Department of Environmental Conservation

Division of Water

Trackdown of Chemical Contaminants to the Niagara River from Buffalo, Tonawanda and North Tonawanda

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Trackdown of Contaminants To The Niagara River From Buffalo, Tonawanda, and North Tonawanda

Simon Litten

April 1996

Bureau of Watershed Assessment and Research
Division of Water
New York State Department of Environmental Conservation

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Forward

This report summarizes the findings of a contaminants trackdown project in the Niagara River basin performed by the New York State Department of Environmental Conservation in support of the Niagara River Toxics Management Plan. It is a part of a process of source identification, remediation and reassessment. It is not intended as an overall appraisal of environmental conditions. The project used analytical methods with greater sensitivity than those routinely available to Federal and State regulatory programs and it sampled at locations not routinely monitored as part of those programs. Discovery of chemical contaminants in these sites and by these methods should not be construed as an indication of regulatory failure or environmental harm. Indeed many of the sites with high contaminant concentrations are undergoing remediation and others are upstream of treatment.

Information of the sort developed here will be used to identify previously unknown contaminant sources and to confirm sources undergoing remediation. Future work of this nature will be undertaken to better define the newly revealed contaminant sources and to revisit sites that have been remediated.

Introduction

Polychlorinated biphenyls (PCBs) are substances of concern in the Great Lakes. PCBs enter the water column of Lake Ontario through sediment resuspension and desorption, through wet and dry precipitation, direct aqueous discharges, and from tributaries. New York State is committed to the "virtual elimination" of PCBs but little can be practically accomplished in regard to reducing recycling in the lake, from atmospheric deposition (107 kg/yr.[1]), or from Lake Erie (440 kg/yr.[2]).

Upstream/downstream river monitoring indicates that between 210 and 91 kg/yr. enters the Niagara River along its length. The increase in flow between the ends of the Niagara River is about 1400 cfs. Under the assumption that all the differential PCB loading was carried in water, that influent would have a mean whole water PCB concentration of 87 ng/L. The current NYS water quality standard for PCB is 1 ng/L and the proposed PCB standard for the protection of people eating Great Lakes fish is to be 0.0039 ng/L.[3] Therefore, both the concentration and the loading of PCBs from Niagara River sources are significant.

Remediation efforts have been completed or begun at several New York State sites in the Niagara Basin. These include sediment remediation of PCB sources from Gill Creek in Niagara Falls (1991) and Pettit Cove in North Tonawanda (1994). Sites contaminated with PCBs currently being remediated include Spaulding Fiber in Tonawanda , 318 Urban St. in Buffalo, and Niagara Transformer in Cheektowaga.

The record of permitted dischargers shows no PCBs[4] (all observations are below the reporting limits) but the reporting limits are usually 65 ng/L. If the detection level was used to set an upper bound, the load would be 12 kg/yr. from industrial sources and 22 kg/yr. from municipal wastewater treatment plants.

Strategies to reduce toxic chemical loading to the Niagara River include trackdown of sources. This may be accomplished by wide-spread sampling to investigate significant surface water and wastewater catchments and to evaluate known and suspected sources. Subsequent work using more refined procedures can then be used to determine which areas need clean-up.

This report concerns sampling performed in 1991, 1993, and 1994 to identify sources of contaminants impinging directly or indirectly on the Niagara River. Most of the

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1 Gobas, F.A.C., M.N. Z'Graggen, and X. Zhang. 1995. Time response of Lake Ontario ecosystem to virtual elimination of PCBs. Environ. Sci. Technol. 29(8):2038-2046.

2 Data Monitoring Group, River Monitoring Committee, 1992-1993. 1995. Joint Evaluation of Upstream/Downstream Niagara River Monitoring Data. Environment Canada, United States Environmental Protection Agency, Ontario Ministry of the Environment, and New York State Department of Environmental Conservation.

3 U.S. Environmental Protection Agency. 1995. Final water quality guidance for the Great Lakes system; final rule. 40 CFR 9, 122, 123, 131, and 132. Fed. Regis. 60(56) 15366-15425. March 23, 1995.

4 Region 9. 1995. 1993-94 Toxic Substance Discharges from Point Sources to the Niagara River. New York State Department of Environmental Conservation.

work was done in Buffalo but a minority of samples were taken in Lackawanna, Tonawanda, North Tonawanda, and Niagara Falls. Sampling was performed in surface waters at Smokes Creek, Buffalo River, Cayuga Creek (Erie County), Scajaquada Creek, Two-Mile Creek, Ellicott Creek, Cayuga Creek (Niagara County), Woods Creek (Grand Island), and Gill Creek (Niagara Falls). Samples were also taken in combined sewers and drains from North Tonawanda, Tonawanda, and Buffalo.

Most of the sampling was done using passive samplers (PISCES) and polychlorinated biphenyls (PCBs) were the primary target. PISCES permits temporally integrated sampling of hydrophobic chemicals over a period of about two weeks. Analysis of concentrated PISCES extract by the PCB congener method allows (or should allow) detections in all samples and fingerprinting. Fingerprinting helps to distinguish the relative importance of different sources.

