PCB contamination and biological impacts in Lyons Creek East: Implementation of a Canada-Ontario decision-making framework for contaminated sediments

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by

Danielle Milani[1] & Rachael Fletcher[2]

[1]National Water Research Institute, Environment Canada
[2]Biomonitoring Section, EMRB, Ontario Ministry of the Environment

Executive Summary

This report describes sediment and biota quality in Lyons Creek East. Previous studies have shown elevated levels of polychlorinated biphenyls (PCBs) in the sediment and detrimental effects on biota in the creek. The National Water Research Institute of Environment Canada (EC) and the Ontario Ministry of Environment (MOE) sampled the creek in the fall of 2002 and 2003, with detailed sampling efforts focusing on the area between the Lyons Creek pumping station at the Welland Canal to Highway 140, an area identified as having the highest levels of PCBs based on a preliminary chemical screening performed by the MOE. Remaining sites were located from Highway 140 to just downstream of the QEW. Four neighbouring creeks, similar in morphology to Lyons Creek, were sampled as reference locations.

Included in the assessment were physico-chemical analyses of the surficial sediment and sediment core samples, resident benthic invertebrate tissue analysis, benthic invertebrate community structure, laboratory sediment toxicity tests, and forage fish, sport fish and mussel tissue analysis.

A risk-based, decision-making framework for the management of contaminated sediment was recently developed by the Canada-Ontario Agreement Sediment Task Group. This framework is a step by step approach to assessing ecological condition, and is based on the ecological risk assessment principles. The overall assessment of each Lyons Creek site is achieved by integrating the information obtained both within and among the following four lines of evidence: sediment chemistry, benthic invertebrate community structure, sediment toxicity and the biomagnification potential for PCBs. Collections of resident sport fish in the creek provided ground-truthing of the model, as well as demonstrating the bioaccumulation of PCBs in higher trophic level organisms. The placement of mussels at select locations in the creek provided an indication of the bioavailability of contaminants from the water column, as well as providing an indication of availability in areas where resident biota were unavailable.

The area of the creek from the Welland Canal to Highway 140 has the highest levels of PCBs and metals in the sediment, higher than sediment quality guidelines (SQGs) and higher than reference creek concentrations. The PCB concentrations at depth in this area also exceed both the SQG criteria and the reference concentrations. The highest PCB concentrations in benthic invertebrates also occur in the upper reaches of the creek, and are elevated above reference creek concentrations. Acute toxicity is evident at 3 sites between the canal and Highway 140, and generally, Lyons Creek communities are similar to those at reference, with 1 site upstream of Highway 140 having a depauperate community compared to reference creeks. Based on resident invertebrate concentrations and biomagnification factors (BMFs) derived from the literature, PCBs were predicted to bioaccumulate in higher trophic level receptors to concentrations that are not protective of adverse effects at between 2 and 11 Lyons Creek sites where tissue had been collected. Bioaccumulation was predicted to be most severe at sites in the upper reaches of the creek. The area of the creek from the canal to Highway 140 has the highest sediment, benthic invertebrate, fish and mussel PCB concentrations, and laboratory toxicity, altered benthic communities and potentially adverse effects due to biomagnification are all observed within this area.

Acknowledgements

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The GLSF, a component of the Great Lakes program, provides resources to demonstrate and implement technologies and techniques to assist in the remediation of Areas of Concern and other priority area in the Great Lakes. The report that follows addresses sediment quality issues in Lyons Creek East, Welland, Ontario (Niagara Area of Concern). Although the report was subject to technical review, it does not necessarily reflect the views of the Sustainability Fund or Environment Canada (EC).

Advice on the study design was provided by Roger Santiago and Janette Anderson (EC-OR), Cheriene Vieira (MOE) and Jocelyn Baker (NPCA). Field technical support was provided by Craig Logan, Sherri Thompson, Jennifer Webber, Jesse Baillargeon and Corrine Siefker (EC-NWRI), Steve Petro (MOE), and Al Vieira, Josh Diamond, Annie Michaud, and Stephanie Chase (NPCA). The organic analysis was performed by Eric Reiner (Dioxins laboratory, MOE, Etobicoke, ON). Station positioning and site maps were provided by the NPCA. Community structure sorting was completed by Sherri Thompson, benthic invertebrate identification by Craig Logan, and toxicity tests by Jennifer Webber. The Niagara Seaway Authority provided land access for sample collection and processing purposes.

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1 Introduction

1.1 Background

In the 1970's, the International Joint Commission (IJC) identified 42 "problem areas" where aquatic environments were considered to be severely degraded. Of these, 17 were along Canadian lakeshores or in rivers shared by Canada and the U.S. In 1985, the IJC Great Lakes Water Quality Board recommended a Remedial Action Plan (RAP) be developed and implemented for each problem area. The goal of the RAP was to restore the "beneficial uses" of the aquatic ecosystem in each problem area, which were now called "Areas of Concern" (AOCs). One of the areas identified by the IJC as impaired was the Niagara River, and in 1987 Canada and the U.S. signed a joint agreement whereby each country pledged their commitment to restore the environmental integrity of these waters.

Since the early 1900's, the Niagara River watershed has shown signs of significant water pollution problems. Increased population, industry and agriculture in the Niagara River watershed have subjected the river to excessive levels of pollutants, such as high levels of bacteria, oil, phosphorus, chlorine, phenols, PCBs and mercury. As part of the Niagara River RAP, tributaries of the river, including Lyons Creek, were identified as part of the AOC. This consideration provides a more consistent ecosystem approach.

In 1999, the Ministry of the Environment (MOE), Environment Canada (EC) and the Niagara Peninsula Conservation Authority (NPCA) entered into an agreement under which the NPCA co-ordinates activities for the continued development and implementation of the Niagara River RAP.

1.2 Environment Canada methods and protocols

The Canadian government's commitment to the GLWQA was renewed in 2000 with the Great Lakes Basin 2020 Action Plan, under which the efforts of eight federal departments to "restore, conserve, and protect the Great Lakes basin" over the next five years were to be co-ordinated. Environment Canada's contribution included the funding of detailed chemical and biological assessments of sediments in Canadian AOCs. The National Water Research Institute (NWRI) was given the responsibility of conducting and reporting on these assessments.

Under the terms of reference for the NWRI's mandate, the Benthic Assessment of Sediment (BEAST) methodology of Reynoldson et al., (1995; 2000) is to be applied to the AOC assessments. BEAST methodology involves the assessment of sediment quality based on multivariate techniques using data on abundances and diversity of benthic invertebrate communities, the functional responses of laboratory organisms in toxicity tests and the physical and chemical attributes of the sediment and overlying water. Data are compared to biological criteria developed previously for the Laurentian Great Lakes (Reynoldson et al., 1995; 2000; 2002). Recent reviews of the BEAST framework have recommended the inclusion of information on the bioaccumulation of contaminants liable to biomagnify, where the prediction of contaminant concentrations in representative consumers of benthic invertebrates and their predators are made using screening-level trophic transfer models (Grapentine et al., 2002).

1.3 Ministry of the Environment methods and protocols

Since the publication of the Provincial Sediment Quality Guidelines (PSQG) in 1992 (MOE, 1993a), there has been a need for guidance on assessing and managing contaminated sediments, particularly with respect to biological assessment tools for determining the severity of sediment contamination. The MOE document "*An Integrated Approach to the Evaluation and Management of Contaminated Sediments*" (MOE, 1996) provides guidance on assessing sediment contamination and devising, where warranted, management strategies for dealing with the contamination.

For a sediment survey to be of maximum benefit, it must meet all of the stated objectives of the study. *An Integrated Approach to the Evaluation and Management of Contaminated Sediments* (MOE 1996) describes a stepwise approach to assessing sediment. The document outlines an ecosystem approach, which recognizes all components (biotic and abiotic) within the sediment. The approach outlined in the report considers the effects of local conditions on organisms that are not directly impacted, such as fish, which frequent a range of sites. Impacts on organisms such as fish may be felt through the food chain by means of bioaccumulation processes, with consequent impacts on higher organisms and on human health.

1.4 Canada-Ontario decision-making framework

The underlying philosophy of the approach to sediment assessment is that observations of elevated concentrations of contaminants alone are not indications of ecological degradation. Rather, it is the biological responses to these contaminants that are the concern. A recommendation on remedial activity requires evidence to be provided of an adverse biological effect either on the biota resident in the sediment, or on biota that are affected by contaminants originating from the sediment, either by physical, chemical or biological relocation.

To make decisions on sediment quality and the need to remediate, four components of information (in addition to knowledge on the stability of sediments) are required: sediment chemistry and grain size, benthic invertebrate community structure, sediment toxicity and invertebrate body burdens (Krantzberg et al., 2000). A risk-based, decision-making framework for the management of contaminated sediment was developed recently by the Canada-Ontario Agreement Sediment Task Group using the above lines of evidence. This decision framework was developed from the Sediment Triad and BEAST frameworks, as described in Grapentine et al., (2002), and has been updated (Figure 1, Chapman, 2005). The overall assessment of each site in Lyons Creek is achieved by integrating the information obtained both within and among the four lines of evidence. Invertebrate body burdens are used to model the biomagnification potential, i.e., if PCBs from sediments in Lyons Creek bioaccumulate in the tissues of resident benthic invertebrates and if the PCBs could *potentially* be transferred through benthic invertebrates to fish, wildlife or humans. Resident forage fish and sport fish collections in Lyons Creek provides a means of “ground truthing” the biomagnification model as well as providing evidence of actual PCB bioaccumulation in higher trophic level organisms.

2 Step 1: Examination of Available Data

2.1 Overview

The initial step of the Ontario-Canada decision-making framework (Figure 1) examines all available information, reports and data to determine the contaminants of potential concern in the sediments and their surficial concentrations. The receptors that may be affected by the contaminants of concern are also identified, and exposure pathways and consumption advisories are also identified in this step of the process (Chapman, 2005).

As the majority of sediment-dwelling organisms inhabit the top 10 cm of sediment, the information gathered considers the surficial sediments. It also considers deeper sediments, their contaminant levels at depth, and the stability of sediments with respect to their likelihood of being uncovered or moved (Chapman, 2005).

2.2 Lyons Creek East

The headwaters of Lyons Creek originate in the Wainfleet Marsh, and historically drained the southerly section of the Municipality of Welland near Dain City, flowing north-east to the Welland River, discharging to the Niagara River near Chippawa. As a result of the construction of the Welland Ship Canal Bypass in the 1960’s, Lyons Creek was bisected in two. One condition of the canal’s construction was that the portion of Lyons Creek downstream of the canal (Lyons Creek East) would have its flow maintained by pumping water from the canal into the creek at a rate that would maintain the original integrity of the creek. Flow from the original headwaters now outlets to the Welland Canal on the west side. The Ministry of Natural Resources has defined the Lyons Creek East as a Class 1 wetland, consisting of a high diversity of fauna and flora present in the area, and meriting a high level of protection from detrimental impacts (Boyd et al., unpublished).

A study of sediments from the west side of Lyons Creek, shortly after a PCB spill from the Ontario Hydro Crowland Transformer in May of 1990, indicated elevated of PCBs in the sediments (Environmental Strategies Ltd., 1992). With the possibility that the observed PCB pollution may have occurred prior to the construction of the Welland Ship Canal Bypass, and hence prior to the bisection of Lyons Creek, an extensive study of the east side of Lyons Creek was proposed.

2.3 Assessment of available data

2.3.1 Historical data

Previous studies, dating from as early as 1978 (Acres, 1978; MOE, 1997; 1998; Boyd et al, unpublished) have shown evidence of elevated levels of PCBs in the sediment and detrimental effects on biota in Lyons Creek. The sediments in the upper reaches of Lyons Creek East have been shown to be highly contaminated with metals and PCBs. Elevated nutrient levels have also been observed in the sediments.

2.3.2 Screening Survey

An initial survey was conducted in 2002 with the objectives of identifying areas of elevated sediment contamination (particularly PCBs). From this, the main areas of concern could be delineated and locations for more detailed studies could be selected.

Study design

Depositional areas with fine silty sediment were targeted for sediment collection. A total of thirty-nine surficial sediment samples were collected from the Lyons Creek system (Figure 2), focusing mainly on the area between the Lyons Creek pumping station at the Welland Canal to Highway 140 (17 sites). The remaining sites were from downstream of Highway 140, at the C.N. railway tracks to downstream of the QEW. Duplicate samples were collected from two of the stations for QA/QC purposes.

Sediment collection is described in detail by Fletcher & Petro (2005), and were analysed for PCBs, metals, organochlorines (OCs), polycyclic aromatic hydrocarbons (PAHs), grain size, and organic content according to MOE protocol (MOE1993b).

Data analysis

Sediment concentrations of the various chemical parameters measured were compared, where applicable, to the Provincial Sediment Quality Guidelines (PSQG) Lowest Effect Level (LEL) and Severe Effect Level (SEL) criteria (MOE, 1993a). The LEL criteria indicate the level of contaminant that can be tolerated by the majority of organisms. The SEL is the level of contamination where a pronounced disturbance of the sediment-dwelling community can be expected; this is the sediment concentration of a compound that would be detrimental to the majority of benthic species.

Multivariate analyses, such as clustering and ordination were also considered. The primary purpose of clustering was to create groups or ‘clusters’ in such a way that the sediment chemistry relationships varied most between the groups and least within the groups.

Multivariate methods of analysis allows all of the sediment chemistry data to be considered simultaneously, and the relationships between the sites based on their sediment chemistry can then be graphically represented in two or more axes. Non-parametric Multi-Dimensional Scaling (NMDS) was used in the analysis (PATN; Belbin, 1993). The NMDS calculates a matrix of dissimilarity values from the sediment chemistry data to create the ordination diagram (Jongman et al., 1995). This is done such that the rank order of dissimilarities of the samples is reflected in their distances in ordination space relative to one another. The Bray-Curtis association measure was used in the analysis to express the dissimilarity between the samples.

Results

Seven cluster groups are identified through cluster analysis; Groups 1, 2, 4, 6 and 7 all contain a single site, whereas Groups 3 and 5 are made up of 13 and 21 of the sites respectively. These groupings are mapped, and are shown in Figure 3.

Ordination using Principle Components Analysis (PCA) allowed the sites to be grouped and plotted according to their similarities in sediment composition (Figure 4). The closer two points are to each other in ordination space, the more similar they are.

Metals

Four metals exceed the PSQG SEL criteria at one or more sites; manganese exceeds the SEL of 1100ug/g at only one of the sites (LC34, 2000ug/g), located downstream of Crowland Road (Table 1). Iron also exceeds the SEL of 40000ug/g at this location (44000ug/g); the SEL for iron is also exceeded at LC14 and LC16 (54000ug/g and 57000ug/g, respectively), both sites are located upstream of Highway 140. Sediment concentrations of zinc and nickel are both elevated over their SEL criteria (820ug/g and 75ug/g, respectively) at LC02, LC16, LC27 and LC33. Each of these sites is situated in areas where deposition is high. Zinc also exceeds its SEL criteria at 7 other locations: LC08 – LC11, LC14, LC24, and LC34.

OC pesticides

OC pesticides are generally low in all of the samples (Table 2), often in concentrations below the MOE method detection limits. Average values for each of the seven groups identified through cluster analysis (also provided in Table 2) were compared. The only OC pesticide present in any significant concentration is pp-DDE, which exceeds the LEL criteria of 5ng/g at 34 of the 39 sample locations (maximum [DDE] at LC02, 750 ng/g). Groups 1, 4, 6 and 7, which represent a general area extending from the area adjacent to the Welland Pipe property (LC02) downstream to Highway 140 (LC17) have significantly higher levels of DDE (mean range: < 5 to 750 ng/g) than the most upstream location (Group2, LC01) or downstream of Highway 140 (mean range: < 5 to 120 ng/g). Although agricultural practices appear to be more prevalent in the downstream locations, these data may be more of a reflection of past land uses.

PAHs

PAHs are generally elevated in the upstream portion of Lyons Creek (LC02 – LC17); the LEL criteria is exceeded at one or more of these locations for 10 of the 12 PAHs for which guidelines are available (Table 3). Site LC02, located adjacent to the Welland Pipe property, exceeds the PSQG criteria for 10 of the 12 parameters considered. The highest concentrations at LC02 are for pyrene (83000 ng/g), chrysene (6000 ng/g), and fluoranthene (3600 ng/g). Downstream of Highway 140, PAH levels are lower than upstream, exceeding only 3 of the 12 criteria (chrysene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene). These values are all lower than those observed upstream of Highway 140 (Table 3).

PCBs

Sediment concentrations are generally higher in the upper portion of the creek and are elevated above the PSQG LEL criteria of 70ng/g at all sites upstream of Montrose (LC01 to LC25; Table 3). The PCB concentrations range from a high of 19000ng/g at Highway 140 (LC16) to non-detect at the QEW (LC36). An overall downstream decrease in PCB concentration is observed, with dramatic drops in concentration occurring just downstream of the CNR railway (LC20), at Conrail (LC31), and downstream of Crowland Road (LC36) (Figure 2). These trends are reflected in the average concentrations observed in the cluster groupings (Figure 5, Table 3).

3 Step 2: Sampling and Analysis Plan

3.1 Overview

Based on the results from Step 1 of the framework, a sampling and analysis plan (SAP) was developed for Lyons Creek, which included filling in the gaps in information identified from Step 1 (Figure 1). It included the sampling of surficial sediments, and based on the contaminant of concern (PCBs - identified in Step 1), toxicity to biota as well as the possibility of biomagnification were considered. Although PAHs exceed the LEL at some sites in the upper portion of the creek, they are not considered a persistent biomagnifiable compound such as PCBs and therefore were not the main focus of this study.

In this step of the framework, the following are considered (Chapman, 2005):

i) Whether the contaminants of concern are present in the sediment above levels that could potentially have a toxic effect, which is addressed by comparing the concentrations of contaminants of concern to their SQGs, and;

ii) Whether the contaminants of concern in the sediment have the potential to biomagnify, and therefore affect the health of biological communities, which is addressed by determining if the biomagnifiable substances are present at quantifiable concentrations.

The two possible decisions are (Chapman, 2005):

Comparison	Decision
All sediments and COPC are less than the SQG-low, <u>and</u> no substances biomagnify	No further assessment or remediation is required
One or more sediment COPC is greater than the SQG-low, <u>and/or</u> one or more of the substances can biomagnify	Potential risk: further assessment is required

COPC – contaminants of potential concern
SQG-low guideline levels resulting in toxicity in less than 5% of the fauna

3.2 Sampling strategy

3.2.1 Sediment

Grab samples of surficial sediment were collected in 2002 and 2003 from a total of 16 sites along Lyons Creek (Table 4), and from 4 streams with similar morphological characteristics as Lyons Creek which were used as reference sites: Tee Creek, Usshers Creek, Black Creek and Beaver Creek (TC, UC, BLC and BEC, respectively).

Depositional areas were targeted for the sediment collection, and were sampled using a petit (or mini) ponar which is designed to ‘grab’ sediment to a depth of 10cm. Composite grabs were homogenized and sent to the MOE laboratory (Etobicoke, ON), with a detailed description of the sampling strategy provided in Fletcher and Petro (2005), and to Caduceon Laboratories (Ottawa, ON), with detailed descriptions provided in Milani and Grapentine (2005).

3.2.2 Bioaccumulation in biota

Benthic macroinvertebrates

Resident invertebrate tissue was collected using a mini-ponar. Details on the collection and handling of invertebrate tissue are provided in Milani and Grapentine (2005). Several distinct invertebrate taxa were collected from each location. Analyses of PCBs were performed on samples composited from organisms within each taxon (i.e., taxa were analyzed separately). Due to sample size requirements and time constraints, taxa of similar functional feeding groups were combined. Amphipods and isopods were combined (hereafter referred to as ‘amphipod’) and damselflies and dragonflies were combined (hereafter referred to as ‘odonate’). Invertebrates were not allowed time to clear sediment from their guts since predators consume whole organisms. PCBs associated with sediment, as well as that incorporated into tissues, are potentially available for transfer through the food chain.

Caged mussels

Mussels have been shown to be shown to be an effective means of biomonitoring PCBs in the aquatic environment (Binelli et al., 2001) as they are able to bioaccumulate organic contaminants from the water (and to some degree from the sediment).

Ten mussels (*Elliptio complanata*) of a similar size range (65-72cm), randomly selected, were placed into 30cm by 45cm envelope shaped mesh cages; 1 cage was deployed at each of 12 locations in Lyons Creek (Table 4, Figure 6) as well as in 3 of the reference streams (Fletcher and Petro, 2005).

A random subset of three individual mussels from each sample were analysed for PCB congeners and lipid content according to the MOE standard laboratory protocol (MOE, 2003). A set of mussels from Balsam Lake was also submitted to the MOE laboratory as a control, and represents background levels of PCB congeners and lipid content observed in unexposed mussels.

Forage fish

Forage fish were collected using a seine net from Lyons Creek in 2002 and 2003, from the Welland River at the mouth of Lyons Creek (mouth), and from three reference creeks: Beaver Creek and Black Creek in 2002, and Usshers Creek in 2003 (Fletcher and Petro, 2005). Bluntnose minnow (*Pimephales notatus*) were targeted for collection in the creeks; this species was not always found so every effort was made to collect an additional species. Three additional species of forage fish: common shiner (*Notropis cornutus*), golden shiner (*Notemigonus crysoleucas*), and spottail shiners (*Notropis hudsonius*) were also targeted. Although McKenny Road had been identified in the past as having fish with elevated PCB concentrations, no fish could be collected during this study.

Each composite sample was made up of a single fish species. Every effort was made to collect enough fish to allow replicate samples of species to be analysed. An attempt was made to collect the same species from each site to allow for among-site comparisons.

Sport fish

Sport fish were collected by electro-fishing from a section of the creek upstream of Highway 140 (LC16) in 2002 and 2003, and downstream of the QEW (LC38), near the mouth of Tee Creek in 2002 only (Table 4). Bowfin (*Amia calva*), carp (*Cyprinus carpo*), brown bullhead (*Ictalurus nebulosus*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*) and black crappie (*Pomoxis nigromaculatus*) were collected from both locations. White suckers (*Catostomus commersoni*) were only collected from LC16, and northern pike (*Esox lucius*), rock bass (*Ambloplites rupestris*), white crappie (*Pomoxis annularis*) and yellow perch (*Perca flavescens*) were only collected from LC38.

Fish tissue samples, consisting of one skinless, boneless dorsal fillet per sample, were sent to the MOE laboratory (Etobicoke, ON) for analyses of PCBs and lipid content (MOE, 2003).

3.2.3 Whole sediment toxicity tests

A mini-Ponar sampler was used to obtain the sediment for toxicity tests (five replicates/grabs per site). Four sediment toxicity tests were performed: *Chironomus riparius* 10-d survival and growth test, *Hyalella azteca* 28-d survival and growth test, *Hexagenia spp.* 21-d survival and growth test and *Tubifex tubifex* 28-d survival and reproduction test. Sediment handling procedures and toxicity test methods are described in Milani and Grapentine (2005).

3.2.4 Benthic community

A stainless steel mini-box core frame (40 cm x 40 cm x 25 cm) and Plexiglas tubes (6.5 cm x 10 cm) were used to obtain the top 10 cm of sediment for sediment chemistry and benthic community samples. At sites where the box core frame could not be used (due to site depth), a ponar sampler was used to obtain the sediment and benthic community samples. Three ponars per site were taken for benthic community structure analysis, and one ponar was taken for chemical and physical properties of the sediment. Complete descriptions on sampling, handling and identification of benthic community samples (to family level) are provided in Milani and Grapentine (2005).

3.3 Quality assurance/quality control (QA/QC)

3.3.1 Field

One randomly chosen site (LC29) was designated as a QA/QC station, where triplicate sediment, water and benthic community samples were collected for determination of within-site and among-sample variability.

3.3.2 Laboratory

For MOE samples, QA/QC included matrix spike recoveries, which were performed on every sample to determine PAH recoveries. For Caduceon Environmental Laboratory, QC involved control charting of influences, standards, and blanks. Reference material was used in each analytical run. Calibration standards were run before and after each run. Blanks and reference standards were run 1 in 20 samples and duplicates were run 1 in 10 samples.

To evaluate control measures for benthic invertebrate enumeration, each month the remaining material from each sorted sample replicate was stored. One sample was randomly selected each month and re-sorted, and the number of new organisms found was counted. The percent of organisms missed (%OM) was calculated using the equation:

$$\frac{\text{\# Organisms Missed}}{\text{Total Organisms Found}} \times 100 = \%\text{OM}$$

If %OM was greater than 5%, two more samples were randomly selected and the %OM was calculated for both. The average %OM was calculated based on the three samples re-picked, and represents the standard sorting efficiency for that month (based on only one sample if %OM is less than 5%).

3.4 Data analysis

3.4.1 Sediment chemistry

Sediment concentrations of the various chemical parameters measured in both the cores and the surficial sediments were compared, where applicable, to the Provincial Sediment Quality Guidelines (PSQG) Lowest Effect Level (LEL) and Severe Effect Level (SEL) criteria (MOE, 1993a).

Multivariate analyses, such as clustering and ordination were also considered. The primary purpose of clustering is to create groups or ‘clusters’ in such a way that the sediment chemistry relationship varies most between groups and least within groups. The sites were clustered using agglomerative clustering techniques, in which clustering analysis starts with a single object (site) and agglomerates into larger clusters based on the Bray-Curtis dissimilarity measures. Multivariate methods of analysis allow all of the sediment chemistry data to be considered simultaneously, and the relationships between the sites based on their sediment chemistry can then be graphically represented in two or more axes.

3.4.2 Bioaccumulation in biota

Benthic macroinvertebrates

The PCB levels in Lyons Creek benthic macroinvertebrates were compared to those in the reference creeks. Sites in which concentrations of total PCBs in invertebrates ($[PCB]_{inv}$) were significantly elevated above background levels for the study area were identified by comparing $[PCB]_{inv}$ for the test sites to the upper 99th % percentile ($\cong$ maximum) for the reference sites. This was done separately for each invertebrate taxon.

Using test and reference sites, the relationships between sediment and invertebrate PCB levels were determined using regression analysis, separately for each invertebrate taxon. The approach was used to estimate the degree to which PCBs in invertebrates is predictable from PCBs in sediment, with and without environmental covariables. Simple linear regression (ordinary least squares) was used for the single predictor ($[PCB]_{sed}$) model. “Best subset” multiple linear regression (Draper and Smith, 1998; Minitab, 2000) was used for the fitting of multiple predictor models. Environmental variables expected to potentially influence uptake of PCB from sediment by biota such as sediment concentrations of total organic C, total P, total N, Fe, and Mn; sediment particle size fractions of sand, silt and clay; overlying water conductivity, dissolved O_2, pH, temperature and nutrients (TKN, total N, total P, NO_3/NO_2) were included in the models. To increase normality of data distributions and linearity of relations between variables, some data were transformed: log(x) for PCBs in sediment and invertebrates; log(x) for nutrients, Fe and Mn in sediment; and arcsine-square root(x) for the particle size fractions. Normality and linearity of the water column data were not generally improved by transformations, so these were analyzed untransformed.

All models fitted to the data included $[PCB]_{sed}$ as a free predictor (i.e., it was not forced to be in the model). The specific null hypothesis of interest was that "the effect of $[PCB]_{sed}$ on $[PCB]_{inv} = 0$, after accounting for effects of other predictors". For the best subset regressions, models were fitted for all combinations of predictors. Determination of the "best" model was based on several criteria (in roughly decreasing order of importance):

- Maximum $R^2_{adjusted}$
- Significance of partial *F*-tests (= *t*-tests) for predictors (especially $[PCB]_{sed}$)
- Significance of *F*-test for regression
- Variance inflation factors (VIFs) for predictors < 10
- Homoscadastic and normally distributed residuals
- Mallow's C_p statistic not >> number of predictors

Lack-of-fit tests for curvature in response-predictor relationships and interactions between predictors were performed and examined for nonsignificance. Observations having large standardized residuals or large influence on the regression were also considered in model evaluations. The best model was identified based on the overall meeting of these criteria. Both single and multiple predictor models were then examined for the degree to which $[PCB]_{sed}$ predicts $[PCB]_{inv}$, as indicated by the significance of the *t*-test of the coefficient for $[PCB]_{sed}$.

Caged mussels

Total PCB concentrations in the mussels were statistically analysed using a one-way analysis of variance (ANOVA). If the ANOVA indicated a significant difference among stations ($p<0.05$), then the differences between sites were compared using a *post hoc* Tukey test.

Several co-planar (dioxin-like) PCB congeners have been shown to cause a number of toxic responses similar to the most toxic dioxin (2,3,7,8-TCDD) (Van den Berg et al., 1998). Using a toxic equivalency factor (TEF, Table 5) concept, the toxicity of the different co-planar PCB congeners relative to the toxicity of 2,3,7,8-TCDD can be determined. The TEF's, in combination with the chemical residue data of each co-planar PCB congener can be used to calculate toxic equivalent (TEQ) concentrations in various media (e.g. fish or mussel tissue). The TEQ concentrations for the co-planar PCB congeners in samples are calculated using the following equation:

$$\text{TEQ} = \sum_{i=1}^{n} ([\text{PCB}]_i \times TEF_i)_n$$

Within a sample, the individual co-planar PCB congener concentrations are multiplied by their respective TEFs (Table 5), and all products are summed to give a TEQ value. This takes into consideration the unique concentrations and toxicities of the individual components within the PCB mixture.

The summed TEQ values for each site are compared to the appropriate Canadian tissue residue guideline (TRG) for the protection of wildlife consuming aquatic biota (CCME, 2001). The TRG of 0.79ng TEQ/kg diet wet weight provides a benchmark for PCBs in aquatic life, above which their mammalian predators may be at risk of consuming PCB concentrations known to result in adverse affects.

Forage fish

The concentration of total PCBs in the different forage fish species collected from each location were first compared to the IJC PCB guideline (100ng/g) for the protection of fish-eating wildlife (IJC, 1988). As a variety of forage fish species were collected at each location, which differed between sites, the most common species collected (creek chub) were compared using an ANOVA. As with the mussel analyses, if the ANOVA indicated a significant difference among the stations ($p<0.05$), the differences between sites were compared using a *post hoc* Tukey test.

Toxic equivalency values for the selected co-planar PCB congeners (Table 5) were also calculated for the forage fish data. These values were compared to the Canadian TRG (0.79ng TEQ/kg diet wet weight; CCME, 2001).

Sport fish

Total PCB concentrations from sport fish collected in 2002 were compared to historical data (1991-2000). These data were also compared to the consumption restriction guidelines outlined in the *Guide to Eating Ontario Sport Fish, 2005-2006* (MOE, 2005).

In addition to comparing the total PCB concentrations observed in the sport fish collected in 2003 to the consumption guidelines (MOE, 2005), toxic equivalency values, based on co-planar PCB concentrations were calculated for the sport fish collected in 2003. These values were compared to Canadian tissue residue guideline (TRG) for the protection of wildlife consuming aquatic biota (CCME, 2001), as outlined above.

3.4.3 Whole sediment toxicity tests

BEAST assessment of toxicological responses were assessed by “Semi-strong” Hybrid multidimensional scaling (HMDS, Belbin, 1993) using the Euclidean distance on standardized data. Principal axis correlation (Belbin, 1993) was used to identify relationships between habitat attributes and toxicity responses. Significant toxicity test endpoints and environmental attributes were identified using Monte-Carlo permutation tests. Test sites were assessed by comparison to confidence bands (90, 99 and 99.9% probability ellipses) derived from Great Lakes reference sites. HMDS was performed using the software PATN (Blatant Fabrications Pty Ltd, 2001).

The relationships between sediment toxicity and sediment contaminants were also assessed graphically (HMDS) and by regression analysis. Initially, to examine general and dominant patterns in the data, comparisons between the toxicity responses and contaminant conditions were made based on integrative, compound variables (from either summation or multivariate ordination of measurement variables). Euclidean distances were calculated for all pairs of the 21 sites based on the 10 toxicity variables, and HMDS performed on the matrix for a 2-dimension solution. The concentrations of various metals were ordinated by principal components analysis (PCA) on log(x)-transformed data. The eigenanalysis was performed on the correlation matrix. Total PCB and PAH variables were integrated by summing the concentrations of the individual congeners. To better detect less dominant (though significant) relationships between two or a few variables, regression analyses were also conducted using the original measurement variables (i.e., individual toxicity endpoints and concentrations of individual compounds).

3.4.4 Benthic community

Using the mean values of abundance counts for macroinvertebrate taxon, the biological structure of the data was examined using ordination (HMDS) applied to a Bray-Curtis distance matrix. Analyses were performed at the family level, as this taxonomic detail is shown to be sensitive for the determination of stress (Reynoldson et al., 2000). Principal axis correlation (Belbin, 1993) was used to identify significant families and habitat attributes. Using the ordination axes scores from the HMDS, sites were also compared using an ANOVA with adjustments for covariates using general linear model (Minitab, 2000). Comparisons to control using the ordination axes scores were made using Bonferroni's simultaneous test. Pairwise comparisons of the means from all sites were performed using Tukey's test. Site comparisons were also made using taxa diversity as well as log(x)-transformed abundances of the following major groups found in Lyons Creek: Tubificidae (Oligochaeta), Chironomidae (Diptera), Hyalellidae (Amphipoda), Gammaridae (Amphipoda), Caenidae (Ephemeroptera), Coenagrionidae (Odonata), and Leptoceridae (Trichoptera).

4 Step 3: Potential Risks based on Contaminant Concentrations

4.1 Overview

Step 3 determines whether the concentration of PCBs observed in the sediment, which exceed their respective guidelines and/or the concentrations of the substances that can biomagnify are significantly elevated (Figure 1). This is determined by statistically assessing which contaminants significantly exceed the reference concentrations (Chapman, 2005).

Two fundamental points are addressed in this step (Chapman, 2005):

i) Whether the concentrations in the sediments of the contaminants of concern, identified in the previous steps, are above the minimal levels shown to be toxic to the biota living in the sediments, and whether these concentrations are not statistically different from the concentrations identified in the reference sites, and;

ii) Whether the contaminants of concern that biomagnify are present in the sediments at concentrations that do not significantly differ from the reference sites.

In establishing these points, the direction in which to proceed is determined (Chapman, 2005):

Comparison	Decision
Concentrations of all sediments COPC are greater than the SQG-low and substances that can biomagnify are less than or equal to reference conditions and do not differ significantly from the reference	No further assessment or remediation is required
Concentrations of one or more sediments COPC which are greater than the SQG-low and/or on or more substances are present that can biomagnify which are greater than reference conditions is significantly higher than the reference	Potential risk: further assessment is required

COPC – contaminants of potential concern
SQG-low guideline levels resulting in toxicity in less than 5% of the fauna

4.2 Comparison with existing objectives and guidelines

4.2.1 Sediment grab samples

Surficial sediment samples collected from Lyons Creek and the four reference streams in 2002 and 2003 were clustered and ordinated based on their sediment chemistry (Table 6, Figures 6 & 7). Cluster analysis groups the sediment samples into six groups (Table 6). Group 1 contains 7 samples, all of which are from sites below Ridge Road and above Highway 140; 5 locations are represented (LC06, LC08, LC10, LC12 and LC14), only 1 of these samples (LC14) was collected from 2002 (Table 6). Group 2 and Group 4 contain one sample each (LC01 and LC03 respectively), both samples were collected in 2002 from above Ridge Road. Group 3 contains 6 samples, 2 from 2002 and 4 from 2003; this group represents 3 Lyons Creek locations in the vicinity of Highway 140 (LC14, LC17 (2002 & 2003) & LC18), and 2 reference locations (Usshers Creek and Black Creek). Group 5 contains 5 samples, all from the lower portion of the creek and all collected in 2003; this group represents 4 sample locations (LC19, LC22, LC23 and LC38). The final group, Group 6, is the largest group and contains 11 samples; 6 of the 11 samples were collected from the reference streams in 2002 and 2003, the remaining 5 samples were collected in 2002 and represent 3 Lyons Creek locations (LC16, LC29 and LC38).

Ordination of the sediment samples, based on sediment chemistry, best explained the cluster groupings with respect to chemical parameters observed in the sediment over three axes (Figures 6 & 7, Stress = 0.052). The ordination plots (Figures 6 & 7) show a strong separation in the site groupings along NMDS Axis 1, which correspond to elevated concentrations of PCBs, PAHs and OCs in the upper portion of Lyons Creek (Table 6, Figures 6a,b,c & 7a,b,c). The PCB, PAH and OC concentrations are generally highest at the site downstream of the Welland Pipe discharge (LC03), often exceeding the PSQG LEL criteria by an order of magnitude (Table 6). Group 1 sites, which represent an area of the creek between Ridge Road and Highway 140 are also elevated in PCBs and many of the PAHs and OCs, although not to the same degree as LC03; only two OCs (Dieldrin and DDE), four PAHs (Benzo(a)pyrene, Benzo(g,h,i)perylene, chrysene and Indeno(1,2,3-c,d)pyrene) and PCBs exceed their respective LEL criteria. Copper, nickel and zinc all exceed the PSQG SEL criteria at LC03 (Figure 9), zinc exceeds the SEL by almost an order of magnitude and appears to be associated with NMDS Axis 1. The average concentration of zinc from the Group 2 sites also exceeds the PSQG SEL criteria (Table 6). The remaining metals tend to influence the position of the sites in ordination space along NMDS Axes 2 and 3. Beryllium, barium, cobalt and vanadium generally were high at the Group 5 sites, and lowest at the most upstream location (Group 2, LC01) which is reflected in the position of these groups in ordination space along Axis 2 with respect to these parameters (Figure 7a & e). Calcium, strontium and to some extent titanium are represented by Axis 3, and tend to be higher in the upstream location (Figure 8a & e).

5 Step 4: Potential for Biomagnification

5.1 Overview

Using [PCB] in sediment and resident sediment dwelling organisms, concentrations of PCBs are modeled in the consumers of sediment-dwelling organisms and their predators, through to the top predators to determine whether or not there is a potential risk. Modeling the concentrations through to the top predators includes the identification of biomagnification factors (BMFs) and the assumption is made that fish feeding is limited to the area under investigation (Chapman, 2005).

Whether or not PCB biomagnification is a potential concern is then determined (Chapman, 2005):

Comparison	Decision
There is no potential for contaminant biomagnification from the sediments through the aquatic food chains	No further assessment or remediation is required relative to biomagnification
There is potential for contaminant biomagnification from the sediments through the aquatic food chains	Potential risk: further assessment of biomagnification is required

5.2 Bioaccumulation in biota

5.2.1 Benthic macroinvertebrates

PCBs

Total PCB concentrations in benthic invertebrates ($[PCB]_{inv}$) are approximately one to two orders of magnitude higher at Lyons Creek sites than at reference sites (Figure 10). Benthos collected from LC12 have the highest [PCBs], ranging from 1000 to 52580ng/g (mean 17400ng/g), followed by sites LC03 (range: 200 to 7230ng/g; mean: 2700ng/g) and LC17 (range: 300 to 5170ng/g; mean: 3460ng/g) (Table 7). Not all four taxa were analysed at each site due to insufficient tissue quantity. On a whole-body, uncleared-gut basis, amphipods accumulate more PCBs at 7 of the 11 Lyons Creek sites (most sites between the pumping station and the railway), while oligochaetes accumulate the most at 3 sites including LC12 (Table 7). Lowest [PCBs] are found in the reference creek benthos (range: 50 to 400ng/g; mean: 150ng/g), followed by benthos collected from site LC01 (range: 230 to 720ng/g; mean: 430ng/g) (Table 7). The isomeric composition of taxa is provided in Milani and Grapentine (2005). Overall, taxa collected from reference creek sites consist primarily of the lower chlorinated biphenyls, whereas the higher chlorinated biphenyls occur in taxa collected between LC08 to LC29.

Comparison of [PCB] to guideline value and reference

Total [PCB] in each invertebrate taxon, converted to a wet weight basis, is shown in Figure 11. The green dotted line represents the 99th percentile for the reference site concentrations and the red line is the IJC tissue objective for the protection of birds and animals which consume fish (100ng/g ww, IJC 1988).

Chironomid

Six sites are above the IJC tissue objective for PCBs (sites LC12 through LC19) and all sites are above the maximum reference site concentration (no data are available for sites LC01 and LC03) (Figure 11). Highest PCB accumulation occurs at sites LC12 and LC17, which show very similar chironomid concentrations. Reference and Lyons Creek site [PCB] range from 12 to 24ng/g and from 72 to 465 ng/g ww, respectively.

Amphipod

Eight sites are above the IJC objective (sites LC03 through LC19) and all Lyons Creek sites except LC38 are above the maximum reference concentration (Figure 11). Highest PCB accumulation occurs at site LC12, followed by LC17 and LC03, where amphipods show similar concentrations. Reference and Lyons Creek concentrations range from 6 to 25ng/g ww and from 10 to 1386ng/g ww, respectively.

Oligochaete

Six sites are above the IJC objective (sites LC03, LC12, LC16, LC17, LC18 and LC29) and all sites are above the maximum reference concentration except LC01 and LC08 (Figure 11). Oligochaetes accumulated the highest concentration of PCBs at site LC12. Reference and Lyons Creek concentrations range from 8 to 43ng/g ww and from 33 to 6149ng/g ww, respectively.

Odonate

One site (LC12) is above the tissue objective and sites LC12 and LC16 are above the maximum reference concentration (Figure 11). Reference and Lyons Creek concentrations are similar, ranging from 12 to 36ng/g ww at reference sites and from 3 to 55ng/g ww at Lyons Creek sites. Odonates accumulate the least amount of PCBs of the four taxa at almost all Lyons Creek sites.

Coplanar PCBs

Concentrations of PCBs in invertebrates, expressed in toxic equivalent units (TEQ), are shown in Figure 12. The red line is the CCME avian tissue residue guideline (TRG), which in the current study applies to the diving duck receptor (the only wildlife receptor in the study that would feed directly on benthic invertebrates), and refers to the concentration of total PCBs in the diets of avian that consume aquatic biota. The TRG for avian, derived by Environment Canada, is 2.4 ng $TEQ \cdot kg^{-1}$ diet ww (CCME, 2001). The mammalian TRG of 0.79 ng $TEQ \cdot kg^{-1}$ diet ww, while lower, was not used in this case as there is no direct feeding relationship from invertebrates to mammals (mink). The TEQ is the summation of each of the 12 co-planar PCB congener's toxic equivalency factor for avian (TEF) × $[\text{coplanar PCB}]_{inv}$. The TEFs were developed to compare toxicities of various PCB congeners relative to the most potent PCB inducer in the cytochrome enzyme system (2,3,7,8-TCDD) (CCME, 2001), and for avian range from 0.00001 to 0.1 (Table 5). All Lyons Creek sites except LC01 and LC03 have at least one taxon with a [TEQ] above the avian TRG (Figure 12). Sites where all four taxa have [TEQ] above the TRG are LC14, LC16, LC18 and LC38. The high [TEQ] observed at sites LC14, LC16, LC18, LC29 and LC38 are due to the high concentration of PCB 126 in the benthos samples. PCB 126 (as well as PCB 81) has the highest TEF (0.1) (Table 5). The high [TEQ] for site LC12 is due primarily to the high concentration of PCB 105 and PCB 118 in the amphipod and oligochaete samples. No reference site [TEQ] is above the TRG. The percentage of coplanar to total PCBs varies among taxa and sites, with an overall range in biota from 0 to 17% at Lyons Creek sites and from 0 to 12% at reference sites. The pattern observed for sediment (overall increase in percentage of coplanar PCBs with distance downstream) is not seen in the biota. The highest percentage of coplanar PCBs to total PCBs is at site LC14 (chironomids – 17%), and for reference sites is BLC01 (odonates – 12%). The highest coplanar PCBs are found in the odonates at 45% of Lyons Creek sites followed by the chironomids at 36% of Lyons Creek sites (odonates have the lowest total PCBs at all Lyons Creek sites; Figures 10 & 11). Coplanar PCBs are very significantly related to total PCBs for all taxa ($r^2 = 0.853$ to 0.999, $p \leq 0.001$).

5.2.2 Relationships between PCB concentrations in tissue and sediment

Concentrations of total PCBs in each invertebrate taxon vs. total PCBs in sediment are plotted in Figure 13, with fitted regression lines using sediment [PCB] alone as the predictor. For the chironomid and amphipod, the slopes are significant ($P \leq 0.05$) and the adjusted r^2 values are 0.625 (chironomid) and 0.874 (amphipod) (Table 8). Predictions of $[\text{PCB}]_{inv}$ are moderately improved for both taxa with pH in the model, bringing the R^2_{adj} values to 0.749 and 0.918 for the chironomid and amphipod, respectively (Table 8). In both cases $[PCB]_{sed}$ is the strongest predictor ($P \leq 0.001$) and the coefficients for pH are positive. For the oligochaete, the addition of pH (positive coefficient), TP in the overlying water (positive coefficient) and sand (negative coefficient) result in a significant slope, with an adjusted r^2 value of 0.783. For the odonate, the slope is not significant, and no additional predictors improve the model.

5.2.3 Calculation of receptor tissue PCB concentrations

Obtaining the information required to estimate PCB concentrations in receptors involved reviewing published literature, unpublished reports, databases, web pages and any other sources of data on BMFs relevant to the benthic invertebrate taxa and receptors; assessing the quality of the BMF data; and tabulating BMFs and estimates of their variability, together with information on the BMF's determination (e.g., location of study, organisms involved, proportion of receptor's diet that is invertebrates, effects of cofactors (if any), assumed ingestion rates and home ranges). Complete results of the PCB literature review and the details and methods used in predicting PCB concentrations in receptor species are provided in Milani and Grapentine (2005). The PCB concentrations in six receptors were predicted on a total PCB basis, using (a) total PCB measurements in invertebrates and (b) total PCB BMF values. Receptors relevant to Lyons Creek included benthivorous fish (catfish, carp), small benthivorous/piscivorous fish (sunfish), large piscivorous fish (bass), diving ducks (goldeneye), and mammals (mink) (Milani and Grapentine, 2005).

Invertebrate PCB concentrations used in the predictions of PCB in receptors were the observed $[PCB]_{inv}$ values for taxa collected from the site. These values were used to obtain minimum and maximum observed $[PCB]_{inv}$ for the taxa collected from the site. "Medium" $[PCB]_{inv}$ for the site was calculated as the mean of the values. Since fish contaminant data are reported for the most part on a wet weight basis, and the guidelines used in this study are also based on wet weights, PCB concentrations in invertebrates were converted to a wet weight basis (see Milani and Grapentine, 2005) for details). For each site, minimum, intermediate and maximum concentrations of PCBs for each receptor were predicted by:

$$C_{rec} = FCM \times C_{inv}$$

where:
C_{rec} = PCB concentration in the consumer (receptor) species
C_{inv} = PCB concentration in invertebrates
FCM = food chain multiplier

The FCM represents the cumulative biomagnification of a substance from one trophic level to a higher trophic level (USEPA 1997c). Whereas a BMF applies to only one trophic level transfer, a FCM refers to one or more, and may be a multiple of more than one BMF. Thus, $FCM = BMF_1 \times BMF_2 \times BMF_3 \times \ldots \times BMF_{n,}$ where 1, 2, 3,…, n are transfers of one trophic level.

Corresponding low, medium and high $[PCB]_{inv}$ and FCMs were used. From the available values, the lowest and the highest FCMs were used for the minimum and maximum prediction, the mean of the values was used for the intermediate prediction. The predicted PCB concentrations in receptors are generic in that they are not specific to particular tissues.

Presentation of model outcomes

Assumptions for model predictions are provided in Milani and Grapentine (2005). Predicted concentrations of PCBs in each receptor species at each sampling site, are shown in Table 9 and Figure 14. Receptor PCB concentrations are presented for "minimum", "intermediate" and "maximum" levels of PCB exposure and uptake scenarios. In each subfigure, predicted $[PCB]_{rec}$ for the six receptors are presented in bar charts comparing reference and test sites. In the bar charts, which have the same logarithmic scales in all subfigures, two criteria concentrations are marked: (1) the maximum (= 99th percentile) of the predicted $[PCB]_{rec}$ for the reference sites, and (2) the IJC tissue objective for the protection of birds and animals which consume fish (100 ng/g ww).

Exceedences of criteria

PCBs – minimum

Under the minimum uptake and exposure scenario, sites LC12 and LC16 (just slightly) are above the IJC tissue objective for the bullhead and carp whereas only LC12 is slightly above the objective for the bluegill and bass (Table 9; Figure 14). (The "low" FCM estimates for bass and bluegill are lower than those for the carp and bullhead.) Site LC03 is below the tissue objective and reference maximum as the minimum invertebrate tissue value used in the calculation is very low (0.003 µg/g ww for the odonate). All reference sites are below the IJC tissue objective. All Lyons Creek sites except LC03 and LC38 are above the predicted reference maximum for each receptor.

PCBs – intermediate

Under the intermediate uptake and exposure scenario, all Lyons Creek sites exceed the IJC tissue objective for all receptors, whereas reference site exceedences are predicted at 0 sites for the bullhead and the bluegill, and at all sites for the carp and bass (Table 9; Figure 14). All Lyons Creek sites are above the predicted reference maximum for each receptor.

PCBs – maximum

The maximum predictions of $[PCB]_{rec}$ result in all Lyons Creek sites exceeding the IJC tissue objective and the reference sites maximum for all fish receptors (Table 9; Figure 14). Reference sites also exceed the tissue objective for all fish receptors.

5.2.4 Mussels

No significant difference in the mussel tissue contaminant concentrations between sites is observed in any of the parameters measured, with the exception of PCBs (Table 10).

Ordination of the mussel data, based on chemical concentrations in the tissue, group together the reference creeks (BC, TC & UC), the Balsam Lake reference mussels, the most downstream Lyons Creek location (LC38) and the mussels deployed at most upstream Lyons Creek locations in 2002 (Group 1; Figure 15). The upstream locations sit on the periphery of this group. These locations do not significantly differ from each other in PCB concentration. PCB concentrations are strongly correlated with Axis 1 (Figure 15b) and explain much of the movement in ordination space of the remaining groups along this axis. The PCB concentrations at each site within each group do not significantly differ from each other. With the exception of Group 4, which is found to be similar to both Groups 3 and 6, PCB concentrations between the groups are generally significantly different from each other (ANOVA, p<0.001).

The highest PCB concentrations are observed in the mussels from Group 7 (LC17), which range from 220ng/g to 510ng/g (mean: 403 ng/g) (Table 10, Figure 16). Tissue concentrations in this group as well as Group 5 (mean PCB = 269ng/g) are all above the IJC guideline for the protection of fish-eating wildlife (IJC, 1988) of 100ng/g and are all significantly higher than any other sample (ANOVA, p<0.001). The IJC guideline in these two groups is exceeded by 1.8 to 5 times. All of the samples in Groups 5 and 7 were collected in 2003, and are all located in the area between downstream of Ridge Road (LC08) and of Highway 140 (LC17). Members from Group 6 also exceed the IJC guideline (mean PCB = 122ng/g, range 75 to 159ng/g), and members from this group are located from Highway 140 (LC16) to the CN railway (LC19).

Based on the toxic equivalency factors for the co-planar (dioxin-like) PCB congeners (CCME, 2001), an over all Toxic Equivalency Value (TEQ) was calculated for the mussel tissue deployed in both 2002 and 2003. The CCME have TEQ guidelines for mammalian and avian species (CCME, 2001), which aims to protect mammals and birds which consume aquatic organisms; the mammalian TEQ value is 0.79ng TEQ/kg. The TEQs calculated for these sites range from zero to 2.54ng TEQ/kg collected in 2002 from LC17 (over three times the tissue residue guideline, Figure 17). Mussels from the reference streams, Balsam Lake and the upstream and downstream locations sampled in both 2002 and 2003 are all below this criterion and are significantly lower than TEQ values observed at the other locations (ANOVA, p<0.001).

5.2.5 Fish

Forage fish

In 2002, total PCB concentrations in forage fish samples vary greatly from each location (Figure 18). At LC03, bluntnose minnows have a mean concentration of 3560ng/g wet weight and differ significantly (ANOVA, p<0.007) from the other locations. Upstream of Highway 140 at LC16, the same species of forage fish has a mean PCB concentration of 7857ng/g wet weight, which is significantly higher (ANOVA, p<0.001) than all other locations, including LC03. At LC38, downstream of the QEW, the only replicate of bluntnose minnnow has a total PCB concentration of 48ng/g, and golden shiners have a mean PCB concentration of 19ng/g. Forage fish at LC38 do not differ significantly in [PCB] from the reference locations or the Welland River.

Bluntnose minnows from the Welland River have a mean PCB concentration of 35ng/g, and spottail shiners from the same location have a PCB concentration of 7ng/g (Table 11). Common shiners from Beaver Creek have an average PCB concentration of 11ng/g. Golden shiners from Black Creek average 26ng/g total PCBs.

Forage fish from Lyons Creek below the QEW, the Welland River, Beaver Creek and Black Creek all have PCB concentrations that are considered relatively low and are all under the IJC guideline (IJC, 1988) for the protection of fish eating wildlife of 100ng/g (Figure 18a). Forage fish collected from the more upstream locations (LC03 and LC16) have total PCB concentrations which exceed the IJC guideline by up to more than 90 times, and on average 35 times at LC03 and 78 times at LC16 (Figure 18a). These data suggest that there is an upstream source of PCBs that may result in potential harm to biota that may consume the fish from these locations.

The forage fish samples were also analysed for dioxin-like PCBs. Seven dioxin-like PCB congeners were identified in the samples. From these seven congeners, Toxic Equivalency values (TEQs) were calculated (Figure 18b). A similar trend to that observed for the total PCB data is observed in the TEQ data, with the TEQ values for LC03 and LC16 significantly higher than all other sites (ANOVA, $p>0.001$). Lyons Creek below the QEW, the Welland River, Beaver Creek and Black Creek all have relatively low TEQ values, below the CCME guideline (CCME, 2001) for mammals of 0.79ng/kg TEQ. At LC03 and above Highway 140 (LC16) the fish collected exceed the TEQ guideline (33.6ng/kg TEQ and 56.8ng/kg TEQ respectively). These concentrations are extremely high and pose a threat to mammals that may consume the fish from these locations.

In 2003, total PCB concentrations are highest in bluntnose minnow at LC03 (2525ng/g ww) (Table 11). The next highest concentration is observed at LC17 (mean: 1760ng/g ww). The PCB concentrations at these two locations do not differ significantly from each other, although LC03 is significantly higher than all other sites (ANOVA, $p>0.001$). An overall downstream trend in PCB concentrations is observed in the PCB concentrations of bluntnose minnow in Lyons Creek (Figure 19a). Golden shiner PCB concentrations increase downstream to LC16 (1700ng/g ww), after which a steady decrease was observed along a downstream gradient (Table 11, Figure 19a).

Unlike the relationships between total PCB concentrations and TEQ values observed in 2002, no such relationship exists in 2003 (Figure 19b). The TEQ values do not appear to be linked to the total PCB concentrations, but rather show a similar pattern to those observed in 2002 in which the highest TEQ values are observed at Highway 140 (LC17, 318ng TEQ/kg) and are significantly higher than all other sites (ANOVA, $p>0.001$). Total PCB concentrations are second highest at LC03 (mean: 126ng TEQ/kg). A decline in TEQ values with distance downstream of Highway 140 for both bluntnose minnow and golden shiner is observed.

Bluntnose minnows collected in 2002 and 2003 were compared to assess differences between years and within Lyons Creek. Total PCBs, TEQs and fish length and lipid concentrations were compared (Figure 20). Although the fish collected in 2002 from LC16 are larger than at the other locations, there are generally no significant differences in the overall size of the fish collected from Lyons Creek or Usshers Creek (Figure 20d). Lipid concentrations in Lyons Creek do not significantly differ from each other, either between locations of year (Figure 20c). The fish collected from Usshers Creek, however, have significantly more lipid than any of the Lyons Creek sites (ANOVA, p<0.001), suggesting that these fish are healthier than those from Lyons Creek.

Total PCB concentrations in the upper portion of Lyons Creek are considerably higher in 2002 than in 2003; concentrations observed at LC16 in 2002 are significantly higher than any other site sampled (ANOVA, p<0.002), and concentrations at LC03 in 2002 are significantly higher than Usshers Creek (ANOVA, p<0.001) (Figure 20a). Tissue PCB concentrations at all other sites do not differ significantly from each other, but a general downstream reduction in PCB concentrations is observed (Figure 20b). Total PCB concentrations exceed the IJC guideline in both years and at all sites from LC03 to LC24, ranging from 340ng/g in 2003 at LC24 to 7857ng/g in 2002 at LC16. Total PCB concentrations downstream of the QEW, at the mouth of Lyons Creek and in Usshers Creek are all well below the IJC criteria for the protection of fish-eating wildlife (mean range: 34.8-46ng/g).

Despite the elevated concentrations of PCBs observed in 2002, the overall TEQ concentrations calculated from the 12 co-planar congeners listed in the CCME guidelines (CCME, 2001) are generally higher in 2003 (Figure 20a). The TEQ concentrations collected from all other sites, in both 2002 and 2003 do not differ significantly. The TEQ concentrations exceed the CCME tissue residue criteria at all sites from LC03 to LC24; a similar trend to that observed in total PCB concentrations. Samples collected in 2002 downstream of LC24 are below the CCME criteria. The TEQ concentrations from the 2003 collections at Usshers Creek exceed the CCME criteria. These differences in the 2002 and 2003 TEQ concentrations can be explained by the presence of PCB congener 126, which is present in the 2003 samples but not in the 2002 samples (Table 11), and PCB 126 has the highest TEF value (0.1) of all 12 co-planar PCB congeners considered in the TEQ calculations (Table 5).

Sport fish

Sport fish were collected from two locations in 2002; upstream of Highway 140 at LC16, and downstream of the QEW (LC38). Bowfin (*Amia calva*), white sucker (*Catostomus commersoni*), carp (*Cyprinus carpo*), brown bullhead (*Ictalurus nebulosus*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lapomis macrochirus*), largemouth bass (*Micropterus salmoides*) and black crappie (*Pomoxis nigromaculatus*) were all collected from LC16. Downstream of the QEW, all of these fish, with the exception of white sucker, were collected, as well as northern pike (*Exos lucius*), rock bass (*Ambloplites rupestris*), white crappie (*Pomoxis ammularis*) and yellow perch (*Perca flavescens*). In 2003, sport fish were only collected from Highway 140 (LC16). At this time, only black crappie, bowfin, carp, largemouth bass, pumpkinseed, rock bass and white sucker were collected. The fish collected in 2003 were analysed for congener specific PCBs as well as total PCBs.

Sport fish have been collected from Lyons Creek at Highway 140 and at the QEW since 1991. The historical total PCB concentrations in the fish collected from 1991 onwards were compared to the 2002 and 2003 data in Figure 21. The mean values have also been compared to the consumption guidelines outlined in the *Guide to Eating Ontario Sport Fish* (MOE, 2005). Fish collected from the QEW (LC38) in 2000 and 2002 were compared (Figure 21b), and although PCB concentrations in the carp are the overall highest for both years, only the carp collected in 2000 (mean: 170ng/g) has any restrictions; these fish are restricted to 4 meals/month. All other fish, for both 2000 and 2002, are below the first level of restrictions (153ng/g: MOE, 2005).

Total PCB concentrations in the sport fish collected from Highway 140 (LC16) are considerably higher than those collected from downstream of the QEW (Figure 21). Although carp show no statistically significant change in PCB concentrations over the past years (regression, $r^2<0.03$), PCB concentrations in the carp from Highway 140 appear to have generally declined since 1991 (Figure 21a). This general trend is also observed in other fish species. All fish collected from all years have had some degree consumption restrictions.

Two-tailed t-tests were used to compare the 2002 PCB concentrations between the two locations sampled. The mean concentrations of PCBs in the fillets of the fish collected from Highway 140 are significantly higher than those in the same species of fish (bowfin, carp, brown bullhead, pumpkinseed, bluegill, largemouth bass and black crappie) observed downstream of the QEW at LC38 (Table 12). When the mean concentrations observed in fish from Highway 140 are compared to the *Guide to Eating Ontario Sport Fish* (MOE, 2005) concentrations for restrictions on consumption, there is a complete consumption restriction, with the exception of brown bullhead (140ng/g) for the sensitive population, which includes children under the age of 15 and women of child-bearing age. For the general population, bluegill, bowfin and largemouth bass are restricted to four meals per month (188, 190 and 278ng/g respectively), black crappie, pumpkinseed and white sucker are all restricted to two meals per month (535, 390 and 540ng/g respectively), and carp are restricted to one meal per month (1164ng/g; Figure 21a).

In 2003, all of the fish collected at Highway 140 have a complete consumption restriction for the sensitive population, with PCB concentrations in the fish ranging from a mean of 313n/g in black crappie and rock bass to 1157ng/g in white sucker. For the general population, all of the fish, with the exception of carp and white sucker are restricted to two meals per month (PCB concentrations for this category ranging from 305-610ng/g). Carp and white sucker are restricted to one meal per month (PCB concentrations 610-1220ng/g).

When regressions were run on all the existing data to assess the concentrations which would likely be observed in fish from different size classes, other fish are also restricted for consumption (Table 13). The Guide to Eating Ontario Sport Fish advises no more than 8 meals per month should be consumed; hence advisories of ‘8’ in Table 13 suggest that there are no restrictions on the fish of that size category. At Highway 140

(LC16), all fish listed, with the exception of bluegill, have a complete restriction for the sensitive population (women of childbearing age and children under 15) in the larger size ranges. Carp, brown bullhead, rock bass, black crappie and pumpkinseed are completely restricted at all sizes. Downstream of the QEW, only carp (55cm and greater), largemouth bass (>30cm) and yellow perch (>25cm) have complete restrictions for the most sensitive populations.

For the general population, complete restrictions are observed at Highway 140 for carp (>50cm) and white sucker (>35cm) (Table 13). Brown bullhead (30-35cm), largemouth bass (30-40cm) and pumpkinseed (>15cm) are restricted to 1 meal/month, and rock bass (>15cm) and black crappie (20-25cm) are restricted to 2 meals/month. Bluegills are restricted to 4 meals/month. All restrictions are a result of elevated PCBs. Downstream of the QEW, carp, brown bullhead, largemouth bass and yellow perch are the only fish restricted; carp (>55cm) is restricted to 1 meal/month, and brown bullhead (30-35cm), largemouth bass (35-40cm) and yellow perch (25-30cm) are all restricted to 4 meals/month. There are no restrictions downstream of the QEW due to PCBs for any of these fish.

The calculated TEQ values were derived from the observed concentrations of the 12 co-planar PCBs in the sport fish collected from Highway 140 in 2003. All of the fish species collected exceed the CCME criteria (0.79ng TEQ/kg) by up to 500 times (white sucker: Table 14, Figure 22). The lowest mean TEQ values are observed in carp (76.2ng TEQ/kg), which have the highest mean PCB concentration (mean: 1116ng/g; Table 12, Figure 22). The co-planar PCB concentrations driving the TEQ values are primarily congener IUPAC number 126 (3,3’,4,4’,5 pentachlorobiphenyl), followed by congener 118 (2,3’,4,4’,5 pentachlorobiphenyl) which mirrors the congeners driving the TEQ values in the forage fish from 2003. Carp TEQ values are the only values that differ significantly from those from any of the other species; TEQ values in carp are significantly lower than those observed in largemouth bass (mean: 76.2ng TEQ/kg and 181ng TEQ/kg respectively, p=0.015).

5.3 Modeled versus actual values

Comparisons of the predicted fish receptor [PCB] with actual [PCB] in fishes collected from Lyons Creek are a means of qualitatively ground truthing the prediction model. Measured [PCB] in fish receptors (sampled at the same time as the benthos) are indications of actual bioaccumulation of PCBs which is thought to occur primarily through dietary sources at the higher trophic levels. Sport fish, such as Brown Bullhead, Carp, Bluegill and Largemouth Bass, were collected just upstream of Highway 140 (LC16) and downstream of the QEW (near site LC38) (see above). Mean [PCB] in all fish fillets collected in 2002 range from 140 to 1164ng/g ww at Highway 140 and from 24 to 76 ng/g ww downstream of the QEW (Fletcher and Petro, 2005). Fish collected in 2003 at Highway 140 are all above the IJC tissue objective of 100ng/g, and the highest [PCB] is observed for carp. Actual values for all sport fish receptors (collected at Highway 140) fall between the minimum and intermediate predicted values. The minimum exposure and uptake scenario underestimates biomagnification while the intermediate and maximum scenarios are from 4 to 30 times and from about 14 to 622 times higher than actual mean concentrations, respectively (BMFs used in the models are based on both whole fish as well as dorsal muscle [PCB] concentrations, whereas actual fish concentrations are based solely on skinless boneless fillets).

6 Step 5: Sediment Toxicity

6.1 Overview

In this step (Figure 1), toxicity of the sediments along Lyons Creek (from the Welland Canal to downstream of the QEW), as well as the reference areas is determined. Laboratory toxicity tests were conducted with four appropriately sensitive, standardized sediment-dwelling and/or sediment associated test organisms and acute and chronic end-points (survival, growth and reproduction) considered (Chapman, 2005).

Comparison	Decision
All sediment end-points are less than or equal to 20% difference from the reference and does not statistically differ from the reference	No further assessment or remediation is required relative to laboratory toxicity
One or more of the sediment end-point are greater than 20% different from the reference	Potential risk: further assessment is required

6.2 Whole sediment toxicity tests

Mean species survival, growth, and reproduction at Lyons Creek and reference creek sites are shown in Table 15. The established criteria for each category (non-toxic, potentially toxic and toxic) based on Reynoldson and Day (1998) for each species are also included. The Great Lakes (GL) reference means for each endpoint are also included. (All sites were compared to GL reference sites.)

Toxicity is evident at three sites: LC03, LC08 and LC12. At site LC03, there is acute toxicity to *Hyalella* (40% survival), *Hexagenia* (2% survival) and *Chironomus* (39% survival); and low *Tubifex* cocoon and young production. At site LC08, there is acute toxicity to *Hyalella* (35% survival), *Hexagenia* (4% survival) and *Tubifex* (35% survival). At site LC12, there is acute and chronic toxicity to *Hexagenia* (46% survival, negative growth) and potential toxicity to *Chironomus* (reduced survival and growth).

Results of the BEAST toxicity assessment (overall toxicity) are summarized in Table 16. Most Lyons Creek sites (11 of 15) are non-toxic, one site is potentially toxic (LC14) and three are severely toxic (LC03, LC08, LC12). The toxic sites (as well as the potentially toxic site) are all located upstream of Highway 140. All reference sites are non-toxic, except BLC02 which is potentially toxic. The ordination plots, summarized on two of three axes, are provided in Milani and Grapentine (2005). The relationship between the habitat variables and toxicity is also shown in these ordinations. Habitat variables are not highly correlated to ordination axes scores in any ordination (highest correlation is seen for Zn, $r^2 = 0.51$, and remaining correlations have $r^2 \leq 0.16$). The departure of LC03 and LC08 from reference is most severe, and these sites are oriented along a gradient of increasing Zn. Zinc is elevated at both sites (LC03: 7969 µg/g, LC08: 1080 µg/g).

6.3 Sediment toxicity and contaminant concentrations

The BEAST assessment does not incorporate any information on organic contaminants in the sediment because organic contaminant concentrations were not measured in Great Lakes reference sediment samples. Therefore, examination of relationships between sediment toxicity and sediment contaminants both graphically and by regression analysis may aid in identifying possible causes of toxicity attributable to organic contaminants (as well as inorganic compounds, sediment nutrients and sediment grain size). The ordination of the multiple measurements of sediment toxicity by HMDS for the Lyons Creek and reference sites produced two descriptors of sediment toxicity (Figure 23). The resultant axes represent the original 10-dimensional among-site resemblances well (stress = 0.07). Principal axis correlation produces a vector for each toxicity endpoint along which the projections of sites in ordination space are maximally correlated. With the exception of *Hyalella* growth (Hagw), all endpoints are significant at (r^2 range: 0.41 to 0.95, $P \leq 0.05$), with *Hexagenia* survival (Hlsu) being the most significant endpoint. The most significant environmental variables include total PCBs, total PAHs and Zn (r^2 range: 0.73 to 0.84, $P \leq 0.001$). Most toxicity endpoints are positively correlated with both axes; therefore, the greater the toxicity of a site, the lower its score for Axis 1 and 2 generally. Site LC08 is distinctly separated from the other sites along Axis 1 and LC03 and LC12 are separated from the other sites on both axes and are oriented along a gradient of increasing PCBs, PAHs and Zn (Figure 23).

Integrated toxicity descriptors (ordination axes scores from the HMDS) and individual measurement variables (sensitive endpoints such as survival/growth of *Hexagenia*, *Hyalella* survival and *Tubifex* young production) were plotted against concentrations of coplanar and total PCBs, total PAHs, an integrated metal toxicity descriptor (nine metals ordinated by Principal Components Analysis) as well as the individual concentrations of metals (As, Cd, Cr, Cu, Fe, Hg, Ni, Pb, Zn), sediment nutrients (TP, TN, TOC) and particle size (percents clay, sand, silt, and mean particle size). Complete results with plots are provided in Milani and Grapentine (2005). The most significant relationships are shown below. Generally, dependent on the toxicity descriptor, toxicity is related to a combination of metals, or to total PAHs and PCBs, with individual toxicity variables and contaminant concentrations showing the strongest relationship. Survival endpoints were arsine square root(x) transformed and growth and reproduction endpoints were log(x) transformed. The degree to which sediment contaminants account for toxicity was assessed by fitting regression models using best subset procedures. Models were fitted for all combinations of (a) individual metals (b) nutrients and particle size (c) total PCBs, PAHs and then (d) all combinations of the best predictors from the three groups.

(This procedure was used to avoid computational difficulties arising from working with 18 predictors simultaneously.) The best models were those having maximum explanatory power, based on R^2_{adjusted}. Predictor coefficients that are negative indicate that decreased survival, growth or reproduction is related to increased contaminant concentrations.

HMDS Axis 1

Axis 1 is graphically related to total PAHs ("logPAHs"). This contaminant descriptor accounts for 56% of the variance in the Axis 1 toxicity descriptor.

Tox Axis1 = 0.123 - 1.28 logPAHs ($p \leq 0.001$)

HMDS Axis 2

Axis 2 is graphically related to total PAHs and PCBs and accounts for 63% of the variance in the Axis 2 toxicity descriptor.

Tox Axis2 = 0.278 - 1.19 logPAHs + 0.244 logPCBs ($p \leq 0.001$)

Hyalella survival

For *Hyalella* survival (Hasu), 25.0% of the variability is explained by total PCBs, 30.9% is explained by PCB 105, and 55.6% of the variability is explained by Pb alone:

Hasu = 1.09 - 0.0909 log total PCBs (p = 0.012)
Hasu = 1.17 - 0.100 log PCB 105 (p = 0.005). Lack of fit test not significant (p = 0.073).
Hasu = 2.26 - 0.706 log Pb ($p = \leq 0.001$)

Hexagenia survival and growth

For *Hexagenia* survival (Hlsu), 30.0% of the variability is explained by total PCBs, while 76.0% of the variability is explained by Pb, Cd and Fe. All predictors are significant ($p \leq 0.002$):

Hlsu = 1.18 - 0.215 log total PCBs (p = 0.006)
Hlsu = 2.87 - 1.90 log Pb - 1.15 log Cd + 2.72 log Fe ($p = \leq 0.001$)

For *Hexagenia* growth (Hlgw), 25.6% of the variability is explained by total PAHs and total PCBs and both predictors are significant (P = 0.021, 0.017):

Hlgw = 0.641 - 0.912 log total PAHs + 0.246 log total PCBs (p = 0.043)

Tubifex young production

For *Tubifex* young production (Ttyg), 40.4% of the variability is explained by total PAHs while 60.4% of the variability is explained by Pb, Cd and Zn. All predictors are significant ($p \leq 0.002$):

Ttyg = 1.18 - 0.327 log total PAHs ($p = 0.002$). Lack of fit test not significant ($p = 0.110$).
Ttyg = 1.69 - 1.34 log Pb - 1.10 log Cd + 0.543 log Zn ($p = 0.001$)

7 Step 6: Benthic Community Composition

7.1 Overview

In shallow areas of high traffic, dredged areas or other habitats of high disturbance, assessments of the sediment-dwelling communities may not be possible, as these types of areas are highly disturbed and will have altered community structures (Chapman, 2005). It was deemed that the assessment of benthic community structure in Lyons Creek was possible and that this line of evidence would be included in the decision-making framework. Lyons Creek communities were compared to reference creek communities.

7.2 Community structure

Benthic communities at reference and Lyons Creek sites consist predominantly of Chironomidae and Tubificidae, which are present at all sites. At Lyons Creek sites, tubificids range from 543 to 40712/m^2 and are generally in lower abundance at downstream sites, and chironomids range from 3076 to 92400/m^2 (Figure 24). At reference sites, tubificids range from 697 to 11037/m^2, and chironomids range from 2117 to 27322/m^2. Other taxon groups present at the majority of Lyons Creek sites include hyalellid (0 to 2654/ m^2) and gammarid amphipods (0 to 1930/m^2), naidid worms (0 to 6031/m^2), ceratopogonid dipterans (0 to 4825/m^2), caenidae mayflies (0 to 6152/m^2), leptocerid caddisflies (0 to 23703/m^2), and coenagrionid odonates (0 to 1870/m^2) (Figure 24). Lyons Creek sites have similar or higher abundances of the major taxa than the reference sites, but there are some notable absences. Leptocerids are absent at 5 sites between the Welland Pipe outfall and Highway 140 (sites LC03 to LC12), and caenids are absent at 2 of these sites (LC10 and LC12) (Figure 24). Site LC12, which has the second highest sediment [PCB] (7.4 µg/g) and which is acutely toxic to mayflies (see Table 14) is void of caddisflies, mayflies and 2 amphipod taxa. The total number of all macroinvertebrate taxa are similar for the reference sites and most Lyons Creek sites, ranging from 17 to 25 (mean 17, median 19) for the reference sites and from 11 to 28 for Lyons Creek sites (mean 20, median 19). Site LC12 has the lowest number of taxa (11) followed by LC08 and LC10 (14 each). Another notable difference between Lyons Creek and reference sites is the presence of zebra mussels (Dreissenidae) at site LC01 (2805/m^2). Dreissenids are absent from all other Lyons Creek sites except LC06 (60/m^2) and are present at 2 of the 6 reference sites in much lower abundance than LC01 (36 to 121/m^2). Complete invertebrate counts are provided in Milani and Grapentine (2005).

The HMDS (using macroinvertebrate family data) reveals that three axes define the structure in the data (stress = 0.130) (Figure 25). The degree of similarity among sites is indicated by the spatial proximity of sites in ordination space. Sites close to each are similar in community structure. Families maximally correlated with the ordination axes scores are shown as vectors. The most maximally correlated families are Chironomidae (r^2 = 0.641), Hyalellidae (r^2 = 0.586), and Tubificidae (r^2 = 0.548), which are shown as vectors in Figure 25. Abundances of Tubificidae and Chironomidae are associated with sites along Axes 1 and 2, respectively, and generally these are sites from the Welland Pipe (LC03) outfall to Highway 140. Abundances of the amphipod taxa are associated with sites along Axes 2, and generally are associated with sites further downstream. Site LC12 is associated with decreased hyalellid and gammarid amphipod taxa (LC12 is oriented along the same vector in the opposite direction of amphipod taxa). Black Creek reference site BLC02 is most different from the rest of the reference sites, separated from the other reference sites along the first axis and is oriented along a gradient of increasing NO_3/NO_2. Environmental variables such as Ca, Cu, Cr, and Pb are associated with sites along the first axis, which generally are sites upstream of Highway 140.

Using the ordination axes scores, the ANOVA F tests and Bonferroni's test show no significant differences between control and test sites. Pairwise comparisons using Tukey's test also reveal no significant differences between any sites. Site comparisons made using log(x)-transformed abundances of dominant macroinvertebrate families found in Lyons Creek (Tubificidae, Chironomidae, Hyalellidae, Gammaridae, Caenidae, Coenagrionidae and Leptoceridae) reveals a significant difference (ANOVA p=0.005) in abundance of coenagrionids (odonates) at control and Lyons Creek sites. Bonferroni's simultaneous tests found a significant decrease in abundance of odonates at site LC12 (none present) compared to controls (p = 0.008). Dunnett's simultaneous tests reveals similar results for LC12 (p = 0.005). Site comparisons made using log(x)-transformed taxon diversity reveals no significant differences between reference creek controls and test sites.

8 Step 7: Decision Matrix

8.1 Overview

The decision matrix is based on ranking data from the available sediment chemistry (Figure 1), toxicity, benthos and biomagnification potential data collected in the previous steps. At this point in the framework, a weight-of-evidence approach is taken; the sediment chemistry is given the least weight and the benthic community data are given the most weight (Chapman, 2005).

The overall assessment of each Lyons Creek site (detailed study) is achieved by the integration of the multiple lines of evidence. Table 17 depicts results of the bulk sediment chemistry, benthic community, toxicity and biomagnification components, shown in a separate columns. A decision is achieved by integration of all lines of evidence. A "●" denotes that adverse effects are likely, a "**O**" denotes that adverse effects may or may not occur, a "O" that adverse effects are unlikely and a dash (e.g., ●-**O**) means "or" (Chapman, 2005).

8.2 Sediment PCBs

A “●” in the contaminant column indicates an elevation of contaminants above a SQG and greater (> 99th percentile) than reference sediment. One or more exceedences of the PCB SEL or PEL (0.277 µg/g) constitute a “●”, one or more exceedences of the LEL or TEL constitute a “○”, and contaminant concentrations below the LEL or TEL constitute a “O”. The SEL for PCBs is not exceeded at any site (LC03 is very close), however, the PEL and the 99th percentile for the reference sites are exceeded at 12 of the 15 Lyons Creek sites (●). One Lyons Creek site (LC29) is above the LEL (as well as the 99th percentile reference sites) (○), and the remaining two Lyons Creek sites (LC01 and LC38) are below the LEL (0.07 µg/g) (O). (For LC03, the SEL is exceeded for metals as well - As, Cu, Ni and Zn.)

8.3 Overall toxicity

A “●” in this column occurs when there is <u>strong</u> evidence of toxicity overall (i.e., a test site falls in Bands 3 or 4 from the BEAST analysis, and where multiple endpoints exhibit major toxicological effects). Sites LC03, LC08 and LC12 fall into this category. These three sites show significant survival, growth and reproduction effects. The remaining sites are designated by “O”, as they have toxicological effects that are either minor or the sites are equivalent to reference.

8.4 Benthos alteration

A “●” in this column occurs when communities are different than reference. Differences in biological structure between reference creek sites (control) and Lyons Creek sites were determined using pattern analysis (ordination) and ANOVAs. Bonferroni’s simultaneous tests detect a significant difference ($p \leq 0.05$) between the reference creek sites and LC12 with respect to abundance of odonates. Site LC12 is the only site where odonates are absent in the creek. Additionally, 2 amphipod families, mayflies, and caddisflies are also absent from LC12. While not statistically significant (ANOVAs), the number of macroinvertebrate taxa present at LC12 is below 2 SD of the reference creek mean.

8.5 Biomagnification potential

A “●” in the column is determined by (a) a significant positive relationship between [PCB] in the sediment and [PCB] in the biota for the study area (three of the four taxa show significant relationships), (b) using the *minimum and intermediate* uptake and exposure scenarios (actual sport fish concentrations fall somewhere between these two scenarios), predicted receptor PCB values are > IJC tissue objective and > the predicted maximum reference concentration.

Under the minimum scenario, all fish receptors exceed the IJC tissue objective at LC12, and 2 of the 4 fish receptors exceed the objective at LC16, and the predicted maximum reference concentrations are exceeded at these sites (●). Under the intermediate scenario, predicted total PCBs in all receptors at all Lyons Creek sites are above the

IJC tissue objective and above the reference maximum. However, since actual PCB concentrations in fish collected at Highway 140 and downstream of the QEW fall between the minimum and intermediate scenarios, adverse effects due to biomagnification at remaining Lyons Creek sites may or may not occur at the remaining sites (○). It is noted, however, that total PCBs in at least 1 of 4 invertebrate taxa are > the IJC tissue objective at sites LC03 – LC29, and 3 of 4 invertebrate taxa are > the tissue objective at sites LC12, LC16, LC17 and LC18 without applying BMFs. Benthic tissue samples were not collected at sites LC06, LC10, LC22, and LC23; therefore, these sites could not be categorized with respect to biomagnification potential.

9 Step 8: Further Assessments

9.1 Overview

The Decision matrix, developed in Step 7 provides 16 possible scenarios, 10 of which result in the determination that the contaminated sediments may pose an environmental risk. In these cases, further assessment is required before a definitive decision can be made (Chapman, 2005).

9.2 Identification of additional work

Studies are currently being conducted to address both human health and ecological concerns, and a human health risk assessment is currently underway for Lyons Creek (East and West). Consultants have been retained to identify gaps and gather the necessary information required to conduct a full human-health risk assessment. Remedial options are also being considered based on the available information which will be appropriate for the risks identified.

10 Step 9: Deeper Sediments

10.1 Overview

The previous steps of the framework have focused predominantly on the surficial (top 10cm) sediments. The deeper sediments may, in well mixed sediments, or those with a long-term on-going source, have chemistry similar to that of the top 10cm, or the chemistry of these deeper sediments may differ considerably from that on the surface. There is therefore a need to determine whether, under unusual but possible natural or human-related circumstances, these deeper sediments may be uncovered and therefore pose a potential threat to the resident fauna (Chapman, 2005).

10.2 Collection of sediment cores

Six locations along Lyons Creek (Table 4, Figure 6) were selected in 2002 for a more in-depth study of ecosystem health. Cores were collected from the most upstream location of Lyons Creek (LC01), downstream of the Welland Pipe property (LC03),

immediately upstream and downstream of Highway 140 (LC16 and LC17 respectively), downstream of McKenny Road (LC29) and Downstream of the QEW (LC38).
Three sediment cores were collected from each location using a KB-corer. The cores were sectioned into 0-10cm, 10-25cm and >25cm sections, and a composite of each section from each of the three cores was homogenized and sent to the MOE laboratory (Etobicoke, ON) for analysis of PCBs, metals, OCs, PAHs, particle size, and nutrient content (MOE, 1993a).

10.3 Analysis and interpretation

Ordination of the data by multivariate analysis show that the sediment cores from the more downstream locations (LC17, LC29 and LC38) group together (Figure 26a), suggesting that the chemistry of the sediments, even at depth, are relatively homogeneous and have a similar composition. The more surficial sediments at LC16, located upstream of Highway 140, also have similar sediment chemistry composition to the downstream locations, but at depth move away from the more downstream locations in ordination space. Deeper sediment at this location has a similar sediment composition to LC03 (downstream of Welland Pipe). The upstream location (LC01) has a different composition from all of the other sites (Figure 26a). The observed difference in sediment composition at this location is primarily driven by particle size, and elevated levels of manganese, magnesium and calcium, and lower levels of cobalt (Figure 26b). Sediment from LC03 and from the deeper sediments of LC16 (>25cm) are characterized by elevated levels of OCs, metals and PCBs. The PCB concentrations at these sites and depths (LC03<10cm, LC03 10-25cm, and LC16>25cm) all exceed the PSQG SEL, suggesting that these sediments may effect the health of sediment dwelling-organisms (Table 18).

Ordinations of the sediment samples based on their PCB congener composition (Figure 27a) groups together the sediments from LC01, LC17, LC29 (at all depths), and the surficial sediments (<10cm) of LC16, indicating that PCB levels and their congener composition are similar. Five PCB congeners are associated with Axis 1 (Figure 27b). These 5 congeners explain the separation of the downstream location (LC38) at all core profiles, the upstream location LC03 (0-25cm) and the deeper sediment at LC16 (>25cm); PCB congener patterns are similar at these locations (Figure 28), but concentrations are generally higher in the surficial sediments at LC03. The most downstream location (LC38) has lower levels of PCBs than the other sites (Figure 28), which is indicated by the separation in ordination space of these samples from the rest of the locations (Figure 27a), and its position away from the direction indicated by the congener vectors (Figure 27b). Generally higher levels of the ‘tri’ homologues are observed in the more contaminated samples of Lyons Creek. The tetra and penta homologues also tend to be higher at LC03 and LC16 >25cm (Table 18, Figure 28).

11 Discussion

11.1 PCBs in sediment

The primary contaminants of concern in Lyons Creek are PCBs. Sediment concentrations are elevated above reference and above the PSQG LEL criteria throughout most of Lyons Creek, from the vicinity of the Welland Pipe property, where concentrations at Ridge Road (LC03) are almost at the PSQG SEL, to as far down as McKenny Road (LC29). At the most upstream location (LC01), sediment PCB levels are significantly lower, and are below the PSQG LEL criteria. The prominent congener pattern in the sediment of Lyons Creek East closely resembles that of aroclor 1248 (more details provided in Fletcher and Petro, 2005). Despite the low PCB concentrations observed at the most upstream location (LC01), the PCB congener patterns at this location are very similar to that observed at the more contaminated sites further downstream (downstream of Welland Pipe). This indicates that although PCB contamination is primarily downstream of Welland Pipe, it does not preclude that the contamination may have originated from a previous upstream source. A Stelco rolling mill and a Hydro transformer station are located in the West portion of Lyons Creek, and a spill from the transformer station occurred prior to the construction of the Welland Canal. Either of the two properties located on the west portion of the creek may also potentially be the source of PCB contamination observed in Lyons Creek East. Some metals (primarily nickel, zinc and copper) are also elevated above the PSQG SEL criteria in the upper portion of the creek (upstream of Highway 140).

11.2 PCBs in biota

Total [PCB] in benthic invertebrates at the majority of Lyons Creek sites are elevated above those for the reference sites for 3 of the 4 benthic invertebrate taxa collected, and benthos from sites LC12 and LC17 are consistently highest in [PCB]. For the odonates, the [PCB] are consistently the lowest. The odonates (samples contained a mixture of dragonflies and damselflies) are predacious invertebrates and will feed on invertebrates as well as small vertebrates such as tadpoles and fish fry. They likely have less direct contact with sediment than the other taxa analyzed which may explain the lower PCB levels. Total [PCBs] in amphipods and chironomids are significantly influenced by sediment [PCBs] (Table 8, Figure 13), and the log-log relationship for $[PCB]_{sed}$ and $[PCB]_{inv}$ across sites is strongest for the amphipods. The amphipods accumulated more PCBs than the other three taxa at 64% of Lyons Creek sites; therefore, it is not surprising that the $[PCB]_{sed}$ - $[PCB]_{inv}$ relationship is strongest for the amphipod. With the addition of pH (positively correlated to total PCB concentration), the amount of variance explained increases by ~4% and ~12% for the amphipods and chironomids, respectively, and $[PCB]_{sed}$ is the most significant predictor. With the addition of pH, total P in the water and %sand, the oligochaete model becomes significant, and the amount of variance explained increases greatly (~60%). There is no significant relationship between $[PCB]_{inv}$ – $[PCB]_{sed}$ for the odonates.

Because concentrations of PCB in the benthic invertebrates were measured without clearing their guts, a fraction of the observed $[PCB]_{inv}$ could include sediment-bound

PCB in the gut. This is relevant for assessing uptake of PCBs by predators of invertebrates, which consume whole organisms, but likely contributes to the strength of the $[PCB]_{sed}$ - $[PCB]_{inv}$ relationship. For the amphipod and chironomid models, the fact that (a) the model that best predicts $[PCB]_{inv}$ includes $[PCB]_{sed}$ as the most significant term and that (b) the magnitude and direction of the regression coefficient is stable across both models suggests a real relationships between $[PCB]_{inv}$ and $[PCB]_{sed}$. Results from this assessment indicate that [PCB] for the amphipods and chironomids is largely determined by $[PCB]_{sed}$. Observing positive relationships between sediment and invertebrate PCB concentrations is evidence that PCB transfers from sediment into the food web.

The results of multivariate analysis suggest that uptake of PCBs by mussels in the portion of the creek from Ridge Road to Highway 140 closely resemble aroclor 1248 (Fletcher and Petro, 2005). Mussels from the most upstream and downstream portions of the creek fall within the 90% confidence ellipse plotted around the reference data, suggesting that these locations are similar in PCB concentration and pattern to that observed in the reference creeks. Mussels from between Ridge Road and Highway 140 all fall outside of the 99%-99.9% ellipses, suggesting that these mussels are considerably different in PCB concentration and congener pattern to the reference.

Mussels deployed downstream of Highway 140 (LC17) in 2002 have the highest PCB concentrations; in 2003 the highest concentrations are observed further upstream of LC12. The PCB concentrations at these sites, as well as the other locations between downstream of Ridge Road (LC08) and Highway 140 all exceed the IJC guideline for the protection of fish-eating wildlife; consumption of these mussels may therefore pose a potential threat to the resident wildlife. The homologue patterns in the clam tissue from the upper portion of the creek closely resemble aroclor 1248. Studies on aroclor 1248 (e.g., Barsotti et al. 1976) have shown that ingestion of 0.1-0.2mg/kg body weight/day of this aroclor over a 2 month period resulted in hair loss, acne and swollen eyelids of Rhesus monkeys. Adverse effects of PCBs on avian wildlife most commonly result in reduced egg productivity and hatchability, as well as reduced chick growth rates. Lillie and co-workers (1974) recorded reduced egg productivity and hatchability in white leghorns fed a diet of 1.2mg/kg aroclor 1248. The concentrations observed in the mussels from Lyons Creek were in the region of three times less than the doses reported by Lillie et al. (1974).

Toxic equivalent (TEQ) concentrations allow us to assess the toxicity of the co-planar (dioxin-like) PCB congeners. These values can then be compared to the Environment Canada tissue residue guideline (TRG) (CCME, 2001); calculated TEQ concentrations above this TRG value puts wildlife consuming these organisms at risk of adverse effects. The calculated TEQ values are most elevated in 2002 at Highway 140. Levels observed in 2003 are similar to those in 2002, with the highest concentrations being recorded at LC12. Mussels located between LC08 and Highway 140 exceed the CCME TEQ criteria (CCME, 2001). These data suggest that bioavailable PCBs upstream of Highway 140 are at concentrations which may have adverse effects to wildlife.

Total PCB concentrations in forage fish collected in 2002 are elevated to concentrations exceeding the IJC criteria for the protection of fish-eating wildlife by as much as 100 times. The highest concentrations in 2003 are observed immediately at Ridge Road, and at the next highest at Highway 140. While PCB tissue concentrations are considerably lower in 2003, concentrations are still elevated over the IJC criteria at Highway 140 by as much as 25 times. Total PCB concentrations recorded in the fish tissue above the IJC criteria pose a threat to organisms eating fish from Lyons Creek.

In 2002, only fish collected from upstream of Highway 140 exceed the CCME TRG (0.79ng TEQ/kg); in 2003, all fish collected from Lyons Creek, as well as from Usshers Creek, exceed the CCME TRG by in excess of 63 to 400 times. The high levels observed in 2003 are primarily driven by congener 126 (3,3’,4,4’,5 pentachlorobiphenyl) which has an extremely high toxic equivalency factor (TEF = 0.1), followed by congener 118 (2,3’,4,4’,5 pentachlorobiphenyl). In 2002, congener 126 is not observed and the TEQs are primarily driven by congener 118. In both years, fish collected from the most downstream location (LC38) have the lowest TEQ values. The distinct downstream trend in TEQ values further supports the evidence suggesting that the source of PCBs to the system originates from the upper portion of the creek and that these concentrations are at levels which can adversely impact the aquatic organisms in the system and the wildlife feeding on these organisms.

The PCB concentrations in the sport fish fillets collected from Highway 140 are significantly higher than those collected from downstream of the QEW; a trend which has been observed in the past. Sport fish have historically been elevated in the vicinity of Highway 140 such that restrictions of as little as 1 meal/month (pumpkinseed, 1994), based on the consumption advice of that time (MOE 1995), have been advised. Carp and white sucker recorded during this study (2002 and 2003) are both observed at concentrations that result in consumption restrictions of one to two meals per month. The highest concentrations observed are in the carp from 2002, which have as much as 3000ng/g PCBs in the tissue. However, when regressions are run on the data to assess the concentrations likely to be observed in fish of different size classes, all fish have some degree of restriction for their consumption. Minks fed on diets containing perch (0.69mg PCB/kg diet), white sucker (0.63mg PCB/kg diet) and whitefish (0.48mg PCB/kg diet) for 7 months exhibited impaired reproduction (Hornshaw et al. 1986). Leghorn chicks fed diets of contaminated carp with PCB residues as high as 6.6mg PCB/kg diet showed a 40% deformity rate (Summer et al. 1996). The concentrations observed in the fish collected from some of the sites in Lyons Creek have the potential to exceed these doses. Although the carp concentrations collected from Highway 140 are all below the concentrations reported by Summer et al. (1996), white sucker concentrations are elevated above those considered by Hornshaw et al. (1986) at which minks exhibited impaired reproduction.

The TEQ concentrations in the fillets collected from Highway 140 in 2003 exceed both the mammalian (0.79ng TEQ/kg) and avian (2.4ng TEQ/kg) TRG (CCME, 2001). As in forage fish, the congener driving these elevated TEQ concentrations is congener 126.

11.3 Sediment toxicity

Laboratory sediment toxicity tests reveal that the mayfly, *Hexagenia* spp. is most sensitive to Lyons Creek sediments, showing an acutely toxic response at three sites (LC03, LC08, LC12), followed by the amphipod *Hyalella*, showing an acutely toxic response at two sites (LC03, LC08). The three toxic sites have the highest total sediment [PCB] (4700 to 12500ng/g dw). *Hexagenia* and *Hyalella* survival-PCB contaminant relationships reveal that about 30% of the variability in survival of both these organisms is explained by sediment total PCBs alone. More variability in *Hyalella* and *Hexagenia* survival is explained by metal contamination (Pb, Cd, Fe), although these individual metal concentrations are below the SELs. Greatest toxicity is observed at site LC03, approximately 4m downstream of the former Welland Pipe outfall, where acute and/or chronic toxicity are evident to all four laboratory organisms. Toxicity to *Tubifex* is observed at two sites (LC03 and LC08), and the modes of toxicity differ. At LC03, the effect is chronic, with low number of cocoons produced per adult, indicating an effect primarily on gametogenesis (cocoon production), whereas at LC08, the effect on *Tubifex* is acute (35% survival). This suggests possibly different cause(s) of toxicity at the different sites. Site LC03 has the highest $[PCB]_{sed}$, and the SELs are also exceeded for As, Cu, Ni, and Zn, whereas at LC08, only Zn is above the SEL. Toxicity is observed to about 750m downstream (LC12) of the pumping station at the Welland Canal, and no toxicity is observed from about 1450m downstream (LC14) on. The three toxic sites, LC03, LC08, and LC12, had an oily residue present on the surface water and the sediment had a distinct strong odour of hydrocarbons that was not observed at other Lyons Creek sites at the time of sampling.

11.4 Benthic community

Lyons creek communities were compared to the reference creek communities. Reference creeks used in the assessment were deemed appropriate for comparison to Lyons Creek based on five parameters: watershed area, stream order, wetland percentage, flow type and sediment type (NPCA 2003).

Overall, abundance and diversity of invertebrate families at Lyons Creek sites are similar or higher to that observed in neighbouring reference creeks, with the average number of organisms/m^2 at Lyons Creek sites ~2 times higher than that at the reference sites. However, site LC12 (severely toxic) has low taxa diversity (less than 2 SD of the reference creek mean) and is void of hyalellid and gammarid amphipods (one or both of which are present at all other Lyons Creek sites) as well as caenid mayflies (present at most other sites), leptocerid caddisflies and there is a significantly lower abundance of coenagrionids (odonates) (present at all other sites including reference). Additionally, the highest PCB accumulation occurs at LC12, and this site has the second highest $[PCB]_{sed}$, (after LC03). Site LC08 (also severely toxic) has low taxa diversity (14 taxa) and is void of caddisflies, showing some concordance between community alteration and toxicity as well. However, other sensitive taxa are present at LC08 such as mayflies and amphipods (Figure 24). Concordance between community impairment and toxicity at site LC03, however, is not strong. While LC03 (severely toxic) is void of caddisflies, taxa diversity is high (22 taxa), and sensitive taxa such as mayflies and amphipods are present (Figure 24). While contaminants are present and sediments are toxic, it is possible that benthic communities have adapted or resistance developed.

11.5 Biomagnification potential

Models involving a range of biomagnification conditions were used to predict potential [PCB] in receptors of concern for Lyons Creek. The receptor species are considered important to the Lyons Creek study area and encompass the trophic levels linking sediments to the top predators, where biomagnification is expected to be greatest. Three levels of dietary exposure and trophic transfer of PCB were assumed: minimum and maximum scenarios to bracket the range of potential outcomes, and an intermediate scenario to characterize “average” conditions. The critical outcome of the evaluation is whether or not the predicted $[PCB]_{rec}$ values for exposed sites exceed the appropriate tissue guideline (IJC objective) and exceed the reference site maximum $[PCB]_{rec}$. For the minimum scenario, 2 of the 11 Lyons Creek sites exceed the IJC tissue objective and maximum reference concentration, and for the intermediate and maximum scenarios, all 11 sites, where tissue was collected, exceed the criteria.

The likelihood of realizing this degree of PCB biomagnification is not clear due to uncertainties associated with predicting receptor [PCB] values and conservative assumptions of the assessment. Reducing uncertainty in the predictions of PCB biomagnification in Lyons Creek would be best achieved by identifying a more narrow range of appropriate BMFs, and by quantifying the actual exposures of receptors to dietary PCB. However, actual PCBs in sport fish collected at Highway 140 clearly show that PCBs accumulate in higher trophic organisms above the IJC guideline and above sport fish consumption advisories (for carp). Comparison of predicted $[PCB]_{rec}$ to actual $[PCB]_{rec}$ reveals that the minimum uptake and exposure scenario underestimates $[PCB]_{rec}$ and the intermediate uptake and exposure scenario overestimates the $[PCB]_{rec}$ (Actual concentrations fall between the minimum and intermediate uptake and exposure scenarios).

The IJC tissue objective applies to concentrations of PCBs in fish, and is for the protection of wildlife consumers of fish. Data are available for direct evaluation of the predicted tissue PCB levels for mink and the diving duck, and a discussion of this is provided in Milani and Grapentine (2005). Generally, for mink, predicted [PCBs] under the minimum to intermediate exposure and uptake scenarios are similar to concentrations observed in wild mink collected from the Great Lakes region. Under the intermediate scenario, predicted mink receptor concentrations could be at levels associated with adverse effects at site LC12, based on toxicity benchmarks provided in the literature (see Milani and Grapentine, 2005).

12 Conclusions

12.1 PCBs

The [PCB] in sediment is most significantly elevated in the upper reaches of Lyons Creek (upstream of Highway 140) and total PCBs in sediment at the majority of Lyons Creek sites are elevated above those at reference sites. The highest [PCB] is found just downstream of the former Welland Pipe outfall (LC03) and [PCB] decreases overall with distance downstream of the pipe. Total [PCB] at the most downstream site (downstream of the QEW) (LC38) is similar to that at the upstream site (LC01). The SEL is not exceeded at any site (LC03 is very close to the SEL), while 12 of the 15 Lyons Creek sites (from LC03 to LC23) exceed the PEL.

The highest PCBs occur in invertebrates collected from LC12, which does not coincide with the highest [PCB] in the sediment. Total [PCB] in the midges are elevated above reference at all Lyons Creek sites, amphipods at 10 of the 11 sites, oligochaetes at 9 of the 11 sites, and odonates at 2 of the 11 sites. Overall, total $[PCB]_{inv}$ decreases downstream of LC12 with levels at the most downstream site similar to that seen at the upstream Lyons Creek site, but is about three to four times higher than at reference sites for two of the four taxa. Total [PCB] are above the IJC PCB objective of 100 ng/g for all 4 taxa at LC12 and for at least 1 taxon at 8 other sites.

12.2 Metals

Some metals (primarily nickel, zinc and copper) are elevated above the PSQG SEL criteria in the upper portion of the creek (upstream of Highway 140). Copper, nickel and zinc all exceed the PSQG SEL criteria at LC03; zinc exceeds the SEL by almost an order of magnitude. Metals in the sediments at these concentrations may pose potential threat to the health of the resident benthic fauna at these sites.

12.3 Toxicity

There is evidence of severe toxicity at 3 sites: LC03, LC08 and LC12. Acute toxicity is evident at these sites for one to three laboratory organisms, and toxicity is most severe for LC03. Toxicity is related to one or a combination of several metals or to PCBs and PAHs.

12.4 Benthic alteration

There is strong evidence of benthic alterations at LC12. Site LC12 has the lowest taxa diversity (below 2 SD of the reference mean), and is void of key taxonomic groups such as odonates, mayflies, caddisflies, and two amphipod families. There is a statistically significant difference in the number of Coenagrionidae (odonates) present between LC12 and controls. Although not statistically significant, macroinvertebrate family diversity is also lower than the reference creek mean at the following sites upstream of Highway 140: LC06, LC08, LC10 and LC16, as well as LC29 (downstream of McKenny Road). Some key sensitive taxonomic groups are absent at LC06, LC08 and LC10 (e.g., leptocerid caddisflies at all 3 sites and caenid mayflies at LC10). It should be noted, however, that while leptocerid caddisflies are absent at site LC06, hydroptilid caddisflies are present at this site ($181/m^2$).

12.5 Biomagnification potential

Total PCBs in biota (except odonates) at most Lyons Creek sites exposed to historical industrial discharges are elevated above those at neighbouring reference creek sites. This suggests that historic effluent discharges are linked to elevated invertebrate PCB concentrations.

Concentrations of total PCBs in sediment are significantly predictive of concentrations in amphipods and chironomids, indicating that sediment [PCB] affects invertebrate [PCB]. (Adjusting for effects of covariates for the oligochaetes also results in a significant positive relationship.)

For the minimum exposure and uptake scenario, 2 sites (LC12, LC16) are predicted to have $[PCB]_{rec}$ higher than the IJC tissue objective and the maximum reference site $[PCB]_{rec}$. For intermediate and maximum exposure and uptake scenarios, all Lyons Creek sites are predicted to have $[PCB]_{rec}$ higher than the criteria. Thus, PCBs could bioaccumulate in receptors to levels that are not protective of adverse effects at between 2 and 11 Lyons Creek sites where tissue was collected. Sites LC12 and LC16 are the most severe.

Using the rule-based, weight-of-evidence approach described in Grapentine et al. (2002) and Chapman (2005) and where all 4 information components are available, management actions are required for LC12 and the risk of biomagnification needs to be fully assessed for LC16 (minimum scenario). Under the intermediate scenario, the risk of biomagnification needs to be fully assessed at all 11 Lyons Creek sites. Sites LC03 and LC08 require monitoring of change in benthic communities due to observed laboratory toxicity at these sites.

The area from Ridge Road (LC03) to Highway 140 (LC16/LC17) is the most critical area of the creek. The highest sediment, invertebrate, mussel and fish PCB concentrations occur in this area. Also observed within this area are toxicity, altered communities and potentially adverse effects due to biomagnification.

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TABLES

Table 1: Surficial sediment chemistry metal concentrations from the initial screening survey of Lyons Creek East.

Group		Aluminum ug/g	Barium ug/g	Beryllium ug/g	Cadmium ug/g	Calcium ug/g	Chromium ug/g	Cobalt ug/g	Copper ug/g	Iron ug/g	Lead ug/g	Magnesium ug/g	Manganese ug/g	Molybdenum ug/g	Nickel ug/g	Strontium ug/g	Titanium ug/g	Vanadium ug/g	Zinc ug/g
1	LC02	16000	150	0.8 <T	*1.8*	57000	*57*	13	*98*	*34000*	*81*	9700	380	4.4	**80**	170	160	39	**2400**
2	LC01	13000	90	0.6 <T	*0.9* <T	70000	22	10	*39*	*20000*	14	14000	450	0.5 <=W	*31*	130	220	28	110
3	LC03	15000	110	0.7 <T	*1.2*	51000	*46*	11	*57*	*29000*	*42*	12000	430	1.6 <T	*48*	120	190	35	*700*
3	LC04	12000	84	0.6 <T	*1*	52000	*38*	11	*49*	*22000*	*33*	14000	420	1.4 <T	*38*	110	210	28	*440*
3	LC05	14000	94	0.7 <T	*1.4*	55000	*38*	11	*49*	*24000*	30	15000	450	0.6 <T	*41*	120	230	32	*450*
3	LC06	13000	86	0.6 <T	*1*	48000	*35*	11	*45*	*24000*	*36*	14000	410	1.3 <T	*42*	96	240	30	*380*
3	LC07	16000	110	0.7 <T	*1.1*	59000	*37*	11	*54*	*26000*	*37*	13000	390	0.8 <T	*44*	140	210	34	*570*
3	LC08	16000	140	0.8 <T	*1.8*	48000	*44*	12	*72*	*36000*	*63*	9700	380	0.8 <T	*58*	150	170	36	**1400**
3	LC09	18000	130	0.8 <T	*1.3*	48000	*42*	12	*56*	*30000*	*48*	12000	400	1.1 <T	*54*	140	220	39	**920**
3	LC10	20000	140	0.9 <T	*1.5*	43000	*47*	13	*67*	*33000*	*60*	13000	400	1 <T	*60*	120	220	42	**1200**
3	LC11	20000	140	0.9 <T	*1.5*	42000	*47*	13	*68*	*33000*	*59*	13000	380	0.9 <T	*60*	120	210	41	**1200**
3	LC12	19000	130	0.8 <T	*1.4*	65000	*37*	12	*53*	*28000*	*38*	11000	360	0.5 <=W	*47*	180	170	38	*580*
3	LC13	21000	130	0.9 <T	*1.2*	43000	*39*	13	*51*	*30000*	*38*	10000	380	0.5 <=W	*50*	150	170	40	*530*
3	LC17	17000	130	0.8 <T	*0.9* <T	41000	*28*	11	*33*	*26000*	21	14000	*600*	0.5 <=W	*35*	89	200	36	*330*
3	LC38	27000	130	1 <T	*1.4*	39000	*36*	14	*29*	*32000*	23	14000	*590*	0.5 <=W	*42*	100	250	47	*150*
	MEAN	17538.5	119.5	0.8	*1.3*	48769.2	*39.5*	11.9	*52.5*	*28692.3*	*40.6*	12669.2	430.0	0.9	*47.6*	125.8	206.9	36.8	*680.8*
4	LC15	24000	140	1 <T	*1.2*	30000	*41*	14	*49*	*32000*	*39*	11000	410	0.5 <=W	*53*	94	180	43	*500*
5	LC18	24000	140	1 <T	*1.1*	15000	*40*	14	*45*	*36000*	*33*	10000	420	0.5 <=W	*54*	65	150	46	*670*
5	LC19	20000	130	0.9 <T	*1.2*	21000	*57*	13	*46*	*31000*	*120*	10000	450	5.9	*50*	72	160	40	*570*
5	LC20	21000	120	0.9 <T	*1.4*	17000	*36*	14	*44*	*32000*	27	9500	450	0.5 <=W	*49*	62	200	42	*570*
5	LC21	24000	130	1 <T	*1.5*	6900	*37*	13	*37*	*34000*	27	9000	*460*	0.5 <=W	*52*	41	210	46	*430*
5	LC22	24000	140	1 <T	*1.3*	8300	*40*	15	*40*	*38000*	*34*	9000	*530*	0.5 <=W	*65*	50	180	47	*740*
5	LC23	25000	140	1.1 <T	*1.6*	7500	*41*	16	*43*	*38000*	*40*	9800	*470*	0.5 <=W	*66*	43	200	50	**970**
5	LC24	22000	120	0.9 <T	*1.3*	6900	*33*	14	*33*	*31000*	26	8300	*720*	0.5 <=W	*49*	41	140	42	*340*
5	LC25	26000	150	1 <T	*1.4*	7000	*40*	14	*40*	*38000*	*40*	8000	*620*	0.5 <=W	*63*	53	130	49	*680*
5	LC26	24000	130	1 <T	*0.9* <T	5800	*36*	13	*34*	*34000*	28	7900	*500*	0.5 <=W	*52*	46	160	45	*490*
5	LC27	21000	110	0.8 <T	*1.6*	6000	*33*	14	*32*	*36000*	*37*	7300	*520*	0.6 <T	**91**	41	170	42	**1000**
5	LC28	20000	110	0.8 <T	*1.2*	7400	*31*	12	*29*	*30000*	*31*	7700	*500*	0.5 <=W	*47*	43	220	40	*520*
5	LC29	18000	100	0.8 <T	*1.3*	7600	*30*	12	*26*	*27000*	26	6700	430	0.5 <=W	*49*	50	200	37	*420*
5	LC30	22000	120	0.9 <T	*1.7*	6600	*38*	15	*33*	*34000*	*39*	8900	*520*	0.5 <=W	*59*	38	160	44	*720*
5	LC31	25000	140	1 <T	*1.5*	6100	*35*	14	*32*	*34000*	*32*	8200	*470*	0.5 <=W	*50*	48	180	48	*430*
5	LC32	27000	160	1 <T	*1.7*	6200	*37*	16	*36*	*37000*	*33*	7700	400	1.2 <T	*60*	60	160	50	*640*
5	LC33	31000	170	1.1 <T	*1.9*	4900	*41*	17	*34*	*39000*	30	7900	*700*	0.8 <T	**78**	100	190	57	**850**
5	LC34	29000	190	1.1 <T	*1.7*	6800	*40*	16	*36*	**44000**	*39*	8200	**2000**	0.9 <T	*72*	60	190	55	**870**
5	LC35	20000	97	0.8 <T	*1.2*	6200	*28*	12	*29*	*29000*	30	5500	450	1.2 <T	*67*	68	110	37	*520*
5	LC39	22000	130	0.9 <T	*1.5*	7100	*31*	19	*26*	*34000*	22	6800	*950*	0.5 <=W	*50*	64	130	41	*300*
5	LC40	24000	120	1 <T	*0.9* <T	6400	*31*	15	*19*	*29000*	*87*	6800	*510*	0.5 <=W	*50*	40	140	45	110
5	LC36	20000	120	0.9 <T	*0.6* <T	12000	*29*	17	*35*	*30000*	*67*	8700	440	0.6 <T	*45*	57	200	41	*170*
	MEAN	23285.7	131.8	0.9	*1.4*	8509.5	*36.4*	14.5	*34.7*	*34047.6*	*40.4*	8185.7	*595.7*	0.9	*58.0*	54.4	170.5	45.0	*571.9*
6	LC14	23000	150	1 <T	*2*	34000	*58*	14	*73*	**54000**	*97*	11000	420	0.9 <T	*64*	110	200	48	**3200**
7	LC16	23000	140	0.9 <T	*1.5*	15000	*52*	14	*62*	**57000**	*51*	9400	*490*	1.5 <T	**85**	59	180	46	**1800**
PSQG *LEL*					*0.6*		*26*		*16*	*20000*	*31*		*460*		*16*				*120*
	SEL				**10**		**110**		**110**	**40000**	**250**		**1100**		**75**				**820**

<T a measurable trace amount

<=W no measurable response (zero)

Table 2: Surficial sediment OC pesticide concentrations from the initial screening survey of Lyons Creek East.

Group		a-BHC (hexachlorocy-clohexane) ng/g	Dieldrin ng/g	Endrin ng/g	g-BHC (hexachlor-ocyclohex-ane) ng/g	g-Chlordane ng/g	pp-DDD ng/g	pp-DDE ng/g	pp-DDT ng/g
1	LC02	1 <=W	4 <T	8 <T	1 <=W	2 <=W	5 <=W	750	15 <T
2	LC01	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	5 <T	5 <=W
3	LC03	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	400	5 <=W
3	LC04	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	120	5 <=W
3	LC05	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	160	5 <=W
3	LC06	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	100	5 <=W
3	LC07	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	140	5 <=W
3	LC08	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	460	5 <=W
3	LC09	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	10 <T	240	5 <=W
3	LC10	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	290	5 <=W
3	LC11	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	210	5 <=W
3	LC12	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	77	5 <=W
3	LC13	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	90	5 <=W
3	LC17	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	120	5 <=W
3	LC38	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	1 <=W	5 <=W
3	MEAN	1.8	2.0 <=W	4.0 <=W	1.0	2.0	5.4	185.2	5.0
4	LC15	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	61	5 <=W
5	LC18	2 <T	4 <T	4 <=W	1 <=W	2 <=W	5 <=W	81	5 <=W
5	LC19	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	91	5 <=W
5	LC20	3 <T	4 <T	4 <=W	1 <=W	2 <=W	5 <=W	48	5 <=W
5	LC21	2 <T	2 <=W	4 <=W	2 <T	2 <=W	5 <=W	33	5 <=W
5	LC22	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	64	5 <=W
5	LC23	3 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	51	5 <=W
5	LC24	1 <=W	8 <T	4 <=W	1 <=W	2 <=W	5 <=W	12	5 <=W
5	LC25	1 <=W	6 <T	4 <=W	1 <=W	2 <=W	5 <=W	46	5 <=W
5	LC26	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	20	5 <=W
5	LC27	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	38	5 <=W
5	LC28	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	18	5 <=W
5	LC29	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	17	5 <=W
5	LC30	1 <=W	16 <T	4 <=W	1 <=W	2 <=W	5 <=W	30	5 <=W
5	LC31	1 <=W	6 <T	4 <=W	1 <=W	2 <=W	5 <=W	11	5 <=W
5	LC32	1 <=W	2 <=W	4 <=W	1 <=W	8 <T	5 <=W	12	5 <=W
5	LC33	1 <=W	4 <T	4 <=W	1 <=W	4 <T	5 <=W	10	5 <=W
5	LC34	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	10	5 <=W
5	LC35	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	4 <T	5 <=W
5	LC39	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	4 <T	5 <=W
5	LC40	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	1 <=W	5 <=W
5	LC36	1 <=W	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	1 <=W	5 <=W
5	MEAN	1.4 <=W	3.6	4.0 <=W	1.0	2.4	5.0	28.7	5.0
6	LC14	4 <T	2 <=W	4 <=W	5 <T	2 <=W	5 <=W	240	5 <=W
7	LC16	2 <T	2 <=W	4 <=W	1 <=W	2 <=W	5 <=W	800	5 <=W
PSQG	*LEL*	*6*	*2*	*3*	*3*		*8*	*5*	
	SEL*	**10000**	**91000**	**130000**	**1000**		**6000**	**19000**	

SEL* corrected for TOC

<W No measurable response (zero)

<T a measurable trace amount

P40 PCB resembles mixture of aroclor 1254 & 1260

PS1 PCB resembles mixture of aroclor 1248, 1254 & 1260

<W for all sites:

a-Chlordane
Aldrin
b-BHC (hexachlorocyclohexane)
Endosulphan I
Endosulphan II
Endosulphan sulphate
Heptachlor
Heptachlor epoxide
Methoxychlor
Mirex
op-DDT
Oxychlordane

Table 3: Surficial sediment chemistry PAH and total PCB concentrations from the initial screening survey of Lyons Creek East.

Group		Acenaphthene (ng/g)	Anthracene (ng/g)	Benzo(a)a-nthracene (ng/g)	Benzo(a)pyrene (ng/g)	Benzo(b)flu-oranthene (ng/g)	Benzo(g,h,i)perylene (ng/g)	Benzo(k)flu-oranthene (ng/g)	Chrysene (ng/g)	d10-phenanthrene (ng/g)	d12-chrysene (ng/g)	d8-naphthalene (ng/g)	Dibenzo(a,h)anthracene (ng/g)	Fluoranthene (ng/g)	Fluorene (ng/g)	Indeno(1,2,3-c,d)pyrene (ng/g)	Naphthalene (ng/g)	Phenanthrene (ng/g)	Pyrene (ng/g)	PCB; total (ng/g)
1	LC02	20 <=W	400 <=W	2600	1800 <T	1800 <T	1800 <T	640 <T	6000	100	130	62	800 <=W	3600	20 <=W	800 <=W	20 <=W	420 <T	8300	15000 PS1
2	LC01	20 <=W	20 <=W	60 <T	80 <T	100	80 <T	40 <T	80 <T	140	84	94	40 <=W	140	20 <=W	40 <=W	20 <=W	80 <T	120	100 PS1
3	LC03	40 <T	160	800	640	1100	800	280	660	100	120	62	160 <T	1100	60 <T	480	60 <T	600	1600	6900 PS1
3	LC04	40 <T	240	680	520	1100	560	320	900	98	110	72	120 <T	1500	80 <T	560	40 <T	800	1300	2500 PS1
3	LC05	20 <=W	80 <T	360	320	640	360	180	520	95	97	66	80 <T	860	40 <T	320	60 <T	360	880	3100 PS1
3	LC06	20 <=W	80 <T	420	400	820	400	240	640	130	96	77	80 <T	1200	40 <T	440	20 <=W	560	1000	1900 PS1
3	LC07	20 <=W	40 <T	320	280	680	320	200	520	100	96	67	80 <T	760	20 <=W	360	20 <=W	340	700	2300 PS1
3	LC08	20 <=W	80 <T	960	560	1100	840	240	2000	100	130	61	160 <T	1400	40 <T	480	20 <=W	380	1900	8200 PS1
3	LC09	40 <T	20 <=W	360	280	580	360	160	660	99	110	57	80 <T	840	60 <T	280	20 <=W	240	780	4700 PS1
3	LC10	20 <=W	40 <T	500	360	820	360	220	860	100	120	57	80 <T	1200	40 <T	360	20 <=W	360	1200	5700 PS1
3	LC11	20 <=W	40 <T	300	240	620	360	160	580	130	100	68	80 <T	680	20 <=W	280	20 <=W	240	760	4100 PS1
3	LC12	20 <=W	40 <T	160	160 <T	360	200	100	300	92	94	52	40 <=W	460	20 <=W	200	20 <=W	180	380	1600 PS1
3	LC13	20 <=W	20 <=W	140	120 <T	300	160 <T	80 <T	280	90	100	56	40 <=W	280	20 <=W	160 <T	20 <=W	120	260	1800 PS1
3	LC17	20 <=W	60 <T	280	160 <T	280	160 <T	80 <T	460	93	110	67	40 <=W	520	20 <=W	120 <T	20 <=W	220	440	2800 PS1
3	LC38	20 <=W	20 <=W	20 <=W	40 <=W	40 <T	40 <=W	20 <=W	20 <=W	84	81	76	40 <=W	40 <T	20 <=W	40 <=W	20 <=W	20 <=W	20 <=W	20 <=W
3	MEAN	24.6 <=W	70.8	407.7	313.8	649.2	378.5	175.4	646.2	100.8	104.9	64.5	83.1	833.8	36.9	313.8	27.7	340.0	863.1	3509.2
4	LC15	20 <=W	20 <=W	120	120 <T	240	120 <T	60 <T	240	130	100	65	40 <=W	260	20 <=W	120 <T	20 <=W	100	220	1200 PS1
5	LC18	20 <=W	20 <=W	220	160 <T	260	200	80 <T	460	95	110	56	40 <=W	340	20 <=W	120 <T	20 <=W	100	320	2900 PS1
5	LC19	20 <=W	20 <=W	140	160 <T	280	240	80 <T	260	130	110	49	40 <=W	220	20 <=W	160 <T	20 <=W	100	200	2000 PS1
5	LC20	20 <=W	20 <=W	120	80 <T	180	120 <T	40 <T	200	97	90	60	40 <=W	160	20 <=W	80 <T	20 <=W	60 <T	140	1600 PS1
5	LC21	20 <=W	20 <=W	80 <T	80 <T	160	120 <T	40 <T	160	78	100	43	40 <=W	140	20 <=W	80 <T	20 <=W	60 <T	120	840 PS1
5	LC22	20 <=W	20 <=W	280	240	360	280	80 <T	540	94	110	47	80 <T	280	20 <=W	120 <T	20 <=W	60 <T	340	1700 PS1
5	LC23	20 <=W	20 <=W	160	160 <T	260	160 <T	60 <T	320	94	84	64	40 <=W	240	20 <=W	120 <T	20 <=W	80 <T	280	1300 PS1
5	LC24	20 <=W	20 <=W	60 <T	80 <T	120	80 <T	40 <T	100	130	77	69	40 <=W	120	20 <=W	80 <T	20 <=W	40 <T	100	260 PS1
5	LC25	20 <=W	20 <=W	160	200	260	240	40 <T	320	97	80	62	80 <T	180	20 <=W	120 <T	20 <=W	60 <T	220	740 PS1
5	LC26	20 <=W	20 <=W	40 <T	80 <T	120	80 <T	20 <=W	100	71	79	61	40 <=W	100	20 <=W	80 <T	20 <=W	40 <T	100	460 PS1
5	LC27	20 <=W	20 <=W	80 <T	80 <T	180	120 <T	40 <T	120	100	79	70	40 <=W	160	20 <=W	80 <T	20 <=W	40 <T	200	960 PS1
5	LC28	20 <=W	20 <=W	40 <T	40 <=W	120	80 <T	40 <T	100	89	81	86	40 <=W	100	20 <=W	40 <=W	20 <=W	40 <T	100	460 PS1
5	LC29	20 <=W	20 <=W	40 <T	40 <=W	120	80 <T	20 <=W	100	93	74	80	40 <=W	100	20 <=W	40 <=W	20 <=W	40 <T	100	480 PS1
5	LC30	20 <=W	20 <=W	100	80 <T	200	120 <T	40 <T	160	81	78	80	40 <=W	240	20 <=W	80 <T	20 <=W	60 <T	220	640 PS1
5	LC31	20 <=W	20 <=W	20 <=W	40 <=W	80 <T	80 <T	20 <=W	80 <T	83	76	61	40 <=W	80 <T	20 <=W	40 <=W	20 <=W	40 <T	60 <T	260 P40
5	LC32	20 <=W	60 <T	140	120 <T	220	80 <T	60 <T	160	110	83	73	40 <=W	380	40 <T	120 <T	20 <=W	280	280	340 PS1
5	LC33	20 <=W	20 <=W	40 <T	40 <=W	120	40 <=W	40 <T	80 <T	110	73	58	40 <=W	120	20 <=W	40 <=W	20 <=W	40 <T	100	260 PS1
5	LC34	20 <=W	20 <=W	40 <T	40 <=W	120	80 <T	40 <T	80 <T	110	79	63	40 <=W	100	20 <=W	40 <=W	20 <=W	40 <T	100	320 PS1
5	LC35	20 <=W	20 <=W	60 <T	40 <=W	160	80 <T	40 <T	100	79	81	72	40 <=W	180	20 <=W	80 <T	20 <=W	80 <T	140	120 PS1
5	LC39	20 <=W	20 <=W	100	80 <T	140	80 <T	40 <T	100	74	81	54	40 <=W	180	20 <=W	80 <T	20 <=W	80 <T	140	40 PS1
5	LC40	20 <=W	20 <=W	60 <T	80 <T	140	80 <T	40 <T	80 <T	110	79	71	40 <=W	140	20 <=W	80 <T	20 <=W	40 <T	100	60 PS1
5	LC36	20 <=W	20 <=W	20 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	92	78	68	40 <=W	20 <=W	20 <=W	40 <=W	20 <=W	20 <=W	20 <=W	20 <=W
5	MEAN	20.0 <=W	21.9 <=W	95.2	93.3	172.4	118.1 <=T	43.8	173.3	96.0	84.9	64.1	43.8 <=W	170.5	21.0	81.9	20.0	66.7	161.0	750.5
6	LC14	20 <=W	20 <=W	320	160 <T	400	200	140	660	100	120	42	40 <=W	900	60 <T	160 <T	20 <=W	120	840	5700 PS1
7	LC16	60 <T	60 <T	1400	480	780	440	200	2500	130	140	50	160 <T	2500	140	200	20 <=W	820	2500	19000 PS1
PSQG	*LEL*		*220*	*320*	*370*		*170*	*240*	*340*				*60*	*750*	*190*	*200*		*560*	*490*	*70*
	SEL*		**37000**	**1480000**	**1440000**		**320000**	**1340000**	**460000**				**130000**	**1020000**	**160000**	**320000**		**950000**	**850000**	**530000**

SEL* corrected for TOC

<W No measurable response (zero) <W for all sites: Acenaphthylene

<T a measurable trace amount

P40 PCB resembles mixture of aroclor 1254 & 1260

PS1 PCB resembles mixture of aroclor 1248, 1254 & 1260

Table 4: Sampling strategy for detailed study: 2002 -2003

Site	Sediment		Caged Mussels	Forage Fish	Sport Fish
	Grab	Core			
LC01	2002	2002	2002		
LC03	2002	2002	2002/2003	2002/2003	
LC06	2003				
LC08	2003		2003	2003	
LC10	2003				
LC12	2002/2003		2003		
LC14	2003		2003		
LC16	2002/2003	2002	2003	2002/2003	2002/2003
LC17	2002/2003	2002	2002	2003	
LC18	2003		2003	2003	
LC19	2003		2003		
LC22	2003				
LC23	2003		2003		
LC24				2003	
LC29	2002/2003	2002	2002		
LC38	2002/2003	2002	2002	2002	2002
mouth				2002	
Tee Cr	2003		2003		
Usshers Cr	2003		2003	2003	
Beaver Cr	2002		2003	2002	
Black Cr	2002			2002	

Table 5: Toxic equivalency factors (TEFs) for selected PCB congeners (Environment Canada, 1998)

IUPAC No.	Structure	TEF (mammalian)*	TEF (avian)*
PCB 77	3,3',4,4'	0.0001	0.05
PCB 81	3,4,4',5	0.0001	0.1
PCB 126	3,3',4,4',5	0.1	0.1
PCB 169	3,3',4,4',5,5'	0.01	0.001
PCB 105	2,3,3',4,4'	0.0001	0.0001
PCB 114	2,3,4,4',5	0.0005	0.0001
PCB 118	2,3',4,4',5	0.0001	0.00001
PCB 123	2',3,4,4',5	0.0001	0.00001
PCB 156	2,3,3',4,4',5	0.0005	0.0001
PCB 157	2,3,3',4,4',5'	0.0005	0.0001
PCB 167	2,3',4,4',5,5'	0.00001	0.00001
PCB 189	2,3,3',4,4',5,5'	0.0001	0.00001

* 1998 WHO TEF values (Van den Berg et al., 1998)

Table 6: General chemistry, OC, PAH and PCB concentrations of surficial sediment groupings (as determined through cluster analysis) collected from Lyons Creek in 2002 and 2003 - General chemistry

		Aluminum	Barium	Beryllium	Cadmium	Calcium	total organic carbon	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Strontium	Titanium	Vanadium	Zinc
		ug/g	ug/g	ug/g	ug/g	ug/g	%	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g
Group 1	02LC12	12800	112	0.6	1 <T	65300	4.8	52	12	59	29700	64		414	50	149	227	16 <=W	**926**
	03LC06*	12500	95	0.4	0.8	70500	4.1	33	13	49	27200	30	15700	494	36	138	236	22	444
	03LC08A*	20000	130	0.9 <T	1.5	65000	4.1	43	13	64	35000	63	14000	480	54	160	230	44	**820**
	03LC08B*	16000	123	0.5	1	63600	4.3	39	15	65	33200	68	15000	493	51	146	254	29	**1080**
	03LC10*	12600	119	0.4	1.1	68000	6.9	34	13	58	29600	45	12200	396	43	179	201	22	**841**
	03LC12	20000	140	0.8 <T	0.9 <T	64000	5.1	37	12	57	29000	36	11000	370	45	180	170	39	690
	03LC14*	22300	151	0.7	1.2	52700	4.4	47	16	65	**46000**	70	12400	460	59	152	271	36	**2440**
	Group 1 average	16600.00	124.29	0.61	1.07	64157.14	4.81	40.71	13.43	59.57	32814.29	53.71	13383.33	443.86	48.29	157.71	227.00	29.71	**1034.43**
Group 2	02LC01	10300	84	0.5	1 <=W	90900	1.9	24	11	39	21200	24		563	27	139	238	14 <=W	126
Group 3	02LC17	15200	119	0.8	1 <=W	31400	5.2	46	13	48	30700	38		492	44	75	200	18 <=W	590
	03LC14	23000	140	0.9 <T	1.2	45000	4.8	38	13	48	31000	30	11000	380	49	140	160	42	530
	03LC17	16000	110	0.8 <T	0.7 <T	45000	2.8	27	12	33	28000	18	16000	600	33	91	220	36	310
	03LC18A*	14900	111	0.5	0.7	28000	6.9	36	12	37	29400	40	15300	489	46	83	161	28	407
	02BLC02	14100	95	0.7	1 <=W	54200	4	38	15	23	28200	49		624	35	104	255	19 <=W	81
	03UC01*	18300	120	0.6	1.2	35800	6.4	27	16	28	24900	18	12200	352	32	91	196	30	166
	Group 3 average	16916.67	115.83	0.72	0.97	39900.00	5.02	35.33	13.50	36.17	28700.00	32.17	13625.00	489.50	39.83	97.33	198.67	28.83	347.33
Group 4	02LC03	12600	135	0.7	2	48100	2.8	56	18	**131**	39900	117		349	**147**	131	190	19 <=W	**7969**
Group 5	03LC19	23000	120	0.9 <T	1.1	15000	4.8	36	13	41	33000	23	10000	440	48	58	210	45	470
	03LC19*	21600	120		0.7	20500	5.1	35	15	44	36900	32	11500	525	46	66	262	38	7.9
	03LC22A*	23500	139	0.8	0.9	6920	5	34	16	41	36100	29	9270	532	58	43	201	37	522
	03LC23*	22000	133	0.8	0.9	10700	6	36	17	42	37900	35	10700	585	54	53	201	39	783
	03LC38	29000	150	1.1 <T	1.3	12000	3.9	36	15	26	37000	14	9200	760	45	74	170	50	160
	Group 5 average	23820	132.4	0.9	0.98	13024	4.96	35.4	15.2	38.8	36180	26.6	10134	568.4	50.2	58.8	208.8	41.8	388.58
Group 6	03TC04	16000	82	0.7 <T	1.2	20000	3.8	22	14	19	23000	12	11000	410	33	45	250	36	110
	03TC04*	18000	104	0.7	0.8	17800	5.3	28	16	22	27100	22	9700	444	36	52	173	33	112
	03UC01	19000	110	0.8 <T	1.4	26000	5.8	25	14	26	23000	14	11000	310	34	69	160	37	170
	02LC16	16300	133	0.8	1 <=W	17200	6.6	40	13	56	31300	47		311	50	62	220	20 <=W	645
	02LC2901	16500	112	0.8	1 <=W	7900	5.4	35	13	36	32100	48		471	50	43	199	19 <=W	656
	02LC29-02	16200	113	0.8	1 <=W	7900	5.8	34	13	35	32100	43		466	48	44	184	19 <=W	651
	02LC2903	16700	115	0.8	1 <=W	8000	5.4	34	13	36	32600	48		483	50	44	199	19 <=W	664
	02LC38	16600	122	1	1 <=W	7900	**10.7**	31	14	27	27200	33		439	46	66	174	23 <=W	172
	02BEC01	17800	143	1	1 <=W	8400	3.2	27	9	30	17100	19		196	25	197	137	23 <=W	81
	02BEC02	14300	102	1	1 <=T	14200	**10.6**	33	15	30	27000	20		402	35	309	170	18 <=W	107
	02BLC01	11900	77	0.8	1 <=W	7900	5.6	31	14	25	23900	26		250	37	72	217	19 <=W	109
	Group 6 average	16300.00	110.27	0.84	1.04	13018.18	6.20	30.91	13.45	31.09	26945.45	30.18	10566.67	380.18	40.36	91.18	189.36	24.18	316.09
	PSQG SEL				**10**		**10%**	**110**		**110**	**4%**	**250**		**1100**	**75**				**820**
	PSQG LEL				0.6		1%	26		16	2%	31		460	16				120

<W no measurable amount (zero)

<T a measurable trace amount

Table 6 cont'd: General chemistry, OC, PAH and PCB concentrations of surficial sediment groupings (as determined through cluster analysis) collected from Lyons Creek in 2002 and 2003 - OC pesticides

		Dieldrin	Endosulphan I	Endosulphan II	Endosulphan sulphate	Endrin	g-BHC (hexachlorocyclohexane)	g-Chlordane	Heptachlor	Heptachlor epoxide	Methoxychlor	Mirex	op-DDT	Oxychlordane	pp-DDD	pp-DDE	pp-DDT	DDT & Metabolites
		ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
Group 1	02LC12	32	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	140	5 <=W	140
	03LC06*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	32	5 <=W	32
	03LC08A*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	94	5 <=W	94
	03LC08B*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	110	5 <=W	110
	03LC10*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	74	5 <=W	74
	03LC12	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	40	5 <=W	40
	03LC14*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	58	5 <=W	58
	Group 1 average	6.29 <=W	2.00 <=W	4.00 <=W	4.00 <=W	4.00 <=W	1.00 <=W	2.00 <=W	1.00 <=W	1.00 <=W	5.00 <=W	5.00 <=W	5.00 <=W	2.00 <=W	5.00 <=W	78.29	5.00 <=W	78.29
Group 2	02LC01	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	2	5 <=W	2 <=W
Group 3	02LC17	4	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	43	5 <=W	44
	03LC14	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	22	5 <=W	22
	03LC17	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	18	5 <=W	18 <T
	03LC18A*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	16	5 <=W	16 <T
	02BLC02	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	1 <=W	5 <=W	2 <=W
	03UC01*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	2 <T	5 <=W	2 <=W
	Group 3 average	2.33	2.00 <=W	4.00 <=W	4.00 <=W	4.00 <=W	1.00 <=W	2.00 <=W	1.00 <=W	1.00 <=W	5.00 <=W	5.00 <=W	5.00 <=W	2.00 <=W	5.00 <=W	17.00	5.00 <=W	17.33 <T
Group 4	02LC03	2 <=W	2 <=W	12	16	24	3	2 <=W	1 <=W	2 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	340	5 <=W	340
Group 5	03LC19	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	18	5 <=W	18 <T
	03LC19*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	26	5 <=W	26
	03LC22A*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	10	5 <=W	10 <T
	03LC23*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	20	5 <=W	20
	03LC29*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	8 <T	5 <=W	8 <T
	03LC38	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	1 <=W	5 <=W	2 <=W
	Group 5 average	2.00 <=W	2.00 <=W	4.00 <=W	4.00 <=W	4.00 <=W	1.00 <=W	2.00 <=W	1.00 <=W	1.00 <=W	5.00 <=W	5.00 <=W	5.00 <=W	2.00 <=W	5.00 <=W	13.83	5.00 <=W	14.00
Group 6	03TC04	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	1 <=W	5 <=W	2 <=W
	03TC04*	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	2 <T	5 <=W	2 <=W
	03UC01	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	1 <=W	5 <=W	2 <=W
	02LC16	8	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	49	5 <=W	50
	02LC2901	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	17	5 <=W	2 <=W
	02LC29-02	4	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	13	5 <=W	14
	02LC2903	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	14	5 <=W	2 <=W
	02LC38	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	3	5 <=W	4
	02BEC01	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	1 <=W	5 <=W	2 <=W
	02BEC02	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	1 <=W	5 <=W	2 <=W
	02BLC01	2 <=W	2 <=W	4 <=W	4 <=W	4 <=W	1 <=W	2 <=W	1 <=W	1 <=W	5 <=W	5 <=W	5 <=W	2 <=W	5 <=W	1 <=W	5 <=W	2 <=W
	Group 6 average	2.73	2.00 <=W	4.00 <=W	4.00 <=W	4.00 <=W	1.00 <=W	2.00 <=W	1.00 <=W	1.00 <=W	5.00 <=W	5.00 <=W	5.00 <=W	2.00 <=W	5.00 <=W	9.36	5.00 <=W	7.64
	PSQG SEL	**91000***				**130000***	**1000*b**	**6000*d**		**5000*b**		**130000***			**6000***	**19000***	**12000*d**	**71000*a**
	PSQG LEL	*2*				*3*	*3c*	*7c*	*NEL=0.3*	*5c*		*7*			*8*	*5*	*7d*	*8a*
							b=90% SCL c=10%SCL	d= chlordane		b=90% SCL c=10%SCL							d=DDT total	a = op+pp-DDT

<W no measurable amount (zero)
<T a measurable trace amount
* SEL to be TOC corrected

Table6 cont'd: General chemistry, OC, PAH and PCB concentrations of surficial sediment groupings (as determined through cluster analysis) collected from Lyons Creek in 2002 and 2003 - PAHs and PCBs

		Acenaphthene ng/g	Acenaphthylene ng/g	Anthracene ng/g	Benzo(a)anthracene ng/g	Benzo(a)pyrene ng/g	Benzo(b)fluoranthene ng/g	Benzo(g,h,i)perylene ng/g	Benzo(k)fluoranthene ng/g	Chrysene ng/g	d10-phenanthrene ng/g	d12-chrysene ng/g	d8-naphthalene ng/g	Dibenzo(a,h)anthracene ng/g	Fluoranthene ng/g	Fluorene ng/g	Indeno(1,2,3-c,d)pyrene ng/g	Naphthalene ng/g	Phenanthrene ng/g	Pyrene ng/g	PCB congeners; total ng/g
Group 1	02LC12	40 <T	20 <=W	60	220	200	380	*240*	100	*400*	78	37	33	40 <=W	680	60	*240*	20 <=W	260	*680*	*7500*
	03LC06*	20 <=W	20 <=W	20 <=W	120	120 <T	200	120 <T	60 <T	180	86	47	53	40 <=W	240	20 <=W	160 <T	20 <=W	120	260	*600*
	03LC08A*	60 <T	20 <=W	60 <T	300	*240*	460	*200*	160	*640*	96	67	48	40 <=W	*860*	80 <T	*320*	20 <=W	360	*760*	*5200*
	03LC08B*	60 <T	20 <=W	160	*420*	*320*	560	*280*	180	*780*	86	57	46	40 <=W	*1300*	120	*400*	20 <=W	*660*	*1100*	*4700*
	03LC10*	20 <=W	20 <=W	40 <T	240	*280*	420	*320*	120	*480*	89	53	42	*80* <T	480	20 <=W	*360*	20 <=W	180	*600*	*2500*
	03LC12	20 <=W	20 <=W	20 <=W	80 <T	120 <T	220	120 <T	60 <T	180	85	62	42	40 <=W	200	20 <=W	*200*	20 <=W	80 <T	200	*910*
	03LC14*	20 <=W	20 <=W	20 <=W	100	80 <T	200	80 <T	60 <T	280	91	61	85	40 <=W	340	40 <T	120 <T	20 <=W	60 <T	340	*2300*
	Group 1 average	34.29 <T	20.00 <=W	54.29 <T	211.43	194.29	348.57	194.29	105.71	420.00	87.29	54.86	49.86	45.71 <T	585.71	51.43 <T	257.14	20.00 <=W	245.71	562.86	3387.14
Group 2	02LC01	20 <=W	20 <=W	20 <=W	40	40 <=W	80	40 <=W	20 <=W	60	100	47	63	40 <=W	120	20 <=W	40 <=W	20 <=W	80	100	25.8
Group 3	02LC17	20 <=W	20 <=W	20 <=W	60	80	120	80	40	100	93	53	49	40 <=W	120	20 <=W	80	20 <=W	60	120	*1300*
	03LC14	20 <=W	20 <=W	20 <=W	40 <T	80 <T	140	80 <T	20 <=W	120	89	57	82	40 <=W	140	20 <=W	120 <T	20 <=W	60 <T	120	*570*
	03LC17	20 <=W	20 <=W	20 <=W	60 <T	80 <T	100	80 <T	40 <T	100	85	58	95	40 <=W	100	20 <=W	80 <T	20 <=W	60 <T	100	*380*
	03LC18A*	20 <=W	20 <=W	20 <=W	100	80 <T	140	120 <T	40 <T	180	87	61	85	40 <=W	160	20 <=W	120 <T	20 <=W	60 <T	160	*450*
	02BLC02	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40	40 <=W	20 <=W	40	120	78	120	40 <=W	80	20 <=W	40 <=W	40	40	60	2.5
	03UC01*	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	86	62	52	40 <=W	40 <T	20 <=W	40 <=W	20 <=W	20 <=W	20 <=W	13
	Group 3 average	20 <=W	20 <=W	20 <=W	50 <T	66.67 <T	93.33	73.33 <T	30.00 <T	93.33	93.33	61.50	80.50	40.00 <=W	106.67	20.00 <=W	80.00 <T	23.33 <=W	50.00 <T	96.67	452.58
Group 4	02LC03	400	400	*400*	*5000*	*2900*	3800	*3100*	*1300*	*9900*	140	140	67	*840*	*13000*	*1100*	*1200*	400	*1200*	*18000*	*13000*
Group 5	03LC19	20 <=W	20 <=W	20 <=W	60 <T	80 <T	120	80 <T	40 <T	120	87	72	47	40 <=W	100	20 <=W	120 <T	20 <=W	40 <T	120	*850*
	03LC19*	20 <=W	20 <=W	20 <=W	80 <T	80 <T	120	120 <T	20 <=W	160	88	62	39	40 <=W	120	20 <=W	80 <T	20 <=W	40 <T	140	*1000*
	03LC22A*	20 <=W	20 <=W	20 <=W	40 <T	40 <=W	80 <T	40 <=W	20 <=W	80 <T	89	62	48	40 <=W	60 <T	20 <=W	80 <T	20 <=W	20 <=W	60 <T	*290*
	03LC23*	20 <=W	20 <=W	20 <=W	120	160 <T	180	160 <T	20 <=W	260	97	64	40	40 <=W	100	20 <=W	80 <T	20 <=W	40 <T	160	*870*
	03LC29*	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	60 <T	40 <=W	20 <=W	60 <T	89	56	48	40 <=W	60 <T	20 <=W	40 <=W	20 <=W	20 <=W	60 <T	*230*
	03LC38	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	40 <T	40 <=W	20 <=W	20 <=W	84	67	53	40 <=W	40 <T	20 <=W	40 <=W	20 <=W	20 <=W	20 <=W	24
	Group 5 average	20.00 <=W	20.00 <=W	20.00 <=W	56.67 <T	73.33 <T	100.00	80.00 <T	23.33 <T	116.67	89.00	63.83	45.83	40.00 <=W	80.00	20.00 <=W	73.33 <T	20.00 <=W	30.00 <T	93.33	544.00
Group 6	03TC04	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	90	68	59	40 <=W	20 <=W	20 <=W	40 <=W	20 <=W	20 <=W	20 <=W	2.6
	03TC04*	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	100	67	58	40 <=W	20 <=W	20 <=W	40 <=W	20 <=W	20 <=W	20 <=W	11
	03UC01	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	91	65	50	40 <=W	40 <T	20 <=W	40 <=W	20 <=W	20 <=W	20 <=W	5.5
	02LC16	20 <=W	20 <=W	20 <=W	60 <T	80	120	80 <T	40 <T	120	72	36	23	40 <=W	120	20 <=W	80 <T	20 <=W	40 <T	120	*1500*
	02LC2901	20 <=W	20 <=W	20 <=W	40 <T	40 <=W	120	80 <T	40 <T	100	110	84	90	40 <=W	80	20 <=W	80 <T	40 <=W	40 <T	80	*450*
	02LC29-02	20 <=W	20 <=W	20 <=W	20 <T	40 <=W	80 <T	80 <T	20 <=W	60 <T	110	58	58	40 <=W	60	20 <=W	40 <=W	20 <=W	20 <=W	60 <T	*410*
	02LC2903	20 <=W	20 <=W	20 <=W	40 <T	40 <=W	120	80 <T	40 <T	100	120	85	91	40 <=W	80	20 <=W	80 <T	40 <T	40 <T	80	*430*
	02LC38	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	20 <=W	40 <=W	40 <T	20 <=W	95	54	55	40 <=W	40 <=T	20 <=W	40 <=W	20 <=W	20 <=W	40 <T	21
	02BEC01	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	140	75	76	40 <=W	20 <=W	20 <=W	40 <=W	20 <=W	20 <=W	20 <=W	16
	02BEC02	20 <=W	20 <=W	20 <=W	20 <=W	40 <=W	20 <=W	40 <=W	20 <=W	20 <=W	140	69	81	40 <=W	20 <=W	20 <=W	40 <=W	20 <=W	20 <=W	20 <=W	12
	02BLC01	20 <=W	20 <=W	20 <=W	80 <T	40 <=W	120	40 <=W	40 <T	80 <T	140	98	100	40 <=W	220	20 <=W	40 <=W	40 <T	100	160	4
	Group 6 average	20.00 <=W	20.00 <=W	20.00 <=W	32.73 <T	43.64 <T	61.82 <T	54.55 <T	29.09 <T	52.73 <T	109.82	69.00	67.36	40.00 <=W	65.45	20.00 <=W	50.91 <T	25.45 <T	32.73 <T	58.18	260.19
	PSQG SEL*			**370000**	**1480000**	**1440000**		**320000**	**1340000**	**460000**				**130000**	**1020000**	**160000**	**320000**		**950000**	**850000**	**530000**
	PSQG LEL			*220*	*320*	*240*		*170*	*240*	*340*				*60*	*750*	*190*	*200*		*560*	*490*	*70*

* SEL to be TOC corrected

<W no measurable amount (zero)

<T a measurable trace amount

Table 6 cont'd: General chemistry, OC, PAH and PCB concentrations of surficial sediment groupings (as determined through cluster analysis) collected from Lyons Creek in 2002 and 2003 - PCB congeners

		Group 1								Group 2	Group 3							Group 4	Group 5								Group 6											
		02LC12	03LC06*	03LC08A*	03LC08B*	03LC10*	03LC12	03LC14*	Group 1 average	02LC01	02LC17	03LC14	03LC17	03LC18A*	02BLC02	03UC01*	Group 3 average	02LC03	03LC19	03LC19*	03LC22A*	03LC23*	03LC29*	03LC38	Group 5 average	03TC04	03TC04*	03UC01	02LC16	02LC29-1	02LC29-2	02LC29-3	02LC38	02BEC01	02BEC02	02BLC01	Group 6 average
2,2',3,5'-tetrachlorobiphenyl	ng/g	660	15	410	62	190	5	45	198.1	2.7	100	4.2	38	7.7	<=W	<=W	25.0	1000	30	41	8.1	2	11	1.5	15.6	<=W	<=W	<=W	120	25	3.7	21	1.3	<=W	0.8	<=W	15.7
2,2',4,5'-tetrachlorobiphenyl	ng/g	540	53	360	520	170	86	220	278.4	1.3	92	56	34	41	<=W	<=W	37.2	830	39	53	19	77	15	2.3	34.2	<=W	<=W	<=W	120	26	35	29	0.11	0.8	0.6	<=W	19.3
2,2',5,5'-tetrachlorobiphenyl	ng/g	750	73	490	720	250	110	310	386.1	2.6	130	75	47	59	<=W	<=W	51.9	1200	54	75	26	120	19	2.4	49.4	<=W	2	<=W	160	34	49	38	0.74	0.7	1.4	<=W	26.0
2,2',5-trichlorobiphenyl	ng/g	560	5.6	430	80	82	3	63	174.8	<=W	42	<=W	13	2.9	<=W	<=W	10.7	730	14	34	3.9	<=W	3.3	<=W	9.9	<=W	<=W	<=W	62	15	8.8	15	6.4	<=W	<=W	<=W	10.8
2,2',6,6'-tetrachlorobiphenyl	ng/g	77	<=W	3.2	1.9	16	4.7	38	20.1	<=W	6.3	3	4.8	1.1	<=W	<=W	2.6	140	0.7	4	5.2	6.2	3.2	<=W	3.3	<=W	<=W	<=W	11	2.7	1.1	2.9	<=W	<=W	<=W	<=W	1.7
2,2',6-trichlorobiphenyl	ng/g	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	73	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W
2,2'3,44'5'-hexachlorobiphenyl	ng/g	88	17	53	70	47	21	30	46.6	<=W	26	10	7.9	8.3	<=W	1	8.9	140	56	53	11	22	6.3	1.3	24.9	<=W	<=W	<=W	28	13	14	15	<=W	<=W	<=W	<=W	6.5
2,2'3,4'5'6-hexachlorobiphenyl	ng/g	74	12	3.7	8.1	37	18	2	22.1	<=W	18	11	5.3	7.4	<=W	2.8	7.5	110	63	56	9.7	28	6.1	1.4	27.4	<=W	2	<=W	21	10	14	12	<=W	<=W	<=W	<=W	5.5
2,2'3,5,5'6-hexachlorobiphenyl	ng/g	18	<=W	11	16	8	2.2	5.7	8.7	<=W	4.9	1.6	0.3	<=W	<=W	<=W	1.2	72	0.1	17	0.36	6.3	0.2	<=W	4.0	<=W	<=W	<=W	5.2	2.9	4.3	3.4	<=W	<=W	<=W	<=W	1.5
2,2'3,5',6-pentachlorobiphenyl	ng/g	1000	120	730	980	390	190	420	547.1	4.7	200	110	8.6	80	<=W	1.7	66.7	1400	99	120	48	140	37	1.9	74.3	1.4	1.8	1.7	250	49	65	55	0.84	0.6	1	0.53	38.8
2,2'4,4',5-pentachlorobiphenyl	ng/g	150	25	90	160	77	38	59	85.6	<=W	39	21	12	16	<=W	<=W	14.7	240	16	19	6.9	27	5	<=W	12.3	<=W	<=W	<=W	48	10	14	11	<=W	0.5	1	<=W	7.7
2,2'4,5,5'-pentachlorobiphenyl	ng/g	220	43	160	220	120	62	100	132.1	0.96	62	37	24	29	<=W	1	25.5	490	40	43	13	51	11	0.4	26.4	<=W	<=W	1	74	20	24	20	<=W	0.7	0.5	<=W	12.8
2,2'4,6,6'-pentachlorobiphenyl	ng/g	<=W	<=W	<=W	<=W	<=W	1.8	2.5	0.7	<=W	<=W	2.2	2.6	3	<=W	<=W	1.4	<=W	2.9	2.6	4.2	1.9	3.3	<=W	2.5	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	1.7	1.4	<=W	0.4
2,3,3'4,4'5-hexachlorobiphenyl	ng/g	8.4	0.7	4.4	7.4	3.4	1.3	2.6	4.0	<=W	2.4	<=W	1.8	1.9	<=W	<=W	1.1	25	2.9	2.5	1.5	0.6	1.4	<=W	1.5	<=W	<=W	<=W	2.5	1.2	0.77	1.3	<=W	<=W	<=W	<=W	0.7
2,3,3'4,4'6-hexachlorobiphenyl	ng/g	10	0.8	4.2	6.8	3.7	1.3	2.3	4.2	<=W	3.1	0.4	1.6	1.7	<=W	<=W	1.2	19	2.9	3	1.8	1.1	0.8	<=W	1.6	<=W	<=W	<=W	3.6	1.6	2.1	1.6	<=W	<=W	<=W	<=W	0.9
2,3,3'4,4'-pentachlorobiphenyl	ng/g	74	0.1	18	2	9.9	7.6	14	17.9	0.1	28	4.9	4.4	5	<=W	<=W	7.1	230	9.4	7.5	5.8	1.5	4.7	<=W	4.8	<=W	<=W	<=W	5.7	11	2.4	4.3	<=W	<=W	<=W	<=W	2.2
2,3,3'4',6-pentachlorobiphenyl	ng/g	260	4.1	150	7.9	110	20	37	84.1	0.77	73	12	25	13	<=W	<=W	20.5	720	19	18	22	4	16	0.8	13.3	<=W	<=W	<=W	60	29	<=W	20	<=W	<=W	<=W	<=W	10.0
2,3,4,4',5-pentachlorobiphenyl	ng/g	9.7	0.97	4.4	7.7	2.7	1.4	2.2	4.2	<=W	2.2	0.63	0.51	0.32	<=W	<=W	0.6	18	0.9	0.7	<=W	0.62	0.6	<=W	0.5	<=W	<=W	<=W	2.5	1.6	<=W	1.7	<=W	<=W	<=W	<=W	0.6
2,3',4',5-tetrachlorobiphenyl	ng/g	810	67	470	410	230	110	300	342.4	2.5	130	67	47	52	<=W	0.9	49.5	1100	48	67	24	99	18	0.8	42.8	0.9	1.2	0.9	160	28	38	30	0.51	1.3	0.7	0.37	23.8
2',3,4-trichlorobiphenyl	ng/g	350	4.8	260	110	57	9.9	36	118.2	1.3	35	6.5	13	6.2	<=W	<=W	10.3	510	13	21	4.1	9.4	3.7	4	9.2	<=W	<=W	<=W	49	5	6.9	0.69	4.1	<=W	<=W	<=W	6.2
2,3,4'-trichlorobiphenyl	ng/g	37	<=W	1.1	2.4	7.6	2	8.7	8.5	<=W	9.5	1.7	<=W	<=W	<=W	<=W	2.2	210	1	<=W	<=W	1.4	1.8	<=W	1.0	<=W	<=W	<=W	<=W	5.3	<=W	<=W	<=W	<=W	<=W	<=W	0.9
2,3'4,4',5-pentachlorobiphenyl	ng/g	210	33	37	51	86	48	80	77.9	<=W	53	27	19	20	<=W	<=W	19.9	320	22	24	10	33	6.4	1.4	16.1	<=W	<=W	<=W	62	13	17	15	<=W	<=W	<=W	<=W	9.8
2,3'4,4',6-pentachlorobiphenyl	ng/g	6.6	2.3	1.9	6.5	0.8	<=W	0.55	2.7	<=W	<=W	<=W	3.1	2.1	<=W	<=W	0.9	6.4	2.4	0.4	0.8	1.6	1.4	<=W	1.1	<=W	<=W	<=W	<=W	0.18	<=W	<=W	<=W	<=W	<=W	<=W	0.1
2,4,4',5-tetrachlorobiphenyl	ng/g	350	29	220	330	98	49	140	173.7	<=W	60	32	21	25	<=W	<=W	23.0	480	23	31	11	52	8.1	<=W	20.9	<=W	<=W	<=W	80	14	20	16	<=W	1	0.3	<=W	12.0
2,4,4'-trichlorobiphenyl	ng/g	690	32	500	590	130	59	270	324.4	4.2	76	42	27	30	2.5	0.6	29.7	700	31	49	18	55	12	0.65	27.6	<=W	0.8	0.6	110	23	33	26	6.2	<=W	<=W	3.1	18.7
22',33',44'-hexachlorobiphenyl	ng/g	12	<=W	1.9	<=W	1.3	<=W	<=W	2.3	<=W	4.4	<=W	<=W	<=W	<=W	<=W	0.9	33	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	1.4	2.5	<=W	0.5	<=W	<=W	<=W	<=W	0.5
22',44',55'-hexachlorobiphenyl	ng/g	53	12	39	70	32	14	25	35.0	<=W	16	8.6	5.3	7.2	<=W	<=W	6.2	110	61	55	7.7	26	6.1	0.9	26.1	<=W	<=W	<=W	17	14	13	16	<=W	1	<=W	<=W	5.6
22',44',66'-hexachlorobiphenyl	ng/g	<=W	3	12	19	10	4.5	9.5	8.3	<=W	<=W	8	2	3.2	<=W	<=W	2.3	<=W	2.2	2.9	1.2	3.6	1.3	<=W	1.9	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	1.2	1.3	<=W	0.3
22'33'44'55'6-nona(Cl)biphenyl	ng/g	1.8	1.6	0.5	1.9	<=W	2.4	3.9	1.8	<=W	<=W	1.7	1.4	2.2	<=W	<=W	1.0	<=W	0.7	0.3	1.7	2.5	2	1.1	1.4	<=W	<=W	<=W	<=W	<=W	<=W	0.21	<=W	0.6	0.4	<=W	0.3
22'33'44'55'-octa(Cl)biphenyl	ng/g	7.6	0.5	4.9	6.2	3.5	0.89	1.7	3.6	<=W	2	0.5	2.2	3.7	<=W	1.4	1.7	19	6.4	8	<=W	2.4	4.5	<=W	3.6	<=W	<=W	<=W	1.7	2.2	1.7	2.7	<=W	<=W	<=W	<=W	0.9
22'33'44'5-heptachlorobiphenyl	ng/g	19	2.9	10	14	8.2	3	6.3	9.1	<=W	5.6	0.72	0.8	0.46	<=W	<=W	1.3	37	20	21	2.7	7.9	1	0.8	8.9	<=W	0.8	<=W	5.3	5	5.5	5.3	<=W	<=W	<=W	<=W	2.1
22'33'44'6-heptachlorobiphenyl	ng/g	3.7	1.3	1.9	3.4	3.9	2	0.23	2.3	<=W	<=W	1.2	0.9	1.4	<=W	<=W	0.7	15	6.8	5.8	2.1	0.9	1.9	<=W	3.0	<=W	<=W	<=W	<=W	0.46	<=W	0.73	<=W	<=W	<=W	<=W	0.3
22'33'455'66'-nona(Cl)biphenyl	ng/g	<=W	<=W	<=W	<=W	<=W	<=W	<=W	0.2	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	0.8	0.4	<=W	0.3
22'33'455'6'-octa(Cl)biphenyl	ng/g	7.1	3.2	4.1	5.8	2.9	0.52	1.1	3.5	<=W	1.1	<=W	1.9	3.3	<=W	<=W	1.2	14	6.6	7.3	3.7	1.5	1.9	0.2	3.5	<=W	<=W	<=W	0.93	1.3	0.81	1.9	<=W	<=W	<=W	<=W	0.6
22'33'45'66'-octa(Cl)biphenyl	ng/g	4.6	2.3	14	20	9.9	4	7.3	8.9	<=W	2	1.1	3.7	0.4	<=W	<=W	1.3	<=W	0.3	<=W	3.1	10	1.5	1.2	2.7	<=W	<=W	<=W	0.2	1.3	2.8	1.5	<=W	<=W	<=W	<=W	0.7
22'33'4'56-heptachlorobiphenyl	ng/g	8.8	2.7	5.1	7.2	3.4	0.4	1.3	4.1	<=W	1.5	0.5	1.8	2.1	<=W	<=W	1.0	11	16	14	0.29	2	3.8	0.8	6.1	<=W	<=W	<=W	1.5	1.6	1.7	1.9	<=W	<=W	<=W	<=W	0.7
22'33'55'66'-octa(Cl)biphenyl	ng/g	<=W	0.8	1.5	1.4	1	<=W	1.1	0.9	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W
22'33'55'6-heptachlorobiphenyl	ng/g	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	0.2	0.2	0.2	2.7	2.5	<=W	1.0	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	0.2
22'344'55'-heptachlorobiphenyl	ng/g	36	6.9	26	34	20	9.4	13	20.8	<=W	11	3.7	1.9	3.1	<=W	1.5	3.6	61	47	49	8.2	18	3.6	0.8	21.1	<=W	0.7	<=W	10	10	12	11	<=W	<=W	0.5	<=W	4.1
22'344'5'6-heptachlorobiphenyl	ng/g	9.7	<=W	4.8	6.7	3.3	2.4	1.8	4.1	<=W	2.4	0.35	2.7	3.6	<=W	<=W	1.6	14	11	11	0.92	3.7	<=W	<=W	4.5	<=W	<=W	<=W	2.9	2.2	2.8	2.5	<=W	<=W	<=W	<=W	1.1
22'34'55'6-heptachlorobiphenyl	ng/g	18	1.9	13	17	8.6	3.8	6.2	9.8	<=W	5	0.78	3.7	0.59	<=W	2.2	2.1	28	26	27	3.1	9	0.8	<=W	11.0	<=W	2	<=W	4.8	4.8	6	5.5	<=W	0.4	0.8	<=W	2.2
22'34'566'-heptachlorobiphenyl	ng/g	11	<=W	5.3	8.2	4.1	1.1	2.3	4.6	<=W	2.4	0.3	2.5	2.9	<=W	<=W	1.4	13	7.3	6.6	3.3	2.4	2	<=W	3.6	<=W	<=W	<=W	2.9	<=W	<=W	<=W	<=W	<=W	<=W	<=W	0.4
2'3,4,4',5-pentachlorobiphenyl	ng/g	24	8.2	13	22	8.3	2.4	7.3	12.2	<=W	4.3	4.9	1.8	3.3	<=W	<=W	2.5	100	4.3	5.7	5.1	20	1.5	<=W	6.1	<=W	<=W	<=W	5	<=W	<=W	<=W	<=W	<=W	<=W	<=W	0.6
23',44',55'-hexachlorobiphenyl	ng/g	2.3	<=W	<=W	4	3.6	0.4	0.6	1.6	<=W	<=W	<=W	1.2	1	<=W	<=W	0.5	<=W	1.3	1.2	1.1	1.3	0.7	<=W	1.0	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W
23',44',5'6-hexachlorobiphenyl	ng/g	53	7.9	37	54	30	14	23	31.3	<=W	16	6.5	2.5	4.7	<=W	<=W	5.0	230	9.3	7.6	7.7	24	3.9	<=W	8.8	<=W	<=W	<=W	16	11	2.4	4.3	<=W	<=W	<=W	<=W	3.1
233'44'55'-heptachlorobiphenyl	ng/g	<=W	<=W	<=W	1.2	<=W	<=W	<=W	0.3	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W
233'44'5'6-heptachlorobiphenyl	ng/g	<=W	<=W	0.6	0.5	0.6	<=W	<=W	0.4	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	0.4	<=W	<=W	0.2	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	1	<=W	<=W	<=W
3,3',4,4'-tetrachlorobiphenyl	ng/g	<=W	<=W	2.7	<=W	3	1.4	2.6	1.7	<=W	<=W	4.7	2	6	<=W	<=W	2.2	<=W	23	25	5.5	9.6	4.9	<=W	11.4	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W	<=W
3,4,4'-trichlorobiphenyl	ng/g	170	6.4	470	15	200	4.7	16	126.0	<=W	37	4.5	2.1	5.7	<=W	<=W	8.6	1100	20	36	5.8	<=W	4.7	<=W	11.4	<=W	<=W	<=W	9.1	43	9.6	31	<=W	<=W	<=W	<=W	9.1

Table 7. Total PCBs in resident benthic invertebrate taxa collected from reference creeks and Lyons Creek (µg/g dw).

Area	**Site**	**Total PCBs**			
		Chironomid	**Amphipod**	**Oligochaete**	**Odonate**
Ref. Creeks	**BEC01**	-[a]	-[a]	-[a]	-[a]
	BEC02	-[a]	-[a]	-[a]	-[a]
	BLC01	**0.126**	**0.166**	-[b]	**0.231**
	BLC02	**0.208**	**0.222**	-[b]	**0.404**
	U01	**0.253**	**0.105**	**0.051**	**0.090**
	TC40	**0.117**	**0.048**	**0.301**	**0.136**
Lyons Creek	LC01	-[b]	0.675	0.336	0.227
	LC03	-[b]	7.232	0.843	0.021
	LC06	-[a]	-[a]	-[a]	-[a]
	LC08	0.677	3.429	0.312	0.220
	LC10	-[a]	-[a]	-[a]	-[a]
	LC12	4.622	10.926	52.577	1.009
	LC14	1.466	3.332	0.939	0.274
	LC16	1.185	2.817	2.439	0.514
	LC17	4.384	5.171	4.002	0.299
	LC18	1.524	1.872	2.290	0.350
	LC19	1.911	2.126	0.699	0.221
	LC22	-[a]	-[a]	-[a]	-[a]
	LC23	-[a]	-[a]	-[a]	-[a]
	LC29	0.758	0.609	2.884	0.275
	LC38	0.936	0.082	0.907	0.135

[a] benthos not collected [b] taxa not analyzed

Table 8. Prediction of whole body concentrations of total PCBs in biota based on sediment total PCB concentration alone ("A" models), and sediment total PCB concentration + other sediment physico-chemical variables ("B" models). The groups of multiple predictors listed are from the models that best predicted $[PCB]_{inv}$ using sediment and water variables. $[PCB]_{sed}$ was retained in all models.

Response ($[PCB]_{inv}$)	Model	Predictor ([X])	Coefficient	P (predictor)	r^2	Adj. r^2	P (regression)
Chironomid	A	Total PCBs	0.3382	0.001	0.656	0.625	0.001
	B	Total PCBs	0.3294	<0.001	0.791	0.749	<0.001
		pH	0.2726	0.030			
Amphipod	A	Total PCBs	0.5506	<0.001	0.883	0.874	<0.001
	B	Total PCBs	0.5508	<0.001	0.929	0.918	<0.001
		pH	4.4520	0.016			
Oligochaete	A	Total PCBs	0.3081	0.082	0.250	0.182	0.082
	B	Total PCBs	0.4531	0.004	0.855	0.783	0.002
		pH	0.5320	0.004			
		Total P (water)	1.5223	0.007			
		Sand	-2.0258	0.032			
Odonate	A	Total PCBs	0.0009	0.991	0.000	0.000	0.991
	B	-	-	-	-	-	-

Table 9a. Predicted total PCB concentrations (µg/g wet weight) in fish receptors. Highlighted values exceed the tissue objective (0.1 µg/g ww, IJC) applicable for fishes.

Receptor		Brown Bullhead			Carp			Bluegill			Largemouth Bass		
Mean PCBs at Hwy 140[a]		0.140			1.164			0.188			0.278		
Mean PCBs Downstream QEW[a]		0.068			0.076			0.024			0.044		
Area	**Site**	**min**	**med**	**max**	**min**	**med**	**max**	**min**	**med**	**max**	**min**	**med**	**max**
Reference	**BLC01**	**0.03**	**0.08**	**0.13**	**0.03**	**0.41**	**0.89**	**0.02**	**0.06**	**0.16**	**0.02**	**0.68**	**9.80**
	BLC02	**0.04**	**0.11**	**0.19**	**0.04**	**0.58**	**1.30**	**0.02**	**0.08**	**0.23**	**0.02**	**0.95**	**14.28**
	UC01	**0.02**	**0.06**	**0.13**	**0.02**	**0.34**	**0.88**	**0.01**	**0.05**	**0.16**	**0.01**	**0.56**	**9.71**
	TC40	**0.01**	**0.10**	**0.23**	**0.01**	**0.51**	**1.57**	**0.01**	**0.07**	**0.28**	**0.01**	**0.84**	**17.26**
Lyons Creek	LC01	0.05	0.22	0.48	0.04	1.16	3.26	0.02	0.16	0.58	0.03	1.91	35.84
	LC03	0.01	1.75	4.67	0.01	9.17	31.79	0.00	1.25	5.63	0.00	15.07	349.72
	LC08	0.06	1.16	2.97	0.05	6.08	20.22	0.03	0.83	3.58	0.03	9.99	222.45
	LC12	0.33	12.57	32.85	0.29	65.82	223.59	0.15	8.97	39.59	0.17	108.19	2459.52
	LC14	0.06	1.02	2.59	0.05	5.36	17.66	0.03	0.73	3.13	0.03	8.82	194.21
	LC16	0.12	0.97	2.31	0.11	5.10	15.73	0.06	0.70	2.78	0.06	8.39	172.98
	LC17	0.06	1.76	4.58	0.05	9.22	31.16	0.03	1.26	5.52	0.03	15.16	342.72
	LC18	0.07	0.63	1.52	0.06	3.32	10.36	0.03	0.45	1.83	0.04	5.45	113.95
	LC19	0.05	0.68	1.69	0.05	3.56	11.51	0.03	0.49	2.04	0.03	5.85	126.60
	LC29	0.06	0.67	1.66	0.05	3.52	11.28	0.03	0.48	2.00	0.03	5.79	124.06
	LC38	0.02	0.22	0.55	0.02	1.17	3.71	0.01	0.16	0.66	0.01	1.93	40.82

[a] MOE 2003

Table 9b. Predicted total PCB concentrations in wildlife receptors.

Area	Site	Goldeneye (µg/g ww)			Mink (µg/g lipid)		
		min	med	max	min	med	max
Reference	**BLC01**	**0.26**	**0.43**	**0.61**	**0.32**	**1.44**	**5.77**
	BLC02	**0.34**	**0.60**	**0.89**	**0.42**	**2.04**	**8.41**
	UC01	**0.14**	**0.35**	**0.61**	**0.09**	**0.97**	**5.04**
	TC40	**0.10**	**0.53**	**1.08**	**0.19**	**1.09**	**4.85**
Lyons Creek	LC01	0.37	1.21	2.24	0.53	5.38	27.85
	LC03	0.04	9.50	21.86	0.06	44.50	271.74
	LC08	0.43	6.30	13.90	0.38	28.85	172.84
	LC12	2.50	68.19	153.72	3.53	118.58	691.65
	LC14	0.47	5.56	12.14	0.67	25.71	150.90
	LC16	0.96	5.29	10.81	1.35	24.09	134.41
	LC17	0.43	9.55	21.42	0.61	44.47	266.30
	LC18	0.56	3.44	7.12	0.78	14.60	81.78
	LC19	0.41	3.69	7.91	0.58	16.99	98.37
	LC29	0.46	3.65	7.75	0.65	6.72	34.89
	LC38	0.18	1.22	2.55	0.33	3.04	15.42

Table 10: PCB congener (ng/g) and lipid (%) data for clams collected from Lyons Creek in 2002 and 2003, and from Balsam Lake (reference).

	2,2',3,5'-tetrachlorobiphenyl	2,2',4,5'-tetrachlorobiphenyl	2,2',5,5'-tetrachlorobiphenyl	2,2',5-trichlorobiphenyl	2,2',6,6'-tetrachlorobiphenyl	2,2',6-trichlorobiphenyl	2,2'3,4,5'-pentachlorobiphenyl	2,2'3,44'5'-hexachlorobiphenyl	2,2'3,4'5'6-hexachlorobiphenyl	2,2'3,5,5'6-hexachlorobiphenyl	2,2'3,5',6-pentachlorobiphenyl	2,2'4,4',5-pentachlorobiphenyl	2,2'4,5,5'-pentachlorobiphenyl	2,2'4,6,6'-pentachlorobiphenyl	2,3,3'4,4'5-hexachlorobiphenyl	2,3,3'4,4'6-hexachlorobiphenyl	2,3,3'4,4'-pentachlorobiphenyl	2,3,3'4',6-pentachlorobiphenyl	2,3,3'44'5'-hexachlorobiphenyl	2,3,4,4',5-pentachlorobiphenyl	2,3',4',5-tetrachlorobiphenyl	2',3,4-trichlorobiphenyl	2,3,4'-trichlorobiphenyl	2,3'4,4',5-pentachlorobiphenyl	2,3'4,4',6-pentachlorobiphenyl	2,4,4',5-tetrachlorobiphenyl	2,4,4'-trichlorobiphenyl	22',33',44'-hexachlorobiphenyl	22',44',55'-hexachlorobiphenyl
03BC1A	<=W	<=W	<=W	<=W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
03BC1B	<=W	<=W	<=W	<=W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
03BC1C	<=W	<=W	<=W	<=W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
03TC1A	<=W	<=W	<=W	<=W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
03TC1B	<=W	<=W	<=W	<=W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
03TC1C	<=W	<=W	<=W	<=W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
03UC1A	<=W	<=W	<=W	<=W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
03UC1B	<=W	<=W	<=W	<=W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
03UC1C	<=W	<=W	<=W	<=W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
03LC03A	1.1	0.6	1.2	4	<W	<W	<W	4.4	1.4	<W	3.3	<W	1.7	<W	<W	<W	0.6	2.2	<W	<W	1	1	1	1.1	<W	1.1	4	<W	4.1
03LC03B	0.6	0.6	1.2	4	<W	<W	<W	6.4	1	<W	2.9	1.5	1.4	<W	<W	<W	0.6	1.9	<W	<W	0.8	<W	1.5	1	<W	1.5	3.5	<W	5.3
03LC03C	1.2	0.4	0.8	<=W	<W	<W	<W	0.6	1.2	<W	2.3	2.4	1.7	<W	<W	<W	<W	1.4	<W	<W	0.4	<W	<W	0.7	<W	1.6	4	<W	7.3
03LC08A	22	20	29	8	<W	<W	<W	2.4	1.2	1.3	36	6.7	11	<W	<W	2.9	0.4	10	<W	<W	23	4.5	<W	6.1	<W	9.5	13	0.4	1
03LC08B	17	14	20	4	<W	<W	<W	2	5	1.2	29	6	10	<W	<W	<W	2.7	12	<W	<W	18	3	<W	6.3	<W	7.7	8	0.8	0.8
03LC08C	22	18	26	8	<W	<W	<W	1	3.2	0.8	33	6.1	11	<W	<W	<W	2.9	13	<W	<W	21	5.5	1	6.8	<W	8.6	12	0.8	1.2
03LC12A	29	23	34	12	<W	<W	<W	2.6	1	1.1	41	7.1	12	<W	0.4	2.3	1.9	13	<W	<W	27	6.5	<W	8	<W	13	14	0.4	1.4
03LC12B	40	33	49	16	<W	<W	<W	4.8	3.8	<W	60	11	18	<W	0.6	2.9	5.6	20	<W	<W	38	9.5	<W	11	<W	19	20	1	2.5
03LC12C	36	27	44	16	<W	<W	<W	4	9.4	1.4	54	9.6	17	<W	0.4	2.4	5.6	18	<W	<W	35	8.5	3	11	<W	17	17	0.8	2.3
03LC14A	28	23	35	12	<W	<W	<W	3.2	1.8	1.2	41	5.9	12	<W	0.6	3.1	3.1	12	<W	<W	27	5.5	1	7.9	<W	14	16	0.8	1.5
03LC14B	21	19	29	10	<W	<W	<W	2.4	1	1.2	35	5.9	9.8	<W	0.4	<W	0.3	8.5	<W	<W	23	4	<W	6.9	<W	11	14	<W	1.2
03LC14C	31	24	38	20	<W	<W	<W	2.2	6.2	1.6	42	6.2	11	<W	0.4	<W	3.7	13	<W	<W	27	8	3	7.2	<W	13	19	1.2	1.3
03LC16A	14	12	18	12	<W	<W	<W	1.4	2.4	1.8	21	2.4	5.3	<W	<W	<W	1.6	5.8	<W	<W	13	3.5	1.5	3.4	<W	7.2	11	0.8	0.7
03LC16B	23	21	28	14	<W	<W	<W	1.4	2.4	3.5	40	4.1	12	<W	<W	<W	2.2	1.3	<W	<W	21	6	1.5	5.1	<W	9.4	16	2.2	0.7
03LC16C	15	10	19	10	<W	<W	<W	1.2	3	0.8	20	1.6	4.3	<W	<W	<W	1.3	5.1	<W	<W	13	2.5	<W	3.1	<W	6.5	8.5	0.4	0.8
03LC18A	14	10	17	10	<W	<W	<W	1.2	3.2	1.1	19	2	4.4	<W	<W	<W	1.1	4.8	0.6	<W	11	2	<W	2.2	<W	5.9	11	0.6	1.1
03LC18B	9.3	8.6	15	4	<W	<W	<W	0.4	1.4	0.6	16	1.3	2.3	<W	<W	<W	0.3	2.9	<W	<W	9.3	<W	<W	2.2	<W	4.6	8	<W	0.2
03LC18C	11	9.4	16	6	<W	<W	<W	0.6	1.8	0.8	17	1.1	2.9	<W	<W	<W	0.7	3.7	<W	<W	10	1	<W	1.7	<W	5.2	8.5	<W	1
03LC19A	6.8	5.2	10	4	<W	<W	<W	1	2.2	<W	12	1	1.6	<W	<W	<W	0.5	2.5	<W	<W	6.1	<W	1.5	1.8	<W	4.2	5.5	<W	0.7
03LC19B	14	12	20	8	<W	<W	<W	1.4	1.8	<W	21	1.7	4.5	<W	<W	<W	0.7	4.8	<W	<W	13	1	<W	2.9	<W	7.4	12	<W	0.6
03LC19C	8.9	7.7	13	4	<W	<W	<W	0.8	2	<W	15	0.6	2.8	<W	<W	<W	0.5	3.3	<W	<W	8.2	2.5	2	2	<W	4.1	7	<W	0.2
03LC23A	2.3	2.3	4.9	<W	<W	<W	<W	1.6	2.6	<W	6.6	0.5	0.3	<W	<W	<W	<W	1	<W	<W	2.2	<W	<W	0.3	<W	2.4	3	<W	0.9
03LC23B	1.3	1.7	3.1	<W	<W	<W	<W	0.6	2	<W	5.6	<W	<W	<W	<W	<W	<W	0.6	<W	<W	1.4	<W	<W	0.2	<W	1.5	2.5	<W	0.4
000LC23C	4.2	3.6	7	<W	<W	<W	<W	0.6	0.4	<W	8.5	0.4	0.8	<W	<W	<W	<W	1.5	<W	<W	3.1	<W	<W	0.4	<W	2.7	4.5	<W	1.3
02LC01A	1.1	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.1	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	2	<W	<W
02LC01B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.1	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	2.5	<W	<W
02LC01C	0.8	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.1	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	2	<W	<W
02LC03A	2.5	<W	1.7	6	<W	<W	<W	<W	<W	<W	2.7	0.1	<W	<W	<W	<W	<W	<W	<W	<W	<W	2	<W	<W	<W	<W	4.5	<W	<W
02LC03B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.1	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
02LC03C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.1	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	2.5	<W	<W
02LC17A	35	37	62	18	1.2	<W	<W	6.6	5.2	2	61	13	26	<W	<W	<W	6.4	23	<W	0.6	48	15	3	16	<W	20	27	<W	2.3
02LC17B	10	23	36	8	<W	<W	<W	1.6	1.8	1.1	33	8.3	13	<W	<W	1.1	1	4.2	<W	0.4	23	2.5	<W	6.2	<W	12	15	<W	<W
02LC17C	43	45	68	22	<W	<W	<W	4	5.4	1.6	71	13	21	<W	<W	<W	4	18	<W	<W	48	11	1	13	<W	25	34	<W	<W
02LC29A	4.8	6	9.4	4	<W	<W	<W	2.8	1.8	0.6	10	2.5	4.7	<W	<W	<W	1	3.6	<W	<W	6.3	3	<W	2.6	<W	2.3	6.5	<W	1.2
02LC29B	3.4	6.6	9.7	<W	<W	<W	<W	2.6	2	<W	9.6	2.5	4.7	<W	<W	<W	<W	3.2	<W	<W	6.1	1.5	<W	2.3	<W	5.5	4.5	<W	2.3
02LC29C	3	6.3	10	<W	<W	<W	<W	2.6	2.2	0.5	10	2.6	4.8	<W	<W	<W	0.6	2.2	<W	<W	6.5	1.5	<W	2.9	<W	3.6	5.5	<W	1.3
02LC38A	<W	<W	<W	4	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	4	<W	<W
02LC38B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	3	<W	<W
02LC38C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
02LCrefA	<W	<W	<W	<W	<W	<W	1.7	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
02LCrefB	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
02LCrefC	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W

	22',44',66'-hexachlorobiphenyl	22'33'44'55'6-nona(Cl)biphenyl	22'33'44'55'-octa(Cl)biphenyl	22'33'44'5-heptachlorobiphenyl	22'33'44'6-heptachlorobiphenyl	22'33'455'66'-nona(Cl)biphenyl	22'33'455'6-octa(Cl)biphenyl	22'33'45'66'-octa(Cl)biphenyl	22'33'4'56-heptachlorobiphenyl	22'33'55'66'-octa(Cl)biphenyl	22'33'55'6-heptachlorobiphenyl	22'344'55'-heptachlorobiphenyl	22'344'5'6-heptachlorobiphenyl	22'34'55'6-heptachlorobiphenyl	22'34'566'-heptachlorobiphenyl	2'3,4,4',5-pentachlorobiphenyl	23',44',55'-hexachlorobiphenyl	23',44',5'6-hexachlorobiphenyl	233'44'55'6-octachlorobiphenyl	233'44'55'-heptachlorobiphenyl	233'44'5'6-heptachlorobiphenyl	3,3',4,4'-tetrachlorobiphenyl	3,3'4,4',5-pentachlorobiphenyl	3,3'4,4'55'-hexachlorobiphenyl	3,4,4',5-tetrachlorobiphenyl	3,4,4'-trichlorobiphenyl	PCB, total congeners	Percent lipid	ng TEQ/kg
03BC1A	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1	0
03BC1B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.93	0
03BC1C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1	0
03TC1A	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1.2	0
03TC1B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1.1	0
03TC1C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1	0
03UC1A	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.45	0
03UC1B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1.1	0
03UC1C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.83	0
03LC03A	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	2.8	<W	<W	<W	<W	<W	1.6	<W	<W	<W	<W	<W	<W	<W	2	41	0.93	0.17
03LC03B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	3.8	<W	<W	<W	<W	<W	0.6	<W	<W	<W	<W	<W	<W	<W	4	43	0.74	0.16
03LC03C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	2.8	<W	<W	<W	<W	<W	0.6	<W	<W	<W	<W	<W	<W	<W	3	39	1	0.07
03LC08A	<W	<W	<W	0.6	<W	<W	<W	1	<W	<W	<W	6.8	<W	0.9	1	1	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	**220**	1	0.75
03LC08B	<W	<W	<W	<W	<W	<W	<W	0.8	<W	<W	<W	7.2	<W	<W	<W	0.8	<W	<W	<W	<W	<W	<W	<W	<W	<W	4	**180**	0.9	**0.98**
03LC08C	<W	<W	<W	0.8	<W	<W	<W	<W	<W	<W	<W	6.6	<W	0.9	5.7	1.4	<W	<W	<W	<W	<W	<W	<W	<W	<W	5	**220**	0.86	**1.11**
03LC12A	1	0.4	<W	0.8	<W	<W	0.4	0.8	0.6	<W	<W	7.4	0.8	0.8	5.8	1.4	<W	2.4	<W	<W	<W	<W	<W	<W	<W	3	**280**	0.8	**1.33**
03LC12B	<W	0.6	<W	1	<W	<W	0.6	1.4	0.7	<W	<W	0.4	0.8	1.1	4.7	1	<W	6.1	<W	<W	<W	<W	<W	<W	<W	10	**390**	1	**2.06**
03LC12C	<W	0.4	<W	0.8	<W	<W	0.4	1	0.6	<W	<W	0.6	0.8	0.9	5	1.6	<W	6	<W	<W	<W	<W	<W	<W	<W	9	**370**	1.1	**2.02**
03LC14A	<W	<W	<W	6.2	<W	<W	<W	1	0.5	<W	<W	<W	0.8	1	5.7	1.2	<W	3.9	<W	<W	<W	<W	<W	<W	<W	6	**280**	1.3	**1.52**
03LC14B	<W	0.4	<W	0.8	<W	<W	0.4	0.8	0.5	<W	<W	8.8	0.8	1	4.5	1.4	<W	3.3	<W	<W	<W	<W	<W	<W	<W	2	**230**	0.82	**1.06**
03LC14C	<W	0.4	<W	1	<W	<W	0.6	1.2	0.6	<W	<W	<W	<W	1.2	6	1.8	<W	3.9	<W	<W	<W	<W	<W	<W	<W	8	**280**	0.79	**1.47**
03LC16A	<W	0.4	<W	0.4	<W	<W	<W	0.8	<W	<W	4.6	<W	<W	0.6	3.5	0.8	<W	1.9	<W	<W	<W	<W	<W	<W	<W	4	**150**	0.64	0.58
03LC16B	<W	1.8	<W	2.6	<W	<W	<W	3	<W	<W	<W	<W	<W	3.4	<W	4	<W	2.2	<W	<W	<W	<W	<W	<W	<W	5	**240**	0.87	**1.13**
03LC16C	<W	0.6	<W	0.8	<W	<W	<W	0.8	<W	<W	<W	3.6	<W	0.7	<W	<W	<W	1.9	<W	<W	<W	<W	<W	<W	<W	2	**140**	0.73	0.44
03LC18A	<W	0.8	<W	0.6	<W	<W	<W	1	0.5	<W	<W	4.2	<W	1.1	<W	1	<W	3.3	<W	<W	<W	<W	<W	<W	<W	2	**140**	0.9	0.73
03LC18B	<W	<W	<W	0.4	<W	<W	<W	<W	<W	<W	<W	3	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	2	92	0.63	0.25
03LC18C	<W	<W	<W	0.6	<W	<W	<W	<W	<W	<W	<W	5.2	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	**110**	0.86	0.24
03LC19A	<W	<W	<W	0.4	<W	<W	<W	<W	<W	<W	<W	3.6	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	71	0.69	0.23
03LC19B	<W	<W	<W	0.4	<W	<W	<W	<W	<W	<W	<W	0.4	<W	0.5	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	**130**	0.98	0.36
03LC19C	<W	<W	<W	0.4	<W	<W	<W	<W	<W	<W	<W	4.4	<W	0.9	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	91	0.71	0.25
03LC23A	<W	<W	<W	0.6	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.7	<W	<W	<W	0.7	<W	<W	<W	<W	<W	<W	<W	<W	34	0.53	0.03
03LC23B	<W	<W	<W	0.6	<W	<W	<W	<W	<W	<W	<W	0.4	<W	0.7	<W	<W	<W	0.3	<W	<W	<W	<W	<W	<W	<W	<W	23	0.72	0.02
000LC23C	<W	<W	<W	1	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.7	<W	<W	<W	0.5	<W	<W	<W	<W	<W	<W	<W	<W	43	0.81	0.04
02LC01A	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	4	0.72	0
02LC01B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	3	1.1	0
02LC01C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	4	0.64	0
02LC03A	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	20	1	0
02LC03B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	5	0.27	0
02LC03C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	3	0.61	0
02LC17A	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1.2	<W	<W	<W	<W	<W	2.3	<W	<W	<W	<W	<W	<W	<W	55	**480**	0.79	**2.54**
02LC17B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	21	**220**	0.66	**0.92**
02LC17C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	0.6	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	66	**510**	0.98	**1.7**
02LC29A	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1.2	<W	<W	<W	<W	<W	1.2	<W	<W	<W	<W	<W	<W	<W	7	84	0.79	0.36
02LC29B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1.8	<W	0.4	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	5	75	0.88	0.23
02LC29C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	1.2	<W	<W	<W	<W	<W	1.3	<W	<W	<W	<W	<W	<W	<W	5	77	0.9	0.35
02LC38A	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	8	1.9	0
02LC38B	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	5	0.85	0
02LC38C	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	5	1.1	0
02LCrefA	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	2	0.72	0
02LCrefB	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	5	1.9	0
02LCrefC	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	5	1.8	0
IJC criteria																											**100**		
CCME TRG																													**0.79**

<W = no measurable amount (zero)

Table 11: PCB congener data, lipid and length for forage fish collected in 2002 and 2003

	Location	Species Name	Length cm	Lipid %	PCB018 ng/g	PCB019 ng/g	PCB022 ng/g	PCB028 ng/g	PCB033 ng/g	PCB037 ng/g	PCB044 ng/g	PCB049 ng/g	PCB052 ng/g	PCB054 ng/g	PCB070 ng/g	PCB074 ng/g	PCB077 ng/g	PCB081 ng/g	PCB087 ng/g	PCB095 ng/g	PCB099 ng/g	PCB101 ng/g	PCB104 ng/g	PCB105 ng/g	PCB110 ng/g	PCB114 ng/g	PCB118 ng/g
2002																											
LC01	Lyons Creek - Ridge Road	Bluntnosed Minnow	4.60	2.80	8.00	0.00	6.00	140.00	12.00	4.00	230.00	210.00	300.00	6.60	330.00	170.00	1.40	0.00	0.00	490.00	130.00	190.00	0.00	72.00	200.00	7.20	160.00
	Lyons Creek - Ridge Road	Bluntnosed Minnow	5.10	2.80	8.00	0.00	5.00	180.00	13.00	350.00	320.00	290.00	420.00	8.60	400.00	200.00	2.20	0.00	0.00	620.00	140.00	260.00	0.00	81.00	260.00	7.90	190.00
	Lyons Creek - Ridge Road	Bluntnosed Minnow	5.30	2.50	6.00	0.00	0.00	130.00	11.00	260.00	220.00	220.00	310.00	7.20	310.00	170.00	1.20	0.00	0.00	460.00	110.00	188.00	0.00	64.00	200.00	6.30	140.00
	Lyons Creek - Ridge Road	Bluntnosed Minnow	5.70	2.00	6.00	0.00	0.00	170.00	20.00	240.00	290.00	270.00	380.00	9.20	400.00	220.00	3.00	0.00	0.00	620.00	150.00	260.00	0.00	44.00	280.00	9.00	210.00
	Lyons Creek - Ridge Road	Bluntnosed Minnow	6.60	2.00	6.00	0.00	11.00	140.00	10.00	330.00	250.00	200.00	280.00	5.40	270.00	150.00	1.20	0.00	0.00	430.00	110.00	190.00	0.00	75.00	200.00	6.30	150.00
LC16	Lyons Creek - Hwy 140	Bluntnosed Minnow	5.40	3.30	10.00	0.00	0.00	310.00	12.00	0.00	440.00	330.00	520.00	15.00	450.00	260.00	3.60	0.00	0.00	780.00	150.00	220.00	0.00	47.00	230.00	7.00	169.00
	Lyons Creek - Hwy 140	Bluntnosed Minnow	6.30	3.20	12.00	0.00	0.00	460.00	16.00	110.00	590.00	480.00	760.00	25.00	660.00	320.00	11.00	0.00	0.00	1000.00	200.00	290.00	0.00	14.00	270.00	10.00	223.00
	Lyons Creek - Hwy 140	Bluntnosed Minnow	8.00	3.30	16.00	0.00	0.00	510.00	24.00	590.00	790.00	720.00	1100.00	39.00	1000.00	480.00	4.40	0.00	0.00	1600.00	300.00	500.00	0.00	79.00	500.00	15.00	343.00
	Lyons Creek - Hwy 140	Bluntnosed Minnow	8.30	3.30	12.00	0.00	0.00	670.00	18.00	1100.00	1100.00	960.00	1600.00	42.00	1400.00	650.00	6.60	0.00	0.00	0.00	410.00	660.00	0.00	210.00	730.00	20.00	510.00
L38	Lyons Creek - Below QEW	Golden Shiner	5.00	2.20	4.00	0.00	0.00	3.50	0.00	3.00	1.50	0.00	1.00	0.00	0.00	7.00	0.00	0.00	0.00	2.00	0.00	0.20	0.00	0.40	0.00	0.00	0.00
	Lyons Creek - Below QEW	Golden Shiner	5.40	2.40	4.00	0.00	0.00	3.50	0.00	2.00	1.10	0.00	0.40	0.00	0.20	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.50	0.00	0.00	0.00
	Lyons Creek - Below QEW	Golden Shiner	5.60	3.50	4.00	0.00	0.00	4.50	1.50	0.00	1.70	0.20	1.20	0.00	0.40	0.50	0.00	0.00	0.00	1.40	0.00	0.20	0.00	0.00	0.00	0.00	0.00
	Lyons Creek - Below QEW	Golden Shiner	5.90	2.80	4.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Lyons Creek - Below QEW	Golden Shiner	7.00	2.80	6.00	0.00	0.00	4.00	1.00	0.00	1.60	0.20	1.70	0.00	1.00	0.60	0.00	0.00	0.00	3.00	0.20	2.90	0.00	0.60	2.30	0.00	2.20
	Lyons Creek - Below QEW	Bluntnosed Minnow	6.30	4.10	4.00	0.00	0.00	4.00	1.00	3.00	2.30	0.20	1.30	0.00	1.00	0.00	0.00	0.00	0.00	3.20	1.40	3.60	0.00	1.30	3.00	0.00	3.00
mouth	Welland River - Lyons Creek mouth	Spottail Shiner	5.70	1.90	4.00	0.00	0.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Welland River - Lyons Creek mouth	Spottail Shiner	6.10	2.30	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Welland River - Lyons Creek mouth	Spottail Shiner	6.50	3.00	4.00	0.00	0.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Welland River - Lyons Creek mouth	Spottail Shiner	6.60	1.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.00	0.00
	Welland River - Lyons Creek mouth	Spottail Shiner	6.80	2.10	4.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Welland River - Lyons Creek mouth	Bluntnosed Minnow	5.40	3.90	4.00	0.00	0.00	3.50	1.00	0.00	0.80	0.20	1.10	0.00	1.00	0.00	0.00	0.00	0.00	2.30	0.90	2.60	0.00	1.30	1.70	0.00	2.90
	Welland River - Lyons Creek mouth	Bluntnosed Minnow	6.20	3.80	6.00	0.00	0.00	5.00	1.50	0.00	2.00	2.40	3.40	0.00	1.40	0.80	0.00	0.00	0.00	4.00	0.60	4.90	0.00	0.00	0.70	0.00	2.80
	Welland River - Lyons Creek mouth	Bluntnosed Minnow	6.40	3.80	4.00	0.00	0.00	4.50	0.00	0.00	0.80	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	1.00	0.00	1.10	0.00	0.00	0.00	0.00	0.50
	Welland River - Lyons Creek mouth	Bluntnosed Minnow	6.70	4.70	0.00	0.00	0.00	5.00	1.00	0.00	0.80	0.50	1.70	0.00	1.30	5.60	0.00	0.00	0.00	3.30	0.40	4.10	0.00	0.00	0.00	0.00	2.60
	Welland River - Lyons Creek mouth	Bluntnosed Minnow	7.60	4.80	4.00	0.00	0.00	5.50	1.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00	2.20	0.00	2.40	0.00	0.00	0.00	0.00	0.00
BLC	Black Creek	Golden Shiner	4.30	3.80	8.00	0.00	0.00	6.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Black Creek	Golden Shiner	4.60	6.10	0.00	0.00	0.00	6.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Black Creek	Golden Shiner	4.80	4.10	4.00	0.00	0.00	5.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Black Creek	Golden Shiner	4.90	3.20	6.00	0.00	0.00	7.00	4.00	0.00	2.10	0.00	0.20	0.00	0.20	2.90	0.00	0.00	0.00	1.20	0.00	1.90	0.00	0.00	0.30	0.00	1.00
	Black Creek	Golden Shiner	5.20	2.70	6.00	0.00	0.00	6.50	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEC	Beaver Creek	Common Shiner	7.10	2.30	4.00	0.00	0.00	3.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Beaver Creek	Common Shiner	7.60	4.10	4.00	0.00	0.00	4.00	1.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00
	Beaver Creek	Common Shiner	8.30	3.30	0.00	0.00	0.00	4.50	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Beaver Creek	Common Shiner	9.00	2.40	0.00	0.00	0.00	4.50	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003																											
LC03	Lyons Creek - Ridge Road	Bluntnosed Minnow	46.30	0.96	0.00	0.00	3.00	35.00	1.00	110.00	90.00	74.00	120.00	2.00	100.00	59.00	8.00	0.00	0.00	180.00	37.00	71.00	0.00	25.00	69.00	4.00	50.00
	Lyons Creek - Ridge Road	Bluntnosed Minnow	58.00	2.00	5.00	0.00	5.00	110.00	5.00	310.00	290.00	250.00	360.00	6.00	330.00	180.00	4.00	0.00	0.00	560.00	130.00	220.00	0.00	74.00	220.00	4.00	160.00
	Lyons Creek - Ridge Road	Bluntnosed Minnow	70.00	1.40	3.00	0.00	13.00	67.00	3.00	200.00	170.00	160.00	230.00	1.00	200.00	110.00	2.00	0.00	0.00	350.00	90.00	140.00	0.00	52.00	140.00	1.00	100.00
	Lyons Creek - Ridge Road	Bluntnosed Minnow	56.40	1.30	0.00	0.00	1.00	48.00	8.00	150.00	180.00	160.00	240.00	2.00	220.00	130.00	3.00	0.00	0.00	370.00	86.00	150.00	0.00	27.00	130.00	2.00	110.00
	Lyons Creek - Ridge Road	Golden Shiner	48.00	2.20	9.00	0.00	2.00	1.00	6.00	47.00	32.00	29.00	43.00	2.00	12.00	19.00	1.00	0.00	0.00	63.00	15.00	26.00	0.00	9.00	25.00	1.00	19.00
	Lyons Creek - Ridge Road	Golden Shiner	48.60	1.40	10.00	0.00	4.00	0.00	3.00	18.00	39.00	46.00	64.00	2.00	12.00	32.00	3.00	0.00	0.00	100.00	23.00	40.00	0.00	11.00	27.00	1.00	29.00
	Lyons Creek - Ridge Road	Golden Shiner	52.60	1.80	11.00	0.00	4.00	1.00	7.00	66.00	44.00	45.00	63.00	2.00	15.00	35.00	3.00	0.00	0.00	100.00	25.00	46.00	0.00	16.00	43.00	1.00	33.00
	Lyons Creek - Ridge Road	Golden Shiner	45.10	2.50	12.00	0.00	9.00	2.00	7.00	57.00	37.00	37.00	50.00	3.00	14.00	24.00	3.00	0.00	0.00	81.00	19.00	36.00	0.00	10.00	31.00	2.00	23.00
	Lyons Creek - Ridge Road	Golden Shiner	49.60	2.00	13.00	0.00	5.00	1.00	3.00	51.00	49.00	49.00	75.00	2.00	16.00	34.00	1.00	0.00	0.00	100.00	25.00	43.00	0.00	6.00	36.00	2.00	31.00
	Lyons Creek - Ridge Road	Golden Shiner	74.60	2.20	36.00	0.00	6.00	90.00	27.00	340.00	220.00	220.00	280.00	7.00	28.00	140.00	3.00	0.00	0.00	450.00	110.00	170.00	0.00	59.00	180.00	2.00	120.00
LC08	Lyons Creek - stn LC08	Golden Shiner	37.30	2.60	34.00	7.00	2.00	62.00	18.00	98.00	100.00	100.00	140.00	1.00	37.00	58.00	2.00	0.00	0.00	200.00	52.00	82.00	0.00	10.00	66.00	3.00	58.00
LC16	Lyons Creek - u/s Hwy 140	Bluntnosed Minnow	44.50	2.60	0.00	0.00	6.00	22.00	5.00	81.00	76.00	69.00	110.00	17.00	77.00	43.00	3.00	0.00	0.00	130.00	31.00	54.00	0.00	18.00	46.00	2.00	37.00
	Lyons Creek - u/s Hwy 140	Bluntnosed Minnow	56.20	3.30	9.00	0.00	5.00	55.00	7.00	200.00	180.00	180.00	260.00	9.00	190.00	110.00	2.00	0.00	0.00	330.00	74.00	140.00	0.00	46.00	120.00	5.00	78.00
	Lyons Creek - u/s Hwy 140	Bluntnosed Minnow	58.40	1.90	3.00	0.00	4.00	46.00	5.00	33.00	140.00	150.00	220.00	8.00	180.00	97.00	2.00	0.00	0.00	290.00	69.00	120.00	0.00	46.00	72.00	2.00	80.00
	Lyons Creek - u/s Hwy 140	Bluntnosed Minnow	43.80	1.90	7.00	0.00	3.00	26.00	5.00	54.00	85.00	83.00	130.00	4.00	90.00	50.00	4.00	0.00	0.00	150.00	31.00	60.00	0.00	8.00	44.00	2.00	34.00
	Lyons Creek - u/s Hwy 140	Golden Shiner	44.80	2.40	25.00	0.00	1.00	17.00	8.00	12.00	37.00	130.00	180.00	5.00	53.00	75.00	4.00	0.00	0.00	210.00	44.00	78.00	0.00	5.00	9.00	3.00	51.00
	Lyons Creek - u/s Hwy 140	Golden Shiner	44.10	2.10	62.00	0.00	2.00	11.00	19.00	180.00	140.00	140.00	190.00	5.00	46.00	85.00	5.00	0.00	0.00	250.00	49.00	81.00	0.00	23.00	66.00	2.00	59.00
	Lyons Creek - u/s Hwy 140	Golden Shiner	51.00	2.10	63.00	0.00	0.00	22.00	17.00	68.00	120.00	150.00	210.00	4.00	61.00	91.00	4.00	0.00	0.00	270.00	55.00	89.00	0.00	24.00	42.00	3.00	66.00
	Lyons Creek - u/s Hwy 140	Golden Shiner	88.00	2.40	98.00	0.00	0.00	8.00	32.00	330.00	250.00	240.00	320.00	3.00	47.00	120.00	2.00	0.00	0.00	390.00	81.00	130.00	0.00	25.00	120.00	4.00	84.00
LC17	Lyons Creek - d/s Hwy 140	Bluntnosed Minnow	39.50	2.80	4.00	0.00	2.00	38.00	4.00	21.00	57.00	110.00	160.00	6.00	120.00	62.00	5.00	0.00	0.00	190.00	43.00	74.00	0.00	26.00	16.00	2.00	53.00
	Lyons Creek - d/s Hwy 140	Bluntnosed Minnow	55.30	2.60	6.00	0.00	2.00	50.00	8.00	180.00	150.00	150.00	220.00	9.00	170.00	95.00	2.00	0.00	0.00	290.00	70.00	110.00	0.00	32.00	92.00	3.00	85.00
	Lyons Creek - d/s Hwy 140	Bluntnosed Minnow	55.80	2.60	4.00	0.00	2.00	39.00	5.00	140.00	130.00	130.00	190.00	6.00	150.00	86.00	2.00	0.00	0.00	250.00	64.00	110.00	0.00	34.00	91.00	2.00	77.00
	Lyons Creek - d/s Hwy 140	Bluntnosed Minnow	67.30	2.20	4.00	0.00	5.00	37.00	5.00	130.00	120.00	130.00	180.00	6.00	150.00	92.00	2.00	0.00	0.00	260.00	63.00	98.00	0.00	32.00	85.00	4.00	76.00
	Lyons Creek - d/s Hwy 140	Bluntnosed Minnow	47.80	2.80	10.00	0.00	1.00	40.00	4.00	27.00	65.00	110.00	170.00	8.00	130.00	68.00	5.00	0.00	0.00	200.00	45.00	84.00	0.00	5.00	33.00	3.00	49.00
	Lyons Creek - d/s Hwy 140	Golden Shiner	45.30	3.50	47.00	0.00	1.00	12.00	14.00	95.00	77.00	77.00	120.00	3.00	40.00	47.00	2.00	0.00	0.00	140.00	24.00	42.00	0.00	10.00	34.00	2.00	27.00
	Lyons Creek - d/s Hwy 140	Golden Shiner	45.80	3.60	50.00	0.00	2.00	13.00	13.00	41.00	85.00	100.00	150.00	3.00	49.00	60.00	3.00	0.00	0.00	180.00	34.00	57.00	0.00	3.00	32.00	2.00	41.00
LC18	Lyons Creek - u/s CN railway	Bluntnosed Minnow	35.90	2.40	0.00	0.00	1.00	26.00	3.00	6.00	67.00	71.00	110.00	3.00	77.00	46.00	4.00	0.00	0.00	130.00	29.00	49.00	0.00	5.00	30.00	2.00	36.00
	Lyons Creek - u/s CN railway	Bluntnosed Minnow	34.60	2.10	0.00	0.00	1.00	26.00	4.00	18.00	65.00	69.00	110.00	3.00	76.00	45.00	3.00	0.00	0.00	130.00	29.00	48.00	0.00	4.00	29.00	2.00	36.00
	Lyons Creek - u/s CN railway	Bluntnosed Minnow	45.10	3.40	0.00	0.00	2.00	29.00	4.00	36.00	77.00	84.00	130.00	5.00	94.00	55.00	1.00	0.00	0.00	160.00	36.00	63.00	0.00	7.00	42.00	2.00	47.00
	Lyons Creek - u/s CN railway	Bluntnosed Minnow	54.40	2.10	0.00	0.00	1.00	21.00	2.00	2.00	23.00	72.00	110.00	3.00	81.00	50.00	20.00	0.00	0.00	130.00	36.00	62.00	0.00	7.00	8.00	2.00	47.00
	Lyons Creek - u/s CN railway	Bluntnosed Minnow	60.70	1.90	0.00	0.00	0.00	12.00	1.00	0.00	13.00	45.00	67.00	1.00	54.00	36.00	4.00	0.00	0.00	94.00	3.00	51.00	0.00	7.00	4.00	2.00	40.00
	Lyons Creek - u/s CN railway	Golden Shiner	44.60	2.40	49.00	0.00	1.00	11.00	12.00	92.00	84.00	84.00	130.00	3.00	39.00	53.00	3.00	0.00	0.00	150.00	28.00	46.00	0.00	11.00	38.00	2.00	37.00
	Lyons Creek - u/s CN railway	Golden Shiner	47.00	3.20	35.00	0.00	2.00	17.00	10.00	23.00	51.00	96.00	140.00	4.00	48.00	60.00	3.00	0.00	0.00	170.00	34.00	57.00	0.00	14.00	12.00	2.00	43.00
LC24	Lyons Creek - @ Pearson Rd	Bluntnosed Minnow	41.70	4.20	9.00	0.00	0.00	7.00	3.00	22.00	13.00	16.00	25.00	0.00	17.00	13.00	3.00	0.00	0.00	42.00	9.00	20.00	0.00	7.00	13.00	0.00	11.00
	Lyons Creek - @ Pearson Rd	Bluntnosed Minnow	56.00	4.30	10.00	0.00	0.00	10.00	4.00	24.00	12.00	13.00	24.00	0.00	12.00	9.00	4.00	0.00	0.00	32.00	6.00	8.00	0.00	7.00	4.00	0.00	18.00
	Lyons Creek - @ Pearson Rd	Golden Shiner	69.30	2.00	10.00	2.00	0.00	20.00	1.00	17.00	21.00	24.00	37.00	1.00	14.00	17.00	1.00	0.00	0.00	50.00	10.00	16.00	0.00	2.00	13.00	1.00	13.00
	Lyons Creek - @ Pearson Rd	Golden Shiner	72.70	3.20	18.00	0.00	0.00	41.00	1.00	48.00	44.00	55.00	81.00	2.00	3.00	4.00	2.00	0.00	0.00	120.00	28.00	43.00	0.00	5.00	32.00	1.00	32.00
	Lyons Creek - @ Pearson Rd	Golden Shiner	81.50	3.30	16.00	0.00	0.00	34.00	2.00	36.00	36.00	42.00	65.00	1.00	29.00	31.00	2.00	0.00	0.00	91.00	23.00	39.00	0.00	8.00	29.00	0.00	25.00
	Lyons Creek - @ Pearson Rd	Golden Shiner	81.00	2.60	10.00	0.00	0.00	17.00	4.00	14.00	19.00	21.00	33.00	2.00	10.00	15.00	2.00	0.00	0.00	44.00	9.00	18.00	0.00	5.00	15.00	1.00	13.00
	Lyons Creek - @ Pearson Rd	Golden Shiner	84.50	3.80	23.00	0.00	0.00	45.00	2.00	50.00	47.00	58.00	86.00	1.00	34.00	39.00	3.00	0.00	0.00	120.00	24.00	39.00	0.00	6.00	31.00	2.00	27.00
UC	Usshers Creek - reference	Bluntnosed Minnow	62.80	7.80	0.00	0.00	2.00	3.00	3.00	0.00	2.00	2.00	3.00	0.00	2.00	1.00	0.00	0.00	0.00	4.00	0.00	3.00	0.00	1.00	2.00	0.00	3.00
	Usshers Creek - reference	Bluntnosed Minnow	66.30	15.00	3.00	0.00	1.00	2.00	1.00	0.00	2.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00	2.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00
	Usshers Creek - reference	Bluntnosed Minnow	68.30	8.50	3.00	0.00	1.00	2.00	1.00	0.00	2.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00	2.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00
	Usshers Creek - reference	Bluntnosed Minnow	71.30	9.20	0.00	0.00	0.00	2.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00	2.00	0.00	1.00	0.00	0.00	1.00	0.00	1.00
	Usshers Creek - reference	Common Shiner	47.60	1.80	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
	Usshers Creek - reference	Common Shiner	49.10	2.30	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Usshers Creek - reference	Common Shiner	51.70	2.20	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Usshers Creek - reference	Common Shiner	50.90	2.30	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00
	Usshers Creek - reference	Common Shiner	51.10	1.90	0.00	0.00	0.00	1.00	1.00	0.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00

Table 11 con't**:** PCB congener data, lipid and length for forage fish collected in 2002 and 2003

	PCB119 ng/g	PCB123 ng/g	PCB126 ng/g	PCB128 ng/g	PCB138 ng/g	PCB149 ng/g	PCB151 ng/g	PCB153 ng/g	PCB155 ng/g	PCB156 ng/g	PCB157 ng/g	PCB158 ng/g	PCB167 ng/g	PCB168 ng/g	PCB169 ng/g	PCB170 ng/g	PCB171 ng/g	PCB177 ng/g	PCB178 ng/g	PCB180 ng/g	PCB183 ng/g	PCB187 ng/g	PCB188 ng/g	PCB189 ng/g	PCB191 ng/g	PCB194 ng/g	PCB199 ng/g	PCB201 ng/g	PCB202 ng/g	PCB205 ng/g	PCB206 ng/g	PCB208 ng/g	PCBTOT ng/g	TEQ ng TEQ/kg
2002																																		
LC01	0.00	18.00	0.00	13.00	84.00	59.00	12.00	61.00	0.00	7.00	0.00	9.80	2.40	61.00	0.00	17.00	3.20	7.80	0.00	39.00	10.00	19.00	12.00	0.00	0.00	6.60	5.80	3.60	0.00	0.00	0.40	0.00	**3100.00**	**32.26**
	0.00	24.00	0.00	16.00	95.00	63.00	16.00	76.00	0.00	8.40	0.00	10.00	3.00	74.00	0.00	18.00	4.00	8.70	0.00	41.00	10.00	20.00	13.00	0.00	0.00	7.80	7.20	3.60	0.00	0.00	0.60	0.00	**4300.00**	**37.90**
	0.00	18.00	0.00	11.00	63.00	44.00	12.00	56.00	0.00	6.20	0.00	7.20	2.00	62.00	0.00	12.00	2.80	6.10	0.00	31.00	7.00	13.00	8.60	0.00	0.00	6.20	5.40	8.40	0.00	0.00	0.00	0.00	**3000.00**	**28.59**
	5.20	28.00	0.00	14.00	110.00	72.00	14.00	86.00	0.00	9.40	0.00	11.00	4.00	60.00	0.00	19.00	4.80	10.00	0.00	47.00	11.00	24.00	14.00	0.00	0.00	9.40	8.80	3.80	0.00	0.00	1.20	0.00	**4100.00**	**37.74**
	0.00	18.00	0.00	14.00	93.00	66.00	11.00	64.00	0.00	7.40	0.00	11.00	2.60	64.00	0.00	20.00	3.40	7.60	0.00	39.00	12.00	18.00	14.00	0.00	0.00	7.60	6.80	4.20	0.00	0.00	0.80	0.00	**3300.00**	**31.30**
LC16	3.70	21.00	0.00	11.00	85.00	59.00	14.00	63.00	0.00	6.20	0.00	9.60	0.00	63.00	0.00	17.00	2.60	6.90	0.00	32.00	9.60	17.00	13.00	0.00	0.00	5.00	4.60	3.40	0.00	0.00	0.00	0.00	**4400.00**	**30.66**
	6.90	28.00	0.00	9.20	110.00	71.00	17.00	74.00	0.00	9.00	0.00	12.00	3.00	46.00	0.00	20.00	3.60	9.50	0.00	39.00	11.00	19.00	16.00	0.00	0.00	6.60	6.20	4.40	0.00	0.00	0.00	0.00	**5956.00**	**37.13**
	10.00	44.00	0.00	25.00	210.00	140.00	34.00	190.00	0.00	14.00	0.00	21.00	6.40	140.00	0.00	46.00	11.00	24.00	0.00	100.00	27.00	54.00	32.00	0.00	0.00	15.00	17.00	7.60	0.00	0.00	1.80	0.00	**9780.00**	**61.60**
	0.00	62.00	0.00	38.00	230.00	160.00	41.00	170.00	0.00	18.00	0.00	23.00	9.00	160.00	0.00	40.00	8.80	19.00	0.00	84.00	21.00	43.00	31.00	0.00	0.00	13.00	14.00	8.60	0.00	0.00	0.00	0.00	**11292.00**	**97.95**
L38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	0.04
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.05
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00
	0.00	0.00	0.00	0.00	2.40	0.00	0.20	0.30	0.00	0.00	0.00	0.90	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.00	0.28
	0.00	0.00	0.00	0.00	4.40	1.60	0.70	2.20	0.00	0.60	0.00	1.10	0.00	2.20	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.00	0.73
mouth	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00
	0.00	0.00	0.00	0.00	1.80	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00
	0.00	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00
	0.00	0.00	0.00	0.00	4.40	1.80	0.00	2.20	0.00	0.60	0.00	0.90	0.00	1.30	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.00	0.72
	0.00	0.00	0.00	0.00	5.40	2.60	0.30	3.30	0.00	0.00	0.00	1.20	0.00	2.10	0.00	0.40	0.00	0.00	0.00	2.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.00	0.28
	0.00	0.00	0.00	0.00	1.60	0.40	0.00	0.50	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00	0.05
	0.00	0.00	0.00	0.00	4.40	2.00	0.30	2.90	0.00	0.40	0.00	1.10	0.00	1.30	0.00	0.00	0.00	0.00	0.00	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.00	0.46
	0.00	0.00	0.00	0.00	3.20	1.60	0.00	2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00
BLC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	0.00
	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00	0.00
	0.00	0.00	0.00	0.00	4.80	1.60	0.40	3.50	0.00	0.00	0.00	1.60	0.00	1.80	0.00	0.60	0.00	0.00	0.00	3.60	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.00	0.10
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00	0.00
BEC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	0.00
	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.03
	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	0.00
	0.00	0.00	0.00	0.00	1.60	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00	0.00
2003																																		
LC03	3.00	50.00	1.00	6.00	26.00	38.00	6.00	19.00	0.00	3.00	5.00	9.00	1.00	52.00	0.00	9.00	2.00	4.00	30.00	7.00	8.00	9.00	10.00	0.00	0.00	5.00	4.00	8.00	0.00	0.00	4.00	2.00	**1400.00**	**119.31**
	9.00	57.00	1.00	11.00	89.00	57.00	9.00	73.00	2.00	5.00	9.00	6.00	4.00	64.00	0.00	13.00	5.00	5.00	100.00	36.00	5.00	14.00	8.00	1.00	1.00	4.00	4.00	13.00	0.00	0.00	5.00	1.00	**3800.00**	**138.64**
	5.00	37.00	1.00	7.00	59.00	81.00	5.00	46.00	3.00	2.00	6.00	3.00	3.00	42.00	0.00	8.00	3.00	2.00	70.00	25.00	3.00	9.00	4.00	1.00	1.00	2.00	1.00	8.00	1.00	0.00	3.00	1.00	**2500.00**	**123.73**
	4.00	31.00	1.00	2.00	59.00	39.00	5.00	46.00	2.00	3.00	7.00	3.00	4.00	45.00	0.00	8.00	5.00	2.00	72.00	25.00	3.00	9.00	5.00	1.00	1.00	2.00	1.00	8.00	1.00	0.00	4.00	2.00	**2400.00**	**123.24**
	2.00	15.00	1.00	3.00	10.00	8.00	2.00	8.00	1.00	1.00	2.00	3.00	1.00	1.00	0.00	12.00	1.00	2.00	13.00	2.00	3.00	4.00	4.00	0.00	0.00	2.00	1.00	2.00	0.00	0.00	2.00	1.00	**460.00**	**106.41**
	1.00	6.00	1.00	0.00	13.00	8.00	3.00	11.00	2.00	2.00	4.00	3.00	1.00	6.00	0.00	3.00	1.00	2.00	19.00	2.00	2.00	4.00	3.00	1.00	0.00	2.00	2.00	3.00	0.00	0.00	1.00	0.00	**580.00**	**108.51**
	7.00	3.00	1.00	3.00	17.00	10.00	3.00	13.00	1.00	2.00	2.00	3.00	1.00	7.00	0.00	2.00	0.00	2.00	21.00	4.00	2.00	4.00	3.00	0.00	0.00	1.00	2.00	3.00	0.00	0.00	1.00	1.00	**680.00**	**108.01**
	5.00	9.00	1.00	3.00	12.00	6.00	3.00	9.00	2.00	2.00	2.00	4.00	1.00	17.00	0.00	4.00	1.00	2.00	14.00	2.00	3.00	5.00	5.00	0.00	0.00	2.00	2.00	3.00	0.00	0.00	2.00	1.00	**580.00**	**107.51**
	1.00	3.00	1.00	2.00	16.00	8.00	3.00	5.00	2.00	2.00	3.00	4.00	1.00	5.00	0.00	5.00	1.00	2.00	19.00	3.00	3.00	5.00	5.00	1.00	1.00	2.00	2.00	4.00	0.00	0.00	1.00	1.00	**650.00**	**107.71**
	5.00	10.00	2.00	8.00	63.00	100.00	5.00	49.00	1.00	2.00	9.00	3.00	3.00	45.00	0.00	8.00	3.00	6.00	72.00	20.00	2.00	8.00	6.00	1.00	1.00	5.00	2.00	5.00	0.00	0.00	2.00	1.00	**2900.00**	**225.83**
LC08	1.00	10.00	1.00	3.00	26.00	22.00	4.00	28.00	4.00	4.00	6.00	5.00	2.00	25.00	0.00	5.00	1.00	3.00	40.00	11.00	3.00	6.00	4.00	0.00	2.00	2.00	2.00	5.00	0.00	0.00	0.00	1.00	**1400.00**	**114.52**
LC16	8.00	7.00	0.00	3.00	12.00	20.00	2.00	18.00	61.00	3.00	2.00	5.00	0.00	17.00	0.00	4.00	1.00	2.00	25.00	7.00	1.00	4.00	5.00	0.00	0.00	3.00	3.00	3.00	0.00	0.00	0.00	0.00	**1000.00**	**10.00**
	3.00	15.00	1.00	6.00	30.00	45.00	8.00	40.00	140.00	5.00	6.00	6.00	3.00	49.00	0.00	6.00	3.00	4.00	70.00	15.00	5.00	9.00	6.00	0.00	0.00	4.00	4.00	10.00	0.00	0.00	0.00	0.00	**2500.00**	**122.13**
	2.00	14.00	1.00	2.00	38.00	38.00	8.00	44.00	28.00	5.00	5.00	7.00	3.00	19.00	0.00	8.00	3.00	5.00	64.00	19.00	6.00	13.00	7.00	0.00	0.00	3.00	3.00	10.00	0.00	0.00	0.00	0.00	**2000.00**	**120.23**
	2.00	7.00	0.00	3.00	13.00	16.00	3.00	19.00	48.00	2.00	2.00	6.00	0.00	18.00	0.00	3.00	4.00	2.00	27.00	7.00	2.00	5.00	4.00	0.00	0.00	3.00	3.00	3.00	0.00	0.00	0.00	0.00	**1100.00**	**8.30**
	1.00	8.00	0.00	0.00	15.00	15.00	3.00	20.00	1.00	3.00	1.00	4.00	0.00	10.00	0.00	3.00	2.00	2.00	27.00	6.00	2.00	4.00	3.00	0.00	0.00	2.00	2.00	3.00	0.00	0.00	0.00	0.00	**1100.00**	**10.30**
	2.00	9.00	0.00	4.00	22.00	17.00	3.00	18.00	4.00	3.00	1.00	6.00	0.00	18.00	0.00	4.00	0.00	2.00	28.00	10.00	3.00	4.00	4.00	0.00	0.00	3.00	2.00	2.00	0.00	0.00	0.00	0.00	**1600.00**	**12.60**
	1.00	10.00	0.00	0.00	27.00	17.00	3.00	22.00	3.00	3.00	3.00	6.00	0.00	19.00	0.00	5.00	1.00	2.00	35.00	12.00	2.00	6.00	5.00	0.00	0.00	2.00	2.00	4.00	0.00	0.00	1.00	0.00	**1500.00**	**14.90**
	2.00	13.00	0.00	5.00	42.00	28.00	7.00	34.00	6.00	4.00	2.00	6.00	0.00	32.00	0.00	7.00	2.00	3.00	52.00	14.00	4.00	8.00	6.00	0.00	0.00	2.00	3.00	5.00	0.00	0.00	0.00	0.00	**2600.00**	**17.40**
LC17	1.00	9.00	6.00	3.00	23.00	20.00	4.00	23.00	16.00	4.00	3.00	6.00	2.00	16.00	0.00	5.00	1.00	3.00	33.00	14.00	2.00	7.00	5.00	0.00	0.00	3.00	3.00	4.00	0.00	0.00	1.00	0.00	**1200.00**	**613.82**
	3.00	13.00	2.00	6.00	55.00	41.00	8.00	52.00	110.00	5.00	10.00	8.00	3.00	53.00	0.00	15.00	4.00	8.00	71.00	41.00	10.00	20.00	11.00	2.00	2.00	7.00	7.00	13.00	0.00	0.00	1.00	2.00	**2300.00**	**222.43**
	2.00	13.00	3.00	7.00	51.00	51.00	12.00	67.00	96.00	6.00	13.00	7.00	3.00	45.00	0.00	15.00	5.00	8.00	90.00	37.00	10.00	21.00	11.00	2.00	2.00	5.00	6.00	19.00	0.00	0.00	2.00	1.00	**2100.00**	**323.33**
	1.00	13.00	3.00	6.00	35.00	39.00	7.00	42.00	100.00	5.00	5.00	6.00	3.00	42.00	0.00	7.00	3.00	5.00	61.00	19.00	6.00	12.00	7.00	2.00	3.00	3.00	3.00	9.00	0.00	0.00	1.00	0.00	**1900.00**	**319.53**
	1.00	11.00	1.00	2.00	20.00	25.00	5.00	24.00	18.00	5.00	6.00	7.00	2.00	17.00	0.00	6.00	2.00	4.00	45.00	10.00	4.00	6.00	4.00	0.00	3.00	5.00	5.00	7.00	0.00	0.00	3.00	2.00	**1300.00**	**114.02**
	3.00	5.00	0.00	2.00	9.00	11.00	2.00	13.00	2.00	2.00	6.00	4.00	2.00	15.00	0.00	2.00	1.00	1.00	20.00	5.00	2.00	3.00	3.00	0.00	0.00	1.00	1.00	2.00	0.00	0.00	0.00	0.00	**920.00**	**9.42**
	1.00	7.00	0.00	0.00	12.00	13.00	3.00	18.00	1.00	3.00	7.00	5.00	2.00	12.00	0.00	3.00	1.00	2.00	27.00	6.00	1.00	4.00	4.00	0.00	0.00	2.00	2.00	3.00	0.00	0.00	0.00	0.00	**1100.00**	**11.42**
LC18	0.00	6.00	1.00	0.00	16.00	14.00	3.00	18.00	0.00	3.00	4.00	5.00	1.00	17.00	0.00	3.00	1.00	2.00	26.00	9.00	1.00	5.00	3.00	0.00	0.00	2.00	2.00	3.00	0.00	0.00	0.00	1.00	**850.00**	**109.61**
	0.00	6.00	1.00	0.00	14.00	13.00	2.00	18.00	0.00	3.00	4.00	5.00	1.00	16.00	0.00	4.00	1.00	2.00	24.00	9.00	0.00	4.00	3.00	0.00	0.00	2.00	2.00	3.00	0.00	0.00	1.00	1.00	**840.00**	**109.41**
	1.00	8.00	1.00	0.00	21.00	21.00	4.00	26.00	0.00	4.00	7.00	5.00	2.00	14.00	0.00	5.00	2.00	3.00	38.00	13.00	4.00	7.00	4.00	0.00	0.00	2.00	3.00	6.00	0.00	0.00	1.00	1.00	**1100.00**	**112.82**
	1.00	8.00	1.00	0.00	20.00	21.00	3.00	29.00	0.00	4.00	8.00	4.00	2.00	11.00	0.00	5.00	2.00	3.00	38.00	14.00	4.00	7.00	5.00	0.00	0.00	3.00	3.00	6.00	0.00	0.00	0.00	1.00	**860.00**	**115.22**
	1.00	6.00	1.00	0.00	27.00	20.00	3.00	35.00	0.00	3.00	7.00	5.00	20.00	11.00	0.00	9.00	2.00	4.00	39.00	25.00	5.00	11.00	6.00	0.00	0.00	5.00	5.00	7.00	0.00	0.00	1.00	0.00	**650.00**	**111.90**
	2.00	6.00	1.00	2.00	12.00	9.00	6.00	16.00	0.00	3.00	2.00	5.00	0.00	15.00	0.00	5.00	1.00	1.00	22.00	7.00	4.00	4.00	4.00	0.00	0.00	3.00	2.00	1.00	0.00	0.00	1.00	3.00	**1000.00**	**109.20**
	0.00	6.00	1.00	2.00	15.00	10.00	2.00	17.00	0.00	5.00	2.00	6.00	0.00	17.00	0.00	3.00	0.00	3.00	23.00	8.00	3.00	4.00	3.00	0.00	0.00	3.00	2.00	1.00	0.00	0.00	2.00	4.00	**970.00**	**111.10**
LC24	1.00	3.00	1.00	2.00	15.00	6.00	3.00	18.00	0.00	2.00	4.00	4.00	0.00	5.00	0.00	7.00	2.00	3.00	16.00	7.00	5.00	8.00	5.00	0.00	0.00	3.00	3.00	5.00	0.00	0.00	1.00	1.00	**360.00**	**105.40**
	1.00	2.00	0.00	2.00	4.00	11.00	3.00	4.00	0.00	1.00	3.00	4.00	0.00	26.00	0.00	6.00	1.00	2.00	19.00	13.00	4.00	6.00	8.00	0.00	0.00	2.00	2.00	4.00	0.00	0.00	1.00	1.00	**320.00**	**5.10**
	1.00	3.00	0.00	1.00	17.00	5.00	1.00	22.00	0.00	0.00	2.00	3.00	0.00	10.00	0.00	2.00	0.00	1.00	15.00	13.00	1.00	2.00	6.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	**390.00**	**3.40**
	1.00	3.00	0.00	1.00	36.00	17.00	0.00	43.00	0.00	1.00	3.00	4.00	0.00	29.00	0.00	5.00	1.00	2.00	37.00	2.00	1.00	6.00	3.00	0.00	0.00	1.00	1.00	3.00	0.00	0.00	0.00	1.00	**820.00**	**6.70**
	2.00	2.00	1.00	1.00	27.00	16.00	1.00	34.00	0.00	1.00	2.00	2.00	0.00	24.00	0.00	3.00	1.00	2.00	31.00	14.00	2.00	5.00	2.00	0.00	0.00	1.00	1.00	2.00	0.00	0.00	1.00	1.00	**690.00**	**105.20**
	3.00	3.00	1.00	1.00	16.00	11.00	1.00	21.00	0.00	1.00	2.00	2.00	0.00	13.00	0.00	2.00	1.00	3.00	19.00	9.00	4.00	1.00	4.00	0.00	0.00	2.00	2.00	4.00	0.00	0.00	1.00	1.00	**380.00**	**104.30**
	2.00	3.00	0.00	1.00	24.00	17.00	2.00	32.00	0.00	1.00	3.00	3.00	0.00	25.00	0.00	4.00	1.00	2.00	34.00	12.00	3.00	5.00	2.00	0.00	0.00	1.00	1.00	3.00	0.00	0.00	1.00	1.00	**820.00**	**6.90**
UC	0.00	3.00	1.00	0.00	5.00	2.00	1.00	3.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	3.00	4.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	57.00	**101.20**
	0.00	1.00	0.00	0.00	2.00	1.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.00	0.20
	0.00	2.00	0.00	0.00	2.00	1.00	1.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.00	0.40
	0.00	3.00	1.00	0.00	2.00	1.00	1.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	29.00	**100.40**
	0.00	1.00	1.00	0.00	2.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.00	**100.10**
	0.00	0.00	0.00	0.00	2.00	1.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.00
	0.00	0.00	0.00	0.00	3.00	1.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.00
	0.00	1.00	0.00	0.00	2.00	1.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	19.00	0.20
	0.00	1.00	0.00	0.00	2.00	1.00	0.00	2.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.00	0.70
IJC criteria																																	**100.00**	
CCME TRG																																		**0.79**

Table 12: PCB concentrations, length, weight and species of sport fish collected from Lyons Creek, 1991-2002

Location	Species	Date	length cm	weight g	total PCB ng/g	
Lyons Creek - Hwy 140	Pumpkinseed	23-Oct-91	9.5	9	1260	
Lyons Creek - Hwy 140	Pumpkinseed	23-Oct-91	10.6	17	80	Trace
Lyons Creek - Hwy 140	Pumpkinseed	23-Oct-91	11.2	19	2500	
Lyons Creek - Hwy 140	Pumpkinseed	23-Oct-91	12.8	36	1460	
Lyons Creek - Hwy 140	Pumpkinseed	23-Oct-91	17.5	126	220	
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	40		80	Trace
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	44.4		310	
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	44.8		340	
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	45.5		320	
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	45.8		260	
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	55.7		500	
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	57.2		440	
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	62.2		200	Trace
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	63.9		380	
Lyons Creek - Hwy 140	Bowfin	01-Nov-91	66.8		240	
Lyons Creek - Hwy 140	Bluegill	05-Nov-91	19.2	160	160	Trace
Lyons Creek - Hwy 140	Bluegill	05-Nov-91	19.5	186	80	Trace
Lyons Creek - Hwy 140	Largemouth Bass	05-Nov-91	24.4	218	160	Trace
Lyons Creek - Hwy 140	Largemouth Bass	05-Nov-91	26.5	261	380	
Lyons Creek - Hwy 140	Rock Bass	05-Nov-91	12.5	43	200	Trace
Lyons Creek - Hwy 140	Rock Bass	05-Nov-91	19.1	146	160	Trace
Lyons Creek - Hwy 140	Rock Bass	05-Nov-91	20.7	172	120	Trace
Lyons Creek - Hwy 140	White Sucker	05-Nov-91	35.5	481	640	
Lyons Creek - Hwy 140	Pumpkinseed	15-Oct-92	13.3	57	0	ND
Lyons Creek - Hwy 140	Pumpkinseed	15-Oct-92	13.5	63	170	Trace
Lyons Creek - Hwy 140	Pumpkinseed	15-Oct-92	13.6	61	145	Trace
Lyons Creek - Hwy 140	Pumpkinseed	15-Oct-92	13.6	58	150	Trace
Lyons Creek - Hwy 140	Pumpkinseed	15-Oct-92	14	71	0	ND
Lyons Creek - Hwy 140	Pumpkinseed	15-Oct-92	15	79	0	ND
Lyons Creek - Hwy 140	Pumpkinseed	15-Oct-92	15.1	90	70	Trace
Lyons Creek - Hwy 140	Pumpkinseed	15-Oct-92	15.1	78	100	Trace
Lyons Creek - Hwy 140	Pumpkinseed	15-Oct-92	15.4	86	130	Trace
Lyons Creek - Hwy 140	Brown Bullhead	03-Nov-92	19.7	88	0	ND
Lyons Creek - Hwy 140	Carp	04-Nov-92	48.5	1954	300	
Lyons Creek - Hwy 140	Carp	04-Nov-92	57.2	3311	20	ND
Lyons Creek - Hwy 140	Carp	04-Nov-92	63.5	4380	140	Trace
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	14.4	72	1400	
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	14.6	70	780	
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	14.9	68	1460	
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	15	81	420	
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	15.3	90	1580	
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	15.5	97	480	
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	16.1	105	680	
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	16.5	111	640	
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	17.2	126	760	
Lyons Creek - Hwy 140	Bluegill	02-Jun-94	17.2	137	1100	
Lyons Creek - Hwy 140	Brown Bullhead	02-Jun-94	22.2	165	360	
Lyons Creek - Hwy 140	Brown Bullhead	02-Jun-94	22.6	150	360	
Lyons Creek - Hwy 140	Brown Bullhead	02-Jun-94	23.3	193	380	
Lyons Creek - Hwy 140	Brown Bullhead	02-Jun-94	27.6	336	680	
Lyons Creek - Hwy 140	Brown Bullhead	02-Jun-94	27.8	294	460	
Lyons Creek - Hwy 140	Brown Bullhead	02-Jun-94	29	329	360	
Lyons Creek - Hwy 140	Brown Bullhead	02-Jun-94	33.1	582	420	
Lyons Creek - Hwy 140	Carp	02-Jun-94	22.6	236	580	
Lyons Creek - Hwy 140	Carp	02-Jun-94	24.8	310	1900	
Lyons Creek - Hwy 140	Carp	02-Jun-94	26	342	880	
Lyons Creek - Hwy 140	Carp	02-Jun-94	26.5	405	820	
Lyons Creek - Hwy 140	Carp	02-Jun-94	27.2	371	2280	
Lyons Creek - Hwy 140	Carp	02-Jun-94	27.3	451	820	
Lyons Creek - Hwy 140	Carp	02-Jun-94	27.8	537	1260	
Lyons Creek - Hwy 140	Carp	02-Jun-94	28.5	617	2800	
Lyons Creek - Hwy 140	Carp	02-Jun-94	29.4	537	1420	
Lyons Creek - Hwy 140	Carp	02-Jun-94	29.7	712	760	
Lyons Creek - Hwy 140	Carp	02-Jun-94	31.8	850	1600	
Lyons Creek - Hwy 140	Carp	02-Jun-94	48.5	1589	1740	
Lyons Creek - Hwy 140	Carp	02-Jun-94	48.9	1700	1400	
Lyons Creek - Hwy 140	Carp	02-Jun-94	51.5	2371	1440	
Lyons Creek - Hwy 140	Carp	02-Jun-94	51.5	1985	2620	
Lyons Creek - Hwy 140	Carp	02-Jun-94	56.4	3026	580	
Lyons Creek - Hwy 140	Carp	02-Jun-94	56.4	2839	1020	
Lyons Creek - Hwy 140	Carp	02-Jun-94	60.5	3810	1700	
Lyons Creek - Hwy 140	Carp	02-Jun-94	63.8	5211	9600	
Lyons Creek - Hwy 140	Carp	02-Jun-94	69	6038	5100	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	20.9	140	480	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	23.3	168	480	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	23.5	189	320	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	23.9	198	600	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	24	175	780	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	25.1	200	620	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	25.2	235	300	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	25.3	231	180	Trace
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	25.9	275	320	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	26.1	269	400	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	26.1	282	440	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	26.8	282	320	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	27.8	324	240	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	28.5	293	500	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	28.7	354	320	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	29.8	351	440	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	30.5	397	300	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	30.5	409	420	
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	30.6	402	180	Trace
Lyons Creek - Hwy 140	Largemouth Bass	02-Jun-94	32.5	542	300	
Lyons Creek - Hwy 140	Pumpkinseed	02-Jun-94	13.8	73	2940	
Lyons Creek - Hwy 140	Pumpkinseed	02-Jun-94	14.5	80	1000	
Lyons Creek - Hwy 140	Pumpkinseed	02-Jun-94	15.1	81	1920	
Lyons Creek - Hwy 140	Pumpkinseed	02-Jun-94	15.5	96	2060	
Lyons Creek - Hwy 140	Pumpkinseed	02-Jun-94	15.5	106	3260	
Lyons Creek - Hwy 140	Pumpkinseed	02-Jun-94	15.6	88	3380	
Lyons Creek - Hwy 140	Pumpkinseed	02-Jun-94	15.7	101	980	
Lyons Creek - Hwy 140	Pumpkinseed	02-Jun-94	15.8	106	2020	
Lyons Creek - Hwy 140	Pumpkinseed	02-Jun-94	16.2	111	1880	
Lyons Creek - Hwy 140	White Sucker	02-Jun-94	23.8	159	440	
Lyons Creek - Hwy 140	White Sucker	02-Jun-94	34.9	512	240	
Lyons Creek - Hwy 140	Black Crappie	28-Oct-99	17.5	77	540	
Lyons Creek - Hwy 140	Black Crappie	28-Oct-99	19.4	89	440	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	15.2	145	240	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	15.3	148	180	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	15.7	148	480	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	15.8	81	380	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	16	81	320	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	16.1	87	200	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	16.1	153	540	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	16.5	95	580	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	17	102	360	
Lyons Creek - Hwy 140	Bluegill	28-Oct-99	17.7	118	200	
Lyons Creek - Hwy 140	Largemouth Bass	28-Oct-99	17	64	220	
Lyons Creek - Hwy 140	Largemouth Bass	28-Oct-99	17.8	73	620	
Lyons Creek - Hwy 140	Largemouth Bass	28-Oct-99	18.2	73	300	
Lyons Creek - Hwy 140	Largemouth Bass	28-Oct-99	18.9	89	260	
Lyons Creek - Hwy 140	Largemouth Bass	28-Oct-99	19.4	91	120	
Lyons Creek - Hwy 140	Largemouth Bass	28-Oct-99	19.8	91	660	
Lyons Creek - Hwy 140	Largemouth Bass	28-Oct-99	20.5	122	540	
Lyons Creek - Hwy 140	Pumpkinseed	28-Oct-99	14	59	580	
Lyons Creek - Hwy 140	Pumpkinseed	28-Oct-99	14.4	65	380	
Lyons Creek - Hwy 140	Pumpkinseed	28-Oct-99	14.4	66	680	
Lyons Creek - Hwy 140	Pumpkinseed	28-Oct-99	14.8	75	620	
Lyons Creek - Hwy 140	Pumpkinseed	28-Oct-99	15.1	78	580	P84
Lyons Creek - Hwy 140	Pumpkinseed	28-Oct-99	15.7	80	620	P84
Lyons Creek - Hwy 140	Black Crappie	21-Oct-02	208	143	220	P84
Lyons Creek - Hwy 140	Black Crappie	21-Oct-02	214	165	160	P84
Lyons Creek - Hwy 140	Black Crappie	21-Oct-02	219	183	140	P84
Lyons Creek - Hwy 140	Black Crappie	21-Oct-02	227	190	260	P84
Lyons Creek - Hwy 140	Black Crappie	21-Oct-02	213	172	720	P84
Lyons Creek - Hwy 140	Black Crappie	21-Oct-02	241	249	620	P84
Lyons Creek - Hwy 140	Bluegill	21-Oct-02	166	105	180	P84
Lyons Creek - Hwy 140	Bluegill	21-Oct-02	178	107	220	P84
Lyons Creek - Hwy 140	Bluegill	21-Oct-02	185	134	160	P84
Lyons Creek - Hwy 140	Bluegill	21-Oct-02	178	154	180	P84
Lyons Creek - Hwy 140	Bluegill	21-Oct-02	191	169	200	P84
Lyons Creek - Hwy 140	Bowfin	21-Oct-02	468	883	440	P84
Lyons Creek - Hwy 140	Bowfin	21-Oct-02	535	1354	160	P84
Lyons Creek - Hwy 140	Bowfin	21-Oct-02	474	879	100	P84
Lyons Creek - Hwy 140	Bowfin	21-Oct-02	545	1485	220	P84
Lyons Creek - Hwy 140	Bowfin	21-Oct-02	582	1784	80	P84
Lyons Creek - Hwy 140	Bowfin	21-Oct-02	546	1532	140	P84
Lyons Creek - Hwy 140	Brown Bullhead	21-Oct-02	233	236	140	
Lyons Creek - Hwy 140	Brown Bullhead	21-Oct-02	296	352	140	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	375	790	340	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	526	2347	2000	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	305	436	1000	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	548	3064	2200	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	585	3048	1100	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	666	5551	200	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	301	458	580	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	580	2881	3000	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	306	699	360	P84
Lyons Creek - Hwy 140	Carp	21-Oct-02	378	778	860	P84
Lyons Creek - Hwy 140	Largemouth Bass	21-Oct-02	181	81	280	P84
Lyons Creek - Hwy 140	Largemouth Bass	21-Oct-02	212	132	180	P84
Lyons Creek - Hwy 140	Largemouth Bass	21-Oct-02	211	133	280	P84
Lyons Creek - Hwy 140	Largemouth Bass	21-Oct-02	191	91	240	P84
Lyons Creek - Hwy 140	Largemouth Bass	21-Oct-02	222	141	260	P84
Lyons Creek - Hwy 140	Largemouth Bass	21-Oct-02	215	130	240	P84
Lyons Creek - Hwy 140	Largemouth Bass	21-Oct-02	228	163	500	P84
Lyons Creek - Hwy 140	Largemouth Bass	21-Oct-02	385	795	240	P84
Lyons Creek - Hwy 140	Pumpkinseed	21-Oct-02	148	65	360	P84
Lyons Creek - Hwy 140	Pumpkinseed	21-Oct-02	157	80	580	P84
Lyons Creek - Hwy 140	Pumpkinseed	21-Oct-02	167	101	400	P84
Lyons Creek - Hwy 140	Pumpkinseed	21-Oct-02	155	81	400	P84
Lyons Creek - Hwy 140	Pumpkinseed	21-Oct-02	153	77	400	P84
Lyons Creek - Hwy 140	Pumpkinseed	21-Oct-02	157	83	420	P84
Lyons Creek - Hwy 140	Pumpkinseed	21-Oct-02	165	103	400	P84
Lyons Creek - Hwy 140	Pumpkinseed	21-Oct-02	152	82	160	P84
Lyons Creek - Hwy 140	White sucker	21-Oct-02	267	195	240	P84
Lyons Creek - Hwy 140	White sucker	21-Oct-02	241	139	360	P84
Lyons Creek - Hwy 140	White sucker	21-Oct-02	456	1094	1200	P84
Lyons Creek - Hwy 140	White sucker	21-Oct-02	262	194	360	P84
Lyons Creek - Hwy 140	black crappie	17-Nov-03	21.8	167	460	P84
Lyons Creek - Hwy 140	black crappie	17-Nov-03	21.5	155	220	P84
Lyons Creek - Hwy 140	black crappie	17-Nov-03	22.0	160	220	P84
Lyons Creek - Hwy 140	black crappie	17-Nov-03	20.8	148	360	P84
Lyons Creek - Hwy 140	black crappie	17-Nov-03	22.3	171	320	P84
Lyons Creek - Hwy 140	black crappie	17-Nov-03	22.5	182	300	P84
Lyons Creek - Hwy 140	bowfin	17-Nov-03	39.1	531	240	P84
Lyons Creek - Hwy 140	bowfin	17-Nov-03	48.3	950	240	P84
Lyons Creek - Hwy 140	bowfin	17-Nov-03	53.7	1482	200	P84
Lyons Creek - Hwy 140	bowfin	17-Nov-03	51.9	1217	940	P84
Lyons Creek - Hwy 140	bowfin	17-Nov-03	47.8	900	160	P84
Lyons Creek - Hwy 140	bowfin	17-Nov-03	50.4	1074	580	P84
Lyons Creek - Hwy 140	bowfin	17-Nov-03	51.5	1098	500	P84
Lyons Creek - Hwy 140	bowfin	17-Nov-03	35.6	376	80	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	38.0	848	1100	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	30.8	465	560	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	41.2	1071	1100	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	41.5	1056	2000	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	47.4	1531	660	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	62.1	3539	1300	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	60.5	3311	3000	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	58.5	3145	620	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	47.6	1672	340	P84
Lyons Creek - Hwy 140	carp	17-Nov-03	36.6	704	480	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	23.3	173	460	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	27.4	308	600	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	24.1	190	260	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	24.2	201	340	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	24.4	186	580	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	25.9	234	800	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	26.1	233	500	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	32.1	477	320	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	33.0	557	560	P84
Lyons Creek - Hwy 140	largemouth bass	17-Nov-03	37.2	900	360	P84
Lyons Creek - Hwy 140	pumpkinseed	17-Nov-03	15.5	82	640	P84
Lyons Creek - Hwy 140	pumpkinseed	17-Nov-03	15.3	78	240	P84
Lyons Creek - Hwy 140	pumpkinseed	17-Nov-03	16.2	103	420	P84
Lyons Creek - Hwy 140	pumpkinseed	17-Nov-03	15.6	87	700	P84
Lyons Creek - Hwy 140	pumpkinseed	17-Nov-03	15.5	81	180	P84
Lyons Creek - Hwy 140	rock bass	17-Nov-03	18.1	116	260	P84
Lyons Creek - Hwy 140	rock bass	17-Nov-03	21.4	187	180	
Lyons Creek - Hwy 140	rock bass	17-Nov-03	16.5	89	340	
Lyons Creek - Hwy 140	rock bass	17-Nov-03	17.8	116	320	P84
Lyons Creek - Hwy 140	rock bass	17-Nov-03	18.6	123	280	P84
Lyons Creek - Hwy 140	rock bass	17-Nov-03	18.0	109	500	P84
Lyons Creek - Hwy 140	white sucker	17-Nov-03	30.2	289	220	P84
Lyons Creek - Hwy 140	white sucker	17-Nov-03	33.2	350	580	P84
Lyons Creek - Hwy 140	white sucker	17-Nov-03	30.8	327	2100	P84
Lyons Creek - Hwy 140	white sucker	17-Nov-03	34.3	434	1200	P84
Lyons Creek - Hwy 140	white sucker	17-Nov-03	35.4	433	1500	P84
Lyons Creek - Hwy 140	white sucker	17-Nov-03	43.0	721	1400	P84
Lyons Creek - Hwy 140	white sucker	17-Nov-03	42.7	816	1100	P84
Lyons Creek - d/s of QEW	Bluegill	18-Jul-00	17.7	121	40	
Lyons Creek - d/s of QEW	Bluegill	18-Jul-00	18.2	133	100	
Lyons Creek - d/s of QEW	Bluegill	18-Jul-00	19.2	149	60	
Lyons Creek - d/s of QEW	Bluegill	18-Jul-00	19.3	155	60	
Lyons Creek - d/s of QEW	Bluegill	18-Jul-00	19.6	166	0	ND
Lyons Creek - d/s of QEW	Brown Bullhead	18-Jul-00	27	330	40	
Lyons Creek - d/s of QEW	Brown Bullhead	18-Jul-00	27.4	332	20	
Lyons Creek - d/s of QEW	Brown Bullhead	18-Jul-00	27.8	416	0	ND
Lyons Creek - d/s of QEW	Brown Bullhead	18-Jul-00	28.8	344	80	
Lyons Creek - d/s of QEW	Brown Bullhead	18-Jul-00	28.9	406	60	
Lyons Creek - d/s of QEW	Carp	18-Jul-00	48.6	1717	80	
Lyons Creek - d/s of QEW	Carp	18-Jul-00	51.3	2007	100	
Lyons Creek - d/s of QEW	Carp	18-Jul-00	52.5	2113	180	
Lyons Creek - d/s of QEW	Carp	18-Jul-00	55	1950	0	ND
Lyons Creek - d/s of QEW	Carp	18-Jul-00	56.2	2421	80	
Lyons Creek - d/s of QEW	Carp	18-Jul-00	58.1	2595	180	
Lyons Creek - d/s of QEW	Carp	18-Jul-00	61.1	3206	640	
Lyons Creek - d/s of QEW	Carp	18-Jul-00	67.5	4900	100	
Lyons Creek - d/s of QEW	Carp	18-Jul-00	72	5105	80	
Lyons Creek - d/s of QEW	Carp	18-Jul-00	73	5545	260	
Lyons Creek - d/s of QEW	Largemouth Bass	18-Jul-00	35.2	721	60	
Lyons Creek - d/s of QEW	Largemouth Bass	18-Jul-00	35.6	762	40	
Lyons Creek - d/s of QEW	Largemouth Bass	18-Jul-00	36.2	803	60	
Lyons Creek - d/s of QEW	Largemouth Bass	18-Jul-00	39.4	954	100	
Lyons Creek - d/s of QEW	Largemouth Bass	18-Jul-00	39.5	921	40	
Lyons Creek - d/s of QEW	Pumpkinseed	18-Jul-00	13.5	57	0	ND
Lyons Creek - d/s of QEW	Pumpkinseed	18-Jul-00	13.9	57	20	
Lyons Creek - d/s of QEW	Pumpkinseed	18-Jul-00	14.2	56	60	
Lyons Creek - d/s of QEW	Pumpkinseed	18-Jul-00	15.5	93	0	ND
Lyons Creek - d/s of QEW	Pumpkinseed	18-Jul-00	15.6	97	80	
Lyons Creek - d/s of QEW	Pumpkinseed	18-Jul-00	16	91	20	
Lyons Creek - d/s of QEW	White Crappie	18-Jul-00	27.6	290	40	
Lyons Creek - d/s of QEW	Black Crappie	21-Oct-02	25.5	345	20	
Lyons Creek - d/s of QEW	Black Crappie	21-Oct-02	26.5	318	20	
Lyons Creek - d/s of QEW	Black Crappie	21-Oct-02	27.4	379	20	
Lyons Creek - d/s of QEW	Black Crappie	21-Oct-02	27.4	352	40	
Lyons Creek - d/s of QEW	Black Crappie	21-Oct-02	27.5	372	0	ND
Lyons Creek - d/s of QEW	Bluegill	21-Oct-02	17.9	125	0	ND
Lyons Creek - d/s of QEW	Bluegill	21-Oct-02	18.7	156	0	ND
Lyons Creek - d/s of QEW	Bluegill	21-Oct-02	18.8	158	0	ND
Lyons Creek - d/s of QEW	Bluegill	21-Oct-02	19.5	173	0	ND
Lyons Creek - d/s of QEW	Bluegill	21-Oct-02	20.1	187	40	
Lyons Creek - d/s of QEW	Bowfin	21-Oct-02	30.3	256	0	ND
Lyons Creek - d/s of QEW	Bowfin	21-Oct-02	42.5	727	100	
Lyons Creek - d/s of QEW	Bowfin	21-Oct-02	45.1	982	20	
Lyons Creek - d/s of QEW	Bowfin	21-Oct-02	47.6	1010	20	
Lyons Creek - d/s of QEW	Bowfin	21-Oct-02	47.6	1055	0	ND
Lyons Creek - d/s of QEW	Bowfin	21-Oct-02	49.4	1208	20	
Lyons Creek - d/s of QEW	Brown Bullhead	21-Oct-02	26.3	242	0	ND
Lyons Creek - d/s of QEW	Brown Bullhead	21-Oct-02	27.3	283	0	ND
Lyons Creek - d/s of QEW	Brown Bullhead	21-Oct-02	29.9	339	60	
Lyons Creek - d/s of QEW	Brown Bullhead	21-Oct-02	30	377	160	
Lyons Creek - d/s of QEW	Brown Bullhead	21-Oct-02	30.2	381	80	
Lyons Creek - d/s of QEW	Carp	21-Oct-02	50.8	1734	40	
Lyons Creek - d/s of QEW	Carp	21-Oct-02	59.3	3291	140	
Lyons Creek - d/s of QEW	Carp	21-Oct-02	61.4	3113	20	
Lyons Creek - d/s of QEW	Carp	21-Oct-02	61.4	2898	0	ND
Lyons Creek - d/s of QEW	Carp	21-Oct-02	63.5	3712	60	
Lyons Creek - d/s of QEW	Carp	21-Oct-02	63.5	4155	300	
Lyons Creek - d/s of QEW	Carp	21-Oct-02	65.6	4150	40	
Lyons Creek - d/s of QEW	Carp	21-Oct-02	65.8	4071	80	
Lyons Creek - d/s of QEW	Carp	21-Oct-02	69.8	5180	40	
Lyons Creek - d/s of QEW	Carp	21-Oct-02	75.5	7942	0	ND
Lyons Creek - d/s of QEW	Largemouth Bass	21-Oct-02	21.6	148	20	
Lyons Creek - d/s of QEW	Largemouth Bass	21-Oct-02	24.7	219	0	ND
Lyons Creek - d/s of QEW	Largemouth Bass	21-Oct-02	25.3	231	20	
Lyons Creek - d/s of QEW	Largemouth Bass	21-Oct-02	30.7	438	0	ND
Lyons Creek - d/s of QEW	Largemouth Bass	21-Oct-02	39	905	140	
Lyons Creek - d/s of QEW	Northern Pike	21-Oct-02	38.2	295	40	
Lyons Creek - d/s of QEW	Northern Pike	21-Oct-02	40.9	380	60	
Lyons Creek - d/s of QEW	Northern Pike	21-Oct-02	48.6	720	20	
Lyons Creek - d/s of QEW	Northern Pike	21-Oct-02	55.7	894	60	
Lyons Creek - d/s of QEW	Northern Pike	21-Oct-02	57.7	1050	20	
Lyons Creek - d/s of QEW	Pumpkinseed	21-Oct-02	17.5	129	0	ND
Lyons Creek - d/s of QEW	Pumpkinseed	21-Oct-02	18.2	158	20	
Lyons Creek - d/s of QEW	Pumpkinseed	21-Oct-02	18.2	136	0	ND
Lyons Creek - d/s of QEW	Pumpkinseed	21-Oct-02	18.8	158	0	ND
Lyons Creek - d/s of QEW	Pumpkinseed	21-Oct-02	19	187	0	ND
Lyons Creek - d/s of QEW	Rock Bass	21-Oct-02	18	123	0	ND
Lyons Creek - d/s of QEW	Rock Bass	21-Oct-02	19.5	153	0	ND
Lyons Creek - d/s of QEW	Rock Bass	21-Oct-02	22.6	250	0	ND
Lyons Creek - d/s of QEW	Rock Bass	21-Oct-02	22.7	237	40	
Lyons Creek - d/s of QEW	Rock Bass	21-Oct-02	23	273	0	ND
Lyons Creek - d/s of QEW	White Crappie	21-Oct-02	23.2	148	60	
Lyons Creek - d/s of QEW	White Crappie	21-Oct-02	23.4	156	40	
Lyons Creek - d/s of QEW	White Crappie	21-Oct-02	26.9	320	20	
Lyons Creek - d/s of QEW	White Crappie	21-Oct-02	29.1	340	40	
Lyons Creek - d/s of QEW	White Crappie	21-Oct-02	31.6	479	40	
Lyons Creek - d/s of QEW	Yellow Perch	21-Oct-02	18.2	72	0	ND
Lyons Creek - d/s of QEW	Yellow Perch	21-Oct-02	20.1	90	40	
Lyons Creek - d/s of QEW	Yellow Perch	21-Oct-02	20.3	96	0	ND
Lyons Creek - d/s of QEW	Yellow Perch	21-Oct-02	21.6	109	0	ND
Lyons Creek - d/s of QEW	Yellow Perch	21-Oct-02	21.7	120	0	ND
Lyons Creek - d/s of QEW	Yellow Perch	21-Oct-02	28.2	316	0	ND

ND no measurable response

Trace trace amounts measured

P84 PCB aroclor mixture of 1248 and 1254

Table 13: MOE *Guide to Eating Ontario Sport Fish* restrictions for fish collected from Lyons Creek at Highway 140 and downstream of the QEW. Consumption advisory is provided for different size classes of fish and is expressed in terms of meals per month. ‘Sensitive’ = women of childbearing age and children under 15. ‘General’ = general population.

		Size category												
		15	20	25	30	35	40	45	50	55	60	65	70	75
Lyons Creek at Hwy. 140 Niagara R.M.														
Carp	General		🟥 1		🟨 1	🟨	🟨	🟨	🟨 0	🟨	🟨	🟩 0		
	Sensitive		🟥 0		🟨 0							🟩 0		
Brown Bullhead	General		🟥 2	🟥	🟥 1									
	Sensitive		🟥 0											
White Sucker	General		🟩 4	🟩 2	🟨 1	🟨 0		🟩 0						
	Sensitive		🟩 4	🟩 0	🟨 0			🟩 0						
Bowfin	General					🟨 4	🟨	🟨 2	🟨	🟦 2				
	Sensitive					🟨 4	🟨	🟨 0	🟨	🟦 0				
Largemouth Bass	General	🟩 4	🟨 2	🟨	🟨 1	🟨								
	Sensitive	🟩 4	🟨 0											
Rock Bass	General	🟨 2												
	Sensitive	🟨 0												
Black Crappie	General		🟨 2											
	Sensitive		🟨 0											
Pumpkinseed	General	🟨 1												
	Sensitive	🟨 0												
Bluegill	General	🟩 4												
	Sensitive	🟩 4												

🟨 2003 PCBs
🟩 2002 PCBs
🟥 1994 PCBs
🟦 1991 PCBs

		Size category												
		15	20	25	30	35	40	45	50	55	60	65	70	75
Lyons Creek downstream of QEW Niagara R.M.														
Northern Pike	General					🟨 8								
	Sensitive					🟨 8								
Carp	General							🟩 8	🟨 8	🟥 1				
	Sensitive							🟩 8	🟨 8	🟥 0				
Brown Bullhead	General	🟩 8	🟨 8		🟨 4									
	Sensitive	🟩 8	🟨 8		🟨 4									
Bowfin	General				🟨 8									
	Sensitive				🟨 4									
Largemouth Bass	General	🟨 8				🟨 4								
	Sensitive	🟨 8		🟨 4	🟨 0									
Yellow Perch	General	🟨 8		🟨 4										
	Sensitive	🟨 8	🟨 4	🟨 0										
Rock Bass	General	🟨 8												
	Sensitive	🟨 8	🟨 4											
Pumpkinseed	General	🟨 8												
	Sensitive	🟨 8												
Bluegill	General	🟨 8												
	Sensitive	🟨 8												
Black Crappie	General		🟨 8											
	Sensitive		🟨 4											
White Crappie	General		🟨 8											
	Sensitive		🟨 4											

🟨 2002 Hg;
🟩 2000 PCBs
🟥 2000 dioxins

Table 14: PCB congener data and calculated TEQ values for sport fish collected from Lyons Creek at Highway 140, 2003

	2,2',3,5'-tetrachlorobiphenyl ng/g	2,2',4,5'-tetrachlorobiphenyl ng/g	2,2',5,5'-tetrachlorobiphenyl ng/g	2,2',5-trichlorobiphenyl ng/g	2,2',6,6'-tetrachlorobiphenyl ng/g	2,2',6-trichlorobiphenyl ng/g	2,2'3,44'5'-hexachlorobiphenyl ng/g	2,2'3,4'5'6-hexachlorobiphenyl ng/g	2,2'3,5,5'6-hexachlorobiphenyl ng/g	2,2'3,5',6-pentachlorobiphenyl ng/g	2,2'4,4',5-pentachlorobiphenyl ng/g	2,2'4,5,5'-pentachlorobiphenyl ng/g	2,3,3'4,4'5-hexachlorobiphenyl ng/g	2,3,3'4,4'6-hexachlorobiphenyl ng/g	2,3,3'4,4'-pentachlorobiphenyl ng/g	2,3,3'4',6-pentachlorobiphenyl ng/g	2,3,3'44'5'-hexachlorobiphenyl ng/g	2,3,4,4',5-pentachlorobiphenyl ng/g	2,3',4',5-tetrachlorobiphenyl ng/g	2',3,4-trichlorobiphenyl ng/g	2,3,4'-trichlorobiphenyl ng/g	2,3'4,4',5-pentachlorobiphenyl ng/g	2,3'4,4',6-pentachlorobiphenyl ng/g	2,4,4',5-tetrachlorobiphenyl ng/g	2,4,4'-trichlorobiphenyl ng/g	22',33',44'-hexachlorobiphenyl ng/g	22',44',55'-hexachlorobiphenyl ng/g	22',44',66'-hexachlorobiphenyl ng/g
black crappie	8.1	20	38	2 <=W	3.2	2 <=W	28	24	2.7	67	18	31	1 <T	1.1	1.7	8.8	6	0.1 <=W	26	1.5 <T	0.5 <=W	25	0.8 <T	23	10	5.2	30	0.1 <=W
black crappie	13	8.3	25	4 <T	0.4 <T	2 <=W	2	5	0.9 <T	19	3.1	7.9	0.6 <T	0.3 <T	0.5 <T	7	2	0.1 <=W	12	0.5 <=W	0.5 <=W	4.8	0.8 <T	21	5.5	0.4 <T	1.5	1.3
black crappie	19	15	35	6 <T	0.4 <T	2 <=W	7	3.4	1.9	34	6.9	12	1.4 <T	0.9 <T	1.6	7.4	5.2	0.1 <=W	21	1.5 <T	0.5 <=W	9.4	1.1	14	9.5	0.2 <=W	7	0.4 <T
black crappie	12	11	22	4 <T	3.6	2 <=W	14	9.2	0.1 <=W	35	7.6	14	0.2 <=W	1.5	1.6	11	2	0.4 <T	13	0.5 <=W	0.5 <=W	13	0.5 <T	19	7	0.8 <T	14	0.4 <T
black crappie	31	38	49	6 <T	2.2	2 <=W	8.2	8.2	2.1	68	11	21	0.4 <T	1.1	0.6 <T	24	0.6 <T	0.2 <T	33	4 <T	0.5 <=W	15	0.6 <T	26	16	0.6 <T	7.3	0.1 <=W
black crappie	25	25	32	6 <T	0.2 <=W	2 <=W	5	3.2	2.2	44	7	15	1.2 <T	0.8 <T	7	21	3.8	1.4	17	4 <T	0.5 <=W	10	0.1 <=W	34	11	0.2 <=W	4.3	0.1 <=W
bowfin	0.1 <=W	3	11	2 <=W	1 <T	2 <=W	4.8	0.8 <T	2.5	25	5.8	4.7	1.2 <T	1.1	2.5	2.6	4	0.1 <=W	2.1	3 <T	1.5 <T	7.6	0.9 <T	13	7.5	1.8 <T	6.6	1.4
bowfin	0.2 <T	4.2	16	2 <=W	3	2 <=W	2.6	3.6	1.5	32	8.1	3.9	1 <T	1	3	1.9	2.4	0.1 <=W	3.7	0.5 <=W	1 <T	10	0.8 <T	15	12	1.6 <T	3.3	1.3
bowfin	2.8	4.2	14	2 <=W	2.4	2 <=W	5	1.2 <T	2.8	25	5.3	6.5	1.2 <T	1	2.6	3.2	4.4	0.3 <T	3.8	3 <T	1.5 <T	7.3	0.1 <=W	13	6.5	1.4 <T	6.7	1.7
bowfin	5.5	21	62	2 <=W	4	2 <=W	31	12	2.9	89	38	39	1.6 <T	1.9	17	20	6.2	1.4	32	4 <T	11	43	2.4	36	28	3.6	43	2.8
bowfin	0.9 <T	10	14	2 <=W	1.8 <T	2 <=W	5.4	3.6	2.9	36	5.6	9.3	1.2 <T	0.9 <T	5.2	9.8	4.4	0.4 <T	9.3	2.5 <T	2.5 <T	13	0.9 <T	10	7	0.2 <=W	5.3	1
bowfin	1.2	15	38	2 <=W	3.2	2 <=W	23	5	1.4	91	30	19	1 <T	2.1	12	14	5.6	0.8 <T	16	0.5 <=W	1.5 <T	38	2.6	36	18	2	47	1.6
bowfin	0.8 <T	6	21	2 <=W	2	2 <=W	28	2.6	2.1	73	48	11	1 <T	2.6	15	5.2	1.8 <T	1.2	7	0.5 <=W	1.5 <T	45	2.5	36	16	2.6	44	1.2
bowfin	3.3	1.2	3.9	4 <T	2.2	2 <=W	0.2 <=W	1.4 <T	0.8 <T	10	0.5 <T	1.3	0.2 <=W	0.4 <T	3	2.5	2.6	0.1 <=W	0.5 <T	3 <T	1.5 <T	2.4	0.1 <=W	2.9	5.5	0.8 <T	1.3	0.6 <T
carp	120	92	150	68	0.6 <T	2 <=W	16	24	4.6	170	32	48	0.2 <=W	0.3 <T	17	48	0.2 <=W	1	59	20	11	38	2.1	56	53	1.2 <T	13	5
carp	52	54	81	20	0.4 <T	2 <=W	15	6.8	0.7 <T	110	27	39	0.2 <=W	0.1 <=W	9.4	32	7.4	0.7 <T	25	5	0.5 <=W	33	1.3	37	20	0.6 <T	12	2.3
carp	160	130	200	90	3	2 <=W	27	17	1.3	230	50	68	0.6 <T	1.2	19	68	7.8	1.6	94	37	1 <T	48	2.8	71	73	1.2 <T	21	0.5 <T
carp	260	210	310	140	5.6	4 <T	40	61	3.8	460	65	110	2	2.3	45	120	11	3	160	45	28	91	1.2	130	120	4.4	31	3.1
carp	69	56	93	30	1.6 <T	2 <=W	12	6.6	0.1 <=W	110	25	32	2.2	2	8.3	33	8.6	0.6 <T	30	7	1 <T	26	0.8 <T	37	22	2.4	8.6	4.3
carp	140	120	190	46	3.2	2 <=W	39	43	2.8	240	60	81	1.4 <T	2.2	30	81	6.8	2.1	55	12	9	63	1.7	79	50	3.8	31	2.2
carp	320	310	430	130	5	2 <=W	120	55	11	650	130	200	4.6	8.9	71	200	6.8	5.5	130	50	11	160	6.6	190	130	7.8	100	7
carp	77	65	100	26	1.6 <T	2 <=W	18	21	2.6	120	27	42	0.2 <=W	0.4 <T	15	42	2.8	0.9 <T	28	8	4 <T	32	0.2 <T	44	25	1 <T	6.5	1.5
carp	29	38	64	22	0.8 <T	2 <=W	8	3.8	2.2	73	15	20	0.6 <T	1.1	0.4 <T	8.5	2	0.1 <=W	25	3.5 <T	3 <T	18	0.8 <T	27	20	0.2 <=W	6.1	2.2
carp	53	43	71	38	4	2 <=W	5.8	3.2	1.7	78	12	19	0.8 <T	1	4.5	17	1.4 <T	0.1 <=W	33	14	1 <T	16	0.3 <T	29	32	0.8 <T	4.1	1.4
largemouth bass	24	20	36	12 <T	0.4 <T	2 <=W	21	19	2.4	53	11	25	0.6 <T	0.6 <T	7.5	20	4.2	1	17	3 <T	1 <T	16	0.7 <T	35	12	1.4 <T	22	0.1 <=W
largemouth bass	46	56	68	20	2.2	2 <=W	15	30	1.1	110	23	49	1.4 <T	0.3 <T	26	61	1 <T	1.3	32	12	14	28	0.6 <T	34	18	1.8 <T	11	2.8
largemouth bass	30	26	57	10 <T	0.6 <T	2 <=W	20	12	1.2	69	22	35	0.6 <T	0.6 <T	8.5	26	1.2 <T	1.5	27	1 <T	0.5 <=W	28	1.1	26	11	0.6 <T	19	0.1 <=W
largemouth bass	38	49	60	14 <T	1 <T	2 <=W	13	9	2.3	95	20	34	1 <T	0.2 <T	5.9	33	0.4 <T	0.2 <T	25	6.5	0.5 <=W	26	0.9 <T	31	16	1.6 <T	10	0.1 <=W
largemouth bass	39	27	61	16 <T	0.4 <T	2 <=W	27	14	1.4	64	21	40	0.6 <T	1	9.7	26	4.4	1.2	21	2.5 <T	0.5 <=W	23	0.5 <T	24	13	1.2 <T	29	5.1
largemouth bass	80	84	110	22	5	2 <=W	27	28	2	170	44	76	3.4	1.5	24	100	6	2.1	50	15	0.5 <=W	48	0.3 <T	52	28	2.2	21	3.2
largemouth bass	26	33	43	8 <T	3.6	2 <=W	22	33	5.2	71	14	31	1.8 <T	0.6 <T	19	42	9.4	1.3	22	3.5 <T	0.5 <=W	34	0.9 <T	27	12	1.8 <T	22	4
largemouth bass	29	39	45	10 <T	0.2 <=W	2 <=W	7.4	7	2	68	13	25	0.6 <T	1	12	40	3.8	0.1 <=W	26	5	0.5 <=W	16	0.4 <T	22	12	1 <T	5.4	2
largemouth bass	30	24	53	6 <T	0.4 <T	2 <=W	11	9.4	4.3	61	7.2	29	2.2	0.1 <=W	12	25	4.8	0.5 <T	21	3 <T	4 <T	19	2	21	8.5	0.8 <T	7.8	6.2
largemouth bass	28	37	49	12 <T	1 <T	2 <=W	8.4	14	1.8	72	13	26	0.6 <T	0.1 <=W	18	39	4.6	0.3 <T	26	4.5 <T	1 <T	31	0.9 <T	25	14	0.6 <T	6.7	2.7
pumpkinseed	3.5	24	50	6 <T	2.2	2 <=W	23	13	0.1 <=W	78	30	50	0.8 <T	0.6 <T	20	39	7.8	0.9 <T	41	2 <T	2.5 <T	42	1.5	26	10	2.6	17	6.2
pumpkinseed	0.7 <T	26	34	4 <T	3.2	2 <=W	12	5.2	0.1 <=W	49	12	22	0.8 <T	1.2	1.1	15	1.6 <T	0.1 <=W	21	1 <T	0.5 <=W	18	0.6 <T	23	8.5	0.8 <T	11	0.5 <T
pumpkinseed	4.9	16	37	6 <T	1.8 <T	2 <=W	5.6	2.8	3	34	7.5	16	1.2 <T	0.7 <T	4.6	15	3.4	0.1 <=W	22	2.5 <T	0.5 <=W	10	0.5 <T	21	8	1.2 <T	4.6	3.2
pumpkinseed	12	33	74	10 <T	2	2 <=W	16	8.8	2	83	9.4	41	0.6 <T	0.3 <T	16	32	6.8	0.8 <T	48	3 <T	0.5 <=W	33	1.5	37	18	1.6 <T	13	0.9 <T
pumpkinseed	1.6	8.8	9.2	6 <T	0.4 <T	2 <=W	1.8 <T	2	1.6	17	1.1	6	0.6 <T	0.1 <=W	2.1	6.9	2	0.1 <=W	5.7	1 <T	3 <T	2.3	1.1	23	5	1 <T	1.3	4.5
rock bass	35	39	54	14 <T	1.2 <T	2 <=W	6.6	5.4	1.6	73	11	23	0.4 <T	0.8 <T	12	33	3	0.1 <=W	13	3 <T	0.5 <=W	16	0.6 <T	22	18	0.8 <T	5.3	3.7
rock bass	17	13	37	10 <T	2.4	2 <=W	5.8	1 <T	2	32	6.7	17	1.2 <T	0.6 <T	0.1 <=W	8.3	3.6	0.1 <=W	6.2	1 <T	0.5 <=W	8.8	0.6 <T	12	12	0.6 <T	4.6	2.7
rock bass	33	25	58	20	2.2	2 <=W	8.8	2	0.1 <=W	58	4.2	20	1.8 <T	0.9 <T	6.4	18	3.4	0.2 <T	19	1.5 <T	0.5 <=W	14	0.3 <T	21	28	0.4 <T	7.6	5
rock bass	44	47	60	16 <T	1.2 <T	2 <=W	7.6	12	0.5 <T	80	14	30	0.6 <T	0.9 <T	16	45	3.4	1.3	9.9	5	0.5 <=W	16	0.7 <T	38	18	0.2 <=W	5.7	0.6 <T
rock bass	22	18	45	8 <T	1.2 <T	2 <=W	6	1.6 <T	1.8	44	11	19	1.6 <T	0.9 <T	2.1	15	3.2	0.5 <T	7.3	0.5 <=W	0.5 <=W	13	0.7 <T	14	13	1 <T	4.1	3.9
rock bass	50	55	77	18 <T	2	2 <=W	12	25	0.5 <T	110	20	36	1.6 <T	0.6 <T	4.7	49	1.4 <T	1.3	15	4 <T	0.5 <=W	25	0.8 <T	67	25	0.6 <T	9.8	2.7
white sucker	18	15	28	8 <T	1.8 <T	2 <=W	4.4	3.6	1.7	36	7.8	11	0.8 <T	1	4.7	10	5.2	0.1 <=W	10	1 <T	1 <T	11	0.1 <=W	15	9	1.8 <T	3.5	1.5
white sucker	57	46	53	18 <T	1.4 <T	2 <=W	14	12	2.8	99	25	31	1.6 <T	0.1 <=W	13	32	7	0.7 <T	50	8	4 <T	27	1.3	35	28	0.4 <T	12	3.3
white sucker	170	150	100	52	0.4 <T	2 <=W	59	30	4.1	330	96	100	3	4.3	42	110	3.6	3.9	150	26	1.5 <T	99	1.8	110	92	3.8	48	1.8
white sucker	86	68	130	32	1.8 <T	2 <=W	27	26	7.9	150	45	56	1.2 <T	1.3	23	55	1 <T	1.6	79	9	9	51	2.9	53	43	1.6 <T	23	5.9
white sucker	150	120	210	40	4	2 <=W	43	45	2.7	270	71	89	2	2.8	34	86	2.6	2.7	120	15	13	73	2.2	92	78	3.6	36	0.4 <T
white sucker	98	94	65	30	2.4	2 <=W	65	25	2	220	110	82	3	4.4	35	88	4.6	3.4	120	7.5	1.5 <T	87	0.1 <=W	83	78	3	58	2.4
white sucker	91	81	77	28	2.8	2 <=W	28	32	0.5 <T	180	48	60	1.2 <T	1.5	24	59	0.8 <T	1.8	75	13	8.5	57	2.8	65	53	2	25	5.5

	22'33'44'55'6-nona(Cl)biphenyl ng/g	22'33'44'55'-octa(Cl)biphenyl ng/g	22'33'44'5-heptachlorobiphenyl ng/g	22'33'44'6-heptachlorobiphenyl ng/g	22'33'455'66'-nona(Cl)biphenyl ng/g	22'33'455'6'-octa(Cl)biphenyl ng/g	22'33'45'66'-octa(Cl)biphenyl ng/g	22'33'4'56-heptachlorobiphenyl ng/g	22'33'55'66'-octa(Cl)biphenyl ng/g	22'33'55'6-heptachlorobiphenyl ng/g	22'344'55'-heptachlorobiphenyl ng/g	22'344'5'6-heptachlorobiphenyl ng/g	22'34'55'6-heptachlorobiphenyl ng/g	22'34'566'-heptachlorobiphenyl ng/g	2'3,4,4',5-pentachlorobiphenyl ng/g	23',44',55'-hexachlorobiphenyl ng/g	23',44',5'6-hexachlorobiphenyl ng/g	233'44'55'-heptachlorobiphenyl ng/g	233'44'5'6-heptachlorobiphenyl ng/g	3,3',4,4'-tetrachlorobiphenyl ng/g	3,3'4,4',5-pentachlorobiphenyl ng/g	3,3'4,4'55'-hexachlorobiphenyl ng/g	3,4,4'-trichlorobiphenyl ng/g	total PCB ng/g	TEQ ng TEQ/kg
black crappie	0.8 <T	1 <T	7	0.8 <T	0.8 <T	0.8 <T	0.2 <=W	3	0.6 <T	44	19	3.2	11	2.2	15	1.4 <T	0.8	0.2 <=W	0.6 <T	0.2 <=W	1.8	0.1 <=W	3 <T	460 P84	**187.684**
black crappie	0.4 <T	0.6 <T	0.8 <T	0.8 <T	0.6 <T	0.8 <T	1.6 <T	0.8 <T	0.4 <T	2	0.2 <=W	0.8 <T	1.3	0.7 <T	3.2	0.2 <=W	0.3	0.2 <=W	0.4 <T	0.2 <=W	1.4	0.1 <=W	2 <T	220 P84	**142.15**
black crappie	0.8 <T	1 <T	0.4 <T	1.2 <T	0.8 <T	1 <T	0.2 <=W	1.3	0.6 <T	8.8	3	1.6 <T	0.5 <T	1.7	1	0.6 <T	3.2	0.2 <=W	0.6 <T	0.2 <=W	2.3	0.1 <=W	12	220 P84	**234.506**
black crappie	1.2 <T	2	2.6	2.6	0.8 <T	2.2	2.2	0.2 <T	0.6 <T	23	8.6	0.8 <T	4	3.2	5.8	1 <T	0.4	0.2 <=W	0.4 <T	0.2 <=W	1.6	0.1 <=W	6 <T	360 P84	**163.25**
black crappie	0.8 <T	1.2 <T	0.6 <T	1.2 <T	0.8 <T	1.2 <T	1 <T	1.3	0.6 <T	23	3.4	1.2 <T	0.7 <T	1.8	2.4	0.6 <T	0.5	0.2 <=W	0.2 <=W	0.2 <=W	1.7	0.1 <=W	24	320 P84	**172.406**
black crappie	0.8 <T	0.8 <T	1.6 <T	0.8 <T	0.8 <T	0.8 <T	2.4	0.8 <T	0.8 <T	15	1.4 <T	1 <T	1	1.3	5.6	0.4 <T	3.8	0.2 <=W	0.2 <=W	0.2 <=W	1.6	0.1 <=W	3 <T	300 P84	**165.464**
bowfin	0.6 <T	1 <T	0.4 <T	1 <T	0.6 <T	1.2 <T	3	0.1 <=W	0.2 <=W	5.4	2.4	2	0.1 <=W	2.3	5.8	0.2 <=W	1.5	0.2 <=W	0.6 <T	2.2	1.3	0.1 <=W	2 <T	240 P84	**134.41**
bowfin	0.6 <T	1 <T	1.4 <T	0.6 <T	0.8 <T	1 <T	1.2 <T	0.1 <=W	0.2 <=W	2.8	0.6 <T	1.2 <T	2.5	1.3	4.2	0.2 <=W	2.1	0.2 <=W	0.2 <=W	0.2 <=W	0.1 <=W	0.1 <=W	1 <=W	240 P84	**3.42**
bowfin	0.8 <T	1.2 <T	0.4 <T	0.8 <T	0.6 <T	1.4 <T	2.6	0.6 <T	0.2 <=W	6	3	2.2	0.5 <T	2.2	5.8	0.2 <=W	1.3	0.2 <=W	0.4 <T	0.2 <=W	0.6 <T	0.1 <=W	2 <T	200 P84	**64.52**
bowfin	1.6 <T	1.4 <T	8.4	0.4 <T	1 <T	1.4 <T	3	1.9	0.8 <T	40	23	4.2	13	3.7	14	0.2 <=W	18	0.2 <=W	0.8 <T	1.8 <T	1	0.1 <=W	1 <=W	940 P84	**112.18**
bowfin	0.6 <T	1 <T	1.4 <T	1 <T	0.6 <T	1.2 <T	3.2	0.9 <T	1 <T	12	1.6 <T	2	0.1 <=W	2	6.8	0.2 <=W	1.6	0.2 <=W	0.4 <T	0.2 <=W	1.4	0.1 <=W	1 <=W	160 P84	**145.5**
bowfin	1 <T	0.2 <=W	8.6	0.6 <T	0.4 <T	0.2 <=W	0.8 <T	0.6 <T	0.6 <T	29	25	4.6	11	3.7	6.4	0.2 <=W	13	0.2 <=W	0.8 <T	1.4 <T	1.4	0.1 <=W	1 <=W	580 P84	**149.48**
bowfin	1.2 <T	1.2 <T	4.8	2.4	0.4 <T	1 <T	3.8	0.1 <=W	0.2 <=W	23	20	1.4 <T	4.9	3	13	0.2 <=W	24	0.4 <T	1 <T	1.4 <T	1	0.1 <=W	1 <=W	500 P84	**109.48**
bowfin	0.6 <T	0.6 <T	1.6 <T	0.4 <T	0.4 <T	0.6 <T	0.6 <T	0.1 <=W	0.2 <=W	3.4	0.2 <=W	0.8 <T	1.6	1	0.2 <=W	0.2 <=W	2.6	0.2 <=W	0.2 <=W	0.2 <=W	0.1 <=W	0.1 <=W	1 <=W	80 P84	**1.84**
carp	0.8 <T	1.6 <T	1 <T	0.8 <T	0.2 <=W	1.6 <T	3.4	2	0.2 <=W	17	4	2.4	0.1 <=W	4	9.8	0.2 <=W	25	0.2 <=W	0.2 <=W	5.6	1	0.1 <=W	18	1100 P84	**107.54**
carp	0.4 <T	1.2 <T	1 <T	0.6 <T	0.4 <T	1.2 <T	2.6	1.5	0.2 <=W	15	4	2	0.5 <T	3	6.6	1 <T	14	0.2 <=W	0.2 <=W	0.2 <=W	0.6 <T	2.1	3 <T	560 P84	**89.96**
carp	0.6 <T	1.2 <T	0.2 <=W	1 <T	0.2 <=W	1.6 <T	0.4 <T	2	0.2 <=W	28	8	0.4 <T	2.1	1.1	19	1 <T	32	0.2 <=W	0.2 <=W	0.8 <T	0.7 <T	2.3	20	1100 P84	**106.69**
carp	1 <T	0.2 <=W	4	1.6 <T	0.6 <T	0.2 <=W	2.2	1	0.2 <=W	44	11	1.2 <T	3.9	2.9	31	1.8 <T	65	0.2 <=W	0.2 <=W	1.6 <T	1.2	0.3 <T	39	2000 P84	**147.878**
carp	1 <T	1.2 <T	0.4 <T	1 <T	0.6 <T	1.8 <T	3.6	2	0.2 <=W	13	2.4	1 <T	0.2 <T	3	5.6	1 <T	12	0.2 <=W	0.2 <=W	0.6 <T	1	2.8	1 <=W	660 P84	**137.76**
carp	0.8 <T	0.8 <T	4.8	1.4 <T	0.2 <=W	0.6 <T	2	0.4 <T	0.2 <=W	41	14	1.8 <T	6.2	3.1	4	0.2 <=W	46	0.2 <=W	0.2 <=W	1.2 <T	1	0.9 <T	12	1300 P84	**123.97**
carp	1.8 <T	2	12	0.6 <T	0.6 <T	2.4	7.8	3.1	0.2 <=W	94	43	8	15	14	16	0.2 <=W	150	0.8 <T	0.6 <T	2.6	0.1 <=W	0.1 <=W	37	3000 P84	**33.49**
carp	0.2 <=W	1.4 <T	1 <T	0.6 <T	0.2 <=W	1 <T	2.2	1.1	0.2 <=W	17	5	2	1.1	3.2	9.6	0.2 <=W	23	0.2 <=W	0.2 <=W	0.2 <=W	0.1 <=W	0.1 <=W	9 <T	620 P84	**7.51**
carp	0.2 <=W	0.8 <T	0.2 <=W	0.4 <T	0.2 <=W	0.6 <T	1.4 <T	0.9 <T	0.6 <T	8.4	2	1.4 <T	2.5	1.7	2.4	0.2 <=W	1.9	0.2 <=W	0.2 <=W	0.2 <=W	0.1 <=W	0.1 <=W	1 <=W	340 P84	**3.38**
carp	0.2 <=W	0.6 <T	1.4 <T	0.2 <=W	0.2 <=W	0.6 <T	1.2 <T	0.6 <T	0.2 <=W	6	1 <T	1 <T	1.2	1.2	1.2 <T	0.2 <=W	5.9	0.2 <=W	0.2 <=W	1.6 <T	0.1 <=W	0.1 <=W	4 <T	480 P84	**3.43**
largemouth bass	1 <T	0.4 <T	5	0.4 <T	1 <T	1.2 <T	3	0.9 <T	0.8 <T	40	13	2	9.3	1.2	10	1.4 <T	8	0.2 <=W	0.2 <=W	2.2	1.6	0.1 <=W	2 <T	460 P84	**166.484**
largemouth bass	0.6 <T	1.2 <T	1.2 <T	1.6 <T	1 <T	1.4 <T	0.8 <T	1.8	1.4 <T	38	3.8	2.4	1.4	2.9	5.6	1.6 <T	16	0.2 <=W	0.4 <T	0.2 <=W	1.9	0.1 <=W	14	600 P84	**197.826**
largemouth bass	0.8 <T	2	3.4	2.8	0.8 <T	2.2	0.8 <T	2.2	1.2 <T	26	9.8	1 <T	5	0.8 <T	9.4	1.8 <T	11	0.2 <=W	0.2 <=W	1.8 <T	2.2	0.1 <=W	1 <=W	260 P84	**226.438**
largemouth bass	0.8 <T	1 <T	0.6 <T	1.2 <T	0.8 <T	1.2 <T	2.6	0.8 <T	0.2 <=W	32	3.2	1.6 <T	1.2	2.1	3.8	0.8 <T	3.9	0.2 <=W	0.2 <=W	0.2 <=W	1.5	0.1 <=W	1 <=W	340 P84	**154.378**
largemouth bass	1 <T	1 <T	6.4	4.6	0.8 <T	0.4 <T	2.6	1	0.2 <=W	35	18	2.8	8.2	2.1	13	1.8 <T	12	0.2 <=W	0.8 <T	0.2 <=W	1.9	0.1 <=W	3 <T	580 P84	**197.688**
largemouth bass	1 <T	2.2	4.2	0.8 <T	0.8 <T	2.2	4.2	1.1	2	83	9.2	0.8 <T	4.1	1.6	13	1 <T	15	0.2 <=W	0.4 <T	3.4	1.9	0.1 <=W	7 <T	800 P84	**204.6**
largemouth bass	1 <T	0.2 <=W	4.8	1.8 <T	0.8 <T	2.4	6.2	0.6 <T	0.2 <=W	66	13	1.8 <T	6.5	1.3	9.2	1.4 <T	10	0.2 <=W	0.6 <T	0.2 <=W	1.4	0.1 <=W	5 <T	500 P84	**152.484**
largemouth bass	0.8 <T	1 <T	1.6 <T	0.8 <T	0.8 <T	0.8 <T	2.6	0.8 <T	1.2 <T	23	1.4 <T	0.6 <T	1.6	1.4	1.6	0.8 <T	6	0.2 <=W	0.2 <=W	0.2 <=W	1.9	0.1 <=W	4 <T	320 P84	**195.168**
largemouth bass	0.6 <T	0.8 <T	0.4 <T	1.2 <T	0.8 <T	1 <T	3	1.8	0.6 <T	14	2.2	1.4 <T	0.2 <T	2.2	3	0.8 <T	13	0.2 <=W	0.2 <=W	0.2 <=W	1.3	0.1 <=W	3 <T	560 P84	**137.158**
largemouth bass	0.6 <T	0.8 <T	0.2 <=W	1.2 <T	0.8 <T	1 <T	3	1.9	1.4 <T	28	2	1 <T	0.2 <T	2.2	1.4	1 <T	8.7	0.2 <=W	0.2 <=W	0.2 <=W	1.7	0.1 <=W	6 <T	360 P84	**177.8**
pumpkinseed	1 <T	1.2 <T	2.8	1.8 <T	0.8 <T	1.8 <T	2.8	1.5	0.6 <T	29	5.4	0.8 <T	2.4	0.4 <T	7.8	1.8 <T	11	1.4 <T	0.6 <T	1.4 <T	1.6	0.1 <=W	1 <=W	640 P84	**172.028**
pumpkinseed	0.8 <T	1.2 <T	1.4 <T	1.6 <T	0.8 <T	0.4 <T	0.2 <=W	2.1	0.4 <T	31	5.2	2	2.7	2.5	1.2	0.8 <T	15	0.2 <=W	0.2 <=W	0.2 <=W	1.3	0.1 <=W	3 <T	240 P84	**133.238**
pumpkinseed	0.6 <T	0.8 <T	0.2 <=W	0.8 <T	0.8 <T	0.8 <T	3	0.7 <T	1.6 <T	7	1.4 <T	1 <T	0.1 <=W	1.3	0.6	0.6 <T	4.6	0.2 <=W	0.2 <=W	0.2 <=W	1.9	0.1 <=W	1 <=W	420 P84	**193.826**
pumpkinseed	0.6 <T	1 <T	1.8 <T	1.4 <T	0.8 <T	1.2 <T	4.4	1.3	1.2 <T	21	3.8	0.2 <=W	1	2.3	6.2	1.6 <T	18	0.2 <=W	0.4 <T	3	1.5	0.1 <=W	3 <T	700 P84	**159.936**
pumpkinseed	0.4 <T	0.4 <T	0.8 <T	0.4 <T	0.6 <T	1.2 <T	0.8 <T	0.6 <T	0.8 <T	5	1.8 <T	0.8 <T	1.7	0.8 <T	2.4	0.2 <=W	2	0.2 <=W	0.2 <=W	0.2 <=W	1.4	0.1 <=W	2 <T	180 P84	**141.98**
rock bass	0.6 <T	1 <T	1.2 <T	0.6 <T	0.8 <T	0.8 <T	2.2	0.7 <T	0.2 <=W	15	1.2 <T	0.2 <=W	0.9 <T	1.1	1.4	0.2 <=W	6.2	0.2 <=W	0.2 <=W	0.2 <=W	1.4	0.1 <=W	2 <T	260 P84	**144.64**
rock bass	0.6 <T	0.8 <T	0.4 <T	0.8 <T	0.6 <T	0.8 <T	2.8	0.8 <T	0.8 <T	6.2	2	1 <T	0.3 <T	1.1	0.2	0.8 <T	0.4	0.2 <=W	0.4 <T	0.2 <=W	1.4	0.1 <=W	11	180 P84	**143.308**
rock bass	0.6 <T	0.6 <T	0.2 <=W	0.6 <T	0.8 <T	0.8 <T	2.6	0.7 <T	1 <T	7	1.8 <T	1 <T	0.3 <T	1.6	3.4	0.8 <T	11	0.2 <=W	0.2 <=W	0.2 <=W	1.7	0.1 <=W	5 <T	340 P84	**175.088**
rock bass	0.8 <T	0.8 <T	1.4 <T	0.6 <T	0.6 <T	0.8 <T	0.6 <T	0.9 <T	0.2 <=W	24	1.4 <T	1 <T	0.2 <T	1.5	2.4	1 <T	9.3	0.2 <=W	0.2 <=W	0.2 <=W	1.9	0.1 <=W	1 <=W	320 P84	**196.1**
rock bass	0.6 <T	0.6 <T	1.4 <T	0.6 <T	0.6 <T	0.6 <T	2.6	0.7 <T	0.2 <=W	7	1 <T	1 <T	2.1	1.3	1	0.6 <T	2.6	0.2 <=W	0.2 <=W	0.2 <=W	1.8	0.1 <=W	1 <=W	280 P84	**184.266**
rock bass	1 <T	0.8 <T	0.4 <T	1.2 <T	1 <T	0.4 <T	2.6	0.6 <T	1.2 <T	41	3.4	1.6 <T	1.3	2.2	5.6	1 <T	0.7	0.2 <=W	0.2 <=W	0.2 <=W	0.2 <T	0.1 <=W	46	500 P84	**25.69**
white sucker	0.6 <T	0.8 <T	2	0.6 <T	0.8 <T	1 <T	1.2 <T	1	0.2 <=W	4.6	0.6 <T	1 <T	2.3	1.4	3	0.2 <=W	5.3	0.2 <=W	0.2 <=W	0.2 <=W	0.1 <=W	0.1 <=W	1 <=W	220 P84	**4.87**
white sucker	0.6 <T	1.2 <T	0.8 <T	0.8 <T	0.6 <T	1.4 <T	2.2	1.6	0.2 <=W	15	3.6	2.4	0.1 <=W	2.8	6.4	0.2 <=W	18	0.2 <=W	0.4 <T	0.2 <=W	0.4 <T	0.1 <=W	8 <T	580 P84	**49.29**
white sucker	1.2 <T	0.4 <T	7.6	2.6	0.4 <T	0.4 <T	2	1.4	0.2 <=W	62	20	3.4	7.1	5.8	34	0.2 <=W	64	0.2 <=W	0.6 <T	2.2	1.6	2	28	2100 P84	**202.97**
white sucker	1.4 <T	3.2	3.6	2.4	0.8 <T	3.2	6.4	5.6	0.2 <=W	32	9.6	0.8 <T	3.4	1.4	14	0.2 <=W	30	0.2 <=W	1.2 <T	1.6 <T	0.4 <T	0.5 <T	11	1200 P84	**55.86**
white sucker	1.2 <T	1.2 <T	5.8	2.2	0.4 <T	0.2 <=W	1 <T	0.8 <T	0.2 <=W	48	16	2.2	5.6	3.6	24	0.2 <=W	50	0.2 <=W	1 <T	2	1.6	1.5	17	1500 P84	**191.95**
white sucker	1.6 <T	1 <T	8.8	4	1 <T	1 <T	1.2 <T	1.5	0.2 <=W	60	26	4.6	7.9	7.4	37	0.2 <=W	61	0.2 <=W	0.8 <T	3.4	3.5	2.9	6 <T	1400 P84	**400.74**
white sucker	1.4 <T	3.2	3.4	2	0.8 <T	3	0.6 <T	4.4	0.2 <=W	32	10	0.8 <T	2.9	1.9	16	0.2 <=W	33	0.2 <=W	1 <T	1.8 <T	1.3	0.1 <=W	16	1100 P84	**141.78**
																									0.79

<=W no measurable response (zero)
<T trace amounts measured
P84 PCB aroclor mixture of 1248 and 1254

Table 15. Whole sediment toxicity test results. Toxicity is bolded, potential toxicity is italicized.

Site	*C. riparius* Growth	*C. riparius* survival	*H. azteca* growth	*H. azteca* survival	*Hexagenia* growth	*Hexagenia* Survival	*T. tubifex* cocoons	*T. tubifex* hatch	*T. tubifex* survival	*T. tubifex* young
GL Ref. Mean	0.35	87.1	0.50	85.6	3.03	96.2	9.9	0.57	97.8	29.0
BEC01	0.21	77.3	0.65	94.7	1.97	98.0	8.7	0.55	100.0	11.8
BEC02	0.20	80.0	0.38	90.7	1.06	100.0	10.3	0.59	100.0	14.5
BLC01	0.21	73.3	0.37	90.7	1.62	100.0	8.4	0.93	100.0	13.3
BLC02	0.23	96.0	0.51	85.3	0.99	94.0	**5.7**	0.87	100.0	*5.2*
UC01	0.47	91.7	0.52	94.7	6.55	100.0	10.5	0.57	100.0	20.4
TC40	0.56	78.7	0.44	93.3	5.58	100.0	9.9	0.52	95.0	17.5
LC01	0.30	96.0	0.64	90.7	3.22	94.0	9.8	0.65	100.0	14.4
LC03	**0.06**	**38.7**	0.27	**40.0**	**-0.09**	**2.0**	**4.1**	0.87	90.0	*2.3*
LC06	0.47	88.0	0.45	90.0	4.90	100.0	10.8	0.64	100.0	19.2
LC08	0.24	78.3	*0.15*	**34.7**	**-0.02**	**4.0**	**0.2**	1.00	**35.0**	**0.0**
LC10	0.38	84.0	0.25	88.0	*0.60*	*84.0*	8.6	0.50	100.0	12.5
LC12	*0.19*	*64.0*	0.37	75.0	**-0.01**	**46.0**	9.1	0.62	100.0	11.2
LC14	0.31	68.0	0.25	83.3	3.07	94.0	7.7	0.64	95.0	11.5
LC16	*0.20*	93.3	0.32	75.0	3.35	96.0	10.9	0.56	100.0	27.2
LC17	0.23	89.3	0.47	76.0	3.72	98.0	10.0	0.51	100.0	25.1
LC18	0.41	90.7	0.71	94.7	5.09	100.0	9.7	0.66	95.0	18.9
LC19	0.40	93.3	0.74	92.0	5.45	100.0	9.2	0.62	100.0	17.8
LC22	0.36	94.7	0.53	92.0	5.75	100.0	9.0	0.47	95.0	19.1
LC23	0.37	89.3	0.47	88.0	4.64	100.0	8.0	0.59	100.0	17.7
LC29	*0.19*	88.3	0.31	83.0	2.90	100.0	10.2	0.57	100.0	24.5
LC38	0.21	78.7	0.37	68.0	3.16	100.0	11.0	0.54	100.0	21.4
Non-toxic	0.49 – 0.21	67.7	0.75 – 0.23	67.0	5.00 – 0.90	85.5	12.4 – 7.2	0.78 – 0.38	88.9	46.3 – 9.9
Potentially Toxic	*0.20 – 0.14*	*67.6 – 58.8*	*0.22 – 0.10*	*66.9– 57.1*	*0.80 – 0*	*85.4 – 80.3*	*7.1 – 5.9*	*0.38 – 0.28*	*88.8– 84.2*	*9.8 – 0.8*
Toxic	**< 0.14**	**< 58.8**	**< 0.10**	**< 57.1**	**neg**	**< 80.3**	**< 5.9**	**< 0.28**	**< 84.2**	**< 0.8**

Table 16. Summary of BEAST assessment of toxicity.

BAND 1 *Non-toxic*		**BAND 2** *Potentially toxic*	**BAND 3** *Toxic*	**BAND 4** *Severely toxic*
BEC01	LC16	**BLC02**		LC03
BEC02	LC17	LC14		LC08
BLC01	LC18			LC12
TC40	LC19			
UC01	LC22			
LC01	LC23			
LC06	LC29			
LC10	LC38			

Table 17. Decision matrix for Lyons Creek sites. Biomagnification potential provided for both minimum and intermediate exposure and uptake scenarios.

Site	**Response for individual decision elements**					**Assessment** Minimum (Min) and Intermediate (Inter) Scenarios
	Sediment PCB Chemistry	**Toxicity**	**Benthos Alteration**	**Biomagnification Potential (min.)**	**Biomagnification Potential (inter.)**	
LC01	○	○	○	○	⭘	Min - No further actions required. Inter - Fully assess risk of biomagnification.
LC03	●	●	○	○	⭘	Min - Determine reason(s) for sediment toxicity. Inter - Above **and** fully assess risk of biomagnification.
LC06	●	○	○	NA	NA	Both – No further actions required but potential for biomagnification not assessed.
LC08	●	●	○	○	⭘	Min - Determine reason(s) for sediment toxicity. Inter - Above **and** fully assess risk of biomagnification.
LC10	●	○	○	NA	NA	Both - No further actions required but potential for biomagnification not assessed.
LC12	●	●	●	●	●	Both - Management actions required.
LC14	●	○	○	○	⭘	Min - No further actions required. Inter - Fully assess risk of biomagnification.
LC16	●	○	○	●	●	Both - Fully assess risk of biomagnification.
LC17	●	○	○	○	⭘	Min - No further actions required. Inter - Fully assess risk of biomagnification.
LC18	●	○	○	○	⭘	Min - No further actions required. Inter - Fully assess risk of biomagnification.
LC19	●	○	○	○	⭘	Min - No further actions required. Inter - Fully assess risk of biomagnification.
LC22	●	○	○	NA	NA	Both - No further actions required but potential for biomagnification not assessed.
LC23	●	○	○	NA	NA	Both - No further actions required but potential for biomagnification not assessed.
LC29	⭘	○	○	○	⭘	Min - No further actions required. Inter - Fully assess risk of biomagnification.
LC38	○	○	○	○	⭘	Min - No further actions required. Inter - Fully assess risk of biomagnification.

NA = not applicable (tissue not collected)

Table 18: Sediment chemistry for core samples collected from different depths in Lyons Creek

	site	LC01	LC01	LC01	LC03	LC03	LC03	LC16	LC16	LC16	LC17	LC17	LC17	LC29	LC29	LC29	LC38	LC38	LC38
	core section (cm)	<10cm	10-25cm	>25cm	<10cm	10-25cm	>25cm	<10cm	10-25cm	>25cm	<10cm	10-25cm	>25cm	<10cm	10-25cm	>25cm	<10cm	10-25cm	>25cm
% <1000 um, >63 um	%	50.62	53.6	63.8	75.84	70.36	67.12	71.93	67.49	63.48	57.11	51.2	63.03	64.5	58.66	67.24	68.88	67.29	67.5
% <2000 um, >1000 um	%	0.04	0.24	0.08	0.24	0.51	0.221	1.35	0.36	0.24	0.32	0.2	0.2	0.44	0.12	0.63	0.32	0.2	0.24
% <63 um	%	49.34	46.16	36.12	23.92	29.13	32.66	26.72	32.15	36.28	42.57	48.6	36.78	35.06	41.22	32.13	30.8	32.51	32.26
2,2',3,5'-tetrachlorobiphenyl	ng/g	18	50	120	8500	4000	420	110	380	4200	88	48	120	29	23	31	7.6	0.99	0.57
2,2',4,5'-tetrachlorobiphenyl	ng/g	20	48	84	6800	3200	330	160	290	3300	100	72	120	27	26	44	10	<W	<W
2,2',5,5'-tetrachlorobiphenyl	ng/g	35	100	130	9400	4500	490	230	420	4700	130	100	170	39	38	63	15	<W	<W
2,2',5-trichlorobiphenyl	ng/g	14	43	84	9500	4200	310	92	350	4100	52	42	110	35	20	40	23	5.5	4
2,2',6,6'-tetrachlorobiphenyl	ng/g	2.8	2.9	7.8	1700	660	3.7	15	39	780	8.2	5.7	15	1.1	<W	3.5	<W	<W	<W
2,2',6-trichlorobiphenyl	ng/g	<W	<W	3.6	780	330	<W	<W	11	180	<W	<W	<W	<W	<W	<W	<W	<W	<W
2,2'3,4,5'-pentachlorobiphenyl	ng/g	<W	46	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
2,2'3,44'5'-hexachlorobiphenyl	ng/g	16	57	26	980	330	5.8	40	0.2	350	23	16	26	13	12	13	2.6	<W	<W
2,2'3,4'5'6-hexachlorobiphenyl	ng/g	11	47	20	720	270	25	40	48	270	22	15	27	14	13	16	2.7	<W	<W
2,2'3,5,5'6-hexachlorobiphenyl	ng/g	4.4	7.8	5.1	300	110	0.1	7.4	9.3	100	4.4	3.4	5.5	3.5	3.5	4.3	1.1	0.38	<W
2,2'3,5',6-pentachlorobiphenyl	ng/g	44	120	160	13000	5500	560	340	620	5900	200	140	250	55	53	70	17	0.13	<W
2,2'4,4',5-pentachlorobiphenyl	ng/g	13	50	36	1600	750	53	89	81	800	48	40	39	15	14	17	4.7	<W	<W
2,2'4,5,5'-pentachlorobiphenyl	ng/g	33	89	53	3200	1400	140	100	140	1700	61	45	69	19	18	24	5.7	<W	<W
2,2'4,6,6'-pentachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
2,3,3'4,4'5-hexachlorobiphenyl	ng/g	4.4	6.5	1.7	170	30	0.2	1.6	5.1	48	0.86	0.66	0.96	0.87	0.7	0.84	<W	<W	<W
2,3,3'4,4'6-hexachlorobiphenyl	ng/g	2.4	9.2	3.4	130	47	5.8	6.2	7.3	51	3.6	3.1	4.2	2.2	2	2.6	<W	<W	<W
2,3,3'4,4'-pentachlorobiphenyl	ng/g	11	26	22	1900	760	74	21	65	830	18	9.7	24	5.9	4.7	4.2	3.1	<W	<W
2,3,3'4',6-pentachlorobiphenyl	ng/g	32	71	65	5100	2500	160	57	170	2700	45	25	59	17	13	11	3.3	<W	<W
2,3,3'44'5'-hexachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
2,3,4,4',5-pentachlorobiphenyl	ng/g	2.1	2.8	1.6	140	70	<W	3.5	5.7	84	2.1	1.2	2.4	<W	<W	<W	<W	<W	<W
2,3',4',5-tetrachlorobiphenyl	ng/g	27	76	120	1000	4400	470	230	430	5000	130	96	170	30	29	45	13	<W	<W
2',3,4-trichlorobiphenyl	ng/g	15	21	52	8000	3100	250	49	200	3300	34	24	59	14	9.6	16	9.6	1.1	<W
2,3,4'-trichlorobiphenyl	ng/g	3.3	3.5	20	3100	1300	57	5.1	70	1200	8.5	3.5	20	4.4	2	1.6	<W	<W	<W
2,3'4,4',5-pentachlorobiphenyl	ng/g	22	78	39	2500	1000	110	89	120	1100	50	36	58	13	12	15	5.4	<W	<W
2,3'4,4',6-pentachlorobiphenyl	ng/g	<W	<W	<W	69	<W	<W	3.3	4.9	19	1.4	<W	1.9	<W	<W	<W	<W	<W	<W
2,4,4',5-tetrachlorobiphenyl	ng/g	11	28	55	4600	2100	210	110	200	2200	66	52	86	16	15	24	5.9	<W	<W
2,4,4'-trichlorobiphenyl	ng/g	19	38	87	9300	3800	330	160	360	4000	91	68	140	32	26	53	19	4.8	5.6
22',33',44'-hexachlorobiphenyl	ng/g	4	8	3.7	260	73	30	0.2	0.2	96	2	0.67	0.2	0.76	0.3	<W	<W	<W	<W
22',44',55'-hexachlorobiphenyl	ng/g	12	33	13	700	240	<W	27	32	250	14	9.6	16	9.7	9.4	12	0.046	<W	<W
22',44',66'-hexachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	160	<W	<W	<W	<W	<W	<W	<W	<W	<W
22'33'44'55'6-nona(Cl)biphenyl	ng/g	<W	<W	<W	28	<W	<W	0.54	0.35	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
22'33'44'55'-octa(Cl)biphenyl	ng/g	2.2	2.2	2.7	120	22	1.8	3.8	3.8	22	1.5	0.78	1.5	1.2	1	1.5	<W	<W	<W
22'33'44'5-heptachlorobiphenyl	ng/g	3.7	5.5	5.8	210	66	1.3	8.9	10	51	4.6	2.9	4.8	4.5	4.1	4.8	<W	<W	<W
22'33'44'6-heptachlorobiphenyl	ng/g	0.29	0.29	<W	63	1.5	<W	1.2	1.6	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
22'33'455'66'-nona(Cl)biphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
22'33'455'6'-octa(Cl)biphenyl	ng/g	0.9	0.9	2.7	110	<W	<W	3	3.2	11	0.57	<W	0.57	0.29	<W	0.66	<W	<W	<W
22'33'45'66'-octa(Cl)biphenyl	ng/g	2	4	6.3	<W	26	<W	4.3	10	<W	<W	2.8	<W	1.7	1.8	3.2	<W	<W	<W
22'33'4'56-heptachlorobiphenyl	ng/g	0.78	0.78	1.2	88	15	<W	2.8	4.1	<W	0.76	<W	1.1	1.2	0.69	0.81	<W	<W	<W
22'33'55'66'-octa(Cl)biphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
22'33'55'6-heptachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
22'344'55'-heptachlorobiphenyl	ng/g	4.2	<W	10	410	130	12	17	19	110	8.7	6.3	9.6	8.8	8.3	10	1.2	<W	<W
22'344'5'6-heptachlorobiphenyl	ng/g	1.2	3.5	3.1	98	<W	<W	6	6.1	28	2.9	1.6	3.5	2	1.7	2.4	<W	<W	<W
22'34'55'6-heptachlorobiphenyl	ng/g	1.5	3	4.4	200	91	<W	8.4	9.2	39	3.7	2.4	4.6	4.1	3.8	5	<W	<W	<W
22'34'566'-heptachlorobiphenyl	ng/g	0.62	4.1	2.1	100	26	<W	7.1	8.2	15	3.1	1.4	4	<W	<W	<W	<W	<W	<W
2'3,4,4',5-pentachlorobiphenyl	ng/g	4.1	4.1	2	470	180	<W	9.4	15	190	3.9	1.4	5	<W	<W	<W	<W	<W	<W
23',44',55'-hexachlorobiphenyl	ng/g	<W	2	<W	<W	<W	<W	0.52	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
23',44',5'6-hexachlorobiphenyl	ng/g	11	33	13	910	340	<W	27	32	310	14	9.6	16	9.7	9.6	9.4	0.046	<W	<W
233'44'55'6-octachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
233'44'55'-heptachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
233'44'5'6-heptachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
3,3',4,4'-tetrachlorobiphenyl	ng/g	1.1	1.1	2.9	30	<W	<W	<W	12	<W	<W	<W	0.31	<W	<W	<W	<W	<W	<W
3,3'4,4',5-pentachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
3,3'4,4'55'-hexachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
3,4,4',5-tetrachlorobiphenyl	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
3,4,4'-trichlorobiphenyl	ng/g	12	12	48	12000	4900	180	17	140	3700	24	10	40	5.2	2.9	2.9	1.6	<W	<W
a-BHC (hexachlorocyclohexane)	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Acenaphthene	ng/g	<W	40	60	520	940	200	<W	<W	220	<W	<W	<W	<W	<W	<W	<W	<W	<W
Acenaphthylene	ng/g	<W	<W	<W	200	200	200	<W	<W	200	<W	<W	<W	<W	<W	<W	<W	<W	<W
a-Chlordane	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Aldrin	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Aluminum	ug/g	12000	11000	11000	20000	29000	31000	22000	26000	23000	17000	19000	20000	22000	23000	21000	25000	29000	30000
Anthracene	ng/g	<W	140	80	440	240	200	<W	40	520	<W	<W	<W	<W	<W	<W	<W	<W	<W
Barium	ug/g	81	76	87	78	42	160	140	160	140	110	120	120	120	120	110	120	130	130
b-BHC (hexachlorocyclohexane)	ng/g	<W	<W	<W	<W	220	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Benzo(a)anthracene	ng/g	200	980	320	3000	5700	1400	140	300	2800	100	60	80	<W	40	40	40	<W	<W
Benzo(a)pyrene	ng/g	240	1100	320	1700	1900	480	120	240	1800	80	<W	80	<W	<W	<W	<W	<W	<W
Benzo(b)fluoranthene	ng/g	320	1500	440	2200	2900	620	220	360	1600	160	120	120	60	80	100	120	40	<W
Benzo(g,h,i)perylene	ng/g	160	720	280	1700	1500	480	160	280	1700	120	80	80	<W	<W	<W	80	<W	<W
Benzo(k)fluoranthene	ng/g	100	520	120	580	1100	200	60	100	400	40	40	40	<W	<W	<W	40	<W	<W
Beryllium	ug/g	0.6	0.6	0.6	0.9	1.1	1	0.9	1.1	0.9	0.8	0.9	0.9	0.9	1	0.9	1.1	1.1	1.1
Cadmium	ug/g	0.5	0.6	0.9	2.6	3.3	1.1	1.1	1.9	2.4	1	0.8	0.8	1	1.2	1.2	1.3	1	1
Calcium	ug/g	92000	72000	65000	28000	8400	4300	18000	17000	13000	37000	41000	29000	9100	15000	18000	14000	6500	5300
Chromium	ug/g	21	21	22	84	91	38	41	48	60	29	28	33	33	34	41	35	38	37
Chrysene	ng/g	200	900	420	6500	9100	2300	240	580	5400	160	100	160	60	60	80	60	20	20
Cobalt	ug/g	8.6	9.1	8.7	14	17	15	13	15	16	11	12	14	13	13	15	16	17	19
Copper	ug/g	40	60	41	150	130	19	51	55	75	35	32	30	33	29	28	30	25	20
DDT & Metabolites	ng/g	12	44	38	760	320	72	66	110	420	44	30	48	12	10	12	8	<W	<W
Dibenzo(a,h)anthracene	ng/g	<W	160	80	400	400	400	<W	80	400	<W	<W	<W	<W	<W	<W	<W	<W	<W
Dieldrin	ng/g	4	<W	<W	<W	<W	<W	26	6	<W	18	10	10	<W	4	4	4	<W	<W
Endosulphan I	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Endosulphan II	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Endosulphan sulphate	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Endrin	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Fluoranthene	ng/g	400	1900	780	8700	21000	4300	260	520	4700	120	100	140	40	60	100	120	40	<W
Fluorene	ng/g	<W	40	60	1100	3300	460	<W	40	700	<W	<W	<W	<W	<W	<W	<W	<W	<W
g-BHC (hexachlorocyclohexane)	ng/g	21	38	54	630	280	100	52	120	430	40	32	62	31	22	35	23	13	3
g-Chlordane	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Heptachlor	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Heptachlor epoxide	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Indeno(1,2,3-c,d)pyrene	ng/g	160	880	240	600	560	400	120	120	400	80	<W	<W	<W	<W	80	80	<W	<W
Iron	ug/g	19000	19000	20000	59000	87000	30000	33000	41000	91000	29000	29000	31000	32000	31000	36000	32000	35000	35000
Lead	ug/g	11	16	22	200	100	11	35	54	69				30	27	44	22	12	9
Magnesium	ug/g	16000	17000	17000	12000	8200	7400	11000	12000	8700	15000	15000	14000	9700	13000	14000	10000	8800	8400
Manganese	ug/g	510	500	520	480	420	230	330	380	560	520	620	540	410	410	470	410	370	360
Methoxychlor	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Mirex	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Molybdenum	ug/g	<W	<W	0.6	6.6	4.6	<W	0.7	1	4	<W	<W	<W	<W	0.8	1	<W	<W	<W
Naphthalene	ng/g	<W	<W	<W	200	200	200	<W	<W	200	<W	<W	<W	<W	<W	<W	<W	<W	<W
Nickel	ug/g	29	33	37	92	140	43	53	67	120	38	38	44	50	48	62	56	46	37
Nitrogen; total Kjeldahl	mg/g	1.5	1.3	1.4	2.9	4.4	3.7	6.4	4.8	4.4	3	1.4	2.1	3.4	3.7	2.4	3.8	3.1	3.2
op-DDT	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Oxychlordane	ng/g	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
PCB congeners; total	ng/g	420	1100	1300	120000	50000	4200	2100	4300	52000	1300	890	1700	440	380	550	150	14	11
Phenanthrene	ng/g	140	520	400	860	1800	200	80	120	3100	80	100	40	20	20	20	40	20	20
Phosphorus; total	mg/g	0.78	0.82	0.88	3	4.9	1	1.2	1.6	7.2	1.3	1.1	1.4	1.4	1	1.5	0.98	0.85	0.78
pp-DDD	ng/g	<W	<W	<W	95	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	10	<W	<W
pp-DDE	ng/g	11	45	38	590	320	73	66	110	420	44	30	49	12	10	12	5	<W	3
pp-DDT	ng/g	<W	<W	<W	75	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W	<W
Pyrene	ng/g	320	1600	700	7900	21000	4700	220	560	6200	120	80	140	40	60	80	80	40	20
Strontium	ug/g	150	120	110	95	66	57	66	67	69	90	100	75	44	58	76	62	56	61
Titanium	ug/g	220	220	170	150	140	70	140	200	170	200	210	150	100	210	150	180	160	160
Vanadium	ug/g	26	26	26	49	58	51	43	53	54	36	39	41	41	45	43	47	54	54
Zinc	ug/g	110	140	220	4000	5400	240	590	800	2800	410	300	400	520	450	650	190	140	110

<W mo measurable amount (zero)

FIGURES

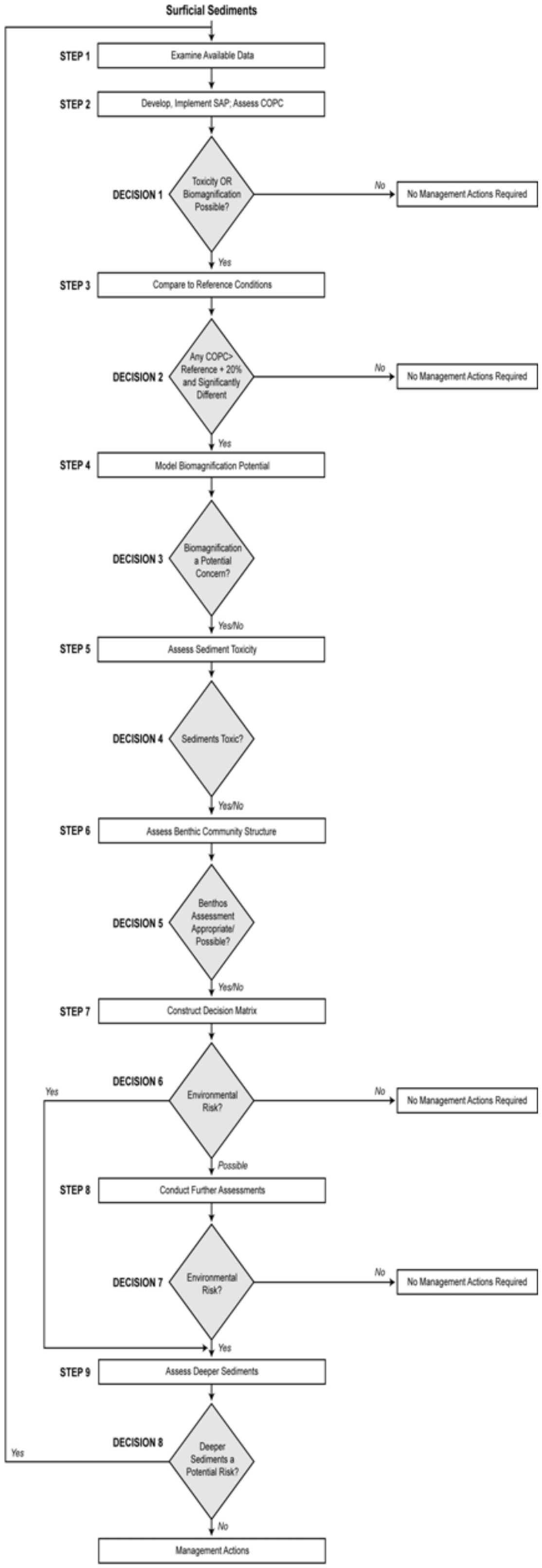


Figure 1: Overview of the Decision-Making Framework for contaminated sediments (from: Chapman, 2005)

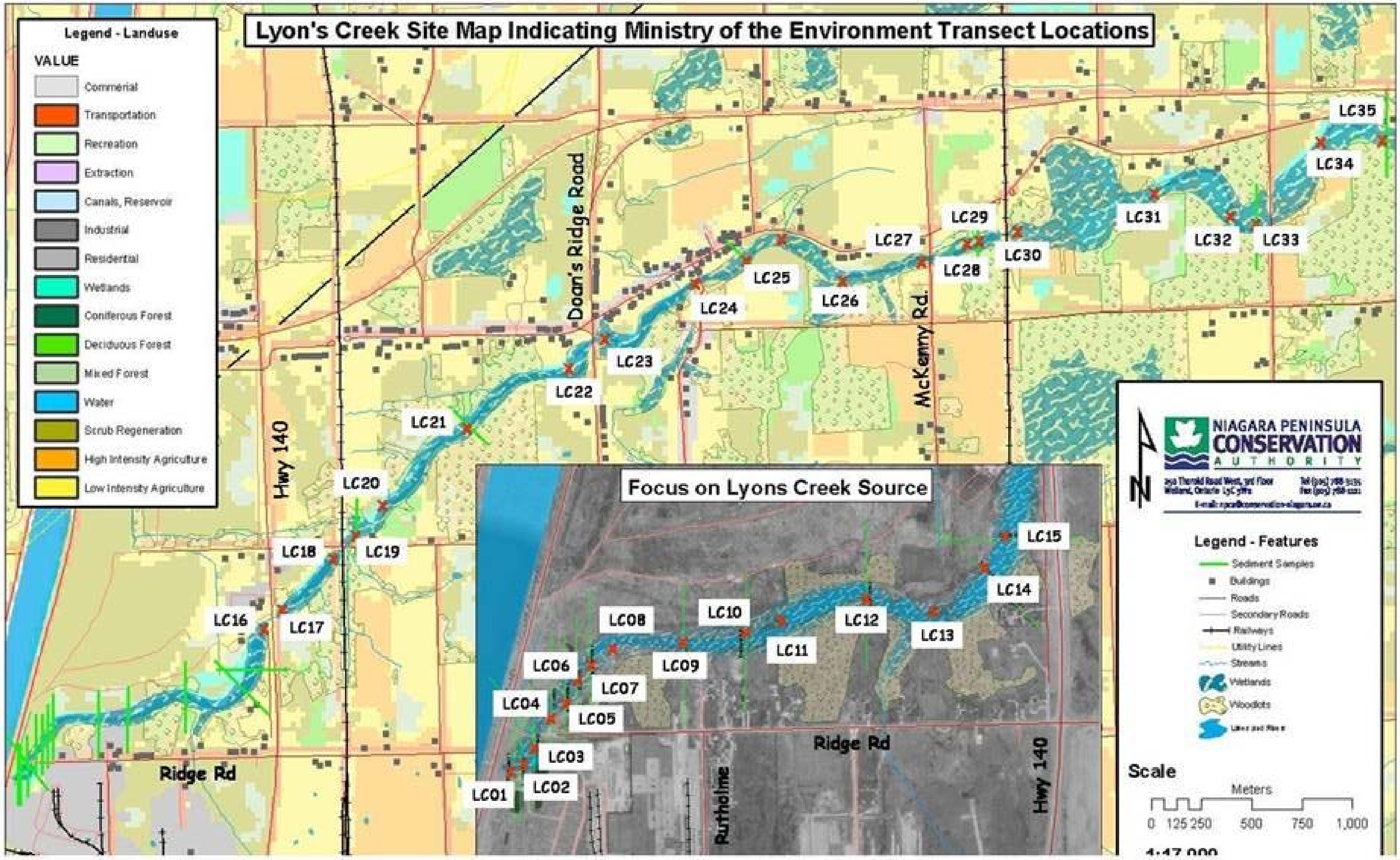


Figure 2a: Sediment sample locations for initial screening survey. Samples were also collected upstream (36) and downstream (39) of Montrose, and upstream (40) and downstream(38) of QEW

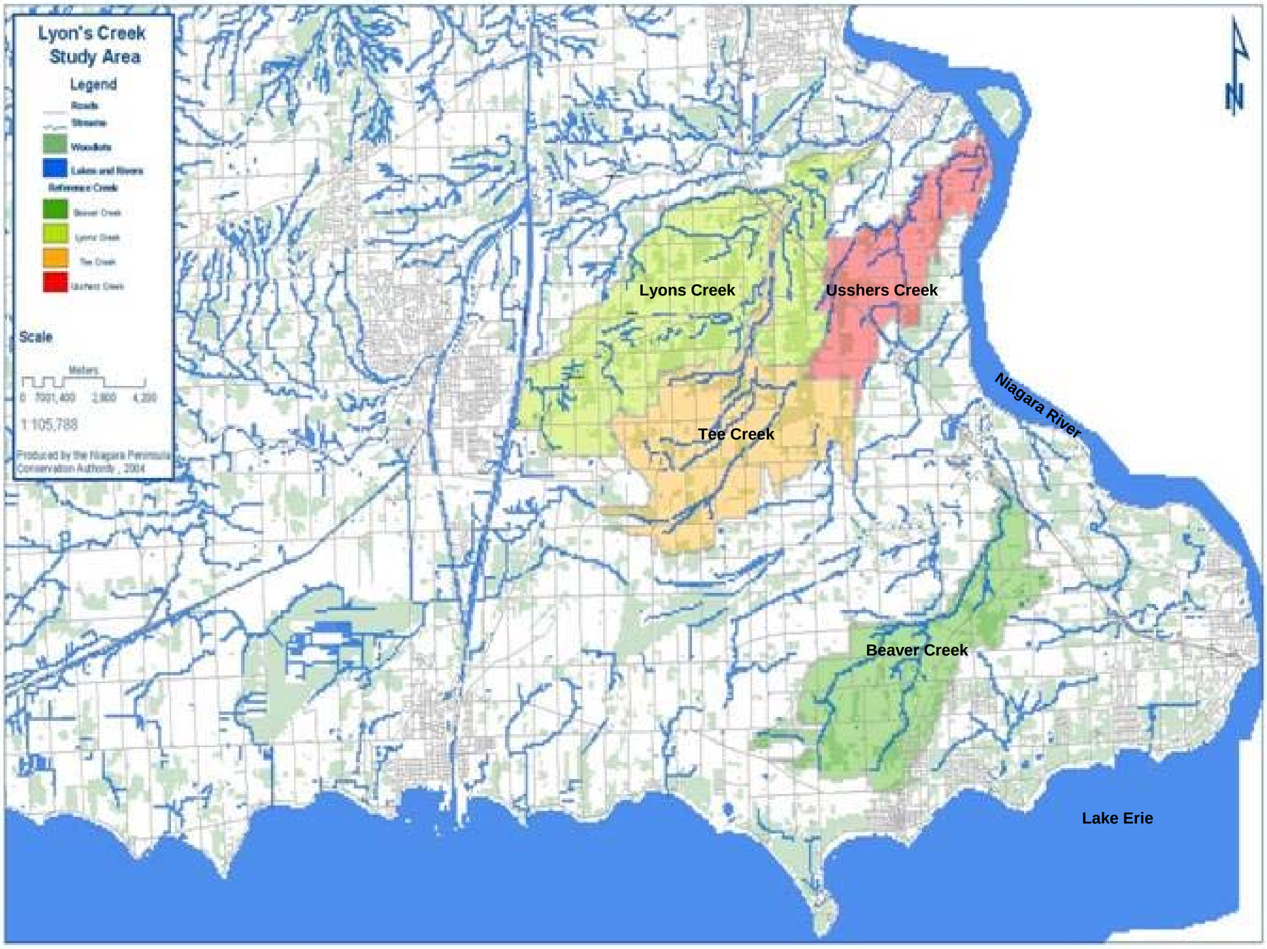


Figure 2b:. Location of reference creeks in relation to Lyons Creek.

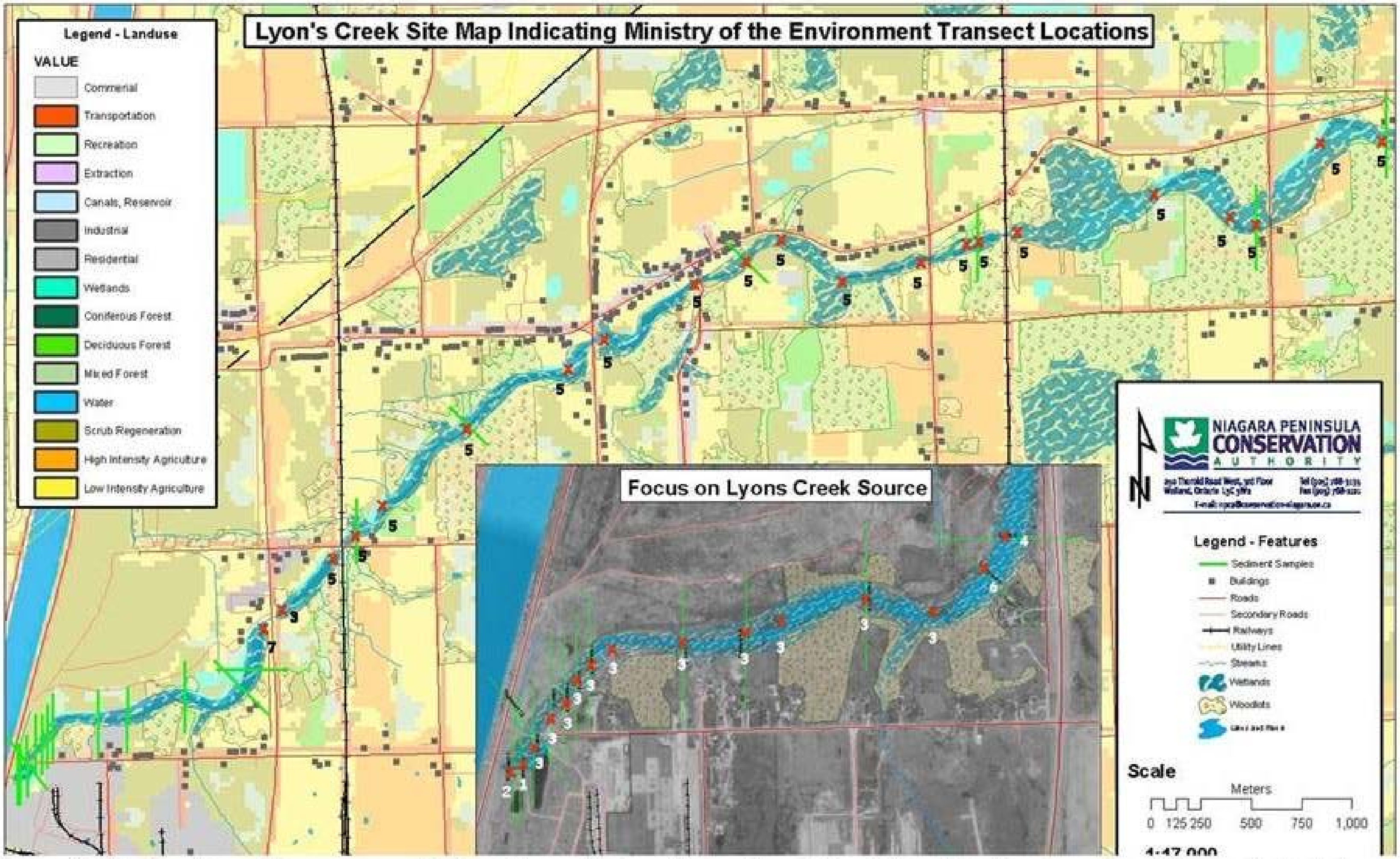


Figure 3: Sediment groupings as a result of cluster analysis on the sediment chemistry data. Group memberships are indicated. Stations located upstream (36) and downstream (39) of Montrose, and upstream of the QEW (40) were part of Group 5, and downstream of QEW (38) was part of Group 3.

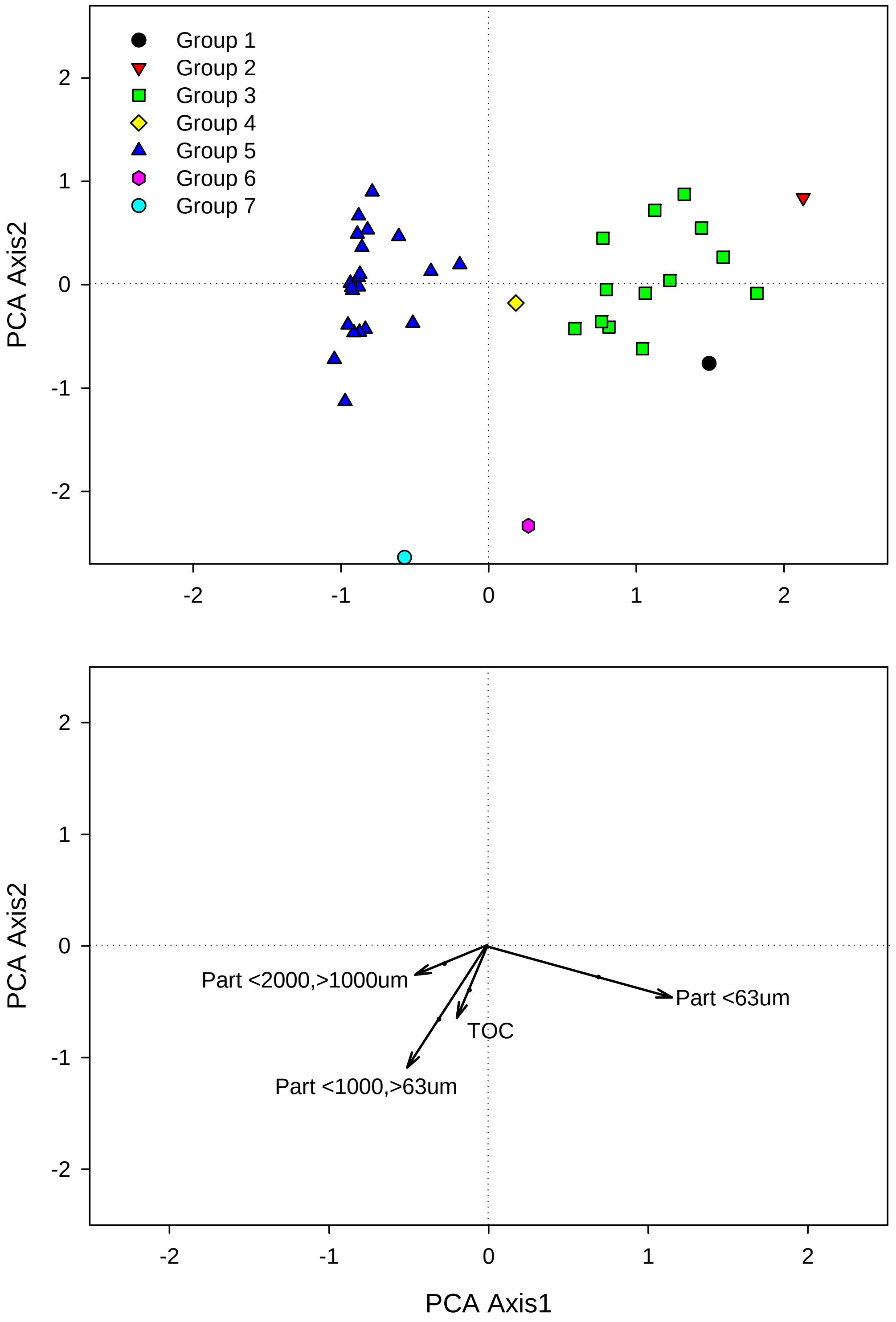


Figure 4: PCA ordination plot of Lyons Creek sediment samples. (A) Depicts the groupings identified through cluster analysis, (B) shows the vectors for Total Organic Carbon (TOC) and the three particle size classes.

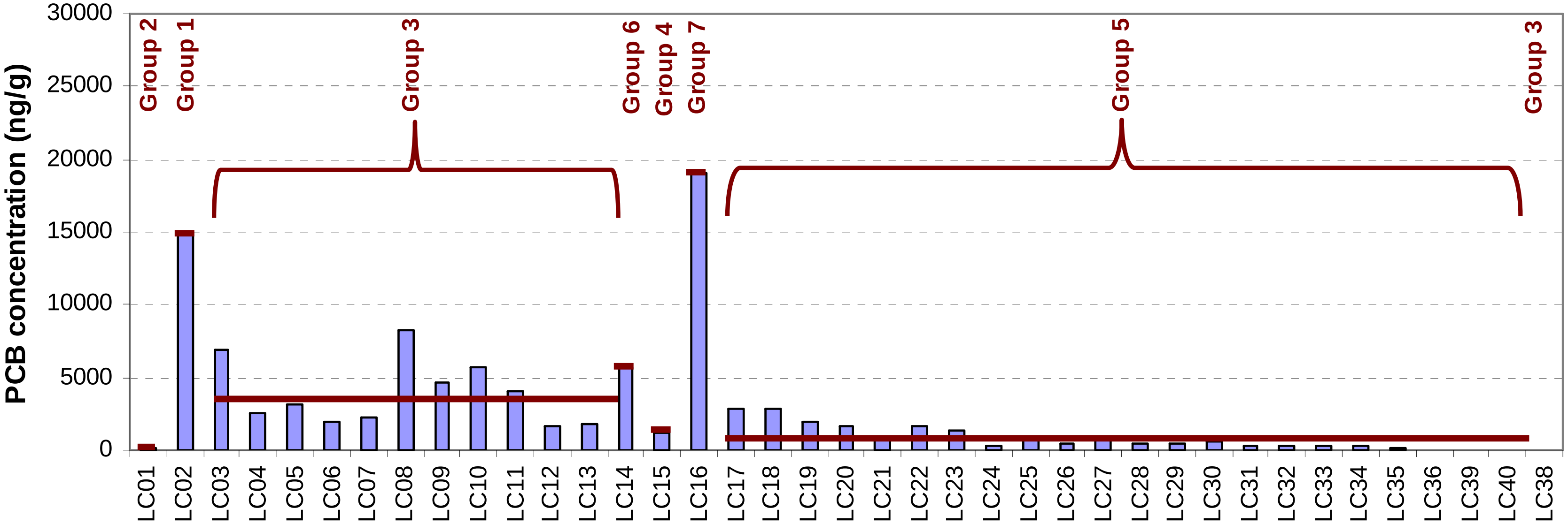


Figure 5: PCB concentrations and sediment grouping relationships for surficial sediments collected from the initial screening survey of Lyons Creek East. Horizontal lines represent mean PCB values for each grouping.

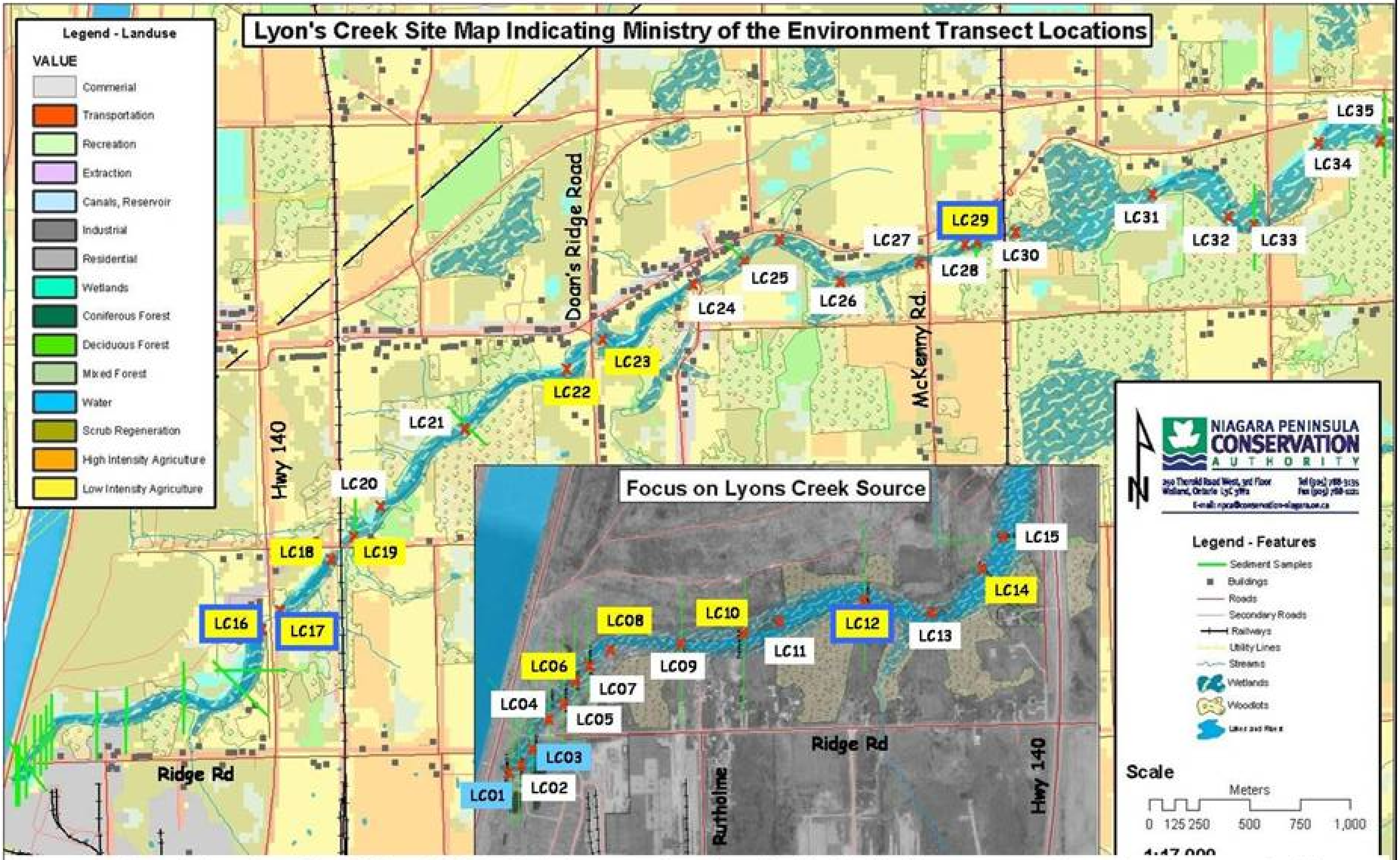


Figure 6: Sample locations for 2002 and 2003 detailed survey. Locations highlighted in blue represent those locations sampled in 2002, and those highlighted in yellow represent the samples collected in 2003 (yellow with blue boarder represent those sampled both years). Samples were also collected downstream of QEW (38).

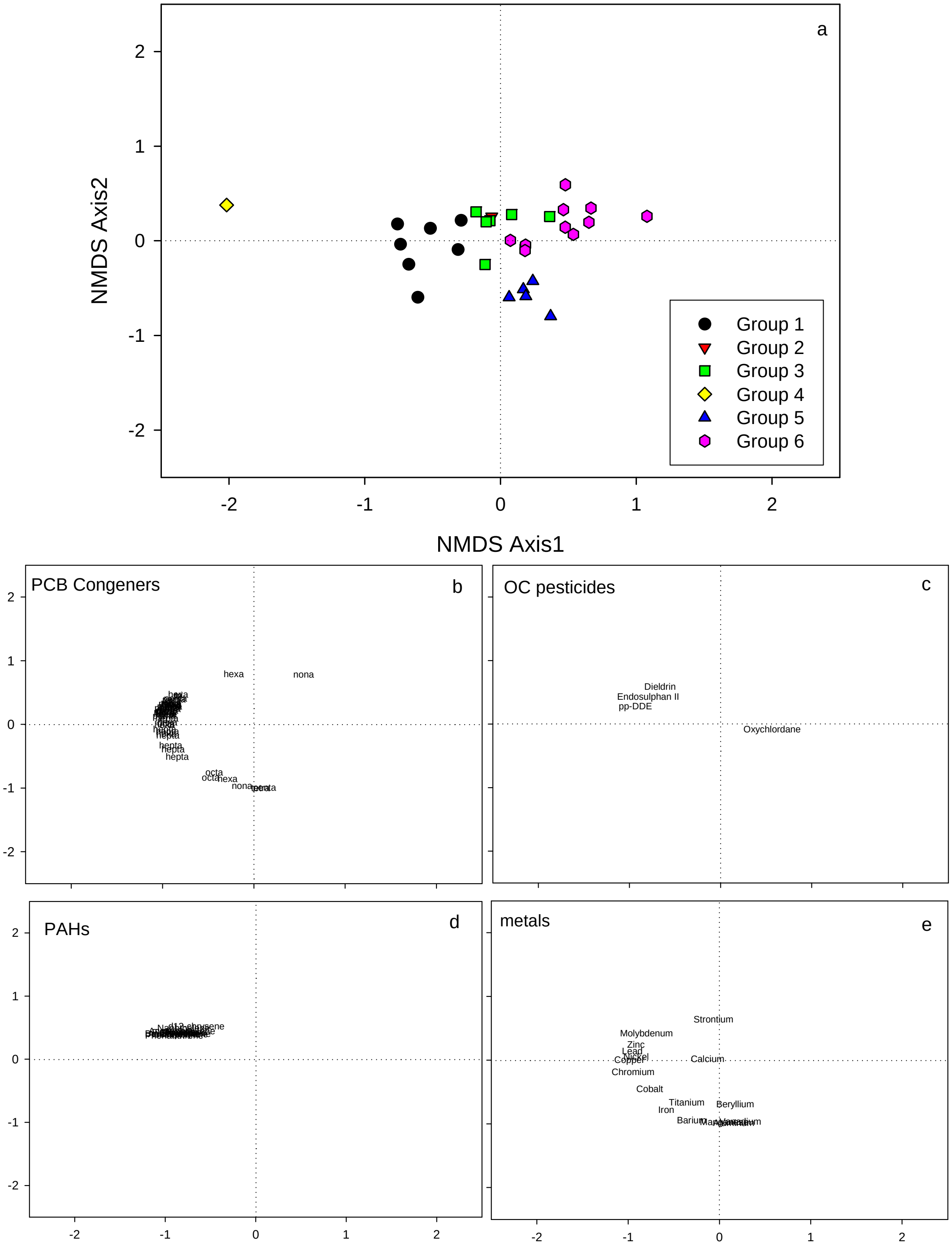


Figure 7: Lyons Creek sediment chemistry, 2002-2003. NMDS Axis1 vs. Axis2. (a) Ordination plot of site groupings. Sediment chemistry vectors are also provided for: PCB congeners (b), OC pesticides (c), PAHs (d) and metals (e).

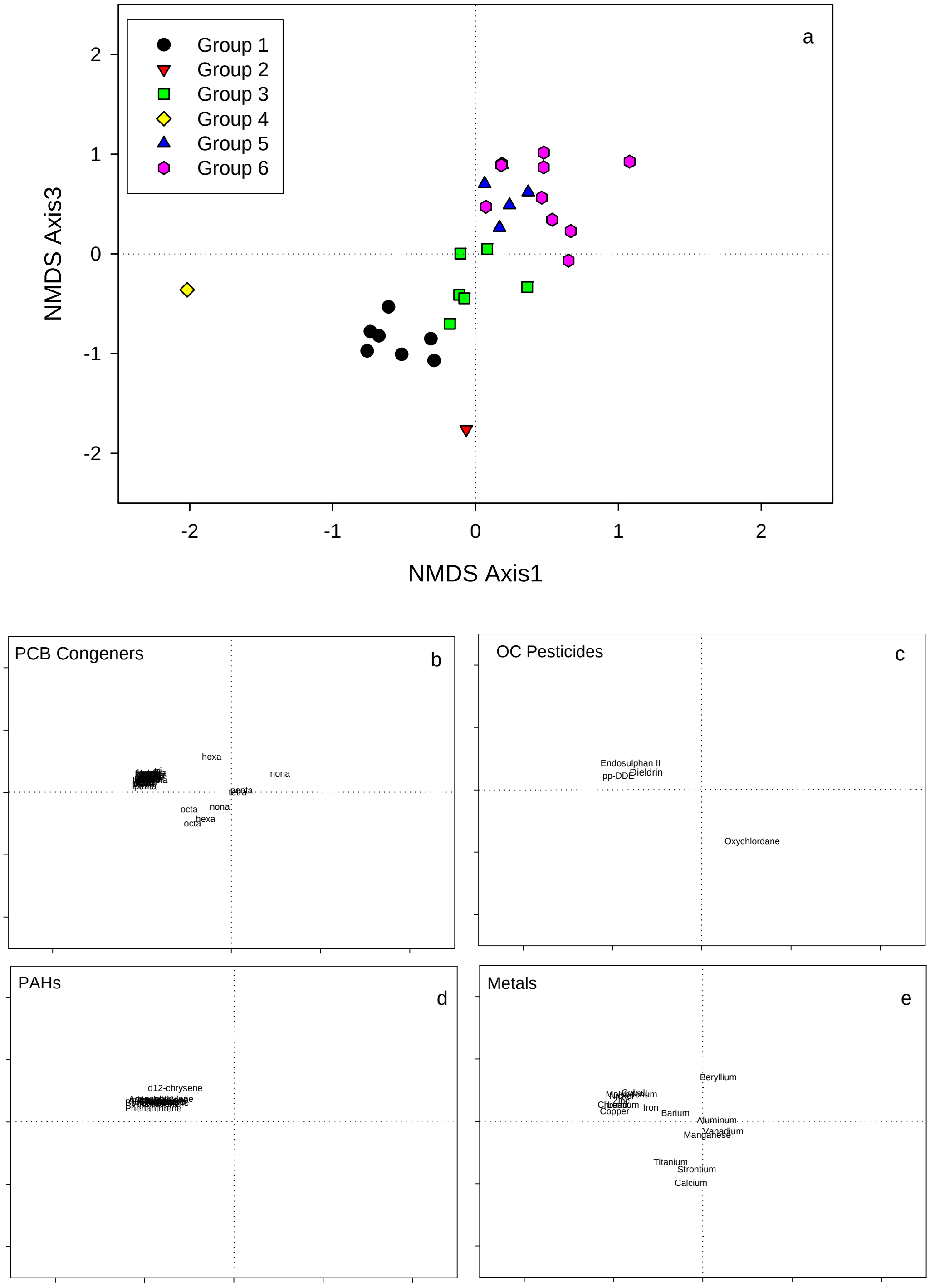


Figure 8: Lyons Creek sediment chemistry, 2002-2003. NMDS Axis1 vs. Axis3. (a) Ordination plot of site groupings. Sediment chemistry vectors are also provided for: PCB congeners (b), OC pesticides (c), PAHs (d) and metals (e).

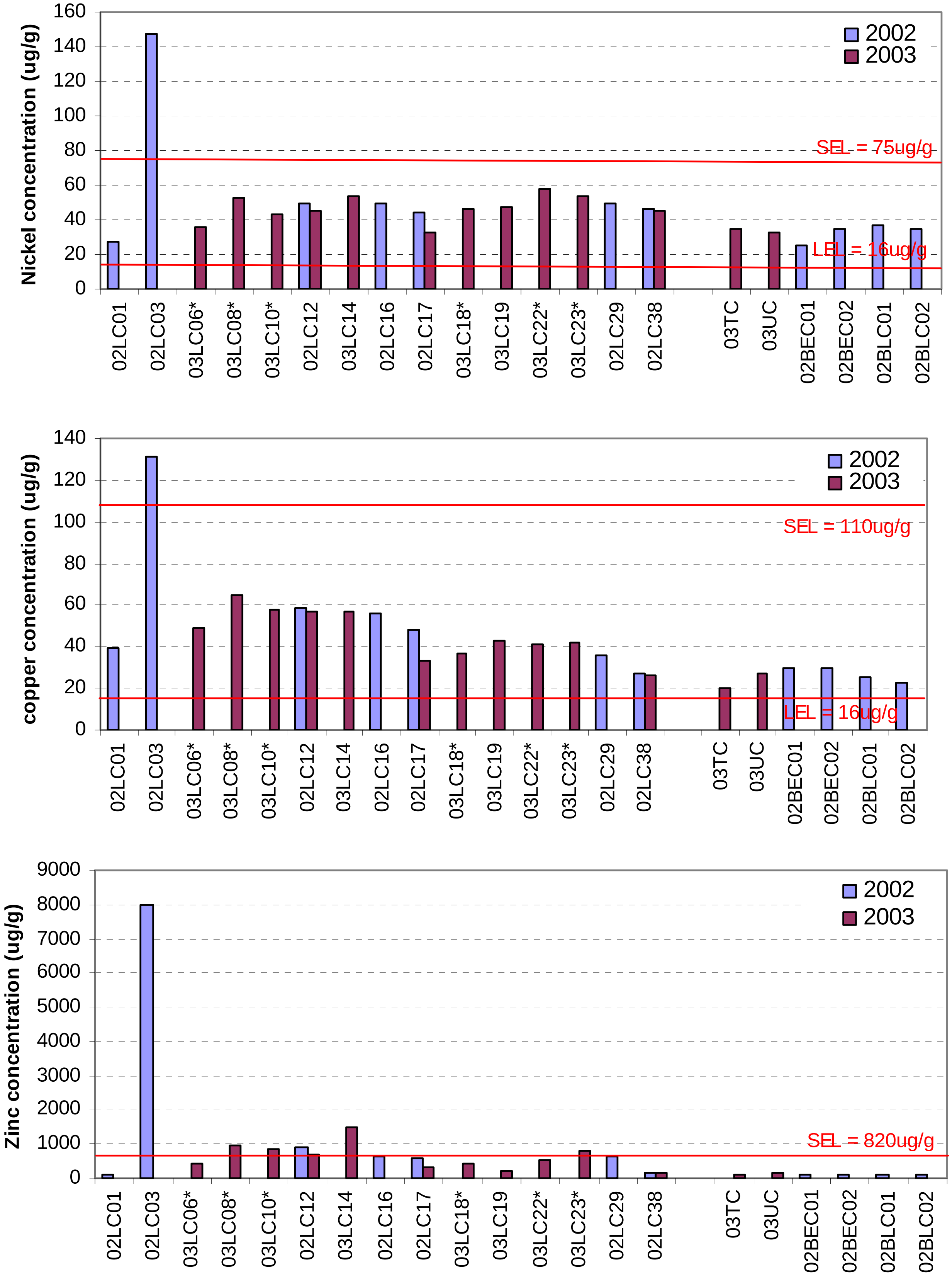


Figure 9: Sediment chemistry concentrations for selected metals from Lyons Creek (2002 & 2003) and the reference creeks (Usshers, Tee, Beaver and Black). PSQG lowest effect levels (LEL) and severe effect levels (SEL) are also plovided.

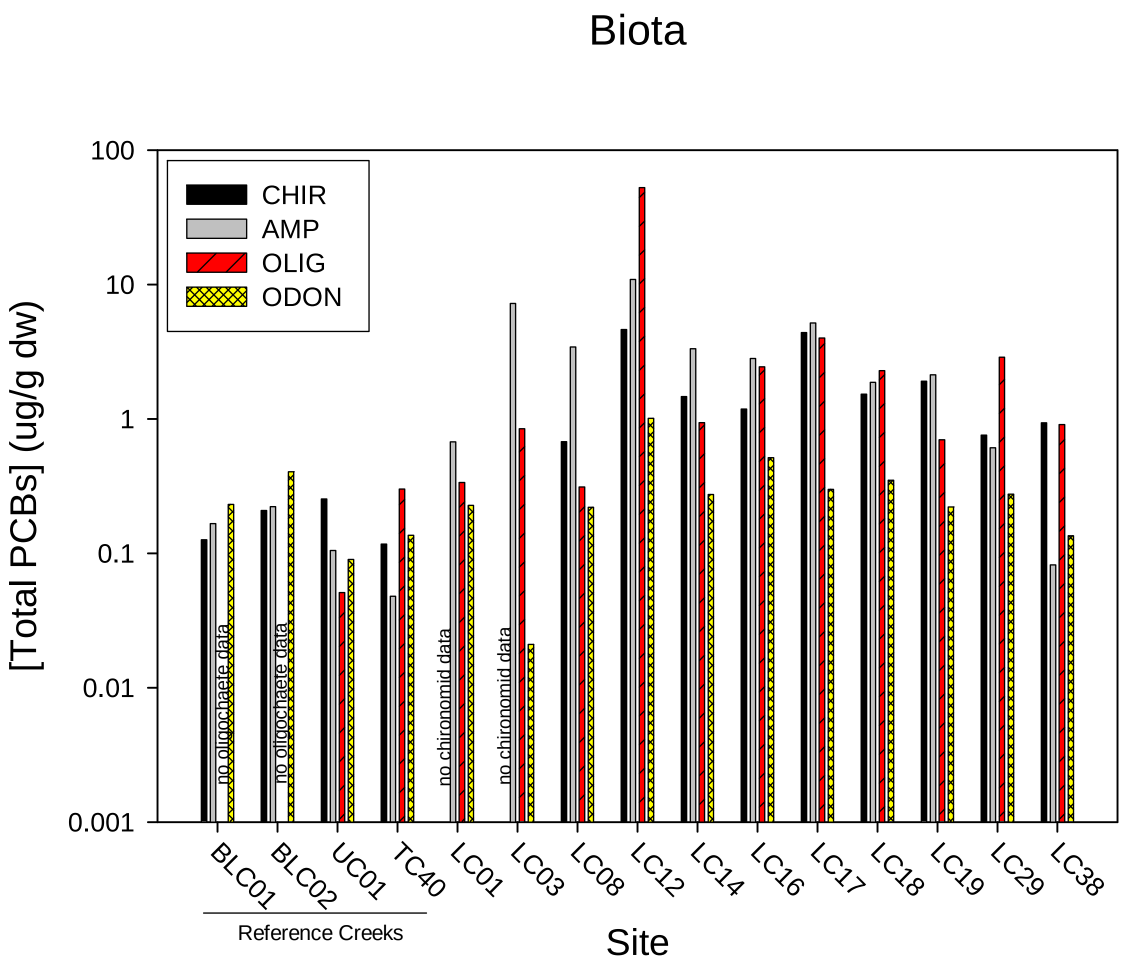


Figure 10 Total PCBs in benthic invertebrates (µg/g dry weight) collected from Lyons Creek (LC) and reference creeks.

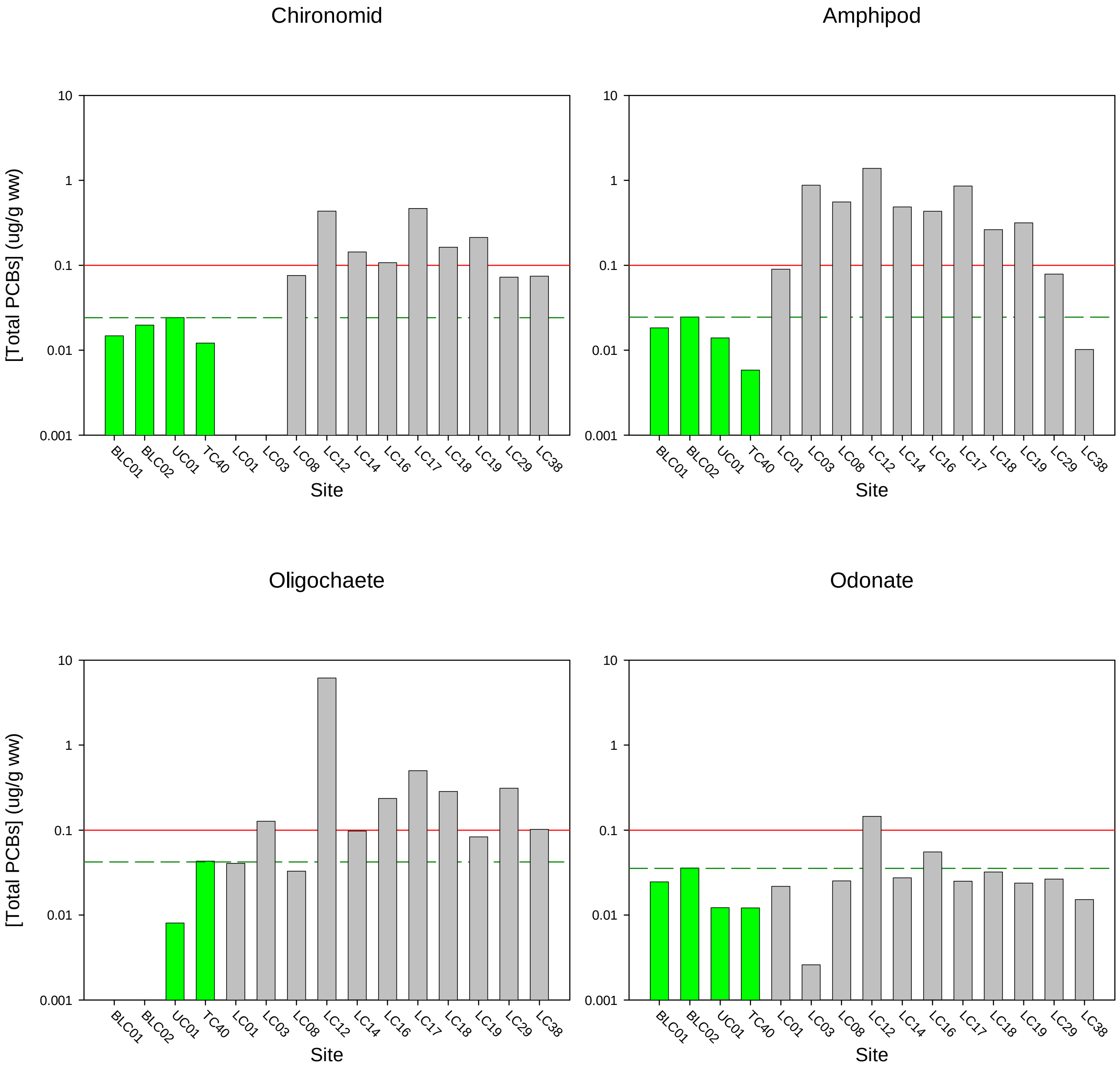


Figure 11 Total PCBs in biota (µg/g wet weight) collected from Lyons Creek (grey) and reference creeks (green). The dotted green line indicates the 99th percentile for the reference sites. The solid red line indicates the IJC guideline for the protection of wildlife consumers of aquatic species (0.1 µg/g ww).

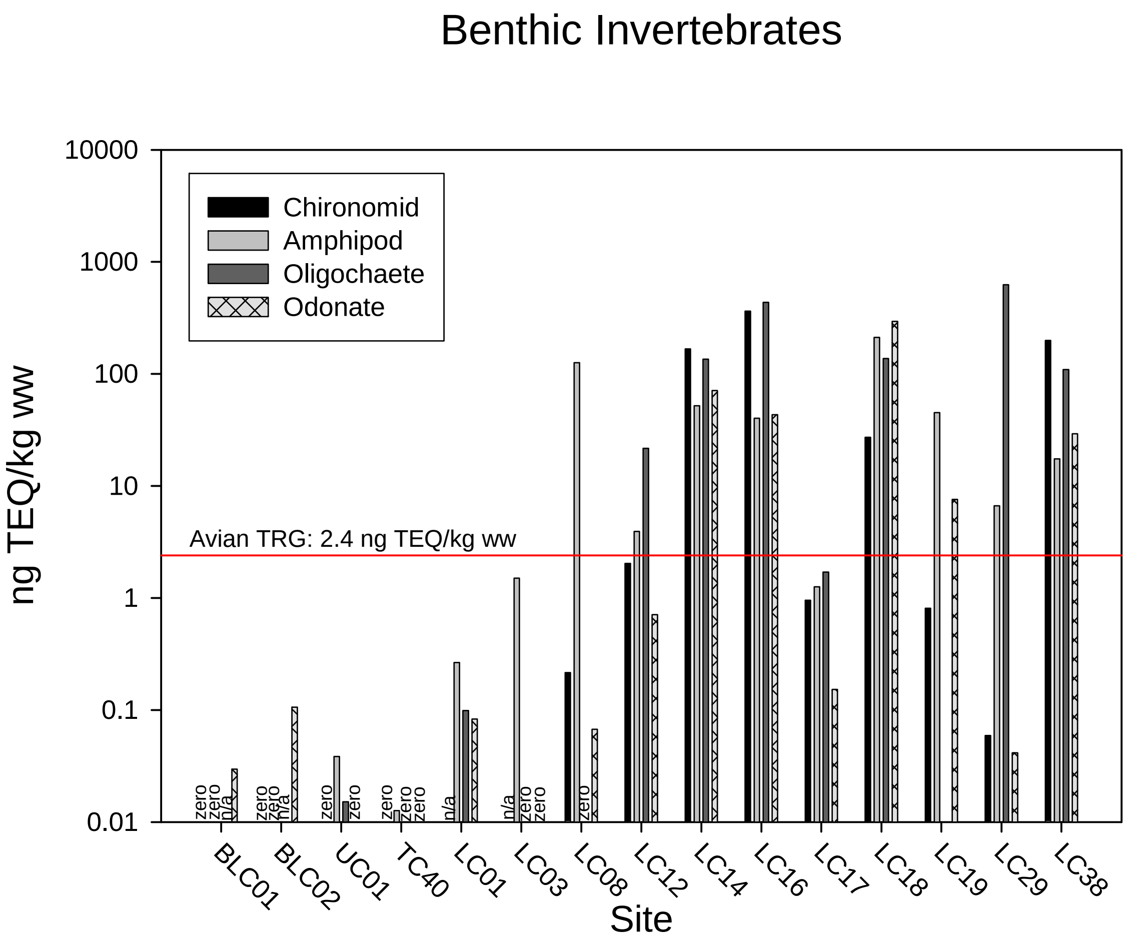


Figure 12 PCB concentrations expressed in toxic equivalent quantities for coplanar PCBs. The red lines indicate the Canadian tissue residue guideline (TRG) for the protection of avian consumers of aquatic biota (CCME 2001).

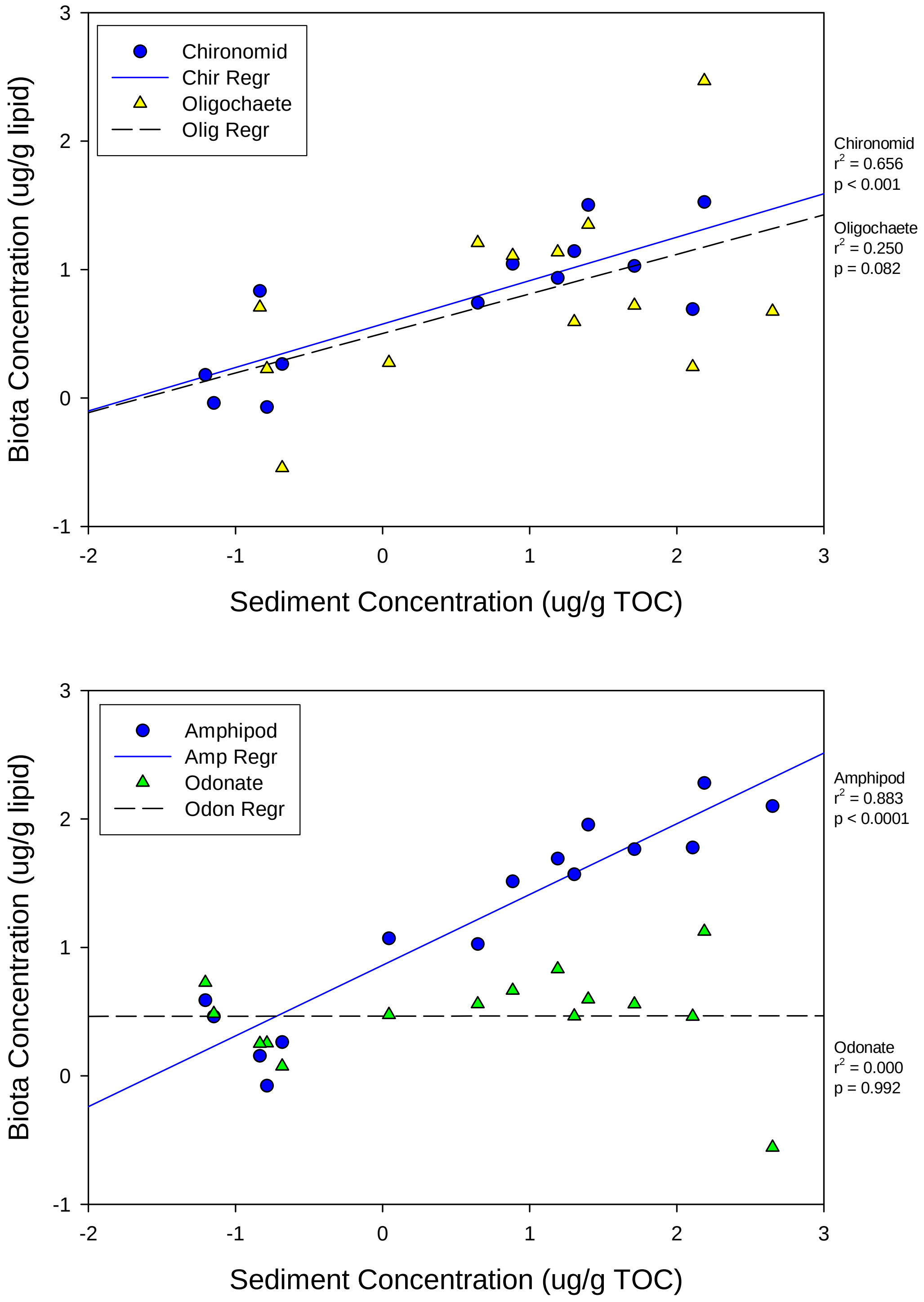


Figure 13 Relationships between total PCBs in biota (normalized to % lipid) and total PCBs in sediment (normalized to % total organic carbon). Separate regression lines are shown for each taxon.

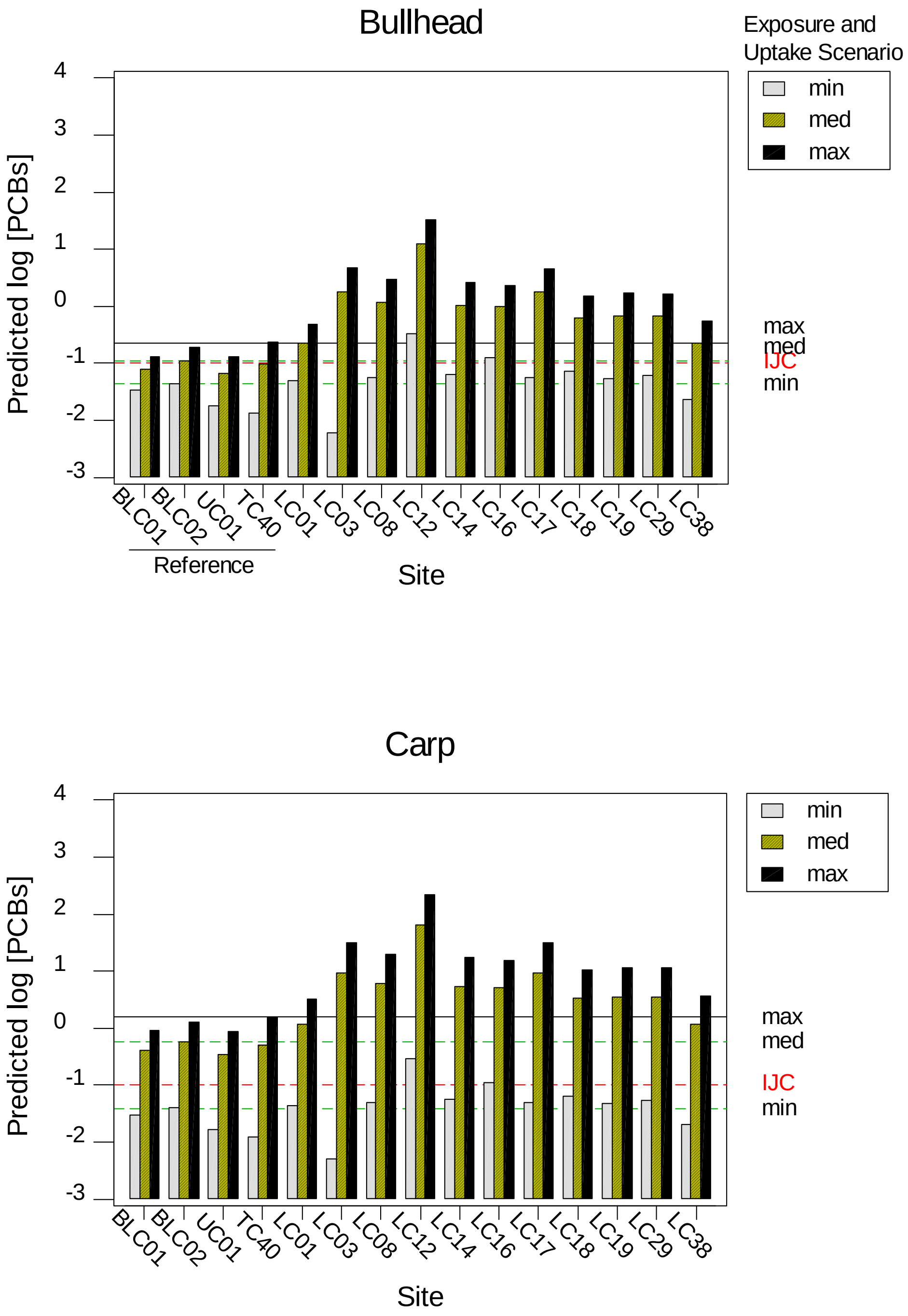
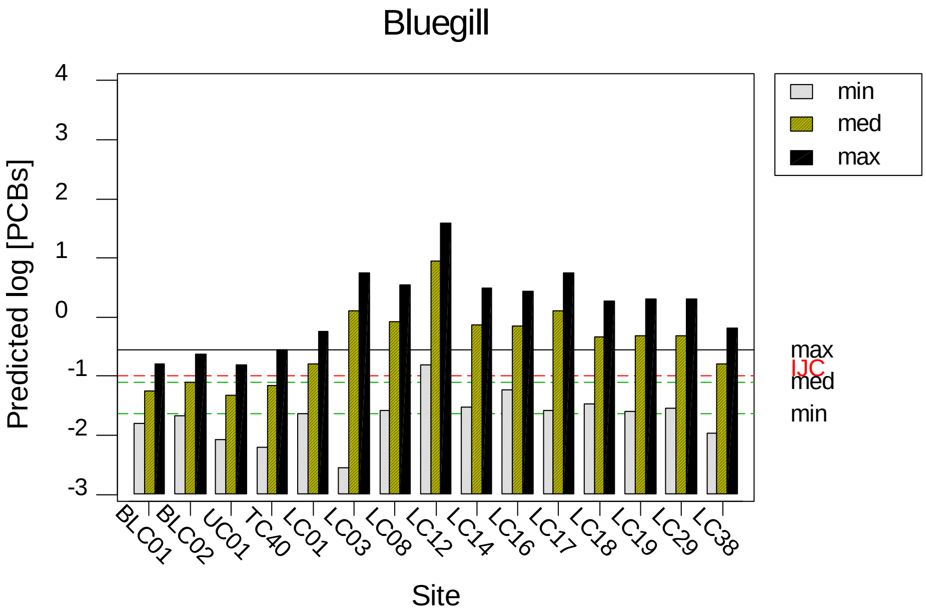


Figure 14a Predictions (minimum, intermediate, and maximum) of total PCBs (µg/g ww) in benthivorous fish receptor species. Charts compare predicted [PCBs] among receptors and between reference and test sites. Highest predicted [PCBs] for reference sites for each scenario is indicated on the chart (min, med, max). The tissue objective (0.1 µg/g ww, IJC), where applicable, is indicated by the red dotted line.



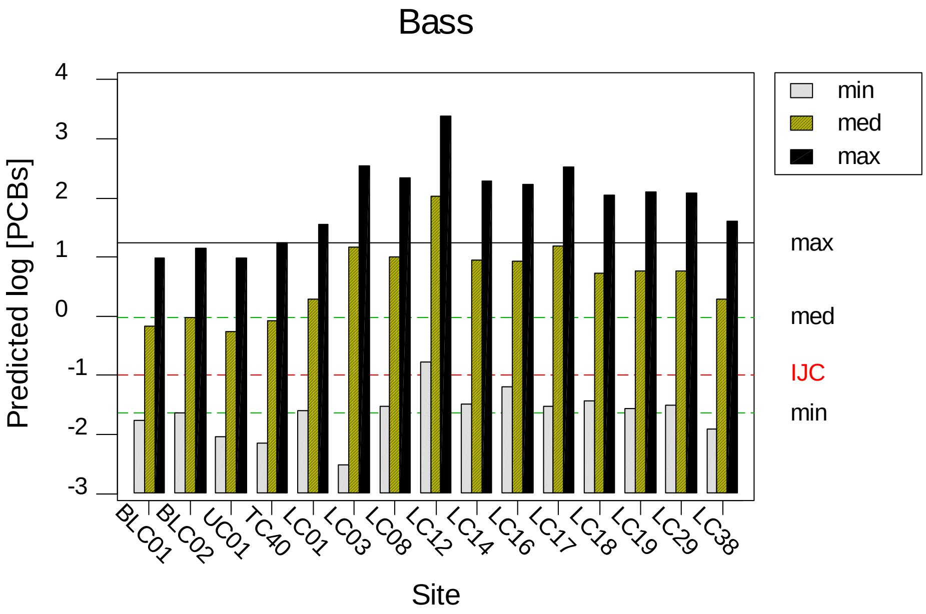
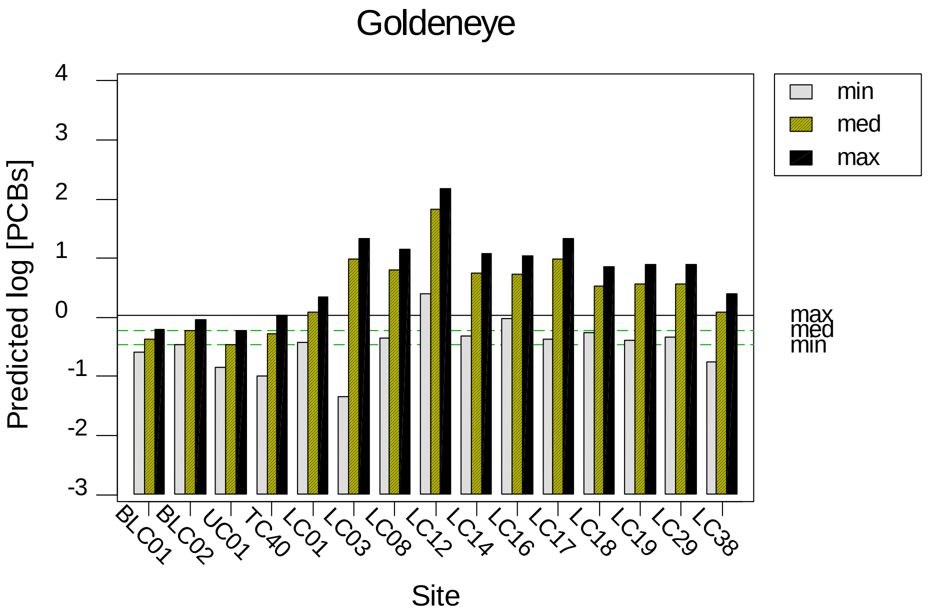


Figure 14b Predictions (minimum, intermediate, and maximum) of total PCBs (µg/g ww) in fish receptor species. Charts compare predicted [PCBs] among receptors and between reference and test sites. Highest predicted [PCBs] for reference sites for each scenario is indicated on the chart (min, med, max). The tissue objective (0.1 µg/g ww, IJC), where applicable, is indicated by the red dotted line.



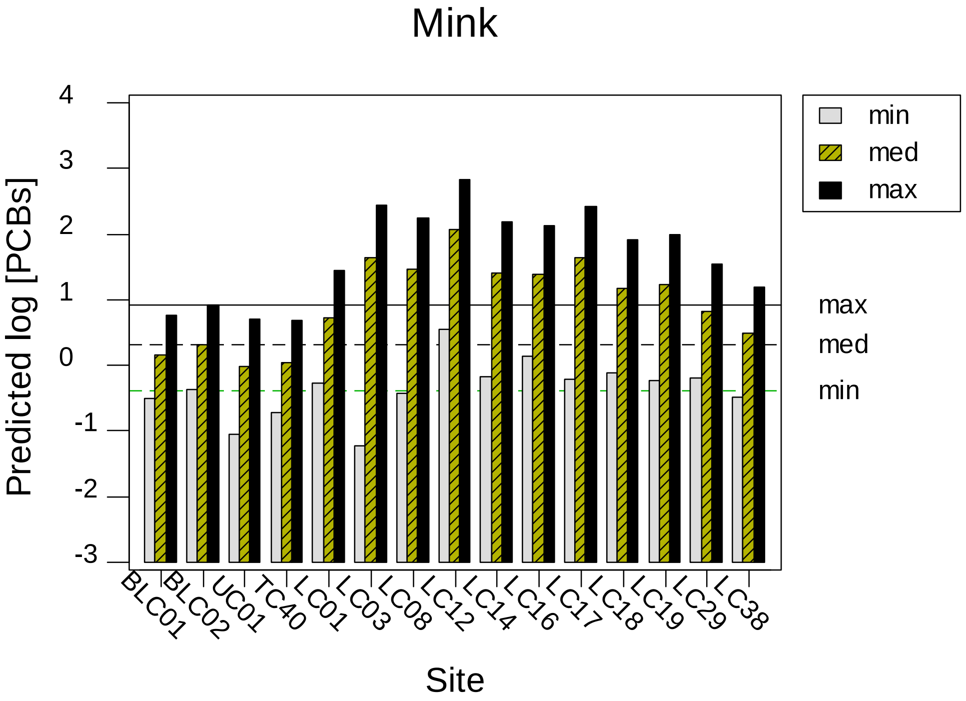


Figure 14c. Predictions (minimum, intermediate, and maximum) of total PCBs in waterfowl (µg/g) and mammal (µg/g lipid) receptor species. Charts compare predicted [PCBs] among receptors and between reference and test sites. Highest predicted [PCBs] for reference sites for each scenario is indicated on the chart (min, med, max).

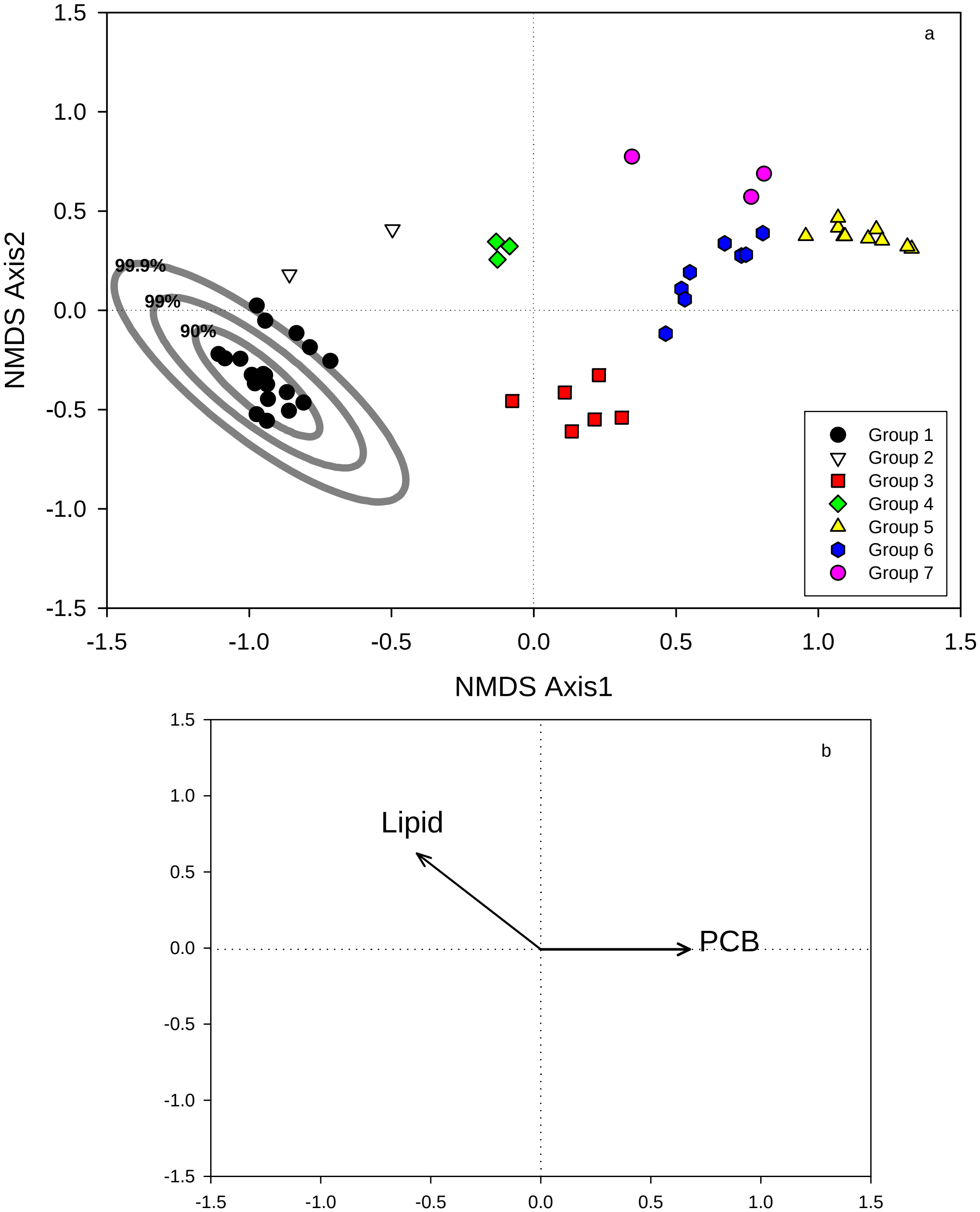


Figure 15 Ordination plot of % lipid and PCB congener concentrations in clams deployed at Lyons Creek and reference streams in 2002 and 2003. 90%, 99% and 99.9% confidence ellipses have been plotted around the reference data.

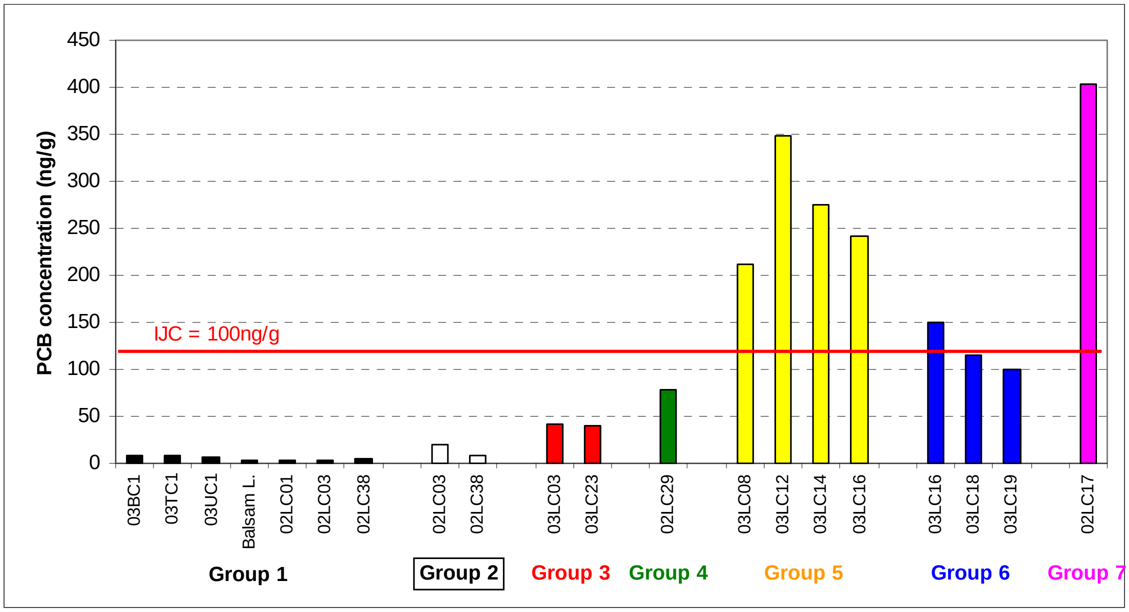


Figure 16 Total PCB concentrations in clam tissue collected from Lyons Creek and reference streams in 2002 and 2003. Groupings identified through cluster analysis are also shown.

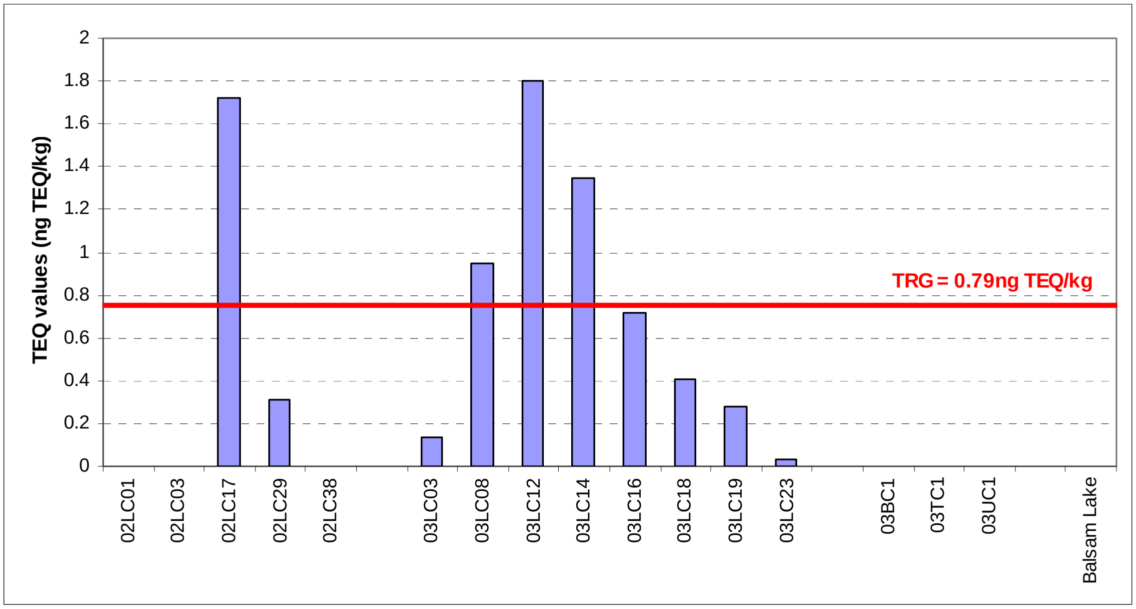


Figure 17 TEQ concentrations of co-planar PCBs in clam tissue from Lyons Creek and reference sites. CCME tissue residue guideline (TRG, CCME2001) is also provided.

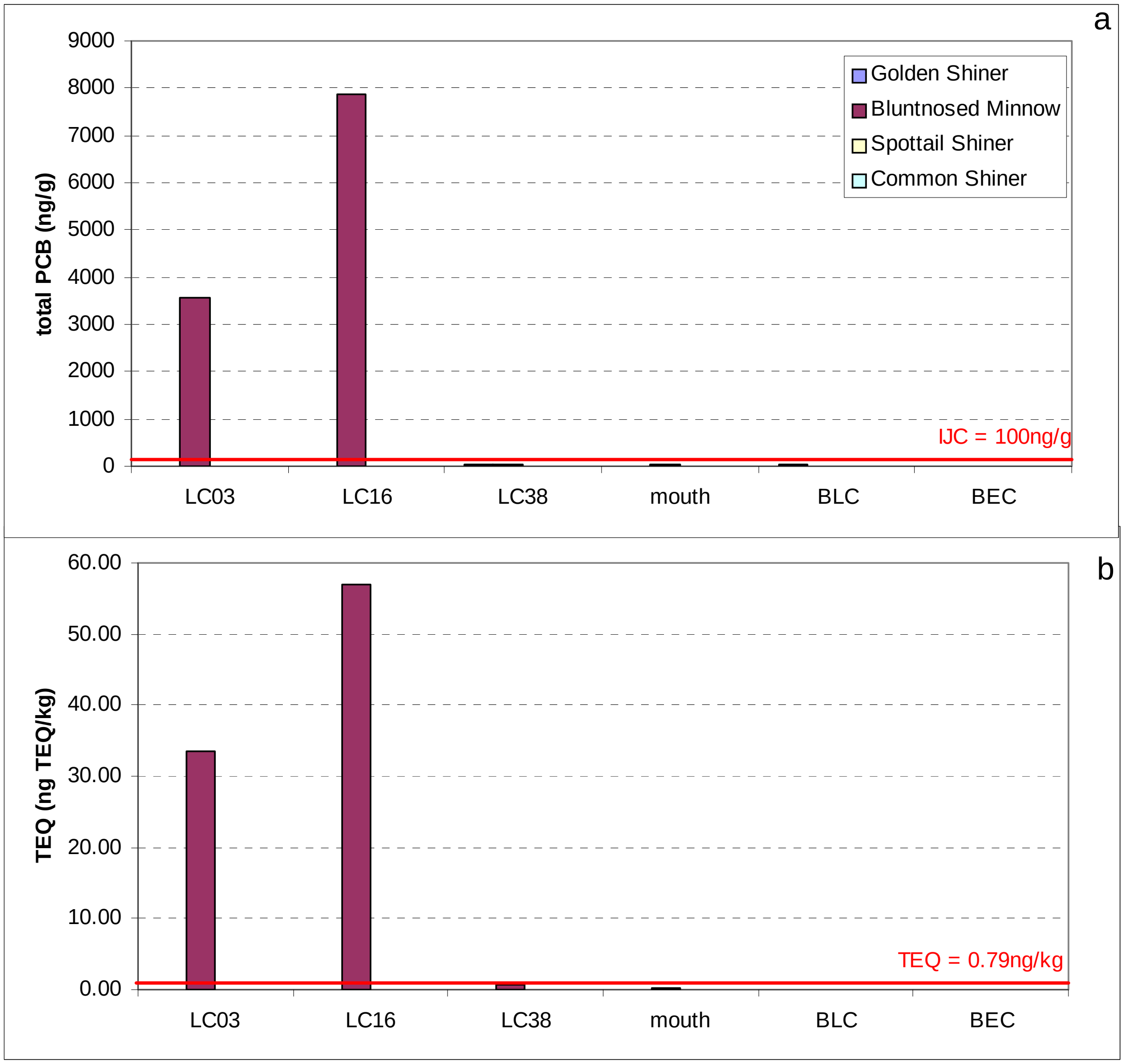


Figure 18 Total PCB concentration and TEQ values for forage fish collected from Lyons Creek and reference fish in 2002.

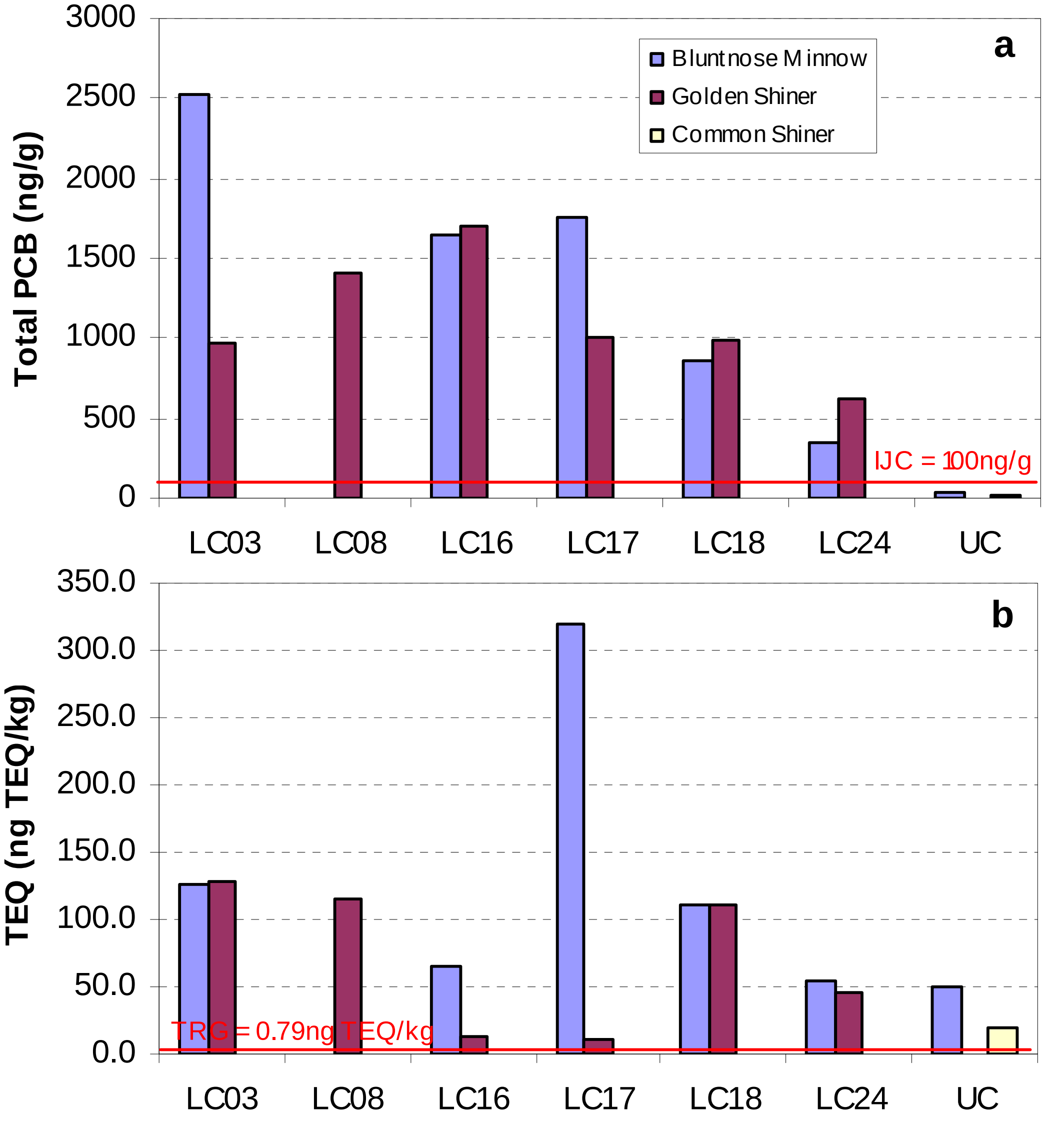


Figure 19: Total PCB (a) and calculated TEQ values (b) for forage fish collected from Lyons Creek and reference streams in 2003

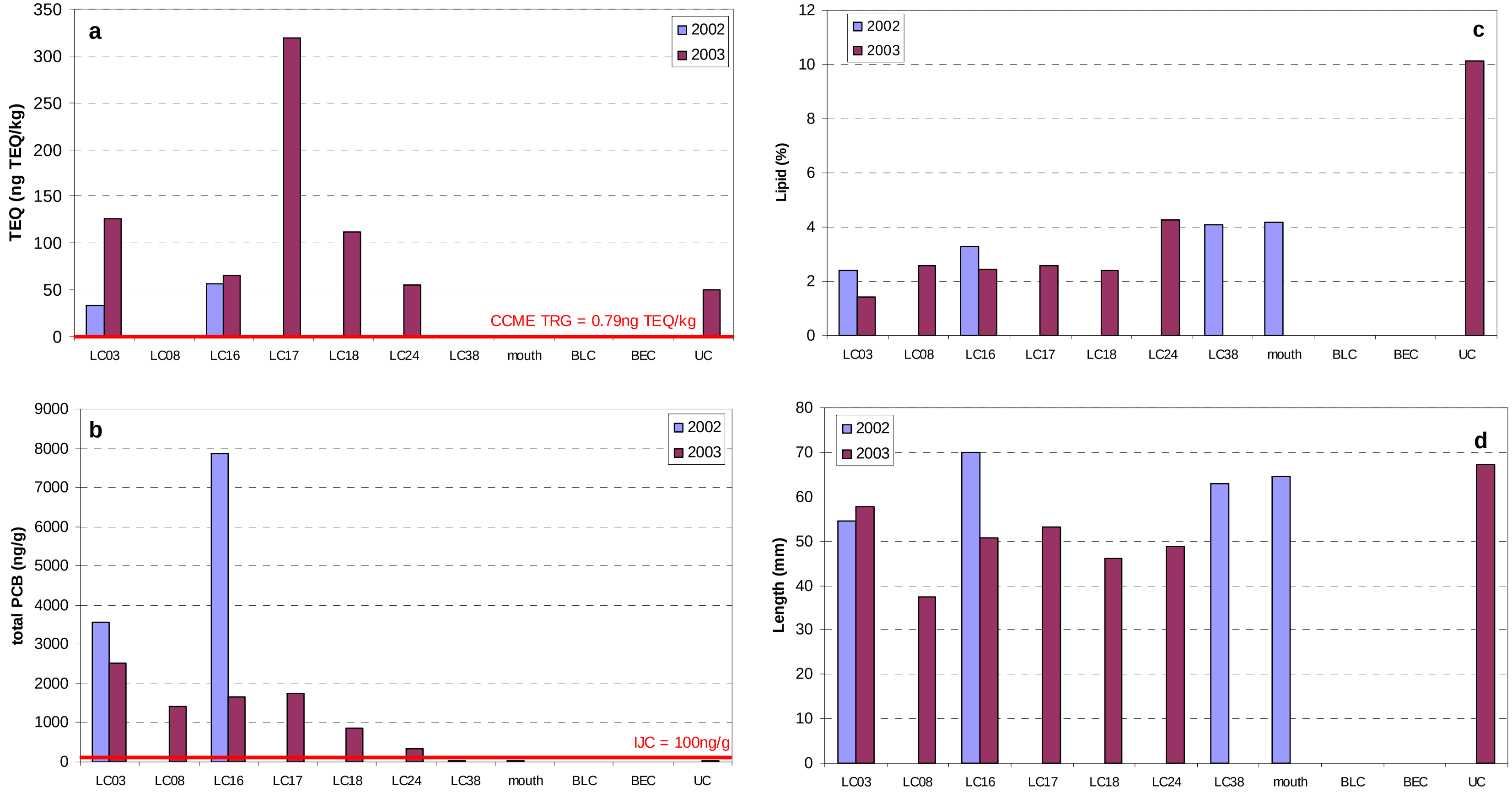


Figure 20: Calculated TEQ values (a), total PCB concentrations (b), and percent lipid (c) and length (d) measurements for bluntnose minnow collected in 2002 and 2003

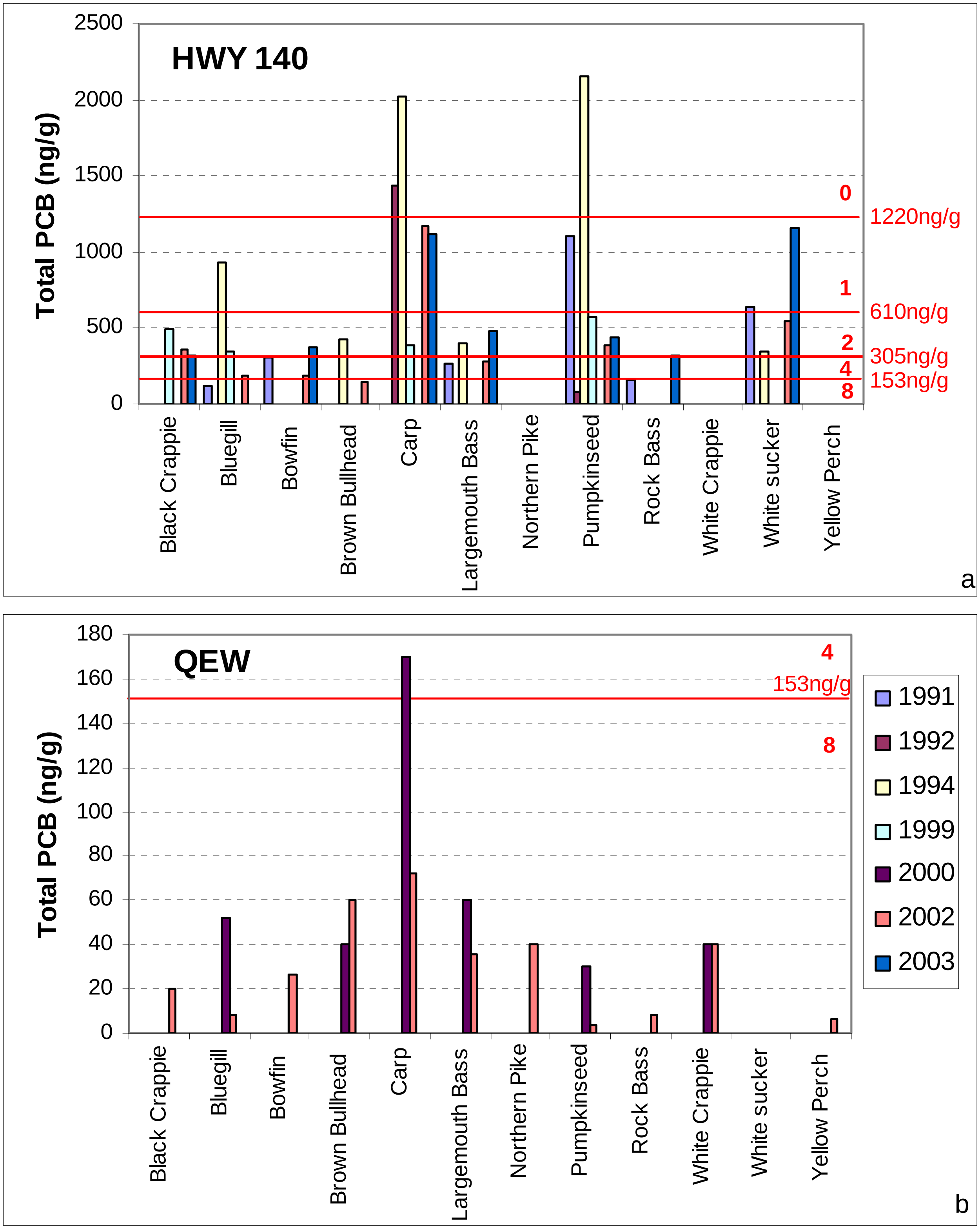


Figure 21: PCB concentrations in sport fish collected from Highway 140 and the QEW from 1991 - 2003. Consumption restrictions are provided; the bolded numbers on the right of the chart indicate the recommended number of meals per month (MOE, 2005)

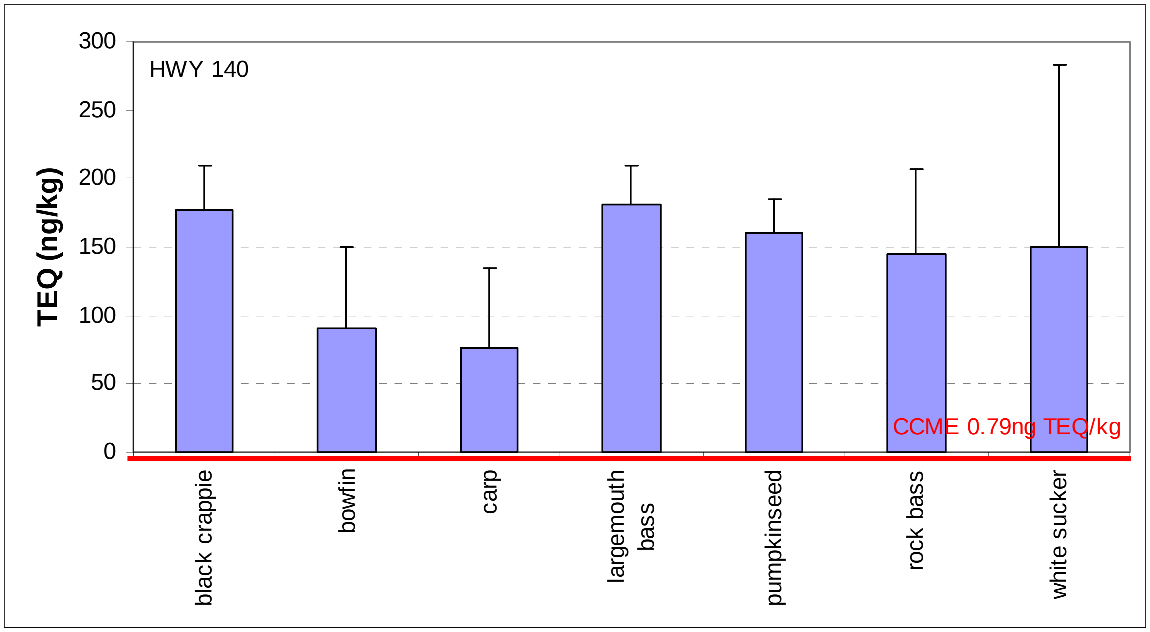


Figure 22: Mean TEQ values calculated for sport fish collected from Highway 140 in 2003. Error bars are shown, and CCME TRG criteria is provided

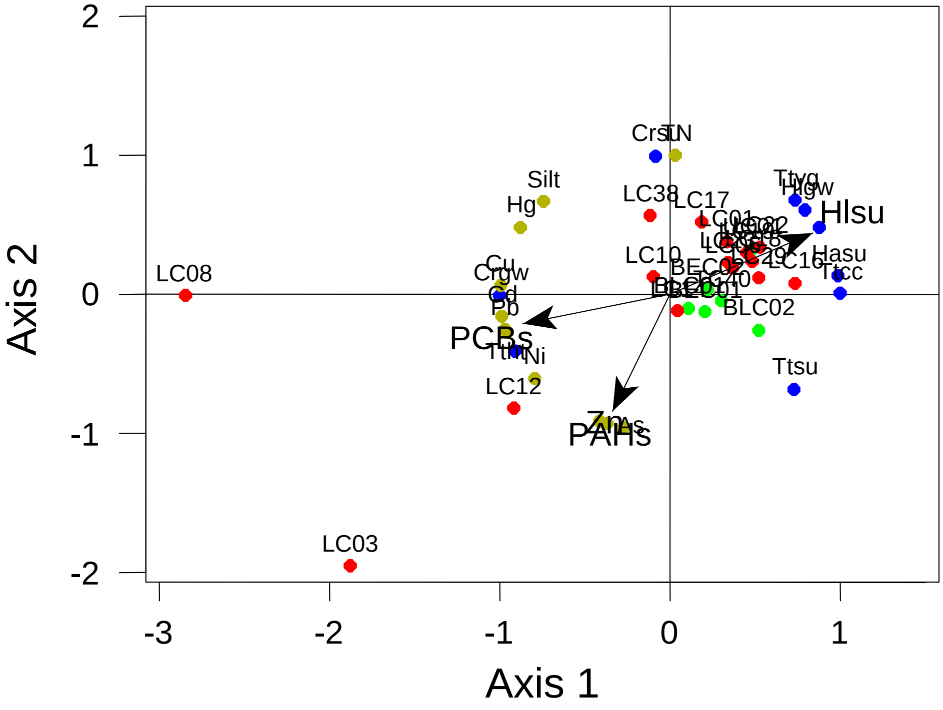


Figure 23 Toxicological response of Lyons Creek and reference sites represented by 2-dimensional hybrid multidimensional scaling (HMDS) (stress = 0.07). The directions of maximum correlations of toxicity endpoints and environmental variables with sites are shown as vectors.

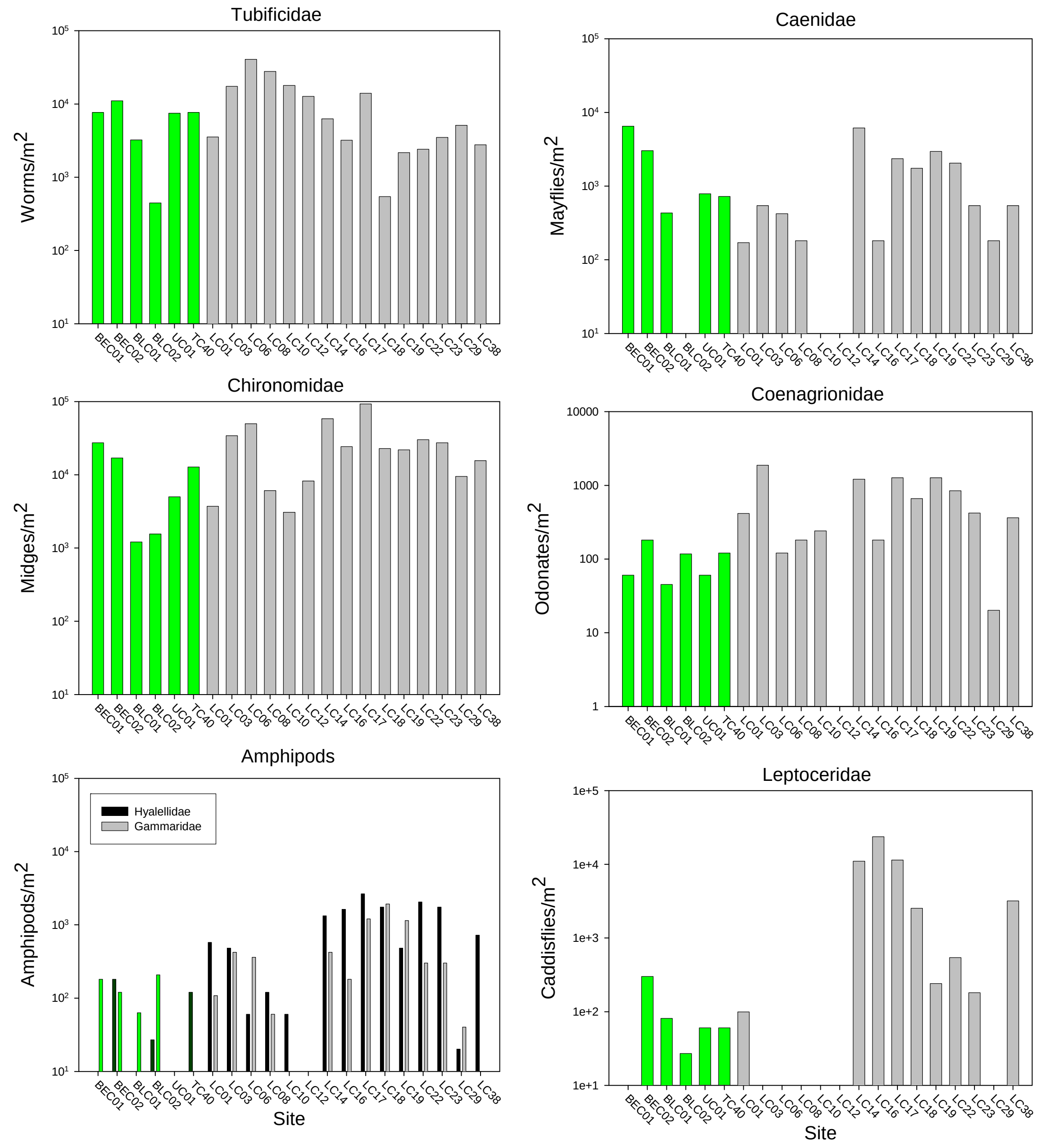


Figure 24 Abundance (per m^2) of most prominent macroinvertebrate taxa and total number of taxa present at reference sites (green) and Lyons Creek sites (grey).

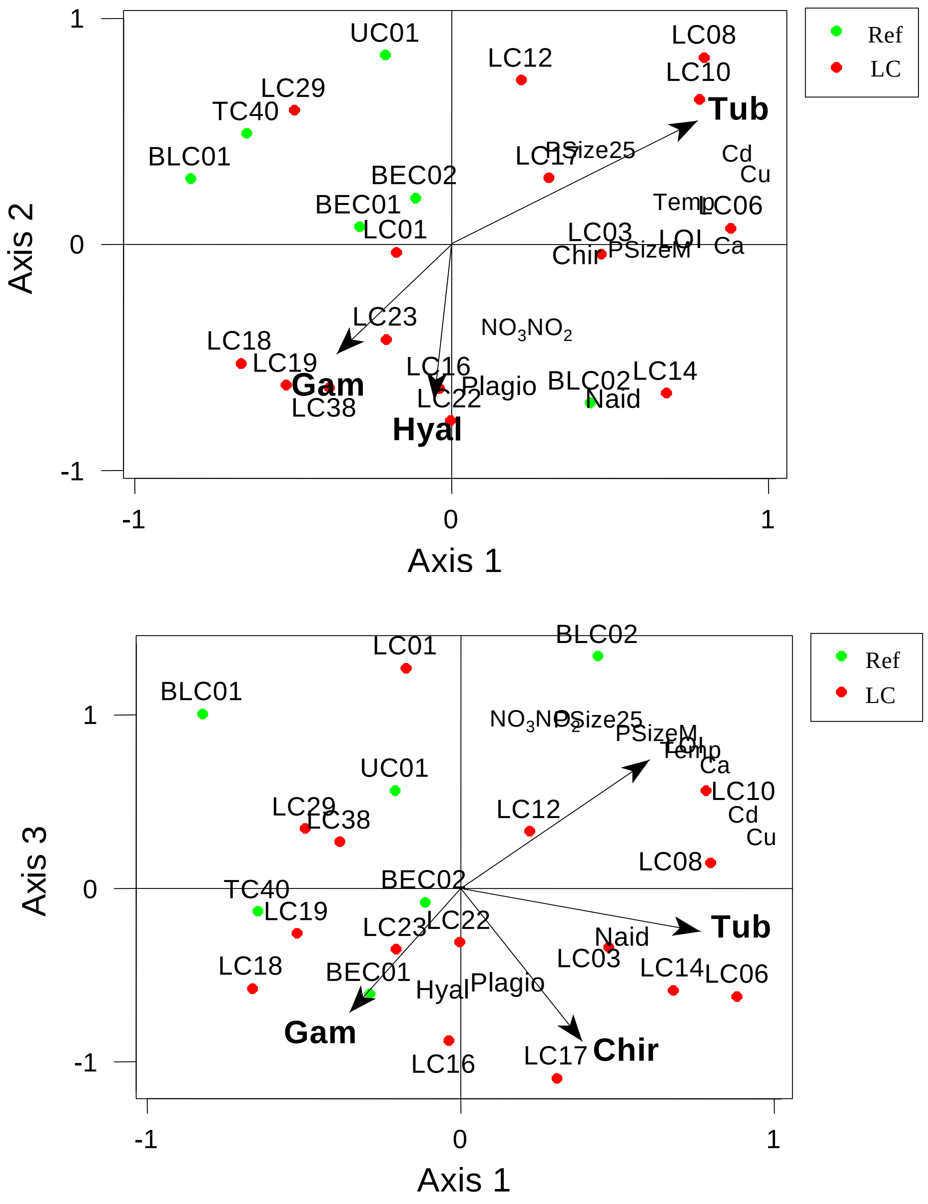


Figure 25 Ordination of Lyons Creek and reference community structure data represented by 3-dimensional hybrid multidimensional scaling (HMDS) (stress = 0.130). The directions of maximum correlations of community endpoints with sites are shown as vectors. [Tub = Tubificidae, Chir = Chironomidae, Naid = Naididae, Hyal = Hyalellidae, Gam = Gammaridae, Plagio = Plagiostomidae]

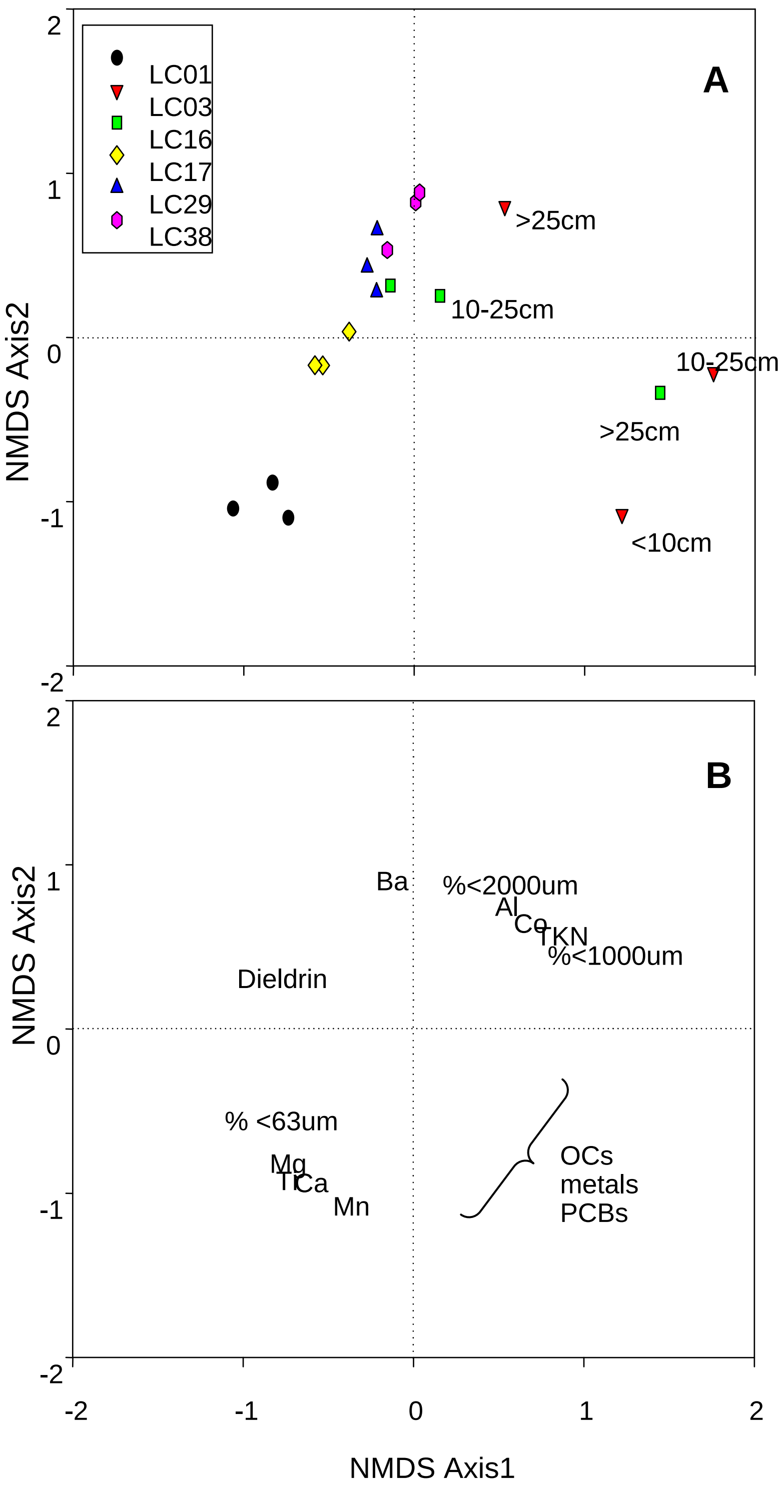


Figure 26: Sediment profile data for Lyons Creek. <10cm represents the surficial 10cm of sediment, 10-25cm represents the sediment collected at a depth of 10-25cm, and >25cm represents the historical sediment collected from a depth of greater than 25cm.

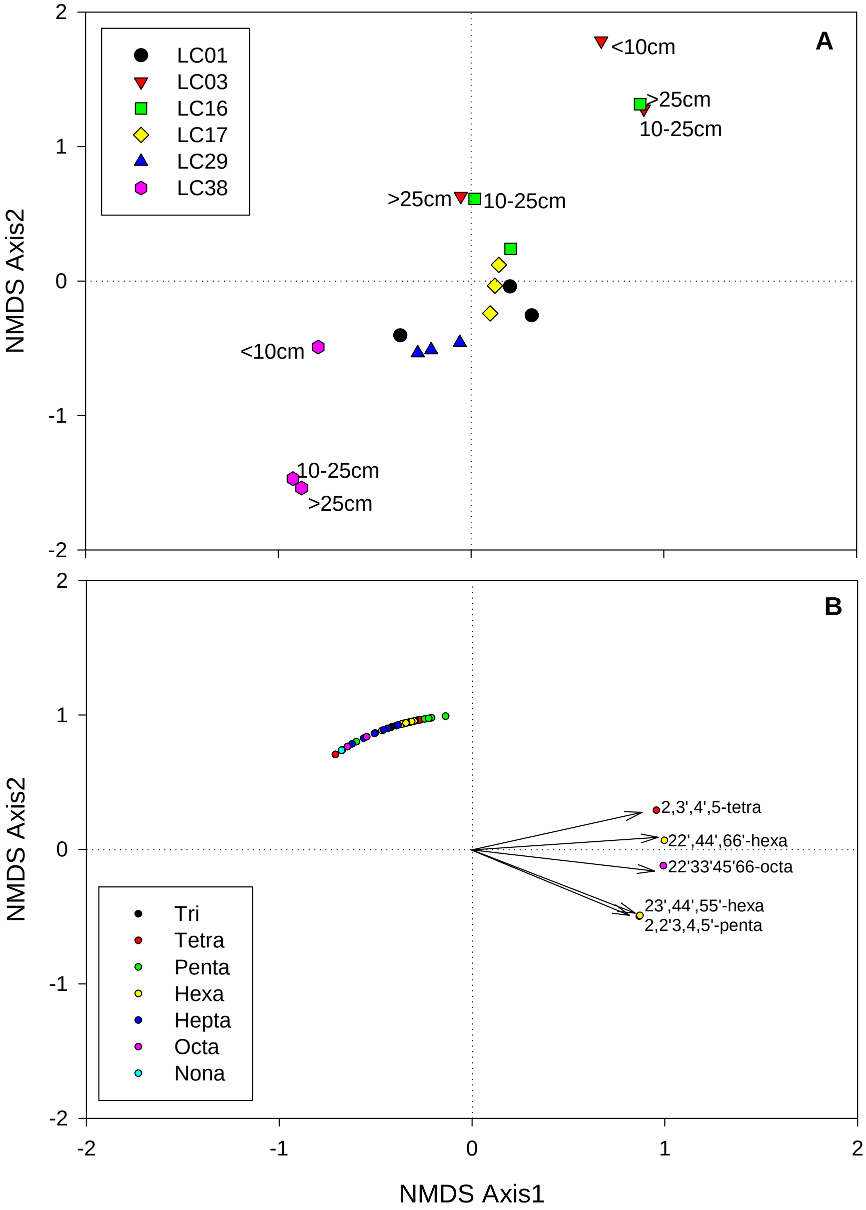


Figure 27: Sediment profiles of PCB congeners for Lyons Creek. (a) sediment cores with sections taken at less than 10cm, 10-25cm and greater than 25cm. (b) vectors of major congener groups

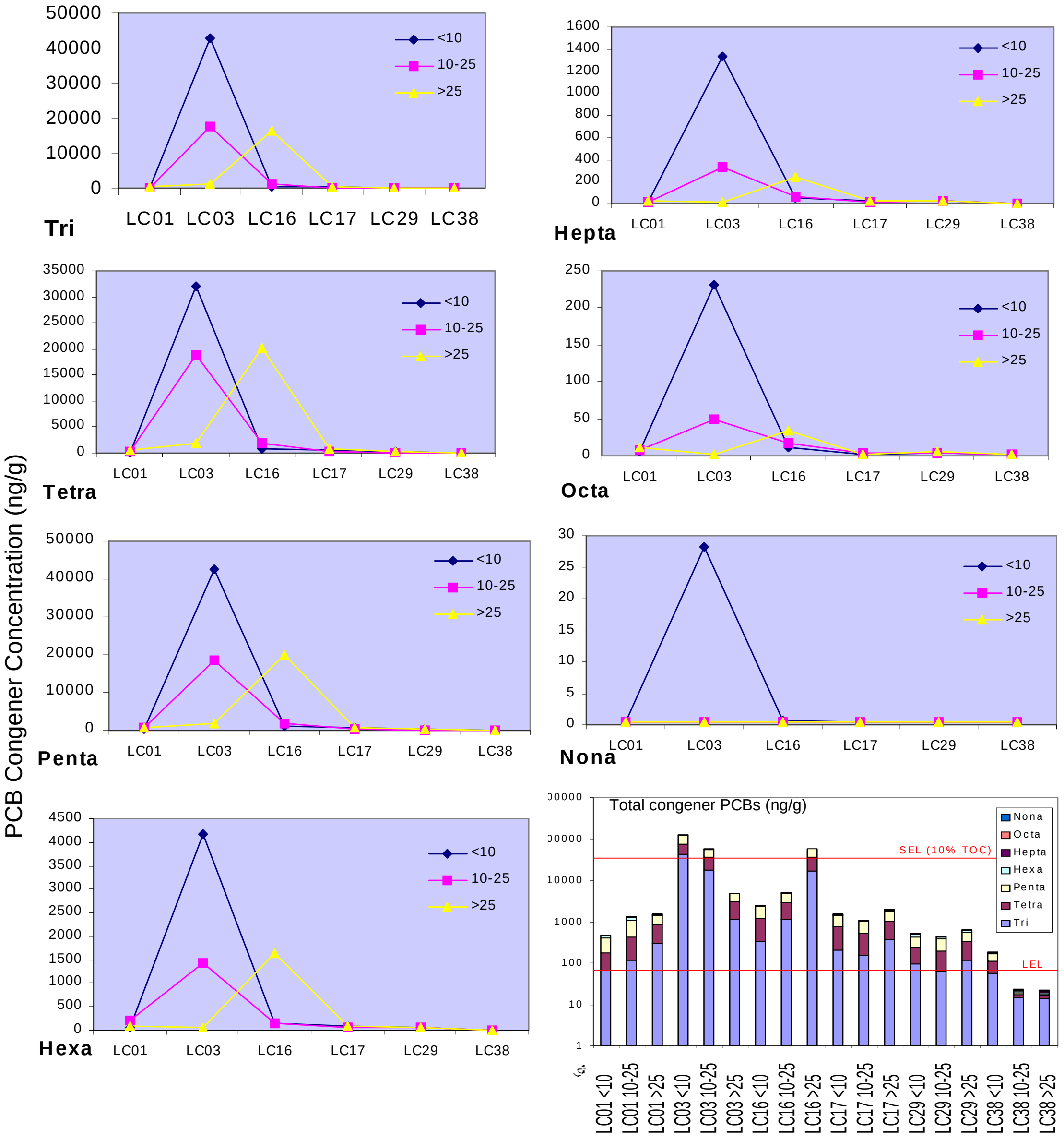


Figure 28 Seven PCB homologues found in the sediment of Lyons Creek. LEL = Provincial Sediment Quality Guidelines Lowest Effect Level criteria (70ng/g), SEL = Severe Effect Level (53,000 ng/g at 10% TOC)