Sediment Quality in Lake Ontario Tributaries: Part One (West of the Bay of Quinte)

A Screening-Level Survey

Environmental Conservation Branch
Ontario Region
EHD
Environment Canada

Ecosystem **H**ealth **D**ivision Report No. ECB/EHD-OR/03-01/I

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April 2003
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Executive Summary

A screening-level survey of recently deposited sediment quality was undertaken in the summer of 2002 near the mouths of tributaries draining to the Niagara River and Lake Ontario as far east as the Bay of Quinte. A total of 147 samples were obtained, representing 131 tributaries and 16 field duplicate samples.

The sampling program was based on the Guidelines for Collecting and Processing Samples of Stream Bed Sediment for Analysis of Trace Elements and Organic Contaminants, developed by the United States Geological Survey (USGS) for the U.S. National Water-Quality Assessment Program (NAWQA; Shelton and Capel, 1994). A number of sub-samples are combined at each site so that one sample is obtained that is representative of the overall conditions in that tributary.

The samples were analysed for 26 organochlorine compounds plus nine (9) PCB Aroclors and Total PCBs. Sixteen (16) PAH compounds and 36 metals were analysed, and the inorganic and organic carbon content as well as grain size distribution of each sample was determined. For many of the tributaries, this study represents the first information related to organic compounds in sediments.

A total of eleven (11) organochlorine parameters were not detected in any sample. The DDT metabolite DDE was the most commonly detected organochlorine, with widespread occurrence. Concentrations were in general also higher than were observed in the 2001 survey of Lake Erie tributaries. A large proportion of sites (50%) had total DDE concentrations exceeding the federal Probable Effect Level. The parent product DDT was also detected at 30% of sites. Endosulfan, an in-use organochlorine pesticide, was also commonly found (endosulfan and/or its metabolites was detected at 20% of sites), but there is no sediment quality guideline for this compound. The banned insecticide chlordane was detected at 14% of sites. Lindane and mirex were only detected at one site each, and the industrial organochlorines HCB and OCS were not detected at any site in this survey. One or more PCB Aroclor was detected in 65 tributaries (50% of all sites). Total PCB concentrations exceeded federal TEL guidelines at 33 sites and the federal PEL was exceeded at a further two (2) sites.

Polycyclic aromatic hydrocarbons (PAHs) were found to be widespread, and each of the PAH compounds analyzed was detected in at least one sample. Exceedence of one or more federal TEL guideline for PAHs occurred at 68% of the sites and PEL exceedences occurred at 18% of sites. In general, PAH concentrations appeared to be higher in or near urbanized areas, but some PAH contamination was observed even at sites with little urbanization nearby.

At many sites, the detection of metals is likely related to the natural occurrence of trace elements in stream sediments. For some metals, however, concentrations appeared to be elevated relative to federal PEL (probable effect level) sediment quality guidelines as well as background levels, and may therefore be toxic to aquatic biota. These metals included: arsenic, cadmium, chromium, copper, mercury, lead, and zinc. Other metals, including manganese and iron, appeared to be elevated at certain sites above background concentrations, as determined using Ontario Geological Survey stream sediment data. Elevated nickel and tin concentrations were observed at one site each.

This work represents a continuation of the screening-level survey conducted in Canadian tributaries to Lake Erie in 2001 (Dove et. al., 2002). Plans are being made to sample additional Lake Ontario tributaries, east from the Bay of Quinte, in 2003. The three years of studies will collectively provide an indication of the contaminant status of Canadian tributaries to the lower Great Lakes and their connecting channels, as well as indicate possible sources of contaminants from Ontario watersheds to the Great Lakes.

1.0 Introduction and Purpose

The Ecosystem Health Division (EHD) of Environment Canada (EC), Ontario Region, conducted a screening-level survey of sediment quality in Canadian tributaries to Lake Ontario during the summer of 2002. The sampling represents the first stages of a track-down program to identify potential sources of contamination to the lower Great Lakes that are not being addressed by other Great Lakes programs. The program constitutes a portion of Environment Canada's commitment towards the Great Lakes Water Quality Agreement (GLWQA), in particular the Lake Ontario Lakewide Management Plan (LaMP), as well as Canadian Environmental Protection Act, in which Canada has committed to the virtual elimination of discharges of persistent toxic substances.

The purpose of the sampling was to assess sediment quality in deposition zones in each tributary prior to discharge to Lake Ontario. One sediment sample, consisting of many subsamples, was taken from each tributary in a manner that is representative of the overall sediment quality in that tributary.

The study was designed to maximize the probability of detecting persistent toxic substances entering the lake, if they exist. The intent of the program is to identify remaining sources of contamination for subsequent follow-up work. It is not the intent at this stage to quantify the loadings of contaminants entering Lake Ontario. Instead, the results from this program will be combined with existing water quality, fisheries, benthic and sediment contaminant information, using a weight-of-evidence approach, to prioritize subsequent track-down efforts.

Targeted parameters for the sediment screening were those identified in the Lake Ontario Lakewide Management Plan (Lake Ontario LaMP) as impairing lake-wide beneficial uses. In addition, a suite of contaminants targeted for virtual elimination in the Canada-U.S. Binational Toxics Strategy (BTS) was considered in order to assess Canada's commitments towards that Strategy. Additional parameters were included for contextual information (such as particle size and total organic carbon) and to improve our understanding of the contaminant status of Lake Ontario tributaries (e.g., metals, pesticides, contaminants of emerging concern).

2.0 Methodology

To achieve the study objectives, the sampling program consisted of a survey-level, screening assessment of recently deposited sediment quality near the mouths of tributaries entering Lake Ontario. The targeted substances are relatively insoluble in water (i.e., hydrophobic) and are therefore typically found at higher concentrations in sediments than in water. In addition, bed sediments in depositional environments provide a time-integrated sample of particulate matter transported by a stream. Analysis of bed sediments alleviated problems associated with detecting trace levels of substances in water samples. Bed sediment sampling can overcome problems detecting periodic or intermittent sources of contaminants in water from non-point pollution sources.

2.1 Field Program

Tributary Selection

A reconnaissance survey was conducted in May and June 2002 to identify tributaries and select the sampling sites. Sediment deposition zones were sought near the mouths of the tributaries such that they were likely downstream from potential contaminant sources yet sufficiently far upstream not to be influenced by the water body into which it drains. In other words, sites were selected to be outside of the zone of lake influence, to the extent possible.

During the reconnaissance survey, the method of access was also identified. Most sites were accessed by wading or were sampled from a bridge crossing. In certain, larger tributaries, sampling sites were accessed by boat. In the majority of cases, the sample site coincided with the most downstream road crossing of the tributary.

Number of Sites

Virtually every tributary draining the Canadian Lake Ontario watersheds was sampled in this program. For many sites, this program has provided its first information about organic contaminants in sediments. The geographic extent of the program was from Fort Erie at the upstream end of the Niagara River to the western end of the Bay of Quinte in the east. Tributaries to the Niagara River as well as Canadian tributaries to Lake Ontario along the southern and northern shores of the lake, up to but not including the Bay of Quinte area, were included in this program. The tributaries sampled during the project are shown in Figure 1 and with their labels (i.e. tributary names) in Appendix B.

A total of 147 samples were obtained, representing 131 tributaries and 16 field duplicate samples. The field duplicates were blind duplicate samples; that is, they were split samples that were assigned a fictitious name in the field (usually a name of a common fish). The blind duplicates were obtained to assess variability due to sample handling and laboratory precision. A list of blind duplicates and the corresponding tributary is provided in Table 1, below.

Table 1. Blind Duplicate Sample Listing

Tributary	Blind Duplicate Sample
Shelter Valley Creek	Darter Creek
Oshawa Creek	Mullet Creek
Montgomery Creek	Ling Creek
Gages Creek	Shad Creek
Bowmanville Creek	Grouper Creek
Wilmot Creek	Chinook Creek
Usshers Creek	Mudcat Creek
Falcon Creek	Cisco Creek
Redhill Creek	Stickleback Creek
Bartlett Creek	Grayling Creek
14 Mile Creek (Oakville)	Redhorse Creek
Mimico Creek	Goby Creek
Don River	Mudminnow Creek
Welland Canal	Sculpin Creek
Pringle Creek	Dace Creek
Proctor Creek	Whitefish Creek

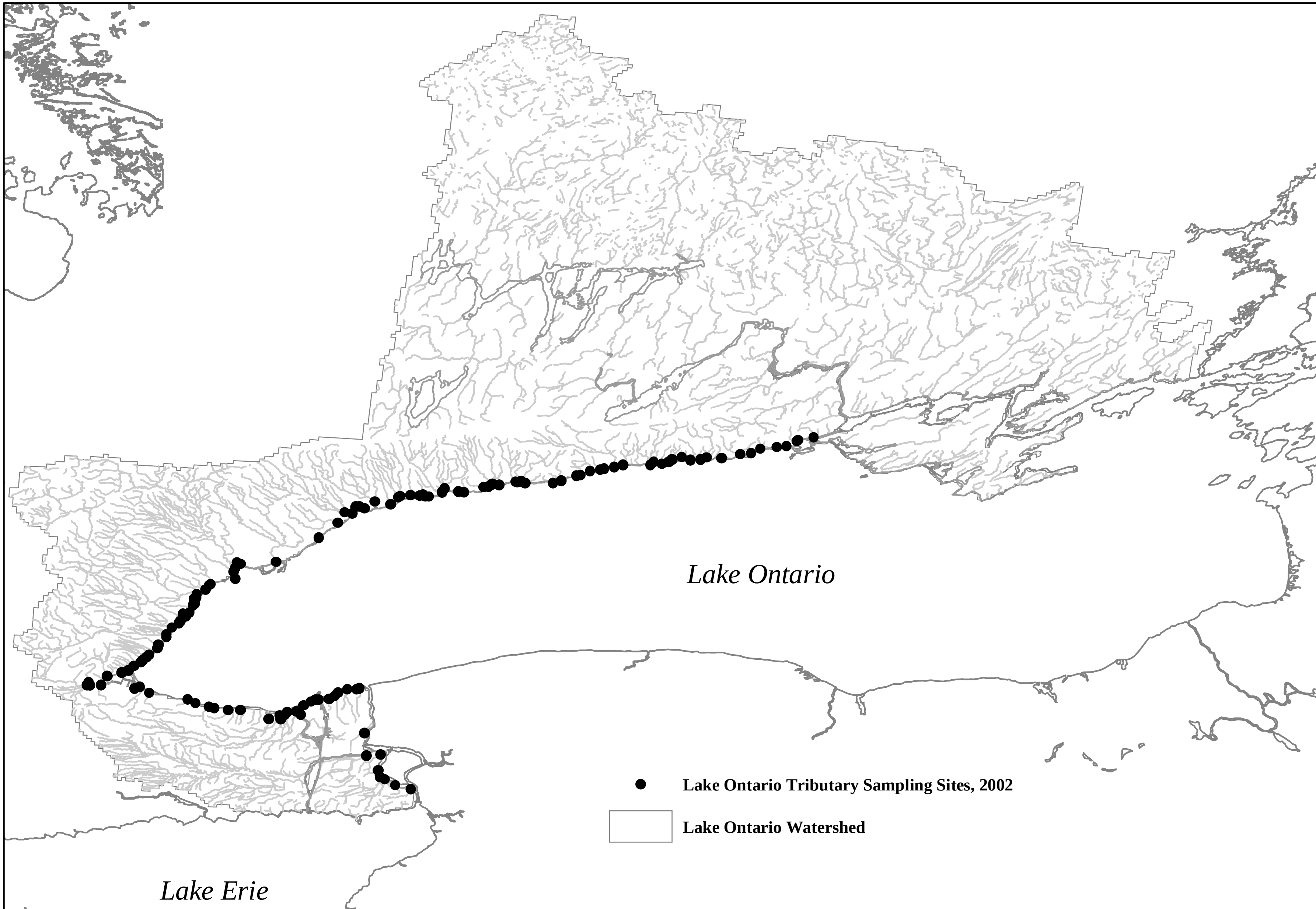

Figure 1. Lake Ontario Tributary Sediment Sampling Locations, 2002

Sampling Methodology

The sampling program was based on the Guidelines for Collecting and Processing Samples of Stream Bed Sediment for Analysis of Trace Elements and Organic Contaminants, developed by the United States Geological Survey (USGS) for the U.S. National Water-Quality Assessment Program (NAWQA; Shelton and Capel, 1994). In the NAWQA program, downstream locations in watersheds are selected to provide a coarse-scale network of sites. At these "integrator" sites, large-scale problems that may not be detected in smaller basins have a reasonable chance of being detected. A number of sub-samples are combined so that one sample is obtained that is representative of the overall conditions in that tributary.

Field Campaign

Sampling was conducted between June 3 and October 11, 2002. One or more depositional reach was sampled upstream of the mouth in each tributary. Only the very fine-grained surface deposits, to a maximum depth of approximately 1 or 2 cm, depending on the site, were collected. These surface sediments better represent relatively recent rather than historic deposition. Sites were selected to be representative of the variety of locations (i.e., mid-channel, left bank, right bank) and habitat types (pools, different depths of water, depositional zones behind obstacles such as boulders or sand bars) present at each site. Only wetted depositional zones were sampled.

Where water depths permitted wading and water velocities were slow enough to permit sample retrieval, samples were obtained using a stainless steel spoon and collected in a glass bowl. At sites where the water depth was too great for wading, or water velocities were swift enough to wash the fine particles from the spoons during sample retrieval, an all-stainless steel Wildco Petite Ponar sampler was used.

Upon arrival at each site, the sampling equipment was thoroughly rinsed in the ambient river water. The surface sediments were collected (either by spoon or Ponar, as described above) and combined in a glass bowl. The sediments were sieved through a 2-mm stainless steel sieve to remove the larger size fractions and to assist with homogenization of the sample. The sample was further homogenized by mixing with a spoon for approximately two minutes.

Several sample jars were filled at each site. In general, four jars were used:

- one 125-mL polyethylene container filled with approximately 2 cm of sediment for metals analysis;
- one 125-mL polyethylene container filled approximately ½ full for total organic carbon and grain size analysis;
- one 250-mL amber glass container with Teflon-lined screw cap filled approximately ¾ full for organochlorine (OC) and polyaromatic hydrocarbon (PAH) analysis, and;
- one 250-mL amber glass container filled approximately ¾ full for archiving purposes.

Sample jars were labeled with permanent marker on both the lids and on laboratory tape affixed to the side of the jars. The recorded information included the site name, date, organization (EHD/OR), and parameters for analysis (e.g. OCs and PAHs, metals, TOC and grain size, Archive). After the appropriate sample jars were filled, the sampling equipment was thoroughly rinsed in the ambient river water.

A field drawing was made and digital photos were taken at each site. A sketch of each tributary reach was made to include its major features, habitat types, approximate dimensions, surrounding land uses, major road crossings, etc. The locations and number of sampling sites were identified on each sketch, and the method of sediment retrieval was noted. A Lowrance Global Map 100 geographic positioning system (GPS) device was used to obtain each location using the position averaging function. The GPS location within the site was included on the sketch.

Samples were kept on ice in portable coolers while in the field. Upon return to the Canada Centre for Inland Waters in Burlington, the samples were decanted then frozen at –10ºC. Samples in glass bottles were frozen on their sides to prevent bottle breakage.

2.2 Laboratory Methods

The samples in polyethylene containers (i.e., those for metals, TOC and grain size analysis) were freeze-dried prior to analysis. Freeze drying, and grain size distribution and organic carbon content analyses were conducted by Natural Resources Canada in Ottawa, Ontario. Once freeze-dried, TOC was analyzed by Leco Cr-412 and grain size fractions were determined using a Lecotrac Particle Size Analyzer LT100.

Metals samples were freeze-dried at NRCan, and subsequently analyzed for a suite of 30 metals at Caduceon Enterprises Inc. using aqua regia digestion methods.

Analysis of organochlorines (OCs) (including PCBs) and polycyclic aromatic hydrocarbons (PAHs) was awarded to Maxxam Analytics Inc. in Mississauga as the result of a competitive bidding process. Frozen, wet sediment samples were sent to Maxxam in the autumn of 2002. Samples were thawed and OCs analyzed by gas chromatography/dual column electron capture detector (GC/ECD) after accelerated solvent extraction following the EPA protocol SW846 EPA 3545. Samples for PAH analysis were extracted using a sonication method. The extracts were then concentrated and analyzed by mass spectrometry (GC/MS). Sample results were reported on a dry weight basis.

The archived sediments are stored frozen at –20 C at the Canada Centre for Inland Waters in Burlington, Ontario. The Ontario Ministry of the Environment is analyzing portions of selected samples for dioxins, furans, dioxin-like PCBs and polychlorinated napthalenes. Other samples may be analyzed for compounds of emerging concern in the future. The results of these analyses will be reported under separate cover as they become available.

2.3 Data Analysis

The laboratory results were analysed in a spreadsheet program. Results were compared with the Federal and Provincial sediment quality objectives and with other sites in this program and a similar initiative conducted in 101 Canadian tributaries to Lake Erie in 2001. The frequency of detection and frequency of exceedence of the sediment quality objectives were computed. Mapping of selected compounds was prepared on 1:250,000 basemaps of the Lake Ontario basin using ArcView 8.1.

3.0 Results

Throughout this report, references and comparisons are made to the federal and provincial sediment quality guidelines. For clarity and consistency, each guideline is assigned a unique colour. The graphics presented in this report use these colours to indicate exceedences of the guidelines. The following colour coding is also referenced in Appendix B:

Guideline	Colour Code
Federal Sediment Quality Guidelines	
Below Threshold Effect Level (TEL)	Green
Above Federal TEL but below PEL	Yellow
Above Probable Effect Level (PEL)	Orange
Provincial Sediment Quality Guidelines	
Below Lowest Effect Level (LEL)	Green
Above LEL but below SEL	Blue
Above Severe Effect Level (SEL)	Red

In this report, concentrations of organic compounds are provided in parts-per-billion (ppb or ng/g). Concentrations of metals are reported in parts-per-million (ppm or ìg/g), with the exception of mercury which is reported in ppb (ng/g).

3.1 Quality Assurance/Quality Control

All laboratories used for the project were CAEAL accredited for their respective analytical parameters. As mentioned above in the methodology, Maxxam Analytical Inc. performed the organochlorine and polycyclic aromatic hydrocarbon analyses. The Maxxam laboratory QA/QC program consisted of blanks, spiked blanks and duplicate samples (i.e., laboratory replicate runs).

All method blanks were within acceptable limits (below method detection limit) and spikes were within acceptable limits (40-130%) for most samples. In some cases, the spikes exceeded the acceptable limit for one surrogate, but in all cases the other surrogate was within acceptable limits.

Varying numbers of laboratory duplicates (replicate runs) were analyzed: seven (7) duplicate organochlorine pesticides and PCB aroclor analyses, and nine (9) PAH analyses. Paired student t-tests were performed to assess differences between the duplicate samples. Only six parameters could be tested, as a minimum of three detections were required for the t-tests. No significant differences were observed between the duplicate samples, for any parameter, at a 95% confidence level.

Paired student t-tests were also performed to assess differences between blind duplicate samples submitted to the laboratory. The majority of parameters could be assessed this way, with the exception of parameters that were detected in fewer than three samples. There were no significant differences observed between the blind duplicate samples at the 95% confidence level, with the exception of PCB Aroclor 1254, which differed significantly between blind duplicate samples ($t = 0.045$).

3.2 Method Detection Limits

All of the analytical parameters used in the study are hydrophobic, i.e., they have a propensity for solid surfaces such as sediments as opposed to the dissolved phase. Sampling very fine, flocculent surface deposits, as was done here, serves to maximize the probability of encountering these parameters, if they are present in the environment. Typical laboratory detection limits are therefore sufficient to detect these parameters at ambient concentrations. The laboratory method detection limits are provided in Table 2, below, for both laboratories used in this study. This Table also provides a useful reference of all parameters measured in the study.

Table 2. Analytical Parameters and Laboratory Method Detection Limits
a. Maxxam Analytics Inc. (Organics)

Polychlorinated Biphenyls (PCBs)		Polycyclic Aromatic Hydrocarbons (PAHs)		Organochlorine Pesticides (OCs)	
Parameter	**MDL**	**Parameter**	**MDL**	**Parameter**	**MDL**
Aroclor 1016	10 ng/g	Naphthalene	5 ng/g	Hexachlorobenzene	2 ng/g
Aroclor 1221	20 ng/g	Acenaphthylene	5 ng/g	o,p'-DDD	2 ng/g
Aroclor 1232	10 ng/g	Acenaphthene	10 ng/g	Endrin aldehyde	2 ng/g
Aroclor 1242	20 ng/g	Fluorene	5 ng/g	o,p'-DDT	2 ng/g
Aroclor 1248	10 ng/g	Phenanthrene	5 ng/g	Toxaphene	80 ng/g
Aroclor 1254	10 ng/g	Anthracene	5 ng/g	o,p'-DDE	2 ng/g
Aroclor 1260	10 ng/g	Fluoranthene	5 ng/g	Aldrin	2 ng/g
Aroclor 1262	10 ng/g	Pyrene	5 ng/g	a-BHC	2 ng/g
Total PCB	10 ng/g	Benz(a)anthracene	10 ng/g	b-BHC	2 ng/g
		Chrysene	10 ng/g	d-BHC	2 ng/g
		Benzo(b)fluoranthene	10 ng/g	Lindane	2 ng/g
		Benzo(k)fluoranthene	10 ng/g	a-Chlordane	2 ng/g
		Benzo(a)pyrene	5 ng/g	g-Chlordane	2 ng/g
		Indeno(1,2,3-cd)pyrene	20 ng/g	p,p'-DDD	2 ng/g
		Dibenzo(a,h)anthracene	20 ng/g	p,p'-DDE	2 ng/g
		Benzo(ghi)perylene	20 ng/g	p,p'-DDT	2 ng/g
				Dieldrin	2 ng/g
				Endosulfan I	2 ng/g
				Endosulfan II	2 ng/g
				Endosulfan sulfate	2 ng/g
				Endrin	2 ng/g
				Heptachlor	2 ng/g
				Heptachlor epoxide	2 ng/g
				Methoxychlor	8 ng/g
				Mirex	2 ng/g
				Octachlorostyrene	2 ng/g

Table 2 cont. Analytical Parameters and Laboratory Method Detection Limits
b. Caduceon Enterprises (Metals)

Parameters	Units	MDL
Aluminum	%	0.01
Antimony	ìg/g	5
Arsenic	ìg/g	5
Barium	ìg/g	1
Beryllium	ìg/g	0.2
Bismuth	ìg/g	5
Cadmium	ìg/g	1
Calcium	%	0.01
Chromium	ìg/g	1
Colbalt	ìg/g	1
Copper	ìg/g	1
Iron	%	0.01
Lead	ìg/g	1
Lithium	ìg/g	1
Magnesium	%	0.01
Manganese	ìg/g	1
Molybdenum	ìg/g	1
Nickel	ìg/g	1
Niobium	ìg/g	5
Potassium	%	0.05
Silver	ìg/g	0.5
Sodium	%	0.01
Strontium	ìg/g	1
Tin	ìg/g	20
Titanium	ìg/g	1
Tungstem	ìg/g	20
Vanadium	ìg/g	1
Yttrium	ìg/g	1
Zinc	ìg/g	1
Mercury	ng/g	5

All laboratory method detection limits were below sediment quality guidelines, with the exception of cadmium (Federal Probable Effect Level = 0.6 ìg/g).

3.3 Laboratory Results

A review of the detection frequency of analytical parameters and exceedences of sediment quality guidelines is provided here. A discussion of the highest observed levels is provided for selected parameters in Section 4. A full listing of the laboratory data for the 131 unique sites is provided in Appendix A. The blind duplicate sample data are not provided but may be obtained from Environment Canada upon request.

3.3.1 Frequency of Detection

In general, organochlorine parameters were not detected, with some notable exceptions. A total of eleven (11) organochlorine parameters were not detected in any sample. In addition, five (5) of the nine (9) PCB Aroclors analyzed were not detected. Each of the PAHs was detected in at least one sample. Four (4) metals parameters were not detected in any sample. The parameters that were not detected are listed below in Table 4.

Table 4. Parameters Not Detected

Organochlorines
• Hexachlorobenzene • Octachlorostyrene • Endrin aldehyde • Toxaphene • Aldrin • a-BHC • b- BHC • d-BHC • Endrin • Heptachlor • Heptachlor epoxide
PCB Aroclors
• Aroclor 1262 • Aroclor 1016 • Aroclor 1221 • Aroclor 1232 • Aroclor 1268
Metals
• Bismuth • Niobium • Antimony • Tungsten

The frequency of detection of the remaining parameters is provided in Table 5, below. Recall that a total of 131 tributaries were sampled. Metals were commonly detected due to their natural presence in sediments. Polycyclic aromatic hydrocarbons were also commonly detected, but this is likely due to anthropogenic sources. Of the organochlorines, the DDT metabolite DDE was the most frequently detected parameter.

Table 5. Frequency of Detection by Parameter

Organochlorines	# Detections	Frequency
P,p'-DDE	92	70%
P,p'-DDD	54	41%
P,p'-DDT	39	30%
O,p'-DDD	19	15%
Endosulfan II	19	15%
O,p'-DDT	18	14%
Endosulfan sulfate	18	14%
g-Chlordane	17	13%
a-Chlordane	15	11%
Endosulfan I	9	7%
Dieldrin	8	6%
Methoxychlor	7	5%
O,p'-DDE	1	1%
Lindane	1	1%
Mirex	1	1%

PAH	# Detections	Frequency
TotalPAH	128	98%
Fluoranthene	126	96%
Pyrene	125	95%
Phenanthrene	119	91%
Benz (a)anthracene	113	86%
Chrysene	113	86%
Benzo(a)pyrene	110	84%
Benzo(b)fluoranthene	101	77%
Benzo(k)fluoranthene	96	73%
Benzo(ghi)perylene	93	71%
Indeno(1,2,3-cd)pyrene	90	69%
Fluorene	80	61%
Naphthalene	64	49%
Acenaphthylene	64	49%
Dibenzo(a,h)anthracene	60	46%
Acenaphthene	53	40%

Metal	# Detections	Frequency
Aluminum	103	100%
Barium	103	100%
Calcium	103	100%
Cobalt	103	100%
Chromium	103	100%
Copper	103	100%
Iron	103	100%
Lithium	103	100%
Magnesium	103	100%
Manganese	103	100%
Sodium	103	100%
Nickel	103	100%
Lead	103	100%
Strontium	103	100%
Titanium	103	100%
Vanadium	103	100%
Ytrium	103	100%
Zinc	103	100%
Mercury	103	100%
Potassium	101	98%
Beryllium	99	96%
Arsenic	82	80%
Silver	64	62%
Molybdenum	18	17%
Cadmium	11	11%
Tin	1	1%

PCB	# Detections	Frequency
Total PCB	65	50%
Aroclor 1254	65	50%
Aroclor 1260	53	40%
Aroclor 1242	8	6%
Aroclor 1248	2	2%

3.3.2 Comparison of Results with Sediment Quality Guidelines

The sediment quality results were compared to the Canadian Environmental Quality Guidelines (Canadian Council of Ministers of the Environment (CCME), 2002). The CCME sediment quality guidelines provide scientific benchmarks, or reference points, for evaluating the potential for observing adverse biological effects in aquatic systems. The guidelines are derived from available toxicological information. A lower value, referred to as the threshold effect level (TEL), represents the concentration below which adverse biological effects are expected to occur rarely. The upper value, referred to as the probable effect level (PEL), represents the level above which adverse effects are expected to occur frequently. Fewer than 25% of adverse effects (in the Biological Effects Database for Sediments) occur below the TEL, and more than 50% of adverse effects occur above the PEL.

Where no federal guidelines were available, the provincial guidelines were used for comparison (Persaud et al., 1992). Provincial Severe Effect Levels for organic compounds and polycyclic aromatic hydrocarbons were calculated individually for each site using the organic carbon concentration in the sediment.

Table 6 provides a summary of the numbers of exceedences of the federal and provincial sediment quality guidelines. A complete list of the sediment quality guidelines themselves is provided in Appendix B.

Table 6. Number of Sites Exceeding Sediment Quality Guidelines

A. Metals	Federal Guidelines		Provincial Guidelines	
	Exceeds TEL[1] Below PEL	Exceeds PEL[2]	Exceeds LEL[3] Below SEL	Exceeds SEL[4]
Arsenic	42	3	39	0
Cadmium	91	3	94	0
Chromium	17	5	31	5
Copper	43	1	83	2
Iron			26	1
Manganese			79	8
Nickel			41	0
Lead	33	7	48	1
Zinc	44	22	64	4
Mercury	8	1	8	0
B. Organochlorines				
Lindane		1	0	0
Chlordane	6	7	9	0
p,p'-DDD			19	1
p,p'-DDE			68	0
Total DDD (o,p' + p,p')	19	20		
Total DDE (o,p' + p,p')	27	65		
Total DDT (o,p' + p,p')	15	25	22	0
Total DDT (incl. metabolites)			64	2
Dieldrin	4	1	5	0
PCB Aroclor 1248			2	0
PCB Aroclor 1254	3	1	4	0
PCB Aroclor 1260			49	0
Total PCB	31	2	13	0

Table 6 cont. Number of Sites Exceeding Sediment Quality Guidelines

C. Polycyclic Aromatic Hydrocarbons	Exceeds TEL[1] Below PEL	Exceeds PEL[2]	Exceeds LEL[3]	Exceeds SEL[4]
Naphthalene	13	2		
Acenaphthylene	58	1		
Acenaphthene	53	9		
Fluorene	40	8	7	0
Phenanthrene	87	24	24	0
Anthracene	47	9	10	0
Fluoranthene	85	9	36	0
Pyrene	89	22	39	0
Benz(a)anthracene	88	21	25	0
Chrysene	84	12	38	0
Benzo(k)fluoranthene			18	0
Benzo(a)pyrene	83	8	19	0
Indeno(1,2,3-cd)pyrene			35	0
Dibenzo(a,h)anthracene	60	9	27	0
Benzo(ghi)perylene			41	0

Notes: 1 Federal Threshold Effect Level
2 Federal Probable Effect Level
3 Provincial Lowest Effect Level
4 Provincial Severe Effect Level

4.0 Discussion

4.1 DDT and Metabolites

DDT (dichlorodiphenyltrichloroethane) is a chlorinated hydrocarbon that has broad-spectrum pesticide properties. It was used in large quantities in the 1950s and 1960s on crops. The U.S. banned the use of DDT in 1973. The use of DDT in Canada was severely restricted in the early 1970s and discontinued in 1985, with the sale and use of existing stocks permitted until the end of 1990 (CCME, 2002). DDT is still used as an insecticide in other countries.

DDT has two metabolites: DDE (dichlorodiphenyldichloroethylene) and DDD (dichloro-diphenyldichloroethane). Each DDT molecule has several isomeric forms, depending on the configurations of the chlorine atoms on the molecule. For comparison with sediment quality guidelines, the laboratory results were analysed according to the following:

Total DDT = o-p’- plus p-p’DDT
Total DDE = o-p’- plus p-p’DDE
Total DDD = o-p’- plus p-p’DDD
Total DDT and metabolites = Total DDT + Total DDE + Total DDD

DDT, including its metabolites, was the most commonly detected organochlorine compound in the current study. A full 72% of samples had detectable quantities of one or more isomer of DDT or its metabolites. The most commonly detected isomer was p-p’-DDE, with a detection frequency of 70%.

DDE was also the parameter that most frequently exceeded sediment quality guidelines. Sixty-five (65) tributaries were found to contain DDE concentrations in excess of the federal probable effect level (6.75 ng/g) and a further 27 tributaries had DDE concentrations exceeding the threshold effect level (1.42 ng/g).

Analysis of the proportion of total DDT comprised by parent product (rather than metabolites) indicates that recent sources of the pesticide may be contributing to the observed concentrations in Lake Ontario tributaries. In eight (8) tributaries, more than ½ of the observed total DDT was parent compound (DDT isomers), not metabolites (DDE or DDD isomers). In some of these tributaries, the concentration of total DDT was also anomalously high. The tributaries with the highest total DDT concentrations are listed below with the proportion of parent DDT (calculated as the ratio of DDT isomers to total DDT, including metabolites) also provided for comparison purposes.

Tributary	Total DDT Concentration (including metabolites) (ng/g)	Proportion of Parent DDT (%)
Bartlett Creek	1,214	43%
Clareview Creek	359	29%
Richardson Creek	340	16%
Two Mile Creek	254	28%
Usshers Creek	228	11%
Four Mile Creek	191	12%
Baker Creek	186	15%
Thirty Mile Creek	184	42%
Treasure Creek	132	28%
Fifty Mile Creek	117	8%
Joshuas Creek	99	34%

A map of the distribution of the DDE exceedences is shown in Figure 2. The map shows that the exceedences are widespread, but the highest concentrations (in excess of 100 ng/g) are all observed in tributaries in the Niagara Region.

DDT is one of the six parameters considered to be lakewide critical pollutants for Lake Ontario. The information from this survey indicates that elevated concentrations may be the result of ongoing sources in certain tributaries. Targeted studies are recommended to determine if ongoing sources of DDT exist in these watersheds.

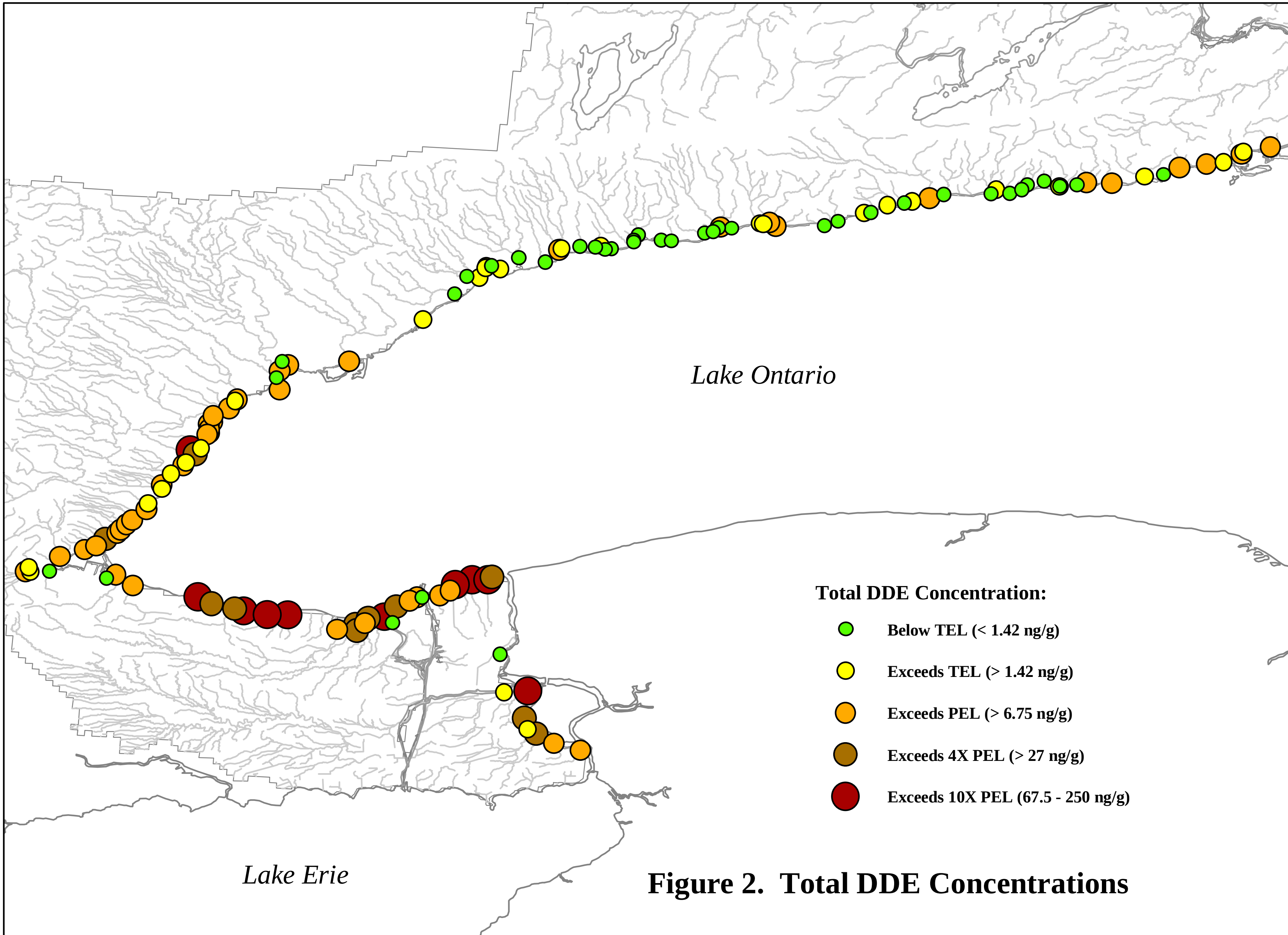

Figure 2. Total DDE Concentrations

4.2 Other Pesticides

4.2.1 Dieldrin

Dieldrin is the major breakdown product of aldrin, a pesticide that was used primarily for termite control and on selected crops. Aldrin and dieldrin are banned in the U.S. and have been discontinued in Canada since 1990.

Aldrin was not detected at any site, but its breakdown product dieldrin was detected at 8 sites. Dieldrin was found at concentrations exceeding the PEL of 6.67 ng/g at one site and exceeding the TEL of 2.85 ng/g at a further four (4) sites. In most cases, the detections were in relatively small tributaries located in urban areas. Figure 3 shows the distribution of dieldrin concentrations across the basin.

Tributary	Dieldrin Concentration (ng/g)
Indian Creek	14
Morrison Creek	4
Richardson Creek	3
Bellamy Ravine Creek	3
Humber River	3

4.2.2. Chlordane

Chlordane is a banned organochlorine insecticide that was used on crops and for flea and ticks on pets. Canada discontinued its use in 1990 due to its persistence and toxicity. Chlordane consists of two isomers; total chlordane was calculated as the sum of a-chlordane and g-chlordane for comparison with sediment quality guidelines.

Total chlordane was detected at eighteen sites, and found above its federal guideline of 8.87 ng/g in the seven tributaries listed below. Other pesticides were also detected at relatively high concentrations at several of these sites (e.g., Richardson Creek also had elevated dieldrin and DDT, Treasure Creek showed elevated DDE, Falcon and Joshua Creeks had elevated endosulfan), therefore local pesticide practices may be adversely impacting on sediment quality in these watersheds.

Tributary	a-Chlordane ng/g	g-Chlordane ng/g	Total Chlordane ng/g
Richardson Creek	20	18	38
Treasure Creek	12	11	23
Walkers Creek	9	8	17
Spring Garden Creek	9	5	14
One Mile Creek	5	6	11
Falcon Creek	5	5	10
Joshua’s Creek	5	4	9

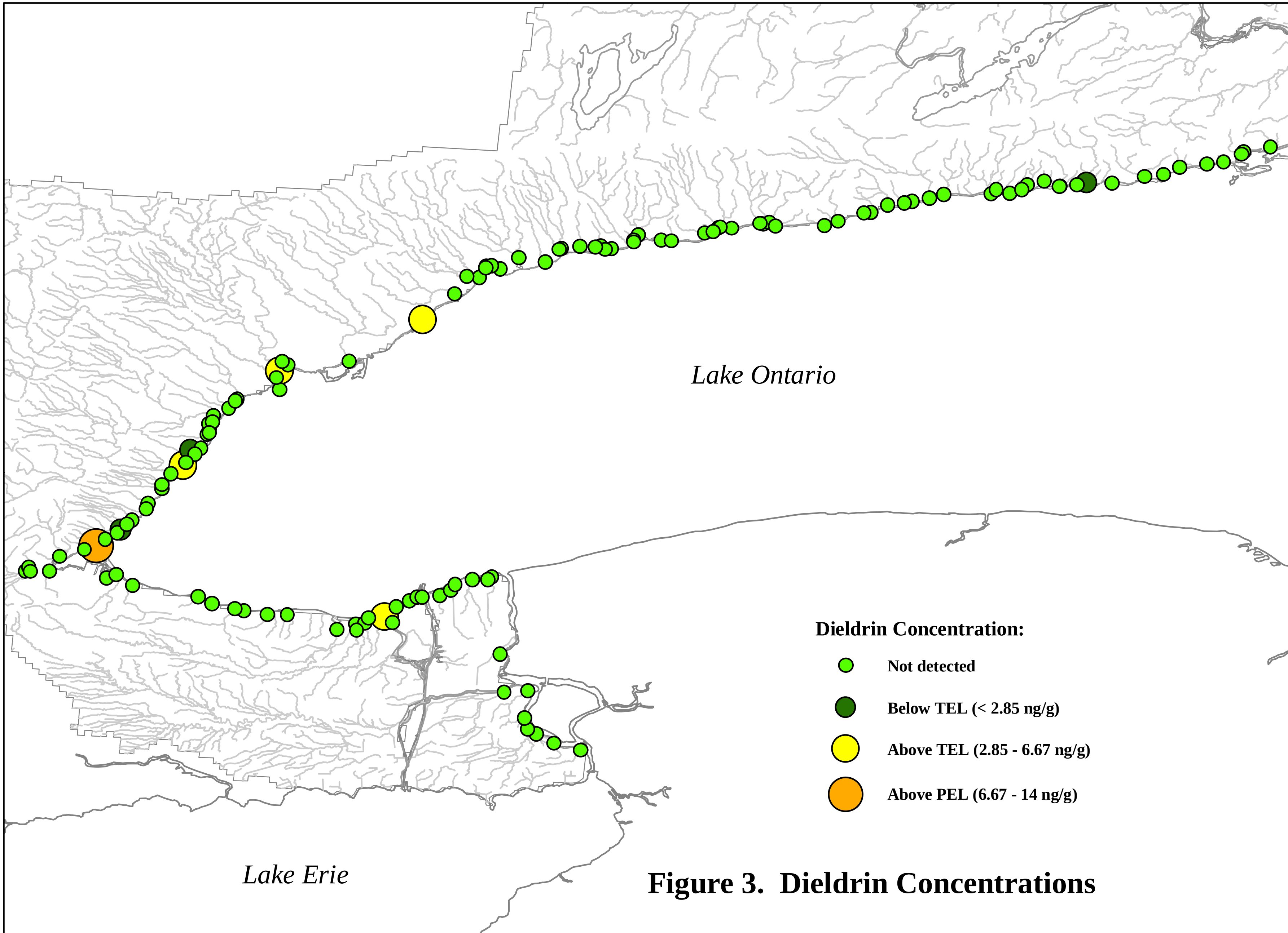

Figure 3. Dieldrin Concentrations

4.2.3 Endosulfan

Endosulfan is a current-use insecticide that is the most heavily applied organochlorine in Ontario (Harris et al., 1998). It is used as an alternative for more persistent organochlorines on a multitude of crops. The heaviest use is in the southern and western portions of the province.

Technical grade endosulfan is a mixture of two stereoisomers; endosulfan I and endosulfan II are present in approximately a 7:3 ratio, respectively (NRCC, 1975). Both were measured in the current study, as well as the primary break-down product of both isomers, endosulfan-sulfate.

One or more isomer of endosulfan was found at 26 sites. In 58% of these cases, the breakdown product was the dominant form. Two tributaries, Falcon Creek and Roseland Creek, contained the highest concentrations of total endosulfan (calculated as the total concentration of the three endosulfan parameters), and the parent compounds were also observed in higher quantities than the break-down product. In Falcon Creek, 72% of all the endosulfan consisted of the parent products (endosulfan I and endosulfan II); in Roseland Creek, 67% of the total endosulfan consisted of parent products. Both of these creeks are located in Burlington, Ontario.

Figure 4 shows the distribution of endosulfan sulfate in tributary sediments across the basin. There were numerous detections in the Niagara Region, but the highest concentrations were observed in tributaries in the Burlington and Oshawa areas.

4.2.4 Lindane

Lindane (or gamma-hexachlorocyclohexane) is a pesticide that is used primarily in Canada as a seed treatment for canola crops and it is also contained in lotions for the treatment of scabies and lice in domestic and agricultural animals and in humans. The use of lindane has recently come under review by the Canadian Pest Management Regulatory Agency, and registered growers of canola have recently agreed to voluntarily withdraw the use of lindane for seed treatment (NRTEE, 2001).

Lindane was only detected in one tributary, Avonhead Creek, located in Mississauga, but it was found to be above the federal probable effect level (3 ng/g compared to the PEL of 1.38 ng/g).

4.2.5 Mirex

Mirex is a banned pesticide that was used previously as a fire ant control and as a flame retardant in plastics, rubber, paint, paper and electrical goods. Mirex was only detected in one tributary, Stoney Creek (0.004 μg/g). There is no federal sediment quality guideline for mirex; the provincial LEL is 0.007 μg/g. The Great Lakes Water Quality Agreement and the Canadian Environmental Protection Act state that discharges of mirex shall be virtually eliminated from the environment. There is no known past use or production of mirex in the Stoney Creek watershed, and its detection would need to be confirmed prior to any further targeted action.

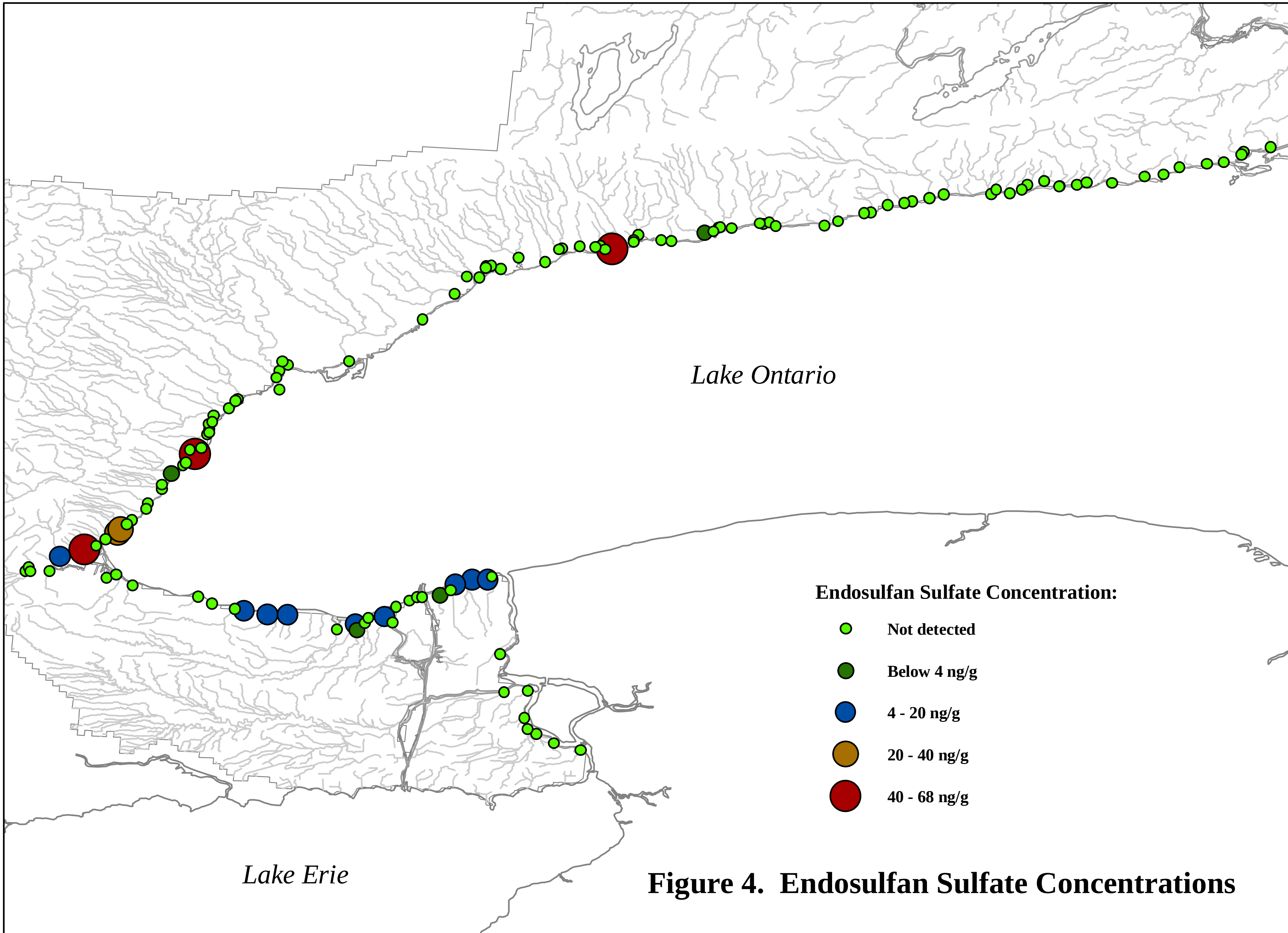

Figure 4. Endosulfan Sulfate Concentrations

4.3 PCBs

Polychlorinated biphenyls, or PCBs, were commonly used in electrical equipment such as transformers and capacitors due to their chemical stability. The manufacture of PCBs was halted in 1977 in the United States. PCBs were not produced in Canada but approximately 40 000 tonnes of PCBS were imported and used commercially prior to the 1980s. Like many other organochlorine compounds, PCBs are persistent, bioaccumulative and toxic. They are the cause of the majority of the fish consumption advisories in each of the Great Lakes and they are considered a priority pollutant by many authorities. The Great Lakes Water Quality Agreement calls for the virtual elimination of discharges of PCBs.

In the current study, PCBs were analysed in the laboratory as Aroclors, the trade name that describes the complex mixture of PCB congeners under which some PCBs were manufactured. This method is much less expensive than the more elaborate congener analyses although it is also less precise and less accurate. The detection limit for Aroclor analysis was 10 ng/g, which is below the sediment quality guidelines and sufficient for the purposes of detecting PCBs in sediments.

Only four of the nine PCB Aroclors were detected in this study. Aroclors 1254, 1260, 1242 and 1248 were detected at 65, 53, 8 and 2 sites, respectively. One or more aroclor was detected in 65 tributaries, representing 50% of all sites sampled. In about one-half of cases where PCBs were detected, the concentration was below the Federal TEL of 34.1 ng/g. The TEL was exceeded at 31 sites, and the PEL (277 ng/g) was exceeded at a further two (2) sites. As shown in Figure 5, the highest concentrations of PCBs were found in a small creek in Hamilton and in 12 Mile Creek near St. Catharines. Sites with Total PCB concentrations above 70 ng/g (the provincial LEL) are listed below.

Tributary	Total PCB concentration (ng/g)
Pioneer Creek	2800
12 Mile Creek	650
West Corbett Creek	230
Redhill Creek	220
Don River	160
Spencer Creek	120
Oshawa Creek	120
Wendigo Creek	110
Tecumseh Creek	100
Appleby Creek	100
Aerocar Creek	90
Humber River	80
Montgomery Creek	80

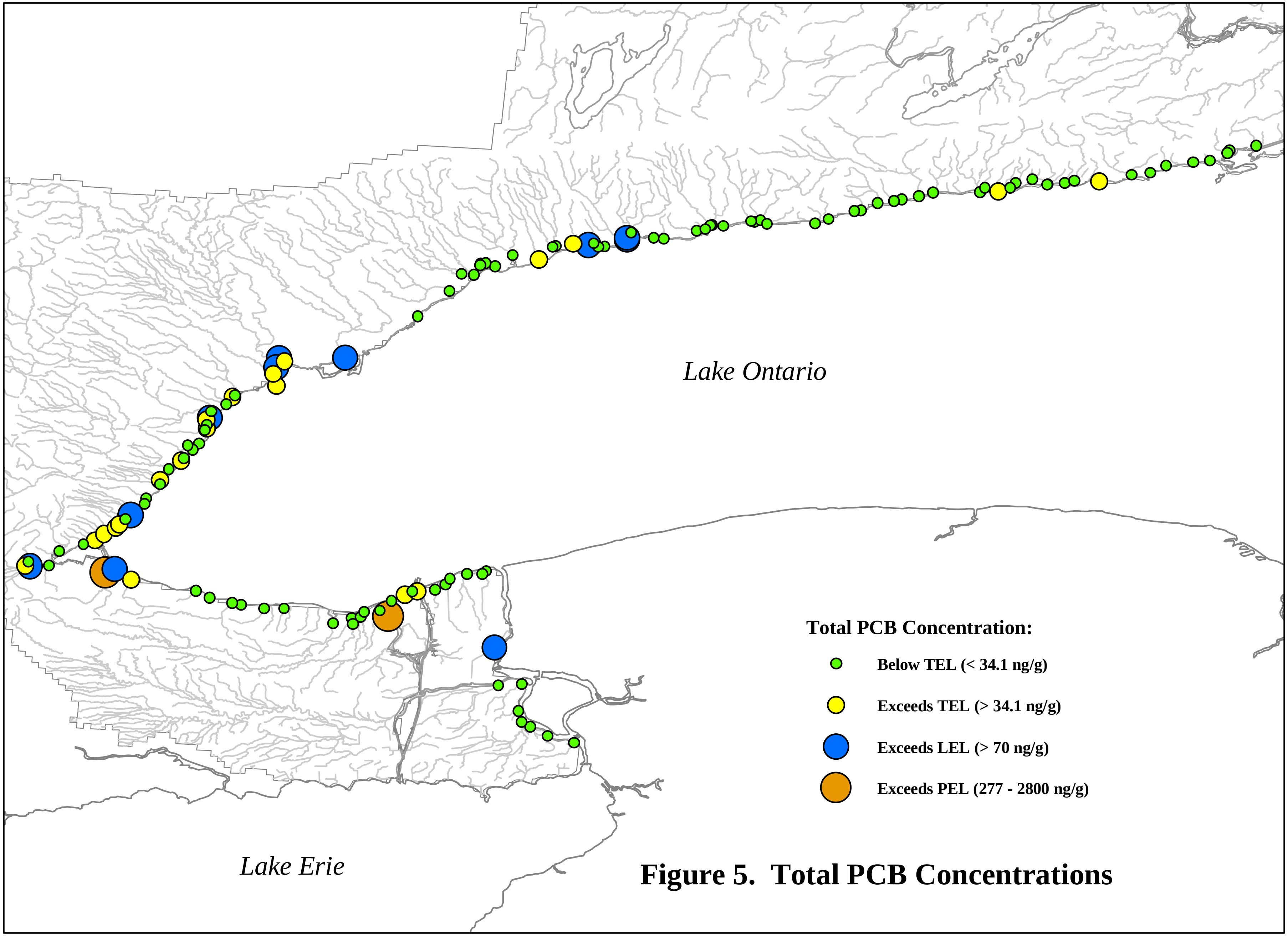

Figure 5. Total PCB Concentrations

At the sites showing PEL exceedences, confirmatory sampling will be initiated. In the case of 12-Mile Creek, a track-down project was initiated by the Ontario Ministry of the Environment in 1999 to attempt to identify the source(s) of contamination. The federal and provincial environmental agencies in Ontario (the Ontario Ministry of the Environment and Environment Canada) have partnered to conduct follow-up work at additional locations in the Great Lakes basin where ambient data indicates potentially significant sources of PCBs may exist. This track-down program is part of the parties' commitment to achieve the virtual elimination of discharges of PCBs in the Great Lakes basin.

4.4 PAHs

Polycyclic aromatic hydrocarbons are produced during the incomplete combustion of organic substances, most commonly the combustion of fossil fuels. As an indicator of human industrial activities, PAH contamination is relatively widespread.

PAHs were commonly detected in the current survey. Of the 16 PAH compounds measured, one or more was found in all but three of the tributaries. The 11 most commonly detected PAHs were found at more than half of the sites examined (see Table 5). A listing is provided below of the ten tributaries with concentrations of total PAH greater than 10,000 ng/g. Sites with the highest total PAH concentrations were located in the most densely populated portion of the basin, between Hamilton and Toronto.

Tributary	Total PAH concentration (ng/g)
Pioneer Creek	71,566
Stoney Creek	25,967
Rambo Creek	19,916
Applewood Creek	19,265
Shoreacres Creek	18,838
Wendigo Creek	16,985
Montgomery Creek	14,751
Chedoke Creek	14,482
Roseland Creek	12,605
Tuck Creek	11,613

4.5 Metals

4.5.1 Arsenic

Arsenic (As) is a metalloid and a nonessential trace element. Its release from anthropogenic sources is mainly from gold and base metal production facilities, with smaller releases from the use of arsenical pesticides, wood preservatives, coal-fired power generation and disposal of domestic and industrial wastes (Environment Canada, 1993).

In the current study, arsenic was found to exceed sediment quality criteria relatively frequently. Of the 131 tributaries, concentrations were above the federal TEL at 45 sites, and above the PEL at three (3) sites. Exceedences of the TEL may be due to naturally elevated As levels. In the National Geochemical Reconnaissance (NGR) program of the Geological Survey of Canada, the

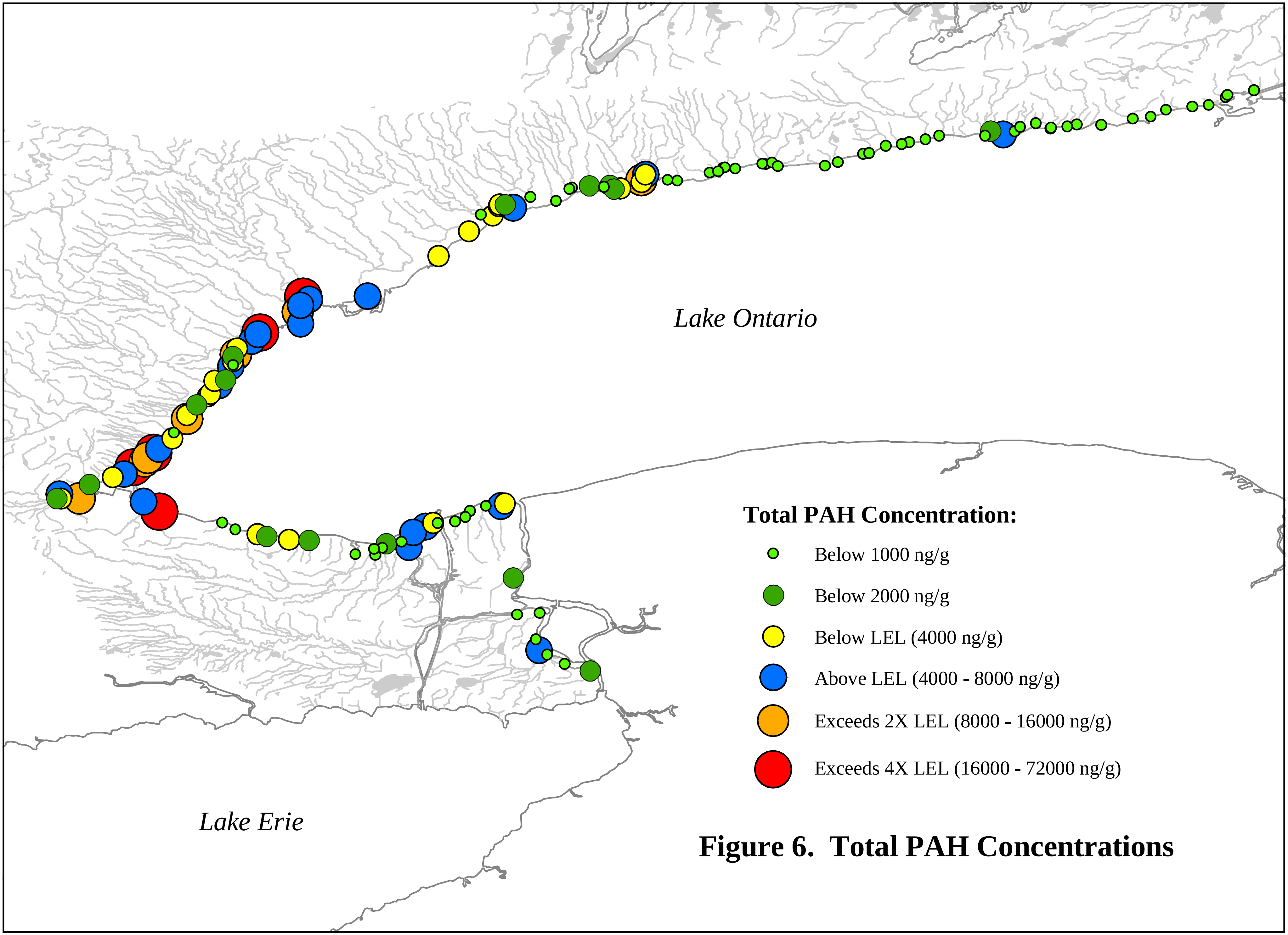

Figure 6. Total PAH Concentrations

mean concentration of arsenic in stream sediments was determined to be 10.7 ìg/g (P.W.B. Friske, 1996 in CCME 2002), which is greater than the federal TEL of 5.9 ìg/g. The PEL exceedences coincide with locations having elevated concentrations of other contaminants and are likely related to anthropogenic activities. A listing of sites showing arsenic concentrations in exceedence of the PEL is provided below.

Tributary	As (ìg/g)
Pioneer Creek	30
Indian Creek	23
Bakers Creek	18

4.5.2 Cadmium

Cadmium (Cd) is a non-essential trace element that is produced commercially from base-metal smelters and refineries, especially zinc refining. It is used in batteries, coatings, pigments, stabilizers and alloys (Hoskin, 1991 in Environment Canada, 1994a). In the current study, the laboratory detection limit of 1 ìg/g was higher than the federal TEL of 0.6 ìg/g. Natural, background levels of cadmium may also be greater than the TEL, as the NGR program determined the mean concentration of cadmium in stream sediments to be 0.63 ìg/g (P.W.B. Friske, 1996 in CCME 2002). In an assessment of the NGR data, Painter et al. (1994) found that 95% of the data were below 1.3 ìg/g.

Cadmium was detected in 19 tributaries in the current study. Three sites showed cadmium concentrations in exceedence of the PEL of 3.5 ìg/g, as listed below. Other contaminants were also found to be elevated in these creeks, and the Cd concentrations in these tributaries likely reflect watershed sources.

Tributary	Cd (ìg/g)
Pioneer Creek	7
Aerocar Creek	4
Montgomery Creek	4

4.5.3 Chromium

Chromium (Cr) is an essential trace element that can be toxic to organisms at elevated levels (CCME 2002). It is not mined in Canada, but its import contributes to the production of pigments, metal finishing, leather tanning and wood preservatives (Nriagu 1988 in Environment Canada 1994b).

Chromium was found at concentrations exceeding the TEL of 37.3 ìg/g at 22 sites, including the five listed below which also exceeded the PEL of 90 ìg/g.

Tributary	Cr (ìg/g)
West Corbett Creek	311
Port Granby Creek	244
Pioneer Creek	209
Intrepid Creek	163
Montgomery Creek	150

4.5.4 Copper

Copper (Cu) is an essential trace element whose anthropogenic sources are mainly from mining and smelting operations. Naturally elevated copper concentrations may contribute to the copper content in streambed sediments. In an analysis of the NGR sediment database, Painter et al. (1994) found that 95% of Cu concentrations were below 76 ìg/g. In the current study, eight sites exceeded this level, as listed below. The highest concentration, 322 ìg/g in Pioneer Creek, Hamilton, comprised the only exceedence of the PEL of 197 ìg/g.

Tributary	Cu (ìg/g)
Pioneer Creek	322
Montgomery Creek	114
Redhill Creek	92
Chedoke Creek	86
Mimico Creek	84
Dunbarton Creek	83
Stoney Creek	80
Don River	80

4.5.5 Mercury

Mercury (Hg) is a nonessential trace element that is toxic, persistent and bioaccumulative. Fish consumption advisories are in effect for mercury in much of the Great Lakes ecosystem. Current uses of mercury include some batteries, dental fillings, thermometers and switches, cathode tubes and household cleaners. Sources of mercury to the environment include mining and smelting, wastewater, fossil fuel combusion and waste incineration.

Sediment from most tributaries contained relatively low concentrations of mercury. Nine sites exceeded the federal TEL of 170 ng/g, including one site which exceeded the PEL of 486 ng/g, as listed below. Local, natural mercury deposits can impact environmental concentrations. The 95^{th} percentile for mercury in the NGR database was determined to be 190 ng/g (Painter et al., 1994). Levels above this are therefore unlikely to be of natural origin.

Tributary	Hg (ng/g)
Montgomery Creek	668
Morrison Creek	433
Chedoke Creek	403
Roseland Creek	393
Pioneer Creek	383
Twelve Mile Barnes	371
Miller Creek	287
Redhill Creek	266
Cooksville Creek	198

As shown in Figure 7 and the above table, only one site contained mercury in excess of the federal PEL. This tributary, Montgomery Creek, is located in Oshawa and was also determined to have elevated concentrations of cadmium, chromium, copper, zinc and relatively high PAH concentrations. A confirmatory sampling event is planned prior to additional, targeted sampling. Mercury is considered to be a lakewide critical pollutant in the Lake Ontario LaMP, therefore targeted actions will be required to address any significant ongoing source of this metal to the lake.

4.5.6 Nickel

Nickel (Ni) is a trace element whose primary anthropogenic sources include primary base metal production and fossil fuel combustion (Environment Canada, 1994c). There is no federal sediment quality guideline for Ni, therefore sediment concentrations were compared with the provincial guidelines. The Lowest Effect Level (LEL) of 16 ìg/g was exceeded at 41 sites. However, exceedences of the LEL can occur naturally. Analysis of the NGR database of stream and lake sediment metals concentrations showed that the 95^{th} percentile for nickel concentration was 60 ìg/g (Painter et al., 1994). Levels greater than this are more likely to indicate anthropogenic impacts. In the current study, only Montgomery Creek exceeded this level, at 67 ìg/g.

4.5.7 Lead

Lead (Pb) is a nonessential trace element. Its past use as an additive in gasoline has resulted in its widespread distribution in the environment above background levels. Currently, sources of lead to the environment include lead processing activities, batteries, and industrial and municipal effluents. Lead concentrations exceeded the federal TEL of 35 ìg/g at 40 sites and the PEL of 91.3 ìg/g at seven (7) sites. Sites showing PEL exceedences are listed below.

The 95^{th} percentile of stream and lake sediment lead concentration in the NGR database was 25 ìg/g (Painter et al., 1994). TEL exceedences are therefore likely due to anthropogenic sources. The high number of TEL exceedences may be due to the widespread use of lead in the past as a fuel additive. At the 7 sites showing PEL exceedences, local sources may also be contributing to elevated levels in the stream sediments.

Tributary	Pb (ìg/g)
Pioneer Creek	296
Montgomery Creek	227
Robinson Creek	116
Applewood Creek	113
GM Drain	109
Stoney Creek	96
Rambo Creek	93

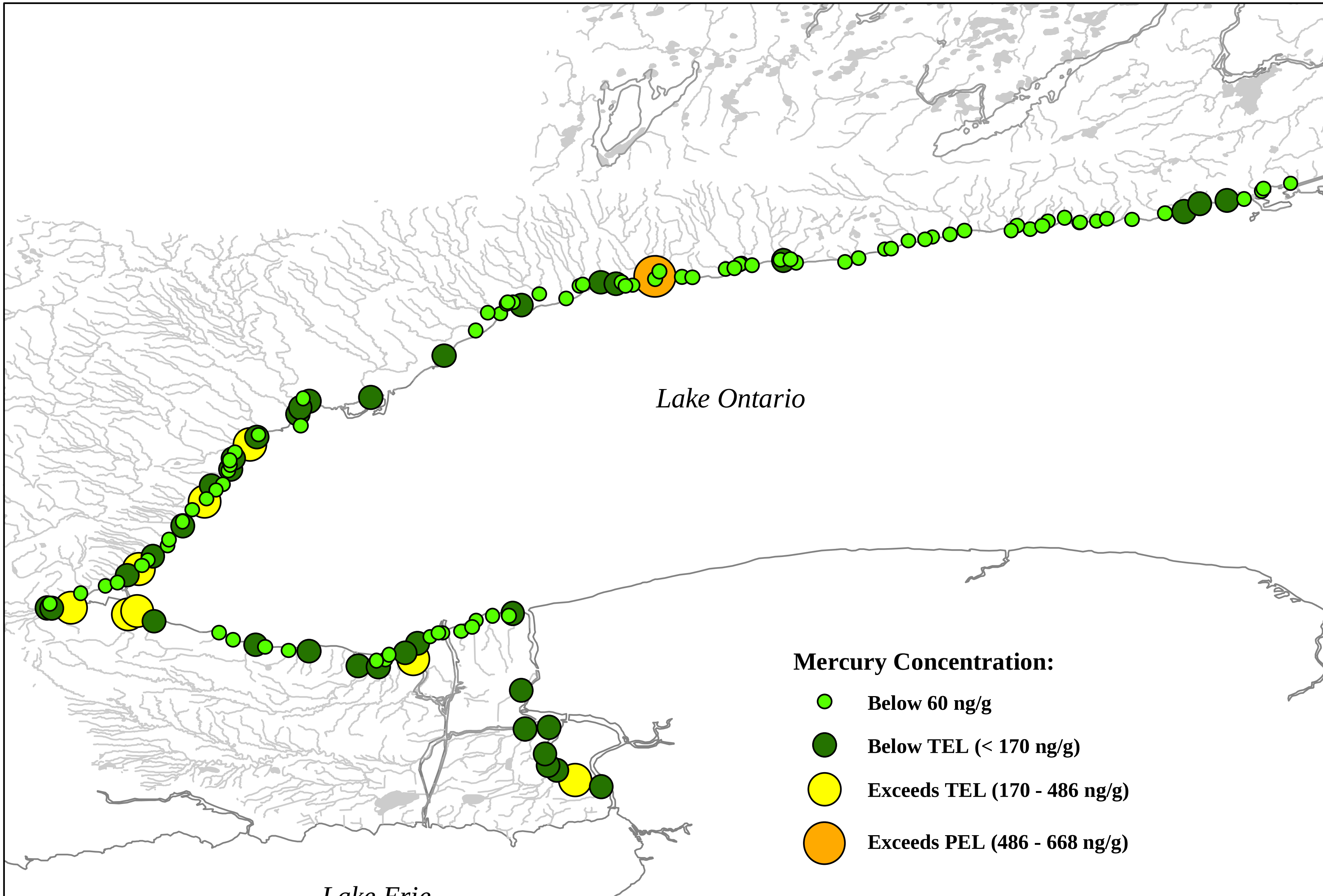

Figure 7. Mercury Concentrations

4.5.8 Zinc

Zinc (Zn) is an essential trace element that is considered toxic to aquatic biota at elevated concentrations (CCME, 2002). Anthropogenic zinc sources are primarily related to metals processing, with smaller releases from fossil fuel burning and ancillary sources such as fertilizers, rubber goods and pharmaceuticals.

In the current study, the federal TEL of 124 ìg/g was exceeded at 66 sites, and the PEL of 315 ìg/g was exceeded at 22 sites. The 95th percentile zinc sediment concentration in the NGR database was 191 ìg/g; 30% of tributaries in the current study exceeded this. The four sites with the highest concentrations also exceeded the provincial SEL of 820 ìg/g, as listed below.

Tributary	Zn (ìg/g)
GM Drain	1587
Pioneer Creek	1572
Montgomery Creek	1303
Aerocar Creek	874

4.5.9 Manganese and Iron

Concentrations of the essential metals manganese and iron were compared with provincial sediment quality guidelines as no federal guidelines are available. Manganese (Mn) concentrations exceeded the LEL of 460 ìg/g at the majority of sites (87) and the SEL of 1100 ìg/g was exceeded at a further eight sites. The eight SEL exceedences are listed below. These exceedences may or may not be related to industrial impacts, but some of these sites (e.g., Pioneer and West Corbett Creeks) also showed guideline exceedences for other parameters.

Tributary	Mn (ìg/g)
Pioneer Creek	2115
West Corbett Creek	1865
Fifty Creek	1421
Salem Creek	1379
One Mile Creek	1300
Stoney Creek	1275
Wesleyville Marsh Creek	1262
Grindstone Creek	1178

For iron, background levels may also be high due to natural sources. Ontario Geological Survey stream sediment data (Fortescue, 1984) shows that the median iron concentration is 3.1% and the 95th percentile of iron concentrations is 5.5%. These values are higher than the provincial LEL of 2% and the SEL of 4%. In the current study, 27 sites exceeded the LEL, including sites at which contamination from anthropogenic sources would not be expected. Only one site, Pioneer Creek, showed an iron concentration in exceedence of the SEL (4.97%).

4.5.10 Other Metals

Silver

Four creeks showed anomalously high concentrations of silver (Ag). The 95th percentile of silver concentrations observed in the current study was 1.5 ìg/g. The creeks listed below showed concentrations of silver above this level. Silver might be contributed by a variety of anthropogenic sources, including industrial sources (e.g., photographic processing or dentistry sources) as well as solid waste or other sources.

Tributary	Ag (ìg/g)
Etobicoke Creek	2.5
Montgomery Creek	2.5
Desjardins Canal	2.0
Don River	2.0

Tin

Tin (Sn) was only detected in three creeks, as listed below. There are no sediment quality guidelines for tin. Tin is principally used as a coating for other metals such as steel in order to prevent corrosion. Organotin compounds are considered to be pollutants of concern; however, total tin was measured here. Two of the three creeks in which tin was detected are located in the Hamilton area. In one of these, Redhill Creek, the concentration was ten-fold greater than at the other sites. Confirmatory sampling is planned in 2003 to address this issue.

Tributary	Sn (ìg/g)
Redhill Creek	115
Pioneer Creek	30
Robinson Creek	20

5.0 Next Steps

The results of these surveys provide information about recently deposited sediment quality, and can be used to help identify if Canadian watersheds are sources of pollutants to the Great Lakes. The results are also used by the Lakewide Management Plans (LaMPs) to prioritize sites for any subsequent follow-up work such as source track-down projects. These screening-level surveys constitute a portion of Environment Canada’s commitment towards the binational Great Lakes Water Quality Agreement and the Canadian Environmental Protection Act, in which Canada has committed to the virtual elimination of discharges of persistent, toxic substances.

By committing to a track-down program, the federal and provincial partners have agreed to conduct follow-up work at locations where ambient data indicate potentially significant sources of persistent, bioaccumulative and toxic substances (PBTs) may exist. The program has, to date, focused on potential PCB sources. Three pilot projects have been conducted in Lake Ontario tributaries where PCB contamination is suspected based on available ambient information. Based on the experiences in these three projects, the project partners are currently developing a decision framework to guide future track-down projects; in particular, to recommend guidelines for the initiation and termination of such projects and to provide recommendations with respect to appropriate project design and sampling methodologies.

By virtue of this document and a series of booklets (in preparation), the information from the current study is being shared with other environmental authorities and partners in Ontario. Follow-up studies to investigate observed exceedences of the federal PEL for PCBs have already been carried out or are planned in 2003. Additional sampling is also planned in approximately 10 tributaries to follow up potential issues detected in this study. Based on these sampling results, a course of action will be determined by the appropriate environmental agencies.

This work represents a continuation of the screening-level surveys of sediment quality conducted by the Ecosystem Health Division of Ontario Region, Environment Canada. In 2001, approximately 100 Canadian tributaries to Lake Erie were sampled, including tributaries to the St. Clair River, Lake St. Clair and the Detroit River (Dove et al., 2002). Plans are being formulated to sample the remaining Lake Ontario tributaries, east from the Bay of Quinte, in 2003. The three years of studies will collectively provide an indication of the contaminant status of Canadian tributaries to the lower Great Lakes and their connecting channels, as well as indicate possible sources of contaminants from Ontario watersheds to the Great Lakes. When combined with other sources of environmental quality information, sites across the lower Great Lakes basin can be prioritized for any necessary targeted follow up efforts such as source track down.

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Appendix A Notes

Note: The following Organochlorine compounds were not detected in any sample and are not included in the table of laboratory results:

Hexachlorobenzene
Octachlorostyrene
Endrin aldehyde
Toxaphene
Aldrin
a-BHC
b-BHC
d-BHC
Endrin
Heptachlor
Heptachlor epoxide
Mirex
PCB Aroclor 1262
PCB Aroclor 1016
PCB Aroclor 1221
PCB Aroclor 1232
PCB Aroclor 1268
Bismuth (Bi)
Niobium (Nb)
Antimony (Sb)
Tungsten (W)

Note: An explanation of Sediment Quality Guideline Short-Forms:

Federal TEL	Threshold Effect Level
Federal PEL	Probable Effect Level
Provincial LEL	Lowest Effect Level
Provincial SEL	Severe Effect Level

Grain size classification:	
Sand	63 m - 2 mm
Silt	2 m - 63 m
Clay	< 2 m

Note: An explanation of Short-Forms and Chemical Compound Names

HCB	Hexachlorobenzene
OCS	Octachlorostyrene
a-BHC	Alpha-benzene hexachloride
b-BHC	Beta-benzene hexachloride
d-BHC	Delta-benzene hexachloride
Lindane	Gamma-benzene hexachloride
Total Chlordane	Sum of alpha- and gamma-Chlordane
o,p'-DDD	Isomer of Dichlorodiphenyldichloroethane
p,p'-DDD	Isomer of Dichlorodiphenyldichloroethane
o,p'-DDE	Isomer of Dichlorodiphenyldichloroethylene
p,p'-DDE	Isomer of Dichlorodiphenyldichloroethylene
o,p'-DDT	Isomer of Dichlorodiphenyltrichloroethane
p,p'-DDT	Isomer of Dichlorodiphenyltrichloroethane
Total DDD	Sum of o,p'- and p,p'-DDD
Total DDE	Sum of o,p'- and p,p'-DDE
Total DDT	Sum of o,p'- and p,p'-DDT
DDT & Metabolites	Sum of Total DDD, Total DDE and Total DDT
Total PCB	Sum of 9 PCB Aroclors
Total PAH	Sum of 16 PAH Compounds
Ag	Silver
Al	Aluminum
As	Arsenic
Ba	Barium
Be	Beryllium
Bi	Bismuth
Ca	Calcium

Cd	Cadmium
Co	Cobalt
Cr	Chromium
Cu	Copper
Fe	Iron
Hg	Mercury
K	Potassium
Li	Lithium
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
Na	Sodium
Nb	Niobium
Ni	Nickel
Pb	Lead
Sb	Antimony
Sn	Tin
Sr	Strontium
Ti	Titanium
V	Vanadium
W	Tungsten
Y	Yttrium
Zn	Zinc
TOC	Total organic carbon
LOI	Loss on ignition
TIC	Total inorganic carbon

Appendix A. Laboratory Results

Tributary	Latitude	Longitude	Sampling Date	Moisture	o,p'-DDD	o,p'-DDT	o,p'-DDE	Lindane	a-Chlordane	g-Chlordane	TotalChlordane	p,p'-DDD	p,p'-DDE	p,p'-DDT	TotalDDD
Name	Decimal Degrees		mm/dd/yyyy	%	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
Aerocar Creek	43.1185	-79.0730	6/3/02	51	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Airport Drain	43.2249	-79.1829	6/4/02	34	ND	ND	ND	ND	ND	ND	ND	ND	12	3	ND
Amberlea Creek	43.8220	-79.0997	7/16/02	41	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND
Appleby Creek	43.3622	-79.7435	6/18/02	58	ND	ND	ND	ND	ND	ND	ND	ND	9	ND	ND
Applewood Creek	43.5826	-79.5513	7/3/02	46	ND	ND	ND	ND	ND	8	8	8	10	ND	8
Arena Creek	44.0320	-77.7210	7/17/02	50	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	ND
Avonhead Creek	43.4930	-79.6172	7/2/02	36	ND	ND	ND	3	ND	ND	ND	5	5	ND	5
Baker Creek	43.1965	-79.5397	6/14/02	48	3	4	ND	ND	ND	ND	ND	25	130	24	28
Bakers Creek	42.9725	-79.0078	6/3/02	65	ND	ND	ND	ND	ND	ND	ND	15	39	ND	15
Barnum House Creek	43.9702	-78.0552	7/30/02	56	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bartlett Creek	43.1890	-79.4598	6/14/02	60	97	67	ND	ND	ND	ND	ND	340	250	460	437
Beach Road Creek	44.0101	-77.7873	7/17/02	79	ND	ND	ND	ND	ND	ND	ND	5	24	ND	5
Bellamy Ravine Creek	43.7274	-79.2143	7/10/02	50	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND
Bennett Creek	43.8931	-78.6523	9/17/02	49	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Birchwood Creek	43.5278	-79.6027	7/3/02	50	ND	ND	ND	ND	ND	ND	ND	3	8	ND	3
Black Creek	42.9808	-79.0238	6/3/02	48	ND	ND	ND	ND	ND	ND	ND	ND	5	ND	ND
Bouchette Point Creek	43.8981	-78.4831	9/18/02	50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bowmanville Creek	43.8944	-78.6754	9/17/02	61	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boyers Creek	43.0019	-79.0297	6/3/02	64	2	ND	ND	ND	ND	ND	ND	10	40	ND	12
Bronte Creek	43.3928	-79.7146	10/11/02	58	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	ND
Brook Creek	43.9574	-78.1455	7/31/02	55	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Brookside Creek	43.9788	-78.0832	7/30/02	49	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butler Creek	44.0136	-77.7564	7/17/02	55	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND
Carruthers Creek	43.8318	-78.9914	7/16/02	45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chedoke Creek	43.2687	-79.8934	6/11/02	56	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Clareview Creek	43.4907	-79.6376	7/2/02	56	12	25	6	ND	3	5	8	57	180	79	69
Cobourg Brook	43.9557	-78.1799	7/31/02	48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Colborne Creek	43.9872	-77.9007	7/30/02	44	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND
Cooksville Creek	43.5659	-79.5672	7/3/02	56	3	ND	ND	ND	2	ND	2	4	11	ND	7
Council Creek	43.9692	-78.0561	7/30/02	62	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND
Covert's Creek	43.9721	-78.1134	7/31/02	43	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Credit River	43.5520	-79.5948	10/11/02	60	ND	ND	ND	ND	ND	ND	ND	ND	7	ND	ND
Darlington Creek	43.8849	-78.7006	9/17/02	50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Desjardins Canal	43.2683	-79.9367	6/10/02	65	ND	ND	ND	ND	ND	ND	ND	5	10	ND	5
Don River	43.6514	-79.3479	7/4/02	58	ND	ND	ND	ND	ND	ND	ND	8	7	ND	8
Duffins Creek	43.8394	-79.0401	7/16/02	45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dunbarton Creek	43.8248	-79.0984	7/16/02	40	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND
East Corbett Creek	43.8612	-78.8903	7/18/02	46	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND
East Lynde Creek	43.8566	-78.9608	7/16/02	55	ND	ND	ND	ND	ND	ND	ND	ND	6	ND	ND
Eighteen Mile Creek	43.1720	-79.3363	7/12/02	47	ND	ND	ND	ND	ND	ND	ND	5	56	3	5
Etobicoke Creek	43.5996	-79.4751	7/4/02	44	ND	ND	ND	ND	ND	ND	ND	ND	7	ND	ND
Falcon Creek	43.3080	-79.8297	6/10/02	41	3	2	ND	ND	5	5	10	2	21	4	5
Farewell Creek	43.8811	-78.8216	8/28/02	48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fifteen Mile Creek	43.1746	-79.3200	6/26/02	55	ND	ND	ND	ND	ND	ND	ND	2	27	ND	2
Fifty Creek	43.2228	-79.6234	6/11/02	61	3	3	ND	ND	ND	ND	ND	12	93	6	15
Forty Mile Creek	43.2003	-79.5565	6/14/02	76	3	3	ND	ND	ND	ND	ND	3	35	9	6

Note: Exceedences of (any) Sediment Quality Guidelines are Indicated in Table

Appendix A. Laboratory Results

Tributary	Latitude	Longitude	Sampling Date	Moisture	o,p'-DDD	o,p'-DDT	o,p'-DDE	Lindane	a-Chlordane	g-Chlordane	TotalChlordane	p,p'-DDD	p,p'-DDE	p,p'-DDT	TotalDDD
Name	Decimal Degrees		mm/dd/yyyy	%	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
Foster Creek	43.9009	-78.5948	9/18/02	46	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	ND
Four Mile Creek	43.2537	-79.1244	6/4/02	65	5	5	ND	ND	ND	ND	ND	14	150	17	19
Fourteen Mile Creek	43.1833	-79.3130	7/12/02	47	ND	6	ND	ND	2	2	4	6	36	5	6
Fourteen Mile Oakville	43.4182	-79.6894	6/19/02	56	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND
Frenchmans Creek	42.9425	-78.9273	6/3/02	59	ND	ND	ND	ND	ND	ND	ND	4	9	ND	4
Gages Creek	43.9555	-78.2664	8/27/02	47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ganaraska River	43.9487	-78.2924	8/27/02	64	ND	ND	ND	ND	ND	ND	ND	ND	12	11	ND
GM Drain	43.8556	-78.8700	7/18/02	52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Grafton Creek	43.9725	-78.0239	7/30/02	52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Graham Creek	43.9039	-78.5831	9/18/02	57	ND	ND	ND	ND	ND	ND	ND	2	7	2	2
Grindstone Creek	43.2954	-79.8747	6/10/02	58	ND	ND	ND	ND	ND	ND	ND	4	19	15	4
Harmony Creek	43.8810	-78.8219	8/28/02	48	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	ND
Highland creek	43.7737	-79.1563	7/10/02	45	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hopkins Creek	43.2763	-79.9313	6/10/02	50	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND
Humber River	43.6334	-79.4751	10/11/02	58	ND	ND	ND	ND	ND	ND	ND	3	7	ND	3
Indian Creek	43.3145	-79.8083	6/10/02	39	2	ND	ND	ND	ND	ND	ND	9	20	9	11
Intrepid Creek	43.8547	-78.8825	7/18/02	41	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Joshuas Creek	43.4824	-79.6285	7/2/02	55	4	5	ND	ND	5	4	9	12	49	29	16
Kittling Creek	43.2097	-79.5982	6/14/02	56	ND	3	ND	ND	ND	ND	ND	14	58	21	14
Krosno Creek	43.8192	-79.0723	7/16/02	49	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND
Little Creek	43.9429	-78.3238	8/27/02	57	ND	ND	ND	ND	ND	ND	ND	ND	2	2	ND
Lornewood Creek	43.5373	-79.6039	7/3/02	46	ND	ND	ND	ND	ND	ND	ND	4	17	7	4
Loughbreeze Creek	43.9908	-77.8663	7/17/02	40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lovekin Creek	43.8974	-78.5721	9/18/02	47	ND	ND	ND	ND	ND	ND	ND	3	24	4	3
Lucas Point Creek	43.9637	-78.1238	7/31/02	39	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lyons Creek	43.0482	-79.0657	6/3/02	56	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND
McCraney Creek	43.4256	-79.6894	6/19/02	52	ND	ND	ND	ND	ND	ND	ND	ND	10	ND	ND
Midtown Creek	43.9642	-78.1697	7/31/02	46	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND
Miller Creek	42.9552	-78.9754	6/3/02	56	ND	ND	ND	ND	ND	ND	ND	7	16	ND	7
Mimico Creek	43.6212	-79.4804	7/4/02	56	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Montgomery Creek	43.8713	-78.8296	8/28/02	44	ND	ND	ND	ND	ND	ND	ND	6	ND	ND	6
Morrison Creek	43.4619	-79.6497	7/2/02	49	ND	ND	ND	ND	2	3	5	ND	10	ND	ND
One Mile Creek	43.2583	-79.0882	6/30/02	59	ND	ND	ND	ND	5	6	11	9	52	ND	9
Orchard Park Creek	43.2038	-79.2623	6/17/02	44	5	ND	ND	ND	2	3	5	9	44	5	14
Oshawa Creek	43.8678	-78.8296	8/26/02	46	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Otty Point Creek	43.9394	-78.3373	8/27/02	47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Petticoat Creek	43.8038	-79.1108	7/17/02	46	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND
Pine Creek	43.8251	-79.0885	7/16/02	50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pioneer Creek	43.2566	-79.7892	6/11/02	63	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Port Britain Creek	43.9360	-78.3676	8/27/02	53	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	ND
Port Granby Creek	43.9053	-78.4588	8/18/02	49	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pringle Creek	43.8606	-78.9288	7/16/02	60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Proctor Creek	44.0280	-77.7243	7/17/02	58	ND	ND	ND	ND	ND	ND	ND	ND	11	ND	ND
Rambo Creek	43.3272	-79.7913	6/18/02	57	ND	4	ND	ND	ND	ND	ND	16	41	13	16
Redhill Creek	43.2626	-79.7724	6/11/02	67	ND	ND	ND	ND	ND	ND	ND	ND	10	ND	ND
Richardson Creek	43.1858	-79.2839	7/12/02	56	9	12	ND	ND	20	18	38	38	240	41	47

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Appendix A. Laboratory Results

Tributary	Latitude	Longitude	Sampling Date	Moisture	o,p'-DDD	o,p'-DDT	o,p'-DDE	Lindane	a-Chlordane	g-Chlordane	TotalChlordane	p,p'-DDD	p,p'-DDE	p,p'-DDT	TotalDDD
Name	Decimal Degrees		mm/dd/yyyy	%	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
Robinson Creek	43.8714	-78.7802	8/28/02	51	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Roseland Creek	43.3388	-79.7699	6/18/02	53	ND	ND	ND	ND	ND	ND	ND	3	19	10	3
Rouge River	43.8056	-79.1340	7/16/02	41	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Salem Creek	44.0042	-77.8374	7/17/02	64	ND	ND	ND	ND	ND	ND	ND	3	7	ND	3
Sersons Creek	43.5791	-79.5554	7/3/02	46	ND	ND	ND	ND	ND	2	2	2	6	ND	2
Sheldon Creek	43.3818	-79.7172	6/19/02	55	ND	ND	ND	ND	ND	ND	ND	ND	7	2	ND
Shelter Valley Creek	43.9764	-78.0062	7/30/02	69	ND	ND	ND	ND	ND	ND	ND	ND	8	ND	ND
Sheridan Creek	43.5179	-79.6066	7/2/02	38	ND	ND	ND	ND	ND	ND	ND	ND	7	3	ND
Shoreacres Creek	43.3544	-79.7530	6/18/02	50	3	ND	ND	ND	2	2	4	ND	12	9	3
Six Mile Creek	43.2335	-79.1633	6/4/02	32	ND	ND	ND	ND	ND	ND	ND	ND	12	2	ND
Sixteen Mile Creek	43.1612	-79.3339	10/11/02	51	ND	ND	ND	ND	ND	ND	ND	7	35	4	7
Sixteen Mile Oakville	43.4463	-79.6719	10/11/02	57	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND
Smithfield Creek	44.0411	-77.6710	7/17/02	60	ND	ND	ND	ND	ND	ND	ND	4	24	3	4
Soper Creek	43.8952	-78.6722	9/17/02	63	ND	ND	ND	ND	ND	ND	ND	3	10	ND	3
Spencer Creek	43.2678	-79.9283	6/11/02	62	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	ND
Spring Creek	43.6448	-79.4591	7/4/02	55	ND	ND	ND	ND	ND	ND	ND	4	9	ND	4
Spring Garden Creek	43.2150	-79.2383	6/17/02	59	ND	ND	ND	ND	9	5	14	2	20	10	2
Stoney Creek	43.2430	-79.7422	6/11/02	54	ND	ND	ND	ND	ND	ND	ND	ND	19	ND	ND
Tecumseh Creek	43.5405	-79.5976	7/3/02	64	ND	ND	ND	ND	ND	ND	ND	12	18	ND	12
Thirty Mile Creek	43.1898	-79.4969	6/14/02	59	ND	10	ND	ND	3	4	7	17	89	68	17
Tooley Creek	43.8698	-78.7618	9/17/02	47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Treasure Creek	43.2446	-79.1545	6/4/02	53	5	14	ND	ND	12	11	23	9	81	23	14
Tuck Creek	43.3450	-79.7645	6/18/02	58	ND	4	ND	ND	ND	2	2	3	16	ND	3
Turtle Creek	43.5207	-79.6025	7/3/02	56	5	ND	ND	ND	ND	ND	ND	34	12	ND	39
Twelve Mile Barnes	43.1751	-79.2695	7/12/02	49	ND	ND	ND	ND	ND	ND	ND	3	ND	ND	3
Twenty Mile Creek	43.1624	-79.3708	6/26/02	59	ND	ND	ND	ND	ND	ND	ND	3	22	4	3
Two Mile Creek	43.2538	-79.0959	6/3/02	51	23	8	ND	ND	ND	ND	ND	90	69	64	113
Usshers Creek	43.0509	-79.0224	6/3/02	66	11	5	ND	ND	2	4	6	61	130	21	72
Walkers Creek	43.2221	-79.2241	6/3/02	47	ND	7	ND	ND	9	8	17	ND	24	3	ND
Wedgewood Creek	43.4666	-79.6457	7/2/02	30	ND	ND	ND	ND	ND	ND	ND	ND	4	2	ND
Welland Canal	43.2217	-79.2156	7/12/02	52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wendigo Creek	43.6501	-79.4700	7/4/02	28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wesleyville Creek	43.9223	-78.3991	8/27/02	57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wesleyville Marsh Creek	43.9208	-78.4108	8/27/02	64	2	ND	ND	ND	ND	ND	ND	6	6	ND	8
West Corbett Creek	43.8585	-78.9004	7/18/02	48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
West Lynde Creek	43.8544	-78.9664	7/16/02	57	ND	ND	ND	ND	ND	ND	ND	2	8	ND	2
Westside Creek	43.8872	-78.6852	9/17/02	48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wicklow Creek	43.9755	-77.9599	7/30/02	76	ND	ND	ND	ND	ND	ND	ND	2	15	ND	2
Wilmot Creek	43.9021	-78.6010	9/18/02	52	ND	ND	ND	ND	ND	ND	ND	ND	5	2	ND

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Appendix A. Laboratory Results

Tributary Name	TotalDDE ng/g	TotalDDT ng/g	TotalDDTMetab ng/g	Dieldrin ng/g	Endosulfan I ng/g	Endosulfan II ng/g	Endosulfan sulfate ng/g	Methoxychlor ng/g	Mirex ng/g	Aroclor 1242 ng/g	Aroclor 1248 ng/g	Aroclor 1254 ng/g	Aroclor 1260 ng/g	Total PCB ng/g
Aerocar Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	60	30	90
Airport Drain	12	3	15	ND	ND	ND	2	ND	ND	ND	ND	ND	ND	ND
Amberlea Creek	2	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Appleby Creek	9	ND	9	ND	ND	ND	ND	ND	ND	ND	40	40	20	100
Applewood Creek	10	ND	18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arena Creek	4	ND	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Avonhead Creek	5	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	20	10	30
Baker Creek	130	28	186	ND	ND	3	9	ND	ND	ND	ND	10	ND	10
Bakers Creek	39	ND	54	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barnum House Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bartlett Creek	250	527	1214	ND	ND	3	9	ND	ND	ND	ND	ND	ND	ND
Beach Road Creek	24	ND	29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bellamy Ravine Creek	2	ND	2	3	ND	ND	ND	ND	ND	ND	ND	10	20	30
Bennett Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Birchwood Creek	8	ND	11	ND	ND	ND	ND	ND	ND	ND	ND	10	70	20
Black Creek	5	ND	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bouchette Point Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bowmanville Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boyers Creek	40	ND	52	ND	ND	ND	ND	210	ND	ND	ND	ND	ND	ND
Bronte Creek	4	ND	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Brook Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	30	20	50
Brookside Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butler Creek	3	ND	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carruthers Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	60	ND	60
Chedoke Creek	ND	ND	ND	ND	ND	ND	ND	19	ND	ND	ND	ND	ND	ND
Clareview Creek	186	104	359	2	ND	ND	ND	10	ND	ND	ND	ND	ND	ND
Cobourg Brook	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Colborne Creek	3	ND	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cooksville Creek	11	ND	18	ND	ND	ND	ND	24	ND	ND	ND	ND	ND	ND
Council Creek	3	ND	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Covert's Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Credit River	7	ND	7	ND	ND	ND	ND	ND	ND	ND	ND	10	10	20
Darlington Creek	ND	ND	ND	ND	ND	ND	4	ND	ND	ND	ND	ND	ND	ND
Desjardins Canal	10	ND	15	ND	ND	ND	ND	ND	ND	ND	ND	40	ND	40
Don River	7	ND	15	ND	ND	ND	ND	ND	ND	20	ND	90	50	160
Duffins Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dunbarton Creek	3	ND	3	ND	ND	ND	ND	ND	ND	ND	ND	10	10	20
East Corbett Creek	2	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	20	ND	20
East Lynde Creek	6	ND	6	ND	ND	ND	ND	ND	ND	ND	ND	20	ND	20
Eighteen Mile Creek	56	3	64	ND	ND	ND	6	ND	ND	ND	ND	ND	ND	ND
Etobicoke Creek	7	ND	7	ND	ND	ND	ND	ND	ND	10	ND	30	30	70
Falcon Creek	21	6	32	ND	82	75	61	ND	ND	ND	ND	20	ND	20
Farewell Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fifteen Mile Creek	27	ND	29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fifty Creek	93	9	117	ND	ND	2	ND	ND	ND	ND	ND	ND	ND	ND
Forty Mile Creek	35	12	53	ND	ND	2	ND	ND	ND	ND	ND	10	ND	10

Note: Exceedences of (any) Sediment Quality Guidelines are Indicated in Table

Appendix A. Laboratory Results

Tributary	TotalDDE	TotalDDT	TotalDDTMetab	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulfate	Methoxychlor	Mirex	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCB
Name	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
Foster Creek	4	ND	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Four Mile Creek	150	22	191	ND	2	5	15	ND	ND	ND	ND	20	10	30
Fourteen Mile Creek	36	11	53	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fourteen Mile Oakville	3	ND	3	ND	ND	ND	ND	ND	ND	ND	ND	20	10	30
Frenchmans Creek	9	ND	13	ND	ND	ND	ND	ND	ND	ND	ND	20	ND	20
Gages Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ganaraska River	12	11	23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GM Drain	ND	ND	ND	ND	ND	3	68	ND	ND	ND	ND	20	10	30
Grafton Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Graham Creek	7	2	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Grindstone Creek	19	15	38	ND	ND	ND	7	ND	ND	ND	ND	20	10	30
Harmony Creek	ND	2	2	ND	ND	ND	ND	ND	ND	ND	ND	7	4	10
Highland creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	8	10
Hopkins Creek	3	ND	3	ND	ND	3	ND	12	ND	ND	ND	ND	ND	ND
Humber River	7	ND	10	3	ND	ND	ND	ND	ND	ND	ND	50	30	80
Indian Creek	20	9	40	14	3	3	ND	ND	ND	ND	ND	50	20	70
Intrepid Creek	ND	ND	ND	ND	ND	ND	ND	14	ND	ND	ND	10	10	30
Joshuas Creek	49	34	99	ND	3	ND	41	ND	ND	ND	ND	10	10	20
Kittling Creek	58	24	96	ND	ND	2	ND	ND	ND	ND	ND	10	10	20
Krosno Creek	2	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	10	10	20
Little Creek	2	2	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lornewood Creek	17	7	28	ND	ND	ND	ND	19	ND	ND	ND	50	10	60
Loughbreeze Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lovekin Creek	24	4	31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lucas Point Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lyons Creek	3	ND	3	ND	ND	ND	ND	ND	ND	ND	ND	20	ND	20
McCraney Creek	10	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	40	10	50
Midtown Creek	2	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Miller Creek	16	ND	23	ND	ND	ND	ND	ND	ND	ND	ND	7	3	10
Mimico Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	40	30	70
Montgomery Creek	ND	ND	6	ND	ND	ND	ND	ND	ND	ND	ND	40	40	80
Morrison Creek	10	ND	10	4	ND	ND	ND	ND	ND	ND	ND	40	20	60
One Mile Creek	52	ND	61	ND	ND	ND	ND	ND	ND	ND	ND	30	8	ND
Orchard Park Creek	44	5	63	ND	ND	ND	ND	ND	ND	ND	ND	20	80	30
Oshawa Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	80	30	10	120
Otty Point Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Petticoat Creek	3	ND	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pine Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pioneer Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	800	ND	1500	600	2800
Port Britain Creek	4	ND	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Port Granby Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pringle Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	30	5	40
Proctor Creek	11	ND	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rambo Creek	41	17	74	ND	ND	5	ND	ND	ND	ND	ND	30	10	40
Redhill Creek	10	ND	10	ND	ND	ND	ND	ND	ND	70	ND	50	100	220
Richardson Creek	240	53	340	3	ND	4	11	ND	ND	ND	ND	20	ND	20

Note: Exceedences of (any) Sediment Quality Guidelines are Indicated in Table

Appendix A. Laboratory Results

Tributary	TotalDDE	TotalDDT	TotalDDTMetab	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulfate	Methoxychlor	Mirex	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCB
Name	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
Robinson Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Roseland Creek	19	10	32	ND	53	5	29	ND	ND	ND	ND	20	20	40
Rouge River	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Salem Creek	7	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sersons Creek	6	ND	8	ND	ND	ND	ND	ND	ND	ND	ND	40	30	70
Sheldon Creek	7	2	9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Shelter Valley Creek	8	ND	8	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sheridan Creek	7	3	10	ND	ND	ND	ND	ND	ND	ND	ND	10	ND	10
Shoreacres Creek	12	9	24	ND	ND	ND	ND	ND	ND	ND	ND	20	ND	20
Six Mile Creek	12	2	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sixteen Mile Creek	35	4	46	ND	ND	ND	2	ND	ND	ND	ND	ND	ND	ND
Sixteen Mile Oakville	2	ND	2	ND	ND	ND	2	ND	ND	ND	ND	ND	10	10
Smithfield Creek	24	3	31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Soper Creek	10	ND	13	ND	ND	ND	ND	ND	ND	ND	ND	7	5	10
Spencer Creek	4	ND	4	ND	ND	ND	ND	ND	ND	ND	ND	20	100	120
Spring Creek	9	ND	13	ND	ND	ND	ND	ND	ND	ND	ND	40	10	50
Spring Garden Creek	20	10	32	ND	ND	2	ND	ND	ND	ND	ND	50	10	60
Stoney Creek	19	ND	19	ND	ND	ND	ND	ND	4	ND	ND	20	40	60
Tecumseh Creek	18	ND	30	ND	2	5	ND	ND	ND	20	ND	70	10	100
Thirty Mile Creek	89	78	184	ND	8	9	13	ND	ND	ND	ND	10	10	20
Tooley Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Treasure Creek	81	37	132	ND	2	5	11	ND	ND	ND	ND	ND	ND	ND
Tuck Creek	16	4	23	2	6	10	21	ND	ND	ND	ND	30	10	40
Turtle Creek	12	ND	51	ND	ND	ND	ND	ND	ND	ND	ND	50	20	70
Twelve Mile Barnes	ND	ND	3	ND	ND	ND	ND	ND	ND	370	ND	230	50	650
Twenty Mile Creek	22	4	29	ND	ND	ND	ND	ND	ND	ND	ND	10	ND	10
Two Mile Creek	69	72	254	ND	ND	5	13	ND	ND	ND	ND	ND	ND	ND
Usshers Creek	130	26	228	ND	ND	ND	ND	ND	ND	ND	ND	20	10	30
Walkers Creek	24	10	34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wedgewood Creek	4	2	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Welland Canal	ND	ND	ND	ND	ND	ND	ND	ND	ND	20	ND	30	10	60
Wendigo Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	60	ND	40	10	110
Wesleyville Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wesleyville Marsh Creek	6	ND	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
West Corbett Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	120	ND	50	60	230
West Lynde Creek	8	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Westside Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wicklow Creek	15	ND	17	ND	ND	ND	ND	ND	ND	ND	ND	30	10	40
Wilmot Creek	5	2	7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Note: Exceedences of (any) Sediment Quality Guidelines are Indicated in Table

Appendix A. Laboratory Results

Tributary	Naphthalene	cenaphthyle	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene
Name	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
Aerocar Creek	32.5	31.7	13	16.7	180	67.5	209	215	139	133	113
Airport Drain	ND	ND	ND	ND	20.2	ND	24.9	20.8	14	10	ND
Amberlea Creek	13.4	8	14	22.6	377	50	779	573	123	476	151
Appleby Creek	12.6	11.8	28	35.3	714	58.8	1610	1680	395	608	339
Applewood Creek	227	15.7	378	532	4470	728	4030	2970	1890	1330	742
Arena Creek	ND	ND	ND	ND	23.7	ND	40.5	31.3	22	20	11
Avonhead Creek	10	7	14	16.5	251	56.6	438	371	205	149	108
Baker Creek	6	10	ND	6	113	18.1	213	201	121	111	62
Bakers Creek	ND	8	ND	8	55.4	10	92.4	76.1	63	47	26
Barnum House Creek	ND	ND	ND	ND	ND	ND	8	7	ND	ND	ND
Bartlett Creek	18.9	14.2	13	15.1	162	25.5	313	385	168	171	106
Beach Road Creek	ND	ND	ND	ND	10.2	ND	52.5	50.8	44	32	22
Bellamy Ravine Creek	ND	7	ND	11	210	37.5	448	389	205	199	150
Bennett Creek	7	ND	ND	ND	14.9	ND	17.2	14.2	15	19	ND
Birchwood Creek	7	6	16	18.9	371	41.2	616	472	256	245	178
Black Creek	ND	63.1	13	24.2	150	141	689	590	592	477	415
Bouchette Point Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bowmanville Creek	ND	ND	ND	ND	123	11.3	177	156	65	107	38
Boyers Creek	ND	9	ND	11.5	115	24	123	99	92	34	21
Bronte Creek	ND	ND	ND	ND	30.6	ND	54.2	41.7	30	31	15
Brook Creek	31.3	14.1	54	75.8	838	132	863	742	452	261	139
Brookside Creek	ND	ND	ND	ND	7	ND	11.3	9	ND	ND	ND
Butler Creek	ND	5	ND	6	16.9	5	26.3	26.3	26	21	21
Carruthers Creek	ND	ND	ND	ND	36.1	ND	64.6	49.4	27	35	26
Chedoke Creek	37.9	36.2	55	63.8	1190	109	3980	5880	934	791	380
Clareview Creek	12.6	8	14	20.2	271	35.3	455	473	224	209	115
Cobourg Brook	ND	ND	ND	10.3	125	14.4	155	137	86	69	38
Colborne Creek	ND	ND	ND	ND	14	ND	22	17.3	13	11	ND
Cooksville Creek	22	11.9	31	33.9	649	76.1	1410	1210	567	507	254
Council Creek	ND	ND	ND	ND	11.9	ND	16.8	13.9	23	ND	ND
Covert's Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Credit River	ND	ND	ND	10.4	231	23.5	457	368	168	242	172
Darlington Creek	29	11.7	ND	8	43.4	13.8	70.3	70.3	34	52	22
Desjardins Canal	33	15.9	15	22.7	157	15.9	219	50	72	145	76
Don River	27.4	26.5	32	55.8	577	131	973	727	195	519	331
Duffins Creek	ND	ND	ND	ND	89.4	11.3	218	169	41	119	46
Dunbarton Creek	18.5	15.5	ND	19.6	335	85.1	544	389	95	337	174
East Corbett Creek	15	9	12	20.4	190	44.9	336	275	73	185	94
East Lynde Creek	ND	ND	ND	ND	85.1	16.5	240	181	48	122	45
Eighteen Mile Creek	ND	ND	ND	ND	10.8	ND	23	20.9	ND	15	ND
Etobicoke Creek	29.9	10.2	66	96.8	885	212	1170	888	255	604	335
Falcon Creek	7	12.6	10	13.8	201	47.8	489	377	108	257	99
Farewell Creek	7	8	17	22.4	396	66.4	1000	759	202	484	172
Fifteen Mile Creek	ND	ND	ND	ND	21.3	7	49.2	39.3	16	26	ND
Fifty Creek	ND	ND	ND	ND	11	ND	22	18.3	ND	ND	ND
Forty Mile Creek	50.8	16.9	26	46.2	348	53.8	446	365	125	332	120

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Appendix A. Laboratory Results

Tributary	Naphthalene	cenaphthyle	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene
Name	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g
Foster Creek	ND	ND	ND	ND	29.6	ND	80.3	62.5	18	49	28
Four Mile Creek	ND	ND	ND	ND	21.7	ND	52.2	47.8	16	37	ND
Fourteen Mile Creek	ND	15.5	ND	12.2	136	47.3	274	225	78	126	53
Fourteen Mile Oakville	68.2	15.2	90	145	1420	380	1790	1340	389	953	482
Frenchmans Creek	9	21.7	ND	13.9	150	57.4	333	271	93	166	83
Gages Creek	ND	9	ND	ND	58	16.7	157	120	31	87	31
Ganaraska River	ND	ND	ND	ND	68.3	ND	179	131	38	88	23
GM Drain	24.5	12.9	13	20.1	225	54.7	350	309	58	321	288
Grafton Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Graham Creek	ND	ND	ND	ND	10	ND	22.4	17.6	ND	ND	ND
Grindstone Creek	15.4	16.2	ND	11.1	134	47.9	363	267	88	222	103
Harmony Creek	7	7	ND	11.9	194	45.7	505	380	89	332	155
Highland creek	7	ND	ND	12.5	215	35.6	473	333	73	308	156
Hopkins Creek	7	ND	19	23.5	512	63.2	1050	927	364	425	264
Humber River	17.9	25.5	28	40	596	105	1200	1090	340	560	259
Indian Creek	8	5	19	23.8	476	58.6	941	814	273	391	217
Intrepid Creek	9	ND	ND	23.2	204	35	243	206	58	100	46
Joshuas Creek	6	ND	23	28.3	570	84.5	1120	847	310	427	234
Kittling Creek	11.8	6	ND	6	76	11.8	124	157	47	98	46
Krosno Creek	11.3	10.6	35	53.5	703	116	1340	999	263	769	307
Little Creek	ND	ND	ND	ND	9	ND	22.1	17.8	11	11	ND
Lornewood Creek	7	ND	14	18.8	252	40.3	412	309	99	208	101
Loughbreeze Creek	ND	ND	ND	ND	ND	ND	7	6	ND	ND	ND
Lovekin Creek	ND	ND	ND	ND	7	ND	ND	ND	ND	ND	ND
Lucas Point Creek	ND	ND	ND	ND	15.4	ND	29.5	26.6	14	23	12
Lyons Creek	ND	ND	ND	ND	22.6	6	41.4	37.7	17	29	13
McCraney Creek	ND	ND	22	24.3	475	54.9	874	681	234	385	188
Midtown Creek	13.8	7	15	20.2	261	45.9	338	274	96	172	65
Miller Creek	ND	ND	ND	ND	20	ND	43	37.9	25	20	ND
Mimico Creek	44.7	35.2	52	78.7	1240	228	1820	1610	368	907	533
Montgomery Creek	401	409	126	218	1410	426	1590	1470	999	1320	1580
Morrison Creek	11.2	10	20	27.3	364	62.2	730	569	264	420	362
One Mile Creek	7	20	ND	15	225	40.8	528	405	198	307	228
Orchard Park Creek	8	ND	16	22.8	370	55.7	837	623	277	496	378
Oshawa Creek	35.5	5	15	24.3	286	48.7	504	372	179	287	219
Otty Point Creek	ND	ND	ND	ND	ND	ND	6	5	ND	ND	ND
Petticoat Creek	ND	ND	14	19.8	425	34.6	796	572	227	421	329
Pine Creek	ND	ND	ND	9	145	27.7	402	300	67	245	89
Pioneer Creek	1230	96	1320	1630	11700	2720	13900	9850	5880	6490	3910
Port Britain Creek	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Port Granby Creek	ND	ND	ND	ND	16.7	ND	31.9	23.6	15	17	10
Pringle Creek	5	ND	ND	10	166	23.9	395	293	120	224	143
Proctor Creek	ND	ND	ND	ND	46.6	10.2	95.8	73.7	38	54	35
Rambo Creek	44.2	14.2	153	194	2630	433	3620	2650	1560	2430	1620
Redhill Creek	33	63.8	22	41.5	246	69.1	822	179	622	604	523
Richardson Creek	ND	ND	ND	ND	9	ND	19.3	13.4	13	11	ND

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Appendix A. Laboratory Results

Tributary Name	Naphthalene ng/g	cenaphthyle ng/g	Acenaphthene ng/g	Fluorene ng/g	Phenanthrene ng/g	Anthracene ng/g	Fluoranthene ng/g	Pyrene ng/g	Benz(a)anthracene ng/g	Chrysene ng/g	Benzo(b)fluoranthene ng/g
Robinson Creek	ND	ND	ND	ND	ND	ND	5	8	ND	ND	ND
Roseland Creek	20	ND	99	132	1620	274	2490	1770	944	1500	956
Rouge River	ND	ND	ND	ND	51.7	6	131	94.3	36	76	47
Salem Creek	ND	ND	ND	ND	9	6	22.2	18.2	20	16	13
Sersons Creek	9	ND	24	34.6	510	79.1	980	702	335	467	274
Sheldon Creek	ND	ND	14	18.8	389	44.4	865	612	268	441	276
Shelter Valley Creek	ND	ND	ND	ND	ND	ND	7	ND	ND	ND	ND
Sheridan Creek	11.7	5	37	50.5	732	126	1410	1010	469	685	458
Shoreacres Creek	25.3	11.6	224	291	2850	490	3400	2560	1510	2160	1530
Six Mile Creek	ND	ND	ND	ND	11.8	ND	17.4	12.8	11	ND	ND
Sixteen Mile Creek	ND	6	ND	8	50.7	18.8	129	97.9	43	59	33
Sixteen Mile Oakville	ND	ND	ND	ND	93.4	16.5	226	164	85	130	86
Smithfield Creek	ND	ND	ND	ND	7	ND	14	10.5	12	ND	ND
Soper Creek	ND	ND	ND	ND	54.3	9	118	82.9	42	66	34
Spencer Creek	7	9	10	13.2	194	38.7	415	328	120	199	101
Spring Creek	36	52	52	76	804	204	1610	1370	500	800	180
Spring Garden Creek	13.3	12.5	31	42.5	724	103	1640	1330	457	772	413
Stoney Creek	114	53	150	220	2500	541	5200	4130	1610	2410	1480
Tecumseh Creek	ND	ND	ND	41	770	117	2060	1620	495	1040	679
Thirty Mile Creek	38	25	ND	34	339	119	619	551	229	364	203
Tooley Creek	ND	ND	ND	ND	8	ND	10	9	ND	ND	ND
Treasure Creek	6	8	ND	7	66.4	16.8	118	104	45	61	29
Tuck Creek	ND	ND	52	65	1220	178	2740	2100	600	1280	522
Turtle Creek	ND	ND	ND	ND	28.3	5	70	70	19	46	32
Twelve Mile Barnes	28.6	63.3	27	42.9	388	148	803	801	408	429	205
Twenty Mile Creek	ND	6	ND	7	45.7	14.7	122	101	47	59	35
Two Mile Creek	5	10	14	16.7	345	48.5	946	752	261	445	285
Usshers Creek	5	9	ND	6	40.8	9	117	99	55	70	33
Walkers Creek	6	7	11	13	207	32.9	552	437	158	280	191
Wedgewood Creek	ND	5	12	17.2	296	43.6	675	527	188	307	150
Welland Canal	12.4	5	ND	10.9	65.9	23.3	129	118	56	89	47
Wendigo Creek	43.6	27.7	252	297	2460	457	3320	2640	1090	1300	967
Wesleyville Creek	ND	ND	ND	ND	ND	ND	21	19.4	13	16	ND
Wesleyville Marsh Creek	ND	ND	ND	ND	13	5	29	24	15	19	10
West Corbett Creek	12.7	6	ND	11.3	94.4	21.8	165	174	54	127	50
West Lynde Creek	ND	ND	ND	ND	ND	ND	15	10.8	ND	ND	ND
Westside Creek	ND	ND	ND	ND	8	ND	17.2	16.6	ND	14	ND
Wicklow Creek	ND	ND	ND	ND	25.4	ND	62.7	50.7	24	31	19
Wilmot Creek	ND	ND	ND	ND	ND	ND	17.8	15.6	ND	13	ND

Note: Exceedences of (any) Sediment Quality Guidelines are Indicated in Table

Appendix A. Laboratory Results

Tributary	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(ghi)perylene	Total PAH	Ag	Al	As	Ba	Be	Ca	Cd	Co	Cr	Cu
Name	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	µg/g	pct	µg/g	µg/g	µg/g	pct	µg/g	µg/g	µg/g	µg/g
Aerocar Creek	63	112	88	23	102	1,538	ND	0.09	8	187	ND	33	4	17	8	65
Airport Drain	ND	8	ND	ND	ND	98	ND	0.53	5	45	0.3	1	ND	8	9	17
Amberlea Creek	185	233	207	54	218	3,484	ND	0.62	ND	63	0.3	8	1	3	17	26
Appleby Creek	150	343	150	26	162	6,324	1.5	0.84	9	123	0.5	8	2	6	48	64
Applewood Creek	314	897	355	79	307	19,265	1.5	0.55	8	39	0.3	6	2	3	63	31
Arena Creek	ND	10.7	ND	ND	ND	159	1.0	0.68	ND	68	0.2	7	1	2	83	11
Avonhead Creek	41	119	71	ND	79	1,936	1.0	0.72	8	55	0.4	7	1	3	21	31
Baker Creek	37	46.5	52	ND	53	1,050	1.0	0.78	8	74	0.5	3	1	10	17	28
Bakers Creek	13	33.7	ND	ND	21	454	ND	1.04	18	76	0.7	2	1	13	42	55
Barnum House Creek	ND	ND	ND	ND	ND	15	ND	0.56	10	67	0.2	5	ND	6	10	6
Bartlett Creek	50	109	67	ND	93	1,711	1.5	0.94	9	111	0.5	7	2	6	35	70
Beach Road Creek	14	23.7	ND	ND	ND	249	ND	0.66	5	109	0.3	5	1	4	17	24
Bellamy Ravine Creek	65	146	106	21	107	2,102	ND	0.38	ND	66	ND	15	2	5	15	31
Bennett Creek	ND	8	ND	ND	ND	95	ND	1.14	ND	114	0.3	10	1	7	17	16
Birchwood Creek	78	154	137	24	141	2,761	ND	0.29	ND	74	ND	6	1	2	9	20
Black Creek	197	380	264	72	264	4,331	ND	0.73	ND	53	0.4	3	1	10	12	18
Bouchette Point Creek	ND	ND	ND	ND	ND	-	ND	0.42	6	59	0.2	7	ND	2	7	5
Bowmanville Creek	39	52.8	42	ND	53	864	ND	0.71	ND	126	0.3	12	1	4	15	16
Boyers Creek	14	21.9	ND	ND	ND	564	ND	1.25	9	83	0.6	1	1	16	32	31
Bronte Creek	10	16	ND	ND	ND	229	ND	1.29	9	104	0.6	7	ND	13	21	27
Brook Creek	84	174	105	23	105	4,093	ND	0.51	5	68	0.2	9	1	6	13	21
Brookside Creek	ND	ND	ND	ND	ND	27	ND	0.44	ND	58	0.1	4	ND	6	8	5
Butler Creek	ND	21.2	ND	ND	ND	175	0.5	0.57	ND	72	0.2	5	1	4	14	9
Carruthers Creek	12	23.4	ND	ND	ND	274	1.0	0.48	ND	44	0.2	5	1	5	10	10
Chedoke Creek	195	268	254	51	257	14,482	1.0	0.78	11	99	0.4	7	1	10	39	86
Clareview Creek	61	118	102	23	155	2,296	0.5	0.87	5	75	0.5	7	2	8	26	49
Cobourg Brook	18	34.9	34	ND	36	758	ND	0.40	ND	71	0.1	12	1	3	9	9
Colborne Creek	ND	9	ND	ND	ND	86	ND	0.46	8	75	0.1	5	ND	5	9	6
Cooksville Creek	133	227	221	44	233	5,630	0.5	0.83	8	57	0.4	7	2	10	35	63
Council Creek	ND	6	ND	ND	ND	72	ND	0.99	5	112	0.3	7	ND	10	14	12
Covert's Creek	ND	ND	ND	ND	ND	-	ND	0.49	5	66	0.1	6	ND	4	9	5
Credit River	109	153	123	23	157	2,237	ND	1.31	ND	118	0.6	10	ND	13	23	48
Darlington Creek	15	27.6	21	ND	22	440	ND	1.07	ND	70	0.4	7	ND	7	16	16
Desjardins Canal	55	56.8	72	ND	76	1,081	2.0	0.47	6	87	0.2	5	1	10	14	38
Don River	273	373	365	105	412	5,123	2.0	0.74	ND	106	0.3	11	2	12	39	80
Duffins Creek	59	54.4	62	ND	67	936	1.0	0.31	ND	50	0.2	11	1	8	25	13
Dunbarton Creek	97	167	121	28	141	2,567	1.0	0.38	1	79	0.2	9	1	7	65	83
East Corbett Creek	84	95.9	99	24	122	1,679	1.0	0.54	ND	68	0.2	10	1	10	22	20
East Lynde Creek	56	56.2	60	ND	64	974	1.5	0.77	ND	86	0.4	10	1	10	16	17
Eighteen Mile Creek	ND	ND	ND	ND	ND	70	1.5	0.91	12	59	0.5	2	1	13	15	23
Etobicoke Creek	267	408	334	76	369	6,006	2.5	0.62	ND	42	0.3	7	1	7	24	43
Falcon Creek	88	126	124	29	122	2,111	1.5	0.43	ND	52	0.3	4	ND	8	10	14
Farewell Creek	234	243	262	65	268	4,206	ND	0.53	ND	74	0.2	11	1	4	11	12
Fifteen Mile Creek	ND	13.9	ND	ND	ND	173	ND	1.16	9	72	0.7	3	ND	13	20	25
Fifty Creek	ND	ND	ND	ND	ND	51	0.5	1.04	14	88	0.6	3	ND	14	19	32
Forty Mile Creek	155	177	163	35	183	2,643	1.0	0.98	ND	103	0.5	10	1	3	24	32

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Appendix A. Laboratory Results

Tributary	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(ghi)perylene	Total PAH	Ag	Al	As	Ba	Be	Ca	Cd	Co	Cr	Cu
Name	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	µg/g	pct	µg/g	µg/g	µg/g	pct	µg/g	µg/g	µg/g	µg/g
Foster Creek	24	25	24	ND	28	368	ND	0.63	6	59	0.2	4	ND	8	11	8
Four Mile Creek	ND	19.6	ND	ND	ND	194	ND	1.16	17	94	0.6	2	ND	12	20	35
Fourteen Mile Creek	45	74.3	57	ND	52	1,195	0.5	0.66	ND	43	0.4	4	ND	10	11	18
Fourteen Mile Oakville	344	515	461	134	443	8,969	0.5	0.92	8	87	0.6	6	1	12	63	65
Frenchmans Creek	72	102	84	27	82	1,565	0.5	0.85	5	55	0.5	3	2	10	73	29
Gages Creek	33	40	41	ND	38	662	ND	0.83	ND	95	0.3	9	ND	8	14	12
Ganaraska River	40	44.6	46	ND	45	703	ND	0.71	ND	134	0.2	16	2	ND	12	10
GM Drain	233	240	195	49	266	2,659	1.0	0.47	ND	113	0.3	16	2	6	56	69
Grafton Creek	ND	ND	ND	ND	ND	-	ND	0.51	ND	64	0.2	5	ND	7	9	8
Graham Creek	ND	ND	ND	ND	ND	50	ND	0.59	ND	83	0.2	12	ND	3	12	7
Grindstone Creek	96	128	117	29	116	1,754	1.0	0.71	9	92	0.4	6	1	9	12	28
Harmony Creek	160	181	155	34	168	2,425	0.5	0.52	ND	55	0.2	11	1	5	13	15
Highland creek	142	156	139	25	143	2,218	1.0	0.31	ND	52	0.2	10	1	9	15	37
Hopkins Creek	180	310	268	73	247	4,733	1.0	0.63	11	89	0.4	7	1	8	14	25
Humber River	271	306	352	108	352	5,650	ND	1.12	8	114	0.5	10	1	12	29	65
Indian Creek	158	202	266	55	264	4,171	0.5	0.46	23	53	0.3	6	ND	9	22	29
Intrepid Creek	30	41.4	46	ND	57	1,099	1.5	0.09	ND	479	ND	29	3	ND	163	48
Joshuas Creek	148	214	280	30	260	4,582	0.5	0.45	5	29	0.3	4	1	8	10	16
Kittling Creek	35	50.2	51	ND	91	811	0.5	0.78	14	88	0.5	7	1	11	31	45
Krosno Creek	362	462	397	108	378	6,314	ND	0.65	ND	67	0.3	9	1	11	26	37
Little Creek	ND	9	ND	ND	ND	80	ND	0.75	7	75	0.3	7	ND	7	16	13
Lornewood Creek	84	99.4	135	27	137	1,944	0.5	0.57	6	61	0.3	7	1	8	40	42
Loughbreeze Creek	ND	ND	ND	ND	ND	13	1.0	0.64	ND	67	0.2	5	1	6	12	7
Lovekin Creek	ND	ND	ND	ND	ND	7	ND	0.61	7	80	0.2	8	ND	5	10	7
Lucas Point Creek	ND	11.2	ND	ND	20	152	ND	0.63	13	66	0.2	5	ND	7	10	8
Lyons Creek	ND	13.3	21	ND	28	229	ND	1.30	12	92	0.7	3	1	15	24	25
McCraney Creek	134	181	203	45	236	3,737	ND	0.70	10	95	0.4	7	1	9	41	60
Midtown Creek	63	65.4	73	ND	77	1,586	ND	0.62	ND	78	0.3	11	1	4	18	26
Miller Creek	38	20.6	ND	ND	ND	205	ND	1.17	12	84	0.7	1	1	15	27	30
Mimico Creek	66	359	326	110	313	8,091	1.0	0.78	ND	87	0.4	11	2	1	42	84
Montgomery Creek	602	1960	938	242	1060	14,751	2.5	1.10	ND	184	0.4	8	4	11	150	114
Morrison Creek	147	272	240	62	280	3,841	ND	0.66	11	58	0.4	5	3	11	26	50
One Mile Creek	101	184	143	41	149	2,592	ND	0.81	9	112	0.5	6	1	9	16	46
Orchard Park Creek	168	256	240	61	258	4,067	ND	0.58	ND	55	0.3	5	1	9	16	51
Oshawa Creek	79	158	149	39	164	2,565	ND	0.39	6	67	0.1	11	1	4	27	18
Otty Point Creek	ND	ND	ND	ND	ND	11	ND	0.81	ND	75	0.3	7	ND	8	14	8
Petticoat Creek	124	220	199	49	199	3,629	ND	0.41	ND	61	0.2	12	1	7	14	20
Pine Creek	118	108	124	26	128	1,789	ND	0.53	ND	54	0.2	8	1	11	17	20
Pioneer Creek	1930	2890	3510	1400	3110	71,566	0.5	1.18	30	192	1.3	11	7	4	209	322
Port Britain Creek	ND	ND	22	ND	23	45	ND	0.57	6	72	0.2	8	ND	4	10	7
Port Granby Creek	ND	ND	ND	ND	ND	114	ND	0.34	ND	50	0.1	8	ND	8	244	7
Pringle Creek	51	93	110	29	123	1,786	1.0	0.52	ND	69	0.2	8	1	10	35	43
Proctor Creek	17	25	29	ND	34	458	ND	0.38	ND	63	ND	8	1	8	10	10
Rambo Creek	602	1160	1190	316	1300	19,916	1.5	0.52	ND	79	0.3	6	1	8	42	63
Redhill Creek	218	488	377	99	420	4,827	1.5	1.17	ND	130	0.6	6	1	11	60	92
Richardson Creek	ND	ND	ND	ND	20	86	ND	1.18	10	75	0.6	2	1	13	22	38

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Appendix A. Laboratory Results

Tributary	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(ghi)perylene	Total PAH	Ag	Al	As	Ba	Be	Ca	Cd	Co	Cr	Cu
Name	ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	µg/g	pct	µg/g	µg/g	µg/g	pct	µg/g	µg/g	µg/g	µg/g
Robinson Creek	ND	ND	ND	ND	ND	13	ND	1.52	ND	142	0.5	12	1	8	23	75
Roseland Creek	433	751	693	182	741	12,605	ND	0.48	ND	75	0.3	10	1	4	29	52
Rouge River	23	27	41	ND	45	578	ND	0.37	ND	51	0.2	10	1	9	14	13
Salem Creek	ND	10	ND	ND	ND	114	0.5	0.46	ND	121	0.2	6	1	2	15	9
Sersons Creek	114	199	217	52	220	4,217	ND	0.48	ND	35	0.3	5	1	7	19	33
Sheldon Creek	120	192	214	50	218	3,722	1.0	0.84	ND	91	0.5	5	1	11	29	24
Shelter Valley Creek	ND	ND	ND	ND	ND	7	ND	0.68	ND	116	0.2	11	1	5	12	10
Sheridan Creek	177	327	342	81	352	6,273	ND	0.83	ND	40	0.5	3	1	11	20	38
Shoreacres Creek	666	1100	879	236	905	18,838	ND	0.63	5	63	0.4	5	1	15	45	51
Six Mile Creek	ND	ND	ND	ND	ND	53	1.0	0.48	ND	38	0.3	4	ND	8	9	14
Sixteen Mile Creek	29	38.2	24	ND	24	561	ND	1.18	ND	65	0.6	1	1	13	21	29
Sixteen Mile Oakville	40	60	79	ND	87	1,067	ND	1.53	11	118	0.8	5	ND	17	23	38
Smithfield Creek	ND	ND	ND	ND	ND	44	ND	0.46	ND	90	0.2	7	1	9	10	7
Soper Creek	16	23	36	ND	39	520	ND	0.92	ND	113	0.3	10	1	7	15	14
Spencer Creek	135	171	113	29	125	2,008	ND	0.64	5	75	0.3	7	1	6	17	31
Spring Creek	444	620	428	124	488	7,788	ND	0.50	ND	107	0.3	4	1	6	24	51
Spring Garden Creek	432	652	478	140	510	7,750	ND	0.64	ND	62	0.4	4	1	11	19	28
Stoney Creek	1450	2490	1570	329	1720	25,967	ND	0.85	5	103	0.6	11	2	2	55	80
Tecumseh Creek	612	770	587	128	653	9,572	ND	0.81	8	91	0.5	6	2	7	35	74
Thirty Mile Creek	182	242	169	ND	212	3,326	ND	0.72	5	88	0.5	5	1	10	22	45
Tooley Creek	ND	ND	ND	ND	ND	27	ND	0.70	ND	66	0.3	12	ND	4	13	10
Treasure Creek	33	45.3	28	ND	33	601	ND	0.67	ND	69	0.3	4	ND	8	12	24
Tuck Creek	665	791	600	157	643	11,613	ND	0.66	ND	78	0.4	7	1	7	31	44
Turtle Creek	17	27.5	25	ND	30	370	ND	0.61	ND	61	0.4	5	1	6	19	31
Twelve Mile Barnes	237	499	269	82	310	4,741	ND	0.56	ND	42	0.3	4	1	10	29	36
Twenty Mile Creek	39	50.9	30	ND	31	588	ND	1.09	10	72	0.6	3	1	13	20	30
Two Mile Creek	241	342	249	67	261	4,288	ND	0.72	ND	65	0.4	2	ND	9	15	24
Usshers Creek	39	56.1	36	ND	37	612	ND	0.95	ND	72	0.6	2	1	13	19	23
Walkers Creek	199	224	175	37	187	2,717	ND	0.68	ND	53	0.4	2	1	10	14	17
Wedgewood Creek	211	238	164	37	171	3,042	ND	0.29	ND	21	0.2	2	ND	6	10	16
Welland Canal	60	66.7	43	ND	52	778	ND	1.50	8	90	0.7	5	1	14	29	46
Wendigo Creek	952	1250	844	224	861	16,985	0.5	0.14	ND	25	ND	6	1	8	5	15
Wesleyville Creek	ND	12.1	ND	ND	ND	82	ND	0.43	5	58	0.1	5	ND	5	8	6
Wesleyville Marsh Creek	12	13	ND	ND	ND	140	ND	0.47	9	106	0.2	4	ND	6	7	6
West Corbett Creek	55	69.7	55	ND	91	987	0.5	0.45	ND	93	0.2	11	2	7	311	56
West Lynde Creek	ND	ND	ND	ND	ND	26	ND	0.70	ND	70	0.3	9	1	9	21	15
Westside Creek	ND	8	ND	ND	ND	64	ND	1.15	ND	90	0.4	5	ND	10	18	12
Wicklow Creek	16	22.4	ND	ND	ND	251	ND	0.40	7	42	0.1	9	ND	5	6	7
Wilmot Creek	ND	ND	ND	ND	ND	46	ND	0.47	ND	81	0.2	12	ND	ND	8	8

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Appendix A. Laboratory Results

Tributary	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sn	Sr	Ti	V	Y	Zn	TIC	TOC	LOI	Sand (63um-2mm)	Silt (63-2um)	Clay (<2um)
Name	pct	ng/g	pct	µg/g	pct	µg/g	µg/g	pct	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	%	%	%	%	%
Aerocar Creek	2.38	76	0.18	14	0.47	454	4	0.07	30	52	ND	866	50	15	3	874	9.0	1.0	4.4	16.6	83.4	ND
Airport Drain	1.35	17	0.03	13	0.36	716	ND	0.03	12	9	ND	28	90	16	6	61	0.4	1.1	3.8	49.9	49.5	0.7
Amberlea Creek	1.53	34	0.09	13	0.58	519	ND	0.07	9	23	ND	104	232	24	8	132	2.9	3.0	6.3	35.7	63.5	0.8
Appleby Creek	2.20	93	0.14	24	1.93	612	ND	0.06	37	58	ND	233	146	28	10	427	3.4	4.6	11.4	23.5	76.2	0.3
Applewood Creek	1.50	44	0.06	16	0.99	411	ND	0.06	13	113	ND	83	97	19	6	233	2.6	2.7	5.8	45.2	54.6	0.1
Arena Creek	1.24	36	0.09	10	0.41	457	ND	0.04	28	8	ND	83	424	24	8	89	2.1	2.5	6.4	34.0	66.0	ND
Avonhead Creek	1.55	56	0.07	21	2.03	525	ND	0.03	14	50	ND	79	82	21	12	172	3.6	1.6	5.3	38.6	60.1	1.3
Baker Creek	1.95	31	0.07	20	0.73	792	ND	0.03	19	33	ND	80	130	24	9	383	1.1	2.4	5.5	27.5	71.2	1.3
Bakers Creek	2.67	83	0.09	21	0.89	382	ND	0.03	48	26	ND	46	144	28	11	137	0.9	5.4	13.2	38.5	61.3	0.1
Barnum House Creek	1.05	22	0.09	7	0.41	562	ND	0.03	7	7	ND	74	402	17	7	37	1.8	3.3	7.8	43.5	56.5	ND
Bartlett Creek	2.26	148	0.09	24	1.56	680	ND	0.23	21	61	ND	221	140	27	10	549	2.4	3.3	8.1	11.6	87.4	1.0
Beach Road Creek	1.38	111	ND	8	0.30	544	4	0.02	5	25	ND	49	258	19	7	68	1.7	15.0	34.8	54.2	45.8	ND
Bellamy Ravine Creek	1.02	61	0.12	9	0.79	477	ND	0.06	4	33	ND	127	182	15	5	150	4.4	2.4	5.0	30.1	69.5	0.4
Bennett Creek	1.60	25	0.26	14	0.70	549	ND	0.08	5	6	ND	148	893	29	11	91	3.4	2.6	7.1	34.3	64.9	0.9
Birchwood Creek	0.90	51	ND	8	0.48	1070	ND	0.05	3	20	ND	69	90	11	6	101	2.0	3.5	6.0	54.0	46.0	ND
Black Creek	1.47	78	0.05	16	0.93	345	3	0.03	22	39	ND	56	122	17	6	93	1.3	2.8	7.6	46.8	52.4	0.9
Bouchette Point Creek	0.91	12	0.11	5	0.42	731	ND	0.04	6	ND	ND	96	338	15	7	23	2.7	2.5	6.1	36.3	63.7	ND
Bowmanville Creek	1.31	30	0.18	9	0.64	539	ND	0.04	9	9	ND	163	395	20	9	64	4.6	4.5	11.3	25.7	74.3	ND
Boyers Creek	2.33	66	0.08	23	0.89	415	4	0.03	37	21	ND	42	140	28	9	139	0.7	6.1	14.3	37.4	61.1	1.5
Bronte Creek	2.26	35	0.29	26	0.96	891	ND	0.04	17	12	ND	114	197	26	13	274	2.2	2.3	6.3	21.7	78.0	0.3
Brook Creek	1.04	35	0.12	7	0.44	374	ND	0.04	7	13	ND	117	389	18	8	136	3.0	3.4	7.6	47.2	52.8	ND
Brookside Creek	0.86	17	0.12	6	0.28	345	ND	0.03	7	5	ND	64	411	15	7	28	1.5	2.6	6.1	40.1	59.9	ND
Butler Creek	1.07	46	ND	8	0.33	521	1	0.02	5	9	ND	64	262	17	7	43	1.7	3.1	9.3	39.0	61.0	ND
Carruthers Creek	0.95	24	ND	9	0.33	253	1	0.04	7	12	ND	64	222	16	6	55	1.3	2.1	5.4	47.0	52.7	0.3
Chedoke Creek	2.00	403	0.08	23	1.99	547	ND	0.05	21	70	ND	149	153	25	9	551	3.1	3.8	7.9	22.0	77.7	0.3
Clareview Creek	1.91	71	0.08	24	1.65	849	2	0.07	15	46	ND	399	113	25	11	276	2.7	3.5	8.3	17.6	81.5	0.9
Cobourg Brook	0.90	19	0.14	7	0.38	370	ND	0.03	3	7	ND	140	301	14	7	40	3.4	2.8	6.3	45.8	54.2	ND
Colborne Creek	0.90	19	0.10	5	0.36	475	ND	0.03	7	5	ND	75	451	15	7	37	1.8	2.5	5.5	43.8	56.2	ND
Cooksville Creek	1.94	198	0.08	23	1.70	513	1	0.08	19	56	ND	120	121	24	8	305	2.7	4.5	9.5	27.9	72.1	ND
Council Creek	1.57	45	0.15	11	0.50	823	ND	0.04	9	12	ND	90	496	24	10	59	2.3	5.6	13.9	33.0	67.0	ND
Covert's Creek	1.04	19	0.11	6	0.40	511	ND	0.04	7	ND	ND	80	458	17	7	29	2.1	2.1	4.8	38.3	61.7	ND
Credit River	2.14	53	0.29	25	1.40	881	ND	0.05	23	24	ND	139	195	26	11	187	3.6	2.9	7.2	14.1	85.1	0.9
Darlington Creek	1.67	19	0.20	13	0.56	477	ND	0.07	8	9	ND	159	661	28	12	80	2.6	3.1	7.5	35.5	64.1	0.4
Desjardins Canal	1.26	88	0.07	13	1.85	465	1	0.09	15	43	ND	77	103	15	7	291	2.3	4.5	10.4	33.8	66.2	ND
Don River	1.74	103	0.10	15	1.21	523	ND	0.06	6	60	ND	138	287	28	8	306	3.8	3.7	8.5	18.3	80.4	1.3
Duffins Creek	1.03	24	0.07	8	0.63	412	ND	0.04	6	11	ND	133	201	19	6	56	3.3	1.8	3.7	41.5	58.2	0.3
Dunbarton Creek	1.76	26	0.06	10	0.78	460	1	0.07	6	31	ND	116	194	21	6	318	3.1	2.0	3.8	37.9	61.8	0.3
East Corbett Creek	1.24	49	0.09	10	0.52	483	ND	0.06	1	22	ND	134	332	23	7	178	3.1	2.3	5.0	37.3	62.3	0.4
East Lynde Creek	1.55	44	0.11	12	0.56	437	ND	0.05	3	15	ND	126	337	25	10	76	3.0	3.2	8.2	23.9	75.1	1.0
Eighteen Mile Creek	1.92	22	0.08	20	0.60	586	ND	0.03	20	14	ND	47	134	24	9	72	0.7	1.4	4.3	24.4	73.8	1.8
Etobicoke Creek	1.63	51	0.08	18	1.22	454	1	0.05	14	45	ND	96	96	20	7	174	2.4	2.3	5.0	35.2	64.1	0.8
Falcon Creek	1.13	54	ND	15	0.61	557	ND	0.03	12	18	ND	56	106	16	6	78	1.3	1.8	4.3	54.9	44.7	0.3
Farewell Creek	1.13	14	0.14	7	0.49	415	ND	0.04	5	7	ND	146	443	17	9	65	3.1	1.8	4.5	41.5	58.5	ND
Fifteen Mile Creek	2.34	57	0.08	23	0.80	526	ND	0.03	24	17	ND	55	173	32	12	77	0.9	2.4	7.0	29.0	69.4	1.5
Fifty Creek	2.28	39	0.10	26	0.81	1421	ND	0.06	23	42	ND	104	128	27	11	234	1.1	2.8	8.4	19.8	79.4	0.8
Forty Mile Creek	1.93	61	0.19	26	1.59	653	ND	0.09	12	57	ND	304	137	27	9	288	3.8	5.8	15.4	34.8	65.2	ND

Note: Exceedences of (any) Sediment Quality Guidelines are Indicated in Table

Appendix A. Laboratory Results

Tributary Name	Fe pct	Hg ng/g	K pct	Li µg/g	Mg pct	Mn µg/g	Mo µg/g	Na pct	Ni µg/g	Pb µg/g	Sn µg/g	Sr µg/g	Ti µg/g	V µg/g	Y µg/g	Zn µg/g	TIC %	TOC %	LOI %	Sand (63um-2mm) %	Silt (63-2um) %	Clay (<2um) %
Foster Creek	1.13	84	0.13	8	0.33	316	ND	0.04	10	7	ND	64	582	20	9	51	1.5	1.6	4.1	41.7	57.9	0.4
Four Mile Creek	2.30	51	0.09	22	0.70	540	ND	0.04	21	20	ND	55	143	29	10	174	0.8	3.8	9.9	31.2	67.9	0.9
Fourteen Mile Creek	1.54	41	ND	16	1.31	659	ND	0.12	14	20	ND	63	117	20	8	78	1.0	1.4	3.9	34.4	63.3	2.3
Fourteen Mile Oakville	2.17	153	0.09	29	1.41	647	ND	0.04	24	33	ND	181	140	28	9	206	2.1	2.6	6.1	26.0	72.3	1.7
Frenchmans Creek	1.74	126	0.06	18	0.76	233	ND	0.03	21	43	ND	229	131	20	8	153	1.2	5.0	10.1	44.5	55.2	0.4
Gages Creek	1.26	12	0.19	10	0.53	453	ND	0.05	5	8	ND	115	614	22	9	75	3.3	1.9	4.9	40.1	58.7	1.1
Ganaraska River	1.30	19	0.20	10	0.61	888	ND	0.05	ND	8	ND	180	437	20	8	44	5.2	3.1	8.2	19.8	80.2	ND
GM Drain	1.88	46	0.11	10	0.80	673	ND	0.09	9	109	ND	197	288	27	7	1587	5.1	3.9	7.7	19.9	79.4	0.8
Grafton Creek	0.94	35	0.11	6	0.37	340	ND	0.04	6	ND	ND	67	348	15	7	42	1.8	4.5	10.4	41.5	58.6	ND
Graham Creek	1.18	9	0.18	9	0.53	421	ND	0.05	6	ND	ND	161	464	19	7	28	4.2	2.2	5.9	21.1	78.6	0.3
Grindstone Creek	1.76	39	0.06	22	1.44	1178	ND	0.04	14	22	ND	86	140	20	10	135	2.4	3.0	8.3	28.8	70.4	0.8
Harmony Creek	1.05	22	0.15	8	0.46	484	ND	0.05	6	26	ND	145	411	18	8	79	3.6	1.8	4.0	45.3	53.9	0.8
Highland creek	0.99	34	0.06	10	0.67	328	ND	0.04	9	15	ND	107	203	19	6	121	3.3	0.9	3.6	42.8	57.2	ND
Hopkins Creek	1.82	31	0.06	19	1.96	899	ND	0.04	13	23	ND	89	138	21	9	165	3.0	2.9	6.7	41.0	58.9	0.1
Humber River	2.04	82	0.24	18	1.51	833	ND	0.06	21	41	ND	138	327	28	10	255	3.7	3.1	7.3	16.7	82.5	0.8
Indian Creek	2.83	36	0.06	17	1.08	916	ND	0.04	16	27	ND	127	106	17	8	317	2.6	2.2	5.4	39.7	59.4	0.9
Intrepid Creek	1.05	17	0.14	10	0.50	889	ND	0.09	ND	26	ND	619	136	28	3	619	8.9	2.4	5.2	33.4	64.1	2.5
Joshuas Creek	1.04	29	ND	13	0.85	392	ND	0.04	12	18	ND	63	84	13	5	96	1.8	2.0	4.3	49.3	50.4	0.3
Kittling Creek	1.96	41	0.08	26	1.98	1040	ND	0.05	21	61	ND	114	118	24	10	413	2.8	3.9	9.0	20.4	78.7	0.9
Krosno Creek	1.26	73	0.09	11	0.59	257	ND	0.05	6	54	ND	118	318	24	8	183	2.9	3.0	8.7	47.0	52.7	0.3
Little Creek	1.16	35	0.12	8	0.39	431	ND	0.03	10	12	ND	95	398	21	9	55	2.6	5.2	12.7	39.2	60.8	ND
Lornewood Creek	1.37	46	0.06	14	1.73	241	ND	0.03	47	28	ND	119	102	24	5	175	1.5	2.6	6.8	42.3	57.7	ND
Loughbreeze Creek	1.26	81	0.05	10	0.35	610	ND	0.03	6	7	ND	64	394	24	8	70	1.4	2.4	5.5	43.3	55.9	0.8
Lovekin Creek	1.02	22	0.14	7	0.39	769	ND	0.03	8	6	ND	103	439	18	8	43	2.8	2.7	7.0	37.9	62.1	ND
Lucas Point Creek	1.15	17	0.11	7	0.38	579	ND	0.04	8	8	ND	67	506	19	8	48	1.7	3.1	7.0	50.0	50.0	ND
Lyons Creek	2.63	83	0.09	23	1.38	685	1	0.03	32	25	ND	45	164	32	8	201	1.4	3.8	3.7	27.2	70.1	2.6
McCraney Creek	1.87	49	0.07	22	1.95	749	ND	0.07	26	57	ND	145	118	24	8	297	3.1	3.9	3.8	29.5	70.2	0.3
Midtown Creek	1.27	30	0.17	8	0.50	609	ND	0.05	8	30	ND	139	403	19	8	143	3.5	3.8	7.8	41.6	58.4	ND
Miller Creek	2.20	287	0.08	23	0.70	382	ND	0.03	32	34	ND	84	166	29	11	114	0.6	4.9	4.9	38.8	60.3	1.0
Mimico Creek	1.94	129	0.09	19	1.87	904	ND	0.06	11	74	ND	139	173	28	8	508	4.0	4.7	4.5	18.9	80.3	0.9
Montgomery Creek	1.98	668	0.25	13	0.70	565	ND	0.06	67	227	ND	129	697	30	10	1303	2.7	4.0	7.9	40.0	59.3	0.8
Morrison Creek	1.56	433	0.05	20	1.27	585	ND	0.06	18	88	ND	127	131	21	9	397	2.0	3.2	3.1	29.1	70.5	0.3
One Mile Creek	1.76	147	0.08	17	1.15	1300	ND	0.03	17	82	ND	65	134	21	10	384	2.2	4.8	4.7	26.9	72.8	0.3
Orchard Park Creek	1.50	116	ND	13	1.40	612	ND	0.03	16	34	ND	54	125	19	8	277	1.9	3.6	3.5	36.4	63.6	ND
Oshawa Creek	1.03	40	0.14	6	0.47	286	ND	0.04	14	20	ND	134	330	16	7	74	3.8	2.4	4.8	32.4	67.1	0.5
Otty Point Creek	1.27	25	0.15	10	0.40	653	ND	0.04	9	6	ND	85	570	22	9	41	2.1	2.4	5.9	34.7	65.3	ND
Petticoat Creek	1.05	37	0.10	10	0.52	425	4	0.07	6	20	ND	100	222	16	6	112	3.6	3.0	2.9	32.3	67.7	ND
Pine Creek	1.26	36	0.07	13	0.44	441	2	0.07	4	23	ND	102	224	19	7	121	2.4	2.2	2.1	33.3	66.1	0.6
Pioneer Creek	4.97	383	0.13	21	2.19	2115	20	0.10	49	296	30	123	419	66	9	1572	6.5	8.5	7.9	36.0	64.0	ND
Port Britain Creek	1.02	14	0.11	7	0.32	560	ND	0.04	6	2	ND	89	397	17	8	36	2.6	2.9	7.0	37.9	62.1	ND
Port Granby Creek	1.27	19	0.08	6	0.54	982	ND	0.04	5	6	ND	100	296	21	6	33	2.5	2.9	6.2	53.8	46.2	ND
Pringle Creek	1.51	81	0.10	11	0.48	297	3	0.06	4	33	ND	100	284	19	8	171	2.6	3.8	3.7	34.7	65.3	ND
Proctor Creek	0.91	49	0.07	11	0.37	606	2	0.04	6	16	ND	83	243	15	6	64	2.8	2.4	2.3	42.5	57.5	ND
Rambo Creek	1.42	88	0.07	18	1.82	768	1	0.05	15	93	ND	108	132	20	7	353	2.5	4.7	4.6	34.6	65.4	ND
Redhill Creek	3.05	266	0.11	27	1.35	693	4	0.09	25	62	115	174	187	29	10	443	2.1	5.6	5.5	15.7	83.4	0.9
Richardson Creek	2.33	66	0.11	22	0.73	538	2	0.03	23	29	ND	45	166	29	11	137	0.7	2.5	2.5	25.2	72.8	1.9

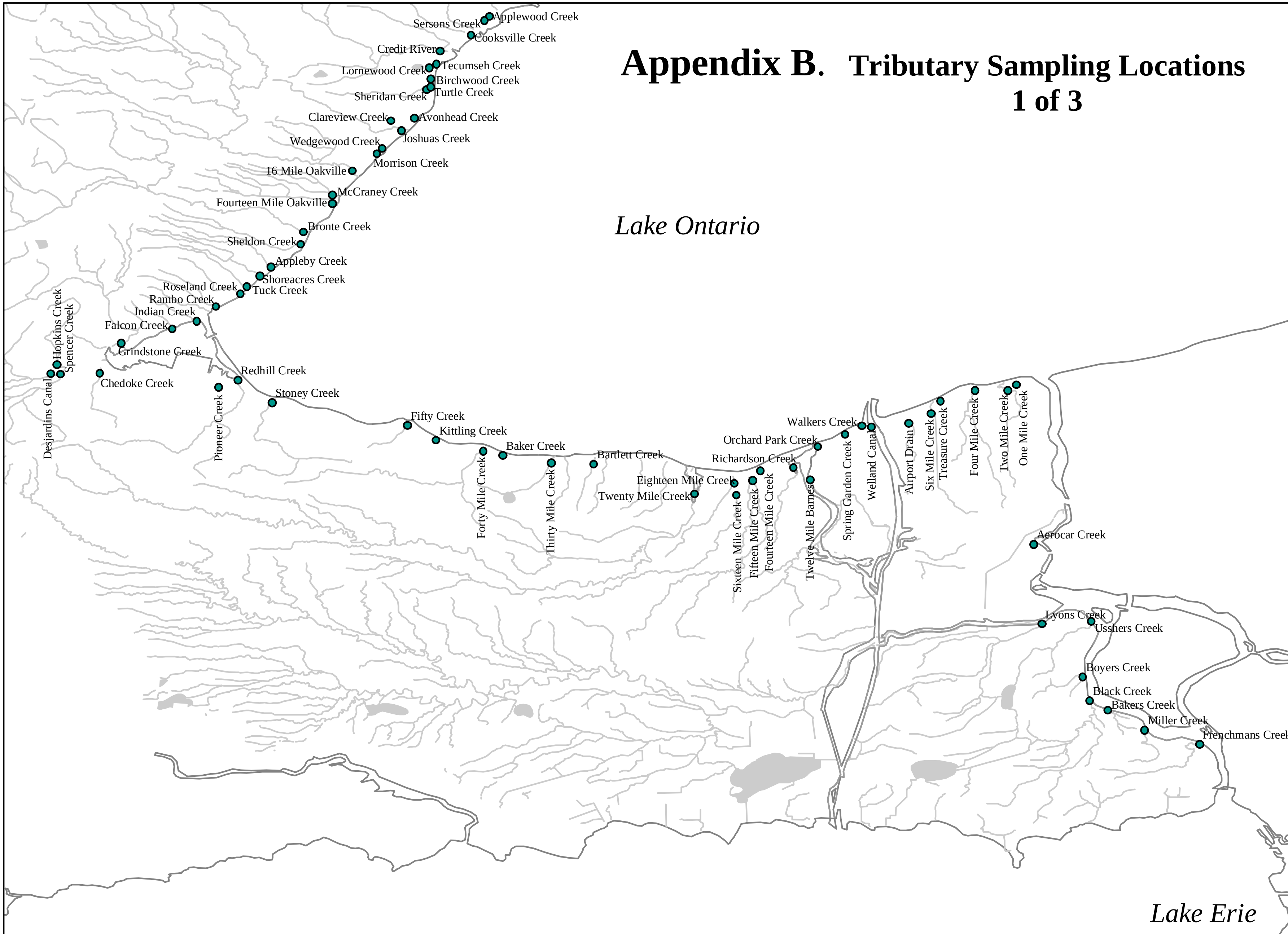
Note: Exceedences of (any) Sediment Quality Guidelines are Indicated in Table

Appendix A. Laboratory Results

Tributary	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sn	Sr	Ti	V	Y	Zn	TIC	TOC	LOI	Sand (63um-2mm)	Silt (63-2um)	Clay (<2um)
Name	pct	ng/g	pct	µg/g	pct	µg/g	µg/g	pct	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	%	%	%	%	%
Robinson Creek	2.02	22	0.29	17	0.76	739	ND	0.06	14	116	20	147	806	36	13	193	3.6	2.5	7.8	21.6	75.0	3.4
Roseland Creek	1.35	393	0.07	17	1.95	642	ND	0.05	9	56	ND	165	105	17	7	347	3.7	4.1	3.9	39.4	60.6	ND
Rouge River	0.99	24	0.07	9	0.68	363	ND	0.04	8	6	ND	120	235	19	7	52	2.8	0.9	0.9	43.6	56.0	0.4
Salem Creek	1.16	61	0.06	10	0.40	1379	1	0.04	4	14	ND	79	285	17	7	40	2.0	6.7	6.6	50.4	49.6	ND
Sersons Creek	1.30	108	ND	14	0.89	332	ND	0.04	12	53	ND	60	109	16	7	165	2.0	2.7	2.6	45.5	54.2	0.3
Sheldon Creek	1.95	48	0.08	27	0.95	678	ND	0.05	22	30	ND	180	148	25	10	182	1.7	3.1	3.0	28.3	71.1	0.6
Shelter Valley Creek	1.31	35	0.15	9	0.59	844	ND	0.04	6	7	ND	134	383	20	8	47	3.8	6.0	13.4	41.0	59.0	ND
Sheridan Creek	1.84	52	0.06	23	0.83	493	1	0.04	20	29	ND	81	108	23	8	143	1.1	1.6	1.6	36.2	62.8	1.0
Shoreacres Creek	1.50	50	0.09	22	1.38	452	5	0.07	54	52	ND	93	139	20	8	234	2.1	4.2	4.1	41.0	59.0	ND
Six Mile Creek	1.41	11	ND	15	0.51	634	ND	0.05	11	10	ND	58	84	16	7	40	1.2	0.6	0.6	53.7	45.3	1.0
Sixteen Mile Creek	2.38	62	0.10	23	0.67	594	ND	0.03	24	26	ND	34	170	29	10	102	0.4	2.2	2.2	13.4	85.8	0.9
Sixteen Mile Oakville	2.82	35	0.31	33	1.15	852	ND	0.05	26	18	ND	113	194	31	13	183	1.6	2.0	6.0	21.7	74.0	4.3
Smithfield Creek	0.96	34	ND	9	0.34	731	ND	0.04	6	10	ND	82	229	15	7	45	2.4	3.8	3.7	31.9	68.1	ND
Soper Creek	1.46	43	0.20	11	0.60	506	ND	0.04	9	9	ND	141	500	23	10	62	3.7	4.2	10.8	25.3	74.4	0.3
Spencer Creek	1.84	69	0.06	17	1.48	1098	ND	0.05	12	44	ND	155	131	20	9	410	2.7	3.2	3.1	27.3	72.7	ND
Spring Creek	1.66	113	0.06	11	0.72	291	2	0.06	11	88	ND	72	182	24	7	235	1.6	3.6	7.3	33.8	66.2	ND
Spring Garden Creek	1.71	48	0.06	14	0.92	809	ND	0.04	15	38	ND	60	118	21	9	263	1.6	3.6	8.4	31.8	67.9	0.3
Stoney Creek	2.13	118	0.11	21	2.14	1275	ND	0.07	16	96	ND	177	192	37	9	538	4.6	3.7	7.5	25.9	73.4	0.8
Tecumseh Creek	2.01	93	0.06	19	1.10	718	ND	0.19	15	50	ND	118	142	25	13	397	2.2	5.7	12.2	38.8	61.2	ND
Thirty Mile Creek	2.05	59	0.07	19	0.95	1046	1	0.11	18	48	ND	137	122	23	10	352	1.8	4.0	9.1	39.0	61.0	ND
Tooley Creek	1.10	12	0.19	9	0.55	321	ND	0.05	6	6	ND	166	409	21	9	50	3.2	2.3	6.3	39.9	60.1	ND
Treasure Creek	1.65	48	0.06	15	0.97	903	ND	0.05	13	32	ND	45	132	20	8	130	1.6	2.7	6.3	34.2	65.8	ND
Tuck Creek	1.62	45	0.11	23	1.60	623	ND	0.06	18	40	ND	173	133	21	9	284	2.9	3.3	7.4	29.4	70.2	0.4
Turtle Creek	1.51	103	0.06	15	0.45	1022	1	0.08	10	57	ND	115	135	21	7	152	1.4	3.3	5.0	40.0	60.0	ND
Twelve Mile Barnes	1.40	371	ND	15	1.17	391	ND	0.03	31	32	ND	45	133	17	8	119	1.8	3.3	5.1	58.9	41.1	ND
Twenty Mile Creek	2.18	74	0.11	21	0.96	518	1	0.04	22	24	ND	67	162	27	10	119	1.0	3.2	7.7	35.5	64.1	0.4
Two Mile Creek	1.51	50	0.06	17	0.70	641	ND	0.04	15	15	ND	50	113	21	8	83	1.0	2.4	5.4	26.5	72.7	0.9
Usshers Creek	1.81	86	0.09	18	0.89	447	ND	0.03	25	24	ND	37	143	25	9	118	0.8	5.3	12.1	42.5	57.2	0.4
Walkers Creek	1.46	45	0.05	16	0.66	646	ND	0.03	15	21	ND	34	125	21	9	116	0.7	2.7	5.9	27.1	72.1	0.8
Wedgewood Creek	0.87	20	ND	9	0.39	259	1	0.04	13	16	ND	45	79	11	5	82	1.0	1.1	2.2	58.0	41.3	0.7
Welland Canal	2.98	55	0.18	34	1.38	746	ND	0.04	34	32	ND	83	267	38	12	167	1.8	1.2	4.0	6.4	73.6	20.0
Wendigo Creek	0.66	36	ND	6	0.58	146	ND	0.04	5	22	ND	78	69	8	3	91	2.0	0.9	1.4	61.9	38.1	ND
Wesleyville Creek	0.99	19	0.08	5	0.30	441	ND	0.03	1	ND	ND	75	416	16	7	45	1.8	-1.3	7.6	41.0	59.0	ND
Wesleyville Marsh Creek	1.29	38	0.08	6	0.23	1262	ND	0.02	3	ND	ND	61	301	14	7	44	1.8	6.1	14.0	43.7	56.3	ND
West Corbett Creek	2.25	71	0.08	7	0.57	1865	ND	0.06	13	46	ND	169	267	38	6	229	3.8	2.6	10.1	44.9	55.1	ND
West Lynde Creek	1.22	50	0.11	10	0.36	334	ND	0.05	9	14	ND	109	353	25	9	65	2.8	4.4	10.7	45.7	54.3	ND
Westside Creek	1.62	14	0.21	12	0.52	423	ND	0.05	9	7	ND	75	795	30	12	60	1.5	1.9	4.6	33.3	65.4	1.3
Wicklow Creek	0.67	38	0.12	6	0.32	238	ND	0.03	4	6	ND	125	237	11	5	42	3.4	5.7	12.7	63.5	36.5	ND
Wilmot Creek	1.07	14	0.13	8	0.43	358	ND	0.04	2	ND	ND	157	376	15	7	34	3.8	2.5	6.3	37.6	62.4	ND

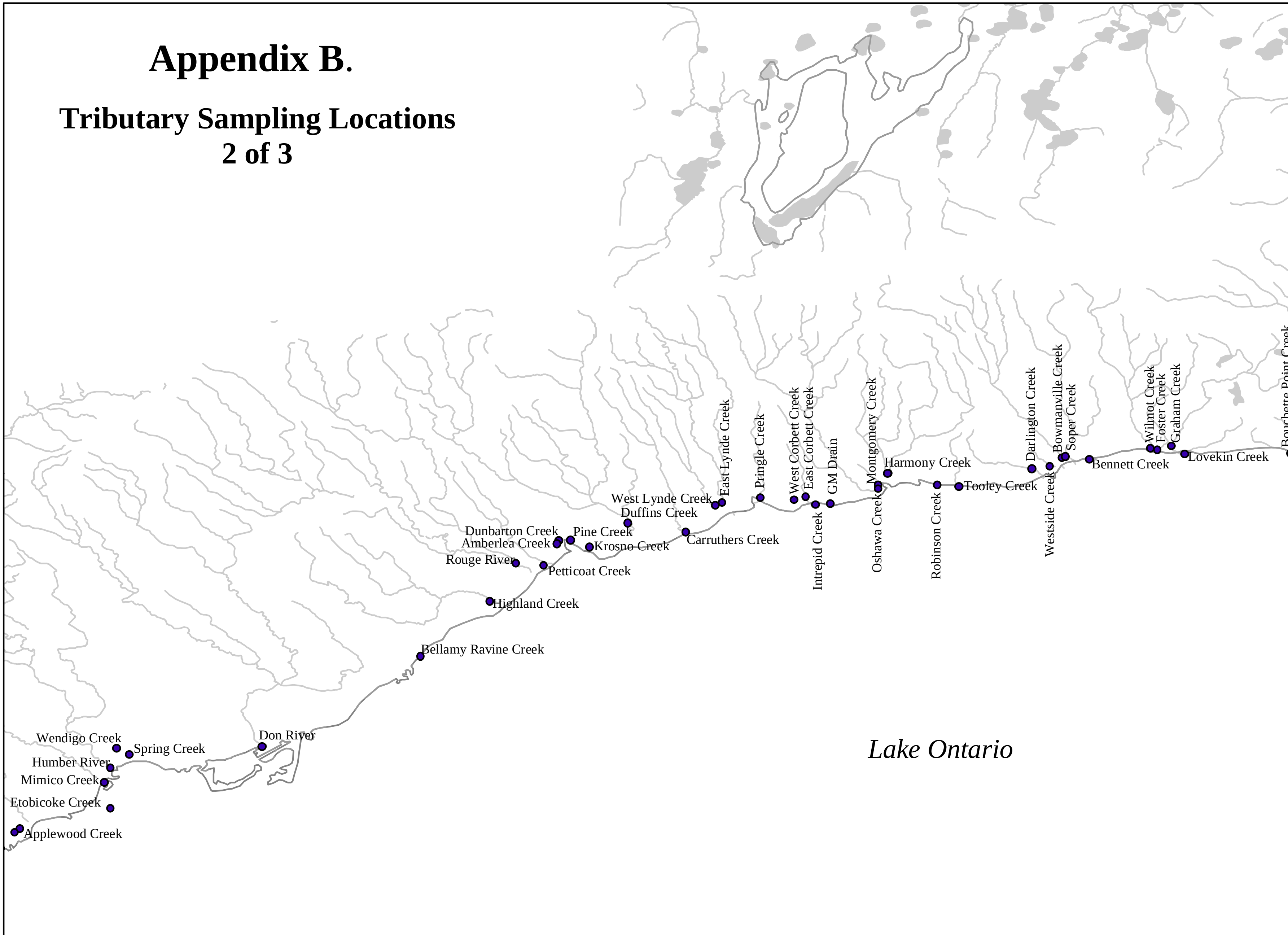
Note: Exceedences of (any) Sediment Quality Guidelines are Indicated in Table

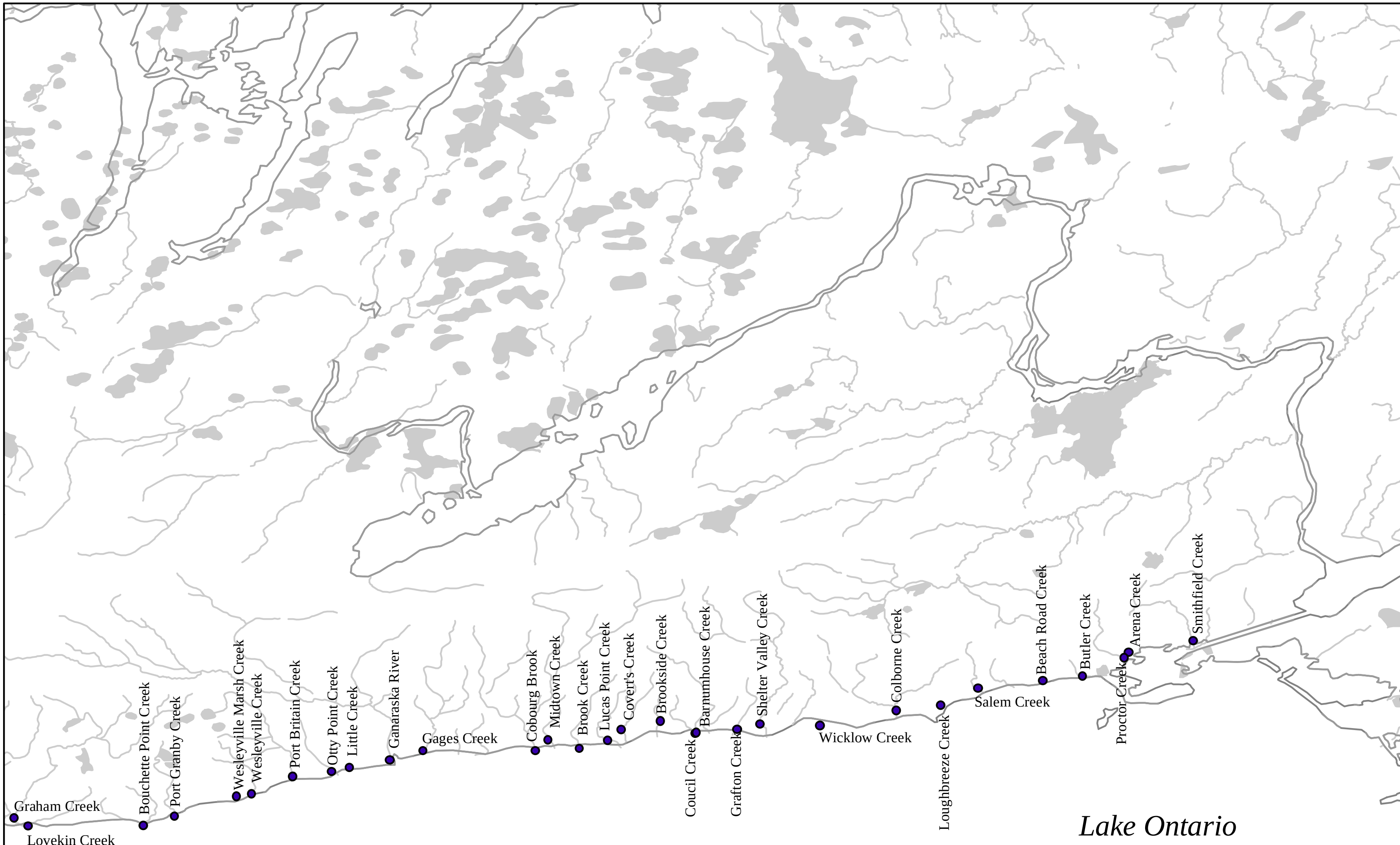
Appendix B. Tributary Sampling Locations 1 of 3



Appendix B.

Tributary Sampling Locations
2 of 3

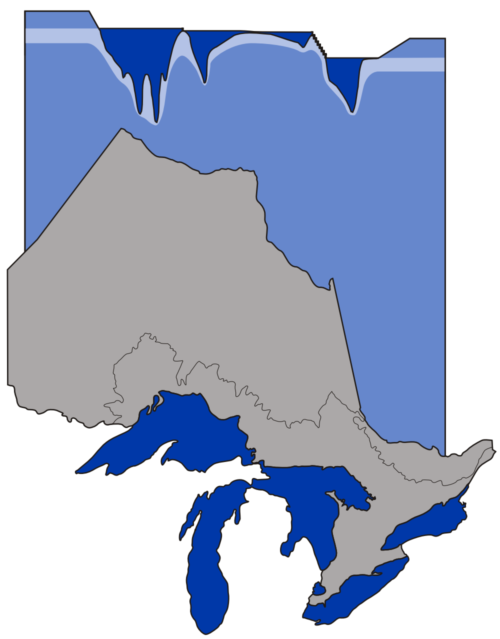




Appendix B. Tributary Sampling Locations
3 of 3

Appendix B: Summary of Federal and Ontario Sediment Quality Guidelines

Compound	Unit	Federal TEL	Federal PEL	Provincial LEL	Provincial SEL
Hexachlorobenzene	ug/g			0.02	24
Endrin aldehyde	ug/g	0.00267	0.0624		
Toxaphene	ug/g	0.0001			
Aldrin	ug/g			0.002	8
a-BHC	ug/g			0.006	10
b-BHC	ug/g			0.005	21
Lindane	ug/g	0.00094	0.00138	0.003	1
Total Chlordane	ug/g	0.0045	0.00887	0.007	6
p,p'-DDD	ug/g			0.008	6
p,p'-DDE	ug/g			0.005	19
Total DDD	ug/g	0.00354	0.00851		
Total DDE	ug/g	0.00142	0.00675		
Total DDT	ug/g	0.00119	0.00477	0.008	71
DDT & Metabolites	ug/g			0.007	12
Dieldrin	ug/g	0.00285	0.00667	0.002	91
Endrin	ug/g	0.00267	0.0624	0.003	130
Heptachlor epoxide	ug/g	0.0006	0.00274	0.005	5
Mirex	ug/g			0.007	130
Aroclor 1016	ug/g			0.007	53
Aroclor 1248	ug/g			0.03	150
Aroclor 1254	ug/g	0.06	0.34	0.06	34
Aroclor 1260	ug/g			0.005	24
Total PCB	ug/g	0.0341	0.277	0.07	530
Naphthalene	ug/kg	34.6	391		
Acenaphthylene	ug/kg	5.87	128		
Acenaphthene	ug/kg	6.71	88.9		
Fluorene	ug/kg	21.2	144	190	
Phenanthrene	ug/kg	41.9	515	560	
Anthracene	ug/kg	46.9	245	220	
Fluoranthene	ug/kg	111	2355	750	
Pyrene	ug/kg	53	875	490	
Benz(a)anthracene	ug/kg	31.7	385	320	
Chrysene	ug/kg	57.1	862	340	
Benzo(k)fluoranthene	ug/kg			240	
Benzo(a)pyrene	ug/kg	31.9	782	370	
Indeno(1,2,3-cd)pyrene	ug/kg			200	
Dibenzo(a,h)anthracene	ug/kg	6.22	135	60	
Benzo(ghi)perylene	ug/kg			170	
Total PAH	ug/kg			4,000	
As (Arsenic)	µg/g	5.9	17	6	33
Cd	µg/g	0.6	3.5	0.6	10
Cr	µg/g	37.3	90	26	110
Cu	µg/g	35.7	197	16	110
Fe	pct			2	4
Mn	µg/g			460	1100
Ni	µg/g			16	75
Pb	µg/g	35	91.3	31	250
Zn	µg/g	123	315	120	820
Mercury	ng/g	170	486	200	2000



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