PCB samples were analyzed by the congener method and by the more conventional US EPA Method 608 procedure. PCB results are reported in several different ways. Individual congener and Aroclor masses are given in appendices; estimated dissolved phase total PCB concentrations are given along with Aroclor designations; and relative abundances of PCB homologs are shown for some samples.

Limited whole water sampling was performed for mercury. Suspended solids for PCBs were field concentrated with pressure filtration at one site in the study area. The captured solids were extracted for PCBs and results from Lake Ontario sites are given for comparative purposes.

Methods

Organics

Sampling concentrated on PCBs. Most of the organics sampling was done using Passive In-Situ Chemical Extraction Samplers (PISCES).[5] PISCES is a metal cylinder of about 200 mL volume. The unit is suspended vertically in water. The top is sealed with a Teflon disk and the bottom is closed with a polyethylene membrane. Operationally, PISCES is filled with 200 mL of a solvent (hexane) and placed in the water where it remains for about two weeks. As a check against contamination, the hexane solvent bottles were tracked as they were used to fill each PISCES. The last 200 mL of hexane from each bottle was poured into a PISCES unit and immediately transferred into a sample bottle to serve as a field blank.

Hydrophobic substances such as PCBs and chlorinated pesticides diffuse through the polyethylene and accumulate in the hexane. An equation developed from laboratory experiments allows us to estimate the effective volume of water sampled (L). If the total analyte in the solvent is measured (ng of analyte), aqueous analyte concentration (ng/L) can be calculated.

Uptake was found to follow the relationship:

$$\text{sampling rate, S (L/cm/day)} = \exp((-6591/T)+19.269)$$

where T is the absolute temperature (degrees K). The effective sample volume (V) is:

$$V = S \times \text{membrane area in cm}^2 \times \text{days of exposure}$$

S does not vary significantly among the congeners in Aroclor 1242, so an average value was used. S was affected by the presence of dissolved organic matter (humic acids), indicating that bound compounds were not accumulated by the samplers. The membrane area in the PISCES used was 23 cm^2. From laboratory experiments a 95% confidence interval is calculated having an error of +/- 40% about the sampling rate. The uptake formula was developed for PCBs. Its utility degrades when it is applied to chemicals other than PCBs. Some non-PCB substances, like the DDTs, are probably adequately handled by the formula but others, for example cyclodiene pesticides (chlordane, endrin, and dieldrin) might not be. Because of these uncertainties, pesticides will not be discussed.

Solvent slowly diffuses out of the sampler through the membrane effectively preventing biological growth and fouling of the membrane surfaces. This process does not affect uptake of the analytes from water since the diffusive process is driven by the activity gradient between the analyte dissolved in water and in the solvent. Sampling rate would only be affected if the solvent-water partitioning approached equilibrium. On the basis of the measured sampling rate, it would take $>10^3$ days to reach 10% of the equilibrium for an analyte with a hexane-water partition coefficient of 10^5. However, if the membrane

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[5] Litten, S., B. Mead, and J. Hassett. 1993. Application of passive samplers (PISCES) to locating a source of PCBs on the Black River, New York. Environ. Sci. and Technol. 12: 639-647.

was punctured exiting solvent would result in loss of accumulated analytes. Field and laboratory studies have shown that the uptake rate is increased as turbulence at the water/membrane interface increases. Until this problem is solved PISCES is not a quantitative tool. However, there is fairly good agreement between PCB concentrations calculated from PISCES and concentrations from other aqueous phase sampling. For example, in 1991 sixteen PISCES were deployed in the Niagara River between May and October at the site of the Fort Erie, Ontario intake used in the upstream/downstream surveillance program.[6] The mean aqueous phase PCB concentration reported by the Data Interpretation Group for the 1991-1992 sampling period was 1.262 ng/L. The mean of the PISCES samples at that site was 1.4 ng/L. The Data Interpretation Group mean aqueous phase PCB concentration from the Niagara-On-The-Lake, Ontario station (at the Lake Ontario mouth of the Niagara River) was 1.135 ng/L whereas the mean of 12 PISCES PCB samples taken between June and October on the New York side of the lower river (off Youngstown, New York) was 3.2 ng/L.

PISCES does not sample particle-bound analytes and is affected by water turbulence. Usually water temperatures are known only at placement and retrieval. Results from PISCES sampling should be regarded as semi-quantitative and are best used as a tool for tracking sources similarly to the uses of sediment and biota sampling. However, the duration and location of exposure are always known for PISCES, no-biotransformation or selective uptake occurs, and PISCES may be placed in sites that do not support survival of biota (sewers for example) or where sediments do not accumulate. PISCES samples continuously for several weeks. PISCES can be installed and retrieved rapidly; as many as 30 have been deployed in a day. They can be placed wherever the membrane will be covered with water and the turbulence is not too great. Because each PISCES is cheap (costing about $20), loss of units through vandalism or accident is tolerable. This allows units to be placed freely in risky situations where one would hesitate to leave more valuable equipment. In many situations, there is no practical alternative to passive sampling.

On return from the field, sample containers were stored in freezers at -10°C prior to analysis. Because of the effectivity of PISCES in abstracting trace hydrophobes from water, and in the sensitivity of well-run PCB congener analyses, PCBs were detected in almost all samples.

PCB data were used to calculate both water concentration (through the previously described equations) and to depict relative homolog abundances were derived from summation of individual congeners as measured by DEC method 91-11 or other similar methods.[7] Clean-up for congener PCBs used sulfuric acid, potassium hydroxide, chromium trioxide, Florisil, and elemental mercury. Hexane from the PISCES was concentrated to a final volume of 1 mL and 1 mL was the injection volume. Analyses from 1991 were performed on a GC/EC using a RTX-5 column, hydrogen carrier gas, and

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6 Litten, S. 1994. Niagara River Cross Channel Homogeneity and Analysis of Upstream/Downstream Monitoring Data. New York State Department of Environmental Conservation. Division of Water, Bureau of Monitoring and Assessment. Albany, NY.

7 New York State Department of Environmental Conservation, Division of Water, Bureau of Technical Services and Research, Analytical Services Section. 1991. DEC 91-11. Albany, NY.

a splitless injector. This procedure was not capable of individually resolving all congeners. The October 1993 and 1994 PISCES samples and the 1994 suspended sediment samples were analyzed using both an RTX-5 and Apiezon columns. In these later analyses individual congeners were reported. Two thermal ramps brought the initial temperature from 194°C to 268°C. The total analysis time was approximately 37 minutes. Minimal detectable amounts of a congener were approximately 0.05 ng.

Field blank results are expected to be less than 5 ng. The median estimated water volume from the Inchcape/Aquatec 1993/4 sampling series was 3.89 L. Thus the concentration of PCBs in a PISCES result due to hexane contamination is expected to be less than 1.28 ng/L. Of the three field blanks reported from the Inchcape/Aquatec series, the greatest contamination level was 2.4 ng. No blank corrections were made.

Hexane samples in the Inchcape/Aquatec series were spiked with tetrachloro-m-xylene, 2,3,3',4,5,5',6-heptachlorobiphenyl (BZ#192), and octachloronaphthalene. Recoveries of the surrogates (shown in the appendices) are expected to be greater than 60% and less than 150%. By these criteria, four samples out of thirty-five were problematic. These were from Nash Rd. (Map #1), Two-Mile Creek at Ensminger Rd. (Map #28), River Rd. in N. Tonawanda (Map #33), and Hamburg S. of Mackinaw (Map #12, 10/5/93).

Thirty-two PISCES PCB samples were collected in 1991 and analyzed by Aquatec. Seven field blanks showed a median contribution of 1.65 ng/L to the final result. Two surrogates, tetrachloro-m-xylene and decachlorobiphenyl (BZ#209) were added in the lab. Seven samples showed problematic recoveries. These were from the Sloan Drain, 7/91 and 10/91 (Map #2); Babcock S. of S. Park, 7/91 (Map #6); Two-Mile Cr. at River Rd, 7/91 (Map #31); Buffalo R. at Ohio, 7/91 (Map #36); Buffalo River at Ohio Drain, 7/91 (Map #43); and Pettit Cove, 7/91 (Map #44).

Results of matrix (hexane) spike blank results show good theoretical congener recoveries (**Table 1**).

Suspended solids can also carry hydrophobic substances such as PCBs. Field filtration methods were used to collect suspended solids in 1994. Filtered water was weighed to determine volumes. The filters were Soxhlet extracted and total analyte amounts (ng) were determined. The total amount was then divided by the mass of water filtered (kg or L). Separate samples for total suspended solids (TSS) were taken so that it would be possible to calculate ng of PCB per gram of suspended solids. Filtration methods were only used for this project in Cayuga Creek (Erie County) but were extensively employed in other sites in the Lake Ontario basin during 1994. Surface waters were collected in a pre-cleaned stainless steel pail (cleaned with distilled water and acetone). The water was pumped through a multiple filter holder (Pentaplate) using a peristaltic pump. Interior surfaces of the filter holder were wiped with distilled water and acetone immediately after and before use. The holder was loaded with glass fiber filters (GFF grade filters 293 mm in diameter; 0.7 μ nominal pore size) which had previously been fired at 450°C for four hours to eliminate contamination. The filters were only touched by acetone rinsed broad-head forceps. After placing the filter on the filter holder, it was wetted with distilled water. Water was pumped through the filter holder with a peristaltic pump. All tubing was flushed with site water for five minutes before sample collection. Water was pumped through until back pressure reached 7 psi which is the maximum pressure recommended by the manufacturer. Thus, all samples of suspended solids have roughly equivalent solids loadings. A small vacuum pump was used to pull excess water from the filter apparatus dead-space. The loaded filters were then re-wrapped in an aluminum foil envelope which had held the filter in the oven and used to keep the filter sealed in the field. Filtered water was weighed on a calibrated electronic scale to determine water volume. Filters were kept iced in the field and stored at -10°C. In the laboratory, filters were Soxhleted for 12 hours and extracts were analyzed for congener PCBs as were the PISCES hexane extracts. Pressure filtration is theoretically more quantitative than PISCES; it does not require empirical equations for the determination of water volume.

Table 1. Percent recovery of matrix spike blanks.

	blank spike	% MSB recovery by sample delivery group 3/23/94	3/24/94
BZ#8	10.0	106	96
BZ#18	10.0	115	109
BZ#28	10.0	101	96
BZ#44	10.0	97	94
BZ#52	10.0	88	88
BZ#66	10.0	104	95
BZ#77	10.0	101	96
BZ#101	10.0	94	95
BZ#105	10.0	102	91
BZ#118	10.0	88	92
BZ#126	10.0	135	117
BZ#128	10.0	90	83
BZ#138	10.0	92	93
BZ#153	10.0	97	100
BZ#170	10.0	114	94
BZ#180	10.0	107	76
BZ#187	10.0	90	90
BZ#195	10.0	108	89
BZ#206	10.0	93	93
BZ#209	10.0	84	77

PCBs are a family of chlorinated biphenyls. Two hundred and nine different isomers or congeners are theoretically possible. The overwhelmingly greatest sources of PCBs were a line of industrial chemicals manufactured by the Monsanto Corporation under the trademark "Aroclor." Monsanto produced Aroclors with different properties for different applications. The Aroclors differed in the percentage chlorine by weight. For example Aroclor 1242 was 42% chlorine by weight and Aroclor 1260 was 60% chlorine. The different Aroclors have different patterns of relative congener abundance. In distinguishing different sources it is helpful to look at relative homolog abundance (**Figure 1**).

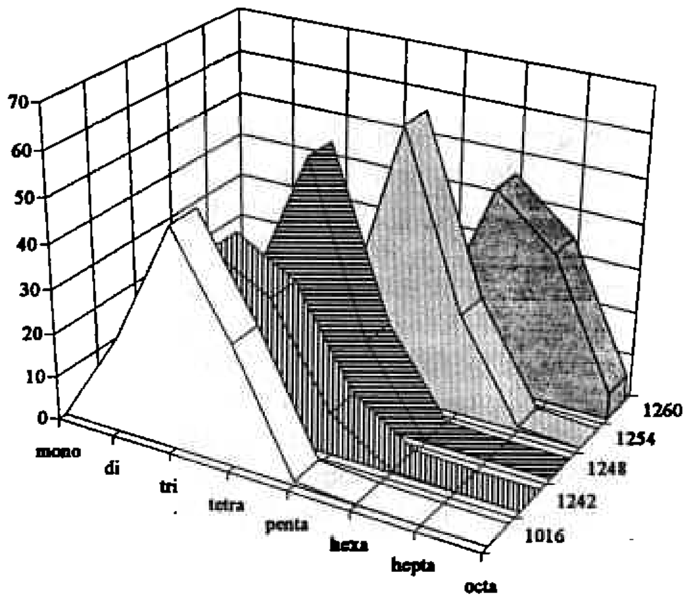

Figure 1. Homolog composition of Aroclors 1016, 1242, 1248, 1254, and 1260. Taken from Webb and McCall.[8] The vertical axis is percent abundance.

Each PCB molecule has between one and ten chlorines. EPA has determined that a monochlorobiphenyl (one chlorine) can be considered to be a polychlorinated biphenyl for regulatory purposes but were ignored here because of analytical problems. Congeners having the same number of chlorines belong to the same homolog group. A sample homolog pattern may be compared with homolog patterns from pure Aroclors to determine which Aroclor was originally present. In actuality, patterns from samples may greatly differ from known Aroclors. The source may have contained more than one Aroclor. Some congeners are more volatile or more soluble, or more likely to be bacterially degraded than others. Environmentally distributed Aroclors will become increasingly different over time from their original composition. Chemicals that are not PCBs may be wrongly identified as PCB congeners. This can seriously distort the pattern of relative homolog abundance.

PCB results in this report are given Aroclor designations dependent on which homologs are most abundant. This was done to facilitate comparisons with the existing soil and ground water data. All quantitations are in the form of summed congeners (excepting monochlorobiphenyls). Relative abundances of homologs are the sum of all congeners having the same molecular weight divided by the total amount of PCB. This

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[8] Webb, R.G., and A.C. McCall. 1973. Quantitative PCB standards for electron capture gas chromatography. J. Chromatographic Science. 11: 366-373.

procedure enables pattern comparison between samples with greatly differing total concentrations.

In 1991 analyses were performed by Aquatec Environmental Services of Burlington, VT. PCB congener analysis was done on a single RTX-5 chromatographic column. Samples collected in October 1993 and March of 1994 were analyzed by Inchcape/Aquatec, the successor to Aquatec Environmental Services, out of Colchester, VT. Here, two chromatographic columns were used, RTX-5 and Apiezon. The 1991 Aquatec data seemed usually to be good but the absence of a second column is a serious defect. Apparently spurious congener results were flagged and given a value of zero.

PCB data are presented in Appendices I and II. They show for each sample the times and dates of PISCES deployment, the mean of the water temperatures at the beginning and termination of deployment, the calculated liters of water sampled, the total ng of PCB contained in the PISCES, and the calculated aqueous concentration. Lastly the appendices display raw data showing the ng recovered of each quantitated pesticide, Aroclor, and PCB congener. Monochlorbiphenyls are not reported in the Appendices.

Appendix I presents data from the 1991 Aquatec work. Problems were encountered in PISCES being damaged and in excessive solvent loss in some high turbulence areas. As an experiment, aluminum window screening was placed over the membranes of some PISCES. Results from such units are designated with an "[S]". Screening did reduce damage and solvent loss but they also reduced PCB uptake. At some sites the screens were thickly covered with a precipitate, probably $CaCO_3$. Appendix II gives the information from Inchcape/Aquatec's 1993 and 1994 analysis.

Inchcape/Aquatec reported 135 individual congeners and one co-elution of two pentachlorobiphenyls (BZs 101 and 90). This was accomplished by running samples on two different chromatographic columns where any congeners that co-eluted on one column did not co-elute on the other (excepting congeners BZ 101 and 90). By a complicated series of subtractions, single congener data were obtained. Because single congeners were obtained, clean homolog summations were possible.

Inchcape/Aquatec data required extensive editing due to false-positives. Concentrations for each PCB congener can be calculated by at least two methods because each congener was independently measured on two chromatographic columns. In many cases, a target PCB congener co-elutes with another PCB congener. For example, on the Apiezon column, congeners BZ 16 and BZ 32 co-elute. BZ 16 appears as a single peak on the RTX-5 column. BZ 16 can be quantitated from the RTX-5 column or it can be quantitated as the Apiezon multiple peak with the amount of BZ 32 subtracted. The best rule is to use the simplest method for each congener. In this example, the RTX-5 quantitation is chosen. But, it can happen that a non-PCB chemical may elute in the RXT-5 BZ 16 retention time window. This sort of thing is not infrequent, especially in very contaminated situations. Co-elution of non-PCB chemicals makes the electron capture congener method prone to false-positives.

These rules were applied to the 1993/1994 Inchcape/Aquatec PCB congener data:

1) When a congener is detected as a single chromatographic peak on both columns, use the lower concentration. This occurs for 44 congeners in the Inchcape/Aquatec output.

2) When a congener is reported by the literature[9] as absent in Aroclors and it was reported as a multiple peak in at least one column, recalculate the concentration from the multiple peak assigning all value to the more probable congener. Compare that value with the value of the congener as determined by using the shortest route to getting the concentration. Choose the lower of the two values. This situation occurs for nine congeners in the Inchcape/Aquatec data set. Do not change values for "absent" congeners that appear as single peaks on both columns.

3) Twenty-three congeners in the Inchcape/Aquatec data set were found to often have reported concentrations much greater than what would be expected from any Aroclor mixture. Recalculate each of them and compared the new value with the original value. Use the lowest. All concentrations were calculated from the data. On occasion, other congeners appeared suspicious and these were also tested by computing their concentration by an alternative method.

Given the differences in laboratory procedures, numerical comparisons (always weak with PISCES) should only be considered within an analytical group. For example, concentrations from the Inchcape/Aquatec series tend to be much larger than those from the 1991 Aquatec.

Mercury

Recent advances in the collection and analysis of mercury samples have resulted in its ubiquitous detection but at concentrations very much less than had been previously reported.[10] Whole water samples were collected directly into rigorously pre-cleaned Teflon 125 mL bottles. The bottles were taped to a weighted rope and lowered into the sewer or stream. Filled bottles were kept cold, kept dark, and delivered to a dedicated mercury laboratory within two days of sampling. Sampling procedures used for mercury did not produce temporally integrated data.

Mercury was sought in the Niagara area only in 1994. Grab samples were sent to Brooks Rand Ltd. of Seattle, WA. In the lab, all samples were acidified and photo oxidized with 1 mL BrCl. An appropriate volume was analyzed using $SnCl_2$ reduction, gold amalgamation, and cold vapor atomic fluorescence spectrometry. In this work, three batches of samples were submitted. Six sets of triplicates were run to determine relative standard deviations. Results are:

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9 Schultz, D.E., G. Petrick, and J.C. Duniker. 1989. Complete characterization of polychlorinated biphenyl congeners in commercial Aroclor and Clophen mixtures by multidimensional gas chromatography-electron capture detection. Environ. Sci and Technol. 23:852-859.

10 Gill, G.A., and W.F. Fitzgerald. 1985. Mercury sampling of open ocean waters at the picomolar level. Deep-Sea Research. 32(3): 287-297.

mean concentration (ng/L)	RSD
3.5	14%
6.94	3%
1.32	8%
48.1	1%
1685	12%
8.55	1%

Method detection levels were computed from standards for each batch. Quantitative detection levels (4 x MDL) for the three batches are shown in terms of 50 mL of analytical volume:

0.14 ng/L
0.69 ng/L
1.02 ng/L

All of these QDLs are significantly below the reported urban wastewater and urban surface water mercury concentrations.

Sampling Sites

Figure 2 shows the study area which extends as far south as Smokes Creek in Lackawanna, as far east as Cayuga Creek (Erie County) in Como Park, and as far north as Cayuga Creek (Niagara County) in Niagara Falls. **Figure 3** shows the Buffalo area in greater detail. Both maps also indicate the positions of inactive hazardous waste sites that may potentially affect sampling locations. **Table 2** names hazardous waste sites, lists relevant chemicals found in them, and their remedial status or their threat status.[11,12] Only sites with relevant chemicals are listed. Some of the noted sites have been remediated and are de-listed but there may still be small residual quantities of target substances associated with the sites.

Smokes Creek (Figure 2)

Smokes Creek passes through the former Bethlehem Steel site in Lackawanna and receives treated waste water from the Lackawanna STP. While Smokes Creek discharges to Lake Erie, its output is swept into the Niagara River and it may be considered a tributary to the Niagara River. PISCES were exposed in lower Smokes Creek (map site # 39) and at Warsaw St.(#40). The sampling sites bracket two inactive hazardous waste sites, Bethlehem Steel (inactive hazardous waste site ❖9) and Lehigh Industrial Park (❖145). The discharge of the City of Lackawanna STP also enters Smokes Creek between the sampling sites. Sampling in the lower creek was marred by vandalism. The successful deployment from October 1991 may also have been affected by backwater from Lake Erie.

An earlier study[13] reported elevated PCB concentrations in laboratory-reared spottail shiners exposed to Smokes Creek sediments in laboratory aquaria. Following publication, it was learned that some of the fish may have been contaminated prior to exposure. This study reexamines the issue of PCBs in Smokes Creek.

Buffalo River

The Buffalo River was sampled at the Ohio Bridge (Fig. 3, #36). Two of its tributaries were also sampled; Cayuga Creek was sampled at Clinton St.(Fig. 2, # 37) and at the entrance to Como Park Lake in Lancaster (Fig 2, #50). Attempts to place PISCES in Cayuga Creek in early 1994 failed but two suspended solids samples were obtained. Buffalo Creek was sampled off Harlem Rd (Fig. 2, #35). Technically, the Buffalo River is the result of the convergence of Cayuga Creek and Buffalo Creek. Harlem Rd. crosses directly after the junction but at that point the two streams are still very distinct. Cayuga Creek is turbid whereas Buffalo Creek is clear. The PISCES was placed in transparent Buffalo Creek water.

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11 Division of Hazardous Waste Remediation, New York State Department of Environmental Conservation. April 1994. Inactive Hazardous Waste Disposal Sites in New York State: Annual Report Appendix Volume 9.

12 New York State Department of Environmental Conservation Hazardous Substances Waste Disposal Task Force in consultation with New York State Department of Health. June 13, 1995. Hazardous Substance Waste Disposal Site Study, Final Report, Appendix J.

13 Litten, S., 1987. Niagara River Area Study. New York State Department of Environmental Conservation. Bureau of Technical Services and Research. Albany, NY

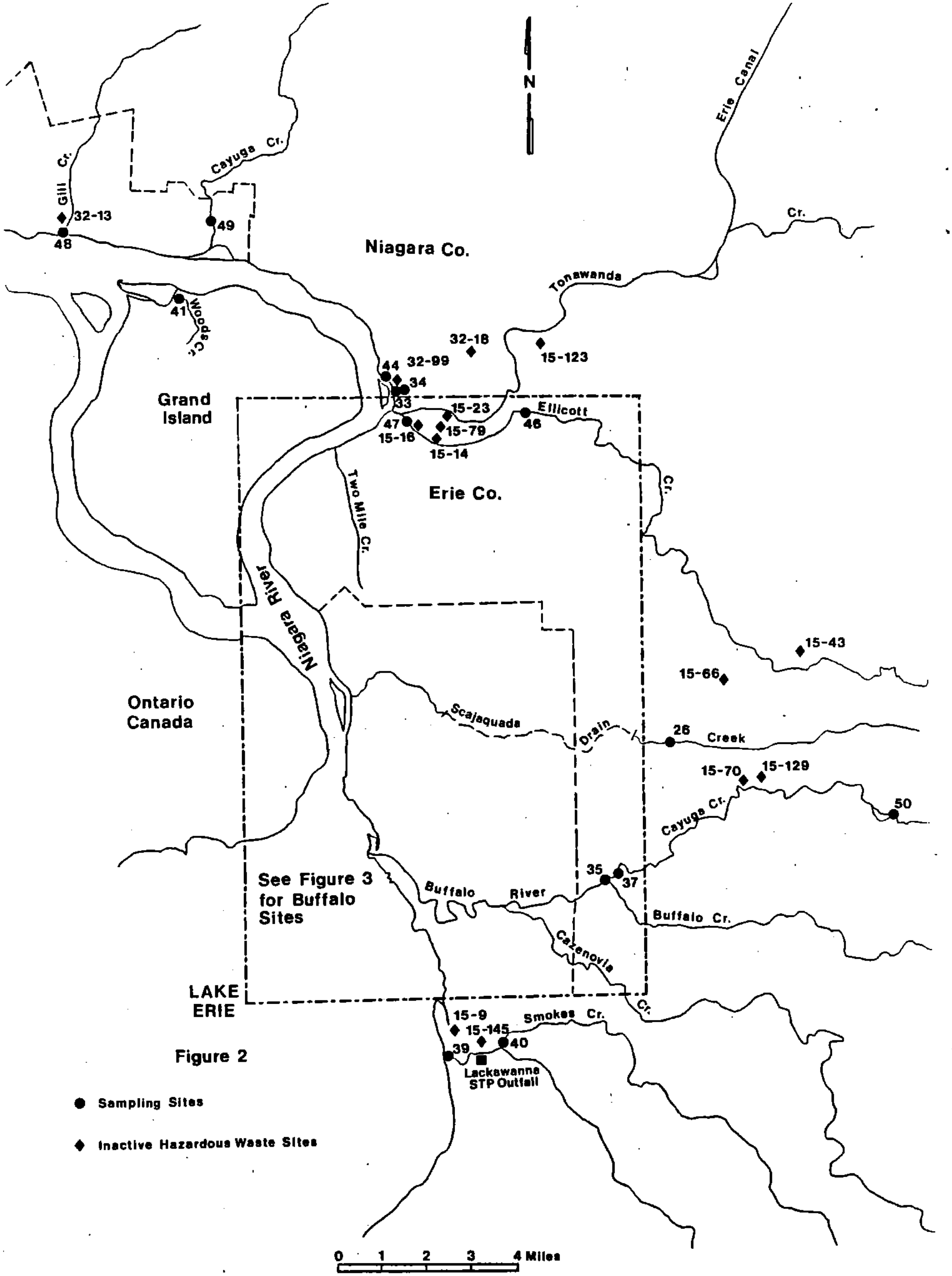
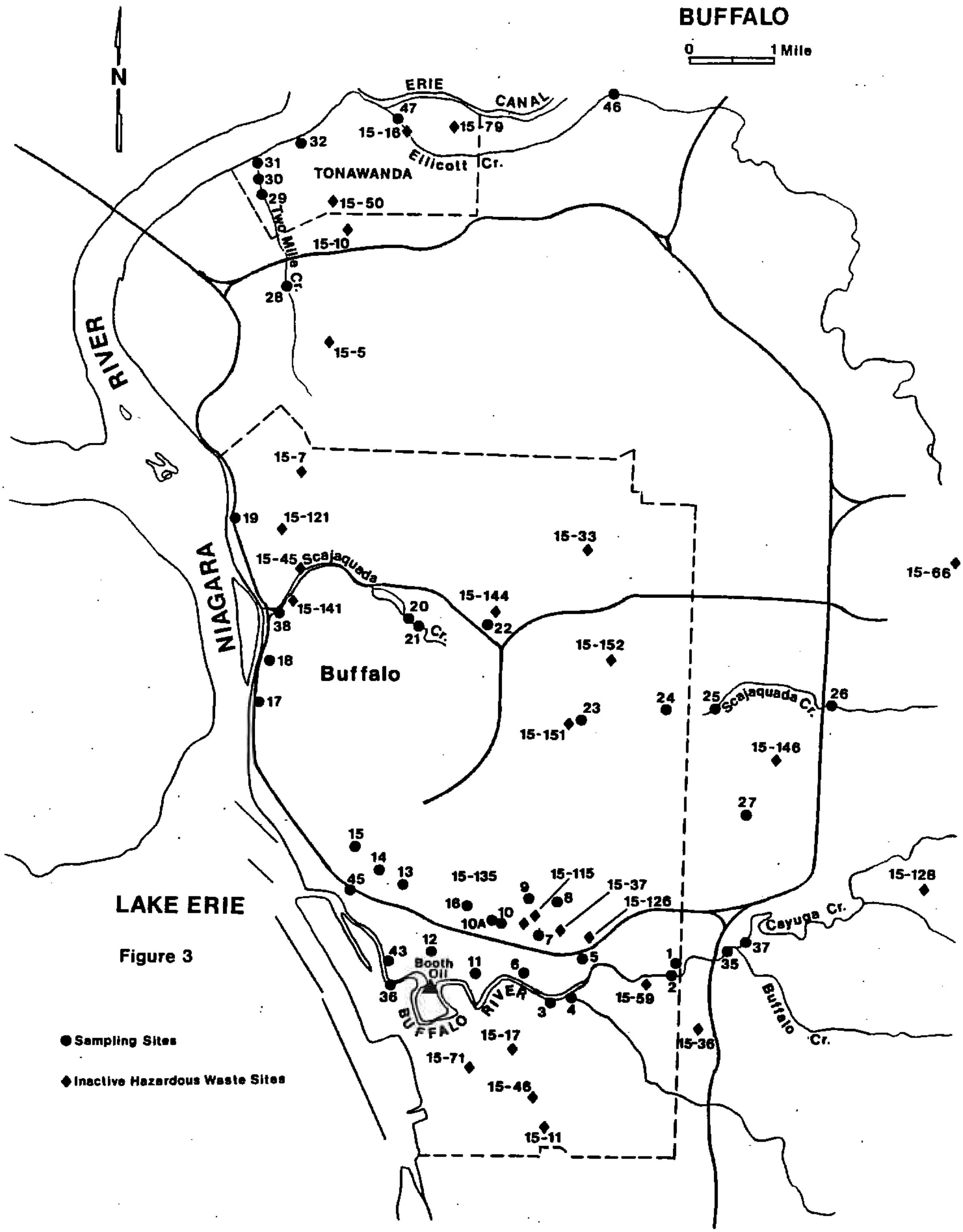

N
Erie Canal
Gill Cr.
Cayuga Cr.
32-13
48
49
Niagara Co.
Cr.
Tonawanda
41
Woods Cr.
32-18
15-123
44
32-99
34
33
Grand Island
15-23
Ellicott
46
47
15-16
15-79
15-14
Two Mile Cr.
Erie Co.
Cr.
Niagara River
15-43
15-66
Ontario Canada
Scajaquada
Drain
26
Creek
15-70
15-129
Cayuga Cr.
50
35
37
See Figure 3 for Buffalo Sites
Buffalo River
Buffalo Cr.
Cazenovia Cr.
LAKE ERIE
15-9
15-145
Smokes Cr.
40
39
Lackawanna STP Outfall
Sampling Sites
Inactive Hazardous Waste Sites
0 1 2 3 4 Miles

Figure 2



BUFFALO
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CANAL
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Cr.
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NIAGARA
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LAKE ERIE
Booth Oil
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Cayuga Cr.
Buffalo Cr.
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15-37
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10
10A
15-126
7
5
15-128
43
12
11
6
1
2
35
37
36
3
4
15-59
15-17
15-36
15-71
15-46
15-11
Sampling Sites
Inactive Hazardous Waste Sites

Figure 3

Table 2. Inactive Hazardous Waste and Hazardous Substance Sites Associated With Sampling Sites.

	Map #	Site name	Target Chemicals	Potential Impact Area	Status
	Erie County				
Fig 2	9	Bethlehem Steel	coal tar sludge, spent pickle liquor	Smokes Cr.	Consent Order with EPA signed
Fig 2	43	Pfohl Brothers	PCBs, dioxin, metals	Ellicott Cr.	ROD issured, design underway
Fig 2	66	Westinghouse Electric	PCBs, solvents	upper Scaj. Cr.	ROD issued
Fig 2	121	Hertel Ave. Site	PCBs	Hertel Ave Trunk	site has been remediated and delisted
Fig 2	145	Lehigh Industrial Park	PCB transformer oil	Smokes Cr.	ROD issued, construction underway
Fig 3	5	Aluminum Matchplate	mercury suspected but not found	Two-Mile Cr.	PSA ongoing
Fig 3	7	Anaconda/ American Brass	PCBs (Aroclor 1254), metals	Hertel Ave. Trunk	PSA completed, class 3 site*
Fig 3	10	Bisonite Paint	transformers with PCB oil	Two-Mile Cr.	PSA ongoing, under design
Fig 3	11	Hopkins St. landfill	mercury	South Buffalo	PSA completed, delisted
Fig 3	16	Columbus McKinnon	PCBs, heavy metals	Ellicott Cr.	ROD completed, remediation completed
Fig 3	17	Donner-Hanna Coke	coke related waste, mercury	Buffalo River	Phase II completed, class 3 site*
Fig 3	33	LaSalle Reservoir	dibenzofurans	Scaj. Tunnel	delisted
Fig 3	36	Madison Wire Company	heavy metals, PAHs	south Buffalo	remediation completed
Fig 3	37	Houdaille Industries	PCBs seen in 1981 but not in 1983	Babcock St.	delisted
Fig 3	45	Pratt &Letchworth	PCBs	lower Scaj. Cr.	remediation completed
Fig 3	46	Niagara Cold Drawn	PCBs, lead	south Buffalo	delisted
Fig 3	50	Spaulding Fiber	PCBs, solvents, phenolics	south Buffalo	Consent Order signed, RI/FