/03/07 | S45-OC-25 4/03/07 | S46-OC-26 4/03/07 | S47-ER-EK-01 4/04/07 (micrograms per liter) | S48-ER-SH-02 4/04/07 (micrograms per liter) | | |
| Aroclor 1016 | 0.145 U | 0.138 U | 0.176 U | 0.159 U | 1.22 U | 1.12 U | 3.90 | NE |
| Aroclor 1221 | 0.097 U | 0.0923 U | 0.117 U | 0.106 U | 1.22 U | 1.12 U | 3.90 | NE |
| Aroclor 1232 | 0.097 U | 0.0923 U | 0.117 U | 0.106 U | 1.22 U | 1.12 U | 3.90 | NE |
| Aroclor 1242 | 0.097 U | 0.0923 U | 0.117 U | 0.106 U | 1.22 U | 1.12 U | 0.22 | NE |
| Aroclor 1248 | 0.097 U | 0.0923 U | 0.117 U | 0.106 U | 1.22 U | 1.12 U | 0.22 | NE |
| Aroclor 1254 | **2.42** | 0.0618 J | 0.117 U | 0.162 | 1.22 U | 1.12 U | 0.22 | NE |
| Aroclor 1260 | 0.116 U | 0.111 U | 0.141 U | 0.127 U | 1.22 U | 1.12 U | 0.22 | NE |
| Total PCBs[c] | *2.42* | *0.0618* | U | *0.162* | U | U | NE | 0.0598 |

Notes:

[a] Human health reference limits taken from EPA Region 9 preliminary remediation goals (PRG) for residential soil exposure

[b] Ecological reference limits were provided by EPA GLNPO

[c] Non-detect results were counted as 0 when calculating total PCBs.

H = Estimated value. Holding time exceeded.

J = Estimated value. Greater than detection limit, but less than reporting limit.

NE = Not established

U = Not detected

**Bold** values exceed human health reference limits.

***Italicized*** values exceed ecological reference limit for total PCBs

All values are expressed in milligrams per kilogram unless otherwise noted.

**TABLE A-8**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S01-DC-01 4/02/07 | S02-DC-02 4/02/07 | S03-DC-03 4/02/07 | S04-DC-04 4/02/07 | S05-DC-05 4/03/07 | S06-DC-06 4/03/07 | | |
| Acenaphthene | 0.447 U | 1.3 U | 0.535 U | 1.38 U | 1.27 U | 1.24 U | 3,700 | NE |
| Acenaphthylene | 0.447 U | 1.3 U | 0.535 U | 1.38 U | 1.27 U | 1.24 U | 3,700 | NE |
| Anthracene | *0.076 J* | 1.3 U | *0.112 J* | 1.38 U | 1.27 U | *0.297 J* | 22,000 | 0.0572 |
| Benzo(a)anthracene | *0.218 J* | *0.517 J* | *0.427 J* | *0.292 J* | *0.31 J* | ***1.3*** | 0.62 | 0.108 |
| Benzo(a)pyrene | ***0.183 J*** | ***0.449 J*** | ***0.305 J*** | ***0.201 J*** | ***0.201 J*** | ***1.05 J*** | 0.062 | 0.15 |
| Benzo(b)fluoranthene | 0.251 J | **0.658 J** | *0.567* | 0.416 J | 0.407 J | **1.58** | 0.62 | NE |
| Benzo(g,h,i)perylene | 0.447 R, M, LC | 1.3 R, M, LC | 0.535 R, M, LC | 1.38 R, M, LC | 1.27 R, M, LC | 1.24 R, M, LC | 2,300 | NE |
| Benzo(k)fluoranthene | 0.0734 J | 0.217 J | 0.212 J | 1.38 U | 0.155 J | 0.606 J | 6.2 | NE |
| Chrysene | *0.31 J* | *0.828 J* | *0.539* | *0.449 J* | *0.43 J* | *1.56* | 62 | 0.166 |
| Dibenz(a,h)anthracene | ***0.0716 J*** | ***0.149 J*** | ***0.0707 J*** | 1.38 U | 1.27 U | ***0.163 J*** | 0.062 | 0.033 |
| Fluoranthene | 0.307 J | *0.974 J* | *1.08* | *0.923 J* | *0.771 J* | *2.53* | 2,300 | 0.423 |
| Fluorene | *0.0859 J* | 1.3 U | 0.0728 J | 1.38 U | 1.27 U | *0.178 J* | 2,700 | 0.0774 |
| Indeno(1,2,3-cd)pyrene | 0.103 J | 0.261 J | 0.216 J | 0.157 J | 0.135 J | 0.499 J | 0.62 | NE |
| Naphthalene | *0.384 J* | *0.694 J* | 0.131 J | *0.51 J* | *0.692 J* | *0.655 J* | 56 | 0.176 |
| Phenanthrene | *0.322 J* | *0.833 J* | *0.574* | *0.496 J* | *0.514 J* | *1.38* | 22,000 | 0.204 |
| Pyrene | *0.414 J* | *1.08 J* | *0.86* | *0.761 J* | *0.593 J* | *2.24* | 2,300 | 0.195 |
| Total PAHs[c] | *2.80* | *6.66* | *5.17* | *4.21* | *4.21* | *14.0* | NE | 1.61 |

# TABLE A-8
# SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
# DUCK AND OTTER CREEKS
# TOLEDO, OHIO

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S07-DC-07 4-02-07 | S08-DC-08 4-02-07 | S09-DC-09 4/02/07 | S10-DC-10 4/03/07 | S11-DC-11 4/03/07 | S12-DC-12 4/03/07 | | |
| Acenaphthene | 0.23 J | 2.25 U | 1 U | 0.719 U | 1.41 U | 2.88 U | 3,700 | NE |
| Acenaphthylene | 1.16 U | 2.25 U | 1 U | 0.719 U | 1.41 U | 2.88 U | 3,700 | NE |
| Anthracene | *0.374 J* | 2.25 U | *0.275 J* | *0.214 J* | 1.41 U | 2.88 U | 22,000 | 0.0572 |
| Benzo(a)anthracene | ***1.19*** | ***0.739 J*** | ***0.918 J*** | ***0.635 J*** | *0.459 J* | 2.88 U | 0.62 | 0.108 |
| Benzo(a)pyrene | ***1.05 J*** | ***0.649 J*** | ***0.898 J*** | ***0.586 J*** | ***0.428 J*** | 2.88 U | 0.062 | 0.15 |
| Benzo(b)fluoranthene | **1.81** | **1.32 J** | **1.48** | **1.1** | **0.853 J** | 0.306 J | 0.62 | NE |
| Benzo(g,h,i)perylene | 1.16 R, M, LC | 2.25 R, M, LC | 1 R, M, LC | 0.719 R, M, LC | 1.41 R, M, LC | 2.88 R, M, LC, CV | 2,300 | NE |
| Benzo(k)fluoranthene | 0.599 J | 0.419 J | 0.519 J | 0.394 J | 0.293 J | 2.88 U | 6.2 | NE |
| Chrysene | *1.53* | *1.1 J* | *1.24* | *0.949* | *0.693 J* | 2.88 U | 62 | 0.166 |
| Dibenz(a,h)anthracene | ***0.169 J*** | 2.25 U | ***0.136 J*** | ***0.0907 J*** | 1.41 U | 2.88 U | 0.062 | 0.033 |
| Fluoranthene | *2.81* | *2.6* | *2.76* | *2.23* | *1.41* | *0.473 J* | 2,300 | 0.423 |
| Fluorene | *0.234 J* | 2.25 U | *0.136 J* | *0.132 J* | *0.217 J* | 2.88 U | 2,700 | 0.0774 |
| Indeno(1,2,3-cd)pyrene | **0.627 J** | 0.478 J | 0.547 J | 0.396 J | 0.27 J | 2.88 U | 0.62 | NE |
| Naphthalene | *0.928 J* | 2.25 U | 1 U | 0.719 U | 1.41 U | 2.88 U | 56 | 0.176 |
| Phenanthrene | *1.26* | *1.25 J* | *1.15* | *1.1* | *1.55* | 2.88 U | 22,000 | 0.204 |
| Pyrene | *2.26* | *1.79 J* | *2* | *1.64* | *1.08 J* | *0.317 J* | 2,300 | 0.195 |
| Total PAHs[c] | *15.07* | *10.3* | *12* | *9.5* | *7.25* | 1.096 | NE | 1.61 |

**TABLE A-8**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S13-DC-13 4/04/07 | S14-DC-14 4/04/07 | S15-DC-15 4/04/07 | S16-DC-16 4/02/07 | S17-DC-17 4/02/07 | S18-DC-18 4/02/07 | | |
| Acenaphthene | 0.394 J | 5.85 | 0.515 U | 1.25 U | 1.25 U | 1.27 U | 3,700 | NE |
| Acenaphthylene | 0.859 U | 0.816 J | 0.515 U | 1.25 U | 1.25 U | 1.27 U | 3,700 | NE |
| Anthracene | *1.54* | *32.4* | 0.515 U | *0.341 J* | *0.171 J* | 1.27 U | 22,000 | 0.0572 |
| Benzo(a)anthracene | ***5.3*** | ***87.2*** | 0.0712 J | ***1.69*** | ***0.934 J*** | ***0.894 J*** | 0.62 | 0.108 |
| Benzo(a)pyrene | ***5.4*** | ***82.5*** | **0.0712 J** | ***1.7*** | ***1.02 J*** | ***0.894 J*** | 0.062 | 0.15 |
| Benzo(b)fluoranthene | **7.65** | **10.7** | 0.105 J | **2.75** | **1.68** | **1.47** | 0.62 | NE |
| Benzo(g,h,i)perylene | 0.859 R, M, LC, CV | 2.53 R, M, LC, CV | 0.515 R, M, LC, CV | 1.25 R, M, LC, CV | 1.25 R, M, LC, CV | 1.27 R, M, LC, CV | 2,300 | NE |
| Benzo(k)fluoranthene | 2.63 | **38.6** | 0.515 U | 0.964 J | 0.583 J | 0.531 J | 6.2 | NE |
| Chrysene | *5.1* | ***80.9*** | 0.0898 J | *1.71* | *1.03 J* | *0.901 J* | 62 | 0.166 |
| Dibenz(a,h)anthracene | ***0.659 J*** | ***9.74*** | 0.515 U | ***0.208 J*** | 1.25 U | 1.27 U | 0.062 | 0.033 |
| Fluoranthene | *10.8* | *190* | 0.182 J | *4.1* | *2.3* | *2.09* | 2,300 | 0.423 |
| Fluorene | *0.619 J* | *8.72* | 0.515 U | 1.25 U | 1.25 U | 1.27 U | 2,700 | 0.0774 |
| Indeno(1,2,3-cd)pyrene | **2.35** | **32.9** | 0.515 U | **0.811 J** | 0.492 J | 0.406 J | 0.62 | NE |
| Naphthalene | *0.253 J* | *1.93 J* | 0.515 U | 1.25 U | 1.25 U | 1.27 U | 56 | 0.176 |
| Phenanthrene | *4.31* | *68.4* | 0.063 J | *1.13 J* | *0.595 J* | *0.584 J* | 22,000 | 0.204 |
| Pyrene | *8.99* | *150* | 0.141 J | *2.96* | *1.67* | *1.63* | 2,300 | 0.195 |
| Total PAHs[c] | *56.0* | *801* | 0.723 | *18.4* | *10.5* | *9.40* | NE | 1.61 |

**TABLE A-8**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S19-DC-19 4/04/07 | S20-OC-01 4/02/07 | S21-OC-02 4/02/07 | S22-OC-03 4/02/07 | S23-OC-04 4/02/07 | S24-OC-05 4/02/07 | | |
| Acenaphthene | 0.578 U | 0.646 U | 0.744 U | 1 U | 0.725 U, H | 0.785 U, H | 3,700 | NE |
| Acenaphthylene | 0.578 U | 0.646 U | 0.744 U | 1 U | 0.725 U, H | 0.785 U, H | 3,700 | NE |
| Anthracene | 0.578 U | *0.142 J* | *0.336 J* | *0.227 J* | *0.277 J, H* | *0.329 J, H* | 22,000 | 0.0572 |
| Benzo(a)anthracene | *0.147 J* | ***0.727*** | ***1.12*** | ***0.761** J* | ***0.666 J, H*** | ***0.872 H*** | 0.62 | 0.108 |
| Benzo(a)pyrene | **0.11 J** | ***0.725*** | ***1.15*** | ***0.888** J* | ***0.551 J, H*** | ***1.21 H*** | 0.062 | 0.15 |
| Benzo(b)fluoranthene | 0.186 J | **1.06** | **2.24** | **1.59** | **0.913 H** | **2.27 H** | 0.62 | NE |
| Benzo(g,h,i)perylene | 0.578 R, M, LC, CV | 0.646 R, M, LC, CV | 0.744 R, LC, CV | 1 R, M, LC, CV | 0.373 R, H, LC | 0.83 R, H, LC | 2,300 | NE |
| Benzo(k)fluoranthene | 0.0717 J | 0.202 J | 0.472 J | 0.442 J | 0.297 J, H | 0.745 J, H | 6.2 | NE |
| Chrysene | 0.103 J | *1.92* | *2.5* | *1.77* | *1.31 H* | *1.76 H* | 62 | 0.166 |
| Dibenz(a,h)anthracene | 0.578 U | ***0.219 J*** | ***0.146 J*** | ***0.141 J*** | ***0.107 J, H*** | ***0.176 J, H*** | 0.062 | 0.033 |
| Fluoranthene | 0.25 J | *0.641 J* | *1.86* | *1.92* | *1.39 H* | *2.94 H* | 2,300 | 0.423 |
| Fluorene | 0.578 U | *0.125 J* | *0.247 J* | *0.163 J* | *0.225 J, H* | *0.303 J, H* | 2,700 | 0.0774 |
| Indeno(1,2,3-cd)pyrene | 0.578 U | 0.233 J | 0.293 J | 0.311 J | 0.29 J, H | **0.711 J, H** | 0.62 | NE |
| Naphthalene | 0.578 U | 0.173 J | *0.517 J* | *0.42 J* | *0.562 J, H* | *0.283 J, H* | 56 | 0.176 |
| Phenanthrene | 0.0752 J | *0.862* | *1.45* | *1.13* | *1.13 H* | *1.13 H* | 22,000 | 0.204 |
| Pyrene | 0.182 J | *1.14* | *2.7* | *2.02* | *1.99 H* | *2.57 H* | 2,300 | 0.195 |
| Total PAHs[c] | 1.12 | *8.17* | *15.0* | *11.78* | *9.71* | *15.30* | NE | 1.61 |

**TABLE A-8**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S25-OC-06 4/02/07 | S26-OC-07 4/03/07 | S27-OC-08 4/03/07 | S28-OC-09 4/04/07 | S29-OC-10 4/04/07 | S30-OC-11 4/03/07 | | |
| Acenaphthene | 0.628 U, H | 0.662 U, H | 0.513 U, H | *1.33 H* | 0.539 U, H | 0.571 U, H | 3,700 | NE |
| Acenaphthylene | 0.628 U, H | 0.662 U, H | 0.513 U, H | 0.44 U, H | 0.539 U, H | 0.571 U, H | 3,700 | NE |
| Anthracene | *0.151 J, H* | *0.208 J, H* | *0.351 J, H* | *3.8 H* | *0.326 J, H* | *0.344 J, H* | 22,000 | 0.0572 |
| Benzo(a)anthracene | *0.305 J, H* | ***0.783 H*** | ***0.719 H*** | ***10.9 H*** | ***1.08 H*** | ***1.77 H*** | 0.62 | 0.108 |
| Benzo(a)pyrene | ***0.294 J, H*** | ***0.865 H*** | ***0.759 H*** | ***7.86 H*** | ***1.29 H*** | ***2.39 H*** | 0.062 | 0.15 |
| Benzo(b)fluoranthene | 0.427 J, H | **1.47 H** | **1.09 H** | **14 H** | **2.25 H** | **4.31 H** | 0.62 | NE |
| Benzo(g,h,i)perylene | 0.148 R, H, LC | 0.474 R, H, LC | 0.325 R, H, LC | 1.92 R, H, LC | 0.495 R, H, LC, CV | 0.91 R, H, LC, CV | 2,300 | NE |
| Benzo(k)fluoranthene | 0.151 J, H | 0.46 J, H | 0.397 J, H | 3.63 H | 0.8 H | 1.38 H | 6.2 | NE |
| Chrysene | *0.586 J, H* | *1.24 H* | *1.12 H* | *12.4 H* | *1.84 H* | *3.11 H* | 62 | 0.166 |
| Dibenz(a,h)anthracene | 0.628 U, H | ***0.124 J, H*** | ***0.0945 J, H*** | ***0.951 H*** | ***0.13 J, H*** | ***0.238 J, H*** | 0.062 | 0.033 |
| Fluoranthene | *0.743 H* | *1.82 H* | *1.55 H* | *18 H* | *3.19 H* | *5.87 H* | 2,300 | 0.423 |
| Fluorene | *0.123 J, H* | *0.142 J, H* | *0.148 J, H* | *1.5 H* | *0.0799 J, H* | *0.146 J, H* | 2,700 | 0.0774 |
| Indeno(1,2,3-cd)pyrene | 0.111 J, H | 0.396 J, H | 0.299 J, H | **2.11 H** | 0.509 H, CV | **0.914 J, H, CV** | 0.62 | NE |
| Naphthalene | 0.162 J, H | 0.662 U, H | *0.176 J, H* | *0.311 J, H* | 0.539 U, H | 0.751 U, H | 56 | 0.176 |
| Phenanthrene | *0.501 J, H* | *0.824 H* | *0.709 H* | *13.1 H* | *2.81 H* | *4.84 H* | 22,000 | 0.204 |
| Pyrene | *1.16 H* | *1.89 H* | *1.93 H* | *17.4 H* | *4.55 H* | *3.82 H* | 2,300 | 0.195 |
| Total PAHs[c] | *4.71* | *10.22* | *9.34* | *107* | *18.9* | *29.13* | NE | 1.61 |

**TABLE A-8**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S31-OC-12 4/03/07 | S32-OC-13 4/03/07 | S33-OC-14 4/03/07 | S34-OC-15 4/03/07 | S35-OC-16 4/03/07 | S36-OC-17 4/03/07 | | |
| Acenaphthene | 0.726 U | 0.532 U | 0.586 U | 0.121 J | 0.748 | 1.15 | 3,700 | NE |
| Acenaphthylene | 0.726 U | 0.532 U | 0.11 J | 0.527 U | 0.5 U | 0.235 J | 3,700 | NE |
| Anthracene | *0.295 J* | *0.291 J* | *0.29 J* | *0.316 J* | *1.34* | *2.6* | 22,000 | 0.0572 |
| Benzo(a)anthracene | ***1.26*** | ***0.891*** | ***1.43*** | ***1.26*** | ***3.49*** | ***7.13*** | 0.62 | 0.108 |
| Benzo(a)pyrene | ***1.66*** | ***0.983*** | ***1.58*** | ***1.38*** | ***2.51*** | ***7.22*** | 0.062 | 0.15 |
| Benzo(b)fluoranthene | **3.76** | **2.15** | **2.52** | **2.44** | **2.86** | **9.52** | 0.62 | NE |
| Benzo(g,h,i)perylene | 0.726 R, M, LC, CV | 0.532 R, M, LC, CV | 0.586 R, M, LC, CV | 0.527 R, LC | 0.441 R, J, LC | 2.22 R, LC | 2,300 | NE |
| Benzo(k)fluoranthene | 1.26 | 0.695 | 0.969 | 0.789 | 0.788 | 3.09 | 6.2 | NE |
| Chrysene | *2.22* | *1.57* | *2.26* | *1.83* | *4.37* | *8.81* | 62 | 0.166 |
| Dibenz(a,h)anthracene | 0.726 U, CV | 0.532 U, CV | ***0.45 J, CV*** | ***0.191 J*** | ***0.0892 J*** | ***1.81*** | 0.062 | 0.033 |
| Fluoranthene | *4.61* | *2.69* | *3.46* | *3.14* | *3.34* | *19.1* | 2,300 | 0.423 |
| Fluorene | *0.119 J* | 0.532 U | *0.118 J* | *0.156 J* | *0.546* | *1.5* | 2,700 | 0.0774 |
| Indeno(1,2,3-cd)pyrene | 0.469 J, CV | 0.245 J, CV | **1.73 CV** | **0.787** | **1.28** | **5.58** | 0.62 | NE |
| Naphthalene | 0.726 U | 0.113 J | 0.109 J | *0.495 J* | *0.313 J* | *1.45* | 56 | 0.176 |
| Phenanthrene | *1.53* | *0.668* | *1.41* | *1.69* | *1.85* | *13.6* | 22,000 | 0.204 |
| Pyrene | *3.09* | *2.33* | *3.87* | *2.59* | *13* | *17.8* | 2,300 | 0.195 |
| Total PAHs[c] | *20.27* | *12.63* | *20.31* | *17.19* | *37* | *100.6* | NE | 1.61 |

**TABLE A-8**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S37-OC-18 4/03/07 | S38-OC-19 4/03/07 | S39-OC-20 4/03/07 | S40-OC-21 4/03/07 | S41-OC-21A 4/04/07 | S42-OC-22 4/03/07 | | |
| Acenaphthene | 0.643 J | 0.18 J | 0.723 | 0.846 U | 0.692 U | 1.63 | 3,700 | NE |
| Acenaphthylene | 1.08 U | 0.416 U | 0.203 J | 0.846 U | 0.692 U | 1.25 U | 3,700 | NE |
| Anthracene | *2.05* | *0.297 J* | *1.81* | *0.232 J* | *0.123 J* | *4.84* | 22,000 | 0.0572 |
| Benzo(a)anthracene | ***3.46*** | ***1.02*** | ***6.79*** | ***1.38*** | *0.598 J* | ***18.4*** | 0.62 | 0.108 |
| Benzo(a)pyrene | ***3.27*** | ***1.13*** | ***6.95*** | ***1.84*** | ***0.773*** | ***20*** | 0.062 | 0.15 |
| Benzo(b)fluoranthene | **4.08** | **1.67** | **9.88** | **2.67** | **1.32** | **24.7** | 0.62 | NE |
| Benzo(g,h,i)perylene | 0.879 R, J, LC | 0.144 R, J, LC | 1.04 R, LC | 0.648 R, J, LC | 0.114 R, J, LC | 8.39 R, LC | 2,300 | NE |
| Benzo(k)fluoranthene | 1.4 | 0.585 | 3.08 | 0.911 | 0.425 J | **7.88** | 6.2 | NE |
| Chrysene | *3.95* | *1.34* | *7.84* | *2.27* | *0.969* | *22.9* | 62 | 0.166 |
| Dibenz(a,h)anthracene | ***0.855 J*** | ***0.174 J*** | ***1.01*** | ***0.581 J*** | ***0.136 J*** | ***4.53*** | 0.062 | 0.033 |
| Fluoranthene | *8.79* | *2.92* | *19.5* | *3.58* | *1.9* | *51.8* | 2,300 | 0.423 |
| Fluorene | *0.859 J* | *0.231 J* | *0.982* | 0.846 U | 0.692 U | *2.39* | 2,700 | 0.0774 |
| Indeno(1,2,3-cd)pyrene | **2.5** | **0.679** | **3.74** | **1.81** | 0.517 J | **17.7** | 0.62 | NE |
| Naphthalene | *0.459 J* | *0.824* | *0.288 J* | 0.846 U | 0.692 U | *0.265 J* | 56 | 0.176 |
| Phenanthrene | *6.93* | *1.67* | *12.4* | *1.34* | *0.645 J* | *26.3* | 22,000 | 0.204 |
| Pyrene | *8.59* | *2.25* | *17.3* | *3.54* | *1.54* | *44.8* | 2,300 | 0.195 |
| Total PAHs[c] | *47.8* | *14.97* | *92.5* | *20.15* | *8.9* | *248* | NE | 1.61 |

# TABLE A-8
## SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - PAHs
## DUCK AND OTTER CREEKS
## TOLEDO, OHIO

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] |
|---|---|---|---|---|---|---|---|---|
| | S43-OC-23 4/03/07 | S44-OC-24 4/03/07 | S45-OC-25 4/03/07 | S46-OC-26 4/03/07 | S47-ER-EK-01 4/04/07 (micrograms per liter) | S47-ER-SH-02 4/04/07 (micrograms per liter) | | |
| Acenaphthene | 0.655 U | 0.509 U | 0.641 U | 0.599 U | 5.26 U, H | 5.15 U, H | 3,700 | NE |
| Acenaphthylene | 0.655 U | 0.509 U | 0.641 U | 0.599 U | 5.26 U, H | 5.15 U, H | 3,700 | NE |
| Anthracene | *0.168 J* | *0.109 J* | *0.162 J* | *0.368 J* | 5.26 U, H | 5.15 U, H | 22,000 | 0.0572 |
| Benzo(a)anthracene | *0.539 J* | *0.375 J* | ***0.704*** | ***1.47*** | 5.26 U, H | 5.15 U, H | 0.62 | 0.108 |
| Benzo(a)pyrene | ***0.46 J*** | ***0.364 J*** | ***0.672*** | ***1.62*** | 5.26 U, H | 5.15 U, H | 0.062 | 0.15 |
| Benzo(b)fluoranthene | 0.56 J | 0.521 | **1.09** | **2.64** | 5.26 U, H | 5.15 U, H | 0.62 | NE |
| Benzo(g,h,i)perylene | 0.08 R, J, LC | 0.125 R, J, LC | 0.214 R, J, LC | 0.173 R, J, LC | 5.26 U, H | 5.15 U, H | 2,300 | NE |
| Benzo(k)fluoranthene | 0.142 J | 0.198 J | 0.373 J | 0.865 | 5.26 U, H | 5.15 U, H | 6.2 | NE |
| Chrysene | *1.15* | *0.478 J* | *0.922* | *2.01* | 5.26 U, H | 5.15 U, H | 62 | 0.166 |
| Dibenz(a,h)anthracene | ***0.147 J*** | ***0.158 J*** | ***0.254 J*** | ***0.217 J*** | 5.26 U, H | 5.15 U, H | 0.062 | 0.033 |
| Fluoranthene | *0.982* | *0.869* | *1.52* | *4.97* | 5.26 U, H | 5.15 U, H | 2,300 | 0.423 |
| Fluorene | *0.113 J* | *0.15 J* | 0.641 U | *0.145 J* | 5.26 U, H | 5.15 U, H | 2,700 | 0.0774 |
| Indeno(1,2,3-cd)pyrene | 0.388 J | 0.382 J | **0.643** | **0.853** | 5.26 U, H | 5.15 U, H | 0.62 | NE |
| Naphthalene | 0.655 U | 0.136 J | 0.168 J | 0.599 U | 5.26 U, H | 5.15 U, H | 56 | 0.176 |
| Phenanthrene | *0.761* | *0.585* | *0.571 J* | *2.11* | 5.26 U, H | 5.15 U, H | 22,000 | 0.204 |
| Pyrene | *1.35* | *0.874* | *1.47* | *3.66* | 5.26 U, H | 5.15 U, H | 2,300 | 0.195 |
| Total PAHs[c] | *6.76* | *5.20* | *8.55* | *20.93* | | | NE | 1.61 |

Notes:

a Human health reference limits taken from EPA Region 9 preliminary remediation goals (PRG) for residential soil exposure

b Ecological reference limits were provided by EPA GLNPO

c Non-detect results were counted as 0 when calculating total PAHs.

CV = Estimated value. Calibration verification results exceed upper or lower control limits.
H = Estimated value. Holding time exceeded.
J = Estimated value. Greater than detection limit, but less than reporting limit.
LC = Estimated value. Laboratory control recoveries exceed upper or lower control limits.
M = Estimated value. Associated matrix spike/matrix spike duplicate recoveries exceed the upper or lower control limits.
NE = Not established
R = Rejected value
U = Analyte not detected at or above reporting limit.

**Bold** values exceed human health reference limits
*Italicized* values exceed ecological reference limits
All values expressed in milligrams per kilogram unless otherwise noted

**TABLE A-9**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL AND GREASE**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S01-DC-01 4/02/07 | S02-DC-02 4/02/07 | S03-DC-03 4/02/07 | S04-DC-04 4/02/07 | S05-DC-05 4/03/07 | S06-DC-06 4/03/07 | | | |
| Arsenic | ***45.5*** | ***46.8*** | **5.48** | ***102*** | ***132*** | ***42.2*** | 0.39 | 9.79 | 11 |
| Barium | 94.9 | 439 | 133 | 526 | 469 | 343 | 5,400 | NE | 210 |
| Cadmium | 0.83 | *5* | 0.49 | *4.58* | *4.49* | *2.35* | 37 | 0.99 | 0.96 |
| Chromium | 26 | *81.9* | 15.9 | *77.4* | *76.2* | *66* | 100,000 | 43.4 | 51 |
| Lead | *112* | *292* | *83.6* | ***402*** | *290* | *240* | 400 | 35.8 | 47 |
| Mercury | 0.05 U,B | *0.19 J* | *0.37* | *0.23* | *0.19* | 0.13 | 23 | 0.18 | 0.12 |
| Selenium | 2.21 U | 5.56 | 2.45 U | 9.6 | 9.97 | 6.07 | 390 | NE | 1.4 |
| Silver | 1.4 U | 2.9 U | 1.4 U | 3.1 U | 2.9 U | 2.6 U | 390 | NE | 0.43 |
| Total Organic Carbon (%) | 8.56 H, LD | 11.1 H, LD | 4.86 H, LD | 7.15 H, LD | 12.2 H, LD | 6.24 H, LD | NE | NE | NE |
| Oil & Grease | 1,100 J | 2,130 J | 2,390 J | 6,360 U | 3,400 J | 2,740 J | NE | NE | NE |
| Percent Solids | 76.9 | 34.2 | 69.4 | 32.3 | 34.1 | 37.9 | NE | NE | NE |

**TABLE A-9**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL AND GREASE**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S07-DC-07 4-02-07 | S08-DC-08 4-02-07 | S09-DC-09 4/02/07 | S10-DC-10 4/03/07 | S11-DC-11 4/03/07 | S12-DC-12 4/03/07 | | | |
| Arsenic | ***72.2*** | ***65.1*** | ***41.3*** | ***29.5*** | ***140*** | ***82.3*** | 0.39 | 9.79 | 11 |
| Barium | 447 | 651 | 324 | 295 | 651 | 2,152 | 5,400 | NE | 210 |
| Cadmium | *3.51* | *3.67* | *2.24* | *1.66* | *3.39* | *16.08* | 37 | 0.99 | 0.96 |
| Chromium | *72.2* | *74.4* | *44.2* | 38.6 | *65.1* | *190* | 100,000 | 43.4 | 51 |
| Lead | *309* | *363* | *186* | *173* | *277* | ***1,076*** | 400 | 35.8 | 47 |
| Mercury | *0.21 J* | *0.18 J* | *0.21 J* | 0.12 J | 0.13 J | *6.82* | 23 | 0.18 | 0.12 |
| Selenium | 7.56 | 7.44 U | 4.72 U | 3.86 U | 7.19 | 30.4 | 390 | NE | 1.4 |
| Silver | *44.7* | 4.6 U | 2.9 U | 2.3 U | 3.4 U | *10.8* | 390 | NE | 0.43 |
| Total Organic Carbon (%) | 15.8 H, LD | 7.48 H, LD | 28.7 H, LD | 5.93 H, LD | 7.33 H, LD | 26.7 H, LD | NE | NE | NE |
| Oil & Grease | 7,600 U | 4,050 J | 3,770 J | 4,060 U | 4,790 J | 13,900 U | NE | NE | NE |
| Percent Solids | 29.1 | 21.5 | 33.9 | 44.0 | 29.2 | 15.8 | NE | NE | NE |

**TABLE A-9**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL AND GREASE**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S13-DC-13 4/04/07 | S14-DC-14 4/04/07 | S15-DC-15 4/04/07 | S16-DC-16 4/02/07 | S17-DC-17 4/02/07 | S18-DC-18 4/02/07 | | | |
| Arsenic | ***22.9*** | ***86*** | ***52.1*** | ***129*** | ***125*** | ***121*** | 0.39 | 9.79 | 11 |
| Barium | 159 | 315 | 68.4 | 514 | 492 | 455 | 5,400 | NE | 210 |
| Cadmium | 0.88 | *1.23* | 0.37 | *3.12* | *3.34* | *3.42* | 37 | 0.99 | 0.96 |
| Chromium | 33.5 | 31.5 | 21.2 | *109* | *121* | *100* | 100,000 | 43.4 | 51 |
| Lead | *108* | *226* | *78.2* | *354* | *393* | *333* | 400 | 35.8 | 47 |
| Mercury | 0.03 U, B | 0.08 J | 0.02 U, B | 0.11 J | 0.12 J | 0.11 J | 23 | 0.18 | 0.12 |
| Selenium | 2.82 U | 15.5 | 3.26 | 18 | 18.7 | 16.7 | 390 | NE | 1.4 |
| Silver | 1.8 U | 2.9 U | 1.6 U | 3.2 U | 3.3 U | 3 U | 390 | NE | 0.43 |
| Total Organic Carbon (%) | 5.09 H, LD | 10.5 H, LD | 2.96 H, LD | 3.33 H, LD | 4 H, LD | 2.56 H, LD | NE | NE | NE |
| Oil & Grease | 1,340 J | 12,600 | 3,040 U | 6,840 U | 6,370 U | 5,610 U | NE | NE | NE |
| Percent Solids | 56.7 | 34.9 | 61.4 | 31.1 | 30.5 | 33.0 | NE | NE | NE |

**TABLE A-9**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL AND GREASE**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S19-DC-19 4/04/07 | S20-OC-01 4/02/07 | S21-OC-02 4/02/07 | S22-OC-03 4/02/07 | S23-OC-04 4/02/07 | S24-OC-05 4/02/07 | | | |
| Arsenic | ***54.1*** | ***12.9*** | ***32.5*** | ***43.1*** | ***29.4*** | ***35.7*** | 0.39 | 9.79 | 11 |
| Barium | 97.1 | 86.6 | 346 | 350 | 385 | 286 | 5,400 | NE | 210 |
| Cadmium | 0.4 | 0.9 | *2.29* | *2.67* | *1.97* | *2.55* | 37 | 0.99 | 0.96 |
| Chromium | 19.1 | *56.2* | *177* | *224* | *385* | *162* | 100,000 | 43.4 | 51 |
| Lead | *68.5* | *89.7* | *260* | *350* | *294* | *333* | 400 | 35.8 | 47 |
| Mercury | 0.04 U, B | 0.1 J | *0.3* | *0.28* | *0.35* | *0.25* | 23 | 0.18 | 0.12 |
| Selenium | 4.46 | 2.43 U | 3.46 U | 4.31 U | 7.24 U | 3.81 U | 390 | NE | 1.4 |
| Silver | 1.6 U | 1.5 U | 2.2 U | 2.7 U | 2.3 U | 2.4 U | 390 | NE | 0.43 |
| Total Organic Carbon (%) | 2.72 H, LD | 1.47 H, LD | 7.44 H, LD | 5.03 H, LD | 4.81 H, LD | 6.39 H, LD | NE | NE | NE |
| Oil & Grease | 3,200 U | 2,730 U | 7,840 | 6,290 | 13,100 | 4,220 J | NE | NE | NE |
| Percent Solids | 62.8 | 65.8 | 46.2 | 37.1 | 44.2 | 42.0 | NE | NE | NE |

**TABLE A-9**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL AND GREASE**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S25-OC-06 4/02/07 | S26-OC-07 4/03/07 | S27-OC-08 4/03/07 | S28-OC-09 4/04/07 | S29-OC-10 4/04/07 | S30-OC-11 4/03/07 | | | |
| Arsenic | ***26.5*** | ***38.1*** | ***27.3*** | ***22.5*** | ***39.5*** | ***52.5*** | 0.39 | 9.79 | 11 |
| Barium | 265 | 220 | 150 | 127 | 189 | 284 | 5,400 | NE | 210 |
| Cadmium | *1.37* | *1.82* | 0.87 | 0.9 | *1.51* | *2.6* | 37 | 0.99 | 0.96 |
| Chromium | *186* | *220* | *121* | *89.8* | *127* | *160* | 100,000 | 43.4 | 51 |
| Lead | *204* | *321* | *187* | *165* | *206* | *306* | 400 | 35.8 | 47 |
| Mercury | *0.26* | *0.35* | *0.22* | *0.28* | *0.2* | *0.28* | 23 | 0.18 | 0.12 |
| Selenium | 6.73 U | 6.41 U | 5.62 U | 2.4 U | 2.74 U | 3.72 U | 390 | NE | 1.4 |
| Silver | 2 U | 2 U | 1.7 U | 1.5 U | 1.7 U | 2.2 U | 390 | NE | 0.43 |
| Total Organic Carbon (%) | 4.56 H, LD | 7.16 H, LD | 2.94 H, LD | 2.48 H, LD | 10.1 H, LD | 5.45 H, LD | NE | NE | NE |
| Oil & Grease | 5,110 | 3,050 J | 2,000 J | 3,120 U | 1,390 J | 2,040 J | NE | NE | NE |
| Percent Solids | 49.0 | 49.9 | 58.7 | 66.8 | 58.3 | 45.7 | NE | NE | NE |

**TABLE A-9**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL AND GREASE**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S31-OC-12 4/03/07 | S32-OC-13 4/03/07 | S33-OC-14 4/03/07 | S34-OC-15 4/03/07 | S35-OC-16 4/03/07 | S36-OC-17 4/03/07 | | | |
| Arsenic | ***54.1*** | ***42.1*** | ***55*** | ***83.5*** | ***46.3*** | ***58.5*** | 0.39 | 9.79 | 11 |
| Barium | 192 | 129 | 336 | 301 | 255 | 190 | 5,400 | NE | 210 |
| Cadmium | *1.69* | *1.3* | *1.77* | *1.65* | *1.12* | *1.68* | 37 | 0.99 | 0.96 |
| Chromium | *279* | *323* | *153* | *184* | *399* | *237* | 100,000 | 43.4 | 51 |
| Lead | *262* | *196* | *397* | *267* | *191* | *237* | 400 | 35.8 | 47 |
| Mercury | *0.2* | 0.15 | 0.11 J | 0.14 | *0.77* | 0.17 | 23 | 0.18 | 0.12 |
| Selenium | 3.14 | 3.65 | 2.44 U | 2.67 | 5.1 U | 3.01 | 390 | NE | 1.4 |
| Silver | 1.7 U | 1.4 U | 1.5 U | 1.7 U | 1.6 U | 1.6 U | 390 | NE | 0.43 |
| Total Organic Carbon (%) | 5.46 H, LD | 3.42 H, LD | 2.48 H, LD | 4.62 H, LD | 4.12 H, LD | 4.96 H, LD | NE | NE | NE |
| Oil & Grease | 1,940 J | 7,460 | 3,350 | 12,500 | 13,000 | 3,910 | NE | NE | NE |
| Percent Solids | 57.3 | 71.3 | 65.5 | 59.9 | 62.7 | 63.2 | NE | NE | NE |

**TABLE A-9**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL AND GREASE**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S37-OC-18 4/03/07 | S38-OC-19 4/03/07 | S39-OC-20 4/03/07 | S40-OC-21 4/03/07 | S41-OC-21A 4/04/07 | S42-OC-22 4/03/07 | | | |
| Arsenic | ***35.8*** | ***34.8*** | ***47.3*** | ***65.7*** | ***56.6*** | ***17.4*** | 0.39 | 9.79 | 11 |
| Barium | 156 | 94.2 | 143 | 318 | 137 | 155 | 5,400 | NE | 210 |
| Cadmium | *1.06* | 0.53 | *1.23* | *1.48* | *1.09* | *2.39* | 37 | 0.99 | 0.96 |
| Chromium | *218* | *76.1* | *103* | *106* | *56.6* | *98.1* | 100,000 | 43.4 | 51 |
| Lead | *202* | *69.7* | *207* | *206* | *102* | *348* | 400 | 35.8 | 47 |
| Mercury | *0.25* | 0.06 U, B | 0.11 | 0.12 J | 0.15 | 0.08 U, B | 23 | 0.18 | 0.12 |
| Selenium | 2.65 U | 2.06 U | 2.36 U | 3.39 U | 2.92 U | 5.22 U | 390 | NE | 1.4 |
| Silver | 1.6 U | 1.3 U | 1.5 U | 2.1 U | 1.8 U | 1.6 U | 390 | NE | 0.43 |
| Total Organic Carbon (%) | 4.38 H, LD | 1.39 H, LD | 2.63 H, LD | 5.51 H, LD | 3.4 H, LD | 5.51 H, LD | NE | NE | NE |
| Oil & Grease | 2,470 J | 1,550 J | 2,740 J | 1,720 J | 1,750 J | 9,120 | NE | NE | NE |
| Percent Solids | 64.2 | 77.5 | 67.7 | 47.2 | 54.8 | 63.2 | NE | NE | NE |

**TABLE A-9**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - RCRA METALS, TOC, AND OIL AND GREASE**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S43-OC-23 4/03/07 | S44-OC-24 4/03/07 | S45-OC-25 4/03/07 | S46-OC-26 4/03/07 | S47-ER-EK-01 4/04/07 (milligrams per liter) | S47-ER-SH-02 4/04/07 (milligrams per liter) | | | |
| Arsenic | ***51*** | **6.67** | ***25.8*** | ***23.8*** | 0.02 U | 0.02 U | 0.39 | 9.79 | 11 |
| Barium | 117 | 62.4 | 207 | 221 | 0.003 U | 0.003 U | 5,400 | NE | 210 |
| Cadmium | 0.8 | 0.51 | *1.46* | *1.48* | 0.002 U | 0.002 U | 37 | 0.99 | 0.96 |
| Chromium | 42.5 | 28.4 | 34.4 | *44.1* | 0.005 U | 0.005 U | 100,000 | 43.4 | 51 |
| Lead | *78.2* | *66.7* | *105* | *144* | 0.015 U | 0.015 U | 400 | 35.8 | 47 |
| Mercury | 0.12 J | *0.21* | 0.08 J | 0.07 U,B | 5E-04 U | 0.0005 U | 23 | 0.18 | 0.12 |
| Selenium | 2.72 U | 2.27 U | 2.75 U | 2.72 U | 0.03 U | 0.03 U | 390 | NE | 1.4 |
| Silver | 1.7 U | 1.4 U | 1.7 U | 1.7 U | 0.005 U | 0.005 U | 390 | NE | 0.43 |
| Total Organic Carbon (%) | 3.07 H, LD | 1.85 H, LD | 13.2 H, LD | 2.61 H, LD | 1.9 J | 1.4 J | NE | NE | NE |
| Oil & Grease | 4,160 | 2,900 | 1,560 J | 2,530 J | | 1.8 U | NE | NE | NE |
| Percent Solids | 58.8 | 70.5 | 58.1 | 58.9 | NA | NA | NE | NE | NE |

Notes:

[a] Human health reference limits taken from EPA Region 9 preliminary remediation goals (PRG) for residential soil exposure (EPA 2004c).

[b] Ecological reference limits were provided by EPA GLNPO (MacDonald and others 2000).

[c] Statewide or available local ecoregion sediment reference values taken from OEPA Guidance for Conducting Ecological Risk Assessments (OEPA 2003a).

% = Percent
B = Analyte detected in laboratory method blank.
H = Estimated value. Holding time exceeded.
J = Estimated value. Greater than detection limit, but less than reporting limit.
LD = Estimated value. Batch quality control for lab duplicate exceeds upper or lower control limits.
NE = Not established
OEPA = Ohio Environmental Protection Agency
R = Value is rejected
U = Analyte not detected at or above reporting limit.

**Bold** values exceed ecological and human health reference limits
*Italicized* values exceed ecological reference limits
All values expressed in milligrams per kilogram unless otherwise noted

**TABLE A-10**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - FULL-SCAN PAHs[a]**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Full Scan | Regularly Reported | Full Scan | Regularly Reported | Full Scan | Regularly Reported | Full Scan | Regularly Reported |
| | S01-DC-01 4/02/07 | S01-DC-01[a] 4/02/07 | S03-DC-03 4/02/07 | S03-DC-03[a] 4/02/07 | S05-DC-05 4/03/07 | S05-DC-05[a] 4/03/07 | S08-DC-08 4-02-07 | S08-DC-08[a] 4-02-07 |
| Acenaphthene | 0.041 IS | 0.447 U | 0.028 J, IS | 0.535 U | 0.42 IS | 1.27 U | 0.099 J, IS | 2.25 U |
| Acenaphthylene | 0.015 J, IS | 0.447 U | 0.011 J, IS | 0.535 U | 0.026 J, IS | 1.27 U | 0.022 J, IS | 2.25 U |
| Anthracene | 0.1 IS | 0.076 J | 0.15 IS | 0.112 J | 0.15 IS | 1.27 U | 0.32 IS | 2.25 U |
| Benzo(a)anthracene | 0.45 IS | 0.218 J | 0.68 IS | 0.427 J | 0.63 IS | 0.31 J | 1.3 IS | 0.739 J |
| Benzo(a)pyrene | 0.55 IS | 0.183 J | 0.69 IS | 0.305 J | 0.61 IS | 0.201 J | 1.3 IS | 0.649 J |
| Benzo(b)flouranthene | 0.57 IS | 0.251 J | 0.77 IS | 0.567 | 0.81 IS | 0.407 J | 2.1 IS | 1.32 J |
| Benzo(e)pyrene | 0.52 IS | NA | 0.47 IS | NA | 0.52 IS | NA | 1.1 IS | NA |
| Benzo(g,h,i)perylene | 0.54 IS | 0.447 R, M, LC | 0.55 IS | 0.535 R, M, LC | 0.49 IS | 1.27 R, M, LC | 1.2 IS | 2.25 R, M, LC |
| Benzo(k)flouranthene | 0.24 IS | 0.0734 J | 0.64 IS | 0.212 J | 0.66 IS | 0.155 J | 1.4 IS | 0.419 J |
| C1-Chrysene | 1.2 IS | NA | 0.45 IS | NA | 0.94 IS | NA | 1 IS | NA |
| C1-Fluorenes | 0.15 IS | NA | 0.038 J, IS | NA | 0.66 IS | NA | 0.05 J, IS | NA |
| C1-Fluoranthenes/pyrene | 0.8 IS | NA | 0.59 IS | NA | 0.61 IS | NA | 1 IS | NA |
| C1-Naphthalenes | 0.55 IS | NA | 0.09 IS | NA | 0.3 IS | NA | 0.079 J, IS | NA |
| C1-Phenanthrenes/anthracenes | 0.9 IS | NA | 0.39 IS | NA | 0.52 IS | NA | 0.66 IS | NA |
| C2-Chrysene | 1 IS | NA | 0.28 IS | NA | 0.74 IS | NA | 0.34 IS | NA |
| C2-Fluorenes | 0.28 IS | NA | 0.064 IS | NA | 0.14 IS | NA | 0.052 J, IS | NA |
| C2-Naphthalenes | 1.9 IS | NA | 0.35 IS | NA | 0.89 IS | NA | 0.25 IS | NA |
| C2-Phenanthrenes/anthracenes | 0.79 IS | NA | 0.25 IS | NA | 0.46 IS | NA | 0.29 IS | NA |
| C3-Chrysene | 0.42 IS | NA | 0.12 IS | NA | 0.51 IS | NA | 0.11 J, IS | NA |
| C3-Fluorenes | 0.53 IS | NA | 0.12 IS | NA | 0.35 IS | NA | 0.088 J, IS | NA |
| C3-Naphthalenes | 1.6 IS | NA | 0.37 IS | NA | 0.74 IS | NA | 0.16 IS | NA |
| C3-Phenanthrenes/anthracenes | 0.6 IS | NA | 0.18 IS | NA | 0.47 IS | NA | 0.15 IS | NA |
| C4-Chrysene | 0.17 IS | NA | 0.055 IS | NA | 0.35 IS | NA | 0.048 J, IS | NA |
| C4-Naphthalenes | 1.3 IS | NA | 0.25 IS | NA | 0.62 IS | NA | 0.12 IS | NA |
| C4-Phenanthrenes/anthracenes | 0.24 IS | NA | 0.064 IS | NA | 0.35 IS | NA | 0.049 J, IS | NA |
| Chrysene | 0.67 IS | 0.31 J | 0.84 IS | 0.539 | 0.83 IS | 0.43 J | 1.9 IS | 1.1 J |
| Dibenz(a,h)anthracene | 0.19 IS | 0.0716 J | 0.15 IS | 0.0707 J | 0.15 IS | 1.27 U | 0.31 IS | 2.25 U |
| Fluoranthene | 0.63 IS | 0.307 J | 2 IS | 1.08 | 1.2 IS | 0.771 J | 4.4 IS | 2.6 |
| Fluorene | 0.081 IS | 0.0859 J | 0.063 IS | 0.0728 J | 0.71 IS | 1.27 U | 0.19 IS | 2.25 U |
| Indeno(1,2,3-cd)pyrene | 0.28 IS | 0.103 J | 0.48 IS | 0.216 J | 0.46 IS | 0.135 J | 1.1 IS | 0.478 J |
| Naphthalene | 0.22 IS | 0.384 J | 0.067 IS | 0.131 J | 0.27 IS | 0.692 J | 0.066 J, IS | 2.25 U |
| Perylene | 0.12 IS | NA | 0.17 IS | NA | 0.17 IS | NA | 0.33 | NA |
| Phenanthrene | 0.43 IS | 0.322 J | 0.73 IS | 0.574 | 0.48 IS | 0.514 J | 1.4 | 1.25 J |
| Pyrene | 0.82 IS | 0.414 J | 1.5 IS | 0.86 | 1.1 IS | 0.593 J | 3.2 IS | 1.79 J |
| TOTAL PAHs[b] | 18.9 | 2.80 | 14 | 5.17 | 18.3 | 4.21 | 26 | 10.3 |

**TABLE A-10**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - FULL-SCAN PAHs[a]**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Full Scan | Regularly Reported | Full Scan | Regularly Reported | Full Scan | Regularly Reported | Full Scan | Regularly Reported |
| | S10-DC-10 4/03/07 | S10-DC-10[a] 4/03/07 | S13-DC-13 4/04/07 | S13-DC-13[a] 4/04/07 | S14-DC-14 4/04/07 | S14-DC-14[a] 4/04/07 | S20-OC-01 4/02/07 | S20-OC-01[a] 4/02/07 |
| Acenaphthene | 0.12 U | 0.719 U | 0.19 U | 0.394 J | 10 | 5.85 | 0.079 U | 0.646 U |
| Acenaphthylene | 0.12 U | 0.719 U | 0.19 U | 0.859 U | 9.5 U | 0.816 J | 0.079 U | 0.646 U |
| Anthracene | 0.24 | 0.214 J | 0.59 | 1.54 | 57 | 32.4 | 0.11 | 0.142 J |
| Benzo(a)anthracene | 1.1 | 0.635 J | 2.1 | 5.3 | 180 | 87.2 | 1.3 | 0.727 |
| Benzo(a)pyrene | 1.2 | 0.586 J | 2.1 | 5.4 | 140 | 82.5 | 1.4 | 0.725 |
| Benzo(b)flouranthene | 1.9 | 1.1 | 2.4 | 7.65 | 150 | 10.7 | 1.8 | 1.06 |
| Benzo(e)pyrene | 0.95 | NA | 1.2 | NA | 77 | NA | 2.1 | NA |
| Benzo(g,h,i)perylene | 1 | 0.719 R, M, LC | 1.4 | 0.859 R, M, LC, CV | 76 | 2.53 R, M, LC, CV | 1.4 | 0.646 R, M, LC, CV |
| Benzo(k)flouranthene | 1.3 | 0.394 J | 2 | 2.63 | 130 | 38.6 | 0.46 | 0.202 J |
| C1-Chrysene | 0.76 | NA | 1 | NA | 61 | NA | 4 | NA |
| C1-Fluorenes | 0.12 U | NA | 0.19 U | NA | 9.5 U | NA | 0.36 | NA |
| C1-Fluoranthenes/pyrene | 0.91 | NA | 1.4 | NA | 100 | NA | 2.9 | NA |
| C1-Naphthalenes | 0.12 U | NA | 0.19 U | NA | 9.5 U | NA | 0.2 | NA |
| C1-Phenanthrenes/anthracenes | 0.39 | NA | 0.88 | NA | 61 | NA | 2 | NA |
| C2-Chrysene | 0.29 | NA | 0.31 | NA | 17 | NA | 3.2 | NA |
| C2-Fluorenes | 0.12 U | NA | 0.19 | NA | 9.5 U | NA | 0.77 | NA |
| C2-Naphthalenes | 0.13 | NA | 1.3 | NA | 16 | NA | 1.7 | NA |
| C2-Phenanthrenes/anthracenes | 0.21 | NA | 0.39 | NA | 19 | NA | 2.2 | NA |
| C3-Chrysene | 0.12 U | NA | 0.19 U | NA | 9.5 U | NA | 1.4 | NA |
| C3-Fluorenes | 0.12 U | NA | 0.19 | NA | 9.5 U | NA | 1.6 | NA |
| C3-Naphthalenes | 0.12 U | NA | 1.5 | NA | 16 | NA | 3.6 | NA |
| C3-Phenanthrenes/anthracenes | 0.12 U | NA | 0.19 U | NA | 9.5 U | NA | 2 | NA |
| C4-Chrysene | 0.12 U | NA | 0.19 U | NA | 9.5 U | NA | 7 | NA |
| C4-Naphthalenes | 0.12 U | NA | 1.1 | NA | 12 | NA | 3.1 | NA |
| C4-Phenanthrenes/anthracenes | 0.12 U | NA | 0.19 U | NA | 9.5 U | NA | 1.1 | NA |
| Chrysene | 1.5 | 0.949 | 2.2 | 5.1 | 160 | 80.9 | 3 | 1.92 |
| Dibenz(a,h)anthracene | 0.28 | 0.0907 J | 0.31 | 0.659 J | 18 | 9.74 | 0.72 | 0.219 J |
| Fluoranthene | 3.4 | 2.23 | 5.3 | 10.8 | 440 | 190 | 1 | 0.641 J |
| Fluorene | 0.12 U | 0.132 J | 0.2 | 0.619 J | 15 | 8.72 | 0.13 | 0.125 J |
| Indeno(1,2,3-cd)pyrene | 1 | 0.396 J | 1.3 | 2.35 | 78 | 32.9 | 0.76 | 0.233 J |
| Naphthalene | 0.12 U | 0.719 U | 0.19 U | 0.253 J | 9.5 U | 1.93 J | 0.079 U | 0.173 J |
| Perylene | 0.32 | NA | 0.57 | NA | 35 | NA | 0.25 | NA |
| Phenanthrene | 0.99 | 1.1 | 1.5 | 4.31 | 140 | 68.4 | 0.71 | 0.862 |
| Pyrene | 2.5 | 1.64 | 4 | 8.99 | 330 | 150 | 2 | 1.14 |
| TOTAL PAHs[b] | 20 | 9.5 | 35 | 56.0 | 2338 | 801 | 54 | 8.17 |

**TABLE A-10**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - FULL-SCAN PAHs[a]**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| | Sample Number and Date Collected | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Full Scan | Regularly Reported | Full Scan | Regularly Reported | Full Scan | Regularly Reported | Full Scan | Regularly Reported |
| Parameter | S22-OC-03 4/02/07 | S22-OC-03[a] 4/02/07 | S24-OC-05 4/02/07 | S24-OC-05[a] 4/02/07 | S26-OC-07 4/03/07 | S26-OC-07[a] 4/03/07 | S30-OC-11 4/03/07 | S30-OC-11[a] 4/03/07 |
| Acenaphthene | 0.079 J | 1 U | 0.12 U | 0.785 U, H | 0.14 | 0.662 U, H | 0.19 U | 0.571 U, H |
| Acenaphthylene | 0.03 J | 1 U | 0.12 U | 0.785 U, H | 0.12 U | 0.662 U, H | 0.19 U | 0.571 U, H |
| Anthracene | 0.23 | 0.227 J | 0.14 | 0.329 J, H | 0.24 | 0.208 J, H | 0.33 | 0.344 J, H |
| Benzo(a)anthracene | 2.6 | 0.761 J | 1.2 | 0.872 H | 1.8 | 0.783 H | 2 | 1.77 H |
| Benzo(a)pyrene | 3.2 | 0.888 J | 1.7 | 1.21 H | 1.9 | 0.865 H | 2.6 | 2.39 H |
| Benzo(b)flouranthene | 3.7 | 1.59 | 2.6 | 2.27 H | 1.9 | 1.47 H | 3.8 | 4.31 H |
| Benzo(e)pyrene | 3.7 | NA | 1.6 | NA | 2 | NA | 2.1 | NA |
| Benzo(g,h,i)perylene | 3 | 1 R, M, LC, CV | 1.8 | 0.83 R, H, LC | 1.5 | 0.474 R, H, LC | 2.4 | 0.91 R, H, LC, CV |
| Benzo(k)flouranthene | 3 | 0.442 J | 2.1 | 0.745 J, H | 1.8 | 0.46 J, H | 2.7 | 1.38 H |
| C1-Chrysene | 7.8 | NA | 1.8 | NA | 6.6 | NA | 2 | NA |
| C1-Florenes | 0.35 | NA | 0.45 | NA | 0.45 | NA | 0.27 | NA |
| C1-Flouran/Pyrenes | 7.7 | NA | 2.2 | NA | 7.1 | NA | 3 | NA |
| C1-Naphthalenes | 0.39 | NA | 0.21 | NA | 0.17 | NA | 0.19 U | NA |
| C1-Phenan/Anthracenes | 3.1 | NA | 1.7 | NA | 3 | NA | 1.3 | NA |
| C2-Chrysene | 9.8 | NA | 1.8 | NA | 8.3 | NA | 1.6 | NA |
| C2-Florenes | 1.3 | NA | 1.4 | NA | 1.7 | NA | 0.6 | NA |
| C2-Naphthalenes | 1.7 | NA | 1.7 | NA | 1.7 | NA | 0.53 | NA |
| C2-Phenan/Anthracenes | 5.8 | NA | 2.7 | NA | 7.2 | NA | 2.5 | NA |
| C3-Chrysene | 5.5 | NA | 1.2 | NA | 5.2 | NA | 0.88 | NA |
| C3-Florenes | 3.9 | NA | 2.8 | NA | 5.1 | NA | 1.6 | NA |
| C3-Naphthalenes | 2.4 | NA | 3.4 | NA | 4.3 | NA | 1.5 | NA |
| C3-Phenan/Anthracenes | 8.5 | NA | 2.9 | NA | 9.3 | NA | 3.3 | NA |
| C4-Chrysene | 2.1 | NA | 0.43 | NA | 2.8 | NA | 0.46 | NA |
| C4-Naphthalenes | 3 | NA | 4.1 | NA | 5 | NA | 1.7 | NA |
| C4-Phenan/Anthracenes | 5.6 | NA | 1.6 | NA | 5.5 | NA | 1.9 | NA |
| Chrysene | 5.1 | 1.77 | 2.1 | 1.76 H | 2.9 | 1.24 H | 3.3 | 3.11 H |
| Dibenz(a,h)anthracene | 0.72 | 0.141 J | 0.27 | 0.176 J, H | 0.43 | 0.124 J, H | 0.58 | 0.238 J, H |
| Flouranthene | 4.2 | 1.92 | 3.5 | 2.94 H | 3 | 1.82 H | 6.4 | 5.87 H |
| Fluorene | 0.15 | 0.163 J | 0.2 | 0.303 J, H | 0.2 | 0.142 J, H | 0.19 U | 0.146 J, H |
| Indeno(1,2,3-cd)pyrene | 2.3 | 0.311 J | 1.6 | 0.711 J, H | 1.3 | 0.396 J, H | 2.3 | 0.914 J, H, CV |
| Naphthalene | 0.19 | 0.42 J | 0.12 U | 0.283 J, H | 0.12 U | 0.662 U, H | 0.19 U | 0.751 U, H |
| Perylene | 0.92 | NA | 0.42 | NA | 0.64 | NA | 0.6 | NA |
| Phenanthrene | 1.2 | 1.13 | 0.84 | 1.13 H | 0.98 | 0.824 H | 1.7 | 4.84 H |
| Pyrene | 4.9 | 2.02 | 3.3 | 2.57 H | 4 | 1.89 H | 5.3 | 3.82 H |
| TOTAL PAHs[b] | 108 | 11.78 | 53.8 | 15.30 | 98 | 10.22 | 59 | 29.13 |

**TABLE A-10**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - FULL-SCAN PAHs[a]**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Full Scan | Regularly Reported | Full Scan | Regularly Reported | Full Scan | Regularly Reported | Full Scan | Regularly Reported |
| | S33-OC-14 4/03/07 | S33-OC-14[a] 4/03/07 | S38-OC-19 4/03/07 | S38-OC-19[a] 4/03/07 | S42-OC-22 4/03/07 | S42-OC-22[a] 4/03/07 | S46-OC-26 4/03/07 | S46-OC-26[a] 4/03/07 |
| Acenaphthene | 0.12 U | 0.586 U | 0.22 | 0.18 J | 1.5 U | 1.63 | 0.18 U | 0.599 U |
| Acenaphthylene | 0.12 U | 0.11 J | 0.12 U | 0.416 U | 1.5 U | 1.25 U | 0.18 U | 0.599 U |
| Anthracene | 0.27 | 0.29 J | 0.76 | 0.297 J | 3.8 | 4.84 | 0.36 | 0.368 J |
| Benzo(a)anthracene | 1.6 | 1.43 | 2.1 | 1.02 | 17 | 18.4 | 1.7 | 1.47 |
| Benzo(a)pyrene | 1.8 | 1.58 | 2 | 1.13 | 19 | 20 | 1.7 | 1.62 |
| Benzo(b)flouranthene | 2.7 | 2.52 | 2.4 | 1.67 | 26 | 24.7 | 2.5 | 2.64 |
| Benzo(e)pyrene | 1.5 | NA | 1.3 | NA | 13 | NA | 1.2 | NA |
| Benzo(g,h,i)perylene | 1.6 | 0.586 R, M, LC, CV | 1.4 | 0.144 R, J, LC | 15 | 8.39 R, LC | 1.4 | 0.173 R, J, LC |
| Benzo(k)flouranthene | 2 | 0.969 | 1.8 | 0.585 | 18 | 7.88 | 1.8 | 0.865 |
| C1-Chrysene | 1.3 | NA | 0.98 | NA | 7.2 | NA | 0.75 | NA |
| C1-Florenes | 0.12 | NA | 0.12 U | NA | 1.5 U | NA | 0.18 U | NA |
| C1-Flouran/Pyrenes | 1.7 | NA | 1.6 | NA | 9.9 | NA | 1 | NA |
| C1-Naphthalenes | 0.12 U | NA | 0.12 U | NA | 1.5 U | NA | 0.18 U | NA |
| C1-Phenan/Anthracenes | 0.7 | NA | 0.85 | NA | 4.6 | NA | 0.52 | NA |
| C2-Chrysene | 0.82 | NA | 0.45 | NA | 2.7 | NA | 0.29 | NA |
| C2-Florenes | 0.29 | NA | 0.15 | NA | 1.5 U | NA | 0.18 U | NA |
| C2-Naphthalenes | 0.34 | NA | 0.36 | NA | 1.5 U | NA | 0.18 U | NA |
| C2-Phenan/Anthracenes | 0.74 | NA | 0.48 | NA | 1.6 | NA | 0.2 | NA |
| C3-Chrysene | 0.4 | NA | 0.18 | NA | 1.5 U | NA | 0.18 U | NA |
| C3-Florenes | 0.75 | NA | 0.38 | NA | 1.5 U | NA | 0.18 U | NA |
| C3-Naphthalenes | 0.59 | NA | 0.29 | NA | 1.5 U | NA | 0.18 U | NA |
| C3-Phenan/Anthracenes | 1.1 | NA | 0.54 | NA | 1.5 U | NA | 0.18 U | NA |
| C4-Chrysene | 0.18 | NA | 0.12 U | NA | 1.5 U | NA | 0.18 U | NA |
| C4-Naphthalenes | 0.72 | NA | 0.39 | NA | 1.5 U | NA | 0.18 U | NA |
| C4-Phenan/Anthracenes | 0.62 | NA | 0.3 | NA | 1.5 U | NA | 0.18 U | NA |
| Chrysene | 2.4 | 2.26 | 2.3 | 1.34 | 19 | 22.9 | 2.1 | 2.01 |
| Dibenz(a,h)anthracene | 0.26 | 0.45 J, CV | 0.34 | 0.174 J | 2.9 | 4.53 | 0.32 | 0.217 J |
| Flouranthene | 4.8 | 3.46 | 6 | 2.92 | 48 | 51.8 | 5.3 | 4.97 |
| Fluorene | 0.12 | 0.118 J | 0.37 | 0.231 J | 1.7 | 2.39 | 0.18 U | 0.145 J |
| Indeno(1,2,3-cd)pyrene | 1.6 | 1.73 CV | 1.4 | 0.679 | 15 | 17.7 | 1.4 | 0.853 |
| Naphthalene | 0.12 U | 0.109 J | 0.12 U | 0.824 | 1.5 U | 0.265 J | 0.18 U | 0.599 U |
| Perylene | 0.47 | NA | 0.49 | NA | 4.5 | NA | 0.42 | NA |
| Phenanthrene | 1.4 | 1.41 | 3.2 | 1.67 | 19 | 26.3 | 1.9 | 2.11 |
| Pyrene | 3.7 | 3.87 | 4.4 | 2.25 | 36 | 44.8 | 3.7 | 3.66 |
| TOTAL PAHs[b] | 37 | 20.31 | 37 | 14.97 | 284 | 248 | 29 | 20.93 |

Notes:

a EPA Central Regional Laboratory analytical results for 16 regularly reported PAHs (not full-scan) are also presented for comparison purposes. These results are also presented for all sampling locations in Table B-4.

b Non-detect results were counted as 0 when calculating total PAHs.

CV = Estimated value. Calibration verification results exceed upper or lower control limits.
H = Estimated value. Holding time exceeded.
IS = Estimated value. Internal standard recoveries exceed the upper or lower control limits.
J = Estimated value. Greater than detection limit, but less than reporting limit.
LC = Estimated value. Laboratory control recoveries exceed upper or lower control limits.
M = Estimated value. Associated matrix spike/matrix spike duplicate recoveries exceed the upper or lower control limits.
NA = Not analyzed
R = Rejected value
U = Analyte not detected at or above reporting limit.

All values expressed in milligrams per kilogram unless otherwise noted

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| S01-DC-01 | Sieve 3/8 | 25.9 | Gravel |
| S01-DC-01 | Sieve 4 | 11.1 | Sand |
| S01-DC-01 | Sieve 10 | 9.3 | Sand |
| S01-DC-01 | Sieve 16 | 5.7 | Sand |
| S01-DC-01 | Sieve 35 | 11.0 | Sand |
| S01-DC-01 | Sieve 50 | 7.3 | Sand |
| S01-DC-01 | Sieve 100 | 9.0 | Sand |
| S01-DC-01 | Sieve 200 | 1.1 | Silt and Clay |
| S01-DC-01 | Pan and Wash through 200 Sieve | 19.6 | Silt and Clay |
| | | | |
| S02-DC-02 | Sieve 3/8 | 2.3 | Gravel |
| S02-DC-02 | Sieve 4 | 0.7 | Sand |
| S02-DC-02 | Sieve 10 | 1.2 | Sand |
| S02-DC-02 | Sieve 16 | 0.8 | Sand |
| S02-DC-02 | Sieve 35 | 1.3 | Sand |
| S02-DC-02 | Sieve 50 | 1.7 | Sand |
| S02-DC-02 | Sieve 100 | 3.4 | Sand |
| S02-DC-02 | Sieve 200 | 4.7 | Silt and Clay |
| S02-DC-02 | Pan and Wash through 200 Sieve | 83.9 | Silt and Clay |
| | | | |
| S03-DC-03 | Sieve 3/8 | 0.0 | Gravel |
| S03-DC-03 | Sieve 4 | 1.5 | Sand |
| S03-DC-03 | Sieve 10 | 8.6 | Sand |
| S03-DC-03 | Sieve 16 | 5.7 | Sand |
| S03-DC-03 | Sieve 35 | 14.6 | Sand |
| S03-DC-03 | Sieve 50 | 12.7 | Sand |
| S03-DC-03 | Sieve 100 | 34.7 | Sand |
| S03-DC-03 | Sieve 200 | 9.8 | Silt and Clay |
| S03-DC-03 | Pan and Wash through 200 Sieve | 12.4 | Silt and Clay |
| | | | |
| S04-DC-04 | Sieve 3/8 | 0.2 | Gravel |
| S04-DC-04 | Sieve 4 | 0.6 | Sand |
| S04-DC-04 | Sieve 10 | 1.1 | Sand |
| S04-DC-04 | Sieve 16 | 1.1 | Sand |
| S04-DC-04 | Sieve 35 | 1.9 | Sand |
| S04-DC-04 | Sieve 50 | 1.4 | Sand |
| S04-DC-04 | Sieve 100 | 3.4 | Sand |
| S04-DC-04 | Sieve 200 | 1.4 | Silt and Clay |
| S04-DC-04 | Pan and Wash through 200 Sieve | 88.9 | Silt and Clay |
| | | | |
| S05-DC-05 | Sieve 3/8 | 0.0 | Gravel |
| S05-DC-05 | Sieve 4 | 0.2 | Sand |
| S05-DC-05 | Sieve 10 | 0.9 | Sand |
| S05-DC-05 | Sieve 16 | 0.8 | Sand |
| S05-DC-05 | Sieve 35 | 1.0 | Sand |
| S05-DC-05 | Sieve 50 | 1.2 | Sand |
| S05-DC-05 | Sieve 100 | 1.5 | Sand |
| S05-DC-05 | Sieve 200 | 1.8 | Silt and Clay |
| S05-DC-05 | Pan and Wash through 200 Sieve | 92.6 | Silt and Clay |

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| | | | |
| S06-DC-06 | Sieve 3/8 | 2.1 | Gravel |
| S06-DC-06 | Sieve 4 | 2.4 | Sand |
| S06-DC-06 | Sieve 10 | 3.3 | Sand |
| S06-DC-06 | Sieve 16 | 2.5 | Sand |
| S06-DC-06 | Sieve 35 | 6.5 | Sand |
| S06-DC-06 | Sieve 50 | 4.6 | Sand |
| S06-DC-06 | Sieve 100 | 9.9 | Sand |
| S06-DC-06 | Sieve 200 | 13.4 | Silt and Clay |
| S06-DC-06 | Pan and Wash through 200 Sieve | 55.3 | Silt and Clay |
| | | | |
| S07-DC-07 | Sieve 3/8 | 2.6 | Gravel |
| S07-DC-07 | Sieve 4 | 1.4 | Sand |
| S07-DC-07 | Sieve 10 | 2.1 | Sand |
| S07-DC-07 | Sieve 16 | 1.7 | Sand |
| S07-DC-07 | Sieve 35 | 2.5 | Sand |
| S07-DC-07 | Sieve 50 | 2.8 | Sand |
| S07-DC-07 | Sieve 100 | 3.9 | Sand |
| S07-DC-07 | Sieve 200 | 3.5 | Silt and Clay |
| S07-DC-07 | Pan and Wash through 200 Sieve | 79.5 | Silt and Clay |
| | | | |
| S08-DC-08 | Sieve 3/8 | 0.0 | Gravel |
| S08-DC-08 | Sieve 4 | 0.3 | Sand |
| S08-DC-08 | Sieve 10 | 1.1 | Sand |
| S08-DC-08 | Sieve 16 | 0.9 | Sand |
| S08-DC-08 | Sieve 35 | -0.8 | Sand |
| S08-DC-08 | Sieve 50 | 1.1 | Sand |
| S08-DC-08 | Sieve 100 | 1.6 | Sand |
| S08-DC-08 | Sieve 200 | 1.3 | Silt and Clay |
| S08-DC-08 | Pan and Wash through 200 Sieve | 94.5 | Silt and Clay |
| | | | |
| S09-DC-09 | Sieve 3/8 | 0.0 | Gravel |
| S09-DC-09 | Sieve 4 | 2.0 | Sand |
| S09-DC-09 | Sieve 10 | 3.7 | Sand |
| S09-DC-09 | Sieve 16 | 3.1 | Sand |
| S09-DC-09 | Sieve 35 | 5.6 | Sand |
| S09-DC-09 | Sieve 50 | 6.2 | Sand |
| S09-DC-09 | Sieve 100 | 9.2 | Sand |
| S09-DC-09 | Sieve 200 | 10.9 | Silt and Clay |
| S09-DC-09 | Pan and Wash through 200 Sieve | 59.3 | Silt and Clay |
| | | | |
| S10-DC-10 | Sieve 3/8 | 0.0 | Gravel |
| S10-DC-10 | Sieve 4 | 0.2 | Sand |
| S10-DC-10 | Sieve 10 | 0.7 | Sand |
| S10-DC-10 | Sieve 16 | 0.6 | Sand |
| S10-DC-10 | Sieve 35 | 1.6 | Sand |
| S10-DC-10 | Sieve 50 | 1.1 | Sand |
| S10-DC-10 | Sieve 100 | 2.4 | Sand |
| S10-DC-10 | Sieve 200 | 1.4 | Silt and Clay |
| S10-DC-10 | Pan and Wash through 200 Sieve | 92.0 | Silt and Clay |

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| | | | |
| S11-DC-11 | Sieve 3/8 | 0.0 | Gravel |
| S11-DC-11 | Sieve 4 | 0.0 | Sand |
| S11-DC-11 | Sieve 10 | 0.2 | Sand |
| S11-DC-11 | Sieve 16 | 0.3 | Sand |
| S11-DC-11 | Sieve 35 | 0.3 | Sand |
| S11-DC-11 | Sieve 50 | 0.3 | Sand |
| S11-DC-11 | Sieve 100 | 0.6 | Sand |
| S11-DC-11 | Sieve 200 | 1.4 | Silt and Clay |
| S11-DC-11 | Pan and Wash through 200 Sieve | 96.9 | Silt and Clay |
| | | | |
| S12-DC-12 | Sieve 3/8 | 0.1 | Gravel |
| S12-DC-12 | Sieve 4 | 2.1 | Sand |
| S12-DC-12 | Sieve 10 | 4.4 | Sand |
| S12-DC-12 | Sieve 16 | 3.2 | Sand |
| S12-DC-12 | Sieve 35 | 6.1 | Sand |
| S12-DC-12 | Sieve 50 | 3.1 | Sand |
| S12-DC-12 | Sieve 100 | 4.0 | Sand |
| S12-DC-12 | Sieve 200 | 0.3 | Silt and Clay |
| S12-DC-12 | Pan and Wash through 200 Sieve | 76.7 | Silt and Clay |
| | | | |
| S13-DC-13 | Sieve 3/8 | 9.0 | Gravel |
| S13-DC-13 | Sieve 4 | 6.3 | Sand |
| S13-DC-13 | Sieve 10 | 4.8 | Sand |
| S13-DC-13 | Sieve 16 | 3.1 | Sand |
| S13-DC-13 | Sieve 35 | 4.6 | Sand |
| S13-DC-13 | Sieve 50 | 6.5 | Sand |
| S13-DC-13 | Sieve 100 | 11.1 | Sand |
| S13-DC-13 | Sieve 200 | 14.0 | Silt and Clay |
| S13-DC-13 | Pan and Wash through 200 Sieve | 40.6 | Silt and Clay |

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| | | | |
| S14-DC-14 | Sieve 3/8 | 4.0 | Gravel |
| S14-DC-14 | Sieve 4 | 12.5 | Sand |
| S14-DC-14 | Sieve 10 | 15.5 | Sand |
| S14-DC-14 | Sieve 16 | 7.2 | Sand |
| S14-DC-14 | Sieve 35 | 13.7 | Sand |
| S14-DC-14 | Sieve 50 | 10.4 | Sand |
| S14-DC-14 | Sieve 100 | 17.8 | Sand |
| S14-DC-14 | Sieve 200 | 3.4 | Silt and Clay |
| S14-DC-14 | Pan and Wash through 200 Sieve | 15.5 | Silt and Clay |
| | | | |
| S15-DC-15 | Sieve 3/8 | 4.9 | Gravel |
| S15-DC-15 | Sieve 4 | 9.5 | Sand |
| S15-DC-15 | Sieve 10 | 9.1 | Sand |
| S15-DC-15 | Sieve 16 | 5.0 | Sand |
| S15-DC-15 | Sieve 35 | 8.0 | Sand |
| S15-DC-15 | Sieve 50 | 11.0 | Sand |
| S15-DC-15 | Sieve 100 | 14.7 | Sand |
| S15-DC-15 | Sieve 200 | 13.3 | Silt and Clay |
| S15-DC-15 | Pan and Wash through 200 Sieve | 24.5 | Silt and Clay |
| | | | |
| S16-DC-16 | Sieve 3/8 | 0.1 | Gravel |
| S16-DC-16 | Sieve 4 | 0.0 | Sand |
| S16-DC-16 | Sieve 10 | 0.0 | Sand |
| S16-DC-16 | Sieve 16 | 0.0 | Sand |
| S16-DC-16 | Sieve 35 | 0.1 | Sand |
| S16-DC-16 | Sieve 50 | 0.2 | Sand |
| S16-DC-16 | Sieve 100 | 0.3 | Sand |
| S16-DC-16 | Sieve 200 | 0.0 | Silt and Clay |
| S16-DC-16 | Pan and Wash through 200 Sieve | 99.4 | Silt and Clay |
| | | | |
| S17-DC-17 | Sieve 3/8 | 0.0 | Gravel |
| S17-DC-17 | Sieve 4 | 0.0 | Sand |
| S17-DC-17 | Sieve 10 | 0.0 | Sand |
| S17-DC-17 | Sieve 16 | 0.0 | Sand |
| S17-DC-17 | Sieve 35 | 0.0 | Sand |
| S17-DC-17 | Sieve 50 | 0.0 | Sand |
| S17-DC-17 | Sieve 100 | 0.1 | Sand |
| S17-DC-17 | Sieve 200 | 0.1 | Silt and Clay |
| S17-DC-17 | Pan and Wash through 200 Sieve | 99.8 | Silt and Clay |
| | | | |
| S18-DC-18 | Sieve 3/8 | 0.0 | Gravel |
| S18-DC-18 | Sieve 4 | 0.0 | Sand |
| S18-DC-18 | Sieve 10 | 0.0 | Sand |
| S18-DC-18 | Sieve 16 | 0.0 | Sand |
| S18-DC-18 | Sieve 35 | 0.0 | Sand |
| S18-DC-18 | Sieve 50 | 0.0 | Sand |
| S18-DC-18 | Sieve 100 | 0.5 | Sand |
| S18-DC-18 | Sieve 200 | 0.3 | Silt and Clay |
| S18-DC-18 | Pan and Wash through 200 Sieve | 99.2 | Silt and Clay |

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| | | | |
| S19-DC-19 | Sieve 3/8 | 0.4 | Gravel |
| S19-DC-19 | Sieve 4 | 3.3 | Sand |
| S19-DC-19 | Sieve 10 | 6.9 | Sand |
| S19-DC-19 | Sieve 16 | 4.0 | Sand |
| S19-DC-19 | Sieve 35 | 9.4 | Sand |
| S19-DC-19 | Sieve 50 | 9.1 | Sand |
| S19-DC-19 | Sieve 100 | 17.9 | Sand |
| S19-DC-19 | Sieve 200 | 0.3 | Silt and Clay |
| S19-DC-19 | Pan and Wash through 200 Sieve | 48.7 | Silt and Clay |
| | | | |
| S20-OC-01 | Sieve 3/8 | 3.4 | Gravel |
| S20-OC-01 | Sieve 4 | 2.3 | Sand |
| S20-OC-01 | Sieve 10 | 1.0 | Sand |
| S20-OC-01 | Sieve 16 | 0.5 | Sand |
| S20-OC-01 | Sieve 35 | 0.0 | Sand |
| S20-OC-01 | Sieve 50 | 2.6 | Sand |
| S20-OC-01 | Sieve 100 | 17.1 | Sand |
| S20-OC-01 | Sieve 200 | 32.6 | Silt and Clay |
| S20-OC-01 | Pan and Wash through 200 Sieve | 40.5 | Silt and Clay |
| | | | |
| S21-OC-02 | Sieve 3/8 | 0.0 | Gravel |
| S21-OC-02 | Sieve 4 | 0.1 | Sand |
| S21-OC-02 | Sieve 10 | 0.9 | Sand |
| S21-OC-02 | Sieve 16 | 0.5 | Sand |
| S21-OC-02 | Sieve 35 | 0.6 | Sand |
| S21-OC-02 | Sieve 50 | 0.9 | Sand |
| S21-OC-02 | Sieve 100 | 0.6 | Sand |
| S21-OC-02 | Sieve 200 | 0.1 | Silt and Clay |
| S21-OC-02 | Pan and Wash through 200 Sieve | 96.4 | Silt and Clay |
| | | | |
| S22-OC-03 | Sieve 3/8 | -0.5 | Gravel |
| S22-OC-03 | Sieve 4 | 0.9 | Sand |
| S22-OC-03 | Sieve 10 | 0.9 | Sand |
| S22-OC-03 | Sieve 16 | 1.1 | Sand |
| S22-OC-03 | Sieve 35 | 3.1 | Sand |
| S22-OC-03 | Sieve 50 | 2.6 | Sand |
| S22-OC-03 | Sieve 100 | 1.7 | Sand |
| S22-OC-03 | Sieve 200 | 8.4 | Silt and Clay |
| S22-OC-03 | Pan and Wash through 200 Sieve | 81.8 | Silt and Clay |
| | | | |
| S23-OC-04 | Sieve 3/8 | 0.0 | Gravel |
| S23-OC-04 | Sieve 4 | 0.0 | Sand |
| S23-OC-04 | Sieve 10 | 0.1 | Sand |
| S23-OC-04 | Sieve 16 | 0.1 | Sand |
| S23-OC-04 | Sieve 35 | 0.1 | Sand |
| S23-OC-04 | Sieve 50 | 0.1 | Sand |
| S23-OC-04 | Sieve 100 | 0.3 | Sand |
| S23-OC-04 | Sieve 200 | 0.5 | Silt and Clay |
| S23-OC-04 | Pan and Wash through 200 Sieve | 98.9 | Silt and Clay |

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| | | | |
| S24-OC-05 | Sieve 3/8 | 0.0 | Gravel |
| S24-OC-05 | Sieve 4 | 0.0 | Sand |
| S24-OC-05 | Sieve 10 | 0.1 | Sand |
| S24-OC-05 | Sieve 16 | 0.2 | Sand |
| S24-OC-05 | Sieve 35 | 0.8 | Sand |
| S24-OC-05 | Sieve 50 | 0.5 | Sand |
| S24-OC-05 | Sieve 100 | 0.1 | Sand |
| S24-OC-05 | Sieve 200 | 4.5 | Silt and Clay |
| S24-OC-05 | Pan and Wash through 200 Sieve | 93.8 | Silt and Clay |
| | | | |
| S25-OC-06 | Sieve 3/8 | -0.4 | Gravel |
| S25-OC-06 | Sieve 4 | 0.0 | Sand |
| S25-OC-06 | Sieve 10 | -0.1 | Sand |
| S25-OC-06 | Sieve 16 | 0.2 | Sand |
| S25-OC-06 | Sieve 35 | 0.3 | Sand |
| S25-OC-06 | Sieve 50 | 0.1 | Sand |
| S25-OC-06 | Sieve 100 | 0.3 | Sand |
| S25-OC-06 | Sieve 200 | 2.2 | Silt and Clay |
| S25-OC-06 | Pan and Wash through 200 Sieve | 97.4 | Silt and Clay |
| | | | |
| S26-OC-07 | Sieve 3/8 | 2.0 | Gravel |
| S26-OC-07 | Sieve 4 | 6.3 | Sand |
| S26-OC-07 | Sieve 10 | 6.0 | Sand |
| S26-OC-07 | Sieve 16 | 4.1 | Sand |
| S26-OC-07 | Sieve 35 | 7.7 | Sand |
| S26-OC-07 | Sieve 50 | 14.9 | Sand |
| S26-OC-07 | Sieve 100 | 14.0 | Sand |
| S26-OC-07 | Sieve 200 | 6.5 | Silt and Clay |
| S26-OC-07 | Pan and Wash through 200 Sieve | 38.5 | Silt and Clay |
| | | | |
| S27-OC-08 | Sieve 3/8 | 0.0 | Gravel |
| S27-OC-08 | Sieve 4 | 0.7 | Sand |
| S27-OC-08 | Sieve 10 | 2.2 | Sand |
| S27-OC-08 | Sieve 16 | 3.1 | Sand |
| S27-OC-08 | Sieve 35 | 13.9 | Sand |
| S27-OC-08 | Sieve 50 | 11.3 | Sand |
| S27-OC-08 | Sieve 100 | 5.2 | Sand |
| S27-OC-08 | Sieve 200 | 25.5 | Silt and Clay |
| S27-OC-08 | Pan and Wash through 200 Sieve | 38.1 | Silt and Clay |
| | | | |
| S28-OC-09 | Sieve 3/8 | 0.0 | Gravel |
| S28-OC-09 | Sieve 4 | 1.8 | Sand |
| S28-OC-09 | Sieve 10 | 5.3 | Sand |
| S28-OC-09 | Sieve 16 | 5.5 | Sand |
| S28-OC-09 | Sieve 35 | 9.5 | Sand |
| S28-OC-09 | Sieve 50 | 15.1 | Sand |
| S28-OC-09 | Sieve 100 | 15.3 | Sand |
| S28-OC-09 | Sieve 200 | 11.8 | Silt and Clay |
| S28-OC-09 | Pan and Wash through 200 Sieve | 35.7 | Silt and Clay |

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| | | | |
| S29-OC-10 | Sieve 3/8 | 0.6 | Gravel |
| S29-OC-10 | Sieve 4 | 5.0 | Sand |
| S29-OC-10 | Sieve 10 | 8.7 | Sand |
| S29-OC-10 | Sieve 16 | 7.5 | Sand |
| S29-OC-10 | Sieve 35 | 13.3 | Sand |
| S29-OC-10 | Sieve 50 | 15.0 | Sand |
| S29-OC-10 | Sieve 100 | 12.7 | Sand |
| S29-OC-10 | Sieve 200 | 9.5 | Silt and Clay |
| S29-OC-10 | Pan and Wash through 200 Sieve | 27.7 | Silt and Clay |
| | | | |
| S30-OC-11 | Sieve 3/8 | 0.0 | Gravel |
| S30-OC-11 | Sieve 4 | 0.5 | Sand |
| S30-OC-11 | Sieve 10 | 3.4 | Sand |
| S30-OC-11 | Sieve 16 | 3.8 | Sand |
| S30-OC-11 | Sieve 35 | 5.2 | Sand |
| S30-OC-11 | Sieve 50 | 6.1 | Sand |
| S30-OC-11 | Sieve 100 | 15.0 | Sand |
| S30-OC-11 | Sieve 200 | 18.6 | Silt and Clay |
| S30-OC-11 | Pan and Wash through 200 Sieve | 47.4 | Silt and Clay |
| | | | |
| S31-OC-12 | Sieve 3/8 | 0.0 | Gravel |
| S31-OC-12 | Sieve 4 | 3.0 | Sand |
| S31-OC-12 | Sieve 10 | 4.1 | Sand |
| S31-OC-12 | Sieve 16 | 5.7 | Sand |
| S31-OC-12 | Sieve 35 | 21.6 | Sand |
| S31-OC-12 | Sieve 50 | 12.9 | Sand |
| S31-OC-12 | Sieve 100 | 1.8 | Sand |
| S31-OC-12 | Sieve 200 | 20.4 | Silt and Clay |
| S31-OC-12 | Pan and Wash through 200 Sieve | 30.5 | Silt and Clay |
| | | | |
| S32-OC-13 | Sieve 3/8 | 0.0 | Gravel |
| S32-OC-13 | Sieve 4 | 0.9 | Sand |
| S32-OC-13 | Sieve 10 | 4.8 | Sand |
| S32-OC-13 | Sieve 16 | 5.7 | Sand |
| S32-OC-13 | Sieve 35 | 17.6 | Sand |
| S32-OC-13 | Sieve 50 | 12.5 | Sand |
| S32-OC-13 | Sieve 100 | 8.9 | Sand |
| S32-OC-13 | Sieve 200 | 19.3 | Silt and Clay |
| S32-OC-13 | Pan and Wash through 200 Sieve | 30.3 | Silt and Clay |
| | | | |
| S33-OC-14 | Sieve 3/8 | 0.0 | Gravel |
| S33-OC-14 | Sieve 4 | 3.2 | Sand |
| S33-OC-14 | Sieve 10 | 6.6 | Sand |
| S33-OC-14 | Sieve 16 | 5.0 | Sand |
| S33-OC-14 | Sieve 35 | 9.2 | Sand |
| S33-OC-14 | Sieve 50 | 13.7 | Sand |
| S33-OC-14 | Sieve 100 | 15.8 | Sand |
| S33-OC-14 | Sieve 200 | 9.5 | Silt and Clay |
| S33-OC-14 | Pan and Wash through 200 Sieve | 37.0 | Silt and Clay |

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| | | | |
| S34-OC-15 | Sieve 3/8 | 0.3 | Gravel |
| S34-OC-15 | Sieve 4 | 3.7 | Sand |
| S34-OC-15 | Sieve 10 | 15.1 | Sand |
| S34-OC-15 | Sieve 16 | 11.5 | Sand |
| S34-OC-15 | Sieve 35 | 21.7 | Sand |
| S34-OC-15 | Sieve 50 | 9.0 | Sand |
| S34-OC-15 | Sieve 100 | 0.7 | Sand |
| S34-OC-15 | Sieve 200 | 13.6 | Silt and Clay |
| S34-OC-15 | Pan and Wash through 200 Sieve | 24.4 | Silt and Clay |
| | | | |
| S35-OC-16 | Sieve 3/8 | 0.0 | Gravel |
| S35-OC-16 | Sieve 4 | 8.5 | Sand |
| S35-OC-16 | Sieve 10 | 11.3 | Sand |
| S35-OC-16 | Sieve 16 | 7.3 | Sand |
| S35-OC-16 | Sieve 35 | 13.8 | Sand |
| S35-OC-16 | Sieve 50 | 10.1 | Sand |
| S35-OC-16 | Sieve 100 | 1.2 | Sand |
| S35-OC-16 | Sieve 200 | 17.9 | Silt and Clay |
| S35-OC-16 | Pan and Wash through 200 Sieve | 29.9 | Silt and Clay |
| | | | |
| S36-OC-17 | Sieve 3/8 | 1.2 | Gravel |
| S36-OC-17 | Sieve 4 | 1.6 | Sand |
| S36-OC-17 | Sieve 10 | 6.8 | Sand |
| S36-OC-17 | Sieve 16 | 8.2 | Sand |
| S36-OC-17 | Sieve 35 | 19.2 | Sand |
| S36-OC-17 | Sieve 50 | 25.0 | Sand |
| S36-OC-17 | Sieve 100 | 17.4 | Sand |
| S36-OC-17 | Sieve 200 | 7.1 | Silt and Clay |
| S36-OC-17 | Pan and Wash through 200 Sieve | 13.5 | Silt and Clay |
| | | | |
| S37-OC-18 | Sieve 3/8 | 3.5 | Gravel |
| S37-OC-18 | Sieve 4 | 0.9 | Sand |
| S37-OC-18 | Sieve 10 | 3.0 | Sand |
| S37-OC-18 | Sieve 16 | 1.9 | Sand |
| S37-OC-18 | Sieve 35 | 10.6 | Sand |
| S37-OC-18 | Sieve 50 | 24.4 | Sand |
| S37-OC-18 | Sieve 100 | 4.2 | Sand |
| S37-OC-18 | Sieve 200 | 33.8 | Silt and Clay |
| S37-OC-18 | Pan and Wash through 200 Sieve | 17.7 | Silt and Clay |
| | | | |
| S38-OC-19 | Sieve 3/8 | 3.0 | Gravel |
| S38-OC-19 | Sieve 4 | 1.9 | Sand |
| S38-OC-19 | Sieve 10 | 11.7 | Sand |
| S38-OC-19 | Sieve 16 | 13.5 | Sand |
| S38-OC-19 | Sieve 35 | 23.4 | Sand |
| S38-OC-19 | Sieve 50 | 12.6 | Sand |
| S38-OC-19 | Sieve 100 | 16.2 | Sand |
| S38-OC-19 | Sieve 200 | 1.9 | Silt and Clay |
| S38-OC-19 | Pan and Wash through 200 Sieve | 15.8 | Silt and Clay |

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| | | | |
| S39-OC-20 | Sieve 3/8 | 2.4 | Gravel |
| S39-OC-20 | Sieve 4 | 2.1 | Sand |
| S39-OC-20 | Sieve 10 | 9.2 | Sand |
| S39-OC-20 | Sieve 16 | 10.5 | Sand |
| S39-OC-20 | Sieve 35 | 22.8 | Sand |
| S39-OC-20 | Sieve 50 | 13.0 | Sand |
| S39-OC-20 | Sieve 100 | 7.1 | Sand |
| S39-OC-20 | Sieve 200 | 8.9 | Silt and Clay |
| S39-OC-20 | Pan and Wash through 200 Sieve | 24.0 | Silt and Clay |
| | | | |
| S40-OC-21 | Sieve 3/8 | 0.3 | Gravel |
| S40-OC-21 | Sieve 4 | 2.5 | Sand |
| S40-OC-21 | Sieve 10 | 4.4 | Sand |
| S40-OC-21 | Sieve 16 | 5.9 | Sand |
| S40-OC-21 | Sieve 35 | 12.9 | Sand |
| S40-OC-21 | Sieve 50 | 16.7 | Sand |
| S40-OC-21 | Sieve 100 | 17.5 | Sand |
| S40-OC-21 | Sieve 200 | 15.3 | Silt and Clay |
| S40-OC-21 | Pan and Wash through 200 Sieve | 24.5 | Silt and Clay |
| | | | |
| S41-OC-21A | Sieve 3/8 | 0.0 | Gravel |
| S41-OC-21A | Sieve 4 | 0.5 | Sand |
| S41-OC-21A | Sieve 10 | 1.5 | Sand |
| S41-OC-21A | Sieve 16 | 1.7 | Sand |
| S41-OC-21A | Sieve 35 | 5.1 | Sand |
| S41-OC-21A | Sieve 50 | 4.5 | Sand |
| S41-OC-21A | Sieve 100 | 4.8 | Sand |
| S41-OC-21A | Sieve 200 | 19.8 | Silt and Clay |
| S41-OC-21A | Pan and Wash through 200 Sieve | 62.1 | Silt and Clay |
| | | | |
| S42-OC-22 | Sieve 3/8 | 0.0 | Gravel |
| S42-OC-22 | Sieve 4 | 1.6 | Sand |
| S42-OC-22 | Sieve 10 | 7.3 | Sand |
| S42-OC-22 | Sieve 16 | 7.1 | Sand |
| S42-OC-22 | Sieve 35 | 9.4 | Sand |
| S42-OC-22 | Sieve 50 | 12.3 | Sand |
| S42-OC-22 | Sieve 100 | 37.6 | Sand |
| S42-OC-22 | Sieve 200 | 10.0 | Silt and Clay |
| S42-OC-22 | Pan and Wash through 200 Sieve | 14.7 | Silt and Clay |
| | | | |
| S43-OC-23 | Sieve 3/8 | 16.6 | Gravel |
| S43-OC-23 | Sieve 4 | 5.0 | Sand |
| S43-OC-23 | Sieve 10 | 4.2 | Sand |
| S43-OC-23 | Sieve 16 | 3.7 | Sand |
| S43-OC-23 | Sieve 35 | 10.3 | Sand |
| S43-OC-23 | Sieve 50 | 8.1 | Sand |
| S43-OC-23 | Sieve 100 | 7.6 | Sand |
| S43-OC-23 | Sieve 200 | 16.1 | Silt and Clay |
| S43-OC-23 | Pan and Wash through 200 Sieve | 28.4 | Silt and Clay |
| | | | |

**TABLE A-11**
**SEDIMENT GRAIN SIZE ANALYSIS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Sample Name | Sieve No. | Percent Retained | Soil Classification |
|---|---|---|---|
| S44-OC-24 | Sieve 3/8 | 0.0 | Gravel |
| S44-OC-24 | Sieve 4 | 0.3 | Sand |
| S44-OC-24 | Sieve 10 | 1.1 | Sand |
| S44-OC-24 | Sieve 16 | 1.0 | Sand |
| S44-OC-24 | Sieve 35 | 1.6 | Sand |
| S44-OC-24 | Sieve 50 | 2.6 | Sand |
| S44-OC-24 | Sieve 100 | 13.4 | Sand |
| S44-OC-24 | Sieve 200 | 36.0 | Silt and Clay |
| S44-OC-24 | Pan and Wash through 200 Sieve | 44.0 | Silt and Clay |
| | | | |
| S45-OC-25 | Sieve 3/8 | 5.7 | Gravel |
| S45-OC-25 | Sieve 4 | 12.8 | Sand |
| S45-OC-25 | Sieve 10 | 12.8 | Sand |
| S45-OC-25 | Sieve 16 | 5.4 | Sand |
| S45-OC-25 | Sieve 35 | 10.5 | Sand |
| S45-OC-25 | Sieve 50 | 8.2 | Sand |
| S45-OC-25 | Sieve 100 | 14.8 | Sand |
| S45-OC-25 | Sieve 200 | 0.5 | Silt and Clay |
| S45-OC-25 | Pan and Wash through 200 Sieve | 29.3 | Silt and Clay |
| | | | |
| S46-OC-26 | Sieve 3/8 | 0.0 | Gravel |
| S46-OC-26 | Sieve 4 | 0.0 | Sand |
| S46-OC-26 | Sieve 10 | 1.7 | Sand |
| S46-OC-26 | Sieve 16 | 3.6 | Sand |
| S46-OC-26 | Sieve 35 | 8.2 | Sand |
| S46-OC-26 | Sieve 50 | 9.9 | Sand |
| S46-OC-26 | Sieve 100 | 10.5 | Sand |
| S46-OC-26 | Sieve 200 | 10.2 | Silt and Clay |
| S46-OC-26 | Pan and Wash through 200 Sieve | 55.9 | Silt and Clay |

# TABLE A-12
## Sediment Sampling for Otter Creek
## ESOI Otter Creek Facility, Oregon, Ohio

| AOI | | IU C | IU C | IU C | IU C | IU C | IU C | IU C | IU C | IU C | IU C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | SITE 1 | SITE 1 | SITE 3 | SITE 3 | SITE 4 | SITE 4 | SITE 4 | SITE 4 | SITE 6 | SITE 6 |
| ENVIRON Sample ID | | SITE1-3SD-0.0 | SITE1-3SD-0 | SITE3-3SD-0.0 | SITE3-3SD-0 | SITE4-3SD-0.0 | SITE4-3SD-0.0D | SITE4-3SD-0 | SITE4-3SD-0D | SITE6-3SD-0.0 | SITE6-3SD-0 |
| Matrix | | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment |
| Depth (ft) | | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 |
| Sample Date | | 8/28/2007 | 10/15/2007 | 8/28/2007 | 10/15/2007 | 8/28/2007 | 8/28/2007 | 10/15/2007 | 10/15/2007 | 8/28/2007 | 10/15/2007 |
| Comments | | | | | | | Field Duplicate | | Field Duplicate | | |
| X Coordinate | | 1703535.46 | 1703535.46 | 1703637.49 | 1703637.49 | 1703559.47 | 1703559.47 | 1703559.47 | 1703559.47 | 1702954.99 | 1702954.99 |
| Y Coordinate | | 732009.62 | 732009.62 | 731536.25 | 731536.25 | 731303.98 | 731303.98 | 731303.98 | 731303.98 | 729610.53 | 729610.53 |
| ***Analyte*** | ***Units*** | | | | | | | | | | |
| 1,4-Dioxane | UG/KG | 110 UJ | | 310 UJ | | 150 UJ | 190 U | | | 350 U | |
| Pentachloroethane | UG/KG | 23 UJ | | 63 UJ | | 31 UJ | 39 U | | | 72 U | |
| Acenaphthene | UG/KG | 6.7 UJ | 69 | 18 R | 16 U | 120 J | 11 UJ | 380 J | 100 J | 21 UJ | 7.7 J |
| Acenaphthylene | UG/KG | 6.2 UJ | 35 | 17 R | 30 U | 110 J | 10 UJ | 340 J | 30 UJ | 19 UJ | 6.4 U |
| Acetophenone | UG/KG | 47 UJ | | 130 UJ | | 62 UJ | 78 U | | | 140 U | |
| 2-Acetylaminofluorene | UG/KG | 620 UJ | | 1700 R | | 820 R | 1000 UJ | | | 1900 UJ | |
| 4-Aminobiphenyl | UG/KG | 500 UJ | | 1400 R | | 660 R | 840 UJ | | | 1600 UJ | |
| Aniline | UG/KG | 78 UJ | | 210 UJ | | 100 UJ | 130 U | | | 240 U | |
| Anthracene | UG/KG | 6.7 UJ | 230 | 18 R | 39 J | 540 J | 11 UJ | 1100 J | 100 J | 21 UJ | 29 |
| C1-Anthracenes/Phenanthrenes | UG/KG | | 850 | | 170 | | | 8100 J | 1200 J | | 83 |
| C2-Anthracenes/Phenanthrenes | UG/KG | | 1400 | | 250 | | | 19000 J | 3100 J | | 190 |
| C3-Anthracenes/Phenanthrenes | UG/KG | | 1600 | | 280 | | | 23000 J | 4100 J | | 200 |
| C4-Anthracenes/Phenanthrenes | UG/KG | | 990 | | 23 U | | | 12000 J | 2500 J | | 100 |
| Aramite (total) | UG/KG | 25 UJ | | 67 R | | 33 R | 41 UJ | | | 77 UJ | |
| Benzo(a)anthracene | UG/KG | 4.9 UJ | 560 | 13 R | 88 | 1800 J | 640 J | 2200 J | 190 J | 15 UJ | 140 |
| C1-Benzo(a)anthracene/Chrysene | UG/KG | | 810 | | 310 | | | 3600 J | 1100 J | | 120 |
| C2-Benzo(a)anthracene/Chrysene | UG/KG | | 840 | | 570 | | | 4100 | 1900 | | 100 |
| C3-Benzo(a)anthracene/Chrysene | UG/KG | | 630 | | 670 | | | 2900 | 1600 | | 93 |
| C4-Benzo(a)anthracene/Chrysene | UG/KG | | 330 | | 490 | | | 1500 | 820 | | 64 |
| Benzo(a)pyrene | UG/KG | 6.7 UJ | 420 | 18 R | 110 | 1600 J | 770 J | 1600 J | 170 J | 610 J | 170 |
| Benzo(b)fluoranthene | UG/KG | 6.2 UJ | 660 | 17 R | 110 | 2100 J | 1100 J | 2400 J | 180 J | 830 J | 290 |
| Benzo(e)pyrene | UG/KG | | 370 | | 240 | | | 1400 J | 190 J | | 180 |
| Benzo(g,h,i)perylene | UG/KG | 6.7 UJ | 260 | 18 R | 130 | 1200 J | 540 J | 780 J | 99 J | 640 J | 170 |
| Benzo(k)fluoranthene | UG/KG | 8.8 UJ | 250 | 24 R | 40 J | 1300 J | 900 J | 880 J | 74 J | 500 J | 150 |
| Benzyl Alcohol | UG/KG | 720 UJ | | 2000 UJ | | 960 UJ | 1200 U | | | 2200 U | |
| bis(2-Chloroethoxy)methane | UG/KG | 110 UJ | | 310 UJ | | 150 UJ | 190 UJ | | | 350 U | |
| bis(2-Chloroethyl) ether | UG/KG | 10 UJ | | 28 UJ | | 14 UJ | 17 U | | | 32 U | |
| bis(2-Ethylhexyl)phthalate | UG/KG | 93 J | | 250 R | | 420 J | 520 J | | | 570 J | |
| 4-Bromophenyl-phenyl ether | UG/KG | 110 UJ | | 290 R | | 140 R | 180 UJ | | | 340 UJ | |
| 2-sec-Butyl-4,6-dinitrophenol | UG/KG | 570 UJ | | 1500 R | | 750 UJ | 950 UJ | | | 1800 UJ | |
| Butylbenzylphthalate | UG/KG | 98 UJ | | 270 R | | 130 R | 160 UJ | | | 300 UJ | |
| 4-Chloro-3-methylphenol | UG/KG | 110 UJ | | 290 UJ | | 140 UJ | 180 UJ | | | 340 U | |
| 4-Chloroaniline | UG/KG | 88 UJ | | 240 UJ | | 120 UJ | 150 UJ | | | 270 U | |
| p-Chlorobenzilate | UG/KG | 18 UJ | | 48 R | | 23 R | 29 UJ | | | 54 UJ | |
| 2-Chloronaphthalene | UG/KG | 110 UJ | | 310 R | | 150 UJ | 190 UJ | | | 350 UJ | |
| 2-Chlorophenol | UG/KG | 130 UJ | | 360 UJ | | 180 UJ | 220 U | | | 420 U | |
| 4-Chlorophenyl-phenyl ether | UG/KG | 120 UJ | | 340 R | | 160 UJ | 210 UJ | | | 380 UJ | |
| Chrysene | UG/KG | 4.7 J | 660 | 13 R | 160 | 2200 J | 1000 J | 2900 J | 350 J | 940 J | 200 |
| Diallate (total) | UG/KG | 24 UJ | | 65 R | | 31 R | 40 UJ | | | 74 UJ | |
| Dibenz(a,h)anthracene | UG/KG | 6.7 UJ | 75 | 18 R | 37 J | 8.9 R | 11 UJ | 240 J | 35 UJ | 21 UJ | 32 |
| Dibenz(a,j)acridine | UG/KG | | | | | | | | | | |
| Dibenzofuran | UG/KG | 100 UJ | | 280 R | | 140 UJ | 170 UJ | | | 320 UJ | |
| 3,3'-Dichlorobenzidine | UG/KG | 93 UJ | | 250 R | | 120 R | 160 UJ | | | 290 UJ | |
| 2,4-Dichlorophenol | UG/KG | 100 UJ | | 280 UJ | | 140 UJ | 170 UJ | | | 320 U | |
| 2,6-Dichlorophenol | UG/KG | 21 UJ | | 56 UJ | | 27 UJ | 35 UJ | | | 64 U | |
| Diethylphthalate | UG/KG | 98 UJ | | 270 R | | 130 UJ | 160 UJ | | | 300 UJ | |
| Dimethoate | UG/KG | 670 UJ | | 1800 R | | 890 R | 1100 UJ | | | 2100 UJ | |
| p-(Dimethylamino)azobenzene | UG/KG | 18 UJ | | 48 R | | 23 R | 29 UJ | | | 54 UJ | |
| 7,12-Dimethylbenz(a)anthracene | UG/KG | 620 UJ | | 1700 R | | 820 R | 1000 UJ | | | 1900 UJ | |
| 3,3'-Dimethylbenzidine | UG/KG | 330 UJ | | 880 R | | 430 R | 540 UJ | | | 1000 UJ | |
| a,a-Dimethylphenethylamine | UG/KG | 570 UJ | | 1500 UJ | | 750 UJ | 950 UJ | | | 1800 U | |

# TABLE A-12
## Sediment Sampling for Otter Creek
## ESOI Otter Creek Facility, Oregon, Ohio

| AOI | | IU C | IU C | IU C | IU C | IU C | IU C | IU C | IU C | IU C | IU C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | SITE 1 | SITE 1 | SITE 3 | SITE 3 | SITE 4 | SITE 4 | SITE 4 | SITE 4 | SITE 6 | SITE 6 |
| ENVIRON Sample ID | | SITE1-3SD-0.0 | SITE1-3SD-0 | SITE3-3SD-0.0 | SITE3-3SD-0 | SITE4-3SD-0.0 | SITE4-3SD-0.0D | SITE4-3SD-0 | SITE4-3SD-0D | SITE6-3SD-0.0 | SITE6-3SD-0 |
| Matrix | | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment |
| Depth (ft) | | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 |
| Sample Date | | 8/28/2007 | 10/15/2007 | 8/28/2007 | 10/15/2007 | 8/28/2007 | 8/28/2007 | 10/15/2007 | 10/15/2007 | 8/28/2007 | 10/15/2007 |
| Comments | | | | | | | Field Duplicate | | Field Duplicate | | |
| X Coordinate | | 1703535.46 | 1703535.46 | 1703637.49 | 1703637.49 | 1703559.47 | 1703559.47 | 1703559.47 | 1703559.47 | 1702954.99 | 1702954.99 |
| Y Coordinate | | 732009.62 | 732009.62 | 731536.25 | 731536.25 | 731303.98 | 731303.98 | 731303.98 | 731303.98 | 729610.53 | 729610.53 |
| ***Analyte*** | ***Units*** | | | | | | | | | | |
| 2,4-Dimethylphenol | UG/KG | 100 UJ | | 280 UJ | | 140 UJ | 170 UJ | | | 320 U | |
| Dimethylphthalate | UG/KG | 110 UJ | | 290 R | | 140 UJ | 180 UJ | | | 340 UJ | |
| Di-n-butylphthalate | UG/KG | 98 UJ | | 270 R | | 130 R | 160 UJ | | | 300 UJ | |
| 4,6-Dinitro-2-methylphenol | UG/KG | 67 UJ | | 180 R | | 89 R | 110 UJ | | | 210 UJ | |
| 1,3-Dinitrobenzene | UG/KG | 620 UJ | | 1700 R | | 820 UJ | 1000 UJ | | | 1900 UJ | |
| 2,4-Dinitrophenol | UG/KG | 430 UJ | | 1200 R | | 570 UJ | 720 UJ | | | 1300 UJ | |
| 2,4-Dinitrotoluene | UG/KG | 93 UJ | | 250 R | | 120 UJ | 160 UJ | | | 290 UJ | |
| 2,6-Dinitrotoluene | UG/KG | 110 UJ | | 290 R | | 140 UJ | 180 UJ | | | 340 UJ | |
| Di-n-octylphthalate | UG/KG | 93 UJ | | 250 R | | 120 R | 160 UJ | | | 290 UJ | |
| Diphenylamine | UG/KG | 110 UJ | | 290 R | | 140 R | 180 UJ | | | 340 UJ | |
| Disulfoton | UG/KG | 21 UJ | | 58 R | | 28 R | 35 UJ | | | 66 UJ | |
| Ethylmethanesulfonate | UG/KG | 21 UJ | | 56 UJ | | 27 UJ | 35 U | | | 64 U | |
| Famphur | UG/KG | 24 UJ | | 65 R | | 31 R | 40 UJ | | | 74 UJ | |
| Fluoranthene | UG/KG | 190 J | 970 | 420 J | 110 | 4400 J | 1800 J | 4700 J | 240 J | 1300 J | 340 |
| C1-Fluoranthenes/Pyrenes | UG/KG | | 990 | | 320 | | | 5500 J | 1400 J | | 140 |
| Fluorene | UG/KG | 6.2 UJ | 130 | 17 R | 24 U | 190 J | 10 UJ | 1500 J | 220 J | 19 UJ | 13 |
| C1-Fluorenes | UG/KG | | 280 | | 62 | | | 4200 J | 590 J | | 23 |
| C2-Fluorenes | UG/KG | | 430 | | 24 U | | | 11000 J | 1100 J | | 28 |
| C3-Fluorenes | UG/KG | | 2.6 U | | 24 U | | | 12000 J | 1800 J | | 69 |
| Hexachlorobenzene | UG/KG | 11 UJ | | 29 R | | 14 R | 18 UJ | | | 34 UJ | |
| Hexachlorobutadiene | UG/KG | 130 UJ | | 360 UJ | | 180 UJ | 220 UJ | | | 420 U | |
| Hexachlorocyclopentadiene | UG/KG | 83 UJ | | 220 R | | 110 UJ | 140 UJ | | | 260 UJ | |
| Hexachloroethane | UG/KG | 140 UJ | | 390 UJ | | 190 UJ | 240 U | | | 450 U | |
| Hexachlorophene | UG/KG | | | | | | | | | | |
| Hexachloropropene | UG/KG | 24 UJ | | 65 UJ | | 31 UJ | 40 UJ | | | 74 U | |
| Indeno(1,2,3-cd)pyrene | UG/KG | 7.5 UJ | 220 | 21 R | 99 | 970 J | 540 J | 700 J | 70 J | 520 J | 140 |
| Isodrin | UG/KG | 33 UJ | | 90 R | | 44 R | 55 UJ | | | 100 UJ | |
| Isophorone | UG/KG | 110 UJ | | 290 UJ | | 140 UJ | 180 UJ | | | 340 U | |
| Isosafrole (total) | UG/KG | 20 UJ | | 55 R | | 27 UJ | 34 UJ | | | 62 UJ | |
| Kepone | UG/KG | | | | | | | | | | |
| Methapyrilene | UG/KG | 620 UJ | | 1700 R | | 820 R | 1000 UJ | | | 1900 UJ | |
| Methyl parathion | UG/KG | 670 UJ | | 1800 R | | 890 R | 1100 UJ | | | 2100 UJ | |
| 3-Methylcholanthrene | UG/KG | 620 UJ | | 1700 R | | 820 R | 1000 UJ | | | 1900 UJ | |
| Methylmethanesulfonate | UG/KG | 21 UJ | | 58 UJ | | 28 UJ | 35 U | | | 66 U | |
| 1-Methylnaphthalene | UG/KG | | 350 | | 67 | | | 910 J | 190 J | | 14 |
| 2-Methylnaphthalene | UG/KG | 7.8 UJ | 490 | 21 UJ | 100 | 10 UJ | 13 UJ | 1200 J | 180 J | 24 U | 21 |
| 2-Methylphenol | UG/KG | 140 UJ | | 390 UJ | | 190 UJ | 240 U | | | 450 U | |
| 3-Methylphenol | UG/KG | 22 UJ | | 60 UJ | | 29 UJ | 37 U | | | 69 U | |
| 4-Methylphenol | UG/KG | 110 UJ | | 310 UJ | | 150 UJ | 190 U | | | 350 U | |
| Naphthalene | UG/KG | 8.3 UJ | 300 | 22 UJ | 68 | 11 UJ | 14 UJ | 810 J | 140 J | 26 U | 14 |
| C2-Naphthalenes | UG/KG | | 1200 | | 190 | | | 6200 J | 1300 J | | 62 |
| C3-Naphthalenes | UG/KG | | 1400 | | 230 | | | 18000 J | 3300 J | | 91 |
| C4-Naphthalenes | UG/KG | | 1100 | | 240 | | | 25000 J | 3000 J | | 100 |
| 1,4-Naphthoquinone | UG/KG | 570 UJ | | 1500 R | | 750 UJ | 950 UJ | | | 1800 UJ | |
| 1-Naphthylamine | UG/KG | 19 UJ | | 50 R | | 25 UJ | 31 UJ | | | 58 UJ | |
| 2-Naphthylamine | UG/KG | 19 UJ | | 52 R | | 25 UJ | 32 UJ | | | 59 UJ | |
| 2-Nitroaniline | UG/KG | 110 UJ | | 310 R | | 150 UJ | 190 UJ | | | 350 UJ | |
| 3-Nitroaniline | UG/KG | 83 UJ | | 220 R | | 110 UJ | 140 UJ | | | 260 UJ | |
| 4-Nitroaniline | UG/KG | 130 UJ | | 360 R | | 180 UJ | 220 UJ | | | 420 UJ | |
| Nitrobenzene | UG/KG | 11 UJ | | 31 UJ | | 15 UJ | 19 UJ | | | 35 U | |
| 2-Nitrophenol | UG/KG | 98 UJ | | 270 UJ | | 130 UJ | 160 UJ | | | 300 U | |

# TABLE A-12
## Sediment Sampling for Otter Creek
## ESOI Otter Creek Facility, Oregon, Ohio

| AOI | | IU C | IU C | IU C | IU C | IU C | IU C | IU C | IU C | IU C | IU C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | SITE 1 | SITE 1 | SITE 3 | SITE 3 | SITE 4 | SITE 4 | SITE 4 | SITE 4 | SITE 6 | SITE 6 |
| ENVIRON Sample ID | | SITE1-3SD-0.0 | SITE1-3SD-0 | SITE3-3SD-0.0 | SITE3-3SD-0 | SITE4-3SD-0.0 | SITE4-3SD-0.0D | SITE4-3SD-0 | SITE4-3SD-0D | SITE6-3SD-0.0 | SITE6-3SD-0 |
| Matrix | | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment | Sediment |
| Depth (ft) | | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 | 0-0.5 |
| Sample Date | | 8/28/2007 | 10/15/2007 | 8/28/2007 | 10/15/2007 | 8/28/2007 | 8/28/2007 | 10/15/2007 | 10/15/2007 | 8/28/2007 | 10/15/2007 |
| Comments | | | | | | | Field Duplicate | | Field Duplicate | | |
| X Coordinate | | 1703535.46 | 1703535.46 | 1703637.49 | 1703637.49 | 1703559.47 | 1703559.47 | 1703559.47 | 1703559.47 | 1702954.99 | 1702954.99 |
| Y Coordinate | | 732009.62 | 732009.62 | 731536.25 | 731536.25 | 731303.98 | 731303.98 | 731303.98 | 731303.98 | 729610.53 | 729610.53 |
| ***Analyte*** | ***Units*** | | | | | | | | | | |
| 4-Nitrophenol | UG/KG | 570 UJ | | 1500 R | | 750 UJ | 950 UJ | | | 1800 UJ | |
| 4-Nitroquinoline-1-oxide | UG/KG | 440 UJ | | 1200 R | | 580 R | 730 UJ | | | 1400 UJ | |
| N-Nitrosodi-n-butylamine | UG/KG | 39 UJ | | 110 UJ | | 51 UJ | 65 UJ | | | 120 U | |
| N-Nitrosodiethylamine | UG/KG | 22 UJ | | 60 UJ | | 29 UJ | 37 U | | | 69 U | |
| N-Nitrosodimethylamine | UG/KG | 83 UJ | | 220 UJ | | 110 UJ | 140 U | | | 260 U | |
| N-Nitrosodiphenylamine | UG/KG | 110 UJ | | 290 R | | 140 R | 180 UJ | | | 340 UJ | |
| N-Nitroso-di-n-propylamine | UG/KG | 120 UJ | | 320 UJ | | 160 UJ | 200 U | | | 370 U | |
| N-Nitrosomethylethylamine | UG/KG | 27 UJ | | 73 UJ | | 36 UJ | 45 U | | | 83 U | |
| N-Nitrosopiperidine | UG/KG | 570 UJ | | 1500 UJ | | 750 UJ | 950 UJ | | | 1800 U | |
| N-Nitrosopyrrolidine | UG/KG | 20 UJ | | 55 UJ | | 27 UJ | 34 U | | | 62 U | |
| 5-Nitro-o-toluidine | UG/KG | 24 UJ | | 65 R | | 31 UJ | 40 UJ | | | 74 UJ | |
| N-Nitrosomorpholine | UG/KG | | | | | | | | | | |
| 2,2'-oxybis(1-Chloropropane) | UG/KG | 130 UJ | | 360 R | | 180 UJ | 220 UJ | | | 420 UJ | |
| Parathion | UG/KG | 620 UJ | | 1700 R | | 820 R | 1000 UJ | | | 1900 UJ | |
| Pentachlorobenzene | UG/KG | 28 UJ | | 76 R | | 37 UJ | 47 UJ | | | 86 UJ | |
| Pentachloronitrobenzene | UG/KG | 31 UJ | | 84 R | | 41 R | 52 UJ | | | 96 UJ | |
| Pentachlorophenol | UG/KG | 420 UJ | | 1200 R | | 560 UJ | 710 UJ | | | 1300 UJ | |
| Perylene | UG/KG | | 130 | | 33 J | | | 450 J | 62 J | | 74 |
| Phenacetin | UG/KG | 35 UJ | | 94 R | | 46 R | 58 UJ | | | 110 UJ | |
| Phenanthrene | UG/KG | 110 J | 890 | 500 J | 110 | 2200 J | 610 J | 6200 J | 310 J | 490 J | 150 |
| Phenol | UG/KG | 130 UJ | | 350 UJ | | 170 UJ | 220 U | | | 400 U | |
| p-Phenylene diamine | UG/KG | 320 UJ | | 860 UJ | | 420 UJ | 530 UJ | | | 980 U | |
| Phorate | UG/KG | 30 UJ | | 83 R | | 40 R | 51 UJ | | | 94 UJ | |
| 2-Picoline | UG/KG | 25 UJ | | 69 UJ | | 34 UJ | 42 U | | | 78 U | |
| Pronamide | UG/KG | 25 UJ | | 67 R | | 33 R | 41 UJ | | | 77 UJ | |
| Pyrene | UG/KG | 220 J | 1100 | 430 | 190 | 3600 J | 1500 J | 4400 J | 460 J | 1300 J | 310 |
| Pyridine | UG/KG | 88 UJ | | 240 | | 120 UJ | 150 U | | | 270 U | |
| Safrole (total) | UG/KG | 22 UJ | | 60 | | 29 UJ | 37 UJ | | | 69 U | |
| Sulfotepp | UG/KG | 24 UJ | | 65 R | | 31 UJ | 40 UJ | | | 74 UJ | |
| 1,2,4,5-Tetrachlorobenzene | UG/KG | 27 UJ | | 74 R | | 36 UJ | 46 UJ | | | 85 UJ | |
| 2,3,4,6-Tetrachlorophenol | UG/KG | 570 UJ | | 1500 R | | 750 UJ | 950 UJ | | | 1800 UJ | |
| Thionazin | UG/KG | 34 UJ | | 91 R | | 44 UJ | 56 UJ | | | 100 UJ | |
| o-Toluidine | UG/KG | 25 UJ | | 69 UJ | | 34 UJ | 42 U | | | 78 U | |
| 2,4,5-Trichlorophenol | UG/KG | 130 UJ | | 350 R | | 170 UJ | 220 UJ | | | 400 UJ | |
| 2,4,6-Trichlorophenol | UG/KG | 110 UJ | | 290 R | | 140 UJ | 180 UJ | | | 340 UJ | |
| O,O,O-Triethyl phosphorothioate | UG/KG | 28 UJ | | 77 UJ | | 38 UJ | 48 UJ | | | 88 U | |
| 1,3,5-Trinitrobenzene | UG/KG | 520 UJ | | 1400 R | | 680 R | 860 UJ | | | 1600 UJ | |
| Organic Carbon (total) | UG/KG | 4100000 | 20000 J | 15000000 | 150000 J | 31000000 | 25000000 | 23000 J | 200000 J | 19000000 | 71000 J |
| Solids (total) | PERCENT | 77.4 | 79.6 | 71.3 | 59.2 | 58.5 | 46.3 | 48.9 | 53.6 | 62.6 | 64.7 |

# TABLE A-12
## Sediment Sampling for Otter Creek
## ESOI Otter Creek Facility, Oregon, Ohio

| AOI | | IU C | | IU C | | SWMU 05 | | SWMU 05 | | SWMU 05 | | SWMU 05 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | | SITE 9 | | SITE 9 | | SED-T-20 | | SED-T-20 | | SED-T-20A | | SED-T-20A | |
| ENVIRON Sample ID | | SITE9-3SD-0.0 | | SITE9-3SD-0 | | SEDT-20-2SD-0.0 | | SED-T20-0.0 | | SEDT-20A-2SD-0.0 | | SED-T20A-0.0 | |
| Matrix | | Sediment | | Sediment | | Sediment | | Sediment | | Sediment | | Sediment | |
| Depth (ft) | | 0-0.5 | | 0-0.5 | | 0-0.5 | | 0-0.5 | | 0-0.5 | | 0-0.5 | |
| Sample Date | | 8/28/2007 | | 10/15/2007 | | 8/29/2007 | | 10/15/2007 | | 8/29/2007 | | 10/15/2007 | |
| Comments | | | | | | | | | | | | | |
| X Coordinate | | 1701874.55 | | 1701874.55 | | 1703620.26 | | 1703620.26 | | 1703610.16 | | 1703610.16 | |
| Y Coordinate | | 727347.39 | | 727347.39 | | 731485.89 | | 731485.89 | | 731461.28 | | 731461.28 | |
| ***Analyte*** | ***Units*** | | | | | | | | | | | | |
| 1,4-Dioxane | UG/KG | 140 | UJ | | | 29 | U | | | 27 | U | | |
| Pentachloroethane | UG/KG | 29 | UJ | | | 5.9 | U | | | 5.6 | U | | |
| Acenaphthene | UG/KG | 8.4 | UJ | 75 | | 1.7 | U | 230 | | 1.6 | U | 3.4 | J |
| Acenaphthylene | UG/KG | 7.8 | UJ | 61 | | 1.6 | U | 64 | | 1.5 | U | 4.1 | J |
| Acetophenone | UG/KG | 58 | UJ | | | 12 | U | | | 11 | U | | |
| 2-Acetylaminofluorene | UG/KG | 780 | UJ | | | 160 | U | | | 150 | U | | |
| 4-Aminobiphenyl | UG/KG | 630 | UJ | | | 130 | U | | | 120 | U | | |
| Aniline | UG/KG | 97 | UJ | | | 20 | U | | | 19 | U | | |
| Anthracene | UG/KG | 240 | J | 180 | J | 1.7 | U | 1000 | | 1.6 | U | 10 | |
| C1-Anthracenes/Phenanthrenes | UG/KG | | | 550 | | | | 1100 | | | | 150 | |
| C2-Anthracenes/Phenanthrenes | UG/KG | | | 1100 | | | | 640 | | | | 190 | |
| C3-Anthracenes/Phenanthrenes | UG/KG | | | 1500 | | | | 460 | | | | 170 | |
| C4-Anthracenes/Phenanthrenes | UG/KG | | | 890 | | | | 210 | | | | 100 | |
| Aramite (total) | UG/KG | 31 | UJ | | | 6.3 | U | | | 6 | U | | |
| Benzo(a)anthracene | UG/KG | 1300 | J | 840 | J | 58 | J | 1700 | | 1.2 | U | 16 | |
| C1-Benzo(a)anthracene/Chrysene | UG/KG | | | 780 | | | | 900 | | | | 48 | |
| C2-Benzo(a)anthracene/Chrysene | UG/KG | | | 750 | | | | 400 | | | | 73 | |
| C3-Benzo(a)anthracene/Chrysene | UG/KG | | | 540 | | | | 200 | | | | 50 | |
| C4-Benzo(a)anthracene/Chrysene | UG/KG | | | 310 | | | | 110 | | | | 33 | |
| Benzo(a)pyrene | UG/KG | 1600 | J | 850 | J | 1.7 | U | 1300 | | 1.6 | U | 17 | |
| Benzo(b)fluoranthene | UG/KG | 2700 | J | 1400 | J | 91 | J | 1900 | | 1.5 | U | 23 | |
| Benzo(e)pyrene | UG/KG | | | 740 | J | | | 830 | | | | 19 | |
| Benzo(g,h,i)perylene | UG/KG | 1400 | J | 630 | J | 1.7 | U | 570 | | 1.6 | U | 21 | |
| Benzo(k)fluoranthene | UG/KG | 1800 | J | 550 | J | 2.2 | U | 690 | | 2.1 | U | 9.2 | |
| Benzyl Alcohol | UG/KG | 910 | UJ | | | 190 | U | | | 170 | U | | |
| bis(2-Chloroethoxy)methane | UG/KG | 140 | UJ | | | 29 | U | | | 27 | U | | |
| bis(2-Chloroethyl) ether | UG/KG | 13 | UJ | | | 2.6 | U | | | 2.5 | U | | |
| bis(2-Ethylhexyl)phthalate | UG/KG | 1100 | J | | | 24 | U | | | 22 | U | | |
| 4-Bromophenyl-phenyl ether | UG/KG | 140 | UJ | | | 28 | U | | | 26 | U | | |
| 2-sec-Butyl-4,6-dinitrophenol | UG/KG | 710 | UJ | | | 150 | U | | | 140 | U | | |
| Butylbenzylphthalate | UG/KG | 120 | UJ | | | 25 | U | | | 24 | U | | |
| 4-Chloro-3-methylphenol | UG/KG | 140 | UJ | | | 28 | U | | | 26 | U | | |
| 4-Chloroaniline | UG/KG | 110 | UJ | | | 22 | U | | | 21 | U | | |
| p-Chlorobenzilate | UG/KG | 22 | UJ | | | 4.5 | U | | | 4.2 | U | | |
| 2-Chloronaphthalene | UG/KG | 140 | UJ | | | 29 | U | | | 27 | U | | |
| 2-Chlorophenol | UG/KG | 170 | UJ | | | 34 | U | | | 32 | U | | |
| 4-Chlorophenyl-phenyl ether | UG/KG | 160 | UJ | | | 32 | U | | | 30 | U | | |
| Chrysene | UG/KG | 2300 | J | 1100 | J | 68 | J | 1500 | | 1.1 | U | 39 | |
| Diallate (total) | UG/KG | 30 | UJ | | | 6.1 | U | | | 5.7 | U | | |
| Dibenz(a,h)anthracene | UG/KG | 8.4 | UJ | 160 | J | 1.7 | U | 170 | | 1.6 | U | 3.8 | U |
| Dibenz(a,j)acridine | UG/KG | | | | | | | | | | | | |
| Dibenzofuran | UG/KG | 130 | UJ | | | 26 | U | | | 25 | U | | |
| 3,3'-Dichlorobenzidine | UG/KG | 120 | UJ | | | 24 | U | | | 22 | U | | |
| 2,4-Dichlorophenol | UG/KG | 130 | UJ | | | 26 | U | | | 25 | U | | |
| 2,6-Dichlorophenol | UG/KG | 26 | UJ | | | 5.3 | U | | | 5 | U | | |
| Diethylphthalate | UG/KG | 120 | UJ | | | 25 | U | | | 24 | U | | |
| Dimethoate | UG/KG | 840 | UJ | | | 170 | U | | | 160 | U | | |
| p-(Dimethylamino)azobenzene | UG/KG | 22 | UJ | | | 4.5 | U | | | 4.2 | U | | |
| 7,12-Dimethylbenz(a)anthracene | UG/KG | 780 | UJ | | | 160 | U | | | 150 | U | | |
| 3,3'-Dimethylbenzidine | UG/KG | 410 | R | | | 83 | UJ | | | 79 | UJ | | |
| a,a-Dimethylphenethylamine | UG/KG | 710 | UJ | | | 150 | U | | | 140 | U | | |

# TABLE A-12
## Sediment Sampling for Otter Creek
## ESOI Otter Creek Facility, Oregon, Ohio

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AOI | | IU C | | IU C | | SWMU 05 | | SWMU 05 | | SWMU 05 | | SWMU 05 | |
| LOCATION | | SITE 9 | | SITE 9 | | SED-T-20 | | SED-T-20 | | SED-T-20A | | SED-T-20A | |
| ENVIRON Sample ID | | SITE9-3SD-0.0 | | SITE9-3SD-0 | | SEDT-20-2SD-0.0 | | SED-T20-0.0 | | SEDT-20A-2SD-0.0 | | SED-T20A-0.0 | |
| Matrix | | Sediment | | Sediment | | Sediment | | Sediment | | Sediment | | Sediment | |
| Depth (ft) | | 0-0.5 | | 0-0.5 | | 0-0.5 | | 0-0.5 | | 0-0.5 | | 0-0.5 | |
| Sample Date | | 8/28/2007 | | 10/15/2007 | | 8/29/2007 | | 10/15/2007 | | 8/29/2007 | | 10/15/2007 | |
| Comments | | | | | | | | | | | | | |
| X Coordinate | | 1701874.55 | | 1701874.55 | | 1703620.26 | | 1703620.26 | | 1703610.16 | | 1703610.16 | |
| Y Coordinate | | 727347.39 | | 727347.39 | | 731485.89 | | 731485.89 | | 731461.28 | | 731461.28 | |
| ***Analyte*** | ***Units*** | | | | | | | | | | | | |
| 2,4-Dimethylphenol | UG/KG | 130 | UJ | | | 26 | U | | | 25 | U | | |
| Dimethylphthalate | UG/KG | 140 | UJ | | | 28 | U | | | 26 | U | | |
| Di-n-butylphthalate | UG/KG | 120 | UJ | | | 25 | U | | | 24 | U | | |
| 4,6-Dinitro-2-methylphenol | UG/KG | 84 | R | | | 17 | U | | | 16 | U | | |
| 1,3-Dinitrobenzene | UG/KG | 780 | UJ | | | 160 | U | | | 150 | U | | |
| 2,4-Dinitrophenol | UG/KG | 540 | UJ | | | 110 | U | | | 100 | U | | |
| 2,4-Dinitrotoluene | UG/KG | 120 | UJ | | | 24 | U | | | 22 | U | | |
| 2,6-Dinitrotoluene | UG/KG | 140 | UJ | | | 28 | U | | | 26 | U | | |
| Di-n-octylphthalate | UG/KG | 120 | UJ | | | 24 | U | | | 22 | U | | |
| Diphenylamine | UG/KG | 140 | UJ | | | 28 | U | | | 26 | U | | |
| Disulfoton | UG/KG | 27 | UJ | | | 5.4 | U | | | 5.1 | U | | |
| Ethylmethanesulfonate | UG/KG | 26 | UJ | | | 5.3 | U | | | 5 | U | | |
| Famphur | UG/KG | 30 | UJ | | | 6.1 | UJ | | | 5.7 | UJ | | |
| Fluoranthene | UG/KG | 3800 | J | 2000 | J | 110 | J | 3900 | | 1.5 | U | 34 | |
| C1-Fluoranthenes/Pyrenes | UG/KG | | | 1100 | | | | 1300 | | | | 35 | |
| Fluorene | UG/KG | 89 | J | 100 | | 1.6 | U | 480 | | 1.5 | U | 9.3 | |
| C1-Fluorenes | UG/KG | | | 110 | | | | 190 | | | | 10 | |
| C2-Fluorenes | UG/KG | | | 350 | | | | 190 | | | | 49 | |
| C3-Fluorenes | UG/KG | | | 670 | | | | 210 | | | | 75 | |
| Hexachlorobenzene | UG/KG | 14 | UJ | | | 2.8 | U | | | 2.6 | U | | |
| Hexachlorobutadiene | UG/KG | 170 | UJ | | | 34 | U | | | 32 | U | | |
| Hexachlorocyclopentadiene | UG/KG | 100 | R | | | 21 | U | | | 20 | U | | |
| Hexachloroethane | UG/KG | 180 | UJ | | | 37 | U | | | 35 | U | | |
| Hexachlorophene | UG/KG | | | | | | | | | | | | |
| Hexachloropropene | UG/KG | 30 | UJ | | | 6.1 | U | | | 5.7 | U | | |
| Indeno(1,2,3-cd)pyrene | UG/KG | 1200 | J | 550 | J | 2 | U | 590 | | 1.9 | U | 9.3 | |
| Isodrin | UG/KG | 42 | UJ | | | 8.5 | U | | | 8 | U | | |
| Isophorone | UG/KG | 140 | UJ | | | 28 | U | | | 26 | U | | |
| Isosafrole (total) | UG/KG | 25 | UJ | | | 5.2 | U | | | 4.9 | U | | |
| Kepone | UG/KG | | | | | | | | | | | | |
| Methapyrilene | UG/KG | 780 | UJ | | | 160 | U | | | 150 | U | | |
| Methyl parathion | UG/KG | 840 | UJ | | | 170 | U | | | 160 | U | | |
| 3-Methylcholanthrene | UG/KG | 780 | UJ | | | 160 | U | | | 150 | U | | |
| Methylmethanesulfonate | UG/KG | 27 | UJ | | | 5.4 | U | | | 5.1 | U | | |
| 1-Methylnaphthalene | UG/KG | | | 74 | | | | 69 | | | | 25 | |
| 2-Methylnaphthalene | UG/KG | 9.7 | UJ | 110 | | 2 | U | 91 | | 1.9 | U | 35 | |
| 2-Methylphenol | UG/KG | 180 | UJ | | | 37 | U | | | 35 | U | | |
| 3-Methylphenol | UG/KG | 28 | UJ | | | 5.7 | U | | | 5.4 | U | | |
| 4-Methylphenol | UG/KG | 140 | UJ | | | 29 | U | | | 27 | U | | |
| Naphthalene | UG/KG | 10 | UJ | 85 | | 2.1 | U | 38 | | 2 | U | 16 | |
| C2-Naphthalenes | UG/KG | | | 310 | | | | 290 | | | | 150 | |
| C3-Naphthalenes | UG/KG | | | 600 | | | | 320 | | | | 320 | |
| C4-Naphthalenes | UG/KG | | | 940 | | | | 320 | | | | 380 | |
| 1,4-Naphthoquinone | UG/KG | 710 | UJ | | | 150 | U | | | 140 | U | | |
| 1-Naphthylamine | UG/KG | 23 | UJ | | | 4.8 | U | | | 4.5 | U | | |
| 2-Naphthylamine | UG/KG | 24 | UJ | | | 4.9 | U | | | 4.6 | U | | |
| 2-Nitroaniline | UG/KG | 140 | UJ | | | 29 | U | | | 27 | U | | |
| 3-Nitroaniline | UG/KG | 100 | UJ | | | 21 | U | | | 20 | U | | |
| 4-Nitroaniline | UG/KG | 170 | UJ | | | 34 | U | | | 32 | U | | |
| Nitrobenzene | UG/KG | 14 | UJ | | | 2.9 | U | | | 2.7 | U | | |
| 2-Nitrophenol | UG/KG | 120 | UJ | | | 25 | U | | | 24 | U | | |

**TABLE A-12**
**Sediment Sampling for Otter Creek**
**ESOI Otter Creek Facility, Oregon, Ohio**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AOI | | IU C | | IU C | | SWMU 05 | | SWMU 05 | | SWMU 05 | | SWMU 05 | |
| LOCATION | | SITE 9 | | SITE 9 | | SED-T-20 | | SED-T-20 | | SED-T-20A | | SED-T-20A | |
| ENVIRON Sample ID | | SITE9-3SD-0.0 | | SITE9-3SD-0 | | SEDT-20-2SD-0.0 | | SED-T20-0.0 | | SEDT-20A-2SD-0.0 | | SED-T20A-0.0 | |
| Matrix | | Sediment | | Sediment | | Sediment | | Sediment | | Sediment | | Sediment | |
| Depth (ft) | | 0-0.5 | | 0-0.5 | | 0-0.5 | | 0-0.5 | | 0-0.5 | | 0-0.5 | |
| Sample Date | | 8/28/2007 | | 10/15/2007 | | 8/29/2007 | | 10/15/2007 | | 8/29/2007 | | 10/15/2007 | |
| Comments | | | | | | | | | | | | | |
| X Coordinate | | 1701874.55 | | 1701874.55 | | 1703620.26 | | 1703620.26 | | 1703610.16 | | 1703610.16 | |
| Y Coordinate | | 727347.39 | | 727347.39 | | 731485.89 | | 731485.89 | | 731461.28 | | 731461.28 | |
| ***Analyte*** | ***Units*** | | | | | | | | | | | | |
| 4-Nitrophenol | UG/KG | 710 | UJ | | | 150 | U | | | 140 | U | | |
| 4-Nitroquinoline-1-oxide | UG/KG | 550 | UJ | | | 110 | UJ | | | 110 | UJ | | |
| N-Nitrosodi-n-butylamine | UG/KG | 49 | UJ | | | 9.9 | U | | | 9.4 | U | | |
| N-Nitrosodiethylamine | UG/KG | 28 | UJ | | | 5.7 | U | | | 5.4 | U | | |
| N-Nitrosodimethylamine | UG/KG | 100 | UJ | | | 21 | U | | | 20 | U | | |
| N-Nitrosodiphenylamine | UG/KG | 140 | UJ | | | 28 | U | | | 26 | U | | |
| N-Nitroso-di-n-propylamine | UG/KG | 150 | UJ | | | 30 | U | | | 29 | U | | |
| N-Nitrosomethylethylamine | UG/KG | 34 | UJ | | | 6.9 | U | | | 6.5 | U | | |
| N-Nitrosopiperidine | UG/KG | 710 | UJ | | | 150 | U | | | 140 | U | | |
| N-Nitrosopyrrolidine | UG/KG | 25 | UJ | | | 5.2 | U | | | 4.9 | U | | |
| 5-Nitro-o-toluidine | UG/KG | 30 | UJ | | | 6.1 | U | | | 5.7 | U | | |
| N-Nitrosomorpholine | UG/KG | | | | | | | | | | | | |
| 2,2'-oxybis(1-Chloropropane) | UG/KG | 170 | UJ | | | 34 | U | | | 32 | U | | |
| Parathion | UG/KG | 780 | UJ | | | 160 | U | | | 150 | U | | |
| Pentachlorobenzene | UG/KG | 35 | UJ | | | 7.1 | U | | | 6.7 | U | | |
| Pentachloronitrobenzene | UG/KG | 39 | UJ | | | 7.9 | U | | | 7.5 | U | | |
| Pentachlorophenol | UG/KG | 530 | UJ | | | 110 | U | | | 100 | U | | |
| Perylene | UG/KG | | | 240 | J | | | 310 | | | | 9.3 | |
| Phenacetin | UG/KG | 43 | UJ | | | 8.9 | U | | | 8.4 | U | | |
| Phenanthrene | UG/KG | 1300 | J | 1100 | J | 48 | J | 3400 | | 2.5 | U | 91 | |
| Phenol | UG/KG | 160 | UJ | | | 33 | U | | | 31 | U | | |
| p-Phenylene diamine | UG/KG | 400 | UJ | | | 81 | UJ | | | 76 | UJ | | |
| Phorate | UG/KG | 38 | UJ | | | 7.8 | U | | | 7.4 | U | | |
| 2-Picoline | UG/KG | 32 | UJ | | | 6.5 | U | | | 6.1 | U | | |
| Pronamide | UG/KG | 31 | UJ | | | 6.3 | U | | | 6 | U | | |
| Pyrene | UG/KG | 3400 | J | 1800 | J | 120 | J | 3300 | | 1.4 | U | 33 | |
| Pyridine | UG/KG | 110 | UJ | | | 22 | U | | | 21 | U | | |
| Safrole (total) | UG/KG | 28 | UJ | | | 5.7 | U | | | 5.4 | U | | |
| Sulfotepp | UG/KG | 30 | UJ | | | 6.1 | U | | | 5.7 | U | | |
| 1,2,4,5-Tetrachlorobenzene | UG/KG | 34 | UJ | | | 7 | U | | | 6.6 | U | | |
| 2,3,4,6-Tetrachlorophenol | UG/KG | 710 | UJ | | | 150 | U | | | 140 | U | | |
| Thionazin | UG/KG | 42 | UJ | | | 8.6 | U | | | 8.1 | U | | |
| o-Toluidine | UG/KG | 32 | UJ | | | 6.5 | U | | | 6.1 | U | | |
| 2,4,5-Trichlorophenol | UG/KG | 160 | UJ | | | 33 | U | | | 31 | U | | |
| 2,4,6-Trichlorophenol | UG/KG | 140 | UJ | | | 28 | U | | | 26 | U | | |
| O,O,O-Triethyl phosphorothioate | UG/KG | 36 | UJ | | | 7.3 | U | | | 6.9 | U | | |
| 1,3,5-Trinitrobenzene | UG/KG | 650 | UJ | | | 130 | U | | | 120 | U | | |
| Organic Carbon (total) | UG/KG | 41000000 | | 51000 | J | 11000000 | | 73000 | J | 4100000 | | 54000 | J |
| Solids (total) | PERCENT | 38.5 | | 73 | | 75.6 | | 73.7 | | 80.2 | | 80.7 | |

# APPENDIX B

# COMPARISON OF COPEC CONCENTRATIONS WITH BENTHIC ORGANISM BENCHMARKS

**TABLE B-1. SUMMARY STATISTICS FOR SEDIMENT FROM DUCK CREEK EXPOSURE AREA A**

| Chemical | EPC | Duck Creek Exposure Area A Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Duck Creek Exposure Area A Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 1.32E+02 | 3.30E+01 | 1.10E+01 | **4.00E+00** | **1.20E+01** |
| Barium | 5.26E+02 | | 2.10E+02 | | 2.50E+00 |
| Cadmium | 5.00E+00 | 4.98E+00 | 9.60E-01 | **1.00E+00** | **5.21E+00** |
| Chromium | 8.19E+01 | 1.11E+02 | 5.10E+01 | 7.38E-01 | 1.61E+00 |
| Lead | 4.02E+02 | 1.49E+02 | 4.70E+01 | **2.70E+00** | **8.55E+00** |
| Mercury | 3.70E-01 | 1.06E+00 | 1.20E-01 | 3.49E-01 | **3.08E+00** |
| Selenium | 9.97E+00 | | 1.40E+00 | | **7.12E+00** |
| Zinc | 9.36E+02 | 4.59E+02 | 1.90E+02 | **2.04E+00** | **4.93E+00** |
| | | | | | |
| 4,4'-DDD | 1.36E+02 | 5.42E+02 | 4.28E+01 | 2.51E-01 | **3.18E+00** |
| 4,4'-DDE | 6.22E+01 | 2.46E+02 | 2.77E+01 | 2.53E-01 | **2.24E+00** |
| 4,4'-DDT | 1.91E+01 | 2.75E+02 | 3.65E+01 | 6.95E-02 | 5.23E-01 |
| Heptachlor | 3.92E+00 | 1.40E+02 | 2.17E+01 | 2.79E-02 | 1.81E-01 |
| Heptachlor epoxide | 1.29E+01 | 1.40E+02 | 2.17E+01 | 9.19E-02 | 5.95E-01 |
| | | | | | |
| Total PCBs | 4.82E+02 | 5.93E+03 | 4.00E+03 | 8.13E-02 | 1.20E-01 |
| | | | | | |
| 2-Methlynaphthalene[4] | 5.90E+02 | 4.92E+03 | 3.92E+04 | 1.20E-01 | 1.50E-02 |
| Acenaphthene[5] | NA | 7.41E+03 | 4.31E+04 | NA | NA |
| Acenaphthylene[5] | NA | 7.41E+03 | 3.97E+04 | NA | NA |
| Anthracene | 1.12E+02 | 7.41E+03 | 5.21E+04 | 1.51E-02 | 2.15E-03 |
| Benzo(a)anthracene | 4.66E+02 | 9.21E+03 | 7.38E+04 | 5.06E-02 | 6.32E-03 |
| Benzo(a)pyrene | 3.75E+02 | 1.27E+04 | 8.48E+04 | 2.95E-02 | 4.42E-03 |
| Benzo(b)fluoranthene[6] | 6.10E+02 | 1.27E+04 | 8.59E+04 | 4.79E-02 | 7.10E-03 |
| Benzo(k)fluoranthene[6] | 2.17E+02 | 1.27E+04 | 7.41E+04 | 1.71E-02 | 2.93E-03 |
| Chrysene | 6.97E+02 | 1.13E+04 | 9.85E+04 | 6.16E-02 | 7.07E-03 |
| Dibenzo(a,h)anthracene[6] | 1.49E+02 | 1.27E+04 | 6.20E+04 | 1.17E-02 | 2.40E-03 |
| Fluoranthene | 1.08E+03 | 1.51E+04 | 4.72E+04 | 7.13E-02 | 2.29E-02 |
| Fluorene | 8.59E+01 | 4.70E+03 | 4.72E+04 | 1.83E-02 | 1.82E-03 |
| Indeno(1,2,3-cd)pyrene[6] | 2.35E+02 | 1.27E+04 | 9.78E+04 | 1.85E-02 | 2.40E-03 |
| Naphthalene | 6.94E+02 | 4.92E+03 | 3.38E+04 | 1.41E-01 | 2.05E-02 |
| Phenanthrene | 7.24E+02 | 1.03E+04 | 5.23E+04 | 7.05E-02 | 1.38E-02 |
| Pyrene | 9.84E+02 | 1.33E+04 | 6.12E+04 | 7.38E-02 | 1.61E-02 |
| Total PAH Mixtures | | | | 7.47E-01 | 1.25E-01 |
| | | | | | |
| Total Organic Carbon | 8.77E+04 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
HQ Hazard Quotient
NA Not applicable, no estimate provided because there were fewer than 4 detected results

**TABLE B-2. SUMMARY STATISTICS FOR SEDIMENT FROM DUCK CREEK EXPOSURE AREA B**

| Chemical | EPC | Duck Creek Exposure Area B Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Duck Creek Exposure Area B Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 1.23E+02 | 3.30E+01 | 1.10E+01 | **3.73E+00** | **1.12E+01** |
| Barium | 6.28E+02 | | 2.10E+02 | | **2.99E+00** |
| Cadmium | 4.49E+00 | 4.98E+00 | 9.60E-01 | 9.02E-01 | **4.68E+00** |
| Chromium | 7.62E+01 | 1.11E+02 | 5.10E+01 | 6.86E-01 | **1.49E+00** |
| Lead | 3.60E+02 | 1.49E+02 | 4.70E+01 | **2.42E+00** | **7.66E+00** |
| Mercury | 2.10E-01 | 1.06E+00 | 1.20E-01 | 1.98E-01 | **1.75E+00** |
| Selenium | 9.97E+00 | | 1.40E+00 | | **7.12E+00** |
| Zinc | 7.62E+02 | 4.59E+02 | 1.90E+02 | **1.66E+00** | **4.01E+00** |
| | | | | | |
| 4,4'-DDD | 2.11E+02 | 6.08E+02 | 4.80E+01 | 3.47E-01 | **4.39E+00** |
| 4,4'-DDE | 1.25E+02 | 2.76E+02 | 3.11E+01 | 4.54E-01 | **4.02E+00** |
| 4,4'-DDT | 3.72E+01 | 3.08E+02 | 4.09E+01 | 1.21E-01 | 9.09E-01 |
| Heptachlor | NA | 1.57E+02 | 2.43E+01 | NA | NA |
| Heptachlor epoxide | 1.47E+01 | 1.57E+02 | 2.43E+01 | 9.34E-02 | 6.05E-01 |
| | | | | | |
| Total PCBs | 1.64E+02 | 6.65E+03 | 4.49E+03 | 2.47E-02 | 3.65E-02 |
| | | | | | |
| 2-Methlynaphthalene[4] | 6.08E+02 | 5.52E+03 | 4.39E+04 | 1.10E-01 | 1.39E-02 |
| Acenaphthene[5] | 2.30E+02 | 8.31E+03 | 4.83E+04 | 2.77E-02 | 4.76E-03 |
| Acenaphthylene[5] | NA | 8.31E+03 | 4.45E+04 | NA | NA |
| Anthracene | 3.74E+02 | 8.31E+03 | 5.84E+04 | 4.50E-02 | 6.40E-03 |
| Benzo(a)anthracene | 1.30E+03 | 1.03E+04 | 8.28E+04 | 1.26E-01 | 1.57E-02 |
| Benzo(a)pyrene | 1.05E+03 | 1.43E+04 | 9.52E+04 | 7.36E-02 | 1.10E-02 |
| Benzo(b)fluoranthene[6] | 1.81E+03 | 1.43E+04 | 9.63E+04 | 1.27E-01 | 1.88E-02 |
| Benzo(k)fluoranthene[6] | 6.06E+02 | 1.43E+04 | 8.30E+04 | 4.25E-02 | 7.30E-03 |
| Chrysene | 1.56E+03 | 1.27E+04 | 1.11E+05 | 1.23E-01 | 1.41E-02 |
| Dibenzo(a,h)anthracene[6] | 1.69E+02 | 1.43E+04 | 6.96E+04 | 1.18E-02 | 2.43E-03 |
| Fluoranthene | 2.81E+03 | 1.70E+04 | 5.29E+04 | 1.65E-01 | 5.31E-02 |
| Fluorene | 2.34E+02 | 5.27E+03 | 5.29E+04 | 4.44E-02 | 4.42E-03 |
| Indeno(1,2,3-cd)pyrene[6] | 6.27E+02 | 1.43E+04 | 1.10E+05 | 4.39E-02 | 5.71E-03 |
| Naphthalene | 9.28E+02 | 5.52E+03 | 3.79E+04 | 1.68E-01 | 2.45E-02 |
| Phenanthrene | 1.38E+03 | 1.15E+04 | 5.86E+04 | 1.20E-01 | 2.35E-02 |
| Pyrene | 2.26E+03 | 1.50E+04 | 6.86E+04 | 1.51E-01 | 3.30E-02 |
| Total PAH Mixtures | | | | **1.38E+00** | 2.39E-01 |
| | | | | | |
| Total Organic Carbon | 9.84E+04 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
HQ Hazard Quotient
NA Not applicable, no estimate provided because there were fewer than 4 detected results

TABLE B-3. SUMMARY STATISTICS FOR SEDIMENT FROM DUCK CREEK EXPOSURE AREA C

| Chemical | EPC | Duck Creek Exposure Area C Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Duck Creek Exposure Area C Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 6.51E+01 | 3.30E+01 | 1.10E+01 | **1.97E+00** | **5.92E+00** |
| Barium | 6.51E+02 | | 2.10E+02 | | **3.10E+00** |
| Cadmium | 3.67E+00 | 4.98E+00 | 9.60E-01 | 7.37E-01 | **3.82E+00** |
| Chromium | 7.44E+01 | 1.11E+02 | 5.10E+01 | 6.70E-01 | **1.46E+00** |
| Lead | 3.63E+02 | 1.49E+02 | 4.70E+01 | **2.44E+00** | **7.72E+00** |
| Mercury | 2.10E-01 | 1.06E+00 | 1.20E-01 | 1.98E-01 | **1.75E+00** |
| Selenium | NA | | 1.40E+00 | | NA |
| Zinc | 6.51E+02 | 4.59E+02 | 1.90E+02 | **1.42E+00** | **3.43E+00** |
| | | | | | |
| 4,4'-DDD | 1.76E+02 | 8.67E+02 | 6.85E+01 | 2.03E-01 | **2.57E+00** |
| 4,4'-DDE | 1.36E+02 | 3.93E+02 | 4.44E+01 | 3.46E-01 | **3.07E+00** |
| 4,4'-DDT | 3.72E+01 | 4.39E+02 | 5.84E+01 | 8.47E-02 | 6.37E-01 |
| Heptachlor | NA | 2.25E+02 | 3.47E+01 | NA | NA |
| Heptachlor epoxide | NA | 2.25E+02 | 3.47E+01 | NA | NA |
| | | | | | |
| Total PCBs | NA | 9.49E+03 | 6.40E+03 | NA | NA |
| | | | | | |
| 2-Methlynaphthalene[4] | NA | 7.87E+03 | 6.26E+04 | NA | NA |
| Acenaphthene[5] | NA | 1.19E+04 | 6.89E+04 | NA | NA |
| Acenaphthylene[5] | NA | 1.19E+04 | 6.34E+04 | NA | NA |
| Anthracene | 2.75E+02 | 1.19E+04 | 8.34E+04 | 2.32E-02 | 3.30E-03 |
| Benzo(a)anthracene | 9.18E+02 | 1.47E+04 | 1.18E+05 | 6.23E-02 | 7.78E-03 |
| Benzo(a)pyrene | 8.98E+02 | 2.04E+04 | 1.36E+05 | 4.41E-02 | 6.62E-03 |
| Benzo(b)fluoranthene[6] | 1.48E+03 | 2.04E+04 | 1.37E+05 | 7.27E-02 | 1.08E-02 |
| Benzo(k)fluoranthene[6] | 5.19E+02 | 2.04E+04 | 1.18E+05 | 2.55E-02 | 4.38E-03 |
| Chrysene | 1.24E+03 | 1.81E+04 | 1.58E+05 | 6.85E-02 | 7.87E-03 |
| Dibenzo(a,h)anthracene[6] | 1.36E+02 | 2.04E+04 | 9.92E+04 | 6.68E-03 | 1.37E-03 |
| Fluoranthene | 2.76E+03 | 2.42E+04 | 7.55E+04 | 1.14E-01 | 3.65E-02 |
| Fluorene | 1.36E+02 | 7.52E+03 | 7.55E+04 | 1.81E-02 | 1.80E-03 |
| Indeno(1,2,3-cd)pyrene[6] | 5.47E+02 | 2.04E+04 | 1.57E+05 | 2.69E-02 | 3.50E-03 |
| Naphthalene | NA | 7.87E+03 | 5.40E+04 | NA | NA |
| Phenanthrene | 1.25E+03 | 1.64E+04 | 8.37E+04 | 7.61E-02 | 1.49E-02 |
| Pyrene | 2.00E+03 | 2.13E+04 | 9.78E+04 | 9.37E-02 | 2.04E-02 |
| Total PAH Mixtures | | | | 6.32E-01 | 1.19E-01 |
| | | | | | |
| Total Organic Carbon | 1.40E+05 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.

HQ Hazard Quotient

NA Not applicable, no estimate provided because there were fewer than 4 detected results

**TABLE B-4. SUMMARY STATISTICS FOR SEDIMENT FROM DUCK CREEK EXPOSURE AREA D**

| Chemical | EPC | Duck Creek Exposure Area D Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Duck Creek Exposure Area D Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 1.40E+02 | 3.30E+01 | 1.10E+01 | **4.24E+00** | **1.27E+01** |
| Barium | 2.15E+03 | | 2.10E+02 | | **1.02E+01** |
| Cadmium | 1.61E+01 | 4.98E+00 | 9.60E-01 | **3.23E+00** | **1.68E+01** |
| Chromium | 1.90E+02 | 1.11E+02 | 5.10E+01 | **1.71E+00** | **3.73E+00** |
| Lead | 1.08E+03 | 1.49E+02 | 4.70E+01 | **7.25E+00** | **2.30E+01** |
| Mercury | 6.82E+00 | 1.06E+00 | 1.20E-01 | **6.43E+00** | **5.68E+01** |
| Selenium | 3.04E+01 | | 1.40E+00 | | **2.17E+01** |
| Zinc | 2.28E+03 | 4.59E+02 | 1.90E+02 | **4.97E+00** | **1.20E+01** |
| | | | | | |
| 4,4'-DDD | 3.88E+02 | 6.87E+02 | 5.42E+01 | 5.65E-01 | **7.16E+00** |
| 4,4'-DDE | 2.85E+02 | 3.11E+02 | 3.51E+01 | 9.16E-01 | **8.12E+00** |
| 4,4'-DDT | 4.86E+01 | 3.48E+02 | 4.62E+01 | 1.40E-01 | **1.05E+00** |
| Heptachlor | NA | 1.78E+02 | 2.74E+01 | NA | NA |
| Heptachlor epoxide | NA | 1.78E+02 | 2.74E+01 | NA | NA |
| | | | | | |
| Total PCBs | NA | 7.51E+03 | 5.07E+03 | NA | NA |
| | | | | | |
| 2-Methlynaphthalene[4] | 3.42E+02 | 6.23E+03 | 4.96E+04 | 5.49E-02 | 6.90E-03 |
| Acenaphthene[5] | 3.94E+02 | 9.39E+03 | 5.46E+04 | 4.20E-02 | 7.22E-03 |
| Acenaphthylene[5] | NA | 9.39E+03 | 5.02E+04 | NA | NA |
| Anthracene | 1.54E+03 | 9.39E+03 | 6.60E+04 | 1.64E-01 | 2.33E-02 |
| Benzo(a)anthracene | 5.30E+03 | 1.17E+04 | 9.34E+04 | 4.54E-01 | 5.67E-02 |
| Benzo(a)pyrene | 5.40E+03 | 1.61E+04 | 1.07E+05 | 3.35E-01 | 5.03E-02 |
| Benzo(b)fluoranthene[6] | 7.65E+03 | 1.61E+04 | 1.09E+05 | 4.75E-01 | 7.03E-02 |
| Benzo(k)fluoranthene[6] | 2.63E+03 | 1.61E+04 | 9.38E+04 | 1.63E-01 | 2.80E-02 |
| Chrysene | 5.10E+03 | 1.43E+04 | 1.25E+05 | 3.56E-01 | 4.09E-02 |
| Dibenzo(a,h)anthracene[6] | 6.59E+02 | 1.61E+04 | 7.85E+04 | 4.09E-02 | 8.39E-03 |
| Fluoranthene | 1.08E+04 | 1.92E+04 | 5.98E+04 | 5.63E-01 | 1.81E-01 |
| Fluorene | 6.19E+02 | 5.95E+03 | 5.98E+04 | 1.04E-01 | 1.04E-02 |
| Indeno(1,2,3-cd)pyrene[6] | 2.35E+03 | 1.61E+04 | 1.24E+05 | 1.46E-01 | 1.90E-02 |
| Naphthalene | 2.53E+02 | 6.23E+03 | 4.28E+04 | 4.06E-02 | 5.91E-03 |
| Phenanthrene | 4.31E+03 | 1.30E+04 | 6.62E+04 | 3.32E-01 | 6.51E-02 |
| Pyrene | 8.99E+03 | 1.69E+04 | 7.74E+04 | 5.32E-01 | 1.16E-01 |
| Total PAH Mixtures | | | | **3.80E+00** | 6.89E-01 |
| | | | | | |
| Total Organic Carbon | 1.11E+05 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
HQ Hazard Quotient
NA Not applicable, no estimate provided because there were fewer than 4 detected results

**TABLE B-5. SUMMARY STATISTICS FOR SEDIMENT FROM DUCK CREEK EXPOSURE AREA E**

| Chemical | EPC | Duck Creek Exposure Area E Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Duck Creek Exposure Area E Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 1.24E+02 | 3.30E+01 | 1.10E+01 | **3.76E+00** | **1.13E+01** |
| Barium | 5.14E+02 | | 2.10E+02 | | **2.45E+00** |
| Cadmium | 3.42E+00 | 4.98E+00 | 9.60E-01 | 6.87E-01 | **3.56E+00** |
| Chromium | 1.21E+02 | 1.11E+02 | 5.10E+01 | **1.09E+00** | **2.37E+00** |
| Lead | 3.93E+02 | 1.49E+02 | 4.70E+01 | **2.64E+00** | **8.36E+00** |
| Mercury | 1.13E-01 | 1.06E+00 | 1.20E-01 | 1.07E-01 | 9.42E-01 |
| Selenium | 1.87E+01 | | 1.40E+00 | | **1.34E+01** |
| Zinc | 7.54E+02 | 4.59E+02 | 1.90E+02 | **1.64E+00** | **3.97E+00** |
| | | | | | |
| 4,4'-DDD | 6.57E+01 | 2.69E+02 | 2.12E+01 | 2.45E-01 | **3.10E+00** |
| 4,4'-DDE | 1.99E+01 | 1.22E+02 | 1.37E+01 | 1.64E-01 | **1.45E+00** |
| 4,4'-DDT | 3.13E+00 | 1.36E+02 | 1.81E+01 | 2.30E-02 | 1.73E-01 |
| Heptachlor | NA | 6.95E+01 | 1.07E+01 | NA | NA |
| Heptachlor epoxide | NA | 6.95E+01 | 1.07E+01 | NA | NA |
| | | | | | |
| Total PCBs | 3.87E+02 | 2.94E+03 | 1.98E+03 | 1.32E-01 | 1.95E-01 |
| | | | | | |
| 2-Methlynaphthalene[4] | 1.05E+03 | 2.44E+03 | 1.94E+04 | 4.31E-01 | 5.42E-02 |
| Acenaphthene[5] | 5.85E+03 | 3.67E+03 | 2.13E+04 | **1.59E+00** | 2.74E-01 |
| Acenaphthylene[5] | 8.16E+02 | 3.67E+03 | 1.96E+04 | 2.22E-01 | 4.15E-02 |
| Anthracene | 3.24E+04 | 3.67E+03 | 2.58E+04 | **8.82E+00** | **1.26E+00** |
| Benzo(a)anthracene | 7.10E+04 | 4.56E+03 | 3.65E+04 | **1.56E+01** | **1.94E+00** |
| Benzo(a)pyrene | 8.25E+04 | 6.30E+03 | 4.20E+04 | **1.31E+01** | **1.96E+00** |
| Benzo(b)fluoranthene[6] | 1.00E+05 | 6.30E+03 | 4.25E+04 | **1.59E+01** | **2.35E+00** |
| Benzo(k)fluoranthene[6] | 3.86E+04 | 6.30E+03 | 3.67E+04 | **6.13E+00** | **1.05E+00** |
| Chrysene | 6.86E+04 | 5.61E+03 | 4.88E+04 | **1.22E+01** | **1.41E+00** |
| Dibenzo(a,h)anthracene[6] | 9.74E+03 | 6.30E+03 | 3.07E+04 | **1.55E+00** | 3.17E-01 |
| Fluoranthene | 1.63E+05 | 7.50E+03 | 2.34E+04 | **2.17E+01** | **6.97E+00** |
| Fluorene | 8.72E+03 | 2.33E+03 | 2.34E+04 | **3.74E+00** | 3.73E-01 |
| Indeno(1,2,3-cd)pyrene[6] | 3.29E+04 | 6.30E+03 | 4.84E+04 | **5.22E+00** | 6.79E-01 |
| Naphthalene | 1.93E+03 | 2.44E+03 | 1.67E+04 | 7.92E-01 | 1.15E-01 |
| Phenanthrene | 6.84E+04 | 5.08E+03 | 2.59E+04 | **1.35E+01** | **2.64E+00** |
| Pyrene | 1.50E+05 | 6.60E+03 | 3.03E+04 | **2.27E+01** | **4.95E+00** |
| Total PAH Mixtures | | | | **1.43E+02** | **2.64E+01** |
| | | | | | |
| Total Organic Carbon | 4.35E+04 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
HQ Hazard Quotient
NA Not applicable, no estimate provided because there were fewer than 4 detected results

**TABLEB- 6. SUMMARY STATISTICS FOR SEDIMENT FROM OTTER CREEK EXPOSURE AREA A**

| Chemical | EPC | Otter Creek Exposure Area A Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Otter Creek Exposure Area A Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 3.83E+01 | 3.30E+01 | 1.10E+01 | **1.16E+00** | **3.48E+00** |
| Barium | 3.85E+02 | | 2.10E+02 | | **1.83E+00** |
| Cadmium | 2.41E+00 | 4.98E+00 | 9.60E-01 | 4.84E-01 | **2.51E+00** |
| Chromium | 3.63E+02 | 1.11E+02 | 5.10E+01 | **3.27E+00** | **7.12E+00** |
| Lead | 3.32E+02 | 1.49E+02 | 4.70E+01 | **2.23E+00** | **7.06E+00** |
| Mercury | 3.32E-01 | 1.06E+00 | 1.20E-01 | 3.13E-01 | **2.77E+00** |
| Selenium | NA | | 1.40E+00 | | NA |
| Zinc | 9.92E+02 | 4.59E+02 | 1.90E+02 | **2.16E+00** | **5.22E+00** |
| | | | | | |
| 4,4'-DDD | 2.37E+01 | 3.25E+02 | 2.57E+01 | 7.28E-02 | 9.22E-01 |
| 4,4'-DDE | 1.63E+01 | 1.47E+02 | 1.66E+01 | 1.11E-01 | 9.80E-01 |
| 4,4'-DDT | NA | 1.65E+02 | 2.19E+01 | NA | NA |
| Heptachlor | NA | 8.43E+01 | 1.30E+01 | NA | NA |
| Heptachlor epoxide | NA | 8.43E+01 | 1.30E+01 | NA | NA |
| | | | | | |
| Total PCBs | 4.55E+02 | 3.56E+03 | 2.40E+03 | 1.28E-01 | 1.89E-01 |
| | | | | | |
| 2-Methlynaphthalene[4] | 1.06E+03 | 2.95E+03 | 2.35E+04 | 3.59E-01 | 4.51E-02 |
| Acenaphthene[5] | NA | 4.45E+03 | 2.59E+04 | NA | NA |
| Acenaphthylene[5] | NA | 4.45E+03 | 2.38E+04 | NA | NA |
| Anthracene | 2.96E+02 | 4.45E+03 | 3.13E+04 | 6.65E-02 | 9.46E-03 |
| Benzo(a)anthracene | 9.27E+02 | 5.53E+03 | 4.43E+04 | 1.68E-01 | 2.09E-02 |
| Benzo(a)pyrene | 1.05E+03 | 7.64E+03 | 5.09E+04 | 1.38E-01 | 2.06E-02 |
| Benzo(b)fluoranthene[6] | 2.27E+03 | 7.64E+03 | 5.16E+04 | 2.97E-01 | 4.40E-02 |
| Benzo(k)fluoranthene[6] | 7.26E+02 | 7.64E+03 | 4.44E+04 | 9.51E-02 | 1.63E-02 |
| Chrysene | 2.03E+03 | 6.79E+03 | 5.91E+04 | 2.99E-01 | 3.43E-02 |
| Dibenzo(a,h)anthracene[6] | 1.85E+02 | 7.64E+03 | 3.72E+04 | 2.42E-02 | 4.97E-03 |
| Fluoranthene | 2.91E+03 | 9.09E+03 | 2.83E+04 | 3.20E-01 | 1.03E-01 |
| Fluorene | 2.41E+02 | 2.82E+03 | 2.83E+04 | 8.54E-02 | 8.51E-03 |
| Indeno(1,2,3-cd)pyrene[6] | 6.43E+02 | 7.64E+03 | 5.87E+04 | 8.42E-02 | 1.10E-02 |
| Naphthalene | 5.62E+02 | 2.95E+03 | 2.03E+04 | 1.90E-01 | 2.77E-02 |
| Phenanthrene | 1.23E+03 | 6.16E+03 | 3.14E+04 | 2.00E-01 | 3.92E-02 |
| Pyrene | 2.37E+03 | 8.00E+03 | 3.67E+04 | 2.96E-01 | 6.46E-02 |
| Total PAH Mixtures | | | | **2.62E+00** | 4.49E-01 |
| | | | | | |
| Total Organic Carbon | 5.27E+04 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
HQ Hazard Quotient
NA Not applicable, no estimate provided because there were fewer than 4 detected results

**TABLE B- 7. SUMMARY STATISTICS FOR SEDIMENT FROM OTTER CREEK EXPOSURE AREA B**

| Chemical | EPC | Otter Creek Exposure Area B Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Otter Creek Exposure Area B Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 4.71E+01 | 3.30E+01 | 1.10E+01 | **1.43E+00** | **4.28E+00** |
| Barium | 2.53E+02 | | 2.10E+02 | | **1.20E+00** |
| Cadmium | 2.22E+00 | 4.98E+00 | 9.60E-01 | 4.46E-01 | **2.31E+00** |
| Chromium | 1.91E+02 | 1.11E+02 | 5.10E+01 | **1.72E+00** | **3.75E+00** |
| Lead | 3.05E+02 | 1.49E+02 | 4.70E+01 | **2.05E+00** | **6.49E+00** |
| Mercury | 3.22E-01 | 1.06E+00 | 1.20E-01 | 3.04E-01 | **2.68E+00** |
| Selenium | NA | | 1.40E+00 | | NA |
| Zinc | 1.04E+03 | 4.59E+02 | 1.90E+02 | **2.27E+00** | **5.47E+00** |
| | | | | | |
| 4,4'-DDD | 1.72E+01 | 3.48E+02 | 2.75E+01 | 4.95E-02 | 6.26E-01 |
| 4,4'-DDE | 1.02E+01 | 1.58E+02 | 1.78E+01 | 6.48E-02 | 5.74E-01 |
| 4,4'-DDT | NA | 1.76E+02 | 2.34E+01 | NA | NA |
| Heptachlor | NA | 9.00E+01 | 1.39E+01 | NA | NA |
| Heptachlor epoxide | NA | 9.00E+01 | 1.39E+01 | NA | NA |
| | | | | | |
| Total PCBs | 2.47E+02 | 3.80E+03 | 2.57E+03 | 6.49E-02 | 9.63E-02 |
| | | | | | |
| 2-Methlynaphthalene[4] | 3.51E+02 | 3.16E+03 | 2.51E+04 | 1.11E-01 | 1.40E-02 |
| Acenaphthene[5] | 1.33E+03 | 4.75E+03 | 2.76E+04 | 2.80E-01 | 4.81E-02 |
| Acenaphthylene[5] | NA | 4.75E+03 | 2.54E+04 | NA | NA |
| Anthracene | 3.80E+03 | 4.75E+03 | 3.34E+04 | 7.99E-01 | 1.14E-01 |
| Benzo(a)anthracene | 1.09E+04 | 5.91E+03 | 4.73E+04 | **1.85E+00** | 2.30E-01 |
| Benzo(a)pyrene | 7.86E+03 | 8.16E+03 | 5.44E+04 | 9.64E-01 | 1.44E-01 |
| Benzo(b)fluoranthene[6] | 1.40E+04 | 8.16E+03 | 5.51E+04 | **1.72E+00** | 2.54E-01 |
| Benzo(k)fluoranthene[6] | 3.63E+03 | 8.16E+03 | 4.75E+04 | 4.45E-01 | 7.64E-02 |
| Chrysene | 1.24E+04 | 7.26E+03 | 6.32E+04 | **1.71E+00** | 1.96E-01 |
| Dibenzo(a,h)anthracene[6] | 9.51E+02 | 8.16E+03 | 3.98E+04 | 1.17E-01 | 2.39E-02 |
| Fluoranthene | 1.80E+04 | 9.71E+03 | 3.03E+04 | **1.85E+00** | 5.95E-01 |
| Fluorene | 1.50E+03 | 3.02E+03 | 3.03E+04 | 4.97E-01 | 4.96E-02 |
| Indeno(1,2,3-cd)pyrene[6] | 2.11E+03 | 8.16E+03 | 6.27E+04 | 2.59E-01 | 3.36E-02 |
| Naphthalene | 3.11E+02 | 3.16E+03 | 2.17E+04 | 9.85E-02 | 1.44E-02 |
| Phenanthrene | 1.31E+04 | 6.58E+03 | 3.35E+04 | **1.99E+00** | 3.91E-01 |
| Pyrene | 1.74E+04 | 8.55E+03 | 3.92E+04 | **2.03E+00** | 4.44E-01 |
| Total PAH Mixtures | | | | **1.47E+01** | **2.63E+00** |
| | | | | | |
| Total Organic Carbon | 5.63E+04 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
HQ Hazard Quotient
NA Not applicable, no estimate provided because there were fewer than 4 detected results

**TABLE B-8. SUMMARY STATISTICS FOR SEDIMENT FROM OTTER CREEK EXPOSURE AREA C**

| Chemical | EPC | Otter Creek Exposure Area C Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Otter Creek Exposure Area C Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 6.30E+01 | 3.30E+01 | 1.10E+01 | **1.91E+00** | **5.73E+00** |
| Barium | 2.80E+02 | | 2.10E+02 | | **1.33E+00** |
| Cadmium | 1.93E+00 | 4.98E+00 | 9.60E-01 | 3.88E-01 | **2.01E+00** |
| Chromium | 3.01E+02 | 1.11E+02 | 5.10E+01 | **2.71E+00** | **5.90E+00** |
| Lead | 3.04E+02 | 1.49E+02 | 4.70E+01 | **2.04E+00** | **6.47E+00** |
| Mercury | 4.26E-01 | 1.06E+00 | 1.20E-01 | 4.02E-01 | **3.55E+00** |
| Selenium | 3.29E+00 | | 1.40E+00 | | **2.35E+00** |
| Zinc | 5.15E+02 | 4.59E+02 | 1.90E+02 | **1.12E+00** | **2.71E+00** |
| | | | | | |
| 4,4'-DDD | 1.87E+01 | 2.70E+02 | 2.13E+01 | 6.94E-02 | 8.79E-01 |
| 4,4'-DDE | 9.95E+00 | 1.22E+02 | 1.38E+01 | 8.15E-02 | 7.22E-01 |
| 4,4'-DDT | NA | 1.37E+02 | 1.81E+01 | NA | NA |
| Heptachlor | NA | 6.98E+01 | 1.08E+01 | NA | NA |
| Heptachlor epoxide | NA | 6.98E+01 | 1.08E+01 | NA | NA |
| | | | | | |
| Total PCBs | 1.13E+04 | 2.95E+03 | 1.99E+03 | **3.83E+00** | **5.68E+00** |
| | | | | | |
| 2-Methlynaphthalene[4] | 5.11E+02 | 2.45E+03 | 1.95E+04 | 2.09E-01 | 2.63E-02 |
| Acenaphthene[5] | 8.49E+02 | 3.69E+03 | 2.14E+04 | 2.30E-01 | 3.96E-02 |
| Acenaphthylene[5] | 2.35E+02 | 3.69E+03 | 1.97E+04 | 6.38E-02 | 1.19E-02 |
| Anthracene | 2.39E+03 | 3.69E+03 | 2.59E+04 | 6.49E-01 | 9.23E-02 |
| Benzo(a)anthracene | 2.63E+03 | 4.58E+03 | 3.67E+04 | 5.74E-01 | 7.17E-02 |
| Benzo(a)pyrene | 2.67E+03 | 6.32E+03 | 4.22E+04 | 4.22E-01 | 6.33E-02 |
| Benzo(b)fluoranthene[6] | 4.02E+03 | 6.32E+03 | 4.27E+04 | 6.36E-01 | 9.42E-02 |
| Benzo(k)fluoranthene[6] | 1.33E+03 | 6.32E+03 | 3.68E+04 | 2.10E-01 | 3.61E-02 |
| Chrysene | 3.57E+03 | 5.63E+03 | 4.90E+04 | 6.35E-01 | 7.29E-02 |
| Dibenzo(a,h)anthracene[6] | 1.81E+03 | 6.32E+03 | 3.08E+04 | 2.86E-01 | 5.87E-02 |
| Fluoranthene | 6.44E+03 | 7.53E+03 | 2.35E+04 | 8.56E-01 | 2.74E-01 |
| Fluorene | 1.50E+03 | 2.34E+03 | 2.35E+04 | 6.42E-01 | 6.39E-02 |
| Indeno(1,2,3-cd)pyrene[6] | 1.72E+03 | 6.32E+03 | 4.86E+04 | 2.72E-01 | 3.54E-02 |
| Naphthalene | 6.73E+02 | 2.45E+03 | 1.68E+04 | 2.75E-01 | 4.01E-02 |
| Phenanthrene | 1.24E+04 | 5.10E+03 | 2.60E+04 | **2.43E+00** | 4.77E-01 |
| Pyrene | 1.08E+04 | 6.63E+03 | 3.04E+04 | **1.63E+00** | 3.55E-01 |
| Total PAH Mixtures | | | | **1.00E+01** | **1.81E+00** |
| | | | | | |
| Total Organic Carbon | 4.36E+04 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
HQ Hazard Quotient
NA Not applicable, no estimate provided because there were fewer than 4 detected results

**TABLE B-9. SUMMARY STATISTICS FOR SEDIMENT FROM OTTER CREEK EXPOSURE AREA D**

| Chemical | EPC | Otter Creek Exposure Area D Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Otter Creek Exposure Area D Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 6.57E+01 | 3.30E+01 | 1.10E+01 | **1.99E+00** | **5.97E+00** |
| Barium | 2.52E+02 | | 2.10E+02 | | **1.20E+00** |
| Cadmium | 2.39E+00 | 4.98E+00 | 9.60E-01 | **4.80E-01** | **2.49E+00** |
| Chromium | 1.06E+02 | 1.11E+02 | 5.10E+01 | 9.55E-01 | **2.08E+00** |
| Lead | 3.48E+02 | 1.49E+02 | 4.70E+01 | **2.34E+00** | **7.40E+00** |
| Mercury | 1.50E-01 | 1.06E+00 | 1.20E-01 | 1.42E-01 | **1.25E+00** |
| Selenium | NA | | 1.40E+00 | | NA |
| Zinc | 9.45E+02 | 4.59E+02 | 1.90E+02 | **2.06E+00** | **4.97E+00** |
| | | | | | |
| 4,4'-DDD | 3.58E+01 | 2.28E+02 | 1.80E+01 | 1.57E-01 | **1.99E+00** |
| 4,4'-DDE | 2.09E+01 | 1.03E+02 | 1.17E+01 | 2.02E-01 | **1.79E+00** |
| 4,4'-DDT | NA | 1.15E+02 | 1.53E+01 | NA | NA |
| Heptachlor | NA | 5.90E+01 | 9.11E+00 | NA | NA |
| Heptachlor epoxide | NA | 5.90E+01 | 9.11E+00 | NA | NA |
| | | | | | |
| Total PCBs | 2.27E+02 | 2.49E+03 | 1.68E+03 | 9.11E-02 | 1.35E-01 |
| | | | | | |
| 2-Methlynaphthalene[4] | 1.57E+02 | 2.07E+03 | 1.64E+04 | 7.59E-02 | 9.54E-03 |
| Acenaphthene[5] | 1.63E+03 | 3.12E+03 | 1.81E+04 | 5.23E-01 | 9.00E-02 |
| Acenaphthylene[5] | 2.03E+02 | 3.12E+03 | 1.67E+04 | 6.51E-02 | 1.22E-02 |
| Anthracene | 4.84E+03 | 3.12E+03 | 2.19E+04 | **1.55E+00** | 2.21E-01 |
| Benzo(a)anthracene | 1.84E+04 | 3.87E+03 | 3.10E+04 | **4.75E+00** | 5.93E-01 |
| Benzo(a)pyrene | 2.00E+04 | 5.35E+03 | 3.57E+04 | **3.74E+00** | 5.61E-01 |
| Benzo(b)fluoranthene[6] | 2.47E+04 | 5.35E+03 | 3.61E+04 | **4.62E+00** | 6.84E-01 |
| Benzo(k)fluoranthene[6] | 7.88E+03 | 5.35E+03 | 3.11E+04 | **1.47E+00** | 2.53E-01 |
| Chrysene | 2.29E+04 | 4.76E+03 | 4.14E+04 | **4.81E+00** | 5.53E-01 |
| Dibenzo(a,h)anthracene[6] | 4.53E+03 | 5.35E+03 | 2.61E+04 | 8.47E-01 | 1.74E-01 |
| Fluoranthene | 5.18E+04 | 6.37E+03 | 1.98E+04 | **8.14E+00** | **2.61E+00** |
| Fluorene | 2.39E+03 | 1.98E+03 | 1.98E+04 | **1.21E+00** | 1.20E-01 |
| Indeno(1,2,3-cd)pyrene[6] | 1.77E+04 | 5.35E+03 | 4.11E+04 | **3.31E+00** | 4.30E-01 |
| Naphthalene | 8.24E+02 | 2.07E+03 | 1.42E+04 | 3.98E-01 | 5.80E-02 |
| Phenanthrene | 2.63E+04 | 4.31E+03 | 2.20E+04 | **6.10E+00** | **1.20E+00** |
| Pyrene | 4.48E+04 | 5.61E+03 | 2.57E+04 | **7.99E+00** | **1.74E+00** |
| Total PAH Mixtures | | | | **4.96E+01** | **9.31E+00** |
| | | | | | |
| Total Organic Carbon | 3.69E+04 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
HQ Hazard Quotient
NA Not applicable, no estimate provided because there were fewer than 4 detected results

**TABLE B-10. SUMMARY STATISTICS FOR SEDIMENT FROM OTTER CREEK EXPOSURE AREA E**

| Chemical | EPC | Otter Creek Exposure Area E Benthic Aquatic Life Probable Effect Criteria/Severe Effect Level[1] | Otter Creek Exposure Area E Benthic Aquatic Life Chronic Toxicity Criteria/Lowest Effect Level[2] | Probable Effect Hazard Quotients[3] | Chronic Hazard Quotients[3] |
|---|---|---|---|---|---|
| | | | | | |
| Arsenic | 5.10E+01 | 3.30E+01 | 1.10E+01 | **1.55E+00** | **4.64E+00** |
| Barium | 2.21E+02 | | 2.10E+02 | | **1.05E+00** |
| Cadmium | 2.39E+00 | 4.98E+00 | 9.60E-01 | 4.80E-01 | **2.49E+00** |
| Chromium | 7.61E+01 | 1.11E+02 | 5.10E+01 | 6.86E-01 | **1.49E+00** |
| Lead | 3.48E+02 | 1.49E+02 | 4.70E+01 | **2.34E+00** | **7.40E+00** |
| Mercury | 1.69E-01 | 1.06E+00 | 1.20E-01 | 1.59E-01 | **1.41E+00** |
| Selenium | NA | | 1.40E+00 | | NA |
| Zinc | 5.38E+02 | 4.59E+02 | 1.90E+02 | **1.17E+00** | **2.83E+00** |
| | | | | | |
| 4,4'-DDD | 3.58E+01 | 3.24E+02 | 2.56E+01 | 1.10E-01 | **1.40E+00** |
| 4,4'-DDE | 2.09E+01 | 1.47E+02 | 1.66E+01 | 1.42E-01 | **1.26E+00** |
| 4,4'-DDT | NA | 1.64E+02 | 2.18E+01 | NA | NA |
| Heptachlor | NA | 8.40E+01 | 1.30E+01 | NA | NA |
| Heptachlor epoxide | NA | 8.40E+01 | 1.30E+01 | NA | NA |
| | | | | | |
| Total PCBs | 2.42E+03 | 3.55E+03 | 2.39E+03 | 6.82E-01 | **1.01E+00** |
| | | | | | |
| 2-Methlynaphthalene[4] | 3.25E+02 | 2.94E+03 | 2.34E+04 | 1.10E-01 | 1.39E-02 |
| Acenaphthene[5] | 1.63E+03 | 4.43E+03 | 2.58E+04 | 3.68E-01 | 6.33E-02 |
| Acenaphthylene[5] | NA | 4.43E+03 | 2.37E+04 | NA | NA |
| Anthracene | 4.84E+03 | 4.43E+03 | 3.12E+04 | **1.09E+00** | 1.55E-01 |
| Benzo(a)anthracene | 1.84E+04 | 5.51E+03 | 4.41E+04 | **3.34E+00** | 4.17E-01 |
| Benzo(a)pyrene | 2.00E+04 | 7.61E+03 | 5.07E+04 | **2.63E+00** | 3.94E-01 |
| Benzo(b)fluoranthene[6] | 2.47E+04 | 7.61E+03 | 5.14E+04 | **3.25E+00** | 4.81E-01 |
| Benzo(k)fluoranthene[6] | 7.88E+03 | 7.61E+03 | 4.43E+04 | **1.04E+00** | 1.78E-01 |
| Chrysene | 2.29E+04 | 6.77E+03 | 5.89E+04 | **3.38E+00** | 3.89E-01 |
| Dibenzo(a,h)anthracene[6] | 4.53E+03 | 7.61E+03 | 3.71E+04 | 5.95E-01 | 1.22E-01 |
| Fluoranthene | 5.18E+04 | 9.06E+03 | 2.82E+04 | **5.72E+00** | **1.83E+00** |
| Fluorene | 2.39E+03 | 2.81E+03 | 2.82E+04 | 8.50E-01 | 8.46E-02 |
| Indeno(1,2,3-cd)pyrene[6] | 1.77E+04 | 7.61E+03 | 5.85E+04 | **2.33E+00** | 3.02E-01 |
| Naphthalene | 2.65E+02 | 2.94E+03 | 2.02E+04 | 9.00E-02 | 1.31E-02 |
| Phenanthrene | 2.63E+04 | 6.14E+03 | 3.13E+04 | **4.28E+00** | 8.41E-01 |
| Pyrene | 4.48E+04 | 7.98E+03 | 3.66E+04 | **5.62E+00** | **1.22E+00** |
| Total PAH Mixtures | | | | **3.47E+01** | **6.51E+00** |
| | | | | | |
| Total Organic Carbon | 5.25E+04 | | | | |

Notes: Units are mg/kg for total organic carbon and metals and µg/kg for all other constituents
**Bold** values indicate a hazard quotient greater than 1.

1 MacDonald, D.D., Ingersoll, C.G., and T.A. Berger. 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Arch. Environ. Contam. Toxicol. 39, 20-31.
Criteria values adjusted when appropriate for the site specific mean total organic carbon content for the Duck and Otter Creeks.

2 Metals - Ohio Environmental Protection Agency (OEPA). 2003. "Ecological Risk Assessment: Guidance Document." February.
Pesticides and PCBs - MacDonald and others[1].
PAHs - Environmental Protection Agency (EPA). 2003. "Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures." November.

3 HQs were calculated using the following equation: HQ = EPC/criteria.

4 The Probable Effect Criteria (PEC) for naphthalene was used as a surrogate.

5 The PEC for anthracene was used as a surrogate.

6 The PEC for benzo(a)pyrene was used as a surrogate.

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
HQ Hazard Quotient
NA Not applicable, no estimate provided because there were fewer than 4 detected results

# APPENDIX C

# HAZARD QUOTIENTS USING THE SCREENING CRITERIA FOR LESIONS FOR BOTTOM-DWELLING FISH

TABLE C-1

SUMMARY OF SCREENING FOR LESIONS IN BOTTOM-DWELLING FISH
SEDIMENTS

| Duck Creek Exposure Area | Total PAHs EPC | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|---|
| | | Neoplasm Lesions | FCA lesions | SDN-N Lesions | SDN-MH/NP Lesions | Proliferative Lesions | Any Lesions |
| | | 2800 | 54 | 940 | 930 | 230 | 620 |
| | (ug/kg) | (ug/kg) | (ug/kg) | (ug/kg) | (ug/kg) | (ug/kg) | (ug/kg) |
| A | 119,377 | **42.6** | **2,210.7** | **127.0** | **128.4** | **519.0** | **192.5** |
| B | 15,946 | **5.7** | **295.3** | **17.0** | **17.1** | **69.3** | **25.7** |
| C | 12,159 | **4.3** | **225.2** | **12.9** | **13.1** | **52.9** | **19.6** |
| D | 56,337 | **20.1** | **1,043.3** | **59.9** | **60.6** | **244.9** | **90.9** |
| E | 835,925 | **298.5** | **15,480.1** | **889.3** | **898.8** | **3,634.5** | **1,348.3** |

PAH  Polynuclear aromatic hydrocarbons
RME  Reasonable maximum exposure concentration - 95 percent upper confidence level or maximum concentration
FCA  Foci of celluar alteration
SDN-N  Specific degenerativer/necrotic
SDN-MH/NP  Specific degenerativer/megalocytic hepatosis or nuclear pleomorphism
ug/kg   micrograms per kilogram

Table C-2
Total PAHs Concentration Sediment - DC-A

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | NP | 4 | 5 | 80 | 1 | 1.38E+03 | 1.38E+03 | 1.26E+02 | 5.90E+02 | 4.39E+02 | 9.03E+02 | (3) | 5.90E+02 |
| Anthracene | µg/kg | NA | 2 | 5 | 40 | 3 | 1.27E+03 | 1.38E+03 | 7.60E+01 | 1.12E+02 | NA | NA | (1) | 1.12E+02 |
| Benzo(a)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 2.18E+02 | 5.17E+02 | 3.53E+02 | 4.66E+02 | (2) | 4.66E+02 |
| Benzo(a)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.83E+02 | 4.49E+02 | 2.68E+02 | 3.75E+02 | (2) | 3.75E+02 |
| Benzo(b)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 2.51E+02 | 6.58E+02 | 4.60E+02 | 6.10E+02 | (2) | 6.10E+02 |
| Benzo(k)fluoranthene | µg/kg | NP | 4 | 5 | 80 | 1 | 1.38E+03 | 1.38E+03 | 7.34E+01 | 2.17E+02 | 1.64E+02 | 3.10E+02 | (3) | 2.17E+02 |
| Chrysene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 3.10E+02 | 8.28E+02 | 5.11E+02 | 6.97E+02 | (2) | 6.97E+02 |
| Dibenzo(a,h)anthracene | µg/kg | NA | 3 | 5 | 60 | 2 | 1.27E+03 | 1.38E+03 | 7.07E+01 | 1.49E+02 | NA | NA | (1) | 1.49E+02 |
| Fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 3.07E+02 | 1.08E+03 | 8.11E+02 | 1.40E+03 | (3) | 1.08E+03 |
| Fluorene | µg/kg | NA | 2 | 5 | 40 | 3 | 1.27E+03 | 1.38E+03 | 7.28E+01 | 8.59E+01 | NA | NA | (1) | 8.59E+01 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.03E+02 | 2.61E+02 | 1.74E+02 | 2.35E+02 | (2) | 2.35E+02 |
| Naphthalene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.31E+02 | 6.94E+02 | 4.82E+02 | 9.42E+02 | (3) | 6.94E+02 |
| Phenanthrene | µg/kg | NP | 18 | 19 | 95 | 0 | 2.88E+03 | 2.88E+03 | 6.30E+01 | 6.84E+04 | 4.55E+03 | 2.68E+04 | (5) | 2.68E+04 |
| Pyrene | µg/kg | NP | 19 | 19 | 100 | 0 | N/A | N/A | 1.41E+02 | 1.50E+05 | 9.51E+03 | 8.73E+04 | (4) | 8.73E+04 |
| Total PAHs | | | | | | | | | | | 1.77E+04 | | | 1.19E+05 |

**Notes:**

EPC — Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
NA — Not applicable, no estimate provided because there were fewer than 4 detected results
Max — Maximum result
Min — Minimum result
µg/kg — Micrograms per kilogram
95UCL — One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.

a — Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
Distribution Codes: NP= nonparametric

b — Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data.

c — The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results.

d — All methods follow EPA (2002, 2007).
Method (Statistic) Codes are defined as follows:
(1) Maximum detected result
(2) 95 percent UCL calculated using Student's *t* distribution
(3), (4) 95 or 99 percent UCL, respectively, calculated using the nonparametric Chebyshev method
(5) 97.5 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL

**References**

U.S. Environmental Protection Agency (EPA). 2002. "Calculating exposure point concentrations at hazardous waste sites." OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.
U.S. Environmental Protection Agency (EPA). 2007. "ProUCL Version 4.0 Technical Guide." Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

Table C-3
Total PAHs Concentration Sediment - DC-B

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | NA | 3 | 4 | 75 | 1 | 2.25E+03 | 2.25E+03 | 2.97E+02 | 6.08E+02 | NA | NA | (1) | 6.08E+02 |
| Acenaphthene | µg/kg | NA | 1 | 4 | 25 | 3 | 1.24E+03 | 2.25E+03 | 2.30E+02 | 2.30E+02 | NA | NA | (1) | 2.30E+02 |
| Anthracene | µg/kg | NA | 2 | 4 | 50 | 2 | 1.27E+03 | 2.25E+03 | 2.97E+02 | 3.74E+02 | NA | NA | (1) | 3.74E+02 |
| Benzo (a)anthracene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 3.10E+02 | 1.30E+03 | 8.85E+02 | 1.87E+03 | (3) | 1.30E+03 |
| Benzo(a)pyrene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 2.01E+02 | 1.05E+03 | 7.38E+02 | 1.62E+03 | (3) | 1.05E+03 |
| Benzo(b)fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 4.07E+02 | 1.81E+03 | 1.28E+03 | 2.62E+03 | (3) | 1.81E+03 |
| Benzo(k)fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 1.55E+02 | 6.06E+02 | 4.45E+02 | 9.06E+02 | (3) | 6.06E+02 |
| Chrysene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 4.30E+02 | 1.56E+03 | 1.16E+03 | 2.30E+03 | (3) | 1.56E+03 |
| Dibenz(a,h)anthracene | µg/kg | NA | 2 | 4 | 50 | 2 | 1.27E+03 | 2.25E+03 | 1.63E+02 | 1.69E+02 | NA | NA | (1) | 1.69E+02 |
| Fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 7.71E+02 | 2.81E+03 | 2.18E+03 | 4.24E+03 | (3) | 2.81E+03 |
| Fluorene | µg/kg | NA | 2 | 4 | 50 | 2 | 1.27E+03 | 2.25E+03 | 1.78E+02 | 2.34E+02 | NA | NA | (1) | 2.34E+02 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 1.35E+02 | 6.27E+02 | 4.35E+02 | 8.93E+02 | (3) | 6.27E+02 |
| Naphthalene | µg/kg | NA | 3 | 4 | 75 | 1 | 2.25E+03 | 2.25E+03 | 6.55E+02 | 9.28E+02 | NA | NA | (1) | 9.28E+02 |
| Phenanthrene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 5.14E+02 | 1.38E+03 | 1.10E+03 | 1.57E+03 | (2) | 1.38E+03 |
| Pyrene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 5.93E+02 | 2.26E+03 | 1.72E+03 | 3.43E+03 | (3) | 2.26E+03 |
| Total PAHs | | | | | | | | | | | 9.94E+03 | | | 1.59E+04 |

**Notes:**

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
NA Not applicable, no estimate provided because there were fewer than 4 detected results
Max Maximum result
Min Minimum result
µg/kg Micrograms per kilogram
95UCL One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.

a Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
Distribution Codes: NP= nonparametric

b Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data.

c The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results.

d All methods follow EPA (2002, 2007).
Method (Statistic) Codes are defined as follows:
(1) Maximum detected result
(2) 95 percent UCL calculated using Student's *t* distribution
(3) 95 percent UCL calculated using the nonparametric Chebyshev method

**References**

U.S. Environmental Protection Agency (EPA). 2002. “Calculating exposure point concentrations at hazardous waste sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.
U.S. Environmental Protection Agency (EPA). 2007. “ProUCL Version 4.0 Technical Guide.” Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

Table C-4
Total PAHs Concentration Sediment - DC-C

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| Anthracene | µg/kg | NA | 2 | 3 | 67 | 1 | 2.25E+03 | 2.25E+03 | 2.14E+02 | 2.75E+02 | NA | NA | (1) | 2.75E+02 |
| Benzo (a)anthracene | µg/kg | NA | 3 | 3 | 100 | 0 | NA | NA | 6.35E+02 | 9.18E+02 | NA | NA | (1) | 9.18E+02 |
| Benzo(a)pyrene | µg/kg | NA | 3 | 3 | 100 | 0 | NA | NA | 5.86E+02 | 8.98E+02 | NA | NA | (1) | 8.98E+02 |
| Benzo(b)fluoranthene | µg/kg | NA | 3 | 3 | 100 | 0 | NA | NA | 1.10E+03 | 1.48E+03 | NA | NA | (1) | 1.48E+03 |
| Benzo(k)fluoranthene | µg/kg | NA | 3 | 3 | 100 | 0 | NA | NA | 3.94E+02 | 5.19E+02 | NA | NA | (1) | 5.19E+02 |
| Chrysene | µg/kg | NA | 3 | 3 | 100 | 0 | NA | NA | 9.49E+02 | 1.24E+03 | NA | NA | (1) | 1.24E+03 |
| Dibenz(a,h)anthracene | µg/kg | NA | 2 | 3 | 67 | 1 | 2.25E+03 | 2.25E+03 | 9.07E+01 | 1.36E+02 | NA | NA | (1) | 1.36E+02 |
| Fluoranthene | µg/kg | NA | 3 | 3 | 100 | 0 | NA | NA | 2.23E+03 | 2.76E+03 | NA | NA | (1) | 2.76E+03 |
| Fluorene | µg/kg | NA | 2 | 3 | 67 | 1 | 2.25E+03 | 2.25E+03 | 1.32E+02 | 1.36E+02 | NA | NA | (1) | 1.36E+02 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NA | 3 | 3 | 100 | 0 | NA | NA | 3.96E+02 | 5.47E+02 | NA | NA | (1) | 5.47E+02 |
| Phenanthrene | µg/kg | NA | 3 | 3 | 100 | 0 | NA | NA | 1.10E+03 | 1.25E+03 | NA | NA | (1) | 1.25E+03 |
| Pyrene | µg/kg | NA | 3 | 3 | 100 | 0 | NA | NA | 1.64E+03 | 2.00E+03 | NA | NA | (1) | 2.00E+03 |
| Total PAHs | | | | | | | | | | | NA | | | 1.22E+04 |

**Notes:**

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
NA Not applicable, no estimate provided because there were fewer than 4 detected results
Max Maximum result
Min Minimum result
µg/kg Micrograms per kilogram
95UCL One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.
a Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
Distribution Codes: NP= nonparametric
b Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data.
c The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results.
d All methods follow EPA (2002, 2007).
Method (Statistic) Codes are defined as follows:
(1) Maximum detected result

**References**

U.S. Environmental Protection Agency (EPA). 2002. "Calculating exposure point concentrations at hazardous waste sites." OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

U.S. Environmental Protection Agency (EPA). 2007. "ProUCL Version 4.0 Technical Guide." Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

Table C-5
Total PAHs Concentration Sediment - DC-D

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | NA | 2 | 4 | 50 | 2 | 7.19E+02 | 2.88E+03 | 2.79E+02 | 3.42E+02 | NA | NA | (1) | 3.42E+02 |
| Acenaphthene | µg/kg | NA | 1 | 4 | 25 | 3 | 7.19E+02 | 2.88E+03 | 3.94E+02 | 3.94E+02 | NA | NA | (1) | 3.94E+02 |
| Anthracene | µg/kg | NA | 2 | 4 | 50 | 1 | 1.41E+03 | 2.88E+03 | 2.14E+02 | 1.54E+03 | NA | NA | (1) | 1.54E+03 |
| Benzo (a)anthracene | µg/kg | NA | 3 | 4 | 75 | 0 | 2.88E+03 | 2.88E+03 | 4.59E+02 | 5.30E+03 | NA | NA | (1) | 5.30E+03 |
| Benzo(a)pyrene | µg/kg | NA | 3 | 4 | 75 | 0 | 2.88E+03 | 2.88E+03 | 4.28E+02 | 5.40E+03 | NA | NA | (1) | 5.40E+03 |
| Benzo(b)fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 3.06E+02 | 7.65E+03 | 2.48E+03 | 1.97E+04 | (2) | 7.65E+03 |
| Benzo(k)fluoranthene | µg/kg | NA | 3 | 4 | 75 | 1 | 2.88E+03 | 2.88E+03 | 2.93E+02 | 2.63E+03 | NA | NA | (1) | 2.63E+03 |
| Chrysene | µg/kg | NA | 3 | 4 | 75 | 0 | 2.88E+03 | 2.88E+03 | 6.93E+02 | 5.10E+03 | NA | NA | (1) | 5.10E+03 |
| Dibenz(a,h)anthracene | µg/kg | NA | 2 | 4 | 50 | 2 | 1.41E+03 | 2.88E+03 | 9.07E+01 | 6.59E+02 | NA | NA | (1) | 6.59E+02 |
| Fluoranthene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 4.73E+02 | 1.08E+04 | 3.73E+03 | 2.75E+04 | (2) | 1.08E+04 |
| Fluorene | µg/kg | NA | 3 | 4 | 75 | 1 | 2.88E+03 | 2.88E+03 | 1.32E+02 | 6.19E+02 | NA | NA | (1) | 6.19E+02 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NA | 3 | 4 | 75 | 1 | 2.88E+03 | 2.88E+03 | 2.70E+02 | 2.35E+03 | NA | NA | (1) | 2.35E+03 |
| Naphthalene | µg/kg | NA | 1 | 4 | 25 | 3 | 7.19E+02 | 2.88E+03 | 2.53E+02 | 2.53E+02 | NA | NA | (1) | 2.53E+02 |
| Phenanthrene | µg/kg | NA | 3 | 4 | 75 | 0 | 2.88E+03 | 2.88E+03 | 1.10E+03 | 4.31E+03 | NA | NA | (1) | 4.31E+03 |
| Pyrene | µg/kg | NP | 4 | 4 | 100 | 0 | NA | NA | 3.17E+02 | 8.99E+03 | 3.01E+03 | 2.30E+04 | (2) | 8.99E+03 |
| Total PAHs | | | | | | | | | | | 9.21E+03 | | | 5.63E+04 |

**Notes:**

EPC — Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
NA — Not applicable, no estimate provided because there were fewer than 4 detected results
Max — Maximum result
Min — Minimum result
µg/kg — Micrograms per kilogram
95UCL — One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.

a — Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
Distribution Codes: NP= nonparametric

b — Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data.

c — The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results.

d — All methods follow EPA (2002, 2007).
Method (Statistic) Codes are defined as follows:

(1) Maximum detected result
(2) 99 percent UCL calculated using the nonparametric Chebyshev method

**References**

U.S. Environmental Protection Agency (EPA). 2002. “Calculating exposure point concentrations at hazardous waste sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.
U.S. Environmental Protection Agency (EPA). 2007. “ProUCL Version 4.0 Technical Guide.” Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

Table C-6
Total PAHs Concentration Sediment - DC-E

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | NA | 1 | 6 | 17 | 3 | 5.15E+02 | 1.27E+03 | 1.05E+03 | 1.05E+03 | NA | NA | (1) | 1.05E+03 |
| Acenaphthene | µg/kg | NA | 1 | 6 | 17 | 0 | 5.15E+02 | 1.27E+03 | 5.85E+03 | 5.85E+03 | NA | NA | (1) | 5.85E+03 |
| Acenaphthylene | µg/kg | NA | 1 | 6 | 17 | 3 | 5.15E+02 | 1.27E+03 | 8.16E+02 | 8.16E+02 | NA | NA | (1) | 8.16E+02 |
| Anthracene | µg/kg | NA | 3 | 6 | 50 | 0 | 5.15E+02 | 1.27E+03 | 1.71E+02 | 3.24E+04 | NA | NA | (1) | 3.24E+04 |
| Benzo (a)anthracene | µg/kg | NP | 6 | 6 | 100 | 0 | NA | NA | 7.12E+01 | 8.72E+04 | 1.52E+04 | 7.10E+04 | (3) | 7.10E+04 |
| Benzo(a)pyrene | µg/kg | NP | 6 | 6 | 100 | 0 | NA | NA | 7.12E+01 | 8.25E+04 | 1.44E+04 | 1.50E+05 | (2) | 8.25E+04 |
| Benzo(b)fluoranthene | µg/kg | NP | 6 | 6 | 100 | 0 | NA | NA | 1.05E+02 | 1.07E+05 | 1.89E+04 | 1.00E+05 | (3) | 1.00E+05 |
| Benzo(k)fluoranthene | µg/kg | NP | 5 | 6 | 83 | 0 | 5.15E+02 | 5.15E+02 | 7.17E+01 | 3.86E+04 | 6.80E+03 | 7.14E+04 | (4) | 3.86E+04 |
| Chrysene | µg/kg | NP | 6 | 6 | 100 | 0 | NA | NA | 8.98E+01 | 8.09E+04 | 1.41E+04 | 6.86E+04 | (3) | 6.86E+04 |
| Dibenz(a,h)anthracene | µg/kg | NA | 2 | 6 | 33 | 0 | 5.15E+02 | 1.27E+03 | 2.08E+02 | 9.74E+03 | NA | NA | (1) | 9.74E+03 |
| Fluoranthene | µg/kg | NP | 6 | 6 | 100 | 0 | NA | NA | 1.82E+02 | 1.90E+05 | 3.32E+04 | 1.63E+05 | (3) | 1.63E+05 |
| Fluorene | µg/kg | NA | 1 | 6 | 17 | 0 | 5.15E+02 | 1.27E+03 | 8.72E+03 | 8.72E+03 | NA | NA | (1) | 8.72E+03 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NP | 4 | 6 | 67 | 0 | 5.15E+02 | 5.78E+02 | 4.06E+02 | 3.29E+04 | 5.92E+03 | 6.25E+04 | (4) | 3.29E+04 |
| Naphthalene | µg/kg | NA | 1 | 6 | 17 | 0 | 5.15E+02 | 1.27E+03 | 1.93E+03 | 1.93E+03 | NA | NA | (1) | 1.93E+03 |
| Phenanthrene | µg/kg | NP | 6 | 6 | 100 | 0 | NA | NA | 6.30E+01 | 6.84E+04 | 1.18E+04 | 1.24E+05 | (2) | 6.84E+04 |
| Pyrene | µg/kg | NP | 6 | 6 | 100 | 0 | NA | NA | 1.41E+02 | 1.50E+05 | 2.61E+04 | 2.73E+05 | (2) | 1.50E+05 |
| Total PAHs | | | | | | | | | | | 1.46E+05 | | | 8.36E+05 |

**Notes:**

EPC — Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
NA — Not applicable, no estimate provided because there were fewer than 4 detected results
Max — Maximum result
Min — Minimum result
µg/kg — Micrograms per kilogram
95UCL — One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.

a — Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
<u>Distribution Codes</u>: NP= nonparametric

b — Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data.

c — The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results.

d — All methods follow EPA (2002, 2007).
<u>Method (Statistic) Codes are defined as follows</u>:
(1) Maximum detected result
(2) 99 percent UCL calculated using the nonparametric Chebyshev method
(3) 99 percent UCL calculated using the MVUE Chebyshev method
(4) 99 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL

**References**


U.S. Environmental Protection Agency (EPA). 2002. “Calculating exposure point concentrations at hazardous waste sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

U.S. Environmental Protection Agency (EPA). 2007. “ProUCL Version 4.0 Technical Guide.” Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

TABLE C-7

SUMMARY OF SCREENING FOR LESIONS IN BOTTOM-DWELLING FISH SEDIMENTS

| Otter Creek Exposure Area | Total PAHs EPC | Screening Criteria Values | | | | | |
|---|---|---|---|---|---|---|---|
| | | Neoplasm Lesions | FCA lesions | SDN-N Lesions | SDN-MH/NP Lesions | Proliferative Lesions | Any Lesions |
| | | 2800 | 54 | 940 | 930 | 230 | 620 |
| | (ug/kg) | (ug/kg) | (ug/kg) | (ug/kg) | (ug/kg) | (ug/kg) | (ug/kg) |
| A | 16,500 | **5.9** | **305.5** | **17.6** | **17.7** | **71.7** | **26.6** |
| B | 107,643 | **38.4** | **1,993.4** | **114.5** | **115.7** | **468.0** | **173.6** |
| C | 53,553 | **19.1** | **991.7** | **57.0** | **57.6** | **232.8** | **86.4** |
| D | 249,054 | **88.9** | **4,612.1** | **265.0** | **267.8** | **1,082.8** | **401.7** |
| E | 248,460 | **88.7** | **4,601.1** | **264.3** | **267.2** | **1,080.3** | **400.7** |

PAH Polynuclear aromatic hydrocarbons
RME Reasonable maximum exposure concentration - 95 percent upper confidence level or maximum concentration
FCA Foci of celluar alteration
SDN-N Specific degenerativer/necrotic
SDN-MH/NP Specific degenerativer/megalocytic hepatosis or nuclear pleomorphism
ug/kg micrograms per kilogram

Table C-8
Total PAHs Concentration Sediment - OC-A

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 1.28E+02 | 1.06E+03 | 5.19E+02 | 1.08E+03 | (2) | 1.06E+03 |
| Anthracene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 1.42E+02 | 3.36E+02 | 2.39E+02 | 2.96E+02 | (1) | 2.96E+02 |
| Benzo (a)anthracene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 3.05E+02 | 1.12E+03 | 7.48E+02 | 9.27E+02 | (1) | 9.27E+02 |
| Benzo(a)pyrene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 2.94E+02 | 1.21E+03 | 8.12E+02 | 1.05E+03 | (1) | 1.05E+03 |
| Benzo(b)fluoranthene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 4.27E+02 | 2.27E+03 | 1.42E+03 | 2.55E+03 | (2) | 2.27E+03 |
| Benzo(k)fluoranthene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 1.51E+02 | 7.45E+02 | 3.96E+02 | 7.26E+02 | (2) | 7.26E+02 |
| Chrysene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 5.86E+02 | 2.50E+03 | 1.58E+03 | 2.03E+03 | (1) | 2.03E+03 |
| Dibenz(a,h)anthracene | µg/kg | NP | 6 | 7 | 86 | 1 | 6.28E+02 | 6.28E+02 | 1.07E+02 | 2.19E+02 | 1.52E+02 | 1.85E+02 | (1) | 1.85E+02 |
| Fluoranthene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 6.41E+02 | 2.94E+03 | 1.62E+03 | 2.91E+03 | (2) | 2.91E+03 |
| Fluorene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 1.23E+02 | 3.03E+02 | 1.90E+02 | 2.41E+02 | (1) | 2.41E+02 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 1.11E+02 | 7.11E+02 | 3.35E+02 | 6.43E+02 | (2) | 6.43E+02 |
| Naphthalene | µg/kg | NP | 6 | 7 | 86 | 1 | 6.62E+02 | 6.62E+02 | 1.62E+02 | 5.62E+02 | 3.53E+02 | 6.60E+02 | (2) | 5.62E+02 |
| Phenanthrene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 5.01E+02 | 1.45E+03 | 1.00E+03 | 1.23E+03 | (1) | 1.23E+03 |
| Pyrene | µg/kg | NP | 7 | 7 | 100 | 0 | NA | NA | 1.14E+03 | 2.70E+03 | 1.92E+03 | 2.37E+03 | (1) | 2.37E+03 |
| Total PAHs | | | | | | | | | | | 1.13E+04 | | | 1.65E+04 |

**Notes:**

EPC — Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
NA — Not applicable, no estimate provided because there were fewer than 4 detected results
Max — Maximum result
Min — Minimum result
µg/kg — Micrograms per kilogram
95UCL — One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.

a — Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
Distribution Codes: NP= nonparametric

b — Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data.

c — The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results.

d — All methods follow EPA (2002, 2007).
Method (Statistic) Codes are defined as follows:
(1) 95 percent UCL calculated using Student's *t* distribution
(2) 99 percent UCL calculated using the nonparametric Chebyshev method

**References**

U.S. Environmental Protection Agency (EPA). 2002. “Calculating exposure point concentrations at hazardous waste sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.
U.S. Environmental Protection Agency (EPA). 2007. “ProUCL Version 4.0 Technical Guide.” Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

Table C-9
Total PAHs Concentration Sediment - OC-B

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | NA | 3 | 5 | 60 | 2 | 5.39E+02 | 7.51E+02 | 1.28E+02 | 3.51E+02 | NA | NA | (1) | 3.51E+02 |
| Acenaphthene | µg/kg | NA | 1 | 5 | 20 | 0 | 5.13E+02 | 7.51E+02 | 1.33E+03 | 1.33E+03 | NA | NA | (1) | 1.33E+03 |
| Anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 2.08E+02 | 3.80E+03 | 1.01E+03 | 7.96E+03 | (3) | 3.80E+03 |
| Benzo (a)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 7.19E+02 | 1.09E+04 | 3.05E+03 | 2.27E+04 | (3) | 1.09E+04 |
| Benzo(a)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 7.59E+02 | 7.86E+03 | 2.63E+03 | 8.47E+03 | (2) | 7.86E+03 |
| Benzo(b)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.09E+03 | 1.40E+04 | 4.62E+03 | 2.86E+04 | (3) | 1.40E+04 |
| Benzo(k)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 3.97E+02 | 3.63E+03 | 1.33E+03 | 3.95E+03 | (2) | 3.63E+03 |
| Chrysene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.12E+03 | 1.24E+04 | 3.94E+03 | 1.33E+04 | (2) | 1.24E+04 |
| Dibenz(a,h)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 9.45E+01 | 9.51E+02 | 3.08E+02 | 1.02E+03 | (2) | 9.51E+02 |
| Fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.55E+03 | 1.80E+04 | 6.09E+03 | 1.95E+04 | (2) | 1.80E+04 |
| Fluorene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 7.99E+01 | 1.50E+03 | 4.03E+02 | 3.13E+03 | (3) | 1.50E+03 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 2.99E+02 | 2.11E+03 | 8.46E+02 | 2.30E+03 | (2) | 2.11E+03 |
| Naphthalene | µg/kg | NA | 2 | 5 | 40 | 3 | 5.39E+02 | 7.51E+02 | 1.76E+02 | 3.11E+02 | NA | NA | (1) | 3.11E+02 |
| Phenanthrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 7.09E+02 | 1.31E+04 | 3.51E+03 | 2.75E+04 | (3) | 1.31E+04 |
| Pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.89E+03 | 1.74E+04 | 5.77E+03 | 1.87E+04 | (2) | 1.74E+04 |
| Total PAHs | | | | | | | | | | | 3.35E+04 | | | 1.08E+05 |

**Notes:**

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
NA Not applicable, no estimate provided because there were fewer than 4 detected results
Max Maximum result
Min Minimum result
µg/kg Micrograms per kilogram
95UCL One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.

a Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
Distribution Codes: NP= nonparametric

b Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data.

c The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results.

d All methods follow EPA (2002, 2007).
Method (Statistic) Codes are defined as follows:
(1) Maximum detected result
(2), (3) 95 or 99 percent UCL, respectively, calculated using the nonparametric Chebyshev method

**References**

U.S. Environmental Protection Agency (EPA). 2002. "Calculating exposure point concentrations at hazardous waste sites." OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

U.S. Environmental Protection Agency (EPA). 2007. "ProUCL Version 4.0 Technical Guide." Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

Table C-10
Total PAHs Concentration Sediment - OC-C

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | NP | 5 | 8 | 62 | 3 | 5.86E+02 | 7.51E+02 | 9.48E+01 | 5.11E+02 | 3.04E+02 | 6.17E+02 | (4) | 5.11E+02 |
| Acenaphthene | µg/kg | NP | 4 | 8 | 50 | 0 | 5.32E+02 | 7.51E+02 | 1.21E+02 | 1.15E+03 | 4.36E+02 | 8.49E+02 | (7) | 8.49E+02 |
| Acenaphthylene | µg/kg | NA | 2 | 8 | 25 | 6 | 5.00E+02 | 1.08E+03 | 1.10E+02 | 2.35E+02 | NA | NA | (1) | 2.35E+02 |
| Anthracene | µg/kg | NP | 8 | 8 | 100 | 0 | NA | NA | 2.90E+02 | 2.60E+03 | 9.41E+02 | 2.39E+03 | (4) | 2.39E+03 |
| Benzo (a)anthracene | µg/kg | G | 8 | 8 | 100 | 0 | NA | NA | 8.91E+02 | 7.13E+03 | 2.59E+03 | 2.63E+03 | (5) | 2.63E+03 |
| Benzo(a)pyrene | µg/kg | G | 8 | 8 | 100 | 0 | NA | NA | 9.83E+02 | 7.22E+03 | 2.62E+03 | 2.67E+03 | (5) | 2.67E+03 |
| Benzo(b)fluoranthene | µg/kg | G | 8 | 8 | 100 | 0 | NA | NA | 2.15E+03 | 9.52E+03 | 3.96E+03 | 4.02E+03 | (5) | 4.02E+03 |
| Benzo(k)fluoranthene | µg/kg | G | 8 | 8 | 100 | 0 | NA | NA | 6.95E+02 | 3.09E+03 | 1.30E+03 | 1.33E+03 | (5) | 1.33E+03 |
| Chrysene | µg/kg | G | 8 | 8 | 100 | 0 | NA | NA | 1.57E+03 | 8.81E+03 | 3.52E+03 | 3.57E+03 | (5) | 3.57E+03 |
| Dibenz(a,h)anthracene | µg/kg | NP | 6 | 8 | 75 | 0 | 5.32E+02 | 7.26E+02 | 8.92E+01 | 1.81E+03 | 5.15E+02 | 1.84E+03 | (6) | 1.81E+03 |
| Fluoranthene | µg/kg | G | 8 | 8 | 100 | 0 | NA | NA | 2.69E+03 | 1.91E+04 | 6.38E+03 | 6.44E+03 | (5) | 6.44E+03 |
| Fluorene | µg/kg | NP | 7 | 8 | 88 | 0 | 5.32E+02 | 5.32E+02 | 1.18E+02 | 1.50E+03 | 4.47E+02 | 1.57E+03 | (6) | 1.50E+03 |
| Indeno(1,2,3-cd)pyrene | µg/kg | G | 8 | 8 | 100 | 0 | NA | NA | 2.45E+02 | 5.58E+03 | 1.69E+03 | 1.72E+03 | (5) | 1.72E+03 |
| Naphthalene | µg/kg | NP | 6 | 8 | 75 | 0 | 7.26E+02 | 7.51E+02 | 1.09E+02 | 1.45E+03 | 4.42E+02 | 6.73E+02 | (8) | 6.73E+02 |
| Phenanthrene | µg/kg | L | 8 | 8 | 100 | 0 | NA | NA | 6.68E+02 | 1.36E+04 | 3.43E+03 | 1.24E+04 | (3) | 1.24E+04 |
| Pyrene | µg/kg | N | 8 | 8 | 100 | 0 | NA | NA | 2.33E+03 | 1.78E+04 | 7.01E+03 | 1.08E+04 | (2) | 1.08E+04 |
| Total PAHs | | | | | | | | | | | 3.56E+04 | | | 5.36E+04 |

**Notes:**

EPC — Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
KM — Kaplan-Meier product limit estimator
NA — Not applicable, no estimate provided because there were fewer than 4 detected results
Max — Maximum result
Min — Minimum result
µg/kg — Micrograms per kilogram
95UCL — One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.

a — Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
Distribution Codes: G= gamma, L= lognormal, N= normal, NP= nonparametric
b — Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data.
c — The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results.
d — All methods follow EPA (2002, 2007).
Method (Statistic) Codes are defined as follows:
(1) Maximum detected result
(2) 95 percent UCL calculated using Student's *t* distribution
(3) 95 percent UCL calculated using Land's H statistic
(4) 95 percent UCL calculated using the nonparametric Chebyshev method
(5) 95 percent UCL calculated using the approximate gamma method
(6) 97.5 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL
(7) 95 percent UCL calculated using the KM mean and a percentile bootstrap to estimate the UCL
(8) 95 percent UCL calculated using the KM mean and a BCa bootstrap to estimate the UCL

**References**

U.S. Environmental Protection Agency (EPA). 2002. "Calculating exposure point concentrations at hazardous waste sites." OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.
U.S. Environmental Protection Agency (EPA). 2007. "ProUCL Version 4.0 Technical Guide." Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

Table C-11
Total PAHs Concentration Sediment - OC-D

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | NA | 2 | 5 | 40 | 3 | 6.92E+02 | 1.25E+03 | 1.41E+02 | 1.57E+02 | NA | NA | (1) | 1.57E+02 |
| Acenaphthene | µg/kg | NA | 3 | 5 | 60 | 0 | 6.92E+02 | 8.46E+02 | 1.80E+02 | 1.63E+03 | NA | NA | (1) | 1.63E+03 |
| Acenaphthylene | µg/kg | NA | 1 | 5 | 20 | 4 | 4.16E+02 | 1.25E+03 | 2.03E+02 | 2.03E+02 | NA | NA | (1) | 2.03E+02 |
| Anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.23E+02 | 4.84E+03 | 1.46E+03 | 1.04E+04 | (2) | 4.84E+03 |
| Benzo (a)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 5.98E+02 | 1.84E+04 | 5.64E+03 | 3.93E+04 | (2) | 1.84E+04 |
| Benzo(a)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 7.73E+02 | 2.00E+04 | 6.14E+03 | 4.24E+04 | (2) | 2.00E+04 |
| Benzo(b)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.32E+03 | 2.47E+04 | 8.05E+03 | 5.23E+04 | (2) | 2.47E+04 |
| Benzo(k)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 4.25E+02 | 7.88E+03 | 2.58E+03 | 1.66E+04 | (2) | 7.88E+03 |
| Chrysene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 9.69E+02 | 2.29E+04 | 7.06E+03 | 4.83E+04 | (2) | 2.29E+04 |
| Dibenz(a,h)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.36E+02 | 4.53E+03 | 1.29E+03 | 9.51E+03 | (2) | 4.53E+03 |
| Fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.90E+03 | 5.18E+04 | 1.59E+04 | 1.11E+05 | (2) | 5.18E+04 |
| Fluorene | µg/kg | NA | 3 | 5 | 60 | 0 | 6.92E+02 | 8.46E+02 | 2.31E+02 | 2.39E+03 | NA | NA | (1) | 2.39E+03 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 5.17E+02 | 1.77E+04 | 4.89E+03 | 3.73E+04 | (2) | 1.77E+04 |
| Naphthalene | µg/kg | NA | 3 | 5 | 60 | 1 | 6.92E+02 | 8.46E+02 | 2.65E+02 | 8.24E+02 | NA | NA | (1) | 8.24E+02 |
| Phenanthrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 6.45E+02 | 2.63E+04 | 8.47E+03 | 5.78E+04 | (2) | 2.63E+04 |
| Pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.54E+03 | 4.48E+04 | 1.39E+04 | 9.60E+04 | (2) | 4.48E+04 |
| Total PAHs | | | | | | | | | | | 7.54E+04 | | | 2.49E+05 |

**Notes:**

EPC Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
NA Not applicable, no estimate provided because there were fewer than 4 detected results
Max Maximum result
Min Minimum result
µg/kg Micrograms per kilogram
95UCL One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.

a Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $W^2$ test (gamma distributions). A 5 level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
Distribution Codes: NP= nonparametric

b Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and but were included in the reported sample size and range for censored data.

c The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals witl 3 or fewer detected results.

d All methods follow EPA (2002, 2007).
Method (Statistic) Codes are defined as follows:
(1) Maximum detected result
(2) 99 percent UCL calculated using the nonparametric Chebyshev method

**References**


U.S. Environmental Protection Agency (EPA). 2002. “Calculating exposure point concentrations at hazardous waste sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.

U.S. Environmental Protection Agency (EPA). 2007. “ProUCL Version 4.0 Technical Guide.” Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

Table C-12
Total PAHs Concentration Sediment - OC-E

| Chemical | Units | Distribution[a] | Number of Samples | | Detection Frequency (Percent) | Censored Data | | | Detected Data | | All Data (Censored and Detected)[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Detected | Total | | Removed[b] | Min | Max | Min | Max | Mean | 95UCL | Method[d] | EPC |
| 2-Methylnaphthalene | µg/kg | NA | 2 | 5 | 40 | 3 | 5.99E+02 | 1.25E+03 | 1.90E+02 | 3.25E+02 | NA | NA | (1) | 3.25E+02 |
| Acenaphthene | µg/kg | NA | 1 | 5 | 20 | 0 | 5.09E+02 | 6.55E+02 | 1.63E+03 | 1.63E+03 | NA | NA | (1) | 1.63E+03 |
| Anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.09E+02 | 4.84E+03 | 1.13E+03 | 1.04E+04 | (2) | 4.84E+03 |
| Benzo (a)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 3.75E+02 | 1.84E+04 | 4.30E+03 | 3.94E+04 | (2) | 1.84E+04 |
| Benzo(a)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 3.64E+02 | 2.00E+04 | 4.62E+03 | 4.29E+04 | (2) | 2.00E+04 |
| Benzo(b)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 5.21E+02 | 2.47E+04 | 5.90E+03 | 5.28E+04 | (2) | 2.47E+04 |
| Benzo(k)fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.42E+02 | 7.88E+03 | 1.89E+03 | 1.68E+04 | (2) | 7.88E+03 |
| Chrysene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 4.78E+02 | 2.29E+04 | 5.49E+03 | 4.89E+04 | (2) | 2.29E+04 |
| Dibenz(a,h)anthracene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 1.47E+02 | 4.53E+03 | 1.06E+03 | 9.69E+03 | (2) | 4.53E+03 |
| Fluoranthene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 8.69E+02 | 5.18E+04 | 1.20E+04 | 1.11E+05 | (2) | 5.18E+04 |
| Fluorene | µg/kg | NP | 4 | 5 | 80 | 0 | 6.41E+02 | 6.41E+02 | 1.13E+02 | 2.39E+03 | 5.87E+02 | 3.49E+03 | (14) | 2.39E+03 |
| Indeno(1,2,3-cd)pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 3.82E+02 | 1.77E+04 | 3.99E+03 | 3.81E+04 | (2) | 1.77E+04 |
| Naphthalene | µg/kg | NA | 3 | 5 | 60 | 2 | 5.99E+02 | 6.55E+02 | 1.36E+02 | 2.65E+02 | NA | NA | (1) | 2.65E+02 |
| Phenanthrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 5.71E+02 | 2.63E+04 | 6.07E+03 | 5.65E+04 | (2) | 2.63E+04 |
| Pyrene | µg/kg | NP | 5 | 5 | 100 | 0 | NA | NA | 8.74E+02 | 4.48E+04 | 1.04E+04 | 9.61E+04 | (2) | 4.48E+04 |
| Total PAHs | | | | | | | | | | | 5.75E+04 | | | 2.48E+05 |

**Notes:**

EPC — Exposure point concentration. The lesser of the 95UCL and the maximum detected result.
NA — Not applicable, no estimate provided because there were fewer than 4 detected results
Max — Maximum result
Min — Minimum result
µg/kg — Micrograms per kilogram
95UCL — One-sided 95 percent upper confidence limit of the mean. Following EPA (2002, 2007), this can be estimated using either a 95, 97.5, or 99 percent UCL.

a — Tested for detected data only using the Shapiro-Wilk W test (normal and lognormal distributions) and the Cramer von Mises $V^2$ test (gamma distributions). A 5 percent level of significance was used in all tests. Distribution tests were only conducted for samples with at least 8 detected results. Distributions not confirmed as normal, lognormal, or gamma, or not tested, were treated as nonparametric in all statistical calculations.
<u>Distribution Codes</u>: NP= nonparametric

b — Number of censored (nondetect) results that exceeded the maximum detected result. These results were excluded from calculations of the mean, 95UCL, and EPC, but were included in the reported sample size and range for censored data.

c — The mean and 95UCL were only calculated for chemicals with at least 4 detected results. The EPC defaulted to the maximum detected result for chemicals with 3 or fewer detected results.

d — All methods follow EPA (2002, 2007).
<u>Method (Statistic) Codes are defined as follows</u>

(1) Maximum detected result
(2) 99 percent UCL calculated using the nonparametric Chebyshev method
(3) 97.5 percent UCL calculated using the KM mean and the nonparametric Chebyshev method to estimate the UCL

**References**

U.S. Environmental Protection Agency (EPA). 2002. “Calculating exposure point concentrations at hazardous waste sites.” OSWER 9285.6-10. Office of Emergency and Remedial Response. Washington, DC. December.
U.S. Environmental Protection Agency (EPA). 2007. “ProUCL Version 4.0 Technical Guide.” Prepared by Singh, A. and A.K. Singh. EPA/600/R-07/041. April.

# APPENDIX D

## BIOASSAY REPORT AND STATISTICAL ANALYSIS OF BIOASSAY DATA AND POTENTIAL STRESSORS

# APPENDIX D

## BIOASSAY REPORT AND STATISICAL ANALYSIS OF BIOASSAY DATA AND POTENTIAL STRESSORS

As part of the investigation of potential sediment contamination at Duck and Otter Creeks, 20-day mortality and growth bioassays tests with *Chronimus tentans* were conducted on sediment from “master locations” within each creek. The full results of the bioassay are presented in this Appendix. One of the goals of the ecological risk assessment is to attempt to identify potential stressors that may be managed to improve the habitat for ecological receptors. In order to identify potential stressors a statistical analysis for various stressors and the bioassay results was performed. Tetra Tech used the following potential stressors for this analysis – acid volatile sulfide/simultaneously extracted metals (AVS/SEM) data and AVS concentrations (Table D-1), PAH toxicity units (Table D-2), percent sediment silt and clay, (Table D-1), oil and grease results, percent dry weight, total organic carbon content(Table D-3), and pesticide/polychlorinated biphenyls hazard quotients (Appendix B Tables B1-B10). The values used in the analysis are summarized in Table D-4.

The following statistical analysis techniques were used to determine if a causal relationship could be identified for the observed sediment toxicity, the SAS statistical package was used to perform this analysis.

1. bivariate correlation matrix for the response variable (per cent survival) and the 7 independent variables (Figure D-1)
2. correlation matrix and pairwise correlations (Tables D-5 and D-6)
3. stepwise regression output for the best multiple regression model that included all 7 independent variables (Table D-7)

The outputs for these analyses are provided in this appendix.

# TABLE D-1
## SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - AVS/SEM
## DUCK AND OTTER CREEKS
## TOLEDO AND OREGON, OHIO

| Parameter | Sample Number and Date Collected | | | | | |
|---|---|---|---|---|---|---|
| | DC-SED-01 4/05/07 | DC-SED-03 4/05/07 | DC-SED-05 4/05/07 | DC-SED-08 4/05/07 | DC-SED-10 4/05/07 | DC-SED-13 4/05/07 |
| Cadmium | 0.0058 B | 0.0085 B | 0.011 | 0.0088 | 0.0049 | 0.0077 |
| Copper | 0.094 B | 0.05 B | 0.035 | 0.087 | 0.074 | 0.099 |
| Lead | 0.08 | 0.097 | 0.21 | 0.14 | 0.082 | 0.83 |
| Nickel | 0.1 B | 0.065 B | 0.24 B | 0.18 B | 0.09 B | 0.14 B |
| Silver | 0.012 M, MS | 0.011 M, MS | 0.023 M, MS | 0.039 M, MS | 0.019 M, MS | 0.014 M, MS |
| Zinc | 1 SD | 0.79 SD | 2.9 SD | 1.7 SD | 0.77 SD | 0.83 SD |
| Mercury | 0.00018 M | 0.00016 M | 0.00035 M | 0.0006 M | 0.00028 M | 0.00021 M |
| Total SEM | 1.29198 | 1.02166 | 3.41935 | 2.1554 | 1.04018 | 1.92091 |
| Acid Volatile Sulfide | 8.7 M | 10.3 M | 59.3 M | 76.4 M | 11.3 M | 20.3 M |
| Ratio of SEM*/AVS | 0.15 | 0.097 | 0.057 | 0.027 | 0.088 | 0.094 |
| Acid Volatile Sulfide (mg/kg) | 279 | 329 | 1900 | 2450 | 361 | 652 |

**TABLE D-1**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - AVS/SEM**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Parameter | Sample Number and Date Collected | | | | | |
|---|---|---|---|---|---|---|
| | DC-SED-14 4/05/07 | OC-SED-01 4/05/07 | OC-SED-03 4/05/07 | OC-SED-05 4/05/07 | OC-SED-07 4/05/07 | OC-SED-11 4/05/07 |
| Cadmium | 0.0038 | 0.0028 B | 0.0071 B | 0.0072 | 0.006 | 0.0073 |
| Copper | 0.025 U | 0.23 | 0.67 | 0.62 | 0.33 | 0.052 |
| Lead | 0.14 | 0.09 | 0.31 | 0.31 | 0.32 | 0.33 |
| Nickel | 0.055 B | 0.087 B | 0.22 B | 0.22 B | 0.21 B | 0.25 B |
| Silver | 0.019 M, MS | 0.013 M, MS | 0.02 M, MS | 0.019 M, MS | 0.019 M, MS | 0.019 M, MS |
| Zinc | 0.99 SD | 0.76 SD | 2.6 SD | 2.7 SD | 1 SD | 2.9 SD |
| Mercury | 0.00029 M | 0.00019 M | 0.00031 M | 0.00029 M | 0.00029 M | 0.00029 M |
| Total SEM | 1.23309 | 1.18299 | 3.82741 | 3.87649 | 1.88529 | 3.55859 |
| Acid Volatile Sulfide | 21.9 M | 2.5 M | 17.6 M | 14 M | 23.4 M | 32.1 M |
| Ratio of SEM*/AVS | 0.055 | 0.48 | 0.22 | 0.28 | 0.12 | 0.11 |
| Acid Volatile Sulfide (mg/kg) | 702 | 80.1 | 565 | 450 | 749 | 1030 |

**TABLE D-1**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - AVS/SEM**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Parameter | Sample Number and Date Collected | | | |
|---|---|---|---|---|
| | OC-SED-14 4/05/07 | OC-SED-19 4/05/07 | OC-SED-22 4/05/07 | OC-SED-26 4/05/07 |
| Cadmium | 0.006 | 0.0028 | 0.0062 | 0.0043 |
| Copper | 0.27 | 0.18 | 0.016 U | 0.17 |
| Lead | 0.36 | 0.13 | 0.22 | 0.17 |
| Nickel | 0.24 B | 0.11 B | 0.12 B | 0.22 B |
| Silver | 0.014 M, MS | 0.0093 M, MS | 0.012 M, MS | 0.015 F, MS |
| Zinc | 2.1 SD | 1.3 SD | 2.6 SD | 1.1 F, CV |
| Mercury | 0.0002 M | 0.00014 M | 0.00018 M | 0.00022 F, MS |
| Total SEM | 2.9902 | 1.73224 | 2.97438 | 1.67952 |
| Acid Volatile Sulfide | 16.9 M | 8.7 M | 39 M | 7.2 M |
| Ratio of SEM*/AVS | 0.18 | 0.2 | 0.074 | 0.24 |
| Acid Volatile Sulfide (mg/kg) | 543 | 280 | 1250 | 231 |

Notes:

AVS = Acid volatile sulfide
B = Result is less than reporting limit but greater than instrument detection limit.
CV = Estimated value. Calibration verification results exceed upper or lower control limits.
F = Estimated value. Relative Percent Difference of field duplicates/replicates exceeds criteria.
mg/kg = Milligrams per kilogram
M = Estimated value. Associated MS/MSD recoveries exceed the upper or lower control limits.
MS = Estimated value. RPD between MS/MSD exceeded specified criteria.
SD = Estimated value. Serial dilution exceeds specified criteria.
SEM = Simultaneously extracted metals

All results expressed in micromoles per gram unless otherwise noted

TABLE D-2

CALCULATION OF EQUILIBRIUM SEDIMENT BENCHMARK TOXIC UNITS FOR SEDIMENTS IN DUCK AND OTTER CREEKS

| Sample and Date of Sample | | | S01-DC-01 4/02/07 | | | | S03-DC-03 4/02/07 | | | | S05-DC-05 4/03/07 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAH | $C_{OC,\ PAH,\ FCV}$ (mg/$g_{oc}$) | $C_{OC,\ PAH,\ Max}$ (mg/$g_{oc}$) | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless |
| Acenaphthene | 491 | 33400 | 0.041 | IS | 0.48 | 0.0010 | 0.028 | J, IS | 0.58 | 0.0012 | 0.42 | IS | 3.44 | 0.0070 |
| Acenaphthylene | 452 | 24000 | 0.015 | J, IS | 0.18 | 0.0004 | 0.011 | J, IS | 0.23 | 0.0005 | 0.026 | J, IS | 0.21 | 0.0005 |
| Anthracene | 594 | 1300 | 0.1 | IS | 1.17 | 0.0020 | 0.15 | IS | 3.09 | 0.0052 | 0.15 | IS | 1.23 | 0.0021 |
| Benzo(a)anthracene | 841 | 4153 | 0.45 | IS | 5.26 | 0.0063 | 0.68 | IS | 13.99 | 0.0166 | 0.63 | IS | 5.16 | 0.0061 |
| Benzo(a)pyrene | 965 | 3840 | 0.55 | IS | 6.43 | 0.0067 | 0.69 | IS | 14.20 | 0.0147 | 0.61 | IS | 5.00 | 0.0052 |
| Benzo(b)fluoranthene | 979 | 2169 | 0.57 | IS | 6.66 | 0.0068 | 0.77 | IS | 15.84 | 0.0162 | 0.81 | IS | 6.64 | 0.0068 |
| Benzo(e)pyrene | 967 | 4300 | 0.52 | IS | 6.07 | 0.0063 | 0.47 | IS | 9.67 | 0.0100 | 0.52 | IS | 4.26 | 0.0044 |
| Benzo(g,h,i)perylene | 1095 | 648 | 0.54 | IS | 6.31 | 0.0097 | 0.55 | IS | 11.32 | 0.0175 | 0.49 | IS | 4.02 | 0.0062 |
| Benzo(k)fluoranthene | 981 | 1220 | 0.24 | IS | 2.80 | 0.0029 | 0.64 | IS | 13.17 | 0.0134 | 0.66 | IS | 5.41 | 0.0055 |
| C1-Chrysene/Benzo(a)anthracene | 929 | -- | 1.2 | IS | 14.02 | 0.0151 | 0.45 | IS | 9.26 | 0.0100 | 0.94 | IS | 7.70 | 0.0083 |
| C1-Fluorenes | 611 | -- | 0.15 | IS | 1.75 | 0.0029 | 0.038 | J, IS | 0.78 | 0.0013 | 0.66 | IS | 5.41 | 0.0089 |
| C1-Fluoranthenes/Pyrenes | 770 | -- | 0.8 | IS | 9.35 | 0.0121 | 0.59 | IS | 12.14 | 0.0158 | 0.61 | IS | 5.00 | 0.0065 |
| C1-Naphthalenes | 444 | -- | 0.55 | IS | 6.43 | 0.0145 | 0.09 | IS | 1.85 | 0.0042 | 0.3 | IS | 2.46 | 0.0055 |
| C1-Phenanthrenes/Anthracenes | 670 | -- | 0.9 | IS | 10.51 | 0.0157 | 0.39 | IS | 8.02 | 0.0120 | 0.52 | IS | 4.26 | 0.0064 |
| C2-Chrysene/Benzo(a)anthracene | 1008 | -- | 1 | IS | 11.68 | 0.0116 | 0.28 | IS | 5.76 | 0.0057 | 0.74 | IS | 6.07 | 0.0060 |
| C2-Fluorenes | 686 | -- | 0.28 | IS | 3.27 | 0.0048 | 0.064 | IS | 1.32 | 0.0019 | 0.14 | IS | 1.15 | 0.0017 |
| C2-Naphthalenes | 510 | -- | 1.9 | IS | 22.20 | 0.0435 | 0.35 | IS | 7.20 | 0.0141 | 0.89 | IS | 7.30 | 0.0143 |
| C2-Phenanthrenes/Anthracenes | 746 | -- | 0.79 | IS | 9.23 | 0.0124 | 0.25 | IS | 5.14 | 0.0069 | 0.46 | IS | 3.77 | 0.0051 |
| C3-Chrysene/Benzo(a)anthracene | 1112 | -- | 0.42 | IS | 4.91 | 0.0044 | 0.12 | IS | 2.47 | 0.0022 | 0.51 | IS | 4.18 | 0.0038 |
| C3-Fluorenes | 769 | -- | 0.53 | IS | 6.19 | 0.0081 | 0.12 | IS | 2.47 | 0.0032 | 0.35 | IS | 2.87 | 0.0037 |
| C3-Naphthalenes | 581 | -- | 1.6 | IS | 18.69 | 0.0322 | 0.37 | IS | 7.61 | 0.0131 | 0.74 | IS | 6.07 | 0.0104 |
| C3-Phenanthrenes/Anthracenes | 829 | -- | 0.6 | IS | 7.01 | 0.0085 | 0.18 | IS | 3.70 | 0.0045 | 0.47 | IS | 3.85 | 0.0046 |
| C4-Chrysene/Benzo(a)anthracene | 1214 | -- | 0.17 | IS | 1.99 | 0.0016 | 0.055 | IS | 1.13 | 0.0009 | 0.35 | IS | 2.87 | 0.0024 |
| C4-Naphthalenes | 657 | -- | 1.3 | IS | 15.19 | 0.0231 | 0.25 | IS | 5.14 | 0.0078 | 0.62 | IS | 5.08 | 0.0077 |
| C4-Phenanthrenes/Anthracenes | 913 | -- | 0.24 | IS | 2.80 | 0.0031 | 0.064 | IS | 1.32 | 0.0014 | 0.35 | IS | 2.87 | 0.0031 |
| Chrysene | 844 | 826 | 0.67 | IS | 7.83 | 0.0095 | 0.84 | IS | 17.28 | 0.0209 | 0.83 | IS | 6.80 | 0.0082 |
| Dibenz(a,h)anthracene | 1123 | 2389 | 0.19 | IS | 2.22 | 0.0020 | 0.15 | IS | 3.09 | 0.0027 | 0.15 | IS | 1.23 | 0.0011 |
| Fluoranthene | 707 | 23870 | 0.63 | IS | 7.36 | 0.0104 | 2 | IS | 41.15 | 0.0582 | 1.2 | IS | 9.84 | 0.0139 |
| Fluorene | 538 | 26000 | 0.081 | IS | 0.95 | 0.0018 | 0.063 | IS | 1.30 | 0.0024 | 0.71 | IS | 5.82 | 0.0108 |
| Indeno(1,2,3-cd)pyrene | 1115 | -- | 0.28 | IS | 3.27 | 0.0029 | 0.48 | IS | 9.88 | 0.0089 | 0.46 | IS | 3.77 | 0.0034 |
| Naphthalene | 385 | 61700 | 0.22 | IS | 2.57 | 0.0067 | 0.067 | IS | 1.38 | 0.0036 | 0.27 | IS | 2.21 | 0.0057 |
| Perylene | 967 | 431 | 0.12 | IS | 1.40 | 0.0033 | 0.17 | IS | 3.50 | 0.0081 | 0.17 | IS | 1.39 | 0.0032 |
| Phenanthrene | 596 | 34300 | 0.43 | IS | 5.02 | 0.0084 | 0.73 | IS | 15.02 | 0.0252 | 0.48 | IS | 3.93 | 0.0066 |
| Pyrene | 697 | 9090 | 0.82 | IS | 9.58 | 0.0137 | 1.5 | IS | 30.86 | 0.0443 | 1.1 | IS | 9.02 | 0.0129 |
| Organic Carbon (total) | | | 8.56 | | | | 4.86 | | | | 12.2 | | | |
| sum total of $ESBTU_{FCVi}$ | | | | | | 0.3140 | | | | 0.3746 | | | | 0.2081 |

Notes:

| | |
|---|---|
| $C_{OC,\ PAH,\ FCV}$ | Effect concentration of a polynuclear aromatic hydrocarbons (PAH) in sediment on an organic carbon basis calculated from the product of its final chronic value (FCV) and Koc |
| $C_{OC,\ PAH,\ Max}$ | Maxiumum solubility limited PAH concentration in deiment on an organic carbon basis |
| Conc. | Concentration |
| $C_{OC}$ | Chemical concentration in sediments on an organic carbon basis |
| $ESBTU_{FCVi}$ | Equilibrirum Partioning Sediment Benchmark Toxic Unit for PAH, based on the FCV |
| mg/$g_{oc}$ | Milligram per gram organic carbon |
| µg/g dry wt. | microgram per gram dry weight |
| -- | no value available |

TABLE D-2

CALCULATION OF EQUILIBRIUM SEDIMENT BENCHMARK TOXIC UNITS FOR SEDIMENTS IN DUCK AND OTTER CREEKS

| Sample and Date of Sample | S08-DC-08 4-02-07 | | | | S10-DC-10 4/03/07 | | | | S13-DC-13 4/04/07 | | | | S14-DC-14 4/04/07 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAH | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless |
| Acenaphthene | 0.099 | J, IS | 1.32 | 0.0027 | 0.12 | U | 1.01 | 0.0021 | 0.19 | U | 1.87 | 0.0038 | 10 | | 95.24 | 0.1940 |
| Acenaphthylene | 0.022 | J, IS | 0.29 | 0.0007 | 0.12 | U | 1.01 | 0.0022 | 0.19 | U | 1.87 | 0.0041 | 9.5 | U | 45.24 | 0.1001 |
| Anthracene | 0.32 | IS | 4.28 | 0.0072 | 0.24 | | 4.05 | 0.0068 | 0.59 | | 11.59 | 0.0195 | 57 | | 542.86 | 0.9139 |
| Benzo(a)anthracene | 1.3 | IS | 17.38 | 0.0207 | 1.1 | | 18.55 | 0.0221 | 2.1 | | 41.26 | 0.0491 | 180 | | 1714.29 | 2.0384 |
| Benzo(a)pyrene | 1.3 | IS | 17.38 | 0.0180 | 1.2 | | 20.24 | 0.0210 | 2.1 | | 41.26 | 0.0428 | 140 | | 1333.33 | 1.3817 |
| Benzo(b)fluoranthene | 2.1 | IS | 28.07 | 0.0287 | 1.9 | | 32.04 | 0.0327 | 2.4 | | 47.15 | 0.0482 | 150 | | 1428.57 | 1.4592 |
| Benzo(e)pyrene | 1.1 | IS | 14.71 | 0.0152 | 0.95 | | 16.02 | 0.0166 | 1.2 | | 23.58 | 0.0244 | 77 | | 733.33 | 0.7584 |
| Benzo(g,h,i)perylene | 1.2 | IS | 16.04 | 0.0248 | 1 | | 16.86 | 0.0260 | 1.4 | | 27.50 | 0.0424 | 76 | | 723.81 | 1.1170 |
| Benzo(k)fluoranthene | 1.4 | IS | 18.72 | 0.0191 | 1.3 | | 21.92 | 0.0223 | 2 | | 39.29 | 0.0401 | 130 | | 1238.10 | 1.2621 |
| C1-Chrysene/Benzo(a)anthracene | 1 | IS | 13.37 | 0.0144 | 0.76 | | 12.82 | 0.0138 | 1 | | 19.65 | 0.0211 | 61 | | 580.95 | 0.6254 |
| C1-Fluorenes | 0.05 | J, IS | 0.67 | 0.0011 | 0.12 | U | 1.01 | 0.0017 | 0.19 | U | 1.87 | 0.0031 | 9.5 | U | 45.24 | 0.0740 |
| C1-Fluoranthenes/Pyrenes | 1 | IS | 13.37 | 0.0174 | 0.91 | | 15.35 | 0.0199 | 1.4 | | 27.50 | 0.0357 | 100 | | 952.38 | 1.2369 |
| C1-Naphthalenes | 0.079 | J, IS | 1.06 | 0.0024 | 0.12 | U | 1.01 | 0.0023 | 0.19 | U | 1.87 | 0.0042 | 9.5 | U | 45.24 | 0.1019 |
| C1-Phenanthrenes/Anthracenes | 0.66 | IS | 8.82 | 0.0132 | 0.39 | | 6.58 | 0.0098 | 0.88 | | 17.29 | 0.0258 | 61 | | 580.95 | 0.8671 |
| C2-Chrysene/Benzo(a)anthracene | 0.34 | IS | 4.55 | 0.0045 | 0.29 | | 4.89 | 0.0049 | 0.31 | | 6.09 | 0.0060 | 17 | | 161.90 | 0.1606 |
| C2-Fluorenes | 0.052 | J, IS | 0.70 | 0.0010 | 0.12 | U | 1.01 | 0.0015 | 0.19 | | 3.73 | 0.0054 | 9.5 | U | 45.24 | 0.0659 |
| C2-Naphthalenes | 0.25 | IS | 3.34 | 0.0066 | 0.13 | | 2.19 | 0.0043 | 1.3 | | 25.54 | 0.0501 | 16 | | 152.38 | 0.2988 |
| C2-Phenanthrenes/Anthracenes | 0.29 | IS | 3.88 | 0.0052 | 0.21 | | 3.54 | 0.0047 | 0.39 | | 7.66 | 0.0103 | 19 | | 180.95 | 0.2426 |
| C3-Chrysene/Benzo(a)anthracene | 0.11 | J, IS | 1.47 | 0.0013 | 0.12 | U | 1.01 | 0.0009 | 0.19 | U | 1.87 | 0.0017 | 9.5 | U | 45.24 | 0.0407 |
| C3-Fluorenes | 0.088 | J, IS | 1.18 | 0.0015 | 0.12 | U | 1.01 | 0.0013 | 0.19 | | 3.73 | 0.0049 | 9.5 | U | 45.24 | 0.0588 |
| C3-Naphthalenes | 0.16 | IS | 2.14 | 0.0037 | 0.12 | U | 1.01 | 0.0017 | 1.5 | | 29.47 | 0.0507 | 16 | | 152.38 | 0.2623 |
| C3-Phenanthrenes/Anthracenes | 0.15 | IS | 2.01 | 0.0024 | 0.12 | U | 1.01 | 0.0012 | 0.19 | U | 1.87 | 0.0023 | 9.5 | U | 45.24 | 0.0546 |
| C4-Chrysene/Benzo(a)anthracene | 0.048 | J, IS | 0.64 | 0.0005 | 0.12 | U | 1.01 | 0.0008 | 0.19 | U | 1.87 | 0.0015 | 9.5 | U | 45.24 | 0.0373 |
| C4-Naphthalenes | 0.12 | IS | 1.60 | 0.0024 | 0.12 | U | 1.01 | 0.0015 | 1.1 | | 21.61 | 0.0329 | 12 | | 57.14 | 0.0870 |
| C4-Phenanthrenes/Anthracenes | 0.049 | J, IS | 0.66 | 0.0007 | 0.12 | U | 1.01 | 0.0011 | 0.19 | U | 1.87 | 0.0020 | 9.5 | U | 45.24 | 0.0495 |
| Chrysene | 1.9 | IS | 25.40 | 0.0308 | 1.5 | | 25.30 | 0.0306 | 2.2 | | 43.22 | 0.0523 | 160 | | 761.90 | 0.9224 |
| Dibenz(a,h)anthracene | 0.31 | IS | 4.14 | 0.0037 | 0.28 | | 4.72 | 0.0042 | 0.31 | | 6.09 | 0.0054 | 18 | | 85.71 | 0.0763 |
| Fluoranthene | 4.4 | IS | 58.82 | 0.0832 | 3.4 | | 57.34 | 0.0811 | 5.3 | | 104.13 | 0.1473 | 440 | | 2095.24 | 2.9636 |
| Fluorene | 0.19 | IS | 2.54 | 0.0047 | 0.12 | U | 1.01 | 0.0019 | 0.2 | | 3.93 | 0.0073 | 15 | | 71.43 | 0.1328 |
| Indeno(1,2,3-cd)pyrene | 1.1 | IS | 14.71 | 0.0132 | 1 | | 16.86 | 0.0151 | 1.3 | | 25.54 | 0.0229 | 78 | | 371.43 | 0.3331 |
| Naphthalene | 0.066 | J, IS | 0.88 | 0.0023 | 0.12 | U | 1.01 | 0.0026 | 0.19 | U | 1.87 | 0.0048 | 9.5 | U | 45.24 | 0.1175 |
| Perylene | 0.33 | | 4.41 | 0.0102 | 0.32 | | 5.40 | 0.0125 | 0.57 | | 11.20 | 0.0260 | 35 | | 166.67 | 0.3867 |
| Phenanthrene | 1.4 | | 18.72 | 0.0314 | 0.99 | | 16.69 | 0.0280 | 1.5 | | 29.47 | 0.0494 | 140 | | 666.67 | 1.1186 |
| Pyrene | 3.2 | IS | 42.78 | 0.0614 | 2.5 | | 42.16 | 0.0605 | 4 | | 78.59 | 0.1127 | 330 | | 1571.43 | 2.2546 |
| Organic Carbon (total) | 7.48 | | | | 5.93 | | | | 5.09 | | | | 10.5 | | | |
| sum total of $ESBTU_{FCVi}$ | | | | 0.4561 | | | | 0.4599 | | | | 0.9603 | | | | 21.7935 |

TABLE D-2

CALCULATION OF EQUILIBRIUM SEDIMENT BENCHMARK TOXIC UNITS FOR SEDIMENTS IN DUCK AND OTTER CREEKS

| Sample and Date of Sample | S20-OC-01 4/02/07 | | | | S22-OC-03 4/02/07 | | | | S24-OC-05 4/02/07 | | | | S26-OC-07 4/03/07 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAH | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/g$_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/g$_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/g$_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | | $C_{OC}$ (µg/g$_{oc}$) | $ESBTU_{FCVi}$ unitless |
| Acenaphthene | 0.079 | U | 2.69 | 0.0055 | 0.079 | J | 1.57 | 0.0032 | 0.12 | U | 0.94 | 0.0019 | 0.14 | | 1.96 | 0.0040 |
| Acenaphthylene | 0.079 | U | 2.69 | 0.0059 | 0.03 | J | 0.60 | 0.0013 | 0.12 | U | 0.94 | 0.0021 | 0.12 | U | 0.84 | 0.0019 |
| Anthracene | 0.11 | | 7.48 | 0.0126 | 0.23 | | 4.57 | 0.0077 | 0.14 | | 1.10 | 0.0018 | 0.24 | | 3.35 | 0.0056 |
| Benzo(a)anthracene | 1.3 | | 88.44 | 0.1052 | 2.6 | | 51.69 | 0.0615 | 1.2 | | 9.39 | 0.0112 | 1.8 | | 25.14 | 0.0299 |
| Benzo(a)pyrene | 1.4 | | 95.24 | 0.0987 | 3.2 | | 63.62 | 0.0659 | 1.7 | | 13.30 | 0.0138 | 1.9 | | 26.54 | 0.0275 |
| Benzo(b)fluoranthene | 1.8 | | 122.45 | 0.1251 | 3.7 | | 73.56 | 0.0751 | 2.6 | | 20.34 | 0.0208 | 1.9 | | 26.54 | 0.0271 |
| Benzo(e)pyrene | 2.1 | | 142.86 | 0.1477 | 3.7 | | 73.56 | 0.0761 | 1.6 | | 12.52 | 0.0129 | 2 | | 27.93 | 0.0289 |
| Benzo(g,h,i)perylene | 1.4 | | 95.24 | 0.1470 | 3 | | 59.64 | 0.0920 | 1.8 | | 14.08 | 0.0217 | 1.5 | | 20.95 | 0.0323 |
| Benzo(k)fluoranthene | 0.46 | | 31.29 | 0.0319 | 3 | | 59.64 | 0.0608 | 2.1 | | 16.43 | 0.0168 | 1.8 | | 25.14 | 0.0256 |
| C1-Chrysene/Benzo(a)anthracene | 4 | | 272.11 | 0.2929 | 7.8 | | 155.07 | 0.1669 | 1.8 | | 14.08 | 0.0152 | 6.6 | | 92.18 | 0.0992 |
| C1-Fluorenes | 0.36 | | 24.49 | 0.0401 | 0.35 | | 6.96 | 0.0114 | 0.45 | | 3.52 | 0.0058 | 0.45 | | 6.28 | 0.0103 |
| C1-Fluoranthenes/Pyrenes | 2.9 | | 197.28 | 0.2562 | 7.7 | | 153.08 | 0.1988 | 2.2 | | 17.21 | 0.0224 | 7.1 | | 99.16 | 0.1288 |
| C1-Naphthalenes | 0.2 | | 13.61 | 0.0306 | 0.39 | | 7.75 | 0.0175 | 0.21 | | 1.64 | 0.0037 | 0.17 | | 2.37 | 0.0053 |
| C1-Phenanthrenes/Anthracenes | 2 | | 136.05 | 0.2031 | 3.1 | | 61.63 | 0.0920 | 1.7 | | 13.30 | 0.0199 | 3 | | 41.90 | 0.0625 |
| C2-Chrysene/Benzo(a)anthracene | 3.2 | | 217.69 | 0.2160 | 9.8 | | 194.83 | 0.1933 | 1.8 | | 14.08 | 0.0140 | 8.3 | | 115.92 | 0.1150 |
| C2-Fluorenes | 0.77 | | 52.38 | 0.0764 | 1.3 | | 25.84 | 0.0377 | 1.4 | | 10.95 | 0.0160 | 1.7 | | 23.74 | 0.0346 |
| C2-Naphthalenes | 1.7 | | 115.65 | 0.2268 | 1.7 | | 33.80 | 0.0663 | 1.7 | | 13.30 | 0.0261 | 1.7 | | 23.74 | 0.0466 |
| C2-Phenanthrenes/Anthracenes | 2.2 | | 149.66 | 0.2006 | 5.8 | | 115.31 | 0.1546 | 2.7 | | 21.13 | 0.0283 | 7.2 | | 100.56 | 0.1348 |
| C3-Chrysene/Benzo(a)anthracene | 1.4 | | 95.24 | 0.0856 | 5.5 | | 109.34 | 0.0983 | 1.2 | | 9.39 | 0.0084 | 5.2 | | 72.63 | 0.0653 |
| C3-Fluorenes | 1.6 | | 108.84 | 0.1415 | 3.9 | | 77.53 | 0.1008 | 2.8 | | 21.91 | 0.0285 | 5.1 | | 71.23 | 0.0926 |
| C3-Naphthalenes | 3.6 | | 244.90 | 0.4215 | 2.4 | | 47.71 | 0.0821 | 3.4 | | 26.60 | 0.0458 | 4.3 | | 60.06 | 0.1034 |
| C3-Phenanthrenes/Anthracenes | 2 | | 136.05 | 0.1641 | 8.5 | | 168.99 | 0.2038 | 2.9 | | 22.69 | 0.0274 | 9.3 | | 129.89 | 0.1567 |
| C4-Chrysene/Benzo(a)anthracene | 7 | | 476.19 | 0.3922 | 2.1 | | 41.75 | 0.0344 | 0.43 | | 3.36 | 0.0028 | 2.8 | | 39.11 | 0.0322 |
| C4-Naphthalenes | 3.1 | | 210.88 | 0.3210 | 3 | | 59.64 | 0.0908 | 4.1 | | 32.08 | 0.0488 | 5 | | 69.83 | 0.1063 |
| C4-Phenanthrenes/Anthracenes | 1.1 | | 74.83 | 0.0820 | 5.6 | | 111.33 | 0.1219 | 1.6 | | 12.52 | 0.0137 | 5.5 | | 76.82 | 0.0841 |
| Chrysene | 3 | | 204.08 | 0.2471 | 5.1 | | 101.39 | 0.1228 | 2.1 | | 16.43 | 0.0199 | 2.9 | | 40.50 | 0.0490 |
| Dibenz(a,h)anthracene | 0.72 | | 48.98 | 0.0436 | 0.72 | | 14.31 | 0.0127 | 0.27 | | 2.11 | 0.0019 | 0.43 | | 6.01 | 0.0053 |
| Fluoranthene | 1 | | 68.03 | 0.0962 | 4.2 | | 83.50 | 0.1181 | 3.5 | | 27.39 | 0.0387 | 3 | | 41.90 | 0.0593 |
| Fluorene | 0.13 | | 8.84 | 0.0164 | 0.15 | | 2.98 | 0.0055 | 0.2 | | 1.56 | 0.0029 | 0.2 | | 2.79 | 0.0052 |
| Indeno(1,2,3-cd)pyrene | 0.76 | | 51.70 | 0.0464 | 2.3 | | 45.73 | 0.0410 | 1.6 | | 12.52 | 0.0112 | 1.3 | | 18.16 | 0.0163 |
| Naphthalene | 0.079 | U | 2.69 | 0.0070 | 0.19 | | 3.78 | 0.0098 | 0.12 | U | 0.94 | 0.0024 | 0.12 | U | 0.84 | 0.0022 |
| Perylene | 0.25 | | 17.01 | 0.0395 | 0.92 | | 18.29 | 0.0424 | 0.42 | | 3.29 | 0.0076 | 0.64 | | 8.94 | 0.0207 |
| Phenanthrene | 0.71 | | 48.30 | 0.0810 | 1.2 | | 23.86 | 0.0400 | 0.84 | | 6.57 | 0.0110 | 0.98 | | 13.69 | 0.0230 |
| Pyrene | 2 | | 136.05 | 0.1952 | 4.9 | | 97.42 | 0.1398 | 3.3 | | 25.82 | 0.0370 | 4 | | 55.87 | 0.0802 |
| Organic Carbon (total) | 1.47 | | | | 5.03 | | | | 6.39 | | | | 7.16 | | | |
| sum total of $ESBTU_{FCVi}$ | | | | 4.6025 | | | | 2.6464 | | | | 0.5624 | | | | 1.7217 |

TABLE D-2

CALCULATION OF EQUILIBRIUM SEDIMENT BENCHMARK TOXIC UNITS FOR SEDIMENTS IN DUCK AND OTTER CREEKS

| Sample and Date of Sample | S30-OC-11 4/03/07 | | | S33-OC-14 4/03/07 | | | S38-OC-19 4/03/07 | | | S42-OC-22 4/03/07 | | | S46-OC-26 4/03/07 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAH | Conc. (µg/g dry wt.) | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless | Conc. (µg/g dry wt.) | $C_{OC}$ (µg/$g_{oc}$) | $ESBTU_{FCVi}$ unitless |
| Acenaphthene | 0.19 U | 1.74 | 0.0036 | 0.12 U | 2.42 | 0.0049 | 0.22 | 15.83 | 0.0322 | 1.5 U | 13.61 | 0.0277 | 0.18 U | 3.45 | 0.0070 |
| Acenaphthylene | 0.19 U | 1.74 | 0.0039 | 0.12 U | 2.42 | 0.0054 | 0.12 U | 4.32 | 0.0095 | 1.5 U | 13.61 | 0.0301 | 0.18 U | 3.45 | 0.0076 |
| Anthracene | 0.33 | 13.31 | 0.0224 | 0.27 | 10.89 | 0.0183 | 0.76 | 54.68 | 0.0920 | 3.8 | 68.97 | 0.1161 | 0.36 | 13.79 | 0.0232 |
| Benzo(a)anthracene | 2 | 80.65 | 0.0959 | 1.6 | 64.52 | 0.0767 | 2.1 | 151.08 | 0.1796 | 17 | 308.53 | 0.3669 | 1.7 | 65.13 | 0.0774 |
| Benzo(a)pyrene | 2.6 | 104.84 | 0.1086 | 1.8 | 72.58 | 0.0752 | 2 | 143.88 | 0.1491 | 19 | 344.83 | 0.3573 | 1.7 | 65.13 | 0.0675 |
| Benzo(b)fluoranthene | 3.8 | 153.23 | 0.1565 | 2.7 | 108.87 | 0.1112 | 2.4 | 172.66 | 0.1764 | 26 | 471.87 | 0.4820 | 2.5 | 95.79 | 0.0978 |
| Benzo(e)pyrene | 2.1 | 84.68 | 0.0876 | 1.5 | 60.48 | 0.0625 | 1.3 | 93.53 | 0.0967 | 13 | 235.93 | 0.2440 | 1.2 | 45.98 | 0.0475 |
| Benzo(g,h,i)perylene | 2.4 | 96.77 | 0.1493 | 1.6 | 64.52 | 0.0996 | 1.4 | 100.72 | 0.1554 | 15 | 272.23 | 0.4201 | 1.4 | 53.64 | 0.0828 |
| Benzo(k)fluoranthene | 2.7 | 108.87 | 0.1110 | 2 | 80.65 | 0.0822 | 1.8 | 129.50 | 0.1320 | 18 | 326.68 | 0.3330 | 1.8 | 68.97 | 0.0703 |
| C1-Chrysene/Benzo(a)anthracene | 2 | 80.65 | 0.0868 | 1.3 | 52.42 | 0.0564 | 0.98 | 70.50 | 0.0759 | 7.2 | 130.67 | 0.1407 | 0.75 | 28.74 | 0.0309 |
| C1-Fluorenes | 0.27 | 10.89 | 0.0178 | 0.12 | 4.84 | 0.0079 | 0.12 U | 4.32 | 0.0071 | 1.5 U | 13.61 | 0.0223 | 0.18 U | 3.45 | 0.0056 |
| C1-Fluoranthenes/Pyrenes | 3 | 120.97 | 0.1571 | 1.7 | 68.55 | 0.0890 | 1.6 | 115.11 | 0.1495 | 9.9 | 179.67 | 0.2333 | 1 | 38.31 | 0.0498 |
| C1-Naphthalenes | 0.19 U | 1.74 | 0.0039 | 0.12 U | 2.42 | 0.0054 | 0.12 U | 4.32 | 0.0097 | 1.5 U | 13.61 | 0.0307 | 0.18 U | 3.45 | 0.0078 |
| C1-Phenanthrenes/Anthracenes | 1.3 | 52.42 | 0.0782 | 0.7 | 28.23 | 0.0421 | 0.85 | 61.15 | 0.0913 | 4.6 | 83.48 | 0.1246 | 0.52 | 19.92 | 0.0297 |
| C2-Chrysene/Benzo(a)anthracene | 1.6 | 64.52 | 0.0640 | 0.82 | 33.06 | 0.0328 | 0.45 | 32.37 | 0.0321 | 2.7 | 49.00 | 0.0486 | 0.29 | 11.11 | 0.0110 |
| C2-Fluorenes | 0.6 | 24.19 | 0.0353 | 0.29 | 11.69 | 0.0170 | 0.15 | 10.79 | 0.0157 | 1.5 U | 13.61 | 0.0198 | 0.18 U | 3.45 | 0.0050 |
| C2-Naphthalenes | 0.53 | 21.37 | 0.0419 | 0.34 | 13.71 | 0.0269 | 0.36 | 25.90 | 0.0508 | 1.5 U | 13.61 | 0.0267 | 0.18 U | 3.45 | 0.0068 |
| C2-Phenanthrenes/Anthracenes | 2.5 | 100.81 | 0.1351 | 0.74 | 29.84 | 0.0400 | 0.48 | 34.53 | 0.0463 | 1.6 | 29.04 | 0.0389 | 0.2 | 7.66 | 0.0103 |
| C3-Chrysene/Benzo(a)anthracene | 0.88 | 35.48 | 0.0319 | 0.4 | 16.13 | 0.0145 | 0.18 | 12.95 | 0.0116 | 1.5 U | 13.61 | 0.0122 | 0.18 U | 3.45 | 0.0031 |
| C3-Fluorenes | 1.6 | 64.52 | 0.0839 | 0.75 | 30.24 | 0.0393 | 0.38 | 27.34 | 0.0356 | 1.5 U | 13.61 | 0.0177 | 0.18 U | 3.45 | 0.0045 |
| C3-Naphthalenes | 1.5 | 60.48 | 0.1041 | 0.59 | 23.79 | 0.0409 | 0.29 | 20.86 | 0.0359 | 1.5 U | 13.61 | 0.0234 | 0.18 U | 3.45 | 0.0059 |
| C3-Phenanthrenes/Anthracenes | 3.3 | 133.06 | 0.1605 | 1.1 | 44.35 | 0.0535 | 0.54 | 38.85 | 0.0469 | 1.5 U | 13.61 | 0.0164 | 0.18 U | 3.45 | 0.0042 |
| C4-Chrysene/Benzo(a)anthracene | 0.46 | 18.55 | 0.0153 | 0.18 | 7.26 | 0.0060 | 0.12 U | 4.32 | 0.0036 | 1.5 U | 13.61 | 0.0112 | 0.18 U | 3.45 | 0.0028 |
| C4-Naphthalenes | 1.7 | 68.55 | 0.1043 | 0.72 | 29.03 | 0.0442 | 0.39 | 28.06 | 0.0427 | 1.5 U | 13.61 | 0.0207 | 0.18 U | 3.45 | 0.0052 |
| C4-Phenanthrenes/Anthracenes | 1.9 | 76.61 | 0.0839 | 0.62 | 25.00 | 0.0274 | 0.3 | 21.58 | 0.0236 | 1.5 U | 13.61 | 0.0149 | 0.18 U | 3.45 | 0.0038 |
| Chrysene | 3.3 | 133.06 | 0.1611 | 2.4 | 96.77 | 0.1172 | 2.3 | 165.47 | 0.2003 | 19 | 344.83 | 0.4175 | 2.1 | 80.46 | 0.0974 |
| Dibenz(a,h)anthracene | 0.58 | 23.39 | 0.0208 | 0.26 | 10.48 | 0.0093 | 0.34 | 24.46 | 0.0218 | 2.9 | 52.63 | 0.0469 | 0.32 | 12.26 | 0.0109 |
| Fluoranthene | 6.4 | 258.06 | 0.3650 | 4.8 | 193.55 | 0.2738 | 6 | 431.65 | 0.6105 | 48 | 871.14 | 1.2322 | 5.3 | 203.07 | 0.2872 |
| Fluorene | 0.19 U | 1.74 | 0.0032 | 0.12 | 4.84 | 0.0090 | 0.37 | 26.62 | 0.0495 | 1.7 | 30.85 | 0.0573 | 0.18 U | 3.45 | 0.0064 |
| Indeno(1,2,3-cd)pyrene | 2.3 | 92.74 | 0.0832 | 1.6 | 64.52 | 0.0579 | 1.4 | 100.72 | 0.0903 | 15 | 272.23 | 0.2442 | 1.4 | 53.64 | 0.0481 |
| Naphthalene | 0.19 U | 1.74 | 0.0045 | 0.12 U | 2.42 | 0.0063 | 0.12 U | 4.32 | 0.0112 | 1.5 U | 13.61 | 0.0354 | 0.18 U | 3.45 | 0.0090 |
| Perylene | 0.6 | 24.19 | 0.0561 | 0.47 | 18.95 | 0.0440 | 0.49 | 35.25 | 0.0818 | 4.5 | 81.67 | 0.1895 | 0.42 | 16.09 | 0.0373 |
| Phenanthrene | 1.7 | 68.55 | 0.1150 | 1.4 | 56.45 | 0.0947 | 3.2 | 230.22 | 0.3863 | 19 | 344.83 | 0.5786 | 1.9 | 72.80 | 0.1221 |
| Pyrene | 5.3 | 213.71 | 0.3066 | 3.7 | 149.19 | 0.2141 | 4.4 | 316.55 | 0.4542 | 36 | 653.36 | 0.9374 | 3.7 | 141.76 | 0.2034 |
| Organic Carbon (total) | 5.45 | | | 2.48 | | | 1.39 | | | 5.51 | | | 2.61 | | |
| sum total of $ESBTU_{FCVi}$ | | | 3.0585 | | | 1.9057 | | | 3.6072 | | | 6.9183 | | | 1.4896 |

**TABLE D-3**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - TOC, OIL AND GREASE, AND PERCENT SOLIDS**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S01-DC-01 4/02/07 | S02-DC-02 4/02/07 | S03-DC-03 4/02/07 | S04-DC-04 4/02/07 | S05-DC-05 4/03/07 | S06-DC-06 4/03/07 | | | |
| Total Organic Carbon (%) | 8.56 H, LD | 11.1 H, LD | 4.86 H, LD | 7.15 H, LD | 12.2 H, LD | 6.24 H, LD | NE | NE | NE |
| Oil & Grease | 1,100 J | 2,130 J | 2,390 J | 6,360 U | 3,400 J | 2,740 J | NE | NE | NE |
| Percent Solids | 76.9 | 34.2 | 69.4 | 32.3 | 34.1 | 37.9 | NE | NE | NE |

**TABLE D-3**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - TOC, OIL AND GREASE, AND PERCENT SOLIDS**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S07-DC-07 4-02-07 | S08-DC-08 4-02-07 | S09-DC-09 4/02/07 | S10-DC-10 4/03/07 | S11-DC-11 4/03/07 | S12-DC-12 4/03/07 | | | |
| Total Organic Carbon (%) | 15.8 H, LD | 7.48 H, LD | 28.7 H, LD | 5.93 H, LD | 7.33 H, LD | 26.7 H, LD | NE | NE | NE |
| Oil & Grease | 7,600 U | 4,050 J | 3,770 J | 4,060 U | 4,790 J | 13,900 U | NE | NE | NE |
| Percent Solids | 29.1 | 21.5 | 33.9 | 44.0 | 29.2 | 15.8 | NE | NE | NE |

**TABLE D-3**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - TOC, OIL AND GREASE, AND PERCENT SOLIDS**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S13-DC-13 4/04/07 | S14-DC-14 4/04/07 | S15-DC-15 4/04/07 | S16-DC-16 4/02/07 | S17-DC-17 4/02/07 | S18-DC-18 4/02/07 | | | |
| Total Organic Carbon (%) | 5.09 H, LD | 10.5 H, LD | 2.96 H, LD | 3.33 H, LD | 4 H, LD | 2.56 H, LD | NE | NE | NE |
| Oil & Grease | 1,340 J | 12,600 | 3,040 U | 6,840 U | 6,370 U | 5,610 U | NE | NE | NE |
| Percent Solids | 56.7 | 34.9 | 61.4 | 31.1 | 30.5 | 33.0 | NE | NE | NE |

**TABLE D-3**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - TOC, OIL AND GREASE, AND PERCENT SOLIDS**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S19-DC-19 4/04/07 | S20-OC-01 4/02/07 | S21-OC-02 4/02/07 | S22-OC-03 4/02/07 | S23-OC-04 4/02/07 | S24-OC-05 4/02/07 | | | |
| Total Organic Carbon (%) | 2.72 H, LD | 1.47 H, LD | 7.44 H, LD | 5.03 H, LD | 4.81 H, LD | 6.39 H, LD | NE | NE | NE |
| Oil & Grease | 3,200 U | 2,730 U | 7,840 | 6,290 | 13,100 | 4,220 J | NE | NE | NE |
| Percent Solids | 62.8 | 65.8 | 46.2 | 37.1 | 44.2 | 42.0 | NE | NE | NE |

**TABLE D-3**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - TOC, OIL AND GREASE, AND PERCENT SOLIDS**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S25-OC-06 4/02/07 | S26-OC-07 4/03/07 | S27-OC-08 4/03/07 | S28-OC-09 4/04/07 | S29-OC-10 4/04/07 | S30-OC-11 4/03/07 | | | |
| Total Organic Carbon (%) | 4.56 H, LD | 7.16 H, LD | 2.94 H, LD | 2.48 H, LD | 10.1 H, LD | 5.45 H, LD | NE | NE | NE |
| Oil & Grease | 5,110 | 3,050 J | 2,000 J | 3,120 U | 1,390 J | 2,040 J | NE | NE | NE |
| Percent Solids | 49.0 | 49.9 | 58.7 | 66.8 | 58.3 | 45.7 | NE | NE | NE |

**TABLE D-3**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - TOC, OIL AND GREASE, AND PERCENT SOLIDS**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S31-OC-12 4/03/07 | S32-OC-13 4/03/07 | S33-OC-14 4/03/07 | S34-OC-15 4/03/07 | S35-OC-16 4/03/07 | S36-OC-17 4/03/07 | | | |
| Total Organic Carbon (%) | 5.46 H, LD | 3.42 H, LD | 2.48 H, LD | 4.62 H, LD | 4.12 H, LD | 4.96 H, LD | NE | NE | NE |
| Oil & Grease | 1,940 J | 7,460 | 3,350 | 12,500 | 13,000 | 3,910 | NE | NE | NE |
| Percent Solids | 57.3 | 71.3 | 65.5 | 59.9 | 62.7 | 63.2 | NE | NE | NE |

**TABLE D-3**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - TOC, OIL AND GREASE, AND PERCENT SOLIDS**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S37-OC-18 4/03/07 | S38-OC-19 4/03/07 | S39-OC-20 4/03/07 | S40-OC-21 4/03/07 | S41-OC-21A 4/04/07 | S42-OC-22 4/03/07 | | | |
| Total Organic Carbon (%) | 4.38 H, LD | 1.39 H, LD | 2.63 H, LD | 5.51 H, LD | 3.4 H, LD | 5.51 H, LD | NE | NE | NE |
| Oil & Grease | 2,470 J | 1,550 J | 2,740 J | 1,720 J | 1,750 J | 9,120 | NE | NE | NE |
| Percent Solids | 64.2 | 77.5 | 67.7 | 47.2 | 54.8 | 63.2 | NE | NE | NE |

**TABLE D-3**
**SUMMARY OF SEDIMENT SAMPLE ANALYTICAL RESULTS - TOC, OIL AND GREASE, AND PERCENT SOLIDS**
**DUCK AND OTTER CREEKS**
**TOLEDO, OHIO**

| Parameter | Sample Number and Date Collected | | | | | | Human Health Reference Limit for Soil[a] | Ecological Reference Limit for Sediment[b] | OEPA Sediment Reference Values[c] |
|---|---|---|---|---|---|---|---|---|---|
| | S43-OC-23 4/03/07 | S44-OC-24 4/03/07 | S45-OC-25 4/03/07 | S46-OC-26 4/03/07 | S47-ER-EK-01 4/04/07 (milligrams per liter) | S47-ER-SH-02 4/04/07 (milligrams per liter) | | | |
| Total Organic Carbon (%) | 3.07 H, LD | 1.85 H, LD | 13.2 H, LD | 2.61 H, LD | 1.9 J | 1.4 J | NE | NE | NE |
| Oil & Grease | 4,160 | 2,900 | 1,560 J | 2,530 J | | 1.8 U | NE | NE | NE |
| Percent Solids | 58.8 | 70.5 | 58.1 | 58.9 | NA | NA | NE | NE | NE |

Notes:

[a] Human health reference limits taken from EPA Region 9 preliminary remediation goals (PRG) for residential soil exposure (EPA 2004c).

[b] Ecological reference limits were provided by EPA GLNPO (MacDonald and others 2000).

[c] Statewide or available local ecoregion sediment reference values taken from OEPA Guidance for Conducting Ecological Risk Assessments (OEPA 2003a).

% = Percent
B = Analyte detected in laboratory method blank.
H = Estimated value. Holding time exceeded.
J = Estimated value. Greater than detection limit, but less than reporting limit.
LD = Estimated value. Batch quality control for lab duplicate exceeds upper or lower control limits.
NE = Not established
OEPA = Ohio Environmental Protection Agency
R = Value is rejected
U = Analyte not detected at or above reporting limit.

**Bold** values exceed ecological and human health reference limits
*Italicized* values exceed ecological reference limits
All values expressed in milligrams per kilogram unless otherwise noted

TABLE D-4

Factors Used To Evaluate Potential Stressors in Bioassay Results for Duck and Otter Creeks

| | Bioassay Survival[a] | AVS/SEM[a] | Σ PAH EDTUb | Sediment Silt and Clay Fraction[a] | TOC[a] | Sediment Solids Fraction[a] | Oil and Grease[a] | Pest/PCB TEC HQ | AVS[a] |
|---|---|---|---|---|---|---|---|---|---|
| | Percent | unitless | Unitless | Percent | Percent | Percent | mg/kg | unitless | mg/kg |
| DC-01 | 43.3 | 0.15 | 0.314 | 20.7 | 8.56 | 76.9 | 1100 | 4.7 | 279 |
| DC-03 | 85 | 0.097 | 0.3746 | 22.2 | 4.86 | 69.4 | 2390 | 3.11 | 329 |
| DC-05 | 40 | 0.057 | 0.2081 | 94.4 | 12.2 | 37.9 | 2740 | 4.69 | 1900 |
| DC-08 | 45 | 0.088 | 0.4561 | 95.8 | 7.48 | 21.5 | 4050 | 11.6 | 2450 |
| DC-10 | 88.3 | 0.088 | 0.4599 | 93.4 | 5.93 | 44 | 4060 | 7.2 | 361 |
| DC-13 | 90 | 0.094 | 0.9603 | 54.6 | 5.09 | 56.7 | 1340 | 12.1 | 652 |
| DC-14 | 86.7 | 0.055 | 21.7935 | 18.9 | 10.5 | 34.9 | 12600 | 2.46 | 702 |
| OC-01 | 60 | 0.48 | 4.6025 | 73.1 | 1.47 | 65.8 | 2730 | 23.3 | 80.1 |
| OC-03 | 48.3 | 0.22 | 2.6464 | 90.2 | 5.03 | 37.1 | 6290 | 3.42 | 565 |
| OC-05 | 16.7 | 0.28 | 0.5624 | 98.3 | 6.39 | 42 | 4220 | 2.36 | 450 |
| OC-07 | 16.7 | 0.12 | 1.7217 | 45 | 7.16 | 49.9 | 3050 | 6.18 | 749 |
| OC-11 | 43.3 | 0.11 | 3.0585 | 66 | 5.45 | 45.7 | 2040 | 1.99 | 1030 |
| OC-14 | 51.7 | 0.18 | 1.9057 | 46.5 | 2.48 | 65.5 | 7460 | 3.28 | 543 |
| OC-19 | 53.3 | 0.2 | 3.6072 | 17.7 | 1.39 | 77.5 | 1550 | 4.83 | 280 |
| OC-22 | 30 | 0.074 | 6.90183 | 24.7 | 5.51 | 63.2 | 9120 | 1.86 | 1250 |
| OC-26 | 35 | 0.24 | 1.4896 | 66.1 | 2.61 | 58.9 | 2530 | 1.68 | 231 |

Note:

| | |
|---|---|
| AVS/SEM | acid volatile sulfide/ simultaneously extracted metals |
| Σ PAH EDTU | Sum of equlibrium partioning sediment benchmark toxic units |
| TOC | total organic carbon |
| mg/kg | milligram per kilogram |
| Pest/PCB TEC HQ | pesticide/polychlorinated biphenyl threshold effect concentration hazard quotient |
| [a] | Values take from SULTrac 2007. |
| [b] | Σ PAH EDTU calculated values found in Table D-1 |

# TETRATECH, EMI
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# DUCK AND OTTER CREEKS

# SEDIMENT TOXICITYTESTING

Presented by:

American Aquatic Testing, Inc.
890 North Graham Street
Allentown, Pennsylvania 18109

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C. Chain of Custody Documentation

# DUCK AND OTTER CREEKS
# SEDIMENT TOXICITY TESTING

## INTRODUCTION

During the month of April 2007, 16 sediment samples were collected from the Duck and Otter Creeks in the Maumee River Area of Concern (MAOC) near Toledo, Ohio. Those sediment samples were used to perform toxicity testing to determine whether the tested matrices represent a significant threat to potential receptor organisms that may inhabit the sediments in that portion of the MAOC.

The Duck and Otter Creek sediment samples were evaluated for toxicity using a 20-day solid phase exposure test, using the freshwater invertebrate *Chironomus tentans* (midge)[1]. At the end of the exposure period, surviving test organisms from the sediment samples were collected, enumerated and weighed. The Duck and Otter Creek sediment sample results were compared to a control test set, all tests being performed under similar conditions. The endpoints used for determination of potential threat were mortality, measured as mean survival and growth, measured as mean dry weight.

## MATERIALS AND METHODS

Sediment grab samples were collected from previously chosen sampling locations in portions of Duck and Otter Creeks where other assessments have been conducted in the past. All sample locations were selected across areas which have been previously identified with impacted sediments.

### *Preparation of sediment samples for testing*

The sediment samples were collected on April 2, 3 and 4, 2007, placed in two-gallon HDPE containers, which were maintained on ice and transported to American Aquatic Testing, Inc.'s (AAT) Allentown, Pennsylvania laboratory on ice. The samples were sieved by AAT personnel using a 1000 µm mesh sieve to remove large debris and indigenous species that could have either competed with or potentially preyed upon the test organisms. The sieved portion of the sediment sample was then transferred to new, clean 1-gallon HDPE containers, sealed and stored at 0-4° C until used for setting up the testing on April 18, 2007.

The control sediment that was used for the test was collected from the Spruce Run Reservoir in Clinton, New Jersey on April 12, 2007, was sieved on April 13, 2007 and stored in the same manner as the Duck and Otter Creek sediment samples.

### *Test organisms*

Test organisms (*Chironomus tentans*) were obtained from stock cultures maintained by Aquatic Biosystems, Inc. of Fort Collins, CO on April 17, 2007. During the short holding period prior to test initiation, the organisms were held under conditions similar to those that they would encounter during the test (see Table I), to acclimate them. At the beginning of the 20-day test exposure the test organisms were <1 day old.

A reference toxicant test using potassium chloride as the toxicant was performed concurrently with the 20-day exposure to evaluate the sensitivity of the lot of organisms used in the sediment test. The test conducted by AAT produced a 48 hr $LC_{50}$ of 2618.3 ppm that falls within the acceptable range of the AAT internal control chart. The mean of the reference toxicant chart is 3207.4 ppm with confidence limits from 181.8 to 6232.9 ppm.

*Experimental procedures*

The entire sediment exposure series for this project consisted of 16 sediment samples collected from Duck and Otter Creeks and one control sediment sample from Spruce Run Reservoir. Test chambers (300 mL tall form borosilicate glass beakers) were filled with 100 mL of sediment. The sediment in each chamber was then covered with 175 mL of test water, EPA moderately hard water, with calcium hardness of 80-100 mg/L. Each sample exposure and control exposure consisted of five replicate chambers. All of the test chambers, following setup, were allowed to settle for 24 hours prior to test initiation.

After the settling period, the overlying water was siphoned off and fresh test water was introduced, using a small, round HDPE disk suspended over the sediment to deflect the water flow and minimize disturbance to the sediment. At the time the test was initiated alkalinity, ammonia, conductivity, dissolved oxygen, hardness, pH and temperature were measured for the overlying water for each test sample and the control.

The exposure period began when 12 randomly selected test organisms were introduced into each test chamber. Care was taken when the organisms were introduced into the test chambers to ensure that the organisms were released beneath the surface of the overlying water to keep air bubbles from forcing the organisms to the surface. Each test chamber was then fed 4.0 mg of fish flake food. Test conditions are summarized in Table I.

Each day during the exposure period observations were carried out on each chamber to determine the number of organisms that were either dead, swimming, on the surface of the sediment or on the surface of the water. Dissolved oxygen, pH and temperature were also measured daily. The overlying water was siphoned off twice a day and replaced as a measure for maintaining sufficient dissolved oxygen levels and prevent anoxic conditions from affecting the test results.. Care was taken to minimize disturbance of the sediment during water renewal.

At the end of the 20-day exposure the final alkalinity, ammonia, conductivity, dissolved oxygen, hardness, pH and temperature were measured, and the test chambers were prepared for the removal of test organisms. Each chamber was gently stirred using a pipette to suspend the sediment in the overlying water. This slurry was then poured into a #60 mesh sieve (250 µm) and gently rinsed in a shallow pan of laboratory water to remove the finer grains of the sediment and retain the test organisms. The remaining contents of the sieve were then placed into a second shallow pan of laboratory water, placed over a light table, and carefully sorted to find the surviving test organisms in each of the five replicates for each site Duck and Otter Creek sediment sample. All surviving organisms from each chamber were then transferred to a 30 mL soufflé cup for live count verification and preparation for weight analysis.

When all test chambers had been sorted and the number of survivors verified, 0.5 mL of ethanol was added to each soufflé cup to dispatch the organisms. They were then transferred to a previously dried and tared aluminum pan and placed into an oven to dry at 105° C for a minimum of six hours. Upon removal from the oven, the pans were placed into a desiccator to cool and then were weighed to the nearest 0.01 mg.

*Data analysis*

Data analysis was performed following procedures published by the USEPA[1] using ToxCalc™ v5.0.23F data analysis software. Survival data were arcsine squareroot transformed, tested for normality using the Kolmogorov D Test, and tested for homogeneity of variances using Bartlett's test. Normally distributed data were analyzed using Analysis of Variance (ANOVA) followed by Dunnett's pairwise comparison of test means, or Bonferroni t Test. Non-normal data or those data sets exhibiting heterogeneity of variances were analyzed using Steel's Many-one Rank test or Wilcoxon Rank Sum, or other analysis as appropriate.

All raw data sheets are located in Appendix A.

**TABLE I: Summary of Conditions for *Chironomus tentans* Toxicity Test**

| | | |
|---|---|---|
| 1. | Test type; | Whole sediment, static, daily renewal |
| 2. | Temperature; | 23.0 +/- 1.0 ° C |
| 3. | Light quality; | Wide-spectrum fluorescent illumination |
| 4. | Light intensity; | 50 - 100 foot-candles |
| 5. | Photoperiod; | 16 hours light, 08 hours dark |
| 6. | Test chamber size; | 300 mL high form borosilicate glass beakers |
| 7. | Sediment volume; | 100 mL / replicate |
| 8. | Overlying water volume; | 175 mL |
| 9. | Renewal; | 2 volume exchanges per day |
| 10. | Age of test organisms; | < 1 day |
| 11. | Number organisms / container; | 12 |
| 12. | Replicates; | 5 |
| 13. | Feeding; | 4.0 mg flake fish food / day |
| 14. | Aeration; | None unless dissolved oxygen concentrations were ≤ 40 % saturation, then ~ 100 bubbles / min. |
| 15. | Overlying water; | Laboratory Reconstituted Moderately Hard Water |
| 16. | Test chamber cleaning; | Only if necessary |
| 17. | Overlying water quality; | D. O., pH and temperature daily; alkalinity, ammonia, conductivity and hardness at beginning and end of test |
| 18. | Test duration; | 20 days |
| 19. | Endpoints; | Percent survival and growth (mean dry weight) |
| 20. | Test acceptability; | Minimum control survival 70 %, average control dry weight 0.6 mg |

## RESULTS

*Effects on Survival – Duck and Otter Creek Sediment Samples*

For the first of the two endpoints used, survival, the data from all sample locations are analyzed in groups which correspond to TABLE 7: DUCK AND OTTER CREEK SAMPLING LOCATIONS BY EXPOSURE AREA taken from the QUALITY ASSURANCE PROJECT PLAN AND FIELD SAMPLING PLAN DUCK AND OTTER CREEKS TOLEDO AND OREGON, OHIO (QAPP). All samples are compared to the laboratory control, which exceeded the required minimum of 70% survival.

Of the nine sediment samples from Otter Creek, only OC-01 exhibited survival not found to be different from the control. All other locations were significantly different from the control sample. Tables II through VI summarize results for Otter Creek Exposure Areas OC-A through OC-E, respectively.

Table II: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-A

| Rep | CONTROL | OC-01 | OC-03* | OC-05* | OC-07* |
|---|---|---|---|---|---|
| A | 91.7 | 41.7 | 58.3 | 41.7 | 41.7 |
| B | 83.3 | 91.7 | 0 | 0 | 0 |
| C | 100 | 75 | 58.3 | 0 | 25 |
| D | 83.3 | 75 | 83.3 | 33.3 | 25 |
| E | 100 | 16.7 | 41.7 | 8.3 | 33.3 |
| **Mean Survival** | **91.7** | **60** | **48.3** | **16.7** | **16.7** |
| **Statistically different from Control?** | | **NO** | **YES** | **YES** | **YES** |

* No growth analysis performed

Table III: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-B

| Rep | CONTROL | OC-07* | OC-11* |
|---|---|---|---|
| A | 91.7 | 41.7 | 50 |
| B | 83.3 | 0 | 58.3 |
| C | 100 | 25 | 50 |
| D | 83.3 | 25 | 33.3 |
| E | 100 | 33.3 | 25 |
| **Mean Survival** | **91.7** | **16.7** | **43.3** |
| **Statistically different from Control?** | | **YES** | **YES** |

* No growth analysis performed

Table IV: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-C

| Rep | CONTROL | OC-11* | OC-14* |
|---|---|---|---|
| A | 91.7 | 50 | 58.3 |
| B | 83.3 | 58.3 | 100 |
| C | 100 | 50 | 33.3 |
| D | 83.3 | 33.3 | 33.3 |
| E | 100 | 25 | 33.3 |
| **Mean Survival** | **91.7** | **43.3** | **51.7** |
| **Statistically different from Control?** | | **YES** | **YES** |

* No growth analysis performed

Table V: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-D

| Rep | CONTROL | OC-19* | OC-22* |
|---|---|---|---|
| A | 91.7 | 58.3 | 58.3 |
| B | 83.3 | 66.7 | 58.3 |
| C | 100 | 33.3 | 0 |
| D | 83.3 | 50 | 8.3 |
| E | 100 | 58.3 | 25 |
| **Mean Survival** | **91.7** | **53.3** | **30** |
| **Statistically different from Control?** | | **YES** | **YES** |

* No growth analysis performed

Table VI: Percent survival of *C. tentans* by replicate chamber and location exposure area OC-E

| Rep | CONTROL | OC-22* | OC-26* |
|---|---|---|---|
| A | 91.7 | 58.3 | 41.7 |
| B | 83.3 | 58.3 | 0 |
| C | 100 | 0 | 58.3 |
| D | 83.3 | 8.3 | 25 |
| E | 100 | 25 | 50 |
| **Mean Survival** | **91.7** | **30** | **35** |
| **Statistically different from Control?** | | **YES** | **YES** |

* No growth analysis performed

Of the seven sediment samples from Duck Creek, sites DC-01, DC-05 and DC-08 exhibited survival that was found to be statistically different from the control sample. The remaining sites; DC-03, DC-010, DC-13 and DC-14 were not found to be different from the control. All other locations were significantly different from the control sample. Tables VII through XI summarize results for Duck Creek Exposure Areas DC-A through DC-E, respectively.

Table VII: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-A

| Rep | CONTROL | DC-01* | DC-03 | DC-05* |
|---|---|---|---|---|
| A | 91.7 | 0 | 100 | 8.3 |
| B | 83.3 | 50 | 83.3 | 25 |
| C | 100 | 58.3 | 83.3 | 66.7 |
| D | 83.3 | 66.7 | 91.7 | 66.7 |
| E | 100 | 41.7 | 66.7 | 33.3 |
| **Mean Survival** | **91.7** | **43.3** | **85** | **40** |
| **Statistically different from Control?** | | **YES** | **NO** | **YES** |

* No growth analysis performed

Table VIII: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-B

| Rep | CONTROL | DC-05* | DC-08* |
|---|---|---|---|
| A | 91.7 | 8.3 | 75 |
| B | 83.3 | 25 | 66.7 |
| C | 100 | 66.7 | 0 |
| D | 83.3 | 66.7 | 83.3 |
| E | 100 | 33.3 | 0 |
| **Mean Survival** | **91.7** | **40** | **45** |
| **Statistically different from Control?** | | **YES** | **YES** |

* No growth analysis performed

Table IX: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-C

| Rep | CONTROL | DC-08* | DC-10 |
|---|---|---|---|
| A | 91.7 | 75 | 75 |
| B | 83.3 | 66.7 | 66.7 |
| C | 100 | 0 | 100 |
| D | 83.3 | 83.3 | 100 |
| E | 100 | 0 | 100 |
| **Mean Survival** | **91.7** | **45** | **88.3** |
| **Statistically different from Control?** | | **YES** | **NO** |

* No growth analysis performed

Table X: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-D

| Rep | CONTROL | DC-10 | DC-13 |
|---|---|---|---|
| A | 91.7 | 75 | 66.7 |
| B | 83.3 | 66.7 | 83.3 |
| C | 100 | 100 | 100 |
| D | 83.3 | 100 | 100 |
| E | 100 | 100 | 100 |
| **Mean Survival** | **91.7** | **88.3** | **90** |
| **Statistically different from Control?** | | **NO** | **NO** |

Table XI: Percent survival of *C. tentans* by replicate chamber and location exposure area DC-E

| Rep | CONTROL | DC-13 | DC-14 |
|---|---|---|---|
| A | 91.7 | 66.7 | 75 |
| B | 83.3 | 83.3 | 83.3 |
| C | 100 | 100 | 91.7 |
| D | 83.3 | 100 | 100 |
| E | 100 | 100 | 83.3 |
| **Mean Survival** | **91.7** | **90** | **86.7** |
| **Statistically different from Control?** | | **NO** | **NO** |

All statistical analyses are provided in Appendix B.

*Effects on Growth – Duck and Otter Creek Sediment Samples*

For the second of the two endpoints used, growth, measured as mean dry weight, the data from all sample locations are analyzed in groups which correspond to TABLE 7: DUCK AND OTTER CREEK SAMPLING LOCATIONS BY EXPOSURE AREA taken from the QUALITY ASSURANCE PROJECT PLAN AND FIELD SAMPLING PLAN DUCK AND OTTER CREEKS TOLEDO AND OREGON, OHIO (QAPP). All samples are compared to the laboratory control, which exceeded the recommended minimum of 0.6 mg per individual.

Of the nine sediment samples from Otter Creek, only OC-01 exhibited growth not found to be different from the control. All other locations were not analyzed for growth as they had significant reduction in survival. Table XII summarizes the result for Otter Creek Exposure Area OC-A.

Table XII: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area OC-A

| Rep | CONTROL | OC-01 |
|---|---|---|
| A | 1.2682 | 2.5940 |
| B | 1.4520 | 1.3055 |
| C | 1.0158 | 1.8178 |
| D | 1.6320 | 1.1944 |
| E | 1.2842 | 4.980 |
| **Mean Dry Weight** | **1.3304** | **2.3783** |
| **Statistically different from Control?** | | **NO** |

Of the seven sediment samples from Duck Otter Creek, several were found to not be significantly different from the control based on survival and were analyzed for growth. In Exposure Area DC-A, sample DC-03 had growth that exceeded that for the control. In Exposure Area DC-C sample DC-10 also exhibited growth greater than the control sample. For Exposure Areas DC-D and DC-E, all samples surpassed the control sample for growth. Tables XIII through XVI summarize the results for Duck Creek Exposure Area DC-A, DC-C, DC-D and DC-E, respectively.

All statistical analyses are provided in Appendix B.

Table XIII: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area DC-A

| Rep | CONTROL | DC-03 |
|---|---|---|
| A | 1.2682 | 1.5092 |
| B | 1.4520 | 1.5200 |
| C | 1.0158 | 1.3780 |
| D | 1.6320 | 1.3564 |
| E | 1.2842 | 1.7813 |
| Mean Dry Weight | **1.3304** | **1.5090** |
| Statistically different from Control? | | NO |

Table XIV: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area DC-C

| Rep | CONTROL | DC-10 |
|---|---|---|
| A | 1.2682 | 1.6778 |
| B | 1.4520 | 2.2550 |
| C | 1.0158 | 1.3108 |
| D | 1.6320 | 1.2783 |
| E | 1.2842 | 1.2333 |
| Mean Dry Weight | **1.3304** | **1.5511** |
| Statistically different from Control? | | NO |

Table XV: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area DC-D

| Rep | CONTROL | DC-10 | DC-13 |
|---|---|---|---|
| A | 1.2682 | 1.6778 | 1.1600 |
| B | 1.4520 | 2.2550 | 1.3950 |
| C | 1.0158 | 1.3108 | 1.3158 |
| D | 1.6320 | 1.2783 | 1.3108 |
| E | 1.2842 | 1.2333 | 1.4983 |
| Mean Dry Weight | **1.3304** | **1.5511** | **1.3360** |
| Statistically different from Control? | | NO | NO |

Table XVI: Mean dry weight in mg. of *C. tentans* by replicate chamber and location exposure area DC-E

| Rep | CONTROL | DC-14 |
|---|---|---|
| A | 1.2682 | 1.7167 |
| B | 1.4520 | 1.3870 |
| C | 1.0158 | 1.4782 |
| D | 1.6320 | 1.1950 |
| E | 1.2842 | 1.5930 |
| Mean Dry Weight | **1.3304** | **1.474** |
| Statistically different from Control? | | **NO** |

**REFERENCES**

[1] **Ingersoll, C.G.** Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates Second Edition EPA 600/R-99/064, MARCH 2000

# APPENDIX A

## RAW DATA FOR *Chironomus tentans* 20 DAY SURVIVAL AND GROWTH TEST

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Deposited 4/15-16/07

## Sediment Test
### American Aquatic Testing, Inc.
### Observations / Live Count

| Conc. | Rep | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 | Day 9 | Day 10 Observ. | Day 10 Final Live Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| OC-01 | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| OC-03 | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| OC-05 | A | N | N | N | W | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| OC-07 | A | N | N | N | W | N | N | N | N | N | N | |
| | B | N | N | N | W | N | N | N | N | N | N | |
| | C | N | N | N | W | N | N | N | N | N | N | |
| | D | N | N | N | W | N | N | N | N | N | N | |
| | E | N | N | N | W | N | N | N | N | N | N | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | Intials | TAP | MKP | MKP | MKP | TAP | TAP | TAP | MKP | MKP | [illegible] | |
| | Date | 4/19 | 4/20 | 4/21 | 4/22 | 4/23 | 4/24 | 4/25 | 4/26 | 4/27 | 04/28 | |

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

FWSEDOBS.wk4

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Deposited 4/15-16/07

# Sediment Test

## American Aquatic Testing, Inc.
## Observations / Live Count

| Conc. | Rep | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 | Day 9 | Day 10 Observ. | Day 10 Final Live Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| ~~Control~~ | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| OC-11 | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| OC-14 | E | N | N | N | N | N | N | N | N | N | N | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| OC-19 | E | N | N | N | N | N | N | N | N | N | N | |
| | F | | | | | | | | 1 | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| OC-22 | E | N | N | N | N | N | N | N | N | N | N | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| OC-26 | E | N | N | N | N | N | N | N | N | N | N | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | Intials | TAP | MRP | MRP | MAP | TAP | TAP | TAP | MRP | MRP | [illegible] | |
| | Date | 4/19 | 4/20 | 4/21 | 4/22 | 4/23 | 4/24 | 4/25 | 4/26 | 4/27 | 04/08 | |

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

FWSEDOBS.wk4

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Deposited 4/15-16/07

# Sediment Test
## American Aquatic Testing, Inc.
### Observations / Live Count

| Conc. | Rep | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 | Day 9 | Day 10 Observ. | Day 10 Final Live Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~Control~~ DC-01 | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| DC-03 | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| DC-05 | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| | ~~F~~ | | | | | | | | | | N | |
| | ~~G~~ | | | | | | | | | | N | |
| | ~~H~~ | | | | | | | | | | | |
| DC-08 | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| DC-10 | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | Intials | TDP | MEP | MKD | MKD | TDP | TDP | TDP | MEP | MEP | [illegible] | |
| | Date | 4/19 | 4/20 | 4/21 | 4/22 | 4/23 | 4/24 | 4/25 | 4/26 | 4/27 | 4/28 | |

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

FWSEDOBS.wk4

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Deposited 4/15-16/07

# Sediment Test
## American Aquatic Testing, Inc.
### Observations / Live Count

| Conc. | Rep | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 | Day 9 | Day 10 Observ. | Day 10 Final Live Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | N | N | N | N | N | N | N | |
| | C | N | N | N | W | N | N | N | N | N | N | |
| [redacted]ol | D | N | N | N | N | N | N | N | N | N | N | |
| | E | N | N | N | N | N | N | N | N | N | N | |
| DC-13 | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | A | N | N | N | N | N | N | N | N | N | N | |
| | B | N | N | N | W | N | N | N | N | N | N | |
| | C | N | N | W | N | N | N | N | N | N | N | |
| | D | N | N | N | N | N | N | N | N | N | N | |
| DC-14 | E | N | N | W | N | N | N | N | N | N | N | |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | A | | | | | | | | | | | |
| | B | | | | | | | | | | | |
| | C | | | | | | | | | | | |
| | D | | | | | | | | | | | |
| | E | | | | | | | | | | | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | A | | | | | | | | | | | |
| | B | | | | | | | | | | | |
| | C | | | | | | | | | | | |
| | D | | | | | | | | | | | |
| | E | | | | | | | | | | | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | A | | | | | | | | | | | |
| | B | | | | | | | | | | | |
| | C | | | | | | | | | | | |
| | D | | | | | | | | | | | |
| | E | | | | | | | | | | | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | Intials | TAP | WP | MAP | MAP | TAP | TAP | TAP | MP | MP | [illegible] | |
| | Date | 4/19 | 4/20 | 4/21 | 4/22 | 4/23 | 4/24 | 4/25 | 4/26 | 4/27 | 4/28 | |

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

FWSEDOBS.wk4

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1810
Hatch Date: Deposited 4/15-16/07

## Sediment Test
**American Aquatic Testing, Inc.**
**Observations / Live Count**

| Conc. | Rep | Day 11 | Day 12 | Day 13 | Day 14 | Day 15 | Day 16 | Day 17 | Day 18 | Day 19 | Day 20 Observ. | Day 20 Final Live Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | A | N | N | N | N | N | 1F | N | 1F | 1F | N | 11 |
| | B | N | N | N | N | N | 2F | N | 1F | 2F | N | 10 |
| | C | N | N | 1F | 1F | N | N | N | 2F | N | N | 12 |
| | D | 1F | 1F | N | N | N | N | N | 1F | 3F | N | 10 |
| | E | N | N | N | N | N | 1F | 1F | 2F | 1M | N | 12 |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| OC-01 | A | N | N | 1F | N | N | N | N | N | N | N | 5 |
| | B | N | N | 1F | 1F | 1F | 2F | N | 2F | 2F | 2F | 11 |
| | C | N | N | N | 1F | 1F | N | 1F | 1F | 2F | 1F | 9 |
| | D | N | 1F | 1F | N | 1F | N | N | 2F | N | N | 9 |
| | E | N | N | N | N | N | N | N | N | 1F | N | 2 |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| OC-03 | A | N | 1F | N | N | N | N | N | N | N | N | 7 |
| | B | N | N | N | N | N | N | N | N | N | N | 0 |
| | C | N | N | N | N | N | N | N | 1F | N | N | 7 |
| | D | N | N | N | N | N | 1F | N | 2F | N | N | 10 |
| | E | N | N | N | N | N | N | N | N | N | N | 5 |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| OC-05 | A | 1F | N | N | N | N | N | N | N | N | N | 5 |
| | B | N | N | N | N | N | N | N | N | N | N | 0 |
| | C | 1F | N | N | N | N | N | N | N | N | N | 0 |
| | D | N | N | N | N | N | N | N | N | N | N | 4 |
| | E | N | N | N | N | N | N | N | N | N | N | 1 |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| OC-07 | A | N | N | 1F | 1F | N | N | N | N | 2F | N | 5 |
| | B | 1F | N | N | N | N | N | N | N | N | N | 0 |
| | C | N | N | N | N | W | N | N | N | N | N | 3 |
| | D | N | N | N | N | N | N | N | N | N | N | 3 |
| | E | N | N | N | N | N | N | N | N | N | N | 4 |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | Intials | [illegible] | TDP | TDP | WDV | MLP | TDP | TDP | TDP | TDP | TDP | TDP |
| | Date | 4/29 | 4/30 | 5/1 | 5/2 | 5/3 | 5/4 | 5/5 | 5/6 | 5/7 | 5/8 | 5/8 |

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

FWSEDOBS.wk4

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Deposited 4/15-16/07

## Sediment Test

**American Aquatic Testing, Inc.**
**Observations / Live Count**

| Conc. | Rep | Day 11 | Day 12 | Day 13 | Day 14 | Day 15 | Day 16 | Day 17 | Day 18 | Day 19 | Day 20 Observ. | Day 20 Final Live Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~Control~~ OC-01 | A | N | N | N | N | W | N | N | N | N | 1F | 6 |
| | B | N | N | N | N | N | N | N | N | N | 1F | 7 |
| | C | N | N | N | N | N | N | N | N | 1F | N | 6 |
| | D | 1F | N | 1F | N | N | N | N | N | N | N | 4 |
| | E | N | N | N | N | N | N | N | N | N | 1F | 3 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| OC-14 | A | N | N | N | N | W | 3F | N | N | N | N | 7 |
| | B | N | N | N | 1F | N | 3F | 1F | N | N | N | 12 |
| | C | N | N | N | N | N | N | N | N | N | N | 4 |
| | D | N | N | N | N | N | N | N | N | N | N | 4 |
| | E | N | N | N | 1F | N | 1F | N | N | N | N | 4 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| OC-19 | A | N | N | N | N | N | 1F | N | N | N | N | 7 |
| | B | N | N | N | N | N | 1F | N | 2F | 3F | N | 8 |
| | C | N | N | N | N | N | N | N | N | N | N | 4 |
| | D | N | N | N | N | N | N | N | N | 1F | 2F | 6 |
| | E | N | N | N | N | N | 2F | N | 2F | N | N | 7 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| OC-22 | A | 1F | N | N | N | W | N | N | N | N | N | 7 |
| | B | N | N | N | N | N | N | N | N | N | N | 7 |
| | C | N | N | N | N | W | N | N | N | N | N | 0 |
| | D | N | N | N | N | N | N | N | N | N | N | 1 |
| | E | N | N | N | N | N | N | N | N | N | N | 3 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| OC-26 | A | 1F | N | N | N | W | 1F | N | N | 2F | 2F | 5 |
| | B | N | N | N | N | N | N | N | N | N | N | 0 |
| | C | N | N | 1F | N | N | 3F | N | N | 2F | 2F | 7 |
| | D | N | N | N | N | N | N | N | N | N | N | 3 |
| | E | N | N | N | N | N | N | N | 1F | N | 1F | 6 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | Intials | GW | TRP | TRP | WW | MLP | TRP | TRP | TRP | TRP | TRP | TRP |
| | Date | 4/29 | 4/30 | 5/1 | 5/2 | 5/3 | 5/4 | 5/5 | 5/6 | 5/7 | 5/8 | 5/8 |

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

FWSEDOBS.wk4

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Deposited 4/15-16/07

# Sediment Test

## American Aquatic Testing, Inc.

### Observations / Live Count

| Conc. | Rep | Day 11 | Day 12 | Day 13 | Day 14 | Day 15 | Day 16 | Day 17 | Day 18 | Day 19 | Day 20 Observ. | Day 20 Final Live Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | N | N | N | N | N | N | N | N | N | N | 0 |
| | B | N | N | N | N | 3F | 2F | N | N | N | N | 6 |
| | C | N | N | N | 2F | 3F | 3F | N | N | N | N | 7 |
| ~~Control~~ | D | N | 1F | N | N | N | N | N | N | 3F | N | 8 |
| | E | N | N | N | N | N | N | N | N | N | N | 5 |
| DC-01 | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | A | N | N | N | 1F | N | N | N | N | N | N | 12 |
| | B | N | N | N | 1F | N | N | N | N | N | N | 10 |
| | C | 1F | 1F | N | N | N | 1F | N | N | 1F | N | 10 |
| DC-03 | D | N | N | N | N | N | N | N | N | 1F | N | 11 |
| | E | N | N | N | N | N | 1F | N | N | N | N | 8 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | A | N | N | N | N | N | N | N | N | N | N | 1 |
| | B | N | N | N | N | N | N | N | N | N | N | 3 |
| | C | N | N | N | N | N | N | N | 1F | N | 1F | 8 |
| DC-05 | D | N | N | N | N | N | 1F | N | N | N | 1F | 8 |
| | E | N | N | N | N | N | N | N | 1F | N | N | 4 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | A | N | 1F | N | N | N | 2F | N | N | N | N | 9 |
| | B | N | N | N | 1F | 1F | 4F | N | N | 1F | N | 8 |
| | C | 1F | N | N | N | N | N | N | N | N | N | 0 |
| DC-08 | D | N | N | N | N | 1F | 2F | N | N | N | N | 10 |
| | E | N | N | N | N | N | N | N | N | N | N | 0 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | A | N | 1F | N | 2F | N | 2F | N | 2F | N | N | 9 |
| | B | N | 1F | 2F | 1F | N | 1F | 1F | 2F | 2F | N | 8 |
| | C | N | 1F | N | N | N | 1F | N | 1F | 1F | N | 12 |
| DC-10 | D | N | N | N | N | N | 1F | N | 2F | 3F | 1F | 12 |
| | E | N | 1F | N | 1F | N | 1F | 1F | 2F | 1F | N | 12 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | Intials | GN | TAP | TAP | KDV | MLD | TAP | TDD | TAP | TAP | TAP | TAP |
| | Date | 4/29 | 4/30 | 5/1 | 5/2 | 5/3 | 5/4 | 5/5 | 5/6 | 5/7 | 5/8 | 5/8 |

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

FWSEDOBS.wk4

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07-1310
Hatch Date: Deposited 4/15-16/07

**Sediment Test**
**American Aquatic Testing, Inc.**
**Observations / Live Count**

| Conc. | Rep | Day 11 | Day 12 | Day 13 | Day 14 | Day 15 | Day 16 | Day 17 | Day 18 | Day 19 | Day 20 Observ. | Day 20 Final Live Count |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ~~Control~~ DC-13 | A | N | N | N | N | N | N | N | N | N | N | 8 |
| | B | N | N | N | 1F | N | N | N | N | 1F | N | 10 |
| | C | N | N | N | N | N | 1F | N | N | 1F | N | 12 |
| | D | N | 1F | N | N | N | N | N | N | N | 1F | 12 |
| | E | N | 1F | N | N | 1F | 1F | N | N | N | 1F | 12 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| DC-14 | A | N | 1F | N | N | N | N | N | N | 1F | N | 9 |
| | B | N | 1F | N | N | N | N | N | N | N | 1F | 10 |
| | C | 1F | 2F | N | N | N | N | 1F | N | N | N | 11 |
| | D | N | N | N | N | N | N | N | N | N | N | 12 |
| | E | N | N | 1F | N | N | N | N | 1F | N | N | 10 |
| | ~~F~~ | | | | | | | | | | | |
| | ~~G~~ | | | | | | | | | | | |
| | ~~H~~ | | | | | | | | | | | |
| | A | | | | | | | | | | | |
| | B | | | | | | | | | | | |
| | C | | | | | | | | | | | |
| | D | | | | | | | | | | | |
| | E | | | | | | | | | | | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | A | | | | | | | | | | | |
| | B | | | | | | | | | | | |
| | C | | | | | | | | | | | |
| | D | | | | | | | | | | | |
| | E | | | | | | | | | | | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | A | | | | | | | | | | | |
| | B | | | | | | | | | | | |
| | C | | | | | | | | | | | |
| | D | | | | | | | | | | | |
| | E | | | | | | | | | | | |
| | F | | | | | | | | | | | |
| | G | | | | | | | | | | | |
| | H | | | | | | | | | | | |
| | Intials | [illegible] | TAP | TAP | [illegible] | MAP | TAP | TAP | TAP | TAP | TAP | TAP |
| | Date | 04/29 | 4/30 | 5/1 | 5/2 | 5/3 | 5/4 | 5/5 | 5/6 | 5/7 | 5/8 | 5/8 |

Comments:

Key: D=dead, W=on water surface, M=swimming, F=on sediment surface, N=no observations

FWSEDOBS.wk4

Client/Toxicant: 140
Project Number: 04-01
Species: C. Tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Deposited 4/15 - 4/16/07

## American Aquatic Testing, Inc.
### Weight Data

| Conc. | Rep | Pan # | A weight of boat (g) | B weight of boat & org. (g) | (B-A)*1000=C dry weight of organisms (mg) | D # of surviving org. | C/D mean dry weight (mg) | C/E $IC_{25}$ & NOEC calc. weight (mg) |
|---|---|---|---|---|---|---|---|---|
| Control | A | 1 | 0.01230 | 0.02625 | 13.95 | 11 | 1.268 | |
| | B | 2 | 0.01122 | 0.02574 | 14.52 | 10 | 1.452 | |
| | C | 3 | 0.01197 | 0.02416 | 12.19 | 12 | 1.016 | |
| | D | 4 | 0.01156 | 0.02788 | 16.32 | 10 | 1.632 | |
| | E | 5 | 0.01219 | 0.02760 | 15.41 | 12 | 1.284 | |
| | ~~F~~ | – | – | – | – | – | – | |
| | ~~G~~ | – | – | – | – | – | – | |
| | ~~H~~ | – | – | – | – | – | – | |
| OC-01 | A | 6 | 0.01182 | 0.02479 | 12.97 | 5 | 2.594 | |
| | B | 7 | 0.01086 | 0.02522 | 14.36 | 11 | 1.306 | |
| | C | 8 | 0.01247 | 0.02883 | 16.36 | 9 | 1.818 | |
| | D | 9 | 0.01131 | 0.02206 | 10.75 | 9 | 1.194 | |
| | E | 10 | 0.00986 | 0.01982 | 9.96 | 2 | 4.980 | |
| | ~~F~~ | – | – | – | – | – | – | |
| | ~~G~~ | – | – | – | – | – | – | |
| | ~~H~~ | – | – | – | – | – | – | |
| OC-03 | A | 11 | 0.01037 | 0.02407 | 13.70 | 7 | 1.957 | |
| | B | 12 | 0.00953 | — | — | 0 | — | |
| | C | 13 | 0.00953 | 0.02572 | 16.19 | 7 | 2.313 | |
| | D | 14 | 0.01009 | 0.02515 | 15.06 | 10 | 1.506 | |
| | E | 15 | 0.00982 | 0.01810 | 8.28 | 5 | 1.656 | |
| | ~~F~~ | – | – | – | – | – | – | |
| | ~~G~~ | – | – | – | – | – | – | |
| | ~~H~~ | – | – | – | – | – | – | |
| OC-05 | A | 16 | 0.00888 | 0.00945 | 0.57 | 5 | 0.114 | |
| | B | 17 | 0.00999 | 0.00000 | — | 0 | — | |
| | C | 18 | 0.00948 | 0.00000 | — | 0 | — | |
| | D | 19 | 0.01044 | 0.01083 | 0.39 | 4 | 0.098 | |
| | E | 20 | 0.00906 | 0.00910 | 0.04 | 1 | 0.040 | |
| | ~~F~~ | – | – | – | – | – | – | |
| | ~~G~~ | – | – | – | – | – | – | |
| | ~~H~~ | – | – | – | – | – | – | |
| | Initials | | [illegible] | thd | thd | MAP | thd | |
| | Date | | 5/8 | 5/9/07 | 5/9/07 | 5/8 | 5/9/07 | |

E = Original number of organisms at test initiation, adjusted for losses.

Observations:

BasicWT.wk3

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Deposited 4/15 - 4/16/07

## American Aquatic Testing, Inc.
### Weight Data

| Conc. | Rep | Pan # | A weight of boat (g) | B weight of boat & org. (g) | (B-A)*1000=C dry weight of organisms (mg) | D # of surviving org. | C/D mean dry weight (mg) | C/E $IC_{25}$ & NOEC calc. weight (mg) |
|---|---|---|---|---|---|---|---|---|
| OC-07 | A | 21 | 0.01024 | 0.01770 | 7.46 | 5 | 1.492 | |
| | B | 22 | 0.00990 | 0.00000 | — | 0 | — | |
| | C | 23 | ~~0.00933~~ 0.00933 | 0.01535 | 6.02 | 3 | 2.007 | |
| | D | 24 | 0.01037 | 0.01558 | 5.21 | 3 | 1.737 | |
| | E | 25 | 0.00912 | 0.01118 | 2.06 | 4 | 0.515 | |
| | ~~F~~ | – | – | – | – | – | – | |
| | ~~G~~ | – | – | – | – | – | – | |
| | ~~H~~ | – | – | – | – | – | – | |
| OC-11 | A | 26 | 0.00962 | 0.01952 | 9.90 | 6 | 1.650 | |
| | B | 27 | 0.00960 | 0.01940 | 9.80 | 7 | 1.400 | |
| | C | 28 | 0.00919 | 0.02249 | 13.30 | 6 | 2.217 | |
| | D | 29 | 0.00950 | 0.01426 | 4.76 | 4 | 1.190 | |
| | E | 30 | 0.00965 | 0.01427 | 4.62 | 3 | 1.540 | |
| | ~~F~~ | – | – | – | – | – | – | |
| | ~~G~~ | – | – | – | – | – | – | |
| | ~~H~~ | – | – | – | – | – | – | |
| OC-14 | A | 31 | 0.00907 | 0.01739 | 8.32 | 7 | 1.189 | |
| | B | 32 | 0.00933 | 0.01894 | 9.61 | 12 | 0.801 | |
| | C | 33 | 0.00972 | 0.01671 | 6.99 | 4 | 1.748 | |
| | D | 34 | 0.00882 | 0.01626 | 7.44 | 4 | 1.860 | |
| | E | 35 | 0.00972 | 0.01778 | 8.06 | 4 | 2.015 | |
| | ~~F~~ | – | – | | | | | |
| | ~~G~~ | – | – | | | | | |
| | ~~H~~ | – | – | | | | | |
| OC-19 | A | 36 | 0.00937 | 0.02085 | 11.48 | 7 | 1.640 | |
| | B | 37 | 0.00979 | 0.01845 | 8.66 | 8 | 1.083 | |
| | C | 38 | 0.01057 | 0.01838 | 7.81 | 4 | 1.953 | |
| | D | 39 | 0.01021 | 0.01899 | 8.78 | 6 | 1.463 | |
| | E | 40 | 0.00992 | 0.01886 | 8.94 | 7 | 1.277 | |
| | ~~F~~ | – | – | | | | | |
| | ~~G~~ | – | – | | | | | |
| | ~~H~~ | – | – | | | | | |
| | Initials / Date | | JP 5/8 | thd 5/9/07 | thd 5/9/07 | MKP 5/8 | thd 5/9/07 | |

E = Original number of organisms at test initiation, adjusted for losses.

Observations: ~~0.0099~~ 0.00933 JP 5/8

BasicWT.wk3

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Approx. 4/15 - 4/16/07

## American Aquatic Testing, Inc.
### Weight Data

| Conc. | Rep | Pan # | A weight of boat (g) | B weight of boat & org. (g) | (B-A)*1000=C dry weight of organisms (mg) | D # of surviving org. | C/D mean dry weight (mg) | C/E IC25 & NOEC calc. weight (mg) |
|---|---|---|---|---|---|---|---|---|
| OC-22 | A | 41 | 0.00930 | 0.02450 | 15.20 | 7 | 2.171 | |
| | B | 42 | 0.01118 | 0.02264 | 11.46 | 7 | 1.637 | |
| | C | 43 | 0.00924 | 0.00000 | — | 0 | — | |
| | D | 44 | 0.01043 | 0.01054 | 0.11 | 1 | 0.110 | |
| | E | 45 | 0.01045 | 0.02017 | 9.72 | 3 | 3.240 | |
| | ~~F~~ | — | — | — | — | — | — | |
| | ~~G~~ | — | — | — | — | — | — | |
| | ~~H~~ | — | — | — | — | — | — | |
| OC-26 | A | 46 | 0.00972 | 0.02623 | 16.51 | 5 | 3.302 | |
| | B | 47 | 0.00995 | 0.00000 | — | 0 | — | |
| | C | 48 | 0.00911 | 0.02175 | 12.64 | 7 | 1.806 | |
| | D | 49 | 0.00871 | 0.01489 | 6.18 | 3 | 2.060 | |
| | E | 50 | 0.00968 | 0.02030 | 10.62 | ~~6~~ ① | 1.770 | |
| | ~~F~~ | — | — | — | — | — | — | |
| | ~~G~~ | — | — | — | — | — | — | |
| | ~~H~~ | — | — | — | — | — | — | |
| DC-01 | A | 51 | 0.00973 | 0.00000 | — | 0 | — | |
| | B | 52 | 0.00929 | 0.02125 | 11.96 | 6 | 1.993 | |
| | C | 53 | 0.00967 | 0.01892 | 9.25 | 7 | 1.321 | |
| | D | 54 | 0.01017 | 0.02085 | 10.68 | 8 | 1.335 | |
| | E | 55 | 0.01003 | 0.01718 | 7.15 | 5 | 1.430 | |
| | ~~F~~ | — | — | — | — | — | — | |
| | ~~G~~ | — | — | — | — | — | — | |
| | ~~H~~ | — | — | — | — | — | — | |
| DC-03 | A | 56 | 0.01035 | 0.02846 | 18.11 | 12 | 1.509 | |
| | B | 57 | 0.01013 | 0.02533 | 15.20 | 10 | 1.520 | |
| | C | 58 | 0.00947 | 0.02325 | 13.78 | 10 | 1.378 | |
| | D | 59 | 0.00960 | 0.02452 | 14.92 | 11 | 1.356 | |
| | E | 60 | 0.01064 | 0.02489 | 14.25 | 8 | 1.781 | |
| | ~~F~~ | — | — | — | — | — | — | |
| | ~~G~~ | — | — | — | — | — | — | |
| | ~~H~~ | — | — | — | — | — | — | |
| | Initials | | JD | thd | thd | MKP | thd | |
| | Date | | 5/8 | 5/9/07 | 5/9/07 | 5/8 | 5/9/07 | |

E = Original number of organisms at test initiation, adjusted for losses.

Observations:
① 6 05/09/07 [initials]

Client/Toxicant: 140
Project Number: 07-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: ~~Approx. 6.0~~ 4/15 - 4/16/07

## American Aquatic Testing, Inc.
### Weight Data

| Conc. | Rep | Pan # | A weight of boat (g) | B weight of boat & org. (g) | (B-A)*1000=C dry weight of organisms (mg) | D # of surviving org. | C/D mean dry weight (mg) | C/E IC25 & NOEC calc. weight (mg) |
|---|---|---|---|---|---|---|---|---|
| DC-05 | A | 61 | 0.01055 | 0.01525 | 4.70 | 1 | 4.700 | |
| | B | 62 | 0.01027 | 0.02137 | 11.10 | 3 | 3.700 | |
| | C | 63 | 0.01107 | 0.02208 | 11.01 | 8 | 1.376 | |
| | D | 64 | 0.00953 | 0.02189 | 12.36 | 8 | 1.545 | |
| | E | 65 | 0.00981 | 0.01884 | 9.03 | 4 | 2.258 | |
| | ~~F~~ | - | - | - | - | - | - | |
| | ~~G~~ | - | - | - | - | - | - | |
| | ~~H~~ | - | - | - | - | - | - | |
| DC-08 | A | 66 | 0.00981 | 0.02799 | 18.18 | 9 | 2.020 | |
| | B | 67 | 0.00979 | 0.02527 | 15.48 | 8 | 1.935 | |
| | C | 68 | 0.01025 | 0.00000 | — | 0 | — | |
| | D | 69 | 0.01069 | 0.02800 | 17.31 | 10 | 1.731 | |
| | E | 70 | 0.01069 | 0.00000 | — | 0 | — | |
| | ~~F~~ | - | - | - | - | - | - | |
| | ~~G~~ | - | - | - | - | - | - | |
| | ~~H~~ | - | - | - | - | - | - | |
| DC-10 | A | 71 | 0.01062 | 0.02572 | 15.10 | 9 | 1.678 | |
| | B | 72 | 0.01242 | 0.03046 | 18.04 | 8 | 2.255 | |
| | C | 73 | 0.00972 | 0.02545 | 15.73 | 12 | 1.311 | |
| | D | 74 | 0.01011 | 0.02545 | 15.34 | 12 | 1.278 | |
| | E | 75 | 0.00999 | 0.02479 | 14.80 | 12 | 1.233 | |
| | ~~F~~ | - | - | - | - | - | - | |
| | ~~G~~ | - | - | - | - | - | - | |
| | ~~H~~ | - | - | - | - | - | - | |
| DC-13 | A | 76 | 0.00845 | 0.01773 | 9.28 | 8 | 1.160 | |
| | B | 77 | 0.00853 | 0.02248 | 13.95 | 10 | 1.395 | |
| | C | 78 | 0.00900 | 0.02479 | 15.79 | 12 | 1.316 | |
| | D | 79 | 0.00884 | 0.02457 | 15.73 | 12 | 1.311 | |
| | E | 80 | 0.00926 | 0.02724 | 17.98 | 12 | 1.498 | |
| | ~~F~~ | - | - | - | - | - | - | |
| | ~~G~~ | - | - | - | - | - | - | |
| | ~~H~~ | - | - | - | - | - | - | |
| | Initials | | QP | thd | thd | MRP | thd | |
| | Date | | 5/8 | 5/9/07 | 5/9/07 | 5/8 | 5/9/07 | |

E = Original number of organisms at test initiation, adjusted for losses.

Observations:

BasicWT.wk3

Client/Toxicant: 140
Project Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310
Hatch Date: Deposited 4/15-4/16/07

## American Aquatic Testing, Inc.
### Weight Data

| Conc. | Rep | Pan # | A weight of boat (g) | B weight of boat & org. (g) | (B-A)*1000=C dry weight of organisms (mg) | D # of surviving org. | C/D mean dry weight (mg) | C/E $IC_{25}$ & NOEC calc. weight (mg) |
|---|---|---|---|---|---|---|---|---|
| DC-14 | A | 81 | 0.01235 | 0.02780 | 15.45 | 9 | 1.717 | |
| | B | 82 | 0.01045 | 0.02432 | 13.87 | 10 | 1.387 | |
| | C | 83 | 0.01056 | 0.02682 | 16.26 | 11 | 1.478 | |
| | D | 84 | 0.01014 | 0.02448 | 14.34 | 12 | 1.195 | |
| | E | 85 | 0.00927 | 0.02520 | 15.93 | 10 | 1.593 | |
| | ~~F~~ | – | | | | | | |
| | ~~G~~ | – | | | | | | |
| | ~~H~~ | – | | | | | | |
| | A | | | | | | | |
| | B | | | | | | | |
| | C | | | | | | | |
| | D | | | | | | | |
| | E | | | | | | | |
| | F | | | | | | | |
| | G | | | | | | | |
| | H | | | | | | | |
| | A | | | | | | | |
| | B | | | | | | | |
| | C | | | | | | | |
| | D | | | | | | | |
| | E | | | | | | | |
| | F | | | | | | | |
| | G | | | | | | | |
| | H | | | | | | | |
| | A | | | | | | | |
| | B | | | | | | | |
| | C | | | | | | | |
| | D | | | | | | | |
| | E | | | | | | | |
| | F | | | | | | | |
| | G | | | | | | | |
| | H | | | | | | | |
| | Initials | | [illegible] | thd | thd | MKP | thd | |
| | Date | | 5/8 | 5/9/07 | 5/9/07 | 5/8 | 5/9/07 | |

E = Original number of organisms at test initiation, adjusted for losses.

Observations:

BasicWT.wk3

Client/Toxicant: 140
Job Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1318

# Freshwater Sediment Test
## American Aquatic Testing, Inc., Physical / Chemical Parameters

| Parameter | Concentration | Day 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMP (C) | Control | 22.0 | 23.0 | 22.0 | 22.5 | 22.0 | 23.0 | 23.0 | 23.0 | 22.5 | 22.0 | 22.5 |
| | OC-01 | 22.0 | 23.0 | 22.0 | 22.5 | 22.0 | 23.0 | 22.5 | 22.5 | 22.5 | 22.0 | 22.5 |
| | OC-03 | 22.0 | 23.0 | 22.0 | 22.0 | 22.0 | 23.0 | 22.5 | 22.5 | 22.5 | 22.0 | 22.5 |
| | OC-05 | 22.0 | 22.5 | 22.0 | 22.0 | 22.0 | 23.0 | 22.5 | 22.5 | 22.5 | 22.0 | 22.0 |
| | OC-07 | 22.0 | 22.5 | 22.0 | 22.0 | 22.0 | 23.0 | 23.0 | 22.5 | 22.5 | 22.0 | 22.5 |
| | OC-11 | 22.0 | 22.5 | 22.0 | 22.0 | 22.0 | 23.0 | 23.5 | 22.5 | 22.0 | 22.0 | 22.0 |
| | OC-14 | 22.0 | 22.5 | 22.0 | 22.0 | 22.0 | 23.0 | 23.5 | 22.5 | 22.0 | 22.0 | 22.0 |
| | OC-19 | 22.0 | 22.5 | 22.0 | 22.0 | 22.0 | 23.0 | 23.5 | 23.0 | 22.0 | 22.0 | 22.0 |
| | OC-22 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 24.0 | 23.0 | 22.0 | 22.0 | 22.0 |
| | OC-26 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 24.0 | 23.0 | 22.0 | 22.0 | 22.0 |
| | DC-01 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 24.0 | 23.0 | 22.0 | 22.0 | 22.0 |
| Dissolved Oxygen (mg/L) | Control | 6.3 | 6.5 | 7.1 | 6.9 | 6.8 | 6.9 | 6.2 | 6.0 | 5.7 | 5.7 | 6.0 |
| | OC-01 | 6.6 | 6.2 | 6.6 | 6.3 | 6.5 | 6.8 | 7.1 | 7.5 | 7.3 | 7.1 | 6.4 |
| | OC-03 | 6.6 | 6.5 | 7.2 | 7.1 | 7.0 | 7.1 | 6.8 | 6.7 | 6.2 | 6.2 | 6.8 |
| | OC-05 | 6.7 | 6.9 | 7.4 | 7.2 | 7.1 | 7.2 | 6.7 | 6.6 | 6.9 | 6.9 | 6.9 |
| | OC-07 | 6.7 | 6.9 | 7.2 | 6.9 | 7.0 | 6.7 | 6.0 | 6.1 | 6.0 | 5.5 | 6.6 |
| | OC-11 | 6.3 | 6.8 | 7.1 | 6.7 | 6.9 | 6.9 | 6.1 | 6.2 | 6.0 | 6.3 | 6.8 |
| | OC-14 | 6.8 | 7.0 | 7.3 | 6.9 | 7.0 | 7.2 | 6.5 | 6.3 | 6.3 | 6.0 | 6.8 |
| | OC-19 | 7.0 | 6.7 | 7.1 | 6.6 | 6.8 | 6.8 | 6.2 | 6.2 | 6.6 | 6.7 | 6.4 |
| | OC-22 | 6.8 | 6.3 | 6.6 | 6.3 | 6.4 | 6.6 | 5.8 | 5.9 | 6.1 | 6.6 | 6.4 |
| | OC-26 | 7.1 | 7.0 | 7.5 | 7.3 | 7.2 | 6.8 | 6.4 | 6.7 | 7.0 | 6.8 | 7.0 |
| | DC-01 | 7.2 | 6.6 | 7.3 | 6.7 | 6.8 | 6.7 | 5.5 | 5.8 | 6.0 | 5.7 | 6.2 |
| pH | Control | 6.9 | 7.6 | 7.7 | 7.6 | 7.5 | 6 ① | 7.6 | 7.7 | 7.9 | 7.5 | 7.6 |
| | OC-01 | 7.3 | 7.6 | 7.7 | 7.6 | 7.5 | 7.5 | 7.7 | 7.8 | 8.1 | 8.3 | 8.2 |
| | OC-03 | 7.3 | 7.7 | 7.8 | 7.6 | 7.6 | 7.7 | 8.4 | 8.6 | 8.6 | 8.9 | 8.8 |
| | OC-05 | 7.4 | 7.8 | 7.8 | 7.8 | 7.7 | 8.3 | 8.7 | 8.8 | 9.0 | 9.0 | 8.8 |
| | OC-07 | 7.5 | 7.8 | 7.9 | 7.9 | 7.8 | 8.3 | 8.5 | 8.8 | 9.1 | 9.0 | 8.9 |
| | OC-11 | 7.5 | 7.8 | 7.9 | 7.9 | 7.8 | 8.4 | 8.5 | 8.6 | 9.0 | 8.9 | 8.9 |
| | OC-14 | 7.5 | 7.8 | 7.9 | 7.9 | 7.8 | 8.3 | 8.4 | 8.7 | 9.1 | 9.1 | 8.9 |
| | OC-19 | 7.5 | 7.8 | 7.9 | 7.9 | 7.9 | 8.3 | 8.5 | 8.6 | 8.9 | 9.0 | 9.0 |
| | OC-22 | 7.5 | 7.7 | 7.8 | 7.9 | 7.9 | 8.4 | 8.5 | 8.6 | 8.9 | 8.8 | 8.9 |
| | OC-26 | 7.5 | 7.8 | 7.8 | 7.9 | 7.9 | 8.4 | 8.3 | 8.4 | 8.8 | 8.9 | 8.9 |
| | DC-01 | 7.5 | 7.8 | 7.9 | 7.9 | 7.9 | 8.5 | 8.8 | 8.5 | 8.9 | 8.9 | 8.9 |
| | Initials | thd | KAK | MEP | MKP | MKP | MEP | thd | MEP | MEP | MEP | [illegible] |
| | Date | 4/18/07 | 4/19 | 4/20 | 4/21 | 4/22 | 4/23 | 4/24/07 | 4/25 | 4/26 | 4/27 | 04/28 |

| Concentration | Cond. (umhos) Initial | Cond. (umhos) Final | Alkalinity (mg/L) Initial | Alkalinity (mg/L) Final | Hardness (mg/L) Initial | Hardness (mg/L) Final | Ammonia (mg/L) Initial | Ammonia (mg/L) Final |
|---|---|---|---|---|---|---|---|---|
| Control | 304 | 316 | 80 | 60 | 100 | 130 | 0.21 | 0.16 |
| OC-01 | 324 | 343 | 90 | 90 | 140 | 180 | 0.46 | 0.02 |
| OC-03 | 321 | 351 | 110 | 100 | 150 | 230 | 0.56 | 0.01 |
| OC-05 | 336 | 342 | 100 | 100 | 140 | 190 | 0.43 | 0.11 |
| OC-07 | 324 | 343 | 100 | 100 | 140 | 180 | 0.65 | 0.00 |
| OC-11 | 332 | 361 | 100 | 90 | 130 | 160 | 0.82 | 0.02 |
| OC-14 | 378 | 353 | 100 | 110 | 110 | 180 | 0.31 | 0.08 |
| OC-19 | 341 | 342 | 100 | 80 | 120 | 150 | 0.40 | 0.00 |
| OC-22 | 355 | 366 | 100 | 90 | 130 | 160 | 0.89 | 0.00 |
| OC-26 | 353 | 344 | 100 | 100 | 120 | 140 | 0.28 | 0.02 |
| DC-01 | 362 | 359 | 100 | 100 | 130 | 170 | 0.39 | 0.01 |
| Initials | thd | TKP | MKP | [illegible] | MKP | [illegible] | TKP | TKP |
| Date | 4/18/07 | 5/8 | 4/18 | 5/8 | 4/18 | 5/8 | 4/18 | 5/8 |

Comments:
① 7.5 MEP 4/23

FWSEDPAR.wk3

Client/Toxicant: 140
Job Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310

# Freshwater Sediment Test
## American Aquatic Testing, Inc.,
## Physical / Chemical Parameters

| Parameter | Concentration | Day 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMP (C) | DC-03 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 24.0 | 23.0 | 22.0 | 22.0 | 22.0 |
| | DC-05 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 24.0 | 23.0 | 22.0 | 22.0 | 22.0 |
| | DC-08 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 24.0 | 23.0 | 22.0 | 22.0 | 22.0 |
| | DC-10 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 24.0 | 22.5 | 22.0 | 22.0 | 22.0 |
| | DC-13 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 24.0 | 22.5 | 22.0 | 22.0 | 22.0 |
| | DC-14 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 23.0 | 24.0 | 23.0 | 22.0 | 22.0 | 22.0 |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| Dissolved Oxygen (mg/L) | DC-03 | 6.4 | 6.6 | 7.1 | 6.7 | 6.6 | 6.7 | 6.1 | 6.2 | 5.9 | 6.1 | 6.6 |
| | DC-05 | 6.7 | 7.1 | 7.4 | 7.0 | 7.1 | 6.9 | 5.8 | 5.7 | 5.8 | 6.0 | 6.3 |
| | DC-08 | 7.4 | 7.3 | 7.3 | 6.8 | 6.9 | 7.3 | 5.6 | 5.9 | 5.4 | 5.5 | 6.1 |
| | DC-10 | 7.3 | 7.6 | 8.3 | 8.0 | 7.9 | 8.0 | 7.5 | 7.8 | 7.9 | 7.9 | 6.9 |
| | DC-13 | 6.6 | 7.0 | 7.7 | 7.3 | 7.2 | 7.3 | 6.0 | 6.6 | 6.6 | 6.5 | 6.6 |
| | DC-14 | 7.0 | 6.7 | 7.1 | 6.0 | 6.2 | 6.4 | 4.8 | 5.9 | 5.7 | 5.3 | 6.0 |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| pH | DC-03 | 7.4 | 7.8 | 7.8 | 7.9 | 7.8 | 8.4 | 8.4 | 8.3 | 8.8 | 8.8 | 8.7 |
| | DC-05 | 7.5 | 7.8 | 7.9 | 7.9 | 7.9 | 8.5 | 8.6 | 8.5 | 9.0 | 9.0 | 8.7 |
| | DC-08 | 7.6 | 7.9 | 7.9 | 7.9 | 7.9 | 8.7 | 8.9 | 8.7 | 9.2 | 9.0 | 8.7 |
| | DC-10 | 7.6 | 7.9 | 8.0 | 8.0 | 7.9 | 8.6 | 8.6 | 8.5 | 9.0 | 8.9 | 8.8 |
| | DC-13 | 7.6 | 7.9 | 8.0 | 8.0 | 8.0 | 8.7 | 8.9 | 8.7 | 9.1 | 9.1 | 8.9 |
| | DC-14 | 7.7 | 7.9 | 7.9 | 8.0 | 8.0 | 8.7 | 8.8 | 8.7 | 9.0 | 9.0 | 8.9 |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | — | — | — | — | — | — | — | — | — | — | — | |
| | Initials | thd | KDA | MEP | MKP | MKP | MPP | thd | MEP | MEP | MEP | [illegible] |
| | Date | 4/18/07 | 4/19 | 4/20 | 4/21 | 4/22 | 4/23 | 4/24 | 4/25 | 4/26 | 4/27 | 4/28 |

| Concentration | Cond. (umhos) Initial | Cond. (umhos) Final | Alkalinity (mg/L) Initial | Alkalinity (mg/L) Final | Hardness (mg/L) Initial | Hardness (mg/L) Final | Ammonia (mg/L) Initial | Ammonia (mg/L) Final |
|---|---|---|---|---|---|---|---|---|
| DC-03 | 357 | 354 | 110 | 90 | 130 | 140 | 0.85 | 0.01 |
| DC-05 | 359 | 361 | 110 | 100 | 130 | 200 | 1.16 | 0.02 |
| DC-08 | 376 | 391 | 110 | 100 | 140 | 230 | 0.43 | 0.01 |
| DC-10 | 348 | 357 | 110 | 110 | 150 | 150 | 1.07 | 0.03 |
| DC-13 | 357 | 374 | 100 | 100 | 120 | 140 | 0.32 | 0.06 |
| DC-14 | 333 | 364 | 100 | 100 | 120 | 160 | 0.24 | 0.07 |
| — | — | | | | | | | |
| — | — | | | | | | | |
| — | — | | | | | | | |
| — | — | | | | | | | |
| — | — | | | | | | | |
| Initials | thd | [illegible]/TRP | MKP | [illegible] | MKP | [illegible] | TRP | TRP |
| Date | 4/18/07 | 5/8 | 4/18 | 5/8 | 4/18 | 5/8 | 4/18 | 5/8 |

Comments:

FWSEDPAR.wk3

Client/Toxicant: 140
Job Number: 04-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310

# Freshwater Sediment Test
## American Aquatic Testing, Inc.,
## Physical / Chemical Parameters

| Parameter | Concentration | Day 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMP (C) | Control | | 23.5 | 22.5 | 23.0 | 23.0 | 24.0 | 23.5 | 23.0 | 22.0 | 22.5 | |
| | OC-01 | | 23.5 | 22.5 | 22.5 | 22.5 | 24.0 | 23.0 | 23.0 | 22.0 | 22.5 | |
| | OC-03 | | 23.0 | 22.0 | 22.5 | 22.5 | 23.5 | 23.0 | 23.0 | 22.0 | 22.0 | |
| | OC-05 | | 23.0 | 22.5 | 22.5 | 22.5 | 23.5 | 23.0 | 23.0 | 22.0 | 22.0 | |
| | OC-07 | | 23.0 | 22.5 | 22.5 | 22.5 | 23.0 | 23.0 | 23.0 | 22.0 | 22.0 | |
| | OC-11 | | 23.0 | 22.5 | 22.5 | 22.0 | 22.5 | 23.0 | 23.0 | 22.0 | 22.0 | |
| | OC-14 | | 22.5 | 22.5 | 22.5 | 22.0 | 22.5 | 23.0 | 23.0 | 22.0 | 22.0 | |
| | OC-19 | | 22.5 | 22.0 | 22.5 | 22.0 | 22.5 | 23.0 | 23.0 | 22.0 | 22.0 | |
| | OC-22 | | 22.5 | 22.0 | 22.5 | 22.0 | 22.5 | 23.0 | 23.0 | 22.0 | 22.0 | |
| | OC-26 | | 22.5 | 22.0 | 22.5 | 22.0 | 22.0 | 22.5 | 23.0 | 22.0 | 22.0 | |
| | DC-01 | | 22.5 | 22.0 | 22.5 | 22.0 | 22.0 | 22.5 | 23.0 | 22.0 | 22.0 | |
| Dissolved Oxygen (mg/L) | Control | | 5.7 | 6.0 | 5.6 | 6.0 | 5.2 | 5.5 | 5.9 | 6.4 | 5.5 | |
| | OC-01 | | 6.3 | 6.2 | 5.4 | 5.7 | 5.2 | 5.4 | 5.8 | 5.3 | 6.5 | |
| | OC-03 | | 6.7 | 6.8 | 7.0 | 6.1 | 5.9 | 6.1 | 6.3 | 6.1 | 7.4 | |
| | OC-05 | | 7.2 | 7.3 | 7.0 | 7.0 | 6.8 | 7.0 | 7.4 | 8.5 | 7.9 | |
| | OC-07 | | 6.4 | 6.2 | 6.2 | 6.0 | 5.7 | 6.0 | 6.3 | 6.2 | 7.3 | |
| | OC-11 | | 6.8 | 6.3 | 6.0 | 6.1 | 6.0 | 6.2 | 6.7 | 5.2 | 5.0 | |
| | OC-14 | | 6.8 | 6.6 | 6.2 | 6.5 | 6.5 | 6.6 | 6.9 | 6.8 | 6.8 | |
| | OC-19 | | 7.1 | 7.0 | 6.1 | 5.8 | 6.3 | 6.7 | 7.1 | 6.2 | 6.6 | |
| | OC-22 | | 6.8 | 6.7 | 6.7 | 5.4 | 6.0 | 6.3 | 6.6 | 5.1 | 5.7 | |
| | OC-26 | | 5.8 | 5.7 | 5.2 | 5.8 | 5.2 | 5.8 | 6.4 | 6.2 | 6.4 | |
| | DC-01 | | 6.3 | 6.4 | 5.1 | 6.0 | 5.9 | 6.1 | 6.6 | 6.4 | 6.8 | |
| pH | Control | | 7.7 | 7.8 | 7.6 | 8.0 | 7.7 | 7.8 | 7.9 | 7.8 | 7.9 | |
| | OC-01 | | 8.8 | 8.6 | 7.9 | 8.4 | 8.5 | 8.6 | 8.5 | 8.2 | 8.2 | |
| | OC-03 | | 9.0 | 8.9 | 8.8 | 8.7 | 8.8 | 8.7 | 8.8 | 8.5 | 8.9 | |
| | OC-05 | | 9.0 | 8.9 | 8.9 | 8.8 | 8.9 | 8.8 | 8.9 | 9.1 | 8.9 | |
| | OC-07 | | 9.1 | 9.0 | 9.0 | 8.9 | 8.9 | 8.8 | 8.8 | 8.8 | 8.9 | |
| | OC-11 | | 8.9 | 8.9 | 8.9 | 8.9 | 8.8 | 8.7 | 8.7 | 8.5 | 8.3 | |
| | OC-14 | | 9.0 | 9.0 | 8.9 | 8.8 | 8.8 | 8.6 | 8.7 | 8.9 | 8.4 | |
| | OC-19 | | 8.9 | 8.8 | 8.8 | 8.7 | 8.7 | 8.5 | 8.6 | 8.5 | 8.4 | |
| | OC-22 | | 8.8 | 8.7 | 8.7 | 8.6 | 8.5 | 8.4 | 8.5 | 8.4 | 8.2 | |
| | OC-26 | | 8.9 | 8.8 | 8.7 | 8.6 | 8.7 | 8.6 | 8.7 | 8.6 | 8.6 | |
| | DC-01 | | 9.1 | 9.0 | 8.9 | 8.6 | 9.0 | 9.0 | 9.0 | 9.0 | 8.6 | |
| | Initials | | MKP | MKP | [illegible] | MKP | VNL | TOD | TOD | VNL | [illegible] | |
| | Date | | 4/30 | 5/1 | 5/2 | 5/3 | 5/4 | 5/5 | 5/6 | 5/7 | 5/8 | |

| Concentration | Cond. (umhos) Initial | Cond. (umhos) Final | Alkalinity (mg/L) Initial | Alkalinity (mg/L) Final | Hardness (mg/L) Initial | Hardness (mg/L) Final | Ammonia (mg/L) Initial | Ammonia (mg/L) Final |
|---|---|---|---|---|---|---|---|---|
| Control | | | | | | | | |
| OC-01 | | | | | | | | |
| OC-03 | | | | | | | | |
| OC-05 | | | | | | | | |
| OC-07 | | | | | | | | |
| OC-11 | | | | | | | | |
| OC-14 | | | | | | | | |
| OC-19 | | | | | | | | |
| OC-22 | | | | | | | | |
| OC-26 | | | | | | | | |
| DC-01 | | | | | | | | |
| Initials | | | | | | | | |
| Date | | | | | | | | |

Comments:

FWSEDPAR.wk3

Client/Toxicant: 140
Job Number: 01-01
Species: C. tentans

Beginning Date & Time: 4-18-07 1520
Ending Date & Time: 5-8-07 1310

# Freshwater Sediment Test
## American Aquatic Testing, Inc.,
## Physical / Chemical Parameters

| Parameter | Concentration | Day 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEMP (C) | ~~Control~~ | — | — | — | — | — | — | — | — | — | — | — |
| | DC-03 | | 22.0 | 22.0 | 22.5 | 22.0 | 22.0 | 22.5 | 23.0 | 22.0 | 22.0 | |
| | DC-05 | | 22.0 | 22.0 | 22.5 | 22.0 | 22.0 | 22.5 | 23.0 | 22.0 | 22.0 | |
| | DC-08 | | 22.0 | 22.0 | 22.5 | 22.0 | 22.0 | 22.5 | 22.5 | 22.0 | 22.0 | |
| | DC-10 | | 22.0 | 22.0 | 22.5 | 22.0 | 22.0 | 22.5 | 22.5 | 22.0 | 22.0 | |
| | DC-13 | | 22.0 | 22.0 | 22.5 | 22.0 | 22.0 | 22.5 | 22.5 | 22.0 | 22.0 | |
| | DC-14 | | 22.0 | 22.0 | 23.0 | 22.0 | 22.5 | 22.5 | 22.5 | 22.0 | 22.5 | |
| | — | | | | | | | | | | | |
| | — | | | | | | | | | | | |
| | — | | | | | | | | | | | |
| | — | | | | | | | | | | | |
| Dissolved Oxygen (mg/L) | ~~Control~~ | — | — | — | — | — | — | — | — | — | — | — |
| | DC-03 | | 6.2 | 6.3 | 5.1 | 5.4 | 5.7 | 5.6 | 6.1 | 5.8 | 5.4 | |
| | DC-05 | | 7.1 | 7.2 | 5.6 | 6.3 | 6.6 | 6.7 | 7.0 | 7.4 | 6.5 | |
| | DC-08 | | 6.0 | 5.4 | 4.4 | 5.9 | 6.6 | 6.5 | 6.9 | 4.4 | 6.0 | |
| | DC-10 | | 6.7 | 6.2 | 5.2 | 6.0 | 6.3 | 6.4 | 6.6 | 7.2 | 6.8 | |
| | DC-13 | | 7.0 | 6.5 | 4.8 | 5.8 | 4.4 | 5.0 | 5.4 | 6.0 | 5.7 | |
| | DC-14 | | 6.3 | 5.9 | 5.1 | 5.3 | 5.4 | 5.6 | 6.0 | 5.2 | 6.0 | |
| | — | | | | | | | | | | | |
| | — | | | | | | | | | | | |
| | — | | | | | | | | | | | |
| | — | | | | | | | | | | | |
| pH | ~~Control~~ | — | — | — | — | — | — | — | — | — | — | — |
| | DC-03 | | 8.6 | 8.7 | 8.7 | 8.5 | 8.4 | 8.5 | 8.6 | 8.5 | 8.4 | |
| | DC-05 | | 8.7 | 8.8 | 8.8 | 8.6 | 8.9 | 8.8 | 8.9 | 9.0 | 8.6 | |
| | DC-08 | | 8.9 | 8.8 | 8.8 | 8.7 | 8.5 | 8.6 | 8.6 | 8.6 | 8.3 | |
| | DC-10 | | 8.9 | 8.9 | 8.8 | 8.7 | 8.8 | 8.8 | 8.8 | 8.8 | 8.4 | |
| | DC-13 | | 9.0 | 8.9 | 8.9 | 8.7 | 8.8 | 8.7 | 8.8 | 8.7 | 8.3 | |
| | DC-14 | | 8.8 | 8.7 | 8.6 | 8.7 | 8.5 | 8.4 | 8.5 | 8.5 | 8.2 | |
| | — | | | | | | | | | | | |
| | — | | | | | | | | | | | |
| | — | | | | | | | | | | | |
| | — | | | | | | | | | | | |
| | Initials | | MRP | MRP | KHD | MKP | VAL | TDP | TDP | VAL | QHRP | |
| | Date | | 4/30 | 5/1 | 5/2 | 5/3 | 5/4 | 5/5 | 5/6 | 5/7 | 5/8 | |

| Concentration | Cond. (umhos) Initial | Cond. (umhos) Final | Alkalinity (mg/L) Initial | Alkalinity (mg/L) Final | Hardness (mg/L) Initial | Hardness (mg/L) Final | Ammonia (mg/L) Initial | Ammonia (mg/L) Final |
|---|---|---|---|---|---|---|---|---|
| ~~Control~~ | — | — | — | — | — | — | — | — |
| DC-03 | | | | | | | | |
| DC-05 | | | | | | | | |
| DC-08 | | | | | | | | |
| DC-10 | | | | | | | | |
| DC-13 | | | | | | | | |
| DC-14 | | | | | | | | |
| — | | | | | | | | |
| — | | | | | | | | |
| — | | | | | | | | |
| — | | | | | | | | |
| Initials | | | | | | | | |
| Date | | | | | | | | |

Comments:

FWSEDPAR.wk3

Job Number: 140-04-01
Species: C. tentans

Start Date & Time: 4-18-07 1520
End Date & Time: 5-8-07 1310

# Sediment Test

## American Aquatic Testing, Inc.,

Water Change Log/Initial Water Readings/General Testing Information

| Test Day | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Morning change(time) | | 910 | 930 | 950 | 915 | 900 | 915 | 1020 | 845 | 0815 | 0950 | 0850 | 900 | 930 | 0920 |
| D.O. mg/L | ~~8.8~~ | 8.7 | 8.6 | 8.6 | 8.8 | 8.7 | 8.5 | 8.1 | 8.7 | 8.9 | 8.6 | 8.4 | 9.0 | 8.9 | 8.3 |
| pH | | 8.1 | 7.9 | 8.0 | 8.0 | 8.4 | 8.3 | 7.8 | 8.1 | 8.0 | 8.0 | 8.1 | 8.2 | 8.3 | 8.5 |
| Temp. (C) | ~~22.0~~ | 22.0 | 22.0 | 22.0 | 23.0 | 23.0 | 24.0 | 24.0 | 23.0 | 23.0 | 23.0 | 23.0 | 22.0 | 23.0 | 23.0 |
| Initials | | TAP | TAP | MKP | MKP | TAP | TAP | TAP | TAP | WDW | SW | SW | TAP | TAP | WDW |
| Date | | 4/19 | 4/20 | 4/21 | 4/22 | 4/23 | 4/24 | 4/25 | 4/26 | 4/27 | 04/28 | 04/29 | 4/30 | 5/1 | 5/2 |
| Afternoon change(time) | (1) ~~1400~~ | 1605 | 1550 | 1535 | 1500 | 1655 | 1745 | 1630 | 1635 | 1700 | 1830 | 1845 | 1515 | 1630 | 1520 |
| D.O. mg/L | 8.9 | 8.7 | 8.5 | 8.6 | 8.5 | 8.6 | 8.3 | 8.1 | 8.4 | 8.4 | 8.5 | 8.3 | 8.7 | 8.0 | 8.5 |
| pH | 8.1 | 8.0 | 8.0 | 8.1 | 8.1 | 8.2 | 8.1 | 7.7 | 8.0 | 8.2 | 8.1 | 8.1 | 8.0 | 7.8 | 8.0 |
| Temp. (C) | 22.0 | 22.5 | 22.5 | 22.0 | 22.0 | 23.5 | 24.0 | 23.5 | 23.0 | 22.5 | 23.0 | 23.0 | 22.0 | 22.0 | 22.5 |
| Initials | TAP | TAP | MKP | MKP | MKP | TAP | TAP | TAP | TAP | MKP | SW | SW | WDW | MKP | WDW |
| Date | 4/18 | 4/19 | 4/20 | 4/21 | 4/22 | 4/23 | 4/24 | 4/25 | 4/26 | 4/27 | 04/28 | 04/29 | 4/30 | 5/1 | 5/2 |

| Test Day | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Morning change(time) | 0945 | 0855 | 920 | 900 | 940 | 0815 | | | | | | | | |
| D.O. mg/L | 8.6 | 8.4 | 8.5 | 8.6 | 8.7 | 8.6 | | | | | | | | |
| pH | 8.4 | 8.3 | 8.3 | 8.3 | 8.2 | 7.9 | | | | | | | | |
| Temp. (C) | 22.5 | 23.0 | 23.0 | 22.5 | 22.5 | 23.0 | | | | | | | | |
| Initials | MKP | WDW | TAP | TAP | TAP | WDW | | | | | | | | |
| Date | 5/3 | 5/4 | 5/5 | 5/6 | 5/7 | 5/8 | | | | | | | | |
| Afternoon change(time) | 1630 | 1530 | 1610 | 1715 | 1830 | | | | | | | | | |
| D.O. mg/L | 8.3 | 8.4 | 8.4 | 8.4 | 8.5 | | | | | | | | | |
| pH | 8.3 | 8.1 | 8.2 | 8.4 | 8.2 | | | | | | | | | |
| Temp. (C) | 22.0 | 22.0 | 23.5 | 23.0 | 23.0 | | | | | | | | | |
| Initials | MKP | MKP | TAP | TAP | SW | | | | | | | | | |
| Date | 5/3 | 5/4 | 5/5 | 5/6 | 05/07 | | | | | | | | | |

Control Sed. collection date/by: 4/12/07 / TAP

Control Sed. sieve date/by: 4/13/07 / TAP

Sieve size used: 1mm

Sample sieve date/by: 4/11 & 4/12/07/TAP

Sieve size used: 1 mm

Organism source: ABS Inc.

Test organism Lot number: 943

Number of animals per chamber: 12

Food Type: Flake

Frequency of feeding: once every other day

Test Chamber size: 300ml

Test Volume of sediment: 100ml

Test Volume of water: 175ml

Test Duration: 20 days

Test Temperature Range: 23±1°C

(1) 1300 - TAP 4/18

# APPENDIX B

# STATISTICAL ANALYSIS OF *Chironomus tentans* 20 DAY SURVIVAL AND GROWTH TEST RESULTS

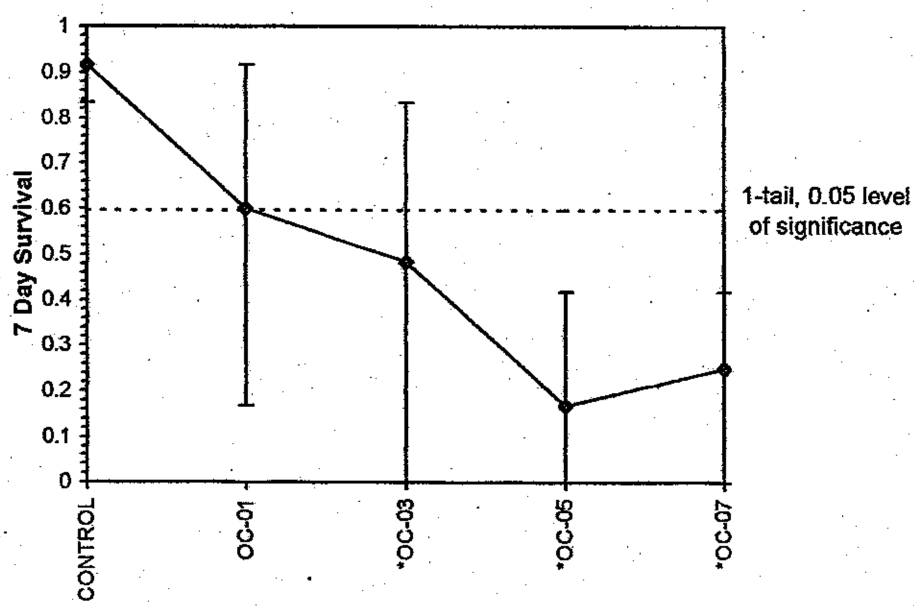
| TETRATECH OTTER CREEK OC-A Survival | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: | 14004OCa | Sample ID: | TETRATECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: | EPAF 94-EPA Freshwater | Test Species: | CT -Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| OC-01 | 0.4167 | 0.9167 | 0.7500 | 0.7500 | 0.1667 |
| OC-03 | 0.5833 | 0.0000 | 0.5833 | 0.8333 | 0.4167 |
| OC-05 | 0.4167 | 0.0000 | 0.0000 | 0.3333 | 0.0833 |
| OC-07 | 0.4167 | 0.0000 | 0.2500 | 0.2500 | 0.3333 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| OC-01 | 0.6000 | 0.6545 | 0.8989 | 0.4205 | 1.2780 | 37.536 | 5 | 2.201 | 2.300 | 0.4046 |
| *OC-03 | 0.4833 | 0.5273 | 0.7470 | 0.1448 | 1.1503 | 49.959 | 5 | 3.065 | 2.300 | 0.4046 |
| *OC-05 | 0.1667 | 0.1818 | 0.3799 | 0.1448 | 0.7017 | 69.277 | 5 | 5.152 | 2.300 | 0.4046 |
| *OC-07 | 0.2500 | 0.2727 | 0.5018 | 0.1448 | 0.7017 | 42.416 | 5 | 4.459 | 2.300 | 0.4046 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.9589 | | 0.888 | | -0.6123 | 0.10565 |
| Bartlett's Test indicates equal variances (p = 0.42) | 3.9015 | | 13.2767 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates significant differences | 0.32557 | 0.35346 | 0.6341 | 0.07735 | 4.4E-04 | 4, 20 |
| Treatments vs CONTROL | | | | | | |

**Dose-Response Plot**






ToxCalc v5.0.23

Reviewed by: [signature]

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## TETRATECH OTTER CREEK OC-A Growth

| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: | 14004OCa | Sample ID: | TETRATECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: | EPAF 94-EPA Freshwater | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 1.2682 | 1.4520 | 1.0158 | 1.6320 | 1.2842 |
| OC-01 | 2.5940 | 1.3055 | 1.8178 | 1.1944 | 4.9800 |

| | | | Transform: Untransformed | | | | | Rank | 1-Tailed |
|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | Sum | Critical |
| CONTROL | 1.3304 | 1.0000 | 1.3304 | 1.0158 | 1.6320 | 17.251 | 5 | | |
| OC-01 | 2.3783 | 1.7876 | 2.3783 | 1.1944 | 4.9800 | 65.416 | 5 | 34.00 | 19.00 |

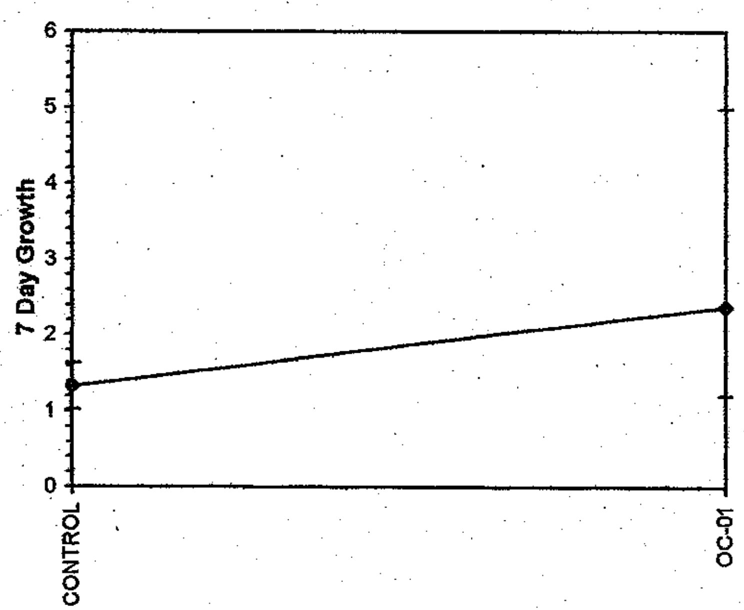
| Auxiliary Tests | Statistic | Critical | Skew | Kurt |
|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.81822 | 0.781 | 1.7532 | 4.55236 |
| F-Test indicates unequal variances (p = 2.68E-03) | 45.9497 | 23.1539 | | |

**Hypothesis Test (1-tail, 0.05)**

Wilcoxon Two-Sample Test indicates no significant differences

Treatments vs CONTROL

**Dose-Response Plot**




 ToxCalc v5.0.23 Reviewed by: [signature]

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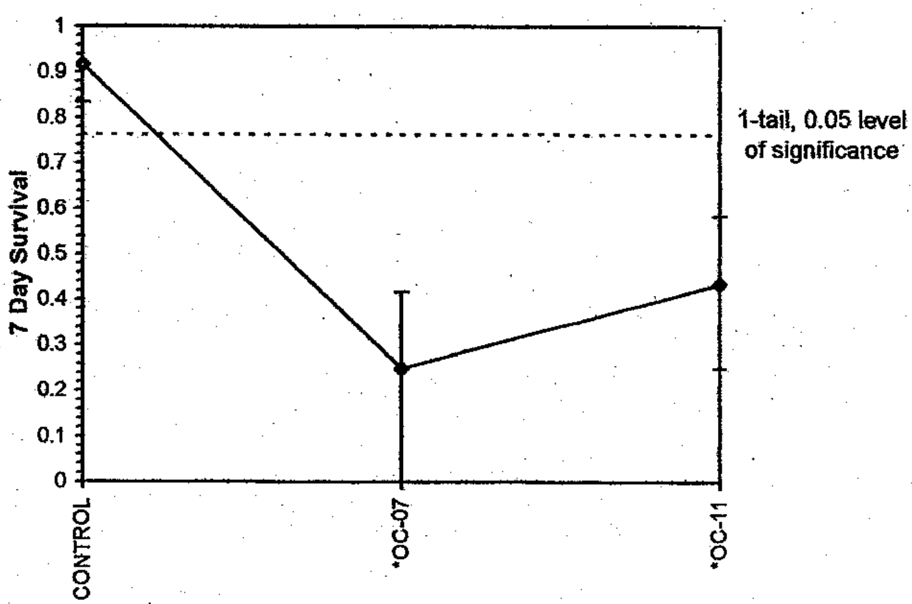
| TETRATECH OTTER CREEK OC-B Survival | | | |
|---|---|---|---|
| Start Date: 4/18/2007 | Test ID: 14004OCb | Sample ID: | TETRATECH |
| End Date: 5/8/2007 | Lab ID: | Sample Type: | SEDIMENT |
| Sample Date: | Protocol: EPAF 94-EPA Freshwater | Test Species: | CT-Chironomus tentans |
| Comments: | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| OC-07 | 0.4167 | 0.0000 | 0.2500 | 0.2500 | 0.3333 |
| OC-11 | 0.5000 | 0.5833 | 0.5000 | 0.3333 | 0.2500 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| *OC-07 | 0.2500 | 0.2727 | 0.5018 | 0.1448 | 0.7017 | 42.416 | 5 | 7.394 | 2.110 | 0.2238 |
| *OC-11 | 0.4333 | 0.4727 | 0.7158 | 0.5236 | 0.8691 | 19.782 | 5 | 5.376 | 2.110 | 0.2238 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.92717 | | 0.835 | | -0.8674 | 0.29848 |
| Bartlett's Test indicates equal variances (p = 0.63) | 0.91034 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates significant differences | 0.15817 | 0.17171 | 0.82169 | 0.02813 | 2.4E-05 | 2, 12 |
| Treatments vs CONTROL | | | | | | |

**Dose-Response Plot**






ToxCalc v5.0.23

Reviewed by: [signature]

B

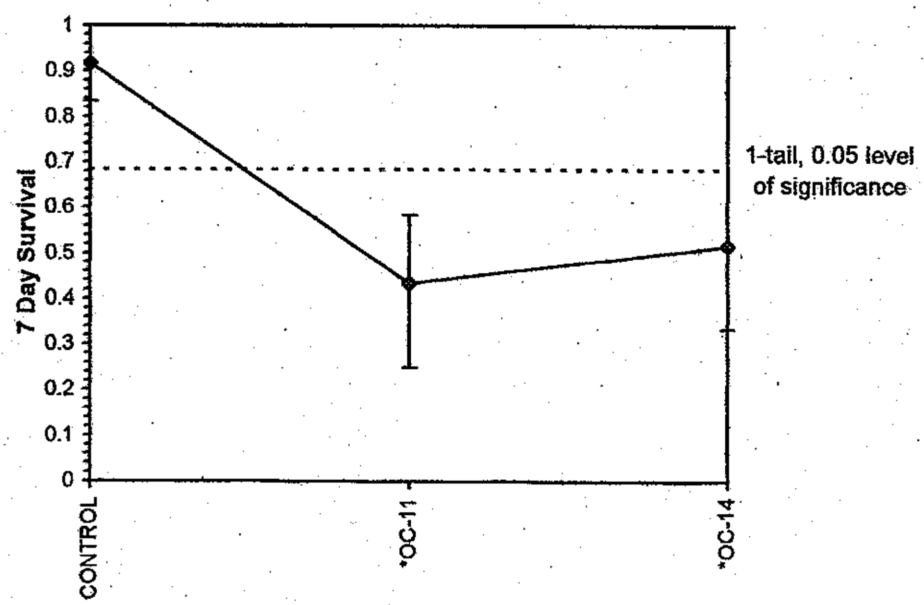
| TETRATECH OTER CREEK OC-C Survival | | | |
|---|---|---|---|
| Start Date: 4/18/2007 | Test ID: 14004OCb | Sample ID: | TETRATECH |
| End Date: 5/8/2007 | Lab ID: | Sample Type: | SEDIMENT |
| Sample Date: | Protocol: EPAF 94-EPA Freshwater | Test Species: | CT-Chironomus tentans |
| Comments: | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| OC-11 | 0.5000 | 0.5833 | 0.5000 | 0.3333 | 0.2500 |
| OC-14 | 0.5833 | 1.0000 | 0.3333 | 0.3333 | 0.3333 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| *OC-11 | 0.4333 | 0.4727 | 0.7158 | 0.5236 | 0.8691 | 19.782 | 5 | 3.871 | 2.110 | 0.3108 |
| *OC-14 | 0.5167 | 0.5636 | 0.8283 | 0.6155 | 1.4260 | 42.459 | 5 | 3.108 | 2.110 | 0.3108 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.84292 | | 0.835 | | 1.48972 | 3.20566 |
| Bartlett's Test indicates equal variances (p = 0.11) | 4.38966 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates significant differences Treatments vs CONTROL | 0.23578 | 0.25598 | 0.45619 | 0.05425 | 0.00521 | 2, 12 |

**Dose-Response Plot**






ToxCalc v5.0.23

Reviewed by: [signature]

C

## TETRATECH OTTER CREEK OC-D Survival

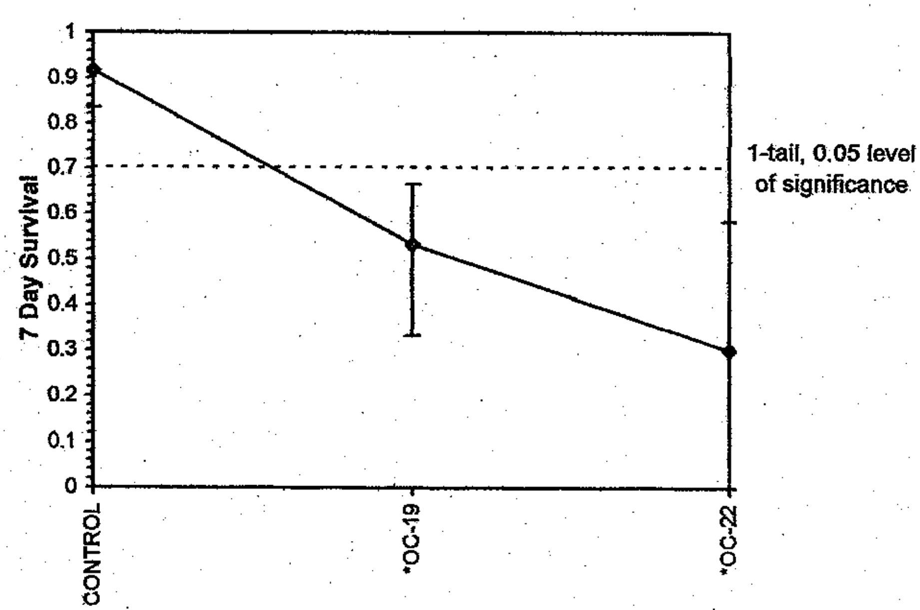
| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: 14004OCD | | Sample ID: | TETRATECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: EPAF 94-EPA Freshwater | | Test Species: | CT Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| OC-19 | 0.5833 | 0.6667 | 0.3333 | 0.5000 | 0.5833 |
| OC-22 | 0.5833 | 0.5833 | 0.0000 | 0.0833 | 0.2500 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| *OC-19 | 0.5333 | 0.5818 | 0.8189 | 0.6155 | 0.9553 | 15.705 | 5 | 3.371 | 2.110 | 0.2925 |
| *OC-22 | 0.3000 | 0.3273 | 0.5399 | 0.1448 | 0.8691 | 61.020 | 5 | 5.383 | 2.110 | 0.2925 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.97078 | | 0.835 | | -0.1044 | -0.1972 |
| Bartlett's Test indicates equal variances (p = 0.12) | 4.23803 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates significant differences | 0.21886 | 0.2376 | 0.71072 | 0.04803 | 5.8E-04 | 2, 12 |
| Treatments vs CONTROL | | | | | | |

**Dose-Response Plot**






ToxCalc v5.0.23

Reviewed by: JD

## TETRATECH OTTER CREEK OC-E Survival

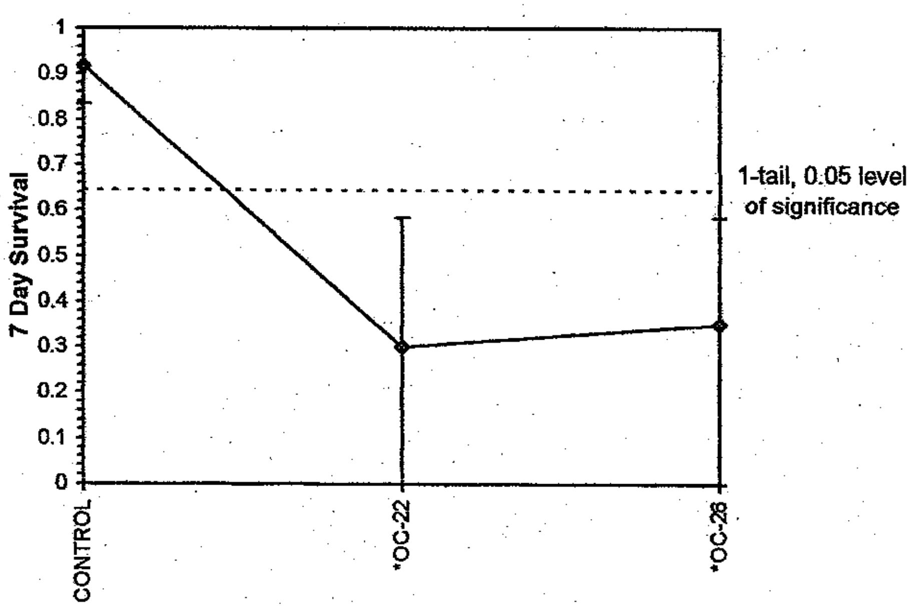
| | | | |
|---|---|---|---|
| Start Date: 4/18/2007 | Test ID: 14004OCD | Sample ID: | TETRATECH |
| End Date: 5/8/2007 | Lab ID: | Sample Type: | SEDIMENT |
| Sample Date: | Protocol: EPAF 94-EPA Freshwater | Test Species: | CT-Chironomus tentans |
| Comments: | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| OC-22 | 0.5833 | 0.5833 | 0.0000 | 0.0833 | 0.2500 |
| OC-26 | 0.4167 | 0.0000 | 0.5833 | 0.2500 | 0.5000 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| *OC-22 | 0.3000 | 0.3273 | 0.5399 | 0.1448 | 0.8691 | 61.020 | 5 | 4.459 | 2.110 | 0.3531 |
| *OC-26 | 0.3500 | 0.3818 | 0.6049 | 0.1448 | 0.8691 | 47.483 | 5 | 4.070 | 2.110 | 0.3531 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.95237 | | 0.835 | | -0.4351 | -0.5997 |
| Bartlett's Test indicates equal variances (p = 0.28) | 2.52307 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates significant differences | 0.27568 | 0.29929 | 0.85414 | 0.07002 | 0.00128 | 2, 12 |
| Treatments vs CONTROL | | | | | | |

### Dose-Response Plot






ToxCalc v5.0.23

Reviewed by: JL

E

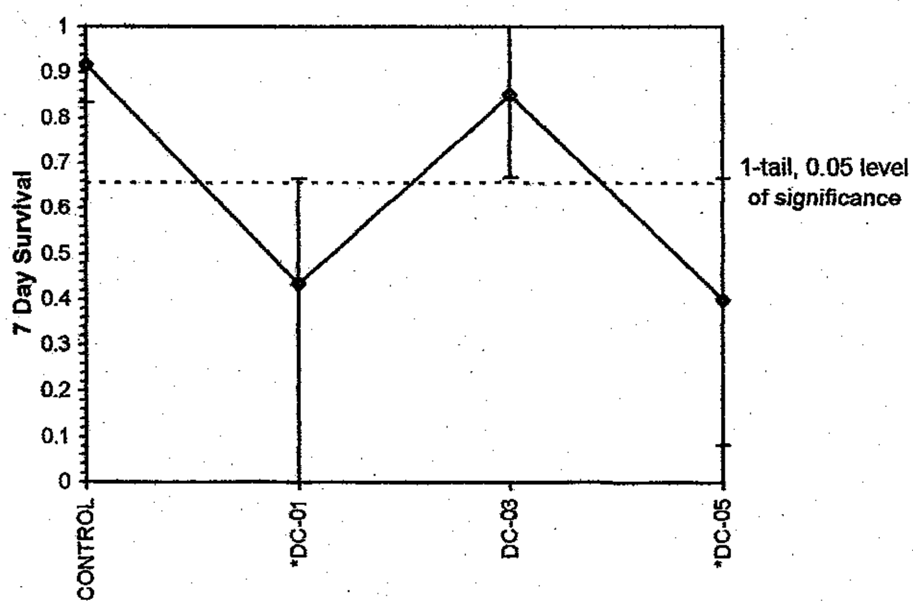
| TETRATECH DUCK CREEK DC-A Survival | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: 14004DCa | | Sample ID: | TETRATECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: EPAF 94-EPA Freshwater | | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| DC-01 | 0.0000 | 0.5000 | 0.5833 | 0.6667 | 0.4167 |
| DC-03 | 1.0000 | 0.8333 | 0.8333 | 0.9167 | 0.6667 |
| DC-05 | 0.0833 | 0.2500 | 0.6667 | 0.6667 | 0.3333 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| *DC-01 | 0.4333 | 0.4727 | 0.6913 | 0.1448 | 0.9553 | 46.252 | 5 | 3.888 | 2.230 | 0.3411 |
| DC-03 | 0.8500 | 0.9273 | 1.1919 | 0.9553 | 1.4260 | 14.629 | 5 | 0.615 | 2.230 | 0.3411 |
| *DC-05 | 0.4000 | 0.4364 | 0.6685 | 0.2928 | 0.9553 | 42.930 | 5 | 4.037 | 2.230 | 0.3411 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.94216 | | 0.868 | | -0.785 | 0.52722 |
| Bartlett's Test indicates equal variances (p = 0.36) | 3.18008 | | 11.3449 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates significant differences | 0.26425 | 0.28689 | 0.52884 | 0.0585 | 9.8E-04 | 3, 16 |
| Treatments vs CONTROL | | | | | | |

**Dose-Response Plot**






ToxCalc v5.0.23

Reviewed by: [signature]

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## TETRATECH DUCK CREEK DC-A Growth

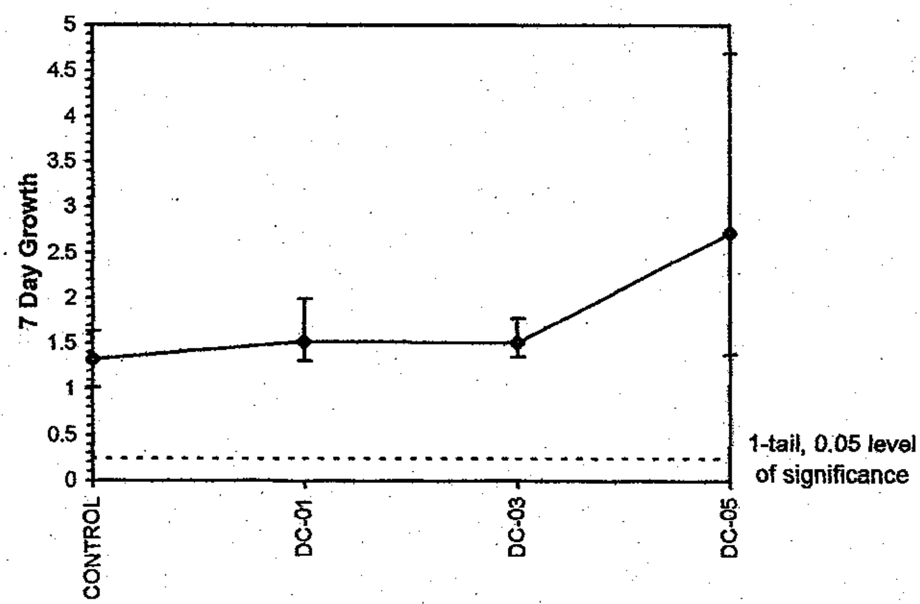
| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: | 14004DCa | Sample ID: | TETRATECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: | EPAF 94-EPA Freshwater | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 1.2682 | 1.4520 | 1.0158 | 1.6320 | 1.2842 |
| DC-01 | 1.9933 | 1.3214 | 1.3350 | 1.4300 | |
| DC-03 | 1.5092 | 1.5200 | 1.3780 | 1.3564 | 1.7813 |
| DC-05 | 4.7000 | 3.7000 | 1.3763 | 1.5450 | 2.2575 |

| | | | Transform: Untransformed | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 1.3304 | 1.0000 | 1.3304 | 1.0158 | 1.6320 | 17.251 | 5 | | | |
| DC-01 | 1.5199 | 1.1424 | 1.5199 | 1.3214 | 1.9933 | 21.005 | 4 | -0.366 | 2.240 | 1.1582 |
| DC-03 | 1.5090 | 1.1342 | 1.5090 | 1.3564 | 1.7813 | 11.222 | 5 | -0.366 | 2.240 | 1.0920 |
| DC-05 | 2.7158 | 2.0412 | 2.7158 | 1.3763 | 4.7000 | 52.981 | 5 | -2.842 | 2.240 | 1.0920 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.88023 | | 0.863 | | 0.84924 | 3.28432 |
| Bartlett's Test indicates unequal variances (p = 1.81E-04) | 19.867 | | 11.3449 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates no significant differences | 1.092 | 0.82078 | 2.00882 | 0.59414 | 0.04625 | 3, 15 |
| Treatments vs CONTROL | | | | | | |

**Dose-Response Plot**






ToxCalc v5.0.23

Reviewed by: [signature]

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## TETRATECH DUCK CREEK DC-B Survival

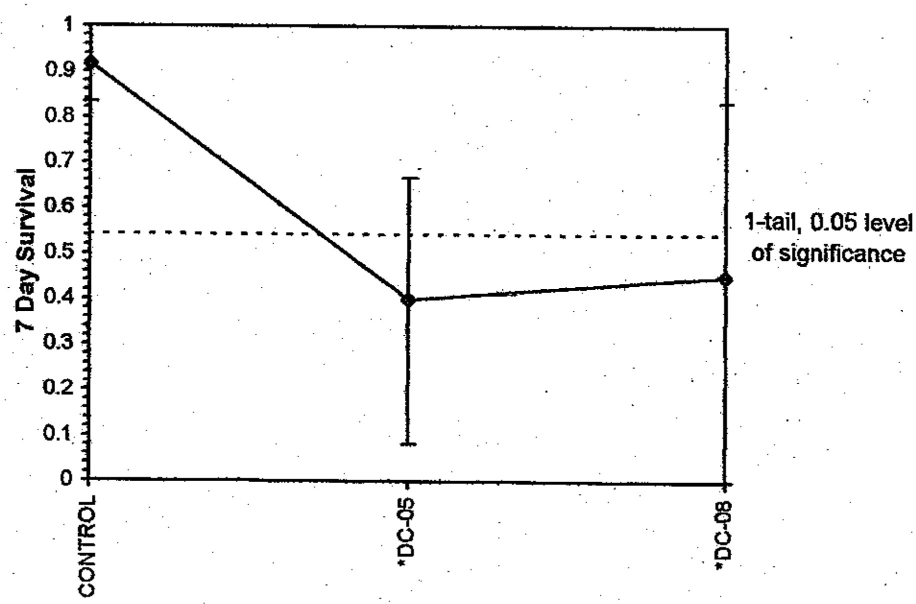
| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: 14004DCb | | Sample ID: | TETRATECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: EPAF 94-EPA Freshwater | | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| DC-05 | 0.0833 | 0.2500 | 0.6667 | 0.6667 | 0.3333 |
| DC-08 | 0.7500 | 0.6667 | 0.0000 | 0.8333 | 0.0000 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| *DC-05 | 0.4000 | 0.4364 | 0.6685 | 0.2928 | 0.9553 | 42.930 | 5 | 2.849 | 2.110 | 0.4574 |
| *DC-08 | 0.4500 | 0.4909 | 0.6885 | 0.1448 | 1.1503 | 72.775 | 5 | 2.757 | 2.110 | 0.4574 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.9374 | | 0.835 | | -0.4289 | -0.7657 |
| Bartlett's Test indicates equal variances (p = 0.08) | 5.09897 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates significant differences<br>Treatments vs CONTROL | 0.37787 | 0.41024 | 0.61574 | 0.11748 | 0.02312 | 2, 12 |

**Dose-Response Plot**






ToxCalc v5.0.23

Reviewed by: gd

B

## TETRATTECH DUCK CREEK DC-C Survival

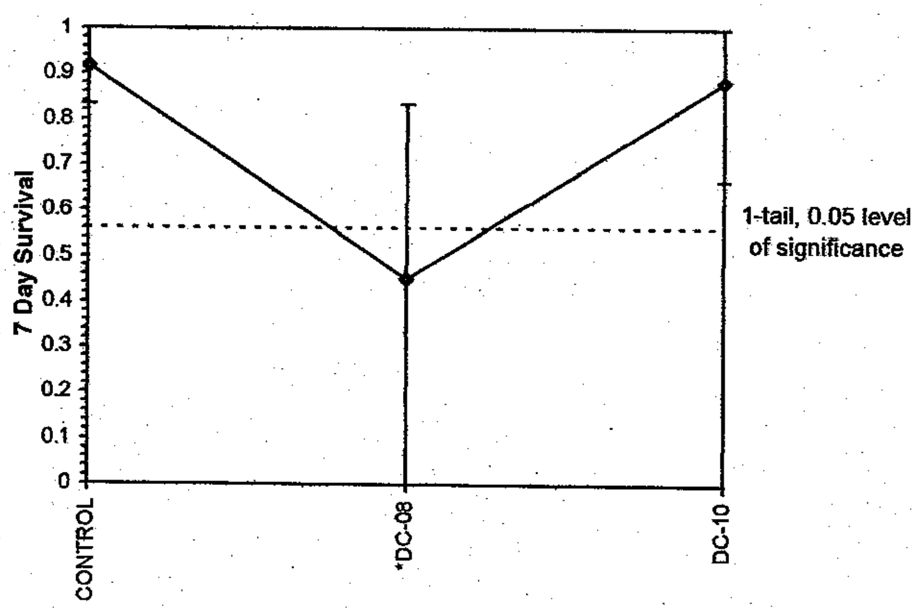
| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: | 14004DCc | Sample ID: | TETRATECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: | EPAF 94-EPA Freshwater | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| DC-08 | 0.7500 | 0.6667 | 0.0000 | 0.8333 | 0.0000 |
| DC-10 | 0.7500 | 0.6667 | 1.0000 | 1.0000 | 1.0000 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| *DC-08 | 0.4500 | 0.4909 | 0.6885 | 0.1448 | 1.1503 | 72.775 | 5 | 2.870 | 2.110 | 0.4394 |
| DC-10 | 0.8833 | 0.9636 | 1.2561 | 0.9553 | 1.4260 | 18.699 | 5 | 0.144 | 2.110 | 0.4394 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.93605 | | 0.835 | | -0.5205 | -0.5136 |
| Bartlett's Test indicates equal variances (p = 0.06) | 5.67451 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates no significant differences | 0.35997 | 0.3908 | 0.5668 | 0.10841 | 0.02328 | 2, 12 |
| Treatments vs CONTROL | | | | | | |

### Dose-Response Plot






ToxCalc v5.0.23

Reviewed by: [illegible]

C

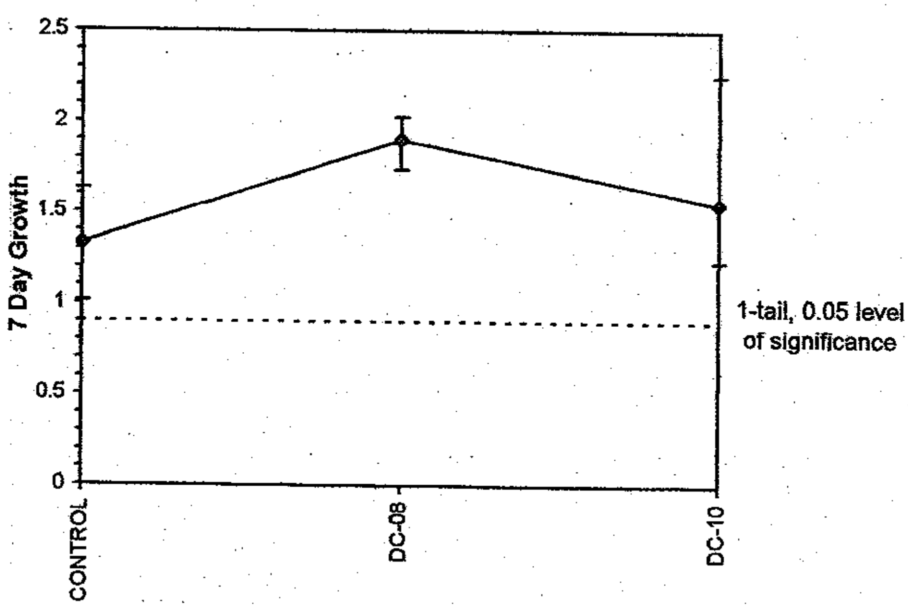
| TETRATECH DUCK CREEK DC-C Growth | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: | 14004DCc | Sample ID: | TETRATECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: | EPAF 94-EPA Freshwater | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| CONTROL | 1.2682 | 1.4520 | 1.0158 | 1.6320 | 1.2842 |
| DC-08 | 2.0200 | 1.9350 | 1.7310 | | |
| DC-10 | 1.6778 | 2.2550 | 1.3108 | 1.2783 | 1.2333 |

| | | | Transform: Untransformed | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| CONTROL | 1.3304 | 1.0000 | 1.3304 | 1.0158 | 1.6320 | 17.251 | 5 | | | |
| DC-08 | 1.8953 | 1.4246 | 1.8953 | 1.7310 | 2.0200 | 7.836 | 3 | -2.447 | 2.150 | 0.4964 |
| DC-10 | 1.5511 | 1.1658 | 1.5511 | 1.2333 | 2.2550 | 27.817 | 5 | -1.103 | 2.150 | 0.4299 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.89906 | | 0.814 | | 1.14703 | 1.72042 |
| Bartlett's Test indicates equal variances (p = 0.26) | 2.69183 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | MSDu | MSDp | MSB | MSE | F-Prob | df |
| Dunnett's Test indicates no significant differences | 0.42988 | 0.32311 | 0.29928 | 0.09995 | 0.0957 | 2, 10 |
| Treatments vs CONTROL | | | | | | |

**Dose-Response Plot**






ToxCalc v5.0.23

Reviewed by: [signature]

## TETRATECH DUCK CREEK DC-D Survival

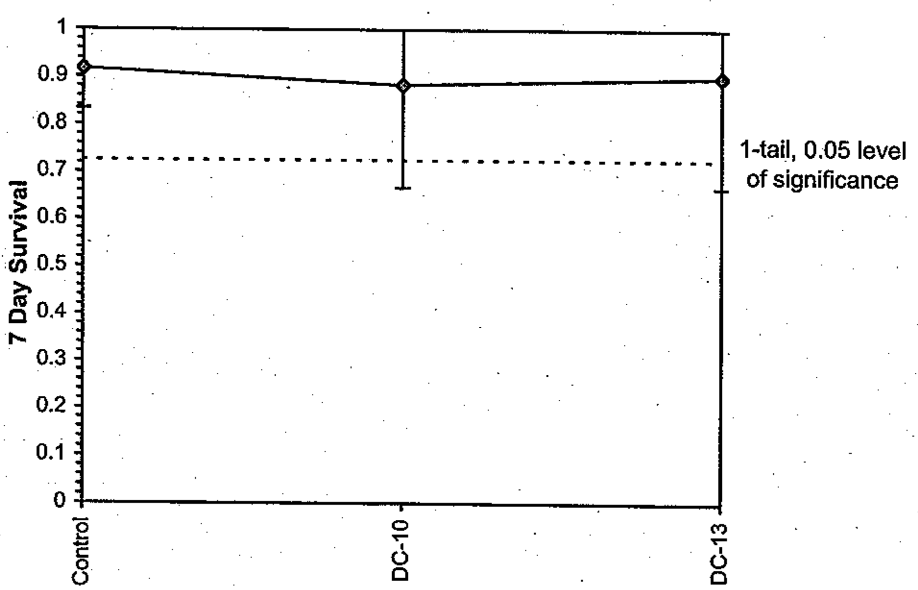
| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: 14004DCd | | Sample ID: | TETRA TECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: EPAF 94-EPA/600/4-91/002 | | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Control | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| DC-10 | 0.7500 | 0.6667 | 1.0000 | 1.0000 | 1.0000 |
| DC-13 | 0.6667 | 0.8333 | 1.0000 | 1.0000 | 1.0000 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| Control | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| DC-10 | 0.8833 | 0.9636 | 1.2561 | 0.9553 | 1.4260 | 18.699 | 5 | 0.236 | 2.110 | 0.2677 |
| DC-13 | 0.9000 | 0.9818 | 1.2767 | 0.9553 | 1.4260 | 16.895 | 5 | 0.074 | 2.110 | 0.2677 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01) | 0.81123 | | 0.835 | | -0.5968 | -1.3265 |
| Bartlett's Test indicates equal variances (p = 0.59) | 1.03851 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates no significant differences | 0.19645 | 0.21328 | 0.00118 | 0.04024 | 0.97123 | 2, 12 |
| Treatments vs Control | | | | | | |

### Dose-Response Plot






ToxCalc v5.0.23

Reviewed by: [signature]

## TETRATECH DUCK CREEK DC-D Growth

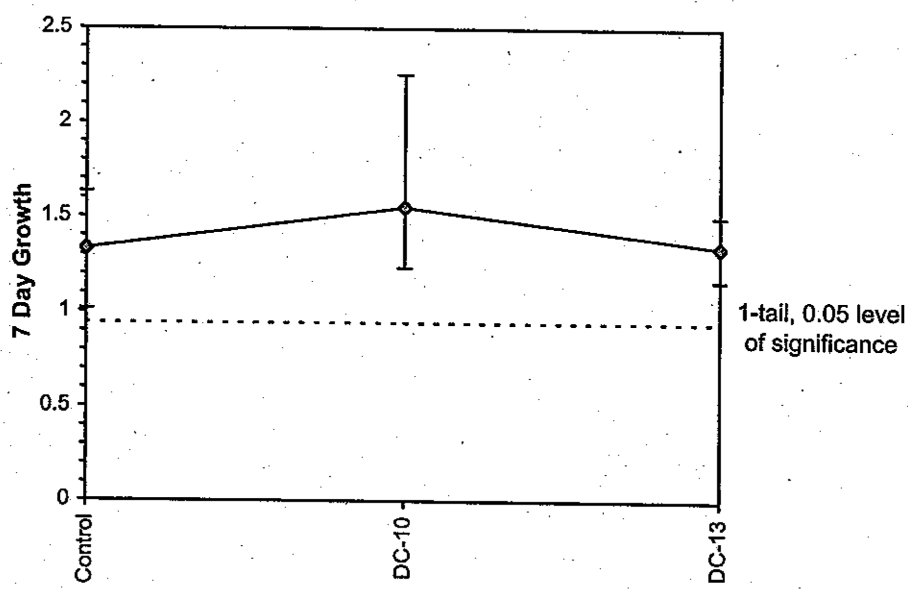
| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: 14004DCd | | Sample ID: | TETRA TECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: EPAF 94-EPA/600/4-91/002 | | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Control | 1.2682 | 1.4520 | 1.0158 | 1.6320 | 1.2842 |
| DC-10 | 1.6778 | 2.2550 | 1.3108 | 1.2783 | 1.2333 |
| DC-13 | 1.1600 | 1.3950 | 1.3158 | 1.3108 | 1.4983 |

| | | | Transform: Untransformed | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| Control | 1.3304 | 1.0000 | 1.3304 | 1.0158 | 1.6320 | 17.251 | 5 | | | |
| DC-10 | 1.5511 | 1.1658 | 1.5511 | 1.2333 | 2.2550 | 27.817 | 5 | -1.198 | 2.110 | 0.3885 |
| DC-13 | 1.3360 | 1.0042 | 1.3360 | 1.1600 | 1.4983 | 9.307 | 5 | -0.030 | 2.110 | 0.3885 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.90486 | | 0.835 | | 1.18421 | 2.16019 |
| Bartlett's Test indicates equal variances (p = 0.08) | 5.00575 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | MSDu | MSDp | MSB | MSE | F-Prob | df |
| Dunnett's Test indicates no significant differences Treatments vs Control | 0.38853 | 0.29203 | 0.07913 | 0.08477 | 0.41995 | 2, 12 |

**Dose-Response Plot**








Reviewed by: [signature]

D

## TETRATECH DUCK CREEK DC-E Survival

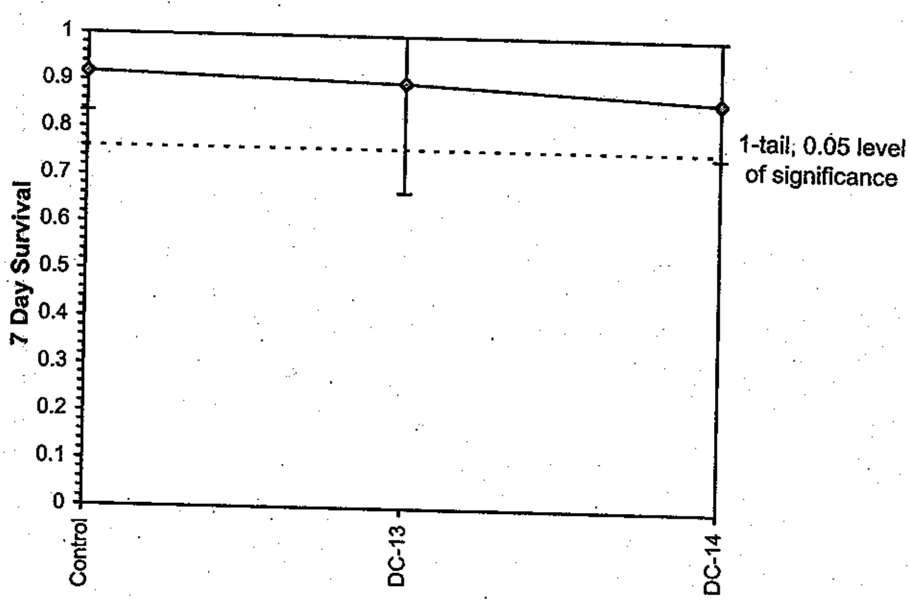
| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: 14004DCe | | Sample ID: | TETRA TECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: EPAF 94-EPA/600/4-91/002 | | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Control | 0.9167 | 0.8333 | 1.0000 | 0.8333 | 1.0000 |
| DC-13 | 0.6667 | 0.8333 | 1.0000 | 1.0000 | 1.0000 |
| DC-14 | 0.7500 | 0.8333 | 0.9167 | 1.0000 | 0.8333 |

| | | | Transform: Arcsin Square Root | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| Control | 0.9167 | 1.0000 | 1.2861 | 1.1503 | 1.4260 | 10.724 | 5 | | | |
| DC-13 | 0.9000 | 0.9818 | 1.2767 | 0.9553 | 1.4260 | 16.895 | 5 | 0.087 | 2.110 | 0.2270 |
| DC-14 | 0.8667 | 0.9455 | 1.2103 | 1.0472 | 1.4260 | 12.037 | 5 | 0.704 | 2.110 | 0.2270 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.91534 | | 0.835 | | -0.4056 | -0.7702 |
| Bartlett's Test indicates equal variances (p = 0.63) | 0.9118 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates no significant differences<br>Treatments vs Control | 0.16085 | 0.17462 | 0.00853 | 0.02892 | 0.74996 | 2, 12 |

Dose-Response Plot






ToxCalc v5.0.23

Reviewed by:

## TETRATECH DUCK CREEK DC-E Growth

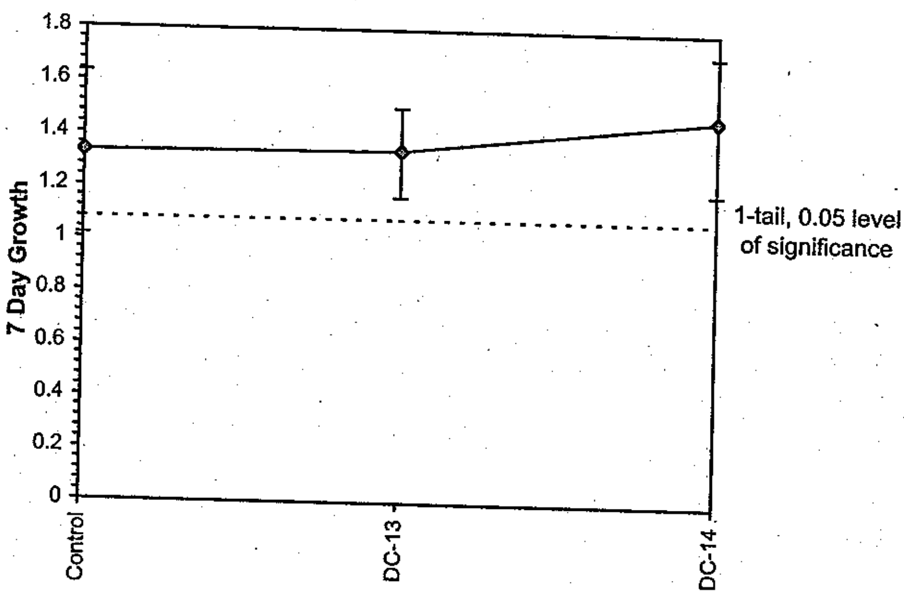
| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/18/2007 | Test ID: | 14004DCe | Sample ID: | TETRA TECH |
| End Date: | 5/8/2007 | Lab ID: | | Sample Type: | SEDIMENT |
| Sample Date: | | Protocol: | EPAF 94-EPA/600/4-91/002 | Test Species: | CT-Chironomus tentans |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Control | 1.2682 | 1.4520 | 1.0158 | 1.6320 | 1.2842 |
| DC-13 | 1.1600 | 1.3950 | 1.3158 | 1.3108 | 1.4983 |
| DC-14 | 1.7167 | 1.3870 | 1.4782 | 1.1950 | 1.5930 |

| | | | Transform: Untransformed | | | | | | 1-Tailed | |
|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD |
| Control | 1.3304 | 1.0000 | 1.3304 | 1.0158 | 1.6320 | 17.251 | 5 | | | |
| DC-13 | 1.3360 | 1.0042 | 1.3360 | 1.1600 | 1.4983 | 9.307 | 5 | -0.046 | 2.110 | 0.2529 |
| DC-14 | 1.4740 | 1.1079 | 1.4740 | 1.1950 | 1.7167 | 13.504 | 5 | -1.197 | 2.110 | 0.2529 |

| Auxiliary Tests | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | 0.97547 | | 0.835 | | -0.147 | -0.3198 |
| Bartlett's Test indicates equal variances (p = 0.52) | 1.30301 | | 9.21035 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test indicates no significant differences | 0.25292 | 0.1901 | 0.03306 | 0.03592 | 0.42477 | 2, 12 |
| Treatments vs Control | | | | | | |

### Dose-Response Plot






ToxCalc v5.0.23

Reviewed by: [signature]

# APPENDIX C

# CHAIN OF CUSTODY DOCUMENTATION

# AMERICAN AQUATIC TESTING, INC.

890 North Graham St.
ALLENTOWN, PA 18109
610 434 9015

Job #: 140-04-01

Client: SulTRAC
Address: 1 South Wacker, 37TH Fl, Chicago, IL 60606
Phone #: 312-201-7788

## CHAIN OF CUSTODY

Client Contact: Jack Brunner

Sample Disposal: Return to client [ ] Lab disposal [X]

| Sample # | Temp °C | Dis. $O_2$ | pH | Alk. mg/L | Hard. mg/L | Cl- mg/L | Sample Identification | Sample Type C = Comp G=Grab | Sample Volume | Sample Date | Sample Time | Acute | Chronic | Sediment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3.5 | | | | | | OC-SED-01 | C | 1GAL | 4/2/07 | 11:55 | | | X | |
| | | | | | | | OC-SED-11 | C | | 4/3/07 | 11:51 | | | X | |
| | | | | | | | DC-SED-10 | C | | 4/3/07 | 10:56 | | | X | |
| | | | | | | | OC-SED-22 | C | | 4/3/07 | 16:26 | | | X | |
| | | | | | | | OC-SED-03 | C | | 4/2/07 | 12:45 | | | X | |

Samples were:
1. Collected by AAT personnel [ ]
Client personnel [X]
2. Transported on ice? Yes [X] No [ ]
3. Received with in holding time? Yes [X] No [ ]
4. Sample matrix is: Liquid [ ] Sediment [X] Soil [ ] Other [ ]

### CUSTODY INFORMATION

| Sample # | Relinquished by: | Received by: | Date | Time | Relinquished by: | Received for Lab: | Date | Time | Lab Use ISTN# |
|---|---|---|---|---|---|---|---|---|---|
| OC-SED-01 | [signature] | FEDEX | 4/4/07 | 1700 | FEDEX | [signature] | 04/05/07 | 0900 | 07277 |
| OC-SED-11 | [signature] | | | | | | | | 07278 |
| DC-SED-10 | [signature] | | | | | | | | 07279 |
| OC-SED-22 | [signature] | | | | | | | | 07280 |
| OC-SED-03 | [signature] | | | | | | | | 07281 |

Special Instructions: Dilution water collection date(s) N/A

Will ammonia be analyzed on these samples? Yes No

Will additional parameters be analyzed on these samples? Yes No

# AMERICAN AQUATIC TESTING, INC.

890 North Graham St.
ALLENTOWN, PA 18109
610 434 9015

Job #: 140-04-01

## CHAIN OF CUSTODY

Client: Sul TRAC
Client Contact: Jack Brunner
Address: 1 South Wacker 37th Fl, Chicago, IL 60606
Phone #: 312-201-7788

**Sample Disposal:** **Return to client** [ ] **Lab disposal** [X]

| Sample # | Temp °C | Dis. $O_2$ | pH | Alk. mg/L | Hard. mg/L | Cl- mg/L | Sample Identification | Sample Type C = Comp G=Grab | Sample Volume | Sample Date | Sample Time | Acute | Chronic | Sediment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4.0 | | | | | | DC-SED-13 | C | 1GAL | 4/4/07 | 11:45 | | | X | |
| | ↓ | | | | | | DC-SED-19 | C | ↓ | 4/3/07 | 14:48 | | | X | |
| | | | | | | | DC-SED-07 | C | | 4/3/07 | 09:30 | | | X | |
| | | | | | | | DC-SED-01 | C | | 4/2/07 | 11:00 | | | X | |
| | | | | | | | DC-SED-03 | C | | 4/2/07 | 10:59 | | | X | |

Initial Chemistry Upon Arrival @ Laboratory (Temp through Cl-); SAMPLE INFORMATION (Sample Identification through Sample Time); Toxicity Testing Requested (Acute through Other).

Samples were:
1. Collected by AAT personnel [ ]
Client personnel [X]
2. Transported on ice? Yes [X] No [ ]
3. Received with in holding time? Yes [X] No [ ]
4. Sample matrix is: Liquid [ ] Sediment [X] Soil [ ] Other [ ]

### CUSTODY INFORMATION

| Sample # | Relinquished by: | Received by: | Date | Time | Relinquished by: | Received for Lab: | Date | Time | Lab Use ISTN# |
|---|---|---|---|---|---|---|---|---|---|
| DC-SED-13 | [signature] | FEDEX | 4/4/07 | 1700 | FEDEX | [signature] | 04/05/07 | 0900 | 07282 |
| DC-SED-19 | [signature] | | ↓ | ↓ | | ↓ | ↓ | ↓ | 07283 |
| DC-SED-07 | [signature] | | | | | | | | 07284 |
| DC-SED-01 | [signature] | | | | | | | | 07285 |
| DC-SED-03 | [signature] | | | | | | | | 07286 |

Special Instructions: Dilution water collection date(s) N/A

Will ammonia be analyzed on these samples? **Yes** No

Will additional parameters be analyzed on these samples? Yes **No**

ENVIROSAFE SERVICES

# AMERICAN AQUATIC TESTING, INC.

890 North Graham St.
ALLENTOWN, PA 18109
610 434 9015

Job #: 140-04-01

Client: Sulteac
Address: 1 South Wacker, 37th Fl, Chicago, IL 60606
Phone #: 312-201-7788

## CHAIN OF CUSTODY

Client Contact: Jack Brunner

Sample Disposal: Return to client [ ] Lab disposal [X]

| Sample # | Temp °C | Dis. $O_2$ | pH | Alk. mg/L | Hard. mg/L | Cl- mg/L | Sample Identification | Sample Type C = Comp G=Grab | Sample Volume | Sample Date | Sample Time | Acute | Chronic | Sediment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4.0 | | | | | | OC-SED-26 | C | 1GAL | 4/3/07 | 17:45 | | | X | |
| | ↓ | | | | | | OC-SED-05 | C | ↓ | 4/3/07 | 09:16 | | | X | |
| | | | | | | | OC-SED-05 | C | | 4/2/07 | 13:45 | | | X | |
| | | | | | | | OC-SED-14 | C | | 4/3/07 | 13:30 | | | X | |

Samples were:
1. Collected by AAT personnel [ ]
Client personnel [X]
2. Transported on ice? Yes [X] No [ ]
3. Received with in holding time? Yes [X] No [ ]
4. Sample matrix is: Liquid [ ] Sediment [X] Soil [ ] Other [ ]

## CUSTODY INFORMATION

| Sample # | Relinquished by: | Received by: | Date | Time | Relinquished by: | Received for Lab: | Date | Time | Lab Use ISTN# |
|---|---|---|---|---|---|---|---|---|---|
| OC-SED-26 | [signature] | FEDEX | 4/4/07 | 1700 | FEDEX | [signature] | 04/05/07 | 0900 | 07287 |
| OC-SED-05 | [signature] | | ↓ | ↓ | | ↓ | ↓ | ↓ | 07288 |
| OC-SED-05 | [signature] | | | | | | | | 07289 |
| OC-SED-14 | [signature] | | | | | | | | 07290 |

Special Instructions: Dilution water collection date(s) N/A

Will ammonia be analyzed on these samples? Yes No
Will additional parameters be analyzed on these samples? Yes No

# AMERICAN AQUATIC TESTING, INC.

890 North Graham St.
ALLENTOWN, PA 18109
610 434 9015

Job #: 140-04-01

## CHAIN OF CUSTODY

Client: SulTRAC
Address: 1 South Wacker, 37TH Fl, Chicago, IL 60606
Phone #: 312-201-7788
Client Contact: Jack Brunner

Sample Disposal: Return to client [ ] Lab disposal [X]

| Sample # | Temp °C | Dis. $O_2$ | pH | Alk. mg/L | Hard. mg/L | Cl- mg/L | Sample Identification | Sample Type C = Comp G=Grab | Sample Volume | Sample Date | Sample Time | Acute | Chronic | Sediment | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | DC-SED-08 | C | 1 GAL | 4/2/07 | 15:12 | | | X | |
| | | | | | | | DC-SED-14 | C | ↓ | 4/4/07 | 11:30 | | | X | |

(Initial Chemistry Upon Arrival @ Laboratory: Temp through Cl-; SAMPLE INFORMATION: Sample Identification through Sample Time; Toxicity Testing Requested: Acute, Chronic, Sediment, Other)

Samples were:
1. Collected by AAT personnel [ ] Client personnel [X]
2. Transported on ice? Yes [X] No [ ]
3. Received with in holding time? Yes [X] No [ ]
4. Sample matrix is: Liquid [ ] Sediment [X] Soil [ ] Other [ ]

### CUSTODY INFORMATION

| Sample # | Relinquished by: | Received by: | Date | Time | Relinquished by: | Received for Lab: | Date | Time | Lab Use ISTN# |
|---|---|---|---|---|---|---|---|---|---|
| DC-SED-08 | [signature] | FEDEX | 4/4/07 | 1700 | FEDEX | [signature] | 04/05/07 | 0900 | 07291 |
| DC-SED-14 | [signature] | | 4/4/07 | 1700 | | ↓ | ↓ | ↓ | 07292 |

Special Instructions: Dilution water collection date(s) N/A

Will ammonia be analyzed on these samples? **Yes** No

Will additional parameters be analyzed on these samples? Yes **No**

# APPENDIX E

# FOOD CHAIN MODEL FOR AVIAN AND MAMMALIAN RECEPTORS

**TABLE E-1: DOSE PARAMETERS FOR THE BELTED KINGFISHER (Ceryle alcyon)**
Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

| Parameter | Average Adult | Units | Reference/Notes |
|---|---|---|---|
| Ingestion Rate$_{food}$ | 8.42E-02 | kg/day | Calculated with body weight of 147 grams using the equation for the food requirement for intake of fresh matter for carnivorous birds (food ingestion rate = [3.048[BW(grams)]^0.665]/1000) (Nagy 2001). |
| Ingestion Rate$_{fish}$ | 5.01E-02 | kg/day | Based on 60 percent of food ingestion rate. |
| Ingestion Rate$_{invertebrate}$ | 3.33E-02 | kg/day | Based on 40 percent of food ingestion rate. |
| Ingestion Rate$_{sediment}$ | 5.89E-04 | kg/day | 0.7 percent of total ingestion rate, based on the bald eagle (Pascoe, Blanchet, and Linder 1996). |
| Sediment Concentrations | Mean Concentration | mg/kg | Based on use of the mean concentration of each chemical in sediment collected from the site (0-1 feet bss) per EPA baseline ERA guidance (EPA 1997). |
| Food Concentrations | Food Chain Model | mg/kg | Food concentrations were estimated using uptake models using concentrations at the site or by multiplying concentrations in sediment in the river by BSAFs for aquatic invertebrates and fish. |
| Diet Composition[a] | 60%<br>40%<br>0.7% | Fish<br>Invertebrates<br>Sediment | Food will consist of 60 percent fish and 40 percent invertebrates because the belted kingfisher was selected as representative species for carnivorous birds (Alexander 1977 as cited in EPA 1993). |
| Foraging Range | 1.5 | km | Territory size is approximately 1.5 km of shoreline (Brooks and David 1987 as cited in EPA 1993). |
| Site Use Factor | 1.00E+00 | Unitless | Based on creek section length (1.716 km) divided by foraging range or 1 which ever is lower (EPA 1997). |
| Body Weight | 1.47E-01 | kg | Mean body weight of adults eastern United States (Brooks and Davis 1987 as cited in EPA 1993). |

**Notes:**

| | |
|---|---|
| BSAF | Biota-sediment accumulation factor |
| bss | Below sediment surface |
| BW | Body weight |
| EPA | U.S. Environmental Protection Agency |
| ERA | Ecological Risk Assessment |
| kg | Kilograms |
| kg/day | Kilograms per day |
| km | Kilometer |
| mg | Milligram |
| mg/kg | Milligrams per kilogram |

**References:**


Nagy, K.A. 2001. "Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds." *Nutrition Abstracts and Reviews* , Series B. Volume 71. Number 10. Pages 2R-12R.

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**TABLE E-2: DOSE PARAMETERS FOR THE AMERICAN MINK (Mustela vision)**
Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

| Parameter | Average Adult | Units | Reference/Notes |
|---|---|---|---|
| Ingestion Rate$_{food}$ | 1.66E-01 | kg/day | Calculated with body weight of 1000 grams using the equation for the food requirement for intake of fresh matter for carnivores (food ingestion rate = [0.794[BW(grams)]^0.773]/1000) (Nagy 2001). |
| Ingestion Rate$_{fish}$ | 1.41E-01 | kg/day | Based on 85 percent of food ingestion rate (Alexander 1977 as cited in EPA 1993). |
| Ingestion Rate$_{invertebrate}$ | 8.28E-03 | kg/day | Based on 5 percent of food ingestion rate (Alexander 1977 as cited in EPA 1993). |
| Ingestion Rate$_{sediment}$ | 1.66E-04 | kg/day | Sediment ingestion expected to be negligible (Sample and Suter 1999). |
| Sediment Concentrations | Mean Concentration | mg/kg | Based on use of the mean concentration of each chemical in sediment collected from the site (0-1 feet bss) per EPA Baseline ERA guidance (EPA 1997). |
| Food Concentrations | Food Chain Model | mg/kg | Food concentrations were estimated using uptake models using concentrations at the site or by multiplying concentrations in sediment in the river by BSAFs for aquatic invertebrates and fish. |
| Diet Composition$_a$ | 85%<br>5%<br>0.1% | Fish<br>Invertebrates<br>Sediment | Food will consist of 85 percent fish and 5 percent invertebrates because the mink was selected as representative species for piecivorous mammal. It was assummed that 10 percent of the diet was not aquatic based and would include small mammals, birds, and vegetation (EPA 1993). |
| Foraging Range | 2.24E+00 | km | Based on Montana/riverine system with sparse vegetation (OEPA 1993). |
| Site Use Factor | 7.66E-01 | Unitless | Based on creek section length (1.716 km) divided by foraging range (EPA 1997). |
| Body Weight | 1.00E+00 | kg | Average body weight from Sample and Suter (1999). |

**Notes:**

| | |
|---|---|
| BSAF | Biota-sediment accumulation factor |
| bss | Below sediment surface |
| EPA | U.S. Environmental Protection Agency |
| ERA | Ecological Risk Assessment |
| kg | Kilograms |
| kg/day | Kilograms per day |
| mg/kg | Milligrams per kilogram |

**References:**


Nagy, K.A. 2001. "Food requirements of wild animals: predictive equations for free-living mammals, reptiles, and birds." Nutrition Abstracts and Reviews, Series B. Volume 71. Number 10. Pages 2R-12R.

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Sample, B.E. and G.W. Suter II. 1999. "Ecological Risk Assessment in a Large River-Reservoir: 4. Piscivorous Wildlife" *Environ. Toxicol. Chem.* 18(4): 610-620.

**TABLE E-3**
**BIOTA-SEDIMENT ACCUMULATION FACTORS**
**DUCK AND OTTER CREEKS**
**TOLEDO AND OREGON, OHIO**

| Chemical | Invertebrate BSAF | Source | Fish BSAF | Source |
|---|---|---|---|---|
| **Metals** | | | | |
| Arsenic | 1.87 E-01 | USACE 2003 | 1.87 E-01 | (1) |
| Barium | 4.01 E-01 | USACE 2003 | 4.01 E-01 | (1) |
| Cadmium | 1.68 E-01 | USACE 2003 | 1.68 E-01 | (1) |
| Chromium | 6.70 E-02 | USACE 2003 | 6.70 E-02 | (1) |
| Lead | 9.00 E-02 | USACE 2003 | 9.00 E-02 | (1) |
| Mercury | 2.05 E-01 | USACE 2003 | 2.05 E-01 | (1) |
| Selenium | 9.52 E-01 | USACE 2003 | 9.52 E-01 | (1) |
| Zinc | 2.70 E-01 | USACE 2003 | 2.70 E-01 | (1) |
| | | | | |
| **PAHs (2)** | | | | |
| *Low Molecular Weight* | | | | |
| 2-Methlynaphthalene | 4.65 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Acenaphthene | 3.0 E-02 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Acenaphthlyene | 7.62 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Anthracene | 1.08 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Fluoranthene | 7.16 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Fluorene | 2.97 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Naphthalene | 2.97 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Phenanthrene | 2.97 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Average | 3.72 E-01 | | 2.57 E-01 | |
| *High Molecular Weight* | | | | |
| Benzo(a)anthracene | 3.31 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Benzo(a)pyrene | 3.42 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Benzo(b)fluoranthene | 4.16 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Benzo(k)fluoranthene | 2.69 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Chrysene | 4.38 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Dibenzo(a,h)anthracene | 3.77 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Indeno(1,2,3-cd)pyrene | 2.10 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Pyrene | 2.97 E-01 | USACE 2006 | 2.57 E-01 | USACE 2006 |
| Average | 3.35 E-01 | | 2.57 E-01 | |

# TABLE E-3
# BIOTA-SEDIMENT ACCUMULATION FACTORS
# DUCK AND OTTER CREEKS
# TOLEDO AND OREGON, OHIO

| Chemical | Invertebrate BSAF | Source | Fish BSAF | Source |
|---|---|---|---|---|
| **Total PCB**s | 3.36 E+00 | USACE 2003 | 2.15 E+00 | USACE 2003 |
| | | | | |
| **Pesticides** | | | | |
| 4,4-DDD | 8.70 E-01 | USACE 2006 | 3.26 E+00 | USACE 2006 |
| 4,4-DDE | 2.23 E+00 | USACE 2006 | 1.26 E+01 | USACE 2006 |
| 4,4-DDT | 1.25 E+00 | USACE 2006 | 7.0 E-01 | USACE 2006 |
| Heptachlor | 1.85 E+00 | Tracey and Hanson 1996 (3) | 3.27 E+00 | Tracey and Hanson 1996(4) |
| Heptachlor epoxide | 1.85 E+00 | Tracey and Hanson 1996 (3) | 3.27 E+00 | Tracey and Hanson 1996 (4) |

Notes:
(1) Fish BSAF assumed to be the same at invertebrate BSAF for all metals.
(2) For PAH compounds without a specific BSAF, the geometric mean for all mollusks and polychaetes is used for the invertebrates and the geometric mean for all benthicaly coupled organisms is used for the fish as reported by USACE (2006).
(3) No specific BSAFs were identified for these compounds; Tracey and Hansen (1996) provided a general BSAF for pesticides which will be applied to these compounds.
(4) Based on the BSAFS ratios between fish and invertebrates presented in Tracey and Hanson (1996), for pesticides without fish BSAF, it is assumed that a trophic factor of 2 would be applied to the invertebrate BSAF to approximate the fish BSAF.

BSAF Biota-sediment accumulation factor
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
DDT Dichlorodiphenyltrichloroethane
USACE U.S. Army Corps of Engineers
BSAF Biota-sediment accumulation factor
PAH Polynuclear aromatic hydrocarbons

**TABLE E-4**
**Avian Toxicity Reference Values**
**Duck and Otter Creeks**

| Chemical | High TRV[a] (mg/kg-bw per day) | Source/Date | Test Species | Endpoint | Low TRV (mg/kg-bw per day) | Source/Date | Test Species | Endpoint |
|---|---|---|---|---|---|---|---|---|
| 4,4'-DDD | 2.62 | EPA 2007a | various species | growth and reproduction | 0.227 | EPA 2007a | various species | growth and reproduction |
| 4,4'-DDE | 2.62 | EPA 2007a | various species | growth and reproduction | 0.227 | EPA 2007a | various species | growth and reproduction |
| 4,4'-DDT | 2.62 | EPA 2007a | various species | growth and reproduction | 0.227 | EPA 2007a | various species | growth and reproduction |
| Arsenic | 17.3 | EPA 2005a | mallard | growth | 2.24 | EPA 2005a | chicken | growth |
| Barium | NA | EPA 2005b | | | NA | EPA 2005b | | |
| Cadmium | 6.3 | EPA 2005c | various species | growth and reproduction | 1.47 | EPA 2005c | various species | growth and reproduction |
| Chromium 3+ | 15.6 | EPA 2008 | various species | growth and reproduction | 2.66 | EPA 2008 | various species | growth and reproduction |
| Heptachlor | 0.65 | EPA 1999 | quail | mortality | 0.065 | EPA 1999 | quail | mortality |
| Heptachlor epoxide | 0.65 | EPA 1999 | quail | mortality | 0.065 | EPA 1999 | quail | mortality |
| Lead | 44.6 | EPA 2005d | various species | growth and reproduction | 1.63 | EPA 2005d | various species | growth and reproduction |
| Mercury | 0.18 | EPA 2002 | mallard | mortality, neurological | 0.039 | EPA 2002 | mallard | reproductive |
| Nickel | 18.6 | EPA 2007b | various species | growth and reproduction | 6.71 | EPA 2007b | various species | growth and reproduction |
| PCB-1254 | 1.3[b] | EPA 2002 | chicken | reproduction | 0.090[a] | EPA 2002 | chicken | reproduction |
| PCB-1260 | 1.3[b] | EPA 2002 | chicken | reproduction | 0.090[a] | EPA 2002 | chicken | reproduction |
| PAH – LMW[c] | NA | EPA 2007c | | | NA | EPA 2007c | | |
| PAH – HMW[d] | NA | EPA 2007c | | | NA | EPA 2007c | | |
| Selenium | 0.91 | EPA 2007d | various species | growth and reproduction | 0.29 | EPA 2007d | various species | growth and reproduction |
| Zinc | 136.8 | EPA 2007e | various species | growth and reproduction | 66.1 | EPA 2007e | various species | growth and reproduction |

Notes:

| | |
|---|---|
| DDD | Dichlorodiphenyldichloroethane |
| DDE | Dichlorodiphenyldichloroethene |
| DDT | Dichlorodiphenyltrichloroethane |
| PCB | Polychlorinated biphenyls |
| PAH – LMW | Polynuclear aromatic hydrocarbons - low molecular weight |
| PAH – HMW | Polynuclear aromatic hydrocarbons - high molecular weight |

[a] The High TRV for values from EPA 2005 a, b, c, d, 2007a, b, c, d, e, and 2008 using the geometric mean of the lowest observed effect level for the accepted studies for growth and reproduction consistent with the method used to calculate the threshold value as outlined in EPA 2003.
[b] The TRV is a surrogate from Total PCBs.
[c] PAH- LWH is the sum of the following compounds – 2-methylnaphthalene, acenaphthene, acenaphthalyene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene.
[d] PAH- HWH is the sum of the following compounds – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.


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EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).
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EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

# TABLE E-4
## Mammalian Toxicity Reference Values
## Duck and Otter Creeks

| Chemical | High TRV[a] (mg/kg-bw per day) | Source/Date | Test Species | Endpoint | Low TRV (mg/kg-bw per day) | Source/Date | Test Species | Endpoint |
|---|---|---|---|---|---|---|---|---|
| 4,4'-DDD | 4.58 | EPA 2007a | various species | growth and reproduction | 0.147 | EPA 2007a | various species | growth and reproduction |
| 4,4'-DDE | 4.58 | EPA 2007a | various species | growth and reproduction | 0.147 | EPA 2007a | various species | growth and reproduction |
| 4,4'-DDT | 4.58 | EPA 2007a | various species | growth and reproduction | 0.147 | EPA 2007a | various species | growth and reproduction |
| Arsenic | 4.6 | EPA 2005a | various species | growth and reproduction | 0.32 | EPA 2005a | various species | growth and reproduction |
| Barium | 268.7 | EPA 2005b | various species | growth and reproduction | 52 | EPA 2005b | various species | growth and reproduction |
| Cadmium | 8.96 | EPA 2005c | various species | growth and reproduction | 0.770 | EPA 2005c | various species | growth and reproduction |
| Chromium 3+/6+ | 58.2/35.5 | EPA 2008 | various species | growth and reproduction | 2.4/9.2 | EPA 2008 | various species | growth and reproduction |
| Heptachlor | 6.8 | EPA 2002 | rat | developmental | 0.13 | EPA 2002 | rat | reproduction |
| Heptachlor epoxide | 6.8 | EPA 2002 | rat | developmental | 0.13 | EPA 2002 | rat | reproduction |
| Lead | 187.0 | EPA 2005d | various species | growth and reproduction | 4.7 | EPA 2005d | various species | growth and reproduction |
| Mercury | 4.0 | EPA 2002 | rat | reproduction, development | 0.25 | EPA 2002 | rat | reproduction, development |
| Nickel | 14.8 | EPA 2007b | various species | growth and reproduction | 1.7 | EPA 2007b | various species | growth and reproduction |
| PCB-1254 | 1.3[b] | EPA 2002 | mouse | reproduction | 0.36[a] | EPA 2002 | mouse | reproduction |
| PCB-1260 | 1.3[b] | EPA 2002 | mouse | reproduction | 0.36[a] | EPA 2002 | mouse | reproduction |
| PAH – LMW[c] | 355.9 | EPA 2007c | various species | growth and reproduction | 65.6 | EPA 2007c | various species | growth and reproduction |
| PAH – HMW[d] | 38.4 | EPA 2007c | various species | growth and reproduction | 0.615 | EPA 2007c | various species | growth and reproduction |
| Selenium | 0.66 | EPA 2007d | various species | growth and reproduction | 0.143 | EPA 2007b | various species | growth and reproduction |
| Zinc | 297.6 | EPA 2007e | various species | growth and reproduction | 75.4 | EPA 2007e | various species | growth and reproduction |

Notes:

DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethene
DDT Dichlorodiphenyltrichloroethane
PCB Polychlorinated biphenyls
PAH – LMW Polynuclear aromatic hydrocarbons - low molecular weight
PAH – HMW Polynuclear aromatic hydrocarbons - high molecular weight

[a] The High TRV for values from EPA 2005 a, b, c, d, 2007a, b, c, d, e, and 2008 using the geometric mean of the lowest observed effect level for the accepted studies for growth and reproduction consistent with the method used to calculate the threshold value as outlined in EPA 2003.
[b] The TRV is a surrogate from Total PCBs.
[c] PAH- LWH is the sum of the following compounds – 2-methylnaphthalene, acenaphthene, acenaphthalyene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene.
[d] PAH- HWH is the sum of the following compounds – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).
EPA 2003. Guidance for Developing Ecological Soil Screening Levels. OSWER Directive 92857-55. November. Available Online at http://www.epa.gov/ecotox/ecossl/SOPs.htm
EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

| TABLE E-5: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio | | | | | | | | | | | | | | | | | | |
| **Section DC-A, EPC** | | | | | | | | | | | | | | | | | | |
| **COPEC** | **Total Prey Ingestion Rate[1] (kg/day)** | **Fish Ingestion Rate[2] (kg/day)** | **Fish BSAF[3] (unitless)** | **Fish Concentration[4] (mg/kg)** | **Fish Daily Dose[5] (mg/day)** | **Invertebrate Ingestion Rate[2] (kg/day)** | **Invertebrate BSAF[3,5] (unitless)** | **Invertebrate Concentration[4] (mg/kg)** | **Invertebrate Daily Dose[5] (mg/day)** | **Sediment Ingestion Rate[6] (kg/day)** | **Sediment Concentration[7] (mg/kg)** | **Sediment Daily Dose[8] (mg/day)** | **SUF** | **Body Weight[9] (kg)** | **Total Daily Dose[10] (mg/kg/day)** | **TRV[11] (mg/kg/day)** | **HQ[12] (based on adjusted TRV)** | **Source of TRV** |
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 2.5E+01 | 1.2E+00 | 3.3E-02 | 1.9E-01 | 2.5E+01 | 8.2E-01 | 5.9E-04 | 1.3E+02 | 7.8E-02 | 1.0E+00 | 1.5E-01 | 1.5E+01 | 1.7E+01 | 8.4E-01 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 2.5E+01 | 1.2E+00 | 3.3E-02 | 1.9E-01 | 2.5E+01 | 8.2E-01 | 5.9E-04 | 1.3E+02 | 7.8E-02 | 1.0E+00 | 1.5E-01 | 1.5E+01 | 2.2E+00 | **6.5E+00** | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 2.1E+02 | 1.1E+01 | 3.3E-02 | 4.0E-01 | 2.1E+02 | 7.0E+00 | 5.9E-04 | 5.3E+02 | 3.1E-01 | 1.0E+00 | 1.5E-01 | 1.2E+02 | NA | --[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 2.1E+02 | 1.1E+01 | 3.3E-02 | 4.0E-01 | 2.1E+02 | 7.0E+00 | 5.9E-04 | 5.3E+02 | 3.1E-01 | 1.0E+00 | 1.5E-01 | 1.2E+02 | NA | --[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 8.4E-01 | 4.2E-02 | 3.3E-02 | 1.7E-01 | 8.4E-01 | 2.8E-02 | 5.9E-04 | 5.0E+00 | 2.9E-03 | 1.0E+00 | 1.5E-01 | 5.0E-01 | 6.3E+00 | 7.9E-02 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 8.4E-01 | 4.2E-02 | 3.3E-02 | 1.7E-01 | 8.4E-01 | 2.8E-02 | 5.9E-04 | 5.0E+00 | 2.9E-03 | 1.0E+00 | 1.5E-01 | 5.0E-01 | 1.5E+00 | 3.4E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 5.5E+00 | 2.7E-01 | 3.3E-02 | 6.7E-02 | 5.5E+00 | 1.8E-01 | 5.9E-04 | 8.2E+01 | 4.8E-02 | 1.0E+00 | 1.5E-01 | 3.4E+00 | 1.6E+01 | 2.2E-01 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 5.5E+00 | 2.7E-01 | 3.3E-02 | 6.7E-02 | 5.5E+00 | 1.8E-01 | 5.9E-04 | 8.2E+01 | 4.8E-02 | 1.0E+00 | 1.5E-01 | 3.4E+00 | 2.7E+00 | **1.3E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.6E+01 | 1.8E+00 | 3.3E-02 | 9.0E-02 | 3.6E+01 | 1.2E+00 | 5.9E-04 | 4.0E+02 | 2.4E-01 | 1.0E+00 | 1.5E-01 | 2.2E+01 | 4.5E+01 | 5.0E-01 | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.6E+01 | 1.8E+00 | 3.3E-02 | 9.0E-02 | 3.6E+01 | 1.2E+00 | 5.9E-04 | 4.0E+02 | 2.4E-01 | 1.0E+00 | 1.5E-01 | 2.2E+01 | 1.6E+00 | **1.4E+01** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 7.6E-02 | 3.8E-03 | 3.3E-02 | 2.1E-01 | 7.6E-02 | 2.5E-03 | 5.9E-04 | 3.7E-01 | 2.2E-04 | 1.0E+00 | 1.5E-01 | 4.4E-02 | 1.8E-01 | 2.5E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 7.6E-02 | 3.8E-03 | 3.3E-02 | 2.1E-01 | 7.6E-02 | 2.5E-03 | 5.9E-04 | 3.7E-01 | 2.2E-04 | 1.0E+00 | 1.5E-01 | 4.4E-02 | 3.9E-02 | **1.1E+00** | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 9.5E+00 | 4.8E-01 | 3.3E-02 | 9.5E-01 | 9.5E+00 | 3.2E-01 | 5.9E-04 | 1.0E+01 | 5.9E-03 | 1.0E+00 | 1.5E-01 | 5.4E+00 | 9.1E-01 | **6.0E+00** | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 9.5E+00 | 4.8E-01 | 3.3E-02 | 9.5E-01 | 9.5E+00 | 3.2E-01 | 5.9E-04 | 1.0E+01 | 5.9E-03 | 1.0E+00 | 1.5E-01 | 5.4E+00 | 2.9E-01 | **1.9E+01** | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.5E+02 | 1.3E+01 | 3.3E-02 | 2.7E-01 | 2.5E+02 | 8.4E+00 | 5.9E-04 | 9.4E+02 | 5.5E-01 | 1.0E+00 | 1.5E-01 | 1.5E+02 | 1.4E+02 | **1.1E+00** | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.5E+02 | 1.3E+01 | 3.3E-02 | 2.7E-01 | 2.5E+02 | 8.4E+00 | 5.9E-04 | 9.4E+02 | 5.5E-01 | 1.0E+00 | 1.5E-01 | 1.5E+02 | 6.6E+01 | **2.2E+00** | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 6.3E-01 | 3.1E-02 | 3.3E-02 | 3.4E+00 | 4.6E-01 | 1.5E-02 | 5.9E-04 | 4.8E-01 | 2.8E-04 | 1.0E+00 | 1.5E-01 | 3.2E-01 | 1.3E+00 | 2.5E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 6.3E-01 | 3.1E-02 | 3.3E-02 | 3.4E+00 | 4.6E-01 | 1.5E-02 | 5.9E-04 | 4.8E-01 | 2.8E-04 | 1.0E+00 | 1.5E-01 | 3.2E-01 | 9.0E-02 | **3.6E+00** | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 2.7E-01 | 1.3E-02 | 3.3E-02 | 8.7E-01 | 3.4E-02 | 1.1E-03 | 5.9E-04 | 1.4E-01 | 8.0E-05 | 1.0E+00 | 1.5E-01 | 9.9E-02 | 2.6E+00 | 3.8E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 2.7E-01 | 1.3E-02 | 3.3E-02 | 8.7E-01 | 3.4E-02 | 1.1E-03 | 5.9E-04 | 1.4E-01 | 8.0E-05 | 1.0E+00 | 1.5E-01 | 9.9E-02 | 2.3E-01 | 4.4E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 4.8E-01 | 2.4E-02 | 3.3E-02 | 2.2E+00 | 4.0E-02 | 1.3E-03 | 5.9E-04 | 6.2E-02 | 3.7E-05 | 1.0E+00 | 1.5E-01 | 1.7E-01 | 2.6E+00 | 6.5E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 4.8E-01 | 2.4E-02 | 3.3E-02 | 2.2E+00 | 4.0E-02 | 1.3E-03 | 5.9E-04 | 6.2E-02 | 3.7E-05 | 1.0E+00 | 1.5E-01 | 1.7E-01 | 2.3E-01 | 7.5E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 8.1E-03 | 4.0E-04 | 3.3E-02 | 1.3E+00 | 6.8E-03 | 2.3E-04 | 5.9E-04 | 1.9E-02 | 1.1E-05 | 1.0E+00 | 1.5E-01 | 4.4E-03 | 2.6E+00 | 1.7E-03 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 8.1E-03 | 4.0E-04 | 3.3E-02 | 1.3E+00 | 6.8E-03 | 2.3E-04 | 5.9E-04 | 1.9E-02 | 1.1E-05 | 1.0E+00 | 1.5E-01 | 4.4E-03 | 2.3E-01 | 1.9E-02 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 7.7E-03 | 3.9E-04 | 3.3E-02 | 1.9E+00 | 2.1E-03 | 6.9E-05 | 5.9E-04 | 3.9E-03 | 2.3E-06 | 1.0E+00 | 1.5E-01 | 3.1E-03 | 6.5E-01 | 4.8E-03 | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 7.7E-03 | 3.9E-04 | 3.3E-02 | 1.9E+00 | 2.1E-03 | 6.9E-05 | 5.9E-04 | 3.9E-03 | 2.3E-06 | 1.0E+00 | 1.5E-01 | 3.1E-03 | 6.5E-02 | 4.8E-02 | EPA 1999 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 2.5E-02 | 1.3E-03 | 3.3E-02 | 1.9E+00 | 6.8E-03 | 2.3E-04 | 5.9E-04 | 1.3E-02 | 7.6E-06 | 1.0E+00 | 1.5E-01 | 1.0E-02 | 6.5E-01 | 1.6E-02 | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 2.5E-02 | 1.3E-03 | 3.3E-02 | 1.9E+00 | 6.8E-03 | 2.3E-04 | 5.9E-04 | 1.3E-02 | 7.6E-06 | 1.0E+00 | 1.5E-01 | 1.0E-02 | 6.5E-02 | 1.6E-01 | EPA 1999 |

## TABLE E-5: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-A, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 6.6E-01 | 3.3E-02 | 3.3E-02 | 3.7E-01 | 4.5E-01 | 1.5E-02 | 5.9E-04 | 4.3E+00 | 2.5E-03 | 1.0E+00 | 1.5E-01 | 3.5E-01 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 6.6E-01 | 3.3E-02 | 3.3E-02 | 3.7E-01 | 4.5E-01 | 1.5E-02 | 5.9E-04 | 4.3E+00 | 2.5E-03 | 1.0E+00 | 1.5E-01 | 3.5E-01 | NA | --[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 4.3E-01 | 2.1E-02 | 3.3E-02 | 3.4E-01 | 2.6E-01 | 8.7E-03 | 5.9E-04 | 2.7E+00 | 1.6E-03 | 1.0E+00 | 1.5E-01 | 2.2E-01 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 4.3E-01 | 2.1E-02 | 3.3E-02 | 3.4E-01 | 2.6E-01 | 8.7E-03 | 5.9E-04 | 2.7E+00 | 1.6E-03 | 1.0E+00 | 1.5E-01 | 2.2E-01 | NA | --[14] | EPA 2007c |

**Notes:**

| | |
|---|---|
| 1 | See TABLE E-1 for total prey ingestion rate calculation. |
| 2 | The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1). |
| 3 | Sources of BSAFs are described in Table E-3. |
| 4 | The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF. |
| | For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates. |
| 5 | Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4). |
| 6 | Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1. |
| 7 | EPC of all site-collected sediment samples were used (see Table E-1). |
| 8 | Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7). |
| 9 | See Table E-1 for basis of body weight. |
| 10 | Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight. |
| 11 | The source of TRVs is described in Table E-4. |
| 12 | HQs were calculated using the following equation: HQ = total daily dose/TRV. |
| 13 | Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively. |
| 14 | No TRV value available; therefore, an HQ could not be calculated. |

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


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EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).

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EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

**Table E-6: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)**

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-A, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 2.5E+01 | 3.5E+00 | 3.3E-02 | 1.9E-01 | 2.5E+01 | 8.2E-01 | 1.7E-04 | 1.3E+02 | 2.2E-02 | 7.7E-01 | 1.0E+00 | 3.3E+00 | 4.6E+00 | 7.2E-01 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 2.5E+01 | 3.5E+00 | 3.3E-02 | 1.9E-01 | 2.5E+01 | 8.2E-01 | 1.7E-04 | 1.3E+02 | 2.2E-02 | 7.7E-01 | 1.0E+00 | 3.3E+00 | 3.2E-01 | **1.0E+01** | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 2.1E+02 | 3.0E+01 | 3.3E-02 | 4.0E-01 | 2.1E+02 | 7.0E+00 | 1.7E-04 | 5.3E+02 | 8.7E-02 | 7.7E-01 | 1.0E+00 | 2.8E+01 | 2.7E+02 | 1.0E-01 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 2.1E+02 | 3.0E+01 | 3.3E-02 | 4.0E-01 | 2.1E+02 | 7.0E+00 | 1.7E-04 | 5.3E+02 | 8.7E-02 | 7.7E-01 | 1.0E+00 | 2.8E+01 | 5.2E+01 | 5.4E-01 | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 8.4E-01 | 1.2E-01 | 3.3E-02 | 1.7E-01 | 8.4E-01 | 2.8E-02 | 1.7E-04 | 5.0E+00 | 8.3E-04 | 7.7E-01 | 1.0E+00 | 1.1E-01 | 9.0E+00 | 1.3E-02 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 8.4E-01 | 1.2E-01 | 3.3E-02 | 1.7E-01 | 8.4E-01 | 2.8E-02 | 1.7E-04 | 5.0E+00 | 8.3E-04 | 7.7E-01 | 1.0E+00 | 1.1E-01 | 7.7E-01 | 1.5E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 5.5E+00 | 7.7E-01 | 3.3E-02 | 6.7E-02 | 5.5E+00 | 1.8E-01 | 1.7E-04 | 8.2E+01 | 1.4E-02 | 7.7E-01 | 1.0E+00 | 7.4E-01 | 5.8E+01 | 1.3E-02 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 5.5E+00 | 7.7E-01 | 3.3E-02 | 6.7E-02 | 5.5E+00 | 1.8E-01 | 1.7E-04 | 8.2E+01 | 1.4E-02 | 7.7E-01 | 1.0E+00 | 7.4E-01 | 2.4E+00 | 3.1E-01 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.6E+01 | 5.1E+00 | 3.3E-02 | 9.0E-02 | 3.6E+01 | 1.2E+00 | 1.7E-04 | 4.0E+02 | 6.7E-02 | 7.7E-01 | 1.0E+00 | 4.9E+00 | 1.9E+02 | 2.6E-02 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.6E+01 | 5.1E+00 | 3.3E-02 | 9.0E-02 | 3.6E+01 | 1.2E+00 | 1.7E-04 | 4.0E+02 | 6.7E-02 | 7.7E-01 | 1.0E+00 | 4.9E+00 | 4.7E+00 | **1.0E+00** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 7.6E-02 | 1.1E-02 | 3.3E-02 | 2.1E-01 | 7.6E-02 | 2.5E-03 | 1.7E-04 | 3.7E-01 | 6.1E-05 | 7.7E-01 | 1.0E+00 | 1.0E-02 | 4.0E+00 | 2.5E-03 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 7.6E-02 | 1.1E-02 | 3.3E-02 | 2.1E-01 | 7.6E-02 | 2.5E-03 | 1.7E-04 | 3.7E-01 | 6.1E-05 | 7.7E-01 | 1.0E+00 | 1.0E-02 | 2.5E-01 | 4.1E-02 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 9.5E+00 | 1.3E+00 | 3.3E-02 | 9.5E-01 | 9.5E+00 | 3.2E-01 | 1.7E-04 | 1.0E+01 | 1.7E-03 | 7.7E-01 | 1.0E+00 | 1.3E+00 | 6.6E-01 | **1.9E+00** | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 9.5E+00 | 1.3E+00 | 3.3E-02 | 9.5E-01 | 9.5E+00 | 3.2E-01 | 1.7E-04 | 1.0E+01 | 1.7E-03 | 7.7E-01 | 1.0E+00 | 1.3E+00 | 1.4E-01 | **8.9E+00** | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.5E+02 | 3.6E+01 | 3.3E-02 | 2.7E-01 | 2.5E+02 | 8.4E+00 | 1.7E-04 | 9.4E+02 | 1.5E-01 | 7.7E-01 | 1.0E+00 | 3.4E+01 | 3.0E+02 | 1.1E-01 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.5E+02 | 3.6E+01 | 3.3E-02 | 2.7E-01 | 2.5E+02 | 8.4E+00 | 1.7E-04 | 9.4E+02 | 1.5E-01 | 7.7E-01 | 1.0E+00 | 3.4E+01 | 7.5E+01 | 4.5E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 6.3E-01 | 8.8E-02 | 3.3E-02 | 3.4E+00 | 4.6E-01 | 1.5E-02 | 1.7E-04 | 4.8E-01 | 8.0E-05 | 7.7E-01 | 1.0E+00 | 7.9E-02 | 1.3E+00 | 6.2E-02 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 6.3E-01 | 8.8E-02 | 3.3E-02 | 3.4E+00 | 4.6E-01 | 1.5E-02 | 1.7E-04 | 4.8E-01 | 8.0E-05 | 7.7E-01 | 1.0E+00 | 7.9E-02 | 3.6E-01 | 2.2E-01 | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 2.7E-01 | 3.8E-02 | 3.3E-02 | 8.7E-01 | 3.4E-02 | 1.1E-03 | 1.7E-04 | 1.4E-01 | 2.3E-05 | 7.7E-01 | 1.0E+00 | 3.0E-02 | 4.6E+00 | 6.5E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 2.7E-01 | 3.8E-02 | 3.3E-02 | 8.7E-01 | 3.4E-02 | 1.1E-03 | 1.7E-04 | 1.4E-01 | 2.3E-05 | 7.7E-01 | 1.0E+00 | 3.0E-02 | 1.5E-01 | 2.0E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 4.8E-01 | 6.7E-02 | 3.3E-02 | 2.2E+00 | 4.0E-02 | 1.3E-03 | 1.7E-04 | 6.2E-02 | 1.0E-05 | 7.7E-01 | 1.0E+00 | 5.2E-02 | 4.6E+00 | 1.1E-02 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 4.8E-01 | 6.7E-02 | 3.3E-02 | 2.2E+00 | 4.0E-02 | 1.3E-03 | 1.7E-04 | 6.2E-02 | 1.0E-05 | 7.7E-01 | 1.0E+00 | 5.2E-02 | 1.5E-01 | 3.6E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 8.1E-03 | 1.1E-03 | 3.3E-02 | 1.3E+00 | 6.8E-03 | 2.3E-04 | 1.7E-04 | 1.9E-02 | 3.2E-06 | 7.7E-01 | 1.0E+00 | 1.0E-03 | 4.6E+00 | 2.3E-04 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 8.1E-03 | 1.1E-03 | 3.3E-02 | 1.3E+00 | 6.8E-03 | 2.3E-04 | 1.7E-04 | 1.9E-02 | 3.2E-06 | 7.7E-01 | 1.0E+00 | 1.0E-03 | 1.5E-01 | 7.1E-03 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 7.7E-03 | 1.1E-03 | 3.3E-02 | 1.9E+00 | 2.1E-03 | 6.9E-05 | 1.7E-04 | 3.9E-03 | 6.5E-07 | 7.7E-01 | 1.0E+00 | 8.9E-04 | 6.8E+00 | 1.3E-04 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 7.7E-03 | 1.1E-03 | 3.3E-02 | 1.9E+00 | 2.1E-03 | 6.9E-05 | 1.7E-04 | 3.9E-03 | 6.5E-07 | 7.7E-01 | 1.0E+00 | 8.9E-04 | 1.3E-01 | 6.8E-03 | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 2.5E-02 | 3.6E-03 | 3.3E-02 | 1.9E+00 | 6.8E-03 | 2.3E-04 | 1.7E-04 | 1.3E-02 | 2.1E-06 | 7.7E-01 | 1.0E+00 | 2.9E-03 | 6.8E+00 | 4.3E-04 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 2.5E-02 | 3.6E-03 | 3.3E-02 | 1.9E+00 | 6.8E-03 | 2.3E-04 | 1.7E-04 | 1.3E-02 | 2.1E-06 | 7.7E-01 | 1.0E+00 | 2.9E-03 | 1.3E-01 | 2.2E-02 | EPA 2002 |

## Table E-6: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-A, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 6.6E-01 | 9.3E-02 | 3.3E-02 | 3.7E-01 | 4.5E-01 | 1.5E-02 | 1.7E-04 | 4.3E+00 | 7.1E-04 | 7.7E-01 | 1.0E+00 | 8.4E-02 | 3.6E+02 | 2.3E-04 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 6.6E-01 | 9.3E-02 | 3.3E-02 | 3.7E-01 | 4.5E-01 | 1.5E-02 | 1.7E-04 | 4.3E+00 | 7.1E-04 | 7.7E-01 | 1.0E+00 | 8.4E-02 | 6.6E+01 | 1.3E-03 | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 4.3E-01 | 6.0E-02 | 3.3E-02 | 3.4E-01 | 2.6E-01 | 8.7E-03 | 1.7E-04 | 2.7E+00 | 4.5E-04 | 7.7E-01 | 1.0E+00 | 5.3E-02 | 3.8E+01 | 1.4E-03 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 4.3E-01 | 6.0E-02 | 3.3E-02 | 3.4E-01 | 2.6E-01 | 8.7E-03 | 1.7E-04 | 2.7E+00 | 4.5E-04 | 7.7E-01 | 1.0E+00 | 5.3E-02 | 6.2E-01 | 8.6E-02 | EPA 2007c |

**Notes:**

| | |
|---|---|
| 1 | See Table E-2 for total prey ingestion rate calculation. |
| 2 | The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2). |
| 3 | Sources of BSAFs are described in Table E-3. |
| 4 | The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF. |
| | For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates. |
| 5 | Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4). |
| 6 | Sediment ingestion rate is 1 percent of prey ingestion rate as described in TABLE E-2. |
| 7 | EPC of all site-collected sediment samples were used (see Table E-2). |
| 8 | Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7). |
| 9 | See Table E-2 for basis of body weight. |
| 10 | Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight. |
| 11 | The source of TRVs is described in Table E-4. |
| 12 | HQs were calculated using the following equation: HQ = total daily dose/TRV. |

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

| TABLE E-7: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio | | | | | | | | | | | | | | | | | | |
| **Section DC-B, EPC** | | | | | | | | | | | | | | | | | | |
| **COPEC** | **Total Prey Ingestion Rate[1] (kg/day)** | **Fish Ingestion Rate[2] (kg/day)** | **Fish BSAF[3] (unitless)** | **Fish Concentration[4] (mg/kg)** | **Fish Daily Dose[5] (mg/day)** | **Invertebrate Ingestion Rate[2] (kg/day)** | **Invertebrate BSAF[3,5] (unitless)** | **Invertebrate Concentration[4] (mg/kg)** | **Invertebrate Daily Dose[5] (mg/day)** | **Sediment Ingestion Rate[6] (kg/day)** | **Sediment Concentration[7] (mg/kg)** | **Sediment Daily Dose[8] (mg/day)** | **SUF** | **Body Weight[9] (kg)** | **Total Daily Dose[10] (mg/kg/day)** | **TRV[11] (mg/kg/day)** | **HQ[12] (based on adjusted TRV)** | **Source of TRV** |
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 2.3E+01 | 1.2E+00 | 3.3E-02 | 1.9E-01 | 2.3E+01 | 7.6E-01 | 5.9E-04 | 1.2E+02 | 7.2E-02 | 8.9E-01 | 1.5E-01 | 1.2E+01 | 1.7E+01 | 7.0E-01 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 2.3E+01 | 1.2E+00 | 3.3E-02 | 1.9E-01 | 2.3E+01 | 7.6E-01 | 5.9E-04 | 1.2E+02 | 7.2E-02 | 8.9E-01 | 1.5E-01 | 1.2E+01 | 2.2E+00 | **5.4E+00** | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 2.5E+02 | 1.3E+01 | 3.3E-02 | 4.0E-01 | 2.5E+02 | 8.4E+00 | 5.9E-04 | 6.3E+02 | 3.7E-01 | 8.9E-01 | 1.5E-01 | 1.3E+02 | NA | --[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 2.5E+02 | 1.3E+01 | 3.3E-02 | 4.0E-01 | 2.5E+02 | 8.4E+00 | 5.9E-04 | 6.3E+02 | 3.7E-01 | 8.9E-01 | 1.5E-01 | 1.3E+02 | NA | --[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 7.5E-01 | 3.8E-02 | 3.3E-02 | 1.7E-01 | 7.5E-01 | 2.5E-02 | 5.9E-04 | 4.5E+00 | 2.6E-03 | 8.9E-01 | 1.5E-01 | 4.0E-01 | 6.3E+00 | 6.3E-02 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 7.5E-01 | 3.8E-02 | 3.3E-02 | 1.7E-01 | 7.5E-01 | 2.5E-02 | 5.9E-04 | 4.5E+00 | 2.6E-03 | 8.9E-01 | 1.5E-01 | 4.0E-01 | 1.5E+00 | 2.7E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 5.1E+00 | 2.6E-01 | 3.3E-02 | 6.7E-02 | 5.1E+00 | 1.7E-01 | 5.9E-04 | 7.6E+01 | 4.5E-02 | 8.9E-01 | 1.5E-01 | 2.9E+00 | 1.6E+01 | 1.8E-01 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 5.1E+00 | 2.6E-01 | 3.3E-02 | 6.7E-02 | 5.1E+00 | 1.7E-01 | 5.9E-04 | 7.6E+01 | 4.5E-02 | 8.9E-01 | 1.5E-01 | 2.9E+00 | 2.7E+00 | **1.1E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.2E+01 | 1.6E+00 | 3.3E-02 | 9.0E-02 | 3.2E+01 | 1.1E+00 | 5.9E-04 | 3.6E+02 | 2.1E-01 | 8.9E-01 | 1.5E-01 | 1.8E+01 | 4.5E+01 | 4.0E-01 | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.2E+01 | 1.6E+00 | 3.3E-02 | 9.0E-02 | 3.2E+01 | 1.1E+00 | 5.9E-04 | 3.6E+02 | 2.1E-01 | 8.9E-01 | 1.5E-01 | 1.8E+01 | 1.6E+00 | **1.1E+01** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 4.3E-02 | 2.2E-03 | 3.3E-02 | 2.1E-01 | 4.3E-02 | 1.4E-03 | 5.9E-04 | 2.1E-01 | 1.2E-04 | 8.9E-01 | 1.5E-01 | 2.2E-02 | 1.8E-01 | 1.2E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 4.3E-02 | 2.2E-03 | 3.3E-02 | 2.1E-01 | 4.3E-02 | 1.4E-03 | 5.9E-04 | 2.1E-01 | 1.2E-04 | 8.9E-01 | 1.5E-01 | 2.2E-02 | 3.9E-02 | 5.8E-01 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 9.5E+00 | 4.8E-01 | 3.3E-02 | 9.5E-01 | 9.5E+00 | 3.2E-01 | 5.9E-04 | 1.0E+01 | 5.9E-03 | 8.9E-01 | 1.5E-01 | 4.8E+00 | 9.1E-01 | **5.3E+00** | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 9.5E+00 | 4.8E-01 | 3.3E-02 | 9.5E-01 | 9.5E+00 | 3.2E-01 | 5.9E-04 | 1.0E+01 | 5.9E-03 | 8.9E-01 | 1.5E-01 | 4.8E+00 | 2.9E-01 | **1.7E+01** | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.1E+02 | 1.0E+01 | 3.3E-02 | 2.7E-01 | 2.1E+02 | 6.8E+00 | 5.9E-04 | 7.6E+02 | 4.5E-01 | 8.9E-01 | 1.5E-01 | 1.1E+02 | 1.4E+02 | 7.8E-01 | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.1E+02 | 1.0E+01 | 3.3E-02 | 2.7E-01 | 2.1E+02 | 6.8E+00 | 5.9E-04 | 7.6E+02 | 4.5E-01 | 8.9E-01 | 1.5E-01 | 1.1E+02 | 6.6E+01 | **1.6E+00** | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 1.9E-01 | 9.5E-03 | 3.3E-02 | 3.4E+00 | 1.4E-01 | 4.7E-03 | 5.9E-04 | 1.6E-01 | 9.7E-05 | 8.9E-01 | 1.5E-01 | 8.6E-02 | 1.3E+00 | 6.8E-02 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 1.9E-01 | 9.5E-03 | 3.3E-02 | 3.4E+00 | 1.4E-01 | 4.7E-03 | 5.9E-04 | 1.6E-01 | 9.7E-05 | 8.9E-01 | 1.5E-01 | 8.6E-02 | 9.0E-02 | 9.6E-01 | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 3.7E-01 | 1.9E-02 | 3.3E-02 | 8.7E-01 | 4.7E-02 | 1.6E-03 | 5.9E-04 | 2.1E-01 | 1.2E-04 | 8.9E-01 | 1.5E-01 | 1.2E-01 | 2.6E+00 | 4.7E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 3.7E-01 | 1.9E-02 | 3.3E-02 | 8.7E-01 | 4.7E-02 | 1.6E-03 | 5.9E-04 | 2.1E-01 | 1.2E-04 | 8.9E-01 | 1.5E-01 | 1.2E-01 | 2.3E-01 | 5.4E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 8.5E-01 | 4.3E-02 | 3.3E-02 | 2.2E+00 | 7.1E-02 | 2.4E-03 | 5.9E-04 | 1.3E-01 | 7.4E-05 | 8.9E-01 | 1.5E-01 | 2.7E-01 | 2.6E+00 | 1.0E-01 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 8.5E-01 | 4.3E-02 | 3.3E-02 | 2.2E+00 | 7.1E-02 | 2.4E-03 | 5.9E-04 | 1.3E-01 | 7.4E-05 | 8.9E-01 | 1.5E-01 | 2.7E-01 | 2.3E-01 | **1.2E+00** | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 1.4E-02 | 7.0E-04 | 3.3E-02 | 1.3E+00 | 1.2E-02 | 3.9E-04 | 5.9E-04 | 3.7E-02 | 2.2E-05 | 8.9E-01 | 1.5E-01 | 6.8E-03 | 2.6E+00 | 2.6E-03 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 1.4E-02 | 7.0E-04 | 3.3E-02 | 1.3E+00 | 1.2E-02 | 3.9E-04 | 5.9E-04 | 3.7E-02 | 2.2E-05 | 8.9E-01 | 1.5E-01 | 6.8E-03 | 2.3E-01 | 3.0E-02 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 5.9E-04 | NA | #VALUE! | 8.9E-01 | 1.5E-01 | #VALUE! | 6.5E-01 | --[14] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 5.9E-04 | NA | #VALUE! | 8.9E-01 | 1.5E-01 | #VALUE! | 6.5E-02 | --[14] | EPA 1999 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 2.6E-02 | 1.3E-03 | 3.3E-02 | 1.9E+00 | 6.9E-03 | 2.3E-04 | 5.9E-04 | 1.5E-02 | 8.7E-06 | 8.9E-01 | 1.5E-01 | 9.3E-03 | 6.5E-01 | 1.4E-02 | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 2.6E-02 | 1.3E-03 | 3.3E-02 | 1.9E+00 | 6.9E-03 | 2.3E-04 | 5.9E-04 | 1.5E-02 | 8.7E-06 | 8.9E-01 | 1.5E-01 | 9.3E-03 | 6.5E-02 | 1.4E-01 | EPA 1999 |

## TABLE E-7: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-B, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.3E+00 | 1.1E+01 | 5.5E-01 | 3.3E-02 | 3.3E+00 | 7.3E+00 | 2.4E-01 | 5.9E-04 | 8.8E+00 | 5.2E-03 | 8.9E-01 | 1.5E-01 | 4.8E+00 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.3E+00 | 1.1E+01 | 5.5E-01 | 3.3E-02 | 3.3E+00 | 7.3E+00 | 2.4E-01 | 5.9E-04 | 8.8E+00 | 5.2E-03 | 8.9E-01 | 1.5E-01 | 4.8E+00 | NA | --[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.8E+00 | 6.9E+00 | 3.5E-01 | 3.3E-02 | 2.4E+00 | 4.3E+00 | 1.4E-01 | 5.9E-04 | 7.1E+00 | 4.2E-03 | 8.9E-01 | 1.5E-01 | 3.0E+00 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.8E+00 | 6.9E+00 | 3.5E-01 | 3.3E-02 | 2.4E+00 | 4.3E+00 | 1.4E-01 | 5.9E-04 | 7.1E+00 | 4.2E-03 | 8.9E-01 | 1.5E-01 | 3.0E+00 | NA | --[14] | EPA 2007c |

**Notes:**

1 See Table E-1 for total prey ingestion rate calculation.

2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1).

3 Sources of BSAFs are described in Table E-3.

4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.

For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.

5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).

6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1.

7 EPC of all site-collected sediment samples were used (see Table E-1).

8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).

9 See Table E-1 for basis of body weight.

10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.

11 The source of TRVs is described in Table E-4.

12 HQs were calculated using the following equation: HQ = total daily dose/TRV.

13 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.

14 No TRV value available; therefore, an HQ could not be calculated.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 1999. Screaning Level Ecological Risk Assessment Protocols for Combustion Facilities. Peer Review Draft. Office of Solid Waste and Emergency Response. EPA530-D99-001A. September.

EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

## TABLE E-8: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-B, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 2.3E+01 | 3.2E+00 | 3.3E-02 | 1.9E-01 | 2.3E+01 | 7.6E-01 | 1.7E-04 | 1.2E+02 | 2.0E-02 | 6.0E-01 | 1.0E+00 | 2.4E+00 | 4.6E+00 | 5.2E-01 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 2.3E+01 | 3.2E+00 | 3.3E-02 | 1.9E-01 | 2.3E+01 | 7.6E-01 | 1.7E-04 | 1.2E+02 | 2.0E-02 | 6.0E-01 | 1.0E+00 | 2.4E+00 | 3.2E-01 | **7.5E+00** | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 2.5E+02 | 3.5E+01 | 3.3E-02 | 4.0E-01 | 2.5E+02 | 8.4E+00 | 1.7E-04 | 6.3E+02 | 1.0E-01 | 6.0E-01 | 1.0E+00 | 2.6E+01 | 2.7E+02 | 9.8E-02 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 2.5E+02 | 3.5E+01 | 3.3E-02 | 4.0E-01 | 2.5E+02 | 8.4E+00 | 1.7E-04 | 6.3E+02 | 1.0E-01 | 6.0E-01 | 1.0E+00 | 2.6E+01 | 5.2E+01 | 5.0E-01 | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 7.5E-01 | 1.1E-01 | 3.3E-02 | 1.7E-01 | 7.5E-01 | 2.5E-02 | 1.7E-04 | 4.5E+00 | 7.4E-04 | 6.0E-01 | 1.0E+00 | 7.9E-02 | 9.0E+00 | 8.8E-03 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 7.5E-01 | 1.1E-01 | 3.3E-02 | 1.7E-01 | 7.5E-01 | 2.5E-02 | 1.7E-04 | 4.5E+00 | 7.4E-04 | 6.0E-01 | 1.0E+00 | 7.9E-02 | 7.7E-01 | 1.0E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 5.1E+00 | 7.2E-01 | 3.3E-02 | 6.7E-02 | 5.1E+00 | 1.7E-01 | 1.7E-04 | 7.6E+01 | 1.3E-02 | 6.0E-01 | 1.0E+00 | 5.4E-01 | 5.8E+01 | 9.2E-03 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 5.1E+00 | 7.2E-01 | 3.3E-02 | 6.7E-02 | 5.1E+00 | 1.7E-01 | 1.7E-04 | 7.6E+01 | 1.3E-02 | 6.0E-01 | 1.0E+00 | 5.4E-01 | 2.4E+00 | 2.2E-01 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.2E+01 | 4.6E+00 | 3.3E-02 | 9.0E-02 | 3.2E+01 | 1.1E+00 | 1.7E-04 | 3.6E+02 | 6.0E-02 | 6.0E-01 | 1.0E+00 | 3.4E+00 | 1.9E+02 | 1.8E-02 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.2E+01 | 4.6E+00 | 3.3E-02 | 9.0E-02 | 3.2E+01 | 1.1E+00 | 1.7E-04 | 3.6E+02 | 6.0E-02 | 6.0E-01 | 1.0E+00 | 3.4E+00 | 4.7E+00 | 7.2E-01 | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 4.3E-02 | 6.1E-03 | 3.3E-02 | 2.1E-01 | 4.3E-02 | 1.4E-03 | 1.7E-04 | 2.1E-01 | 3.5E-05 | 6.0E-01 | 1.0E+00 | 4.5E-03 | 4.0E+00 | 1.1E-03 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 4.3E-02 | 6.1E-03 | 3.3E-02 | 2.1E-01 | 4.3E-02 | 1.4E-03 | 1.7E-04 | 2.1E-01 | 3.5E-05 | 6.0E-01 | 1.0E+00 | 4.5E-03 | 2.5E-01 | 1.8E-02 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 9.5E+00 | 1.3E+00 | 3.3E-02 | 9.5E-01 | 9.5E+00 | 3.2E-01 | 1.7E-04 | 1.0E+01 | 1.7E-03 | 6.0E-01 | 1.0E+00 | 9.9E-01 | 6.6E-01 | **1.5E+00** | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 9.5E+00 | 1.3E+00 | 3.3E-02 | 9.5E-01 | 9.5E+00 | 3.2E-01 | 1.7E-04 | 1.0E+01 | 1.7E-03 | 6.0E-01 | 1.0E+00 | 9.9E-01 | 1.4E-01 | **6.9E+00** | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.1E+02 | 2.9E+01 | 3.3E-02 | 2.7E-01 | 2.1E+02 | 6.8E+00 | 1.7E-04 | 7.6E+02 | 1.3E-01 | 6.0E-01 | 1.0E+00 | 2.1E+01 | 3.0E+02 | 7.2E-02 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.1E+02 | 2.9E+01 | 3.3E-02 | 2.7E-01 | 2.1E+02 | 6.8E+00 | 1.7E-04 | 7.6E+02 | 1.3E-01 | 6.0E-01 | 1.0E+00 | 2.1E+01 | 7.5E+01 | 2.8E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 1.9E-01 | 2.7E-02 | 3.3E-02 | 3.4E+00 | 1.4E-01 | 4.7E-03 | 1.7E-04 | 1.6E-01 | 2.7E-05 | 6.0E-01 | 1.0E+00 | 1.9E-02 | 1.3E+00 | 1.5E-02 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 1.9E-01 | 2.7E-02 | 3.3E-02 | 3.4E+00 | 1.4E-01 | 4.7E-03 | 1.7E-04 | 1.6E-01 | 2.7E-05 | 6.0E-01 | 1.0E+00 | 1.9E-02 | 3.6E-01 | 5.2E-02 | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 3.7E-01 | 5.2E-02 | 3.3E-02 | 8.7E-01 | 4.7E-02 | 1.6E-03 | 1.7E-04 | 2.1E-01 | 3.5E-05 | 6.0E-01 | 1.0E+00 | 3.2E-02 | 4.6E+00 | 7.0E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 3.7E-01 | 5.2E-02 | 3.3E-02 | 8.7E-01 | 4.7E-02 | 1.6E-03 | 1.7E-04 | 2.1E-01 | 3.5E-05 | 6.0E-01 | 1.0E+00 | 3.2E-02 | 1.5E-01 | 2.2E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 8.5E-01 | 1.2E-01 | 3.3E-02 | 2.2E+00 | 7.1E-02 | 2.4E-03 | 1.7E-04 | 1.3E-01 | 2.1E-05 | 6.0E-01 | 1.0E+00 | 7.3E-02 | 4.6E+00 | 1.6E-02 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 8.5E-01 | 1.2E-01 | 3.3E-02 | 2.2E+00 | 7.1E-02 | 2.4E-03 | 1.7E-04 | 1.3E-01 | 2.1E-05 | 6.0E-01 | 1.0E+00 | 7.3E-02 | 1.5E-01 | 5.0E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 1.4E-02 | 2.0E-03 | 3.3E-02 | 1.3E+00 | 1.2E-02 | 3.9E-04 | 1.7E-04 | 3.7E-02 | 6.2E-06 | 6.0E-01 | 1.0E+00 | 1.4E-03 | 4.6E+00 | 3.1E-04 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 1.4E-02 | 2.0E-03 | 3.3E-02 | 1.3E+00 | 1.2E-02 | 3.9E-04 | 1.7E-04 | 3.7E-02 | 6.2E-06 | 6.0E-01 | 1.0E+00 | 1.4E-03 | 1.5E-01 | 9.6E-03 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 6.0E-01 | 1.0E+00 | --[13] | 6.8E+00 | --[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 6.0E-01 | 1.0E+00 | --[13] | 1.3E-01 | --[13] | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 2.6E-02 | 3.6E-03 | 3.3E-02 | 1.9E+00 | 6.9E-03 | 2.3E-04 | 1.7E-04 | 1.5E-02 | 2.4E-06 | 6.0E-01 | 1.0E+00 | 2.3E-03 | 6.8E+00 | 3.4E-04 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 2.6E-02 | 3.6E-03 | 3.3E-02 | 1.9E+00 | 6.9E-03 | 2.3E-04 | 1.7E-04 | 1.5E-02 | 2.4E-06 | 6.0E-01 | 1.0E+00 | 2.3E-03 | 1.3E-01 | 1.8E-02 | EPA 2002 |

## TABLE E-8: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-B, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.3E+00 | 1.1E+01 | 1.5E+00 | 3.3E-02 | 3.3E+00 | 7.3E+00 | 2.4E-01 | 1.7E-04 | 8.8E+00 | 1.5E-03 | 6.0E-01 | 1.0E+00 | 1.1E+00 | 3.6E+02 | 3.0E-03 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.3E+00 | 1.1E+01 | 1.5E+00 | 3.3E-02 | 3.3E+00 | 7.3E+00 | 2.4E-01 | 1.7E-04 | 8.8E+00 | 1.5E-03 | 6.0E-01 | 1.0E+00 | 1.1E+00 | 6.6E+01 | 1.6E-02 | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.8E+00 | 6.9E+00 | 9.7E-01 | 3.3E-02 | 2.4E+00 | 4.3E+00 | 1.4E-01 | 1.7E-04 | 7.1E+00 | 1.2E-03 | 6.0E-01 | 1.0E+00 | 6.7E-01 | 3.8E+01 | 1.7E-02 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.8E+00 | 6.9E+00 | 9.7E-01 | 3.3E-02 | 2.4E+00 | 4.3E+00 | 1.4E-01 | 1.7E-04 | 7.1E+00 | 1.2E-03 | 6.0E-01 | 1.0E+00 | 6.7E-01 | 6.2E-01 | **1.1E+00** | EPA 2007c |

**Notes:**

1 See Table E-2 for total prey ingestion rate calculation.

2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2).

3 Sources of BSAFs are described in Table E-3.

4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.

For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.

5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).

6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-2.

7 EPC of all site-collected sediment samples were used (see Table E-2).

8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).

9 See Table E-2 for basis of body weight.

10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.

11 The source of TRVs is described in Table E-4.

12 HQs were calculated using the following equation: HQ = total daily dose/TRV.

13 A sediment concentration is not available for Heptachlor.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

## TABLE E-9: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-C, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 1.2E+01 | 6.1E-01 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 4.0E-01 | 5.9E-04 | 6.5E+01 | 3.8E-02 | 5.7E-01 | 1.5E-01 | 4.1E+00 | 1.7E+01 | 2.4E-01 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 1.2E+01 | 6.1E-01 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 4.0E-01 | 5.9E-04 | 6.5E+01 | 3.8E-02 | 5.7E-01 | 1.5E-01 | 4.1E+00 | 2.2E+00 | **1.8E+00** | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 2.6E+02 | 1.3E+01 | 3.3E-02 | 4.0E-01 | 2.6E+02 | 8.7E+00 | 5.9E-04 | 6.5E+02 | 3.8E-01 | 5.7E-01 | 1.5E-01 | 8.6E+01 | NA | --[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 2.6E+02 | 1.3E+01 | 3.3E-02 | 4.0E-01 | 2.6E+02 | 8.7E+00 | 5.9E-04 | 6.5E+02 | 3.8E-01 | 5.7E-01 | 1.5E-01 | 8.6E+01 | NA | --[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 6.2E-01 | 3.1E-02 | 3.3E-02 | 1.7E-01 | 6.2E-01 | 2.1E-02 | 5.9E-04 | 3.7E+00 | 2.2E-03 | 5.7E-01 | 1.5E-01 | 2.1E-01 | 6.3E+00 | 3.3E-02 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 6.2E-01 | 3.1E-02 | 3.3E-02 | 1.7E-01 | 6.2E-01 | 2.1E-02 | 5.9E-04 | 3.7E+00 | 2.2E-03 | 5.7E-01 | 1.5E-01 | 2.1E-01 | 1.5E+00 | 1.4E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 5.0E+00 | 2.5E-01 | 3.3E-02 | 6.7E-02 | 5.0E+00 | 1.7E-01 | 5.9E-04 | 7.4E+01 | 4.4E-02 | 5.7E-01 | 1.5E-01 | 1.8E+00 | 1.6E+01 | 1.1E-01 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 5.0E+00 | 2.5E-01 | 3.3E-02 | 6.7E-02 | 5.0E+00 | 1.7E-01 | 5.9E-04 | 7.4E+01 | 4.4E-02 | 5.7E-01 | 1.5E-01 | 1.8E+00 | 2.7E+00 | 6.7E-01 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.3E+01 | 1.6E+00 | 3.3E-02 | 9.0E-02 | 3.3E+01 | 1.1E+00 | 5.9E-04 | 3.6E+02 | 2.1E-01 | 5.7E-01 | 1.5E-01 | 1.1E+01 | 4.5E+01 | 2.6E-01 | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.3E+01 | 1.6E+00 | 3.3E-02 | 9.0E-02 | 3.3E+01 | 1.1E+00 | 5.9E-04 | 3.6E+02 | 2.1E-01 | 5.7E-01 | 1.5E-01 | 1.1E+01 | 1.6E+00 | **7.0E+00** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 4.3E-02 | 2.2E-03 | 3.3E-02 | 2.1E-01 | 4.3E-02 | 1.4E-03 | 5.9E-04 | 2.1E-01 | 1.2E-04 | 5.7E-01 | 1.5E-01 | 1.4E-02 | 1.8E-01 | 8.0E-02 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 4.3E-02 | 2.2E-03 | 3.3E-02 | 2.1E-01 | 4.3E-02 | 1.4E-03 | 5.9E-04 | 2.1E-01 | 1.2E-04 | 5.7E-01 | 1.5E-01 | 1.4E-02 | 3.9E-02 | 3.7E-01 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | --[15] | --[15] | 3.3E-02 | 9.5E-01 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 5.7E-01 | 1.5E-01 | --[15] | 9.1E-01 | --[15] | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | --[15] | --[15] | 3.3E-02 | 9.5E-01 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 5.7E-01 | 1.5E-01 | --[15] | 2.9E-01 | --[15] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 1.8E+02 | 8.8E+00 | 3.3E-02 | 2.7E-01 | 1.8E+02 | 5.8E+00 | 5.9E-04 | 6.5E+02 | 3.8E-01 | 5.7E-01 | 1.5E-01 | 5.8E+01 | 1.4E+02 | 4.3E-01 | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 1.8E+02 | 8.8E+00 | 3.3E-02 | 2.7E-01 | 1.8E+02 | 5.8E+00 | 5.9E-04 | 6.5E+02 | 3.8E-01 | 5.7E-01 | 1.5E-01 | 5.8E+01 | 6.6E+01 | 8.8E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | --[15] | --[15] | 3.3E-02 | 3.4E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 5.7E-01 | 1.5E-01 | #VALUE! | 1.3E+00 | --[15] | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | --[15] | --[15] | 3.3E-02 | 3.4E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 5.7E-01 | 1.5E-01 | #VALUE! | 9.0E-02 | --[15] | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 2.2E-01 | 1.1E-02 | 3.3E-02 | 8.7E-01 | 2.7E-02 | 9.1E-04 | 5.9E-04 | 1.8E-01 | 1.0E-04 | 5.7E-01 | 1.5E-01 | 4.6E-02 | 2.6E+00 | 1.8E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 2.2E-01 | 1.1E-02 | 3.3E-02 | 8.7E-01 | 2.7E-02 | 9.1E-04 | 5.9E-04 | 1.8E-01 | 1.0E-04 | 5.7E-01 | 1.5E-01 | 4.6E-02 | 2.3E-01 | 2.0E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 6.5E-01 | 3.3E-02 | 3.3E-02 | 2.2E+00 | 5.4E-02 | 1.8E-03 | 5.9E-04 | 1.4E-01 | 8.0E-05 | 5.7E-01 | 1.5E-01 | 1.3E-01 | 2.6E+00 | 5.1E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 6.5E-01 | 3.3E-02 | 3.3E-02 | 2.2E+00 | 5.4E-02 | 1.8E-03 | 5.9E-04 | 1.4E-01 | 8.0E-05 | 5.7E-01 | 1.5E-01 | 1.3E-01 | 2.3E-01 | 5.9E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 9.8E-03 | 4.9E-04 | 3.3E-02 | 1.3E+00 | 8.3E-03 | 2.8E-04 | 5.9E-04 | 3.7E-02 | 2.2E-05 | 5.7E-01 | 1.5E-01 | 3.1E-03 | 2.6E+00 | 1.2E-03 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 9.8E-03 | 4.9E-04 | 3.3E-02 | 1.3E+00 | 8.3E-03 | 2.8E-04 | 5.9E-04 | 3.7E-02 | 2.2E-05 | 5.7E-01 | 1.5E-01 | 3.1E-03 | 2.3E-01 | 1.3E-02 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 5.7E-01 | 1.5E-01 | --[15] | 6.5E-01 | --[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 5.7E-01 | 1.5E-01 | --[15] | 6.5E-02 | --[15] | EPA 1999 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 5.7E-01 | 1.5E-01 | --[15] | 6.5E-01 | --[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 5.7E-01 | 1.5E-01 | --[15] | 6.5E-02 | --[15] | EPA 1999 |

## TABLE E-9: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-C, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 6.2E-01 | 3.1E-02 | 3.3E-02 | 3.7E-01 | 4.2E-01 | 1.4E-02 | 5.9E-04 | 6.4E+00 | 3.8E-03 | 5.7E-01 | 1.5E-01 | 1.9E-01 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 6.2E-01 | 3.1E-02 | 3.3E-02 | 3.7E-01 | 4.2E-01 | 1.4E-02 | 5.9E-04 | 6.4E+00 | 3.8E-03 | 5.7E-01 | 1.5E-01 | 1.9E-01 | NA | --[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 5.6E-01 | 2.8E-02 | 3.3E-02 | 3.4E-01 | 3.4E-01 | 1.1E-02 | 5.9E-04 | 5.7E+00 | 3.4E-03 | 5.7E-01 | 1.5E-01 | 1.7E-01 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 5.6E-01 | 2.8E-02 | 3.3E-02 | 3.4E-01 | 3.4E-01 | 1.1E-02 | 5.9E-04 | 5.7E+00 | 3.4E-03 | 5.7E-01 | 1.5E-01 | 1.7E-01 | NA | --[14] | EPA 2007c |

**Notes:**

1 See Table E-1 for total prey ingestion rate calculation.
2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1).
3 Sources of BSAFs are described in Table E-3.
4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.
For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.
5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).
6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1.
7 EPC of all site-collected sediment samples were used (see Table E-1).
8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).
9 See Table E-1 for basis of body weight.
10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.
11 The source of TRVs is described in Table E-4.
12 HQs were calculated using the following equation: HQ = total daily dose/TRV.
13 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.
14 No TRV value available; therefore, an HQ could not be calculated.
15 No sediment concentrations.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 1999. Screaning Level Ecological Risk Assessment Protocols for Combustion Facilities. Peer Review Draft. Office of Solid Waste and Emergency Response. EPA530-D99-001A. September.
EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).
EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

**TABLE E-10: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)**

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-C, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 1.2E+01 | 1.7E+00 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 4.0E-01 | 1.7E-04 | 6.5E+01 | 1.1E-02 | 3.8E-01 | 1.0E+00 | 8.1E-01 | 4.6E+00 | 1.8E-01 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 1.2E+01 | 1.7E+00 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 4.0E-01 | 1.7E-04 | 6.5E+01 | 1.1E-02 | 3.8E-01 | 1.0E+00 | 8.1E-01 | 3.2E-01 | **2.5E+00** | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 2.6E+02 | 3.7E+01 | 3.3E-02 | 4.0E-01 | 2.6E+02 | 8.7E+00 | 1.7E-04 | 6.5E+02 | 1.1E-01 | 3.8E-01 | 1.0E+00 | 1.7E+01 | 2.7E+02 | 6.5E-02 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 2.6E+02 | 3.7E+01 | 3.3E-02 | 4.0E-01 | 2.6E+02 | 8.7E+00 | 1.7E-04 | 6.5E+02 | 1.1E-01 | 3.8E-01 | 1.0E+00 | 1.7E+01 | 5.2E+01 | 3.3E-01 | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 6.2E-01 | 8.7E-02 | 3.3E-02 | 1.7E-01 | 6.2E-01 | 2.1E-02 | 1.7E-04 | 3.7E+00 | 6.1E-04 | 3.8E-01 | 1.0E+00 | 4.1E-02 | 9.0E+00 | 4.6E-03 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 6.2E-01 | 8.7E-02 | 3.3E-02 | 1.7E-01 | 6.2E-01 | 2.1E-02 | 1.7E-04 | 3.7E+00 | 6.1E-04 | 3.8E-01 | 1.0E+00 | 4.1E-02 | 7.7E-01 | 5.4E-02 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 5.0E+00 | 7.0E-01 | 3.3E-02 | 6.7E-02 | 5.0E+00 | 1.7E-01 | 1.7E-04 | 7.4E+01 | 1.2E-02 | 3.8E-01 | 1.0E+00 | 3.4E-01 | 5.8E+01 | 5.8E-03 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 5.0E+00 | 7.0E-01 | 3.3E-02 | 6.7E-02 | 5.0E+00 | 1.7E-01 | 1.7E-04 | 7.4E+01 | 1.2E-02 | 3.8E-01 | 1.0E+00 | 3.4E-01 | 2.4E+00 | 1.4E-01 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.3E+01 | 4.6E+00 | 3.3E-02 | 9.0E-02 | 3.3E+01 | 1.1E+00 | 1.7E-04 | 3.6E+02 | 6.0E-02 | 3.8E-01 | 1.0E+00 | 2.2E+00 | 1.9E+02 | 1.2E-02 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.3E+01 | 4.6E+00 | 3.3E-02 | 9.0E-02 | 3.3E+01 | 1.1E+00 | 1.7E-04 | 3.6E+02 | 6.0E-02 | 3.8E-01 | 1.0E+00 | 2.2E+00 | 4.7E+00 | 4.7E-01 | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 4.3E-02 | 6.1E-03 | 3.3E-02 | 2.1E-01 | 4.3E-02 | 1.4E-03 | 1.7E-04 | 2.1E-01 | 3.5E-05 | 3.8E-01 | 1.0E+00 | 2.9E-03 | 4.0E+00 | 7.2E-04 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 4.3E-02 | 6.1E-03 | 3.3E-02 | 2.1E-01 | 4.3E-02 | 1.4E-03 | 1.7E-04 | 2.1E-01 | 3.5E-05 | 3.8E-01 | 1.0E+00 | 2.9E-03 | 2.5E-01 | 1.1E-02 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | --[13] | --[13] | 3.3E-02 | 9.5E-01 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 3.8E-01 | 1.0E+00 | --[13] | 6.6E-01 | --[13] | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | --[13] | --[13] | 3.3E-02 | 9.5E-01 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 3.8E-01 | 1.0E+00 | --[13] | 1.4E-01 | --[13] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 1.8E+02 | 2.5E+01 | 3.3E-02 | 2.7E-01 | 1.8E+02 | 5.8E+00 | 1.7E-04 | 6.5E+02 | 1.1E-01 | 3.8E-01 | 1.0E+00 | 1.2E+01 | 3.0E+02 | 3.9E-02 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 1.8E+02 | 2.5E+01 | 3.3E-02 | 2.7E-01 | 1.8E+02 | 5.8E+00 | 1.7E-04 | 6.5E+02 | 1.1E-01 | 3.8E-01 | 1.0E+00 | 1.2E+01 | 7.5E+01 | 1.6E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | --[13] | --[13] | 3.3E-02 | 3.4E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 3.8E-01 | 1.0E+00 | --[13] | 1.3E+00 | --[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | --[13] | --[13] | 3.3E-02 | 3.4E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 3.8E-01 | 1.0E+00 | --[13] | 3.6E-01 | --[13] | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 2.2E-01 | 3.0E-02 | 3.3E-02 | 8.7E-01 | 2.7E-02 | 9.1E-04 | 1.7E-04 | 1.8E-01 | 2.9E-05 | 3.8E-01 | 1.0E+00 | 1.2E-02 | 4.6E+00 | 2.6E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 2.2E-01 | 3.0E-02 | 3.3E-02 | 8.7E-01 | 2.7E-02 | 9.1E-04 | 1.7E-04 | 1.8E-01 | 2.9E-05 | 3.8E-01 | 1.0E+00 | 1.2E-02 | 1.5E-01 | 8.2E-02 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 6.5E-01 | 9.1E-02 | 3.3E-02 | 2.2E+00 | 5.4E-02 | 1.8E-03 | 1.7E-04 | 1.4E-01 | 2.3E-05 | 3.8E-01 | 1.0E+00 | 3.6E-02 | 4.6E+00 | 7.8E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 6.5E-01 | 9.1E-02 | 3.3E-02 | 2.2E+00 | 5.4E-02 | 1.8E-03 | 1.7E-04 | 1.4E-01 | 2.3E-05 | 3.8E-01 | 1.0E+00 | 3.6E-02 | 1.5E-01 | 2.4E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 9.8E-03 | 1.4E-03 | 3.3E-02 | 1.3E+00 | 8.3E-03 | 2.8E-04 | 1.7E-04 | 3.7E-02 | 6.2E-06 | 3.8E-01 | 1.0E+00 | 6.4E-04 | 4.6E+00 | 1.4E-04 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 9.8E-03 | 1.4E-03 | 3.3E-02 | 1.3E+00 | 8.3E-03 | 2.8E-04 | 1.7E-04 | 3.7E-02 | 6.2E-06 | 3.8E-01 | 1.0E+00 | 6.4E-04 | 1.5E-01 | 4.3E-03 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 3.8E-01 | 1.0E+00 | --[13] | 6.8E+00 | --[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 3.8E-01 | 1.0E+00 | --[13] | 1.3E-01 | --[13] | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 3.8E-01 | 1.0E+00 | --[13] | 6.8E+00 | --[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 3.8E-01 | 1.0E+00 | --[13] | 1.3E-01 | --[13] | EPA 2002 |

## TABLE E-10: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-C, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 6.2E-01 | 8.8E-02 | 3.3E-02 | 3.7E-01 | 4.2E-01 | 1.4E-02 | 1.7E-04 | 6.4E+00 | 1.1E-03 | 3.8E-01 | 1.0E+00 | 3.9E-02 | 3.6E+02 | 1.1E-04 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 6.2E-01 | 8.8E-02 | 3.3E-02 | 3.7E-01 | 4.2E-01 | 1.4E-02 | 1.7E-04 | 6.4E+00 | 1.1E-03 | 3.8E-01 | 1.0E+00 | 3.9E-02 | 6.6E+01 | 6.0E-04 | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 5.6E-01 | 7.8E-02 | 3.3E-02 | 3.4E-01 | 3.4E-01 | 1.1E-02 | 1.7E-04 | 5.7E+00 | 9.5E-04 | 3.8E-01 | 1.0E+00 | 3.5E-02 | 3.8E+01 | 9.0E-04 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 5.6E-01 | 7.8E-02 | 3.3E-02 | 3.4E-01 | 3.4E-01 | 1.1E-02 | 1.7E-04 | 5.7E+00 | 9.5E-04 | 3.8E-01 | 1.0E+00 | 3.5E-02 | 6.2E-01 | 5.6E-02 | EPA 2007c |

**Notes:**

| | |
|---|---|
| 1 | See Table E-2 for total prey ingestion rate calculation. |
| 2 | The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2). |
| 3 | Sources of BSAFs are described in Table E-3 |
| 4 | The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF. For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. |
| 5 | Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4). |
| 6 | Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-2. |
| 7 | EPC of all site-collected sediment samples were used (see Table E-2). |
| 8 | Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7). |
| 9 | See Table E-2 for basis of body weight. |
| 10 | Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight. |
| 11 | The source of TRVs is described in Table E-4. |
| 12 | HQs were calculated using the following equation: HQ = total daily dose/TRV. |
| 13 | No sediment concentrations. |

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

**TABLE E-11: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)**

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-D, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 2.6E+01 | 1.3E+00 | 3.3E-02 | 1.9E-01 | 2.6E+01 | 8.7E-01 | 5.9E-04 | 1.4E+02 | 8.3E-02 | 9.6E-01 | 1.5E-01 | 1.5E+01 | 1.7E+01 | 8.5E-01 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 2.6E+01 | 1.3E+00 | 3.3E-02 | 1.9E-01 | 2.6E+01 | 8.7E-01 | 5.9E-04 | 1.4E+02 | 8.3E-02 | 9.6E-01 | 1.5E-01 | 1.5E+01 | 2.2E+00 | **6.6E+00** | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 8.6E+02 | 4.3E+01 | 3.3E-02 | 4.0E-01 | 8.6E+02 | 2.9E+01 | 5.9E-04 | 2.2E+03 | 1.3E+00 | 9.6E-01 | 1.5E-01 | 4.8E+02 | NA | --[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 8.6E+02 | 4.3E+01 | 3.3E-02 | 4.0E-01 | 8.6E+02 | 2.9E+01 | 5.9E-04 | 2.2E+03 | 1.3E+00 | 9.6E-01 | 1.5E-01 | 4.8E+02 | NA | --[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 2.7E+00 | 1.4E-01 | 3.3E-02 | 1.7E-01 | 2.7E+00 | 9.0E-02 | 5.9E-04 | 1.6E+01 | 9.5E-03 | 9.6E-01 | 1.5E-01 | 1.5E+00 | 6.3E+00 | 2.4E-01 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 2.7E+00 | 1.4E-01 | 3.3E-02 | 1.7E-01 | 2.7E+00 | 9.0E-02 | 5.9E-04 | 1.6E+01 | 9.5E-03 | 9.6E-01 | 1.5E-01 | 1.5E+00 | 1.5E+00 | **1.0E+00** | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 1.3E+01 | 6.4E-01 | 3.3E-02 | 6.7E-02 | 1.3E+01 | 4.2E-01 | 5.9E-04 | 1.9E+02 | 1.1E-01 | 9.6E-01 | 1.5E-01 | 7.6E+00 | 1.6E+01 | 4.9E-01 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 1.3E+01 | 6.4E-01 | 3.3E-02 | 6.7E-02 | 1.3E+01 | 4.2E-01 | 5.9E-04 | 1.9E+02 | 1.1E-01 | 9.6E-01 | 1.5E-01 | 7.6E+00 | 2.7E+00 | **2.9E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 9.7E+01 | 4.9E+00 | 3.3E-02 | 9.0E-02 | 9.7E+01 | 3.2E+00 | 5.9E-04 | 1.1E+03 | 6.4E-01 | 9.6E-01 | 1.5E-01 | 5.7E+01 | 4.5E+01 | **1.3E+00** | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 9.7E+01 | 4.9E+00 | 3.3E-02 | 9.0E-02 | 9.7E+01 | 3.2E+00 | 5.9E-04 | 1.1E+03 | 6.4E-01 | 9.6E-01 | 1.5E-01 | 5.7E+01 | 1.6E+00 | **3.5E+01** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 1.4E+00 | 7.0E-02 | 3.3E-02 | 2.1E-01 | 1.4E+00 | 4.6E-02 | 5.9E-04 | 6.8E+00 | 4.0E-03 | 9.6E-01 | 1.5E-01 | 7.8E-01 | 1.8E-01 | **4.4E+00** | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 1.4E+00 | 7.0E-02 | 3.3E-02 | 2.1E-01 | 1.4E+00 | 4.6E-02 | 5.9E-04 | 6.8E+00 | 4.0E-03 | 9.6E-01 | 1.5E-01 | 7.8E-01 | 3.9E-02 | **2.0E+01** | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 2.9E+01 | 1.4E+00 | 3.3E-02 | 9.5E-01 | 2.9E+01 | 9.6E-01 | 5.9E-04 | 3.0E+01 | 1.8E-02 | 9.6E-01 | 1.5E-01 | 1.6E+01 | 9.1E-01 | **1.7E+01** | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 2.9E+01 | 1.4E+00 | 3.3E-02 | 9.5E-01 | 2.9E+01 | 9.6E-01 | 5.9E-04 | 3.0E+01 | 1.8E-02 | 9.6E-01 | 1.5E-01 | 1.6E+01 | 2.9E-01 | **5.5E+01** | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 6.2E+02 | 3.1E+01 | 3.3E-02 | 2.7E-01 | 6.2E+02 | 2.0E+01 | 5.9E-04 | 2.3E+03 | 1.3E+00 | 9.6E-01 | 1.5E-01 | 3.4E+02 | 1.4E+02 | **2.5E+00** | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 6.2E+02 | 3.1E+01 | 3.3E-02 | 2.7E-01 | 6.2E+02 | 2.0E+01 | 5.9E-04 | 2.3E+03 | 1.3E+00 | 9.6E-01 | 1.5E-01 | 3.4E+02 | 6.6E+01 | **5.2E+00** | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | --[15] | --[15] | 3.3E-02 | 3.4E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 9.6E-01 | 1.5E-01 | --[15] | 1.3E+00 | --[15] | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | --[15] | --[15] | 3.3E-02 | 3.4E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 9.6E-01 | 1.5E-01 | --[15] | 9.0E-02 | --[15] | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 6.0E-01 | 3.0E-02 | 3.3E-02 | 8.7E-01 | 7.6E-02 | 2.5E-03 | 5.9E-04 | 3.9E-01 | 2.3E-04 | 9.6E-01 | 1.5E-01 | 2.1E-01 | 2.6E+00 | 8.2E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 6.0E-01 | 3.0E-02 | 3.3E-02 | 8.7E-01 | 7.6E-02 | 2.5E-03 | 5.9E-04 | 3.9E-01 | 2.3E-04 | 9.6E-01 | 1.5E-01 | 2.1E-01 | 2.3E-01 | 9.5E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 1.7E+00 | 8.6E-02 | 3.3E-02 | 2.2E+00 | 1.4E-01 | 4.8E-03 | 5.9E-04 | 2.9E-01 | 1.7E-04 | 9.6E-01 | 1.5E-01 | 5.9E-01 | 2.6E+00 | 2.3E-01 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 1.7E+00 | 8.6E-02 | 3.3E-02 | 2.2E+00 | 1.4E-01 | 4.8E-03 | 5.9E-04 | 2.9E-01 | 1.7E-04 | 9.6E-01 | 1.5E-01 | 5.9E-01 | 2.3E-01 | **2.6E+00** | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 1.6E-02 | 8.1E-04 | 3.3E-02 | 1.3E+00 | 1.4E-02 | 4.5E-04 | 5.9E-04 | 4.9E-02 | 2.9E-05 | 9.6E-01 | 1.5E-01 | 8.4E-03 | 2.6E+00 | 3.2E-03 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 1.6E-02 | 8.1E-04 | 3.3E-02 | 1.3E+00 | 1.4E-02 | 4.5E-04 | 5.9E-04 | 4.9E-02 | 2.9E-05 | 9.6E-01 | 1.5E-01 | 8.4E-03 | 2.3E-01 | 3.7E-02 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 9.6E-01 | 1.5E-01 | --[15] | 6.5E-01 | --[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 9.6E-01 | 1.5E-01 | --[15] | 6.5E-02 | --[15] | EPA 1999 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 9.6E-01 | 1.5E-01 | --[15] | 6.5E-01 | --[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 9.6E-01 | 1.5E-01 | --[15] | 6.5E-02 | --[15] | EPA 1999 |

## TABLE E-11: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-D, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 3.3E+00 | 1.7E-01 | 3.3E-02 | 3.7E-01 | 2.3E+00 | 7.6E-02 | 5.9E-04 | 2.7E+01 | 1.6E-02 | 9.6E-01 | 1.5E-01 | 1.7E+00 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 3.3E+00 | 1.7E-01 | 3.3E-02 | 3.7E-01 | 2.3E+00 | 7.6E-02 | 5.9E-04 | 2.7E+01 | 1.6E-02 | 9.6E-01 | 1.5E-01 | 1.7E+00 | NA | --[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 3.6E+00 | 1.8E-01 | 3.3E-02 | 3.4E-01 | 2.2E+00 | 7.3E-02 | 5.9E-04 | 2.9E+01 | 1.7E-02 | 9.6E-01 | 1.5E-01 | 1.7E+00 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 3.6E+00 | 1.8E-01 | 3.3E-02 | 3.4E-01 | 2.2E+00 | 7.3E-02 | 5.9E-04 | 2.9E+01 | 1.7E-02 | 9.6E-01 | 1.5E-01 | 1.7E+00 | NA | --[14] | EPA 2007c |

**Notes:**

| | |
|---|---|
| 1 | See Table E-1 for total prey ingestion rate calculation. |
| 2 | The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1). |
| 3 | Sources of BSAFs are described in Table E-3. |
| 4 | The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF. |
| | For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates. |
| 5 | Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4). |
| 6 | Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1. |
| 7 | EPC of all site-collected sediment samples were used (see Table E-1). |
| 8 | Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7). |
| 9 | See Table E-1 for basis of body weight. |
| 10 | Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight. |
| 11 | The source of TRVs is described in Table E-4. |
| 12 | HQs were calculated using the following equation: HQ = total daily dose/TRV. |
| 13 | Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively. |
| 14 | No TRV value available; therefore, a HQ could not be calculated. |
| 15 | No sediment concentration. |

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


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EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

## TABLE E-12: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-D, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 2.6E+01 | 3.7E+00 | 3.3E-02 | 1.9E-01 | 2.6E+01 | 8.7E-01 | 1.7E-04 | 1.4E+02 | 2.3E-02 | 6.4E-01 | 1.0E+00 | 2.9E+00 | 4.6E+00 | 6.4E-01 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 2.6E+01 | 3.7E+00 | 3.3E-02 | 1.9E-01 | 2.6E+01 | 8.7E-01 | 1.7E-04 | 1.4E+02 | 2.3E-02 | 6.4E-01 | 1.0E+00 | 2.9E+00 | 3.2E-01 | **9.2E+00** | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 8.6E+02 | 1.2E+02 | 3.3E-02 | 4.0E-01 | 8.6E+02 | 2.9E+01 | 1.7E-04 | 2.2E+03 | 3.6E-01 | 6.4E-01 | 1.0E+00 | 9.6E+01 | 2.7E+02 | 3.6E-01 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 8.6E+02 | 1.2E+02 | 3.3E-02 | 4.0E-01 | 8.6E+02 | 2.9E+01 | 1.7E-04 | 2.2E+03 | 3.6E-01 | 6.4E-01 | 1.0E+00 | 9.6E+01 | 5.2E+01 | **1.9E+00** | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 2.7E+00 | 3.8E-01 | 3.3E-02 | 1.7E-01 | 2.7E+00 | 9.0E-02 | 1.7E-04 | 1.6E+01 | 2.7E-03 | 6.4E-01 | 1.0E+00 | 3.0E-01 | 9.0E+00 | 3.4E-02 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 2.7E+00 | 3.8E-01 | 3.3E-02 | 1.7E-01 | 2.7E+00 | 9.0E-02 | 1.7E-04 | 1.6E+01 | 2.7E-03 | 6.4E-01 | 1.0E+00 | 3.0E-01 | 7.7E-01 | 3.9E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 1.3E+01 | 1.8E+00 | 3.3E-02 | 6.7E-02 | 1.3E+01 | 4.2E-01 | 1.7E-04 | 1.9E+02 | 3.1E-02 | 6.4E-01 | 1.0E+00 | 1.4E+00 | 5.8E+01 | 2.5E-02 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 1.3E+01 | 1.8E+00 | 3.3E-02 | 6.7E-02 | 1.3E+01 | 4.2E-01 | 1.7E-04 | 1.9E+02 | 3.1E-02 | 6.4E-01 | 1.0E+00 | 1.4E+00 | 2.4E+00 | 6.0E-01 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 9.7E+01 | 1.4E+01 | 3.3E-02 | 9.0E-02 | 9.7E+01 | 3.2E+00 | 1.7E-04 | 1.1E+03 | 1.8E-01 | 6.4E-01 | 1.0E+00 | 1.1E+01 | 1.9E+02 | 5.9E-02 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 9.7E+01 | 1.4E+01 | 3.3E-02 | 9.0E-02 | 9.7E+01 | 3.2E+00 | 1.7E-04 | 1.1E+03 | 1.8E-01 | 6.4E-01 | 1.0E+00 | 1.1E+01 | 4.7E+00 | **2.3E+00** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 1.4E+00 | 2.0E-01 | 3.3E-02 | 2.1E-01 | 1.4E+00 | 4.6E-02 | 1.7E-04 | 6.8E+00 | 1.1E-03 | 6.4E-01 | 1.0E+00 | 1.6E-01 | 4.0E+00 | 3.9E-02 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 1.4E+00 | 2.0E-01 | 3.3E-02 | 2.1E-01 | 1.4E+00 | 4.6E-02 | 1.7E-04 | 6.8E+00 | 1.1E-03 | 6.4E-01 | 1.0E+00 | 1.6E-01 | 2.5E-01 | 6.3E-01 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 2.9E+01 | 4.1E+00 | 3.3E-02 | 9.5E-01 | 2.9E+01 | 9.6E-01 | 1.7E-04 | 3.0E+01 | 5.0E-03 | 6.4E-01 | 1.0E+00 | 3.2E+00 | 6.6E-01 | **4.9E+00** | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 2.9E+01 | 4.1E+00 | 3.3E-02 | 9.5E-01 | 2.9E+01 | 9.6E-01 | 1.7E-04 | 3.0E+01 | 5.0E-03 | 6.4E-01 | 1.0E+00 | 3.2E+00 | 1.4E-01 | **2.3E+01** | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 6.2E+02 | 8.7E+01 | 3.3E-02 | 2.7E-01 | 6.2E+02 | 2.0E+01 | 1.7E-04 | 2.3E+03 | 3.8E-01 | 6.4E-01 | 1.0E+00 | 6.9E+01 | 3.0E+02 | 2.3E-01 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 6.2E+02 | 8.7E+01 | 3.3E-02 | 2.7E-01 | 6.2E+02 | 2.0E+01 | 1.7E-04 | 2.3E+03 | 3.8E-01 | 6.4E-01 | 1.0E+00 | 6.9E+01 | 7.5E+01 | 9.1E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | --[13] | --[13] | 3.3E-02 | 3.4E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 6.4E-01 | 1.0E+00 | --[13] | 1.3E+00 | --[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | --[13] | --[13] | 3.3E-02 | 3.4E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 6.4E-01 | 1.0E+00 | --[13] | 3.6E-01 | --[13] | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 6.0E-01 | 8.5E-02 | 3.3E-02 | 8.7E-01 | 7.6E-02 | 2.5E-03 | 1.7E-04 | 3.9E-01 | 6.4E-05 | 6.4E-01 | 1.0E+00 | 5.6E-02 | 4.6E+00 | 1.2E-02 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 6.0E-01 | 8.5E-02 | 3.3E-02 | 8.7E-01 | 7.6E-02 | 2.5E-03 | 1.7E-04 | 3.9E-01 | 6.4E-05 | 6.4E-01 | 1.0E+00 | 5.6E-02 | 1.5E-01 | 3.8E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 1.7E+00 | 2.4E-01 | 3.3E-02 | 2.2E+00 | 1.4E-01 | 4.8E-03 | 1.7E-04 | 2.9E-01 | 4.7E-05 | 6.4E-01 | 1.0E+00 | 1.6E-01 | 4.6E+00 | 3.5E-02 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 1.7E+00 | 2.4E-01 | 3.3E-02 | 2.2E+00 | 1.4E-01 | 4.8E-03 | 1.7E-04 | 2.9E-01 | 4.7E-05 | 6.4E-01 | 1.0E+00 | 1.6E-01 | 1.5E-01 | **1.1E+00** | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 1.6E-02 | 2.3E-03 | 3.3E-02 | 1.3E+00 | 1.4E-02 | 4.5E-04 | 1.7E-04 | 4.9E-02 | 8.0E-06 | 6.4E-01 | 1.0E+00 | 1.8E-03 | 4.6E+00 | 3.8E-04 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 1.6E-02 | 2.3E-03 | 3.3E-02 | 1.3E+00 | 1.4E-02 | 4.5E-04 | 1.7E-04 | 4.9E-02 | 8.0E-06 | 6.4E-01 | 1.0E+00 | 1.8E-03 | 1.5E-01 | 1.2E-02 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 6.4E-01 | 1.0E+00 | --[13] | 6.8E+00 | --[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 6.4E-01 | 1.0E+00 | --[13] | 1.3E-01 | --[13] | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 6.4E-01 | 1.0E+00 | --[13] | 6.8E+00 | --[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 6.4E-01 | 1.0E+00 | --[13] | 1.3E-01 | --[13] | EPA 2002 |

## TABLE E-12: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-D, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 3.3E+00 | 4.7E-01 | 3.3E-02 | 3.7E-01 | 2.3E+00 | 7.6E-02 | 1.7E-04 | 2.7E+01 | 4.5E-03 | 6.4E-01 | 1.0E+00 | 3.5E-01 | 3.6E+02 | 9.9E-04 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 3.3E+00 | 4.7E-01 | 3.3E-02 | 3.7E-01 | 2.3E+00 | 7.6E-02 | 1.7E-04 | 2.7E+01 | 4.5E-03 | 6.4E-01 | 1.0E+00 | 3.5E-01 | 6.6E+01 | 5.4E-03 | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 3.6E+00 | 5.0E-01 | 3.3E-02 | 3.4E-01 | 2.2E+00 | 7.3E-02 | 1.7E-04 | 2.9E+01 | 4.8E-03 | 6.4E-01 | 1.0E+00 | 3.7E-01 | 3.8E+01 | 9.7E-03 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 3.6E+00 | 5.0E-01 | 3.3E-02 | 3.4E-01 | 2.2E+00 | 7.3E-02 | 1.7E-04 | 2.9E+01 | 4.8E-03 | 6.4E-01 | 1.0E+00 | 3.7E-01 | 6.2E-01 | 6.0E-01 | EPA 2007c |

**Notes:**

1 See Table E-2 for total prey ingestion rate calculation.
2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2).
3 Sources of BSAFs are described in Table E-3.
4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.
For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.
5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).
6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-2.
7 EPC of all site-collected sediment samples were used (see Table E-2).
8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).
9 See Table E-2 for basis of body weight.
10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.
11 The source of TRVs is described in Table E-4.
12 HQs were calculated using the following equation: HQ = total daily dose/TRV.
13 No sediment concentration.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).
EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
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EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

**TABLE E-13: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)**

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-E, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 7.3E+00 | 3.7E-01 | 3.3E-02 | 1.9E-01 | 7.3E+00 | 2.4E-01 | 5.9E-04 | 3.9E+01 | 2.3E-02 | 1.6E-01 | 1.5E-01 | 6.7E-01 | 1.7E+01 | 3.9E-02 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 7.3E+00 | 3.7E-01 | 3.3E-02 | 1.9E-01 | 7.3E+00 | 2.4E-01 | 5.9E-04 | 3.9E+01 | 2.3E-02 | 1.6E-01 | 1.5E-01 | 6.7E-01 | 2.2E+00 | 3.0E-01 | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 6.4E+01 | 3.2E+00 | 3.3E-02 | 4.0E-01 | 6.4E+01 | 2.1E+00 | 5.9E-04 | 1.6E+02 | 9.4E-02 | 1.6E-01 | 1.5E-01 | 5.8E+00 | NA | --[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 6.4E+01 | 3.2E+00 | 3.3E-02 | 4.0E-01 | 6.4E+01 | 2.1E+00 | 5.9E-04 | 1.6E+02 | 9.4E-02 | 1.6E-01 | 1.5E-01 | 5.8E+00 | NA | --[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 1.9E-01 | 9.5E-03 | 3.3E-02 | 1.7E-01 | 1.9E-01 | 6.3E-03 | 5.9E-04 | 1.1E+00 | 6.7E-04 | 1.6E-01 | 1.5E-01 | 1.7E-02 | 6.3E+00 | 2.8E-03 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 1.9E-01 | 9.5E-03 | 3.3E-02 | 1.7E-01 | 1.9E-01 | 6.3E-03 | 5.9E-04 | 1.1E+00 | 6.7E-04 | 1.6E-01 | 1.5E-01 | 1.7E-02 | 1.5E+00 | 1.2E-02 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 2.5E+00 | 1.2E-01 | 3.3E-02 | 6.7E-02 | 2.5E+00 | 8.2E-02 | 5.9E-04 | 3.7E+01 | 2.2E-02 | 1.6E-01 | 1.5E-01 | 2.4E-01 | 1.6E+01 | 1.6E-02 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 2.5E+00 | 1.2E-01 | 3.3E-02 | 6.7E-02 | 2.5E+00 | 8.2E-02 | 5.9E-04 | 3.7E+01 | 2.2E-02 | 1.6E-01 | 1.5E-01 | 2.4E-01 | 2.7E+00 | 9.1E-02 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 1.0E+01 | 5.1E-01 | 3.3E-02 | 9.0E-02 | 1.0E+01 | 3.4E-01 | 5.9E-04 | 1.1E+02 | 6.7E-02 | 1.6E-01 | 1.5E-01 | 9.7E-01 | 4.5E+01 | 2.2E-02 | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 1.0E+01 | 5.1E-01 | 3.3E-02 | 9.0E-02 | 1.0E+01 | 3.4E-01 | 5.9E-04 | 1.1E+02 | 6.7E-02 | 1.6E-01 | 1.5E-01 | 9.7E-01 | 1.6E+00 | 6.0E-01 | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 2.3E-02 | 1.2E-03 | 3.3E-02 | 2.1E-01 | 2.3E-02 | 7.7E-04 | 5.9E-04 | 1.1E-01 | 6.7E-05 | 1.6E-01 | 1.5E-01 | 2.1E-03 | 1.8E-01 | 1.2E-02 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 2.3E-02 | 1.2E-03 | 3.3E-02 | 2.1E-01 | 2.3E-02 | 7.7E-04 | 5.9E-04 | 1.1E-01 | 6.7E-05 | 1.6E-01 | 1.5E-01 | 2.1E-03 | 3.9E-02 | 5.4E-02 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 5.4E+00 | 2.7E-01 | 3.3E-02 | 9.5E-01 | 5.4E+00 | 1.8E-01 | 5.9E-04 | 5.7E+00 | 3.4E-03 | 1.6E-01 | 1.5E-01 | 4.8E-01 | 9.1E-01 | 5.3E-01 | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 5.4E+00 | 2.7E-01 | 3.3E-02 | 9.5E-01 | 5.4E+00 | 1.8E-01 | 5.9E-04 | 5.7E+00 | 3.4E-03 | 1.6E-01 | 1.5E-01 | 4.8E-01 | 2.9E-01 | **1.7E+00** | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 6.2E+01 | 3.1E+00 | 3.3E-02 | 2.7E-01 | 6.2E+01 | 2.1E+00 | 5.9E-04 | 2.3E+02 | 1.4E-01 | 1.6E-01 | 1.5E-01 | 5.6E+00 | 1.4E+02 | 4.1E-02 | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 6.2E+01 | 3.1E+00 | 3.3E-02 | 2.7E-01 | 6.2E+01 | 2.1E+00 | 5.9E-04 | 2.3E+02 | 1.4E-01 | 1.6E-01 | 1.5E-01 | 5.6E+00 | 6.6E+01 | 8.5E-02 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 2.1E+00 | 1.1E-01 | 3.3E-02 | 2.1E+00 | 9.2E-01 | 3.1E-02 | 5.9E-04 | 3.9E-01 | 2.3E-04 | 1.6E-01 | 1.5E-01 | 1.4E-01 | 1.3E+00 | 1.1E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 2.1E+00 | 1.1E-01 | 3.3E-02 | 2.1E+00 | 9.2E-01 | 3.1E-02 | 5.9E-04 | 3.9E-01 | 2.3E-04 | 1.6E-01 | 1.5E-01 | 1.4E-01 | 9.0E-02 | **1.6E+00** | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 5.4E-01 | 2.7E-02 | 3.3E-02 | 8.7E-01 | 6.5E-02 | 2.2E-03 | 5.9E-04 | 6.6E-02 | 3.9E-05 | 1.6E-01 | 1.5E-01 | 3.1E-02 | 2.6E+00 | 1.2E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 5.4E-01 | 2.7E-02 | 3.3E-02 | 8.7E-01 | 6.5E-02 | 2.2E-03 | 5.9E-04 | 6.6E-02 | 3.9E-05 | 1.6E-01 | 1.5E-01 | 3.1E-02 | 2.3E-01 | 1.4E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 6.4E-01 | 3.2E-02 | 3.3E-02 | 2.2E+00 | 5.1E-02 | 1.7E-03 | 5.9E-04 | 2.0E-02 | 1.2E-05 | 1.6E-01 | 1.5E-01 | 3.6E-02 | 2.6E+00 | 1.4E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 6.4E-01 | 3.2E-02 | 3.3E-02 | 2.2E+00 | 5.1E-02 | 1.7E-03 | 5.9E-04 | 2.0E-02 | 1.2E-05 | 1.6E-01 | 1.5E-01 | 3.6E-02 | 2.3E-01 | 1.6E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 5.6E-03 | 2.8E-04 | 3.3E-02 | 1.3E+00 | 4.5E-03 | 1.5E-04 | 5.9E-04 | 3.1E-03 | 1.8E-06 | 1.6E-01 | 1.5E-01 | 4.5E-04 | 2.6E+00 | 1.7E-04 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | 5.6E-03 | 2.8E-04 | 3.3E-02 | 1.3E+00 | 4.5E-03 | 1.5E-04 | 5.9E-04 | 3.1E-03 | 1.8E-06 | 1.6E-01 | 1.5E-01 | 4.5E-04 | 2.3E-01 | 2.0E-03 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 1.6E-01 | 1.5E-01 | --[15] | 6.5E-01 | --[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 1.6E-01 | 1.5E-01 | --[15] | 6.5E-02 | --[15] | EPA 1999 |

## TABLE E-13: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-E, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 1.6E-01 | 1.5E-01 | --[15] | 6.5E-01 | --[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | --[15] | --[15] | 3.3E-02 | 1.9E+00 | --[15] | --[15] | 5.9E-04 | NA | --[15] | 1.6E-01 | 1.5E-01 | --[15] | 6.5E-02 | --[15] | EPA 1999 |
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.8E+02 | 1.4E+01 | 3.3E-02 | 3.7E-01 | 1.8E+02 | 6.1E+00 | 5.9E-04 | 4.3E+02 | 2.5E-01 | 1.6E-01 | 1.5E-01 | 2.2E+01 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.8E+02 | 1.4E+01 | 3.3E-02 | 3.7E-01 | 1.8E+02 | 6.1E+00 | 5.9E-04 | 4.3E+02 | 2.5E-01 | 1.6E-01 | 1.5E-01 | 2.2E+01 | NA | --[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.6E+02 | 1.3E+01 | 3.3E-02 | 3.4E-01 | 1.5E+02 | 5.1E+00 | 5.9E-04 | 4.0E+02 | 2.4E-01 | 1.6E-01 | 1.5E-01 | 2.0E+01 | NA | --[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.6E+02 | 1.3E+01 | 3.3E-02 | 3.4E-01 | 1.5E+02 | 5.1E+00 | 5.9E-04 | 4.0E+02 | 2.4E-01 | 1.6E-01 | 1.5E-01 | 2.0E+01 | NA | --[14] | EPA 2007c |

**Notes:**

| | |
|---|---|
| 1 | See Table E-1 for total prey ingestion rate calculation. |
| 2 | The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1). |
| 3 | Sources of BSAFs are described in Table E-3. |
| 4 | The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF. |
| | For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates. |
| 5 | Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4). |
| 6 | Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1. |
| 7 | EPC of all site-collected sediment samples were used (see Table E-1). |
| 8 | Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7). |
| 9 | See Table E-1 for basis of body weight. |
| 10 | Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight. |
| 11 | The source of TRVs is described in Table E-4. |
| 12 | HQs were calculated using the following equation: HQ = total daily dose/TRV. |
| 13 | Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively. |
| 14 | No TRV value; therefore, a HQ could not be calculated. |
| 15 | No sediment concentration. |

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 1999. Screaning Level Ecological Risk Assessment Protocols for Combustion Facilities. Peer Review Draft. Office of Solid Waste and Emergency Response. EPA530-D99-001A. September.

EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

## TABLE E-14: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-E, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 7.3E+00 | 1.0E+00 | 3.3E-02 | 1.9E-01 | 7.3E+00 | 2.4E-01 | 1.7E-04 | 3.9E+01 | 6.5E-03 | 1.0E-01 | 1.0E+00 | 1.3E-01 | 4.6E+00 | 2.9E-02 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 7.3E+00 | 1.0E+00 | 3.3E-02 | 1.9E-01 | 7.3E+00 | 2.4E-01 | 1.7E-04 | 3.9E+01 | 6.5E-03 | 1.0E-01 | 1.0E+00 | 1.3E-01 | 3.2E-01 | 4.2E-01 | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 6.4E+01 | 9.0E+00 | 3.3E-02 | 4.0E-01 | 6.4E+01 | 2.1E+00 | 1.7E-04 | 1.6E+02 | 2.6E-02 | 1.0E-01 | 1.0E+00 | 1.2E+00 | 2.7E+02 | 4.3E-03 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 6.4E+01 | 9.0E+00 | 3.3E-02 | 4.0E-01 | 6.4E+01 | 2.1E+00 | 1.7E-04 | 1.6E+02 | 2.6E-02 | 1.0E-01 | 1.0E+00 | 1.2E+00 | 5.2E+01 | 2.2E-02 | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 1.9E-01 | 2.7E-02 | 3.3E-02 | 1.7E-01 | 1.9E-01 | 6.3E-03 | 1.7E-04 | 1.1E+00 | 1.9E-04 | 1.0E-01 | 1.0E+00 | 3.5E-03 | 9.0E+00 | 3.9E-04 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 1.9E-01 | 2.7E-02 | 3.3E-02 | 1.7E-01 | 1.9E-01 | 6.3E-03 | 1.7E-04 | 1.1E+00 | 1.9E-04 | 1.0E-01 | 1.0E+00 | 3.5E-03 | 7.7E-01 | 4.5E-03 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 2.5E+00 | 3.5E-01 | 3.3E-02 | 6.7E-02 | 2.5E+00 | 8.2E-02 | 1.7E-04 | 3.7E+01 | 6.1E-03 | 1.0E-01 | 1.0E+00 | 4.5E-02 | 2.7E+04 | 1.7E-06 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 2.5E+00 | 3.5E-01 | 3.3E-02 | 6.7E-02 | 2.5E+00 | 8.2E-02 | 1.7E-04 | 3.7E+01 | 6.1E-03 | 1.0E-01 | 1.0E+00 | 4.5E-02 | 2.7E+03 | 1.7E-05 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 1.0E+01 | 1.4E+00 | 3.3E-02 | 9.0E-02 | 1.0E+01 | 3.4E-01 | 1.7E-04 | 1.1E+02 | 1.9E-02 | 1.0E-01 | 1.0E+00 | 1.9E-01 | 1.9E+02 | 9.9E-04 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 1.0E+01 | 1.4E+00 | 3.3E-02 | 9.0E-02 | 1.0E+01 | 3.4E-01 | 1.7E-04 | 1.1E+02 | 1.9E-02 | 1.0E-01 | 1.0E+00 | 1.9E-01 | 4.7E+00 | 4.0E-02 | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 2.3E-02 | 3.3E-03 | 3.3E-02 | 2.1E-01 | 2.3E-02 | 7.7E-04 | 1.7E-04 | 1.1E-01 | 1.9E-05 | 1.0E-01 | 1.0E+00 | 4.2E-04 | 4.0E+00 | 1.1E-04 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 2.3E-02 | 3.3E-03 | 3.3E-02 | 2.1E-01 | 2.3E-02 | 7.7E-04 | 1.7E-04 | 1.1E-01 | 1.9E-05 | 1.0E-01 | 1.0E+00 | 4.2E-04 | 2.5E-01 | 1.7E-03 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 5.4E+00 | 7.6E-01 | 3.3E-02 | 9.5E-01 | 5.4E+00 | 1.8E-01 | 1.7E-04 | 5.7E+00 | 9.4E-04 | 1.0E-01 | 1.0E+00 | 9.8E-02 | 6.6E-01 | 1.5E-01 | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 5.4E+00 | 7.6E-01 | 3.3E-02 | 9.5E-01 | 5.4E+00 | 1.8E-01 | 1.7E-04 | 5.7E+00 | 9.4E-04 | 1.0E-01 | 1.0E+00 | 9.8E-02 | 1.4E-01 | 6.9E-01 | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 6.2E+01 | 8.7E+00 | 3.3E-02 | 2.7E-01 | 6.2E+01 | 2.1E+00 | 1.7E-04 | 2.3E+02 | 3.8E-02 | 1.0E-01 | 1.0E+00 | 1.1E+00 | 3.0E+02 | 3.8E-03 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 6.2E+01 | 8.7E+00 | 3.3E-02 | 2.7E-01 | 6.2E+01 | 2.1E+00 | 1.7E-04 | 2.3E+02 | 3.8E-02 | 1.0E-01 | 1.0E+00 | 1.1E+00 | 7.5E+01 | 1.5E-02 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.5E-01 | 1.3E-02 | 3.3E-02 | 3.0E-01 | 1.3E-01 | 4.4E-03 | 5.9E-04 | 3.9E-01 | 2.3E-04 | 1.0E-01 | 1.0E+00 | 1.8E-03 | 1.3E+00 | 1.4E-03 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.5E-01 | 1.3E-02 | 3.3E-02 | 3.0E-01 | 1.3E-01 | 4.4E-03 | 5.9E-04 | 3.9E-01 | 2.3E-04 | 1.0E-01 | 1.0E+00 | 1.8E-03 | 3.6E-01 | 5.0E-03 | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 5.4E-01 | 7.6E-02 | 3.3E-02 | 8.7E-01 | 6.5E-02 | 2.2E-03 | 1.7E-04 | 6.6E-02 | 1.1E-05 | 1.0E-01 | 1.0E+00 | 8.2E-03 | 4.6E+00 | 1.8E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 5.4E-01 | 7.6E-02 | 3.3E-02 | 8.7E-01 | 6.5E-02 | 2.2E-03 | 1.7E-04 | 6.6E-02 | 1.1E-05 | 1.0E-01 | 1.0E+00 | 8.2E-03 | 1.5E-01 | 5.6E-02 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 6.4E-01 | 9.0E-02 | 3.3E-02 | 2.2E+00 | 5.1E-02 | 1.7E-03 | 1.7E-04 | 2.0E-02 | 3.3E-06 | 1.0E-01 | 1.0E+00 | 9.5E-03 | 4.6E+00 | 2.1E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 6.4E-01 | 9.0E-02 | 3.3E-02 | 2.2E+00 | 5.1E-02 | 1.7E-03 | 1.7E-04 | 2.0E-02 | 3.3E-06 | 1.0E-01 | 1.0E+00 | 9.5E-03 | 1.5E-01 | 6.5E-02 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 5.6E-03 | 7.8E-04 | 3.3E-02 | 1.3E+00 | 4.5E-03 | 1.5E-04 | 1.7E-04 | 3.1E-03 | 5.2E-07 | 1.0E-01 | 1.0E+00 | 9.7E-05 | 4.6E+00 | 2.1E-05 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | 5.6E-03 | 7.8E-04 | 3.3E-02 | 1.3E+00 | 4.5E-03 | 1.5E-04 | 1.7E-04 | 3.1E-03 | 5.2E-07 | 1.0E-01 | 1.0E+00 | 9.7E-05 | 1.5E-01 | 6.6E-04 | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 1.0E-01 | 1.0E+00 | --[13] | 6.8E+00 | --[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 1.0E-01 | 1.0E+00 | --[13] | 1.3E-01 | --[13] | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 1.0E-01 | 1.0E+00 | --[13] | 6.8E+00 | --[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | --[13] | --[13] | 3.3E-02 | 1.9E+00 | --[13] | --[13] | 1.7E-04 | NA | --[13] | 1.0E-01 | 1.0E+00 | --[13] | 1.3E-01 | --[13] | EPA 2002 |

## TABLE E-14: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Duck Creek Area of Concern, Ohio

**Section DC-E, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 2.8E+02 | 4.0E+01 | 3.3E-02 | 3.7E-01 | 1.8E+02 | 6.1E+00 | 1.7E-04 | 4.3E+02 | 7.2E-02 | 1.0E-01 | 1.0E+00 | 4.8E+00 | 3.6E+02 | 1.3E-02 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 2.8E+02 | 4.0E+01 | 3.3E-02 | 3.7E-01 | 1.8E+02 | 6.1E+00 | 1.7E-04 | 4.3E+02 | 7.2E-02 | 1.0E-01 | 1.0E+00 | 4.8E+00 | 6.6E+01 | 7.3E-02 | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 2.6E+02 | 3.7E+01 | 3.3E-02 | 3.4E-01 | 1.5E+02 | 5.1E+00 | 1.7E-04 | 4.0E+02 | 6.7E-02 | 1.0E-01 | 1.0E+00 | 4.4E+00 | 3.8E+01 | 1.1E-01 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 2.6E+02 | 3.7E+01 | 3.3E-02 | 3.4E-01 | 1.5E+02 | 5.1E+00 | 1.7E-04 | 4.0E+02 | 6.7E-02 | 1.0E-01 | 1.0E+00 | 4.4E+00 | 6.2E-01 | **7.1E+00** | EPA 2007c |

**Notes:**

1 See Table E-2 for total prey ingestion rate calculation.
2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2).
3 Sources of BSAFs are described in Table E-3.
4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.
For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.
5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).
6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-2.
7 EPC of all site-collected sediment samples were used (see Table E-2).
8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).
9 See Table E-2 for basis of body weight.
10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.
11 The source of TRVs is described in Table E-4.
12 HQs were calculated using the following equation: HQ = total daily dose/TRV.
13 No sediment concentration.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002)
EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

**TABLE E-15: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)**

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-A, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 7.2E+00 | 3.6E-01 | 3.3E-02 | 1.9E-01 | 7.2E+00 | 2.4E-01 | 5.9E-04 | 3.8E+01 | 2.3E-02 | 1.0E+00 | 1.5E-01 | 4.2E+00 | 1.7E+01 | 2.4E-01 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 7.2E+00 | 3.6E-01 | 3.3E-02 | 1.9E-01 | 7.2E+00 | 2.4E-01 | 5.9E-04 | 3.8E+01 | 2.3E-02 | 1.0E+00 | 1.5E-01 | 4.2E+00 | 2.2E+00 | **1.9E+00** | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 1.5E+02 | 7.7E+00 | 3.3E-02 | 4.0E-01 | 1.5E+02 | 5.1E+00 | 5.9E-04 | 3.9E+02 | 2.3E-01 | 1.0E+00 | 1.5E-01 | 8.9E+01 | NA | ---[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 1.5E+02 | 7.7E+00 | 3.3E-02 | 4.0E-01 | 1.5E+02 | 5.1E+00 | 5.9E-04 | 3.9E+02 | 2.3E-01 | 1.0E+00 | 1.5E-01 | 8.9E+01 | NA | ---[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 4.0E-01 | 2.0E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 5.9E-04 | 2.4E+00 | 1.4E-03 | 1.0E+00 | 1.5E-01 | 2.4E-01 | 6.3E+00 | 3.8E-02 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 4.0E-01 | 2.0E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 5.9E-04 | 2.4E+00 | 1.4E-03 | 1.0E+00 | 1.5E-01 | 2.4E-01 | 1.5E+00 | 1.6E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 2.4E+01 | 1.2E+00 | 3.3E-02 | 6.7E-02 | 2.4E+01 | 8.1E-01 | 5.9E-04 | 3.6E+02 | 2.1E-01 | 1.0E+00 | 1.5E-01 | 1.5E+01 | 1.6E+01 | 9.8E-01 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 2.4E+01 | 1.2E+00 | 3.3E-02 | 6.7E-02 | 2.4E+01 | 8.1E-01 | 5.9E-04 | 3.6E+02 | 2.1E-01 | 1.0E+00 | 1.5E-01 | 1.5E+01 | 2.7E+00 | **5.7E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.0E+01 | 1.5E+00 | 3.3E-02 | 9.0E-02 | 3.0E+01 | 9.9E-01 | 5.9E-04 | 3.3E+02 | 2.0E-01 | 1.0E+00 | 1.5E-01 | 1.8E+01 | 4.5E+01 | 4.1E-01 | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.0E+01 | 1.5E+00 | 3.3E-02 | 9.0E-02 | 3.0E+01 | 9.9E-01 | 5.9E-04 | 3.3E+02 | 2.0E-01 | 1.0E+00 | 1.5E-01 | 1.8E+01 | 1.6E+00 | **1.1E+01** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 6.8E-02 | 3.4E-03 | 3.3E-02 | 2.1E-01 | 6.8E-02 | 2.3E-03 | 5.9E-04 | 3.3E-01 | 2.0E-04 | 1.0E+00 | 1.5E-01 | 4.0E-02 | 1.8E-01 | 2.2E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 6.8E-02 | 3.4E-03 | 3.3E-02 | 2.1E-01 | 6.8E-02 | 2.3E-03 | 5.9E-04 | 3.3E-01 | 2.0E-04 | 1.0E+00 | 1.5E-01 | 4.0E-02 | 3.9E-02 | **1.0E+00** | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | ---[15] | ---[15] | 3.3E-02 | 9.5E-01 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 9.1E-01 | ---[15] | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | ---[15] | ---[15] | 3.3E-02 | 9.5E-01 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.9E-01 | ---[15] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.7E+02 | 1.3E+01 | 3.3E-02 | 2.7E-01 | 2.7E+02 | 8.9E+00 | 5.9E-04 | 9.9E+02 | 5.8E-01 | 1.0E+00 | 1.5E-01 | 1.6E+02 | 1.4E+02 | **1.1E+00** | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.7E+02 | 1.3E+01 | 3.3E-02 | 2.7E-01 | 2.7E+02 | 8.9E+00 | 5.9E-04 | 9.9E+02 | 5.8E-01 | 1.0E+00 | 1.5E-01 | 1.6E+02 | 6.6E+01 | **2.4E+00** | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 9.8E-01 | 4.9E-02 | 3.3E-02 | 3.4E+00 | 7.3E-01 | 2.4E-02 | 5.9E-04 | 4.6E-01 | 2.7E-04 | 1.0E+00 | 1.5E-01 | 5.0E-01 | 1.3E+00 | 3.9E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 9.8E-01 | 4.9E-02 | 3.3E-02 | 3.4E+00 | 7.3E-01 | 2.4E-02 | 5.9E-04 | 4.6E-01 | 2.7E-04 | 1.0E+00 | 1.5E-01 | 5.0E-01 | 9.0E-02 | **5.6E+00** | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 7.8E-02 | 3.9E-03 | 3.3E-02 | 8.7E-01 | 9.8E-03 | 3.3E-04 | 5.9E-04 | 2.4E-02 | 1.4E-05 | 1.0E+00 | 1.5E-01 | 2.9E-02 | 2.6E+00 | 1.1E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 7.8E-02 | 3.9E-03 | 3.3E-02 | 8.7E-01 | 9.8E-03 | 3.3E-04 | 5.9E-04 | 2.4E-02 | 1.4E-05 | 1.0E+00 | 1.5E-01 | 2.9E-02 | 2.3E-01 | 1.3E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 2.1E-01 | 1.0E-02 | 3.3E-02 | 2.2E+00 | 1.7E-02 | 5.7E-04 | 5.9E-04 | 1.6E-02 | 9.6E-06 | 1.0E+00 | 1.5E-01 | 7.5E-02 | 2.6E+00 | 2.8E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 2.1E-01 | 1.0E-02 | 3.3E-02 | 2.2E+00 | 1.7E-02 | 5.7E-04 | 5.9E-04 | 1.6E-02 | 9.6E-06 | 1.0E+00 | 1.5E-01 | 7.5E-02 | 2.3E-01 | 3.3E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.6E+00 | ---[15] | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.3E-01 | ---[15] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |

## TABLE E-15: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-A, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.2E+00 | 1.1E-01 | 3.3E-02 | 3.7E-01 | 1.5E+00 | 5.1E-02 | 5.9E-04 | 8.7E+00 | 5.1E-03 | 1.0E+00 | 1.5E-01 | 1.1E+00 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.2E+00 | 1.1E-01 | 3.3E-02 | 3.7E-01 | 1.5E+00 | 5.1E-02 | 5.9E-04 | 8.7E+00 | 5.1E-03 | 1.0E+00 | 1.5E-01 | 1.1E+00 | NA | ---[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.0E+00 | 1.0E-01 | 3.3E-02 | 3.4E-01 | 1.2E+00 | 4.1E-02 | 5.9E-04 | 7.8E+00 | 4.6E-03 | 1.0E+00 | 1.5E-01 | 1.0E+00 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 2.0E+00 | 1.0E-01 | 3.3E-02 | 3.4E-01 | 1.2E+00 | 4.1E-02 | 5.9E-04 | 7.8E+00 | 4.6E-03 | 1.0E+00 | 1.5E-01 | 1.0E+00 | NA | ---[14] | EPA 2007c |

**Notes:**

| | |
|---|---|
| 1 | See Table E-1 for total prey ingestion rate calculation. |
| 2 | The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1). |
| 3 | Sources of BSAFs are described in Table E-3. |
| 4 | The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF. |
| | For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates. |
| 5 | Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4). |
| 6 | Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1. |
| 7 | EPC of all site-collected sediment samples were used (see Table E-1). |
| 8 | Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7). |
| 9 | See Table E-1 for basis of body weight. |
| 10 | Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight. |
| 11 | The source of TRVs is described in Table E-4. |
| 12 | HQs were calculated using the following equation: HQ = total daily dose/TRV. |
| 13 | Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively. |
| 14 | No TRV value; therefore, a HQ could not be calculated. |
| 15 | No sediment concentration. |

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


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EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

## TABLE E-16: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-A, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 7.2E+00 | 1.0E+00 | 3.3E-02 | 1.9E-01 | 7.2E+00 | 2.4E-01 | 1.7E-04 | 3.8E+01 | 6.3E-03 | 1.0E+00 | 1.0E+00 | 1.3E+00 | 4.6E+00 | 2.7E-01 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 7.2E+00 | 1.0E+00 | 3.3E-02 | 1.9E-01 | 7.2E+00 | 2.4E-01 | 1.7E-04 | 3.8E+01 | 6.3E-03 | 1.0E+00 | 1.0E+00 | 1.3E+00 | 3.2E-01 | **3.9E+00** | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 1.5E+02 | 2.2E+01 | 3.3E-02 | 4.0E-01 | 1.5E+02 | 5.1E+00 | 1.7E-04 | 3.9E+02 | 6.4E-02 | 1.0E+00 | 1.0E+00 | 2.7E+01 | 2.7E+02 | 1.0E-01 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 1.5E+02 | 2.2E+01 | 3.3E-02 | 4.0E-01 | 1.5E+02 | 5.1E+00 | 1.7E-04 | 3.9E+02 | 6.4E-02 | 1.0E+00 | 1.0E+00 | 2.7E+01 | 5.2E+01 | 5.2E-01 | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 4.0E-01 | 5.7E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 1.7E-04 | 2.4E+00 | 4.0E-04 | 1.0E+00 | 1.0E+00 | 7.1E-02 | 9.0E+00 | 7.9E-03 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 4.0E-01 | 5.7E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 1.7E-04 | 2.4E+00 | 4.0E-04 | 1.0E+00 | 1.0E+00 | 7.1E-02 | 7.7E-01 | 9.2E-02 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 2.4E+01 | 3.4E+00 | 3.3E-02 | 6.7E-02 | 2.4E+01 | 8.1E-01 | 1.7E-04 | 3.6E+02 | 6.0E-02 | 1.0E+00 | 1.0E+00 | 4.3E+00 | 5.8E+01 | 7.4E-02 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 2.4E+01 | 3.4E+00 | 3.3E-02 | 6.7E-02 | 2.4E+01 | 8.1E-01 | 1.7E-04 | 3.6E+02 | 6.0E-02 | 1.0E+00 | 1.0E+00 | 4.3E+00 | 2.4E+00 | **1.8E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.0E+01 | 4.2E+00 | 3.3E-02 | 9.0E-02 | 3.0E+01 | 9.9E-01 | 1.7E-04 | 3.3E+02 | 5.5E-02 | 1.0E+00 | 1.0E+00 | 5.3E+00 | 1.9E+02 | 2.8E-02 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.0E+01 | 4.2E+00 | 3.3E-02 | 9.0E-02 | 3.0E+01 | 9.9E-01 | 1.7E-04 | 3.3E+02 | 5.5E-02 | 1.0E+00 | 1.0E+00 | 5.3E+00 | 4.7E+00 | **1.1E+00** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 6.8E-02 | 9.6E-03 | 3.3E-02 | 2.1E-01 | 6.8E-02 | 2.3E-03 | 1.7E-04 | 3.3E-01 | 5.5E-05 | 1.0E+00 | 1.0E+00 | 1.2E-02 | 4.0E+00 | 3.0E-03 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 6.8E-02 | 9.6E-03 | 3.3E-02 | 2.1E-01 | 6.8E-02 | 2.3E-03 | 1.7E-04 | 3.3E-01 | 5.5E-05 | 1.0E+00 | 1.0E+00 | 1.2E-02 | 2.5E-01 | 4.8E-02 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | ---[13] | ---[13] | 3.3E-02 | 9.5E-01 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 6.6E-01 | ---[13] | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | ---[13] | ---[13] | 3.3E-02 | 9.5E-01 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.4E-01 | ---[13] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.7E+02 | 3.8E+01 | 3.3E-02 | 2.7E-01 | 2.7E+02 | 8.9E+00 | 1.7E-04 | 9.9E+02 | 1.6E-01 | 1.0E+00 | 1.0E+00 | 4.7E+01 | 3.0E+02 | 1.6E-01 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.7E+02 | 3.8E+01 | 3.3E-02 | 2.7E-01 | 2.7E+02 | 8.9E+00 | 1.7E-04 | 9.9E+02 | 1.6E-01 | 1.0E+00 | 1.0E+00 | 4.7E+01 | 7.5E+01 | 6.2E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 9.8E-01 | 1.4E-01 | 3.3E-02 | 3.4E+00 | 7.3E-01 | 2.4E-02 | 1.7E-04 | 4.6E-01 | 7.5E-05 | 1.0E+00 | 1.0E+00 | 1.6E-01 | 1.3E+00 | 1.3E-01 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 9.8E-01 | 1.4E-01 | 3.3E-02 | 3.4E+00 | 7.3E-01 | 2.4E-02 | 1.7E-04 | 4.6E-01 | 7.5E-05 | 1.0E+00 | 1.0E+00 | 1.6E-01 | 3.6E-01 | 4.5E-01 | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 7.8E-02 | 1.1E-02 | 3.3E-02 | 8.7E-01 | 9.8E-03 | 3.3E-04 | 1.7E-04 | 2.4E-02 | 3.9E-06 | 1.0E+00 | 1.0E+00 | 1.1E-02 | 4.6E+00 | 2.5E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 7.8E-02 | 1.1E-02 | 3.3E-02 | 8.7E-01 | 9.8E-03 | 3.3E-04 | 1.7E-04 | 2.4E-02 | 3.9E-06 | 1.0E+00 | 1.0E+00 | 1.1E-02 | 1.5E-01 | 7.7E-02 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 2.1E-01 | 2.9E-02 | 3.3E-02 | 2.2E+00 | 1.7E-02 | 5.7E-04 | 1.7E-04 | 1.6E-02 | 2.7E-06 | 1.0E+00 | 1.0E+00 | 3.0E-02 | 4.6E+00 | 6.5E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 2.1E-01 | 2.9E-02 | 3.3E-02 | 2.2E+00 | 1.7E-02 | 5.7E-04 | 1.7E-04 | 1.6E-02 | 2.7E-06 | 1.0E+00 | 1.0E+00 | 3.0E-02 | 1.5E-01 | 2.0E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 4.6E+00 | ---[13] | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.5E-01 | ---[13] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |

## TABLE E-16: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-A, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 2.2E+00 | 3.2E-01 | 3.3E-02 | 3.7E-01 | 1.5E+00 | 5.1E-02 | 1.7E-04 | 8.7E+00 | 1.4E-03 | 1.0E+00 | 1.0E+00 | 3.7E-01 | 3.6E+02 | 1.0E-03 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 2.2E+00 | 3.2E-01 | 3.3E-02 | 3.7E-01 | 1.5E+00 | 5.1E-02 | 1.7E-04 | 8.7E+00 | 1.4E-03 | 1.0E+00 | 1.0E+00 | 3.7E-01 | 6.6E+01 | 5.6E-03 | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 2.0E+00 | 2.8E-01 | 3.3E-02 | 3.4E-01 | 1.2E+00 | 4.1E-02 | 1.7E-04 | 7.8E+00 | 1.3E-03 | 1.0E+00 | 1.0E+00 | 3.3E-01 | 3.8E+01 | 8.5E-03 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 2.0E+00 | 2.8E-01 | 3.3E-02 | 3.4E-01 | 1.2E+00 | 4.1E-02 | 1.7E-04 | 7.8E+00 | 1.3E-03 | 1.0E+00 | 1.0E+00 | 3.3E-01 | 6.2E-01 | 5.3E-01 | EPA 2007c |

**Notes:**

| | |
|---|---|
| 1 | See Table E-2 for total prey ingestion rate calculation. |
| 2 | The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2). |
| 3 | Sources of BSAFs are described in Table E-3. |
| 4 | The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF. |
| | For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates. |
| 5 | Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4). |
| 6 | Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-2. |
| 7 | EPC of all site-collected sediment samples were used (see Table E-2). |
| 8 | Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7). |
| 9 | See Table E-2 for basis of body weight. |
| 10 | Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight. |
| 11 | The source of TRVs is described in Table E-4. |
| 12 | HQs were calculated using the following equation: HQ = total daily dose/TRV. |
| 13 | No sediment concentration. |

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

| TABLE E-17: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio | | | | | | | | | | | | | | | | | | |
| **Section OC-B, EPC** | | | | | | | | | | | | | | | | | | |
| **COPEC** | **Total Prey Ingestion Rate[1] (kg/day)** | **Fish Ingestion Rate[2] (kg/day)** | **Fish BSAF[3] (unitless)** | **Fish Concentration[4] (mg/kg)** | **Fish Daily Dose[5] (mg/day)** | **Invertebrate Ingestion Rate[2] (kg/day)** | **Invertebrate BSAF[3,5] (unitless)** | **Invertebrate Concentration[4] (mg/kg)** | **Invertebrate Daily Dose[5] (mg/day)** | **Sediment Ingestion Rate[6] (kg/day)** | **Sediment Concentration[7] (mg/kg)** | **Sediment Daily Dose[8] (mg/day)** | **SUF** | **Body Weight[9] (kg)** | **Total Daily Dose[10] (mg/kg/day)** | **TRV[11] (mg/kg/day)** | **HQ[12] (based on adjusted TRV)** | **Source of TRV** |
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 8.8E+00 | 4.4E-01 | 3.3E-02 | 1.9E-01 | 8.8E+00 | 2.9E-01 | 5.9E-04 | 4.7E+01 | 2.8E-02 | 1.0E+00 | 1.5E-01 | 5.2E+00 | 1.7E+01 | 3.0E-01 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 8.8E+00 | 4.4E-01 | 3.3E-02 | 1.9E-01 | 8.8E+00 | 2.9E-01 | 5.9E-04 | 4.7E+01 | 2.8E-02 | 1.0E+00 | 1.5E-01 | 5.2E+00 | 2.2E+00 | **2.3E+00** | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 1.0E+02 | 5.1E+00 | 3.3E-02 | 4.0E-01 | 1.0E+02 | 3.4E+00 | 5.9E-04 | 2.5E+02 | 1.5E-01 | 1.0E+00 | 1.5E-01 | 5.9E+01 | NA | ---[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 1.0E+02 | 5.1E+00 | 3.3E-02 | 4.0E-01 | 1.0E+02 | 3.4E+00 | 5.9E-04 | 2.5E+02 | 1.5E-01 | 1.0E+00 | 1.5E-01 | 5.9E+01 | NA | ---[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 3.7E-01 | 1.9E-02 | 3.3E-02 | 1.7E-01 | 3.7E-01 | 1.2E-02 | 5.9E-04 | 2.2E+00 | 1.3E-03 | 1.0E+00 | 1.5E-01 | 2.2E-01 | 6.3E+00 | 3.5E-02 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 3.7E-01 | 1.9E-02 | 3.3E-02 | 1.7E-01 | 3.7E-01 | 1.2E-02 | 5.9E-04 | 2.2E+00 | 1.3E-03 | 1.0E+00 | 1.5E-01 | 2.2E-01 | 1.5E+00 | 1.5E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 1.3E+01 | 6.4E-01 | 3.3E-02 | 6.7E-02 | 1.3E+01 | 4.3E-01 | 5.9E-04 | 1.9E+02 | 1.1E-01 | 1.0E+00 | 1.5E-01 | 8.0E+00 | 1.6E+01 | 5.1E-01 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 1.3E+01 | 6.4E-01 | 3.3E-02 | 6.7E-02 | 1.3E+01 | 4.3E-01 | 5.9E-04 | 1.9E+02 | 1.1E-01 | 1.0E+00 | 1.5E-01 | 8.0E+00 | 2.7E+00 | **3.0E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 2.7E+01 | 1.4E+00 | 3.3E-02 | 9.0E-02 | 2.7E+01 | 9.1E-01 | 5.9E-04 | 3.1E+02 | 1.8E-01 | 1.0E+00 | 1.5E-01 | 1.7E+01 | 4.5E+01 | 3.8E-01 | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 2.7E+01 | 1.4E+00 | 3.3E-02 | 9.0E-02 | 2.7E+01 | 9.1E-01 | 5.9E-04 | 3.1E+02 | 1.8E-01 | 1.0E+00 | 1.5E-01 | 1.7E+01 | 1.6E+00 | **1.0E+01** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 6.6E-02 | 3.3E-03 | 3.3E-02 | 2.1E-01 | 6.6E-02 | 2.2E-03 | 5.9E-04 | 3.2E-01 | 1.9E-04 | 1.0E+00 | 1.5E-01 | 3.9E-02 | 1.8E-01 | 2.2E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 6.6E-02 | 3.3E-03 | 3.3E-02 | 2.1E-01 | 6.6E-02 | 2.2E-03 | 5.9E-04 | 3.2E-01 | 1.9E-04 | 1.0E+00 | 1.5E-01 | 3.9E-02 | 3.9E-02 | 9.9E-01 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | ---[15] | ---[15] | 3.3E-02 | 9.5E-01 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 9.1E-01 | ---[15] | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | ---[15] | ---[15] | 3.3E-02 | 9.5E-01 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.9E-01 | ---[15] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.8E+02 | 1.4E+01 | 3.3E-02 | 2.7E-01 | 2.8E+02 | 9.3E+00 | 5.9E-04 | 1.0E+03 | 6.1E-01 | 1.0E+00 | 1.5E-01 | 1.6E+02 | 1.4E+02 | **1.2E+00** | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.8E+02 | 1.4E+01 | 3.3E-02 | 2.7E-01 | 2.8E+02 | 9.3E+00 | 5.9E-04 | 1.0E+03 | 6.1E-01 | 1.0E+00 | 1.5E-01 | 1.6E+02 | 6.6E+01 | **2.5E+00** | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 5.0E-01 | 2.5E-02 | 3.3E-02 | 3.4E+00 | 3.7E-01 | 1.2E-02 | 5.9E-04 | 2.5E-01 | 1.5E-04 | 1.0E+00 | 1.5E-01 | 2.5E-01 | 1.3E+00 | 2.0E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 5.0E-01 | 2.5E-02 | 3.3E-02 | 3.4E+00 | 3.7E-01 | 1.2E-02 | 5.9E-04 | 2.5E-01 | 1.5E-04 | 1.0E+00 | 1.5E-01 | 2.5E-01 | 9.0E-02 | **2.8E+00** | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 5.3E-02 | 2.6E-03 | 3.3E-02 | 8.7E-01 | 6.6E-03 | 2.2E-04 | 5.9E-04 | 1.7E-02 | 1.0E-05 | 1.0E+00 | 1.5E-01 | 2.0E-02 | 2.6E+00 | 7.5E-03 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 5.3E-02 | 2.6E-03 | 3.3E-02 | 8.7E-01 | 6.6E-03 | 2.2E-04 | 5.9E-04 | 1.7E-02 | 1.0E-05 | 1.0E+00 | 1.5E-01 | 2.0E-02 | 2.3E-01 | 8.6E-02 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 1.2E-01 | 6.1E-03 | 3.3E-02 | 2.2E+00 | 1.0E-02 | 3.4E-04 | 5.9E-04 | 1.0E-02 | 6.0E-06 | 1.0E+00 | 1.5E-01 | 4.4E-02 | 2.6E+00 | 1.7E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 1.2E-01 | 6.1E-03 | 3.3E-02 | 2.2E+00 | 1.0E-02 | 3.4E-04 | 5.9E-04 | 1.0E-02 | 6.0E-06 | 1.0E+00 | 1.5E-01 | 4.4E-02 | 2.3E-01 | 1.9E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.6E+00 | ---[15] | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.3E-01 | ---[15] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |

## TABLE E-17: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-B, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 1.3E+01 | 6.8E-01 | 3.3E-02 | 3.7E-01 | 9.2E+00 | 3.1E-01 | 5.9E-04 | 5.6E+01 | 3.3E-02 | 1.0E+00 | 1.5E-01 | 6.9E+00 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 1.3E+01 | 6.8E-01 | 3.3E-02 | 3.7E-01 | 9.2E+00 | 3.1E-01 | 5.9E-04 | 5.6E+01 | 3.3E-02 | 1.0E+00 | 1.5E-01 | 6.9E+00 | NA | ---[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 1.3E+01 | 6.3E-01 | 3.3E-02 | 3.4E-01 | 7.7E+00 | 2.6E-01 | 5.9E-04 | 5.2E+01 | 3.1E-02 | 1.0E+00 | 1.5E-01 | 6.2E+00 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 1.3E+01 | 6.3E-01 | 3.3E-02 | 3.4E-01 | 7.7E+00 | 2.6E-01 | 5.9E-04 | 5.2E+01 | 3.1E-02 | 1.0E+00 | 1.5E-01 | 6.2E+00 | NA | ---[14] | EPA 2007c |

**Notes:**

1 See Table E-1 for total prey ingestion rate calculation.
2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1).
3 Sources of BSAFs are described in Table E-3.
4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.
For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.
5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).
6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1.
7 EPC of all site-collected sediment samples were used (see Table E-1).
8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).
9 See Table E-1 for basis of body weight.
10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.
11 The source of TRVs is described in Table E-4.
12 HQs were calculated using the following equation: HQ = total daily dose/TRV.
13 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.
14 No TRV value available; therefore, an HQ could not be calculated.
15 No sediment concentration.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


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EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).

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EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

**TABLE E-18: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)**

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-B, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 8.8E+00 | 1.2E+00 | 3.3E-02 | 1.9E-01 | 8.8E+00 | 2.9E-01 | 1.7E-04 | 4.7E+01 | 7.8E-03 | 6.8E-01 | 1.0E+00 | 1.0E+00 | 4.6E+00 | 2.3E-01 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 8.8E+00 | 1.2E+00 | 3.3E-02 | 1.9E-01 | 8.8E+00 | 2.9E-01 | 1.7E-04 | 4.7E+01 | 7.8E-03 | 6.8E-01 | 1.0E+00 | 1.0E+00 | 3.2E-01 | **3.2E+00** | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 1.0E+02 | 1.4E+01 | 3.3E-02 | 4.0E-01 | 1.0E+02 | 3.4E+00 | 1.7E-04 | 2.5E+02 | 4.2E-02 | 6.8E-01 | 1.0E+00 | 1.2E+01 | 2.7E+02 | 4.4E-02 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 1.0E+02 | 1.4E+01 | 3.3E-02 | 4.0E-01 | 1.0E+02 | 3.4E+00 | 1.7E-04 | 2.5E+02 | 4.2E-02 | 6.8E-01 | 1.0E+00 | 1.2E+01 | 5.2E+01 | 2.3E-01 | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 3.7E-01 | 5.2E-02 | 3.3E-02 | 1.7E-01 | 3.7E-01 | 1.2E-02 | 1.7E-04 | 2.2E+00 | 3.7E-04 | 6.8E-01 | 1.0E+00 | 4.4E-02 | 9.0E+00 | 4.9E-03 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 3.7E-01 | 5.2E-02 | 3.3E-02 | 1.7E-01 | 3.7E-01 | 1.2E-02 | 1.7E-04 | 2.2E+00 | 3.7E-04 | 6.8E-01 | 1.0E+00 | 4.4E-02 | 7.7E-01 | 5.7E-02 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 1.3E+01 | 1.8E+00 | 3.3E-02 | 6.7E-02 | 1.3E+01 | 4.3E-01 | 1.7E-04 | 1.9E+02 | 3.2E-02 | 6.8E-01 | 1.0E+00 | 1.5E+00 | 5.8E+01 | 2.6E-02 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 1.3E+01 | 1.8E+00 | 3.3E-02 | 6.7E-02 | 1.3E+01 | 4.3E-01 | 1.7E-04 | 1.9E+02 | 3.2E-02 | 6.8E-01 | 1.0E+00 | 1.5E+00 | 2.4E+00 | 6.3E-01 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 2.7E+01 | 3.9E+00 | 3.3E-02 | 9.0E-02 | 2.7E+01 | 9.1E-01 | 1.7E-04 | 3.1E+02 | 5.0E-02 | 6.8E-01 | 1.0E+00 | 3.3E+00 | 1.9E+02 | 1.7E-02 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 2.7E+01 | 3.9E+00 | 3.3E-02 | 9.0E-02 | 2.7E+01 | 9.1E-01 | 1.7E-04 | 3.1E+02 | 5.0E-02 | 6.8E-01 | 1.0E+00 | 3.3E+00 | 4.7E+00 | 6.9E-01 | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 6.6E-02 | 9.3E-03 | 3.3E-02 | 2.1E-01 | 6.6E-02 | 2.2E-03 | 1.7E-04 | 3.2E-01 | 5.3E-05 | 6.8E-01 | 1.0E+00 | 7.8E-03 | 4.0E+00 | 1.9E-03 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 6.6E-02 | 9.3E-03 | 3.3E-02 | 2.1E-01 | 6.6E-02 | 2.2E-03 | 1.7E-04 | 3.2E-01 | 5.3E-05 | 6.8E-01 | 1.0E+00 | 7.8E-03 | 2.5E-01 | 3.1E-02 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | ---[13] | ---[13] | 3.3E-02 | 9.5E-01 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 6.8E-01 | 1.0E+00 | ---[13] | 6.6E-01 | ---[13] | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | ---[13] | ---[13] | 3.3E-02 | 9.5E-01 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 6.8E-01 | 1.0E+00 | ---[13] | 1.4E-01 | ---[13] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.8E+02 | 4.0E+01 | 3.3E-02 | 2.7E-01 | 2.8E+02 | 9.3E+00 | 1.7E-04 | 1.0E+03 | 1.7E-01 | 6.8E-01 | 1.0E+00 | 3.3E+01 | 3.0E+02 | 1.1E-01 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.8E+02 | 4.0E+01 | 3.3E-02 | 2.7E-01 | 2.8E+02 | 9.3E+00 | 1.7E-04 | 1.0E+03 | 1.7E-01 | 6.8E-01 | 1.0E+00 | 3.3E+01 | 7.5E+01 | 4.4E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 5.0E-01 | 7.0E-02 | 3.3E-02 | 3.4E+00 | 3.7E-01 | 1.2E-02 | 1.7E-04 | 2.5E-01 | 4.1E-05 | 6.8E-01 | 1.0E+00 | 5.6E-02 | 1.3E+00 | 4.4E-02 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 5.0E-01 | 7.0E-02 | 3.3E-02 | 3.4E+00 | 3.7E-01 | 1.2E-02 | 1.7E-04 | 2.5E-01 | 4.1E-05 | 6.8E-01 | 1.0E+00 | 5.6E-02 | 3.6E-01 | 1.5E-01 | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 5.3E-02 | 7.4E-03 | 3.3E-02 | 8.7E-01 | 6.6E-03 | 2.2E-04 | 1.7E-04 | 1.7E-02 | 2.8E-06 | 6.8E-01 | 1.0E+00 | 5.2E-03 | 4.6E+00 | 1.1E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 5.3E-02 | 7.4E-03 | 3.3E-02 | 8.7E-01 | 6.6E-03 | 2.2E-04 | 1.7E-04 | 1.7E-02 | 2.8E-06 | 6.8E-01 | 1.0E+00 | 5.2E-03 | 1.5E-01 | 3.5E-02 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 1.2E-01 | 1.7E-02 | 3.3E-02 | 2.2E+00 | 1.0E-02 | 3.4E-04 | 1.7E-04 | 1.0E-02 | 1.7E-06 | 6.8E-01 | 1.0E+00 | 1.2E-02 | 4.6E+00 | 2.6E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 1.2E-01 | 1.7E-02 | 3.3E-02 | 2.2E+00 | 1.0E-02 | 3.4E-04 | 1.7E-04 | 1.0E-02 | 1.7E-06 | 6.8E-01 | 1.0E+00 | 1.2E-02 | 1.5E-01 | 8.0E-02 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 6.8E-01 | 1.0E+00 | ---[13] | 4.6E+00 | ---[13] | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 6.8E-01 | 1.0E+00 | ---[13] | 1.5E-01 | ---[13] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 6.8E-01 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 6.8E-01 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 6.8E-01 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 6.8E-01 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |

## TABLE E-18: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-B, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 1.3E+01 | 1.9E+00 | 3.3E-02 | 3.7E-01 | 9.2E+00 | 3.1E-01 | 1.7E-04 | 5.6E+01 | 9.2E-03 | 6.8E-01 | 1.0E+00 | 1.5E+00 | 3.6E+02 | 4.2E-03 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 1.3E+01 | 1.9E+00 | 3.3E-02 | 3.7E-01 | 9.2E+00 | 3.1E-01 | 1.7E-04 | 5.6E+01 | 9.2E-03 | 6.8E-01 | 1.0E+00 | 1.5E+00 | 6.6E+01 | 2.3E-02 | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 1.3E+01 | 1.8E+00 | 3.3E-02 | 3.4E-01 | 7.7E+00 | 2.6E-01 | 1.7E-04 | 5.2E+01 | 8.6E-03 | 6.8E-01 | 1.0E+00 | 1.4E+00 | 3.8E+01 | 3.6E-02 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 1.3E+01 | 1.8E+00 | 3.3E-02 | 3.4E-01 | 7.7E+00 | 2.6E-01 | 1.7E-04 | 5.2E+01 | 8.6E-03 | 6.8E-01 | 1.0E+00 | 1.4E+00 | 6.2E-01 | **2.2E+00** | EPA 2007c |

**Notes:**

1 See Table E-2 for total prey ingestion rate calculation.

2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2).

3 Sources of BSAFs are described in Table E-3.

4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.
For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.

5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).

6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-2.

7 EPC of all site-collected sediment samples were used (see Table E-2).

8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).

9 See Table E-2 for basis of body weight.

10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.

11 The source of TRVs is described in Table E-4.

12 HQs were calculated using the following equation: HQ = total daily dose/TRV.

13 No sediment concentration.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

| TABLE E-19: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio | | | | | | | | | | | | | | | | | | |
| **Section OC-C, EPC** | | | | | | | | | | | | | | | | | | |
| **COPEC** | **Total Prey Ingestion Rate[1] (kg/day)** | **Fish Ingestion Rate[2] (kg/day)** | **Fish BSAF[3] (unitless)** | **Fish Concentration[4] (mg/kg)** | **Fish Daily Dose[5] (mg/day)** | **Invertebrate Ingestion Rate[2] (kg/day)** | **Invertebrate BSAF[3,5] (unitless)** | **Invertebrate Concentration[4] (mg/kg)** | **Invertebrate Daily Dose[5] (mg/day)** | **Sediment Ingestion Rate[6] (kg/day)** | **Sediment Concentration[7] (mg/kg)** | **Sediment Daily Dose[8] (mg/day)** | **SUF** | **Body Weight[9] (kg)** | **Total Daily Dose[10] (mg/kg/day)** | **TRV[11] (mg/kg/day)** | **HQ[12] (based on adjusted TRV)** | **Source of TRV** |
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 1.2E+01 | 5.9E-01 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 3.9E-01 | 5.9E-04 | 6.3E+01 | 3.7E-02 | 1.0E+00 | 1.5E-01 | 6.9E+00 | 1.7E+01 | 4.0E-01 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 1.2E+01 | 5.9E-01 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 3.9E-01 | 5.9E-04 | 6.3E+01 | 3.7E-02 | 1.0E+00 | 1.5E-01 | 6.9E+00 | 2.2E+00 | **3.1E+00** | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 1.1E+02 | 5.6E+00 | 3.3E-02 | 4.0E-01 | 1.1E+02 | 3.7E+00 | 5.9E-04 | 2.8E+02 | 1.7E-01 | 1.0E+00 | 1.5E-01 | 6.5E+01 | NA | ---[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 1.1E+02 | 5.6E+00 | 3.3E-02 | 4.0E-01 | 1.1E+02 | 3.7E+00 | 5.9E-04 | 2.8E+02 | 1.7E-01 | 1.0E+00 | 1.5E-01 | 6.5E+01 | NA | ---[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 3.2E-01 | 1.6E-02 | 3.3E-02 | 1.7E-01 | 3.2E-01 | 1.1E-02 | 5.9E-04 | 1.9E+00 | 1.1E-03 | 1.0E+00 | 1.5E-01 | 1.9E-01 | 6.3E+00 | 3.0E-02 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 3.2E-01 | 1.6E-02 | 3.3E-02 | 1.7E-01 | 3.2E-01 | 1.1E-02 | 5.9E-04 | 1.9E+00 | 1.1E-03 | 1.0E+00 | 1.5E-01 | 1.9E-01 | 1.5E+00 | 1.3E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 2.0E+01 | 1.0E+00 | 3.3E-02 | 6.7E-02 | 2.0E+01 | 6.7E-01 | 5.9E-04 | 3.0E+02 | 1.8E-01 | 1.0E+00 | 1.5E-01 | 1.3E+01 | 1.6E+01 | 8.1E-01 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 2.0E+01 | 1.0E+00 | 3.3E-02 | 6.7E-02 | 2.0E+01 | 6.7E-01 | 5.9E-04 | 3.0E+02 | 1.8E-01 | 1.0E+00 | 1.5E-01 | 1.3E+01 | 2.7E+00 | **4.8E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 2.7E+01 | 1.4E+00 | 3.3E-02 | 9.0E-02 | 2.7E+01 | 9.1E-01 | 5.9E-04 | 3.0E+02 | 1.8E-01 | 1.0E+00 | 1.5E-01 | 1.7E+01 | 4.5E+01 | 3.8E-01 | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 2.7E+01 | 1.4E+00 | 3.3E-02 | 9.0E-02 | 2.7E+01 | 9.1E-01 | 5.9E-04 | 3.0E+02 | 1.8E-01 | 1.0E+00 | 1.5E-01 | 1.7E+01 | 1.6E+00 | **1.0E+01** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 8.7E-02 | 4.4E-03 | 3.3E-02 | 2.1E-01 | 8.7E-02 | 2.9E-03 | 5.9E-04 | 4.3E-01 | 2.5E-04 | 1.0E+00 | 1.5E-01 | 5.1E-02 | 1.8E-01 | 2.8E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 8.7E-02 | 4.4E-03 | 3.3E-02 | 2.1E-01 | 8.7E-02 | 2.9E-03 | 5.9E-04 | 4.3E-01 | 2.5E-04 | 1.0E+00 | 1.5E-01 | 5.1E-02 | 3.9E-02 | **1.3E+00** | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 3.1E+00 | 1.6E-01 | 3.3E-02 | 9.5E-01 | 3.1E+00 | 1.0E-01 | 5.9E-04 | 3.3E+00 | 1.9E-03 | 1.0E+00 | 1.5E-01 | 1.8E+00 | 9.1E-01 | **2.0E+00** | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | 3.1E+00 | 1.6E-01 | 3.3E-02 | 9.5E-01 | 3.1E+00 | 1.0E-01 | 5.9E-04 | 3.3E+00 | 1.9E-03 | 1.0E+00 | 1.5E-01 | 1.8E+00 | 2.9E-01 | **6.2E+00** | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 1.4E+02 | 7.0E+00 | 3.3E-02 | 2.7E-01 | 1.4E+02 | 4.6E+00 | 5.9E-04 | 5.2E+02 | 3.0E-01 | 1.0E+00 | 1.5E-01 | 8.1E+01 | 1.4E+02 | 5.9E-01 | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 1.4E+02 | 7.0E+00 | 3.3E-02 | 2.7E-01 | 1.4E+02 | 4.6E+00 | 5.9E-04 | 5.2E+02 | 3.0E-01 | 1.0E+00 | 1.5E-01 | 8.1E+01 | 6.6E+01 | **1.2E+00** | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 3.0E+01 | 1.5E+00 | 3.3E-02 | 3.4E+00 | 2.2E+01 | 7.2E-01 | 5.9E-04 | 1.1E+01 | 6.7E-03 | 1.0E+00 | 1.5E-01 | 1.5E+01 | 1.3E+00 | **1.2E+01** | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 3.0E+01 | 1.5E+00 | 3.3E-02 | 3.4E+00 | 2.2E+01 | 7.2E-01 | 5.9E-04 | 1.1E+01 | 6.7E-03 | 1.0E+00 | 1.5E-01 | 1.5E+01 | 9.0E-02 | **1.7E+02** | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 7.4E-02 | 3.7E-03 | 3.3E-02 | 8.7E-01 | 9.3E-03 | 3.1E-04 | 5.9E-04 | 1.9E-02 | 1.1E-05 | 1.0E+00 | 1.5E-01 | 2.7E-02 | 2.6E+00 | 1.0E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 7.4E-02 | 3.7E-03 | 3.3E-02 | 8.7E-01 | 9.3E-03 | 3.1E-04 | 5.9E-04 | 1.9E-02 | 1.1E-05 | 1.0E+00 | 1.5E-01 | 2.7E-02 | 2.3E-01 | 1.2E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 1.5E-01 | 7.7E-03 | 3.3E-02 | 2.2E+00 | 1.3E-02 | 4.2E-04 | 5.9E-04 | 1.0E-02 | 5.9E-06 | 1.0E+00 | 1.5E-01 | 5.5E-02 | 2.6E+00 | 2.1E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 1.5E-01 | 7.7E-03 | 3.3E-02 | 2.2E+00 | 1.3E-02 | 4.2E-04 | 5.9E-04 | 1.0E-02 | 5.9E-06 | 1.0E+00 | 1.5E-01 | 5.5E-02 | 2.3E-01 | 2.4E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.6E+00 | ---[15] | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.3E-01 | ---[15] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |

## TABLE E-19: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-C, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 1.1E+01 | 5.6E-01 | 3.3E-02 | 3.7E-01 | 7.6E+00 | 2.5E-01 | 5.9E-04 | 3.6E+01 | 2.1E-02 | 1.0E+00 | 1.5E-01 | 5.7E+00 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 1.1E+01 | 5.6E-01 | 3.3E-02 | 3.7E-01 | 7.6E+00 | 2.5E-01 | 5.9E-04 | 3.6E+01 | 2.1E-02 | 1.0E+00 | 1.5E-01 | 5.7E+00 | NA | ---[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 5.5E+00 | 2.8E-01 | 3.3E-02 | 3.4E-01 | 3.4E+00 | 1.1E-01 | 5.9E-04 | 1.8E+01 | 1.0E-02 | 1.0E+00 | 1.5E-01 | 2.7E+00 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 5.5E+00 | 2.8E-01 | 3.3E-02 | 3.4E-01 | 3.4E+00 | 1.1E-01 | 5.9E-04 | 1.8E+01 | 1.0E-02 | 1.0E+00 | 1.5E-01 | 2.7E+00 | NA | ---[14] | EPA 2007c |

**Notes:**

1 See Table E-1 for total prey ingestion rate calculation.
2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1).
3 Sources of BSAFs are described in Table E-3.
4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.
For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.
5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).
6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1.
7 EPC of all site-collected sediment samples were used (see Table E-1).
8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).
9 See Table E-1 for basis of body weight.
10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.
11 The source of TRVs is described in Table E-4.
12 HQs were calculated using the following equation: HQ = total daily dose/TRV.
13 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.
14 No TRV value available; therefore, a HQ could not be calculated.
15 No sediment concentration.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 1999. Screaning Level Ecological Risk Assessment Protocols for Combustion Facilities. Peer Review Draft. Office of Solid Waste and Emergency Response. EPA530-D99-001A. September.

EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

## TABLE E-20: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-C, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 1.2E+01 | 1.7E+00 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 3.9E-01 | 1.7E-04 | 6.3E+01 | 1.0E-02 | 1.0E+00 | 1.0E+00 | 2.1E+00 | 4.6E+00 | 4.5E-01 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 1.2E+01 | 1.7E+00 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 3.9E-01 | 1.7E-04 | 6.3E+01 | 1.0E-02 | 1.0E+00 | 1.0E+00 | 2.1E+00 | 3.2E-01 | **6.4E+00** | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 1.1E+02 | 1.6E+01 | 3.3E-02 | 4.0E-01 | 1.1E+02 | 3.7E+00 | 1.7E-04 | 2.8E+02 | 4.6E-02 | 1.0E+00 | 1.0E+00 | 2.0E+01 | 2.7E+02 | 7.3E-02 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 1.1E+02 | 1.6E+01 | 3.3E-02 | 4.0E-01 | 1.1E+02 | 3.7E+00 | 1.7E-04 | 2.8E+02 | 4.6E-02 | 1.0E+00 | 1.0E+00 | 2.0E+01 | 5.2E+01 | 3.8E-01 | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 3.2E-01 | 4.6E-02 | 3.3E-02 | 1.7E-01 | 3.2E-01 | 1.1E-02 | 1.7E-04 | 1.9E+00 | 3.2E-04 | 1.0E+00 | 1.0E+00 | 5.7E-02 | 9.0E+00 | 6.3E-03 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 3.2E-01 | 4.6E-02 | 3.3E-02 | 1.7E-01 | 3.2E-01 | 1.1E-02 | 1.7E-04 | 1.9E+00 | 3.2E-04 | 1.0E+00 | 1.0E+00 | 5.7E-02 | 7.7E-01 | 7.4E-02 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 2.0E+01 | 2.8E+00 | 3.3E-02 | 6.7E-02 | 2.0E+01 | 6.7E-01 | 1.7E-04 | 3.0E+02 | 5.0E-02 | 1.0E+00 | 1.0E+00 | 3.6E+00 | 5.8E+01 | 6.1E-02 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 2.0E+01 | 2.8E+00 | 3.3E-02 | 6.7E-02 | 2.0E+01 | 6.7E-01 | 1.7E-04 | 3.0E+02 | 5.0E-02 | 1.0E+00 | 1.0E+00 | 3.6E+00 | 2.4E+00 | **1.5E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 2.7E+01 | 3.8E+00 | 3.3E-02 | 9.0E-02 | 2.7E+01 | 9.1E-01 | 1.7E-04 | 3.0E+02 | 5.0E-02 | 1.0E+00 | 1.0E+00 | 4.8E+00 | 1.9E+02 | 2.6E-02 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 2.7E+01 | 3.8E+00 | 3.3E-02 | 9.0E-02 | 2.7E+01 | 9.1E-01 | 1.7E-04 | 3.0E+02 | 5.0E-02 | 1.0E+00 | 1.0E+00 | 4.8E+00 | 4.7E+00 | **1.0E+00** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 8.7E-02 | 1.2E-02 | 3.3E-02 | 2.1E-01 | 8.7E-02 | 2.9E-03 | 1.7E-04 | 4.3E-01 | 7.1E-05 | 1.0E+00 | 1.0E+00 | 1.5E-02 | 4.0E+00 | 3.8E-03 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 8.7E-02 | 1.2E-02 | 3.3E-02 | 2.1E-01 | 8.7E-02 | 2.9E-03 | 1.7E-04 | 4.3E-01 | 7.1E-05 | 1.0E+00 | 1.0E+00 | 1.5E-02 | 2.5E-01 | 6.1E-02 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 3.1E+00 | 4.4E-01 | 3.3E-02 | 9.5E-01 | 3.1E+00 | 1.0E-01 | 1.7E-04 | 3.3E+00 | 5.4E-04 | 1.0E+00 | 1.0E+00 | 5.5E-01 | 6.6E-01 | 8.3E-01 | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | 3.1E+00 | 4.4E-01 | 3.3E-02 | 9.5E-01 | 3.1E+00 | 1.0E-01 | 1.7E-04 | 3.3E+00 | 5.4E-04 | 1.0E+00 | 1.0E+00 | 5.5E-01 | 1.4E-01 | **3.8E+00** | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 1.4E+02 | 2.0E+01 | 3.3E-02 | 2.7E-01 | 1.4E+02 | 4.6E+00 | 1.7E-04 | 5.2E+02 | 8.5E-02 | 1.0E+00 | 1.0E+00 | 2.4E+01 | 3.0E+02 | 8.2E-02 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 1.4E+02 | 2.0E+01 | 3.3E-02 | 2.7E-01 | 1.4E+02 | 4.6E+00 | 1.7E-04 | 5.2E+02 | 8.5E-02 | 1.0E+00 | 1.0E+00 | 2.4E+01 | 7.5E+01 | 3.2E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 3.0E+01 | 4.2E+00 | 3.3E-02 | 3.4E+00 | 2.2E+01 | 7.2E-01 | 1.7E-04 | 1.1E+01 | 1.9E-03 | 1.0E+00 | 1.0E+00 | 4.9E+00 | 1.3E+00 | **3.8E+00** | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 3.0E+01 | 4.2E+00 | 3.3E-02 | 3.4E+00 | 2.2E+01 | 7.2E-01 | 1.7E-04 | 1.1E+01 | 1.9E-03 | 1.0E+00 | 1.0E+00 | 4.9E+00 | 3.6E-01 | **1.4E+01** | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 7.4E-02 | 1.0E-02 | 3.3E-02 | 8.7E-01 | 9.3E-03 | 3.1E-04 | 1.7E-04 | 1.9E-02 | 3.1E-06 | 1.0E+00 | 1.0E+00 | 1.1E-02 | 4.6E+00 | 2.3E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 7.4E-02 | 1.0E-02 | 3.3E-02 | 8.7E-01 | 9.3E-03 | 3.1E-04 | 1.7E-04 | 1.9E-02 | 3.1E-06 | 1.0E+00 | 1.0E+00 | 1.1E-02 | 1.5E-01 | 7.3E-02 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 1.5E-01 | 2.2E-02 | 3.3E-02 | 2.2E+00 | 1.3E-02 | 4.2E-04 | 1.7E-04 | 1.0E-02 | 1.6E-06 | 1.0E+00 | 1.0E+00 | 2.2E-02 | 4.6E+00 | 4.8E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 1.5E-01 | 2.2E-02 | 3.3E-02 | 2.2E+00 | 1.3E-02 | 4.2E-04 | 1.7E-04 | 1.0E-02 | 1.6E-06 | 1.0E+00 | 1.0E+00 | 2.2E-02 | 1.5E-01 | 1.5E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 4.6E+00 | ---[13] | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.5E-01 | ---[13] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |

## TABLE E-20: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-C, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 1.1E+01 | 1.6E+00 | 3.3E-02 | 3.7E-01 | 7.6E+00 | 2.5E-01 | 1.7E-04 | 3.6E+01 | 5.9E-03 | 1.0E+00 | 1.0E+00 | 1.8E+00 | 3.6E+02 | 5.1E-03 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 1.1E+01 | 1.6E+00 | 3.3E-02 | 3.7E-01 | 7.6E+00 | 2.5E-01 | 1.7E-04 | 3.6E+01 | 5.9E-03 | 1.0E+00 | 1.0E+00 | 1.8E+00 | 6.6E+01 | 2.8E-02 | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 5.5E+00 | 7.8E-01 | 3.3E-02 | 3.4E-01 | 3.4E+00 | 1.1E-01 | 1.7E-04 | 1.8E+01 | 2.9E-03 | 1.0E+00 | 1.0E+00 | 9.0E-01 | 3.8E+01 | 2.3E-02 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 5.5E+00 | 7.8E-01 | 3.3E-02 | 3.4E-01 | 3.4E+00 | 1.1E-01 | 1.7E-04 | 1.8E+01 | 2.9E-03 | 1.0E+00 | 1.0E+00 | 9.0E-01 | 6.2E-01 | **1.5E+00** | EPA 2007c |

**Notes:**

1 See Table E-2 for total prey ingestion rate calculation.
2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2).
3 Sources of BSAFs are described in Table E-3.
4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.
For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.
5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).
6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-2.
7 EPC of all site-collected sediment samples were used (see Table E-2).
8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).
9 See Table E-2 for basis of body weight.
10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.
11 The source of TRVs is described in Table E-4.
12 HQs were calculated using the following equation: HQ = total daily dose/TRV.
13 No sediment concentration.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).
EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

| TABLE E-21: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio | | | | | | | | | | | | | | | | | | |
| **Section OC-D, EPC** | | | | | | | | | | | | | | | | | | |
| **COPEC** | **Total Prey Ingestion Rate[1] (kg/day)** | **Fish Ingestion Rate[2] (kg/day)** | **Fish BSAF[3] (unitless)** | **Fish Concentration[4] (mg/kg)** | **Fish Daily Dose[5] (mg/day)** | **Invertebrate Ingestion Rate[2] (kg/day)** | **Invertebrate BSAF[3,5] (unitless)** | **Invertebrate Concentration[4] (mg/kg)** | **Invertebrate Daily Dose[5] (mg/day)** | **Sediment Ingestion Rate[6] (kg/day)** | **Sediment Concentration[7] (mg/kg)** | **Sediment Daily Dose[8] (mg/day)** | **SUF** | **Body Weight[9] (kg)** | **Total Daily Dose[10] (mg/kg/day)** | **TRV[11] (mg/kg/day)** | **HQ[12] (based on adjusted TRV)** | **Source of TRV** |
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 1.2E+01 | 6.2E-01 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 4.1E-01 | 5.9E-04 | 6.6E+01 | 3.9E-02 | 1.0E+00 | 1.5E-01 | 7.2E+00 | 1.7E+01 | 4.2E-01 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 1.2E+01 | 6.2E-01 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 4.1E-01 | 5.9E-04 | 6.6E+01 | 3.9E-02 | 1.0E+00 | 1.5E-01 | 7.2E+00 | 2.2E+00 | **3.2E+00** | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 1.0E+02 | 5.1E+00 | 3.3E-02 | 4.0E-01 | 1.0E+02 | 3.4E+00 | 5.9E-04 | 2.5E+02 | 1.5E-01 | 1.0E+00 | 1.5E-01 | 5.8E+01 | NA | ---[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 1.0E+02 | 5.1E+00 | 3.3E-02 | 4.0E-01 | 1.0E+02 | 3.4E+00 | 5.9E-04 | 2.5E+02 | 1.5E-01 | 1.0E+00 | 1.5E-01 | 5.8E+01 | NA | ---[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 4.0E-01 | 2.0E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 5.9E-04 | 2.4E+00 | 1.4E-03 | 1.0E+00 | 1.5E-01 | 2.4E-01 | 6.3E+00 | 3.8E-02 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 4.0E-01 | 2.0E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 5.9E-04 | 2.4E+00 | 1.4E-03 | 1.0E+00 | 1.5E-01 | 2.4E-01 | 1.5E+00 | 1.6E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 7.1E+00 | 3.6E-01 | 3.3E-02 | 6.7E-02 | 7.1E+00 | 2.4E-01 | 5.9E-04 | 1.1E+02 | 6.2E-02 | 1.0E+00 | 1.5E-01 | 4.5E+00 | 1.6E+01 | 2.9E-01 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 7.1E+00 | 3.6E-01 | 3.3E-02 | 6.7E-02 | 7.1E+00 | 2.4E-01 | 5.9E-04 | 1.1E+02 | 6.2E-02 | 1.0E+00 | 1.5E-01 | 4.5E+00 | 2.7E+00 | **1.7E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.1E+01 | 1.6E+00 | 3.3E-02 | 9.0E-02 | 3.1E+01 | 1.0E+00 | 5.9E-04 | 3.5E+02 | 2.1E-01 | 1.0E+00 | 1.5E-01 | 1.9E+01 | 4.5E+01 | 4.3E-01 | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.1E+01 | 1.6E+00 | 3.3E-02 | 9.0E-02 | 3.1E+01 | 1.0E+00 | 5.9E-04 | 3.5E+02 | 2.1E-01 | 1.0E+00 | 1.5E-01 | 1.9E+01 | 1.6E+00 | **1.2E+01** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 3.1E-02 | 1.5E-03 | 3.3E-02 | 2.1E-01 | 3.1E-02 | 1.0E-03 | 5.9E-04 | 1.5E-01 | 8.8E-05 | 1.0E+00 | 1.5E-01 | 1.8E-02 | 1.8E-01 | 1.0E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 3.1E-02 | 1.5E-03 | 3.3E-02 | 2.1E-01 | 3.1E-02 | 1.0E-03 | 5.9E-04 | 1.5E-01 | 8.8E-05 | 1.0E+00 | 1.5E-01 | 1.8E-02 | 3.9E-02 | 4.6E-01 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | ---[15] | ---[15] | 3.3E-02 | 9.5E-01 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 9.1E-01 | ---[15] | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | ---[15] | ---[15] | 3.3E-02 | 9.5E-01 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.9E-01 | ---[15] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.6E+02 | 1.3E+01 | 3.3E-02 | 2.7E-01 | 2.6E+02 | 8.5E+00 | 5.9E-04 | 9.5E+02 | 5.6E-01 | 1.0E+00 | 1.5E-01 | 1.5E+02 | 1.4E+02 | **1.1E+00** | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 2.6E+02 | 1.3E+01 | 3.3E-02 | 2.7E-01 | 2.6E+02 | 8.5E+00 | 5.9E-04 | 9.5E+02 | 5.6E-01 | 1.0E+00 | 1.5E-01 | 1.5E+02 | 6.6E+01 | **2.2E+00** | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 7.0E-01 | 3.5E-02 | 3.3E-02 | 3.4E+00 | 5.2E-01 | 1.7E-02 | 5.9E-04 | 2.3E-01 | 1.3E-04 | 1.0E+00 | 1.5E-01 | 3.6E-01 | 1.3E+00 | 2.8E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 7.0E-01 | 3.5E-02 | 3.3E-02 | 3.4E+00 | 5.2E-01 | 1.7E-02 | 5.9E-04 | 2.3E-01 | 1.3E-04 | 1.0E+00 | 1.5E-01 | 3.6E-01 | 9.0E-02 | **4.0E+00** | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 1.7E-01 | 8.4E-03 | 3.3E-02 | 8.7E-01 | 2.1E-02 | 7.0E-04 | 5.9E-04 | 3.6E-02 | 2.1E-05 | 1.0E+00 | 1.5E-01 | 6.2E-02 | 2.6E+00 | 2.4E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 1.7E-01 | 8.4E-03 | 3.3E-02 | 8.7E-01 | 2.1E-02 | 7.0E-04 | 5.9E-04 | 3.6E-02 | 2.1E-05 | 1.0E+00 | 1.5E-01 | 6.2E-02 | 2.3E-01 | 2.7E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 3.8E-01 | 1.9E-02 | 3.3E-02 | 2.2E+00 | 3.2E-02 | 1.1E-03 | 5.9E-04 | 2.1E-02 | 1.2E-05 | 1.0E+00 | 1.5E-01 | 1.4E-01 | 2.6E+00 | 5.2E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 3.8E-01 | 1.9E-02 | 3.3E-02 | 2.2E+00 | 3.2E-02 | 1.1E-03 | 5.9E-04 | 2.1E-02 | 1.2E-05 | 1.0E+00 | 1.5E-01 | 1.4E-01 | 2.3E-01 | 6.0E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.6E+00 | ---[15] | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.3E-01 | ---[15] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |

| TABLE E-21: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio | | | | | | | | | | | | | | | | | | |
| **Section OC-D, EPC** | | | | | | | | | | | | | | | | | | |
| **COPEC** | **Total Prey Ingestion Rate[1] (kg/day)** | **Fish Ingestion Rate[2] (kg/day)** | **Fish BSAF[3] (unitless)** | **Fish Concentration[4] (mg/kg)** | **Fish Daily Dose[5] (mg/day)** | **Invertebrate Ingestion Rate[2] (kg/day)** | **Invertebrate BSAF[3,5] (unitless)** | **Invertebrate Concentration[4] (mg/kg)** | **Invertebrate Daily Dose[5] (mg/day)** | **Sediment Ingestion Rate[6] (kg/day)** | **Sediment Concentration[7] (mg/kg)** | **Sediment Daily Dose[8] (mg/day)** | **SUF** | **Body Weight[9] (kg)** | **Total Daily Dose[10] (mg/kg/day)** | **TRV[11] (mg/kg/day)** | **HQ[12] (based on adjusted TRV)** | **Source of TRV** |
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 4.9E+01 | 2.5E+00 | 3.3E-02 | 3.7E-01 | 3.3E+01 | 1.1E+00 | 5.9E-04 | 1.3E+02 | 7.8E-02 | 1.0E+00 | 1.5E-01 | 2.5E+01 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 4.9E+01 | 2.5E+00 | 3.3E-02 | 3.7E-01 | 3.3E+01 | 1.1E+00 | 5.9E-04 | 1.3E+02 | 7.8E-02 | 1.0E+00 | 1.5E-01 | 2.5E+01 | NA | ---[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 4.3E+01 | 2.1E+00 | 3.3E-02 | 3.4E-01 | 2.6E+01 | 8.8E-01 | 5.9E-04 | 1.2E+02 | 6.8E-02 | 1.0E+00 | 1.5E-01 | 2.1E+01 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 4.3E+01 | 2.1E+00 | 3.3E-02 | 3.4E-01 | 2.6E+01 | 8.8E-01 | 5.9E-04 | 1.2E+02 | 6.8E-02 | 1.0E+00 | 1.5E-01 | 2.1E+01 | NA | ---[14] | EPA 2007c |

**Notes:**

| | |
|---|---|
| 1 | See Table E-1 for total prey ingestion rate calculation. |
| 2 | The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1). |
| 3 | Sources of BSAFs are described in Table E-3. |
| 4 | The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF. |
| | For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates. |
| 5 | Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4). |
| 6 | Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1. |
| 7 | EPC of all site-collected sediment samples were used (see Table E-1). |
| 8 | Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7). |
| 9 | See Table E-1 for basis of body weight. |
| 10 | Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight. |
| 11 | The source of TRVs is described in Table E-4. |
| 12 | HQs were calculated using the following equation: HQ = total daily dose/TRV. |
| 13 | Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively. |
| 14 | No TRV value available; therefore, a HQ could not be calculated. |
| 15 | No sediment concentration. |

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


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EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

## TABLE E-22: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-D, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 1.2E+01 | 1.7E+00 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 4.1E-01 | 1.7E-04 | 6.6E+01 | 1.1E-02 | 8.4E-01 | 1.0E+00 | 1.8E+00 | 4.6E+00 | 3.9E-01 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 1.2E+01 | 1.7E+00 | 3.3E-02 | 1.9E-01 | 1.2E+01 | 4.1E-01 | 1.7E-04 | 6.6E+01 | 1.1E-02 | 8.4E-01 | 1.0E+00 | 1.8E+00 | 3.2E-01 | **5.7E+00** | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 1.0E+02 | 1.4E+01 | 3.3E-02 | 4.0E-01 | 1.0E+02 | 3.4E+00 | 1.7E-04 | 2.5E+02 | 4.2E-02 | 8.4E-01 | 1.0E+00 | 1.5E+01 | 2.7E+02 | 5.5E-02 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 1.0E+02 | 1.4E+01 | 3.3E-02 | 4.0E-01 | 1.0E+02 | 3.4E+00 | 1.7E-04 | 2.5E+02 | 4.2E-02 | 8.4E-01 | 1.0E+00 | 1.5E+01 | 5.2E+01 | 2.9E-01 | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 4.0E-01 | 5.6E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 1.7E-04 | 2.4E+00 | 4.0E-04 | 8.4E-01 | 1.0E+00 | 5.9E-02 | 9.0E+00 | 6.6E-03 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 4.0E-01 | 5.6E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 1.7E-04 | 2.4E+00 | 4.0E-04 | 8.4E-01 | 1.0E+00 | 5.9E-02 | 7.7E-01 | 7.7E-02 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 7.1E+00 | 1.0E+00 | 3.3E-02 | 6.7E-02 | 7.1E+00 | 2.4E-01 | 1.7E-04 | 1.1E+02 | 1.8E-02 | 8.4E-01 | 1.0E+00 | 1.1E+00 | 5.8E+01 | 1.8E-02 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 7.1E+00 | 1.0E+00 | 3.3E-02 | 6.7E-02 | 7.1E+00 | 2.4E-01 | 1.7E-04 | 1.1E+02 | 1.8E-02 | 8.4E-01 | 1.0E+00 | 1.1E+00 | 2.4E+00 | 4.4E-01 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.1E+01 | 4.4E+00 | 3.3E-02 | 9.0E-02 | 3.1E+01 | 1.0E+00 | 1.7E-04 | 3.5E+02 | 5.8E-02 | 8.4E-01 | 1.0E+00 | 4.6E+00 | 1.9E+02 | 2.5E-02 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.1E+01 | 4.4E+00 | 3.3E-02 | 9.0E-02 | 3.1E+01 | 1.0E+00 | 1.7E-04 | 3.5E+02 | 5.8E-02 | 8.4E-01 | 1.0E+00 | 4.6E+00 | 4.7E+00 | 9.9E-01 | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 3.1E-02 | 4.3E-03 | 3.3E-02 | 2.1E-01 | 3.1E-02 | 1.0E-03 | 1.7E-04 | 1.5E-01 | 2.5E-05 | 8.4E-01 | 1.0E+00 | 4.5E-03 | 4.0E+00 | 1.1E-03 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 3.1E-02 | 4.3E-03 | 3.3E-02 | 2.1E-01 | 3.1E-02 | 1.0E-03 | 1.7E-04 | 1.5E-01 | 2.5E-05 | 8.4E-01 | 1.0E+00 | 4.5E-03 | 2.5E-01 | 1.8E-02 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | ---[13] | ---[13] | 3.3E-02 | 9.5E-01 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 8.4E-01 | 1.0E+00 | ---[13] | 6.6E-01 | ---[13] | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | ---[13] | ---[13] | 3.3E-02 | 9.5E-01 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 8.4E-01 | 1.0E+00 | ---[13] | 1.4E-01 | ---[13] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.6E+02 | 3.6E+01 | 3.3E-02 | 2.7E-01 | 2.6E+02 | 8.5E+00 | 1.7E-04 | 9.5E+02 | 1.6E-01 | 8.4E-01 | 1.0E+00 | 3.8E+01 | 3.0E+02 | 1.3E-01 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 2.6E+02 | 3.6E+01 | 3.3E-02 | 2.7E-01 | 2.6E+02 | 8.5E+00 | 1.7E-04 | 9.5E+02 | 1.6E-01 | 8.4E-01 | 1.0E+00 | 3.8E+01 | 7.5E+01 | 5.0E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 7.0E-01 | 9.9E-02 | 3.3E-02 | 3.4E+00 | 5.2E-01 | 1.7E-02 | 1.7E-04 | 2.3E-01 | 3.8E-05 | 8.4E-01 | 1.0E+00 | 9.8E-02 | 1.3E+00 | 7.6E-02 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 7.0E-01 | 9.9E-02 | 3.3E-02 | 3.4E+00 | 5.2E-01 | 1.7E-02 | 1.7E-04 | 2.3E-01 | 3.8E-05 | 8.4E-01 | 1.0E+00 | 9.8E-02 | 3.6E-01 | 2.7E-01 | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 1.7E-01 | 2.4E-02 | 3.3E-02 | 8.7E-01 | 2.1E-02 | 7.0E-04 | 1.7E-04 | 3.6E-02 | 5.9E-06 | 8.4E-01 | 1.0E+00 | 2.0E-02 | 4.6E+00 | 4.5E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 1.7E-01 | 2.4E-02 | 3.3E-02 | 8.7E-01 | 2.1E-02 | 7.0E-04 | 1.7E-04 | 3.6E-02 | 5.9E-06 | 8.4E-01 | 1.0E+00 | 2.0E-02 | 1.5E-01 | 1.4E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 3.8E-01 | 5.3E-02 | 3.3E-02 | 2.2E+00 | 3.2E-02 | 1.1E-03 | 1.7E-04 | 2.1E-02 | 3.5E-06 | 8.4E-01 | 1.0E+00 | 4.6E-02 | 4.6E+00 | 1.0E-02 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 3.8E-01 | 5.3E-02 | 3.3E-02 | 2.2E+00 | 3.2E-02 | 1.1E-03 | 1.7E-04 | 2.1E-02 | 3.5E-06 | 8.4E-01 | 1.0E+00 | 4.6E-02 | 1.5E-01 | 3.1E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 8.4E-01 | 1.0E+00 | ---[13] | 4.6E+00 | ---[13] | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 8.4E-01 | 1.0E+00 | ---[13] | 1.5E-01 | ---[13] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 8.4E-01 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 8.4E-01 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 8.4E-01 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 8.4E-01 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |

## TABLE E-22: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-D, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 4.9E+01 | 6.9E+00 | 3.3E-02 | 3.7E-01 | 3.3E+01 | 1.1E+00 | 1.7E-04 | 1.3E+02 | 2.2E-02 | 8.4E-01 | 1.0E+00 | 6.8E+00 | 3.6E+02 | 1.9E-02 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 4.9E+01 | 6.9E+00 | 3.3E-02 | 3.7E-01 | 3.3E+01 | 1.1E+00 | 1.7E-04 | 1.3E+02 | 2.2E-02 | 8.4E-01 | 1.0E+00 | 6.8E+00 | 6.6E+01 | 1.0E-01 | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 4.3E+01 | 6.0E+00 | 3.3E-02 | 3.4E-01 | 2.6E+01 | 8.8E-01 | 1.7E-04 | 1.2E+02 | 1.9E-02 | 8.4E-01 | 1.0E+00 | 5.8E+00 | 3.8E+01 | 1.5E-01 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 4.3E+01 | 6.0E+00 | 3.3E-02 | 3.4E-01 | 2.6E+01 | 8.8E-01 | 1.7E-04 | 1.2E+02 | 1.9E-02 | 8.4E-01 | 1.0E+00 | 5.8E+00 | 6.2E-01 | **9.5E+00** | EPA 2007c |

**Notes:**

| | |
|---|---|
| 1 | See Table E-2 for total prey ingestion rate calculation. |
| 2 | The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2). |
| 3 | Sources of BSAFs are described in Table E-3. |
| 4 | The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF. |
| | For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates. |
| 5 | Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4). |
| 6 | Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-2. |
| 7 | EPC of all site-collected sediment samples were used (see Table E-2). |
| 8 | Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7). |
| 9 | See Table E-2 for basis of body weight. |
| 10 | Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight. |
| 11 | The source of TRVs is described in Table E-4. |
| 12 | HQs were calculated using the following equation: HQ = total daily dose/TRV. |
| 13 | No sediment concentration. |

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

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EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

## TABLE E-23: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-E, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 9.5E+00 | 4.8E-01 | 3.3E-02 | 1.9E-01 | 9.5E+00 | 3.2E-01 | 5.9E-04 | 5.1E+01 | 3.0E-02 | 1.0E+00 | 1.5E-01 | 5.6E+00 | 1.7E+01 | 3.2E-01 | EPA 2005a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.9E-01 | 9.5E+00 | 4.8E-01 | 3.3E-02 | 1.9E-01 | 9.5E+00 | 3.2E-01 | 5.9E-04 | 5.1E+01 | 3.0E-02 | 1.0E+00 | 1.5E-01 | 5.6E+00 | 2.2E+00 | **2.5E+00** | EPA 2005a |
| **BARIUM[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 8.9E+01 | 4.4E+00 | 3.3E-02 | 4.0E-01 | 8.9E+01 | 2.9E+00 | 5.9E-04 | 2.2E+02 | 1.3E-01 | 1.0E+00 | 1.5E-01 | 5.1E+01 | NA | ---[14] | EPA 2005b |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 4.0E-01 | 8.9E+01 | 4.4E+00 | 3.3E-02 | 4.0E-01 | 8.9E+01 | 2.9E+00 | 5.9E-04 | 2.2E+02 | 1.3E-01 | 1.0E+00 | 1.5E-01 | 5.1E+01 | NA | ---[14] | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 4.0E-01 | 2.0E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 5.9E-04 | 2.4E+00 | 1.4E-03 | 1.0E+00 | 1.5E-01 | 2.4E-01 | 6.3E+00 | 3.8E-02 | EPA 2005c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.7E-01 | 4.0E-01 | 2.0E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 5.9E-04 | 2.4E+00 | 1.4E-03 | 1.0E+00 | 1.5E-01 | 2.4E-01 | 1.5E+00 | 1.6E-01 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 5.1E+00 | 2.6E-01 | 3.3E-02 | 6.7E-02 | 5.1E+00 | 1.7E-01 | 5.9E-04 | 7.6E+01 | 4.5E-02 | 1.0E+00 | 1.5E-01 | 3.2E+00 | 1.6E+01 | 2.0E-01 | EPA 2008 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 6.7E-02 | 5.1E+00 | 2.6E-01 | 3.3E-02 | 6.7E-02 | 5.1E+00 | 1.7E-01 | 5.9E-04 | 7.6E+01 | 4.5E-02 | 1.0E+00 | 1.5E-01 | 3.2E+00 | 2.7E+00 | **1.2E+00** | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.1E+01 | 1.6E+00 | 3.3E-02 | 9.0E-02 | 3.1E+01 | 1.0E+00 | 5.9E-04 | 3.5E+02 | 2.1E-01 | 1.0E+00 | 1.5E-01 | 1.9E+01 | 4.5E+01 | 4.3E-01 | EPA 2005d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.0E-02 | 3.1E+01 | 1.6E+00 | 3.3E-02 | 9.0E-02 | 3.1E+01 | 1.0E+00 | 5.9E-04 | 3.5E+02 | 2.1E-01 | 1.0E+00 | 1.5E-01 | 1.9E+01 | 1.6E+00 | **1.2E+01** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 3.5E-02 | 1.7E-03 | 3.3E-02 | 2.1E-01 | 3.5E-02 | 1.2E-03 | 5.9E-04 | 1.7E-01 | 1.0E-04 | 1.0E+00 | 1.5E-01 | 2.0E-02 | 1.8E-01 | 1.1E-01 | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.1E-01 | 3.5E-02 | 1.7E-03 | 3.3E-02 | 2.1E-01 | 3.5E-02 | 1.2E-03 | 5.9E-04 | 1.7E-01 | 1.0E-04 | 1.0E+00 | 1.5E-01 | 2.0E-02 | 3.9E-02 | 5.2E-01 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | ---[15] | ---[15] | 3.3E-02 | 9.5E-01 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 9.1E-01 | ---[15] | EPA 2007d |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 9.5E-01 | ---[15] | ---[15] | 3.3E-02 | 9.5E-01 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.9E-01 | ---[15] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 1.5E+02 | 7.3E+00 | 3.3E-02 | 2.7E-01 | 1.5E+02 | 4.8E+00 | 5.9E-04 | 5.4E+02 | 3.2E-01 | 1.0E+00 | 1.5E-01 | 8.5E+01 | 1.4E+02 | 6.2E-01 | EPA 2007e |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.7E-01 | 1.5E+02 | 7.3E+00 | 3.3E-02 | 2.7E-01 | 1.5E+02 | 4.8E+00 | 5.9E-04 | 5.4E+02 | 3.2E-01 | 1.0E+00 | 1.5E-01 | 8.5E+01 | 6.6E+01 | **1.3E+00** | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 5.3E+00 | 2.6E-01 | 3.3E-02 | 3.4E+00 | 3.9E+00 | 1.3E-01 | 5.9E-04 | 2.4E+00 | 1.4E-03 | 1.0E+00 | 1.5E-01 | 2.7E+00 | 1.3E+00 | **2.1E+00** | EPA 2002 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.2E+00 | 5.3E+00 | 2.6E-01 | 3.3E-02 | 3.4E+00 | 3.9E+00 | 1.3E-01 | 5.9E-04 | 2.4E+00 | 1.4E-03 | 1.0E+00 | 1.5E-01 | 2.7E+00 | 9.0E-02 | **3.0E+01** | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 1.2E-01 | 5.9E-03 | 3.3E-02 | 8.7E-01 | 1.5E-02 | 4.9E-04 | 5.9E-04 | 3.6E-02 | 2.1E-05 | 1.0E+00 | 1.5E-01 | 4.4E-02 | 2.6E+00 | 1.7E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | 1.2E-01 | 5.9E-03 | 3.3E-02 | 8.7E-01 | 1.5E-02 | 4.9E-04 | 5.9E-04 | 3.6E-02 | 2.1E-05 | 1.0E+00 | 1.5E-01 | 4.4E-02 | 2.3E-01 | 1.9E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 2.7E-01 | 1.3E-02 | 3.3E-02 | 2.2E+00 | 2.2E-02 | 7.4E-04 | 5.9E-04 | 2.1E-02 | 1.2E-05 | 1.0E+00 | 1.5E-01 | 9.6E-02 | 2.6E+00 | 3.7E-02 | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 1.3E+01 | 2.7E-01 | 1.3E-02 | 3.3E-02 | 2.2E+00 | 2.2E-02 | 7.4E-04 | 5.9E-04 | 2.1E-02 | 1.2E-05 | 1.0E+00 | 1.5E-01 | 9.6E-02 | 2.3E-01 | 4.2E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.6E+00 | ---[15] | EPA 2007a |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 7.0E-01 | ---[15] | ---[15] | 3.3E-02 | 1.3E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 2.3E-01 | ---[15] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-01 | ---[15] | EPA 1999 |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 3.3E+00 | ---[15] | ---[15] | 3.3E-02 | 1.9E+00 | ---[15] | ---[15] | 5.9E-04 | NA | ---[15] | 1.0E+00 | 1.5E-01 | ---[15] | 6.5E-02 | ---[15] | EPA 1999 |

## TABLE E-23: BELTED KINGFISHER DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-E, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 3.4E+01 | 1.7E+00 | 3.3E-02 | 3.7E-01 | 2.3E+01 | 7.8E-01 | 5.9E-04 | 1.3E+02 | 7.8E-02 | 1.0E+00 | 1.5E-01 | 1.8E+01 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 3.4E+01 | 1.7E+00 | 3.3E-02 | 3.7E-01 | 2.3E+01 | 7.8E-01 | 5.9E-04 | 1.3E+02 | 7.8E-02 | 1.0E+00 | 1.5E-01 | 1.8E+01 | NA | ---[14] | EPA 2007c |
| **HIGH MOLECULAR PAHs[13]** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 3.0E+01 | 1.5E+00 | 3.3E-02 | 3.4E-01 | 1.9E+01 | 6.2E-01 | 5.9E-04 | 1.2E+02 | 6.8E-02 | 1.0E+00 | 1.5E-01 | 1.5E+01 | NA | ---[14] | EPA 2007c |
| Dose/Low TRV | 8.4E-02 | 5.0E-02 | 2.6E-01 | 3.0E+01 | 1.5E+00 | 3.3E-02 | 3.4E-01 | 1.9E+01 | 6.2E-01 | 5.9E-04 | 1.2E+02 | 6.8E-02 | 1.0E+00 | 1.5E-01 | 1.5E+01 | NA | ---[14] | EPA 2007c |

**Notes:**

1 See Table E-1 for total prey ingestion rate calculation.
2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-1).
3 Sources of BSAFs are described in Table E-3.
4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.
For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.
5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).
6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-1.
7 EPC of all site-collected sediment samples were used (see Table E-1).
8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).
9 See Table E-1 for basis of body weight.
10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.
11 The source of TRVs is described in Table E-4.
12 HQs were calculated using the following equation: HQ = total daily dose/TRV.
13 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 1999. Screaning Level Ecological Risk Assessment Protocols for Combustion Facilities. Peer Review Draft. Office of Solid Waste and Emergency Response. EPA530-D99-001A. September.

EPA. 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002).

EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2005d. Ecological Soil Screening Levels for Lead. OSWER Directive 9285.7-70. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007a. Ecological Soil Screening Levels for DDT and Metabolites. OSWER Directive 9285.7-76. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007b. Ecological Soil Screening Levels for Nickel. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007c. Ecological Soil Screening Levels for Polynuclear Aromatic Hydrocarbons. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007d. Ecological Soil Screening Levels for Selenium. OSWER Directive 9285.7-72. July. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2007e. Ecological Soil Screening Levels for Zinc. OSWER Directive 9285.7-73. June. Available Online at: http://www.epa.gov/ecotox/ecossl/.

EPA. 2008. Ecological Soil Screening Levels for Chromium. OSWER Directive 9285.7-66. April. Available Online at: http://www.epa.gov/ecotox/ecossl/.

| TABLE E-24: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio | | | | | | | | | | | | | | | | | | |
| **Section OC-E, EPC** | | | | | | | | | | | | | | | | | | |
| **COPEC** | **Total Prey Ingestion Rate[1] (kg/day)** | **Fish Ingestion Rate[2] (kg/day)** | **Fish BSAF[3] (unitless)** | **Fish Concentration[4] (mg/kg)** | **Fish Daily Dose[5] (mg/day)** | **Invertebrate Ingestion Rate[2] (kg/day)** | **Invertebrate BSAF[3,5] (unitless)** | **Invertebrate Concentration[4] (mg/kg)** | **Invertebrate Daily Dose[5] (mg/day)** | **Sediment Ingestion Rate[6] (kg/day)** | **Sediment Concentration[7] (mg/kg)** | **Sediment Daily Dose[8] (mg/day)** | **SUF** | **Body Weight[9] (kg)** | **Total Daily Dose[10] (mg/kg/day)** | **TRV[11] (mg/kg/day)** | **HQ[12] (based on adjusted TRV)** | **Source of TRV** |
| **ARSENIC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 9.5E+00 | 1.3E+00 | 3.3E-02 | 1.9E-01 | 9.5E+00 | 3.2E-01 | 1.7E-04 | 5.1E+01 | 8.4E-03 | 1.0E+00 | 1.0E+00 | 1.7E+00 | 4.6E+00 | 3.6E-01 | EPA 2005a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.9E-01 | 9.5E+00 | 1.3E+00 | 3.3E-02 | 1.9E-01 | 9.5E+00 | 3.2E-01 | 1.7E-04 | 5.1E+01 | 8.4E-03 | 1.0E+00 | 1.0E+00 | 1.7E+00 | 3.2E-01 | **5.2E+00** | EPA 2005a |
| **BARIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 8.9E+01 | 1.2E+01 | 3.3E-02 | 4.0E-01 | 8.9E+01 | 2.9E+00 | 1.7E-04 | 2.2E+02 | 3.7E-02 | 1.0E+00 | 1.0E+00 | 1.5E+01 | 2.7E+02 | 5.8E-02 | EPA 2005b |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 4.0E-01 | 8.9E+01 | 1.2E+01 | 3.3E-02 | 4.0E-01 | 8.9E+01 | 2.9E+00 | 1.7E-04 | 2.2E+02 | 3.7E-02 | 1.0E+00 | 1.0E+00 | 1.5E+01 | 5.2E+01 | 3.0E-01 | EPA 2005b |
| **CADMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 4.0E-01 | 5.6E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 1.7E-04 | 2.4E+00 | 4.0E-04 | 1.0E+00 | 1.0E+00 | 7.0E-02 | 9.0E+00 | 7.8E-03 | EPA 2005c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.7E-01 | 4.0E-01 | 5.6E-02 | 3.3E-02 | 1.7E-01 | 4.0E-01 | 1.3E-02 | 1.7E-04 | 2.4E+00 | 4.0E-04 | 1.0E+00 | 1.0E+00 | 7.0E-02 | 7.7E-01 | 9.1E-02 | EPA 2005c |
| **CHROMIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 5.1E+00 | 7.2E-01 | 3.3E-02 | 6.7E-02 | 5.1E+00 | 1.7E-01 | 1.7E-04 | 7.6E+01 | 1.3E-02 | 1.0E+00 | 1.0E+00 | 9.0E-01 | 5.8E+01 | 1.5E-02 | EPA 2008 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 6.7E-02 | 5.1E+00 | 7.2E-01 | 3.3E-02 | 6.7E-02 | 5.1E+00 | 1.7E-01 | 1.7E-04 | 7.6E+01 | 1.3E-02 | 1.0E+00 | 1.0E+00 | 9.0E-01 | 2.4E+00 | 3.7E-01 | EPA 2008 |
| **LEAD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.1E+01 | 4.4E+00 | 3.3E-02 | 9.0E-02 | 3.1E+01 | 1.0E+00 | 1.7E-04 | 3.5E+02 | 5.8E-02 | 1.0E+00 | 1.0E+00 | 5.5E+00 | 1.9E+02 | 2.9E-02 | EPA 2005d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.0E-02 | 3.1E+01 | 4.4E+00 | 3.3E-02 | 9.0E-02 | 3.1E+01 | 1.0E+00 | 1.7E-04 | 3.5E+02 | 5.8E-02 | 1.0E+00 | 1.0E+00 | 5.5E+00 | 4.7E+00 | **1.2E+00** | EPA 2005d |
| **MERCURY** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 3.5E-02 | 4.9E-03 | 3.3E-02 | 2.1E-01 | 3.5E-02 | 1.2E-03 | 1.7E-04 | 1.7E-01 | 2.8E-05 | 1.0E+00 | 1.0E+00 | 6.1E-03 | 4.0E+00 | 1.5E-03 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.1E-01 | 3.5E-02 | 4.9E-03 | 3.3E-02 | 2.1E-01 | 3.5E-02 | 1.2E-03 | 1.7E-04 | 1.7E-01 | 2.8E-05 | 1.0E+00 | 1.0E+00 | 6.1E-03 | 2.5E-01 | 2.4E-02 | EPA 2002 |
| **SELENIUM** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | ---[13] | ---[13] | 3.3E-02 | 9.5E-01 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 6.6E-01 | ---[13] | EPA 2007d |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 9.5E-01 | ---[13] | ---[13] | 3.3E-02 | 9.5E-01 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.4E-01 | ---[13] | EPA 2007d |
| **ZINC** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 1.5E+02 | 2.0E+01 | 3.3E-02 | 2.7E-01 | 1.5E+02 | 4.8E+00 | 1.7E-04 | 5.4E+02 | 8.9E-02 | 1.0E+00 | 1.0E+00 | 2.5E+01 | 3.0E+02 | 8.5E-02 | EPA 2007e |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.7E-01 | 1.5E+02 | 2.0E+01 | 3.3E-02 | 2.7E-01 | 1.5E+02 | 4.8E+00 | 1.7E-04 | 5.4E+02 | 8.9E-02 | 1.0E+00 | 1.0E+00 | 2.5E+01 | 7.5E+01 | 3.4E-01 | EPA 2007e |
| **TOTAL PCBs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 5.3E+00 | 7.4E-01 | 3.3E-02 | 3.4E+00 | 3.9E+00 | 1.3E-01 | 1.7E-04 | 2.4E+00 | 4.0E-04 | 1.0E+00 | 1.0E+00 | 8.7E-01 | 1.3E+00 | 6.8E-01 | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.2E+00 | 5.3E+00 | 7.4E-01 | 3.3E-02 | 3.4E+00 | 3.9E+00 | 1.3E-01 | 1.7E-04 | 2.4E+00 | 4.0E-04 | 1.0E+00 | 1.0E+00 | 8.7E-01 | 3.6E-01 | **2.4E+00** | EPA 2002 |
| **4,4'-DDD** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 1.2E-01 | 1.7E-02 | 3.3E-02 | 8.7E-01 | 1.5E-02 | 4.9E-04 | 1.7E-04 | 3.6E-02 | 5.9E-06 | 1.0E+00 | 1.0E+00 | 1.7E-02 | 4.6E+00 | 3.7E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | 1.2E-01 | 1.7E-02 | 3.3E-02 | 8.7E-01 | 1.5E-02 | 4.9E-04 | 1.7E-04 | 3.6E-02 | 5.9E-06 | 1.0E+00 | 1.0E+00 | 1.7E-02 | 1.5E-01 | 1.2E-01 | EPA 2007a |
| **4,4'-DDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 2.7E-01 | 3.8E-02 | 3.3E-02 | 2.2E+00 | 2.2E-02 | 7.4E-04 | 1.7E-04 | 2.1E-02 | 3.5E-06 | 1.0E+00 | 1.0E+00 | 3.8E-02 | 4.6E+00 | 8.4E-03 | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 1.3E+01 | 2.7E-01 | 3.8E-02 | 3.3E-02 | 2.2E+00 | 2.2E-02 | 7.4E-04 | 1.7E-04 | 2.1E-02 | 3.5E-06 | 1.0E+00 | 1.0E+00 | 3.8E-02 | 1.5E-01 | 2.6E-01 | EPA 2007a |
| **4,4'-DDT** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 4.6E+00 | ---[13] | EPA 2007a |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 7.0E-01 | ---[13] | ---[13] | 3.3E-02 | 1.3E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.5E-01 | ---[13] | EPA 2007a |
| **HEPTACHLOR** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |
| **HEPTACHLOR EPOXIDE** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 6.8E+00 | ---[13] | EPA 2002 |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 3.3E+00 | ---[13] | ---[13] | 3.3E-02 | 1.9E+00 | ---[13] | ---[13] | 1.7E-04 | NA | ---[13] | 1.0E+00 | 1.0E+00 | ---[13] | 1.3E-01 | ---[13] | EPA 2002 |

## TABLE E-24: MINK DOSE CALCULATIONS AND HAZARD QUOTIENTS (Step 2)

Final Ecological Risk Assesment, Otter Creek Area of Concern, Ohio

**Section OC-E, EPC**

| COPEC | Total Prey Ingestion Rate[1] (kg/day) | Fish Ingestion Rate[2] (kg/day) | Fish BSAF[3] (unitless) | Fish Concentration[4] (mg/kg) | Fish Daily Dose[5] (mg/day) | Invertebrate Ingestion Rate[2] (kg/day) | Invertebrate BSAF[3,5] (unitless) | Invertebrate Concentration[4] (mg/kg) | Invertebrate Daily Dose[5] (mg/day) | Sediment Ingestion Rate[6] (kg/day) | Sediment Concentration[7] (mg/kg) | Sediment Daily Dose[8] (mg/day) | SUF | Body Weight[9] (kg) | Total Daily Dose[10] (mg/kg/day) | TRV[11] (mg/kg/day) | HQ[12] (based on adjusted TRV) | Source of TRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOW MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 3.4E+01 | 4.8E+00 | 3.3E-02 | 3.7E-01 | 2.3E+01 | 7.8E-01 | 1.7E-04 | 1.3E+02 | 2.2E-02 | 1.0E+00 | 1.0E+00 | 5.6E+00 | 3.6E+02 | 1.6E-02 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 3.4E+01 | 4.8E+00 | 3.3E-02 | 3.7E-01 | 2.3E+01 | 7.8E-01 | 1.7E-04 | 1.3E+02 | 2.2E-02 | 1.0E+00 | 1.0E+00 | 5.6E+00 | 6.6E+01 | 8.6E-02 | EPA 2007c |
| **HIGH MOLECULAR PAHs** | | | | | | | | | | | | | | | | | | |
| Dose/High TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 3.0E+01 | 4.2E+00 | 3.3E-02 | 3.4E-01 | 1.9E+01 | 6.2E-01 | 1.7E-04 | 1.2E+02 | 1.9E-02 | 1.0E+00 | 1.0E+00 | 4.9E+00 | 3.8E+01 | 1.3E-01 | EPA 2007c |
| Dose/Low TRV | 1.7E-01 | 1.4E-01 | 2.6E-01 | 3.0E+01 | 4.2E+00 | 3.3E-02 | 3.4E-01 | 1.9E+01 | 6.2E-01 | 1.7E-04 | 1.2E+02 | 1.9E-02 | 1.0E+00 | 1.0E+00 | 4.9E+00 | 6.2E-01 | **7.9E+00** | EPA 2007c |

**Notes:**

1 See Table E-2 for total prey ingestion rate calculation.
2 The invertebrate and fish ingestion rates are 40 percent and 60 percent of the total prey ingestion rate, respectively (see Table E-2).
3 Sources of BSAFs are described in Table E-3.
4 The invertebrate and fish concentrations were calculated for inorganics by multiplying the EPC sediment concentration by the BSAF.
For organics compounds tisuse concentrations were calculated by multiply the BSAF by the ratio of sediment concentration and fraction organic carbon, and the fraction lipid concentration. Fraction lipid concentration used was 5.3 percent for fish and 2.5 percent for invertebrates.
5 Invertebrate and fish daily doses were calculated by multiplying the ingestion rate (see note 2) by the tissue concentration (see note 4).
6 Sediment ingestion rate is 1 percent of prey ingestion rate as described in Table E-2.
7 EPC of all site-collected sediment samples were used (see Table E-2).
8 Sediment daily dose was calculated by multiplying the sediment ingestion rate (see note 6) by sediment concentration (see note 7).
9 See Table E-2 for basis of body weight.
10 Total daily dose is calculated using the following equation: total daily dose = (invertebrate daily dose + fish daily dose + sediment daily dose)*SUF)/receptor species body weight.
11 The source of TRVs is described in Table E-4.
12 HQs were calculated using the following equation: HQ = total daily dose/TRV.

| | | | |
|---|---|---|---|
| BASF | Biota-sediment accumulation factors | kg | Kilogram |
| COPEC | Chemical of potential ecological concern | kg/day | Kilogram per day |
| DDD | Dichlorodiphenyldichloroethane | mg/day | Milligram per day |
| DDE | Dichlorodiphenyldichloroethene | mg/kg | Milligram per kilogram |
| DDT | Dichlorodiphenyltrichloroethane | NA | Not applicable |
| EPC | Exposure Point Concentration | PAH | Polynuclear aromatic hydrocarbons |
| HQ | Hazard Quotient | PCB | Polychlorinated biphenyls |
| TRV | Toxicity reference value | SUF | Site Use Factor |

**Resources:**


United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals and Birds (Revision Date 11/21/2002).
EPA. 2005a. Ecological Soil Screening Levels for Arsenic. OSWER Directive 9285.7-62. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005b. Ecological Soil Screening Levels for Barium. OSWER Directive 9285.7-63. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
EPA. 2005c. Ecological Soil Screening Levels for Cadmium. OSWER Directive 9285.7-65. March. Available Online at: http://www.epa.gov/ecotox/ecossl/.
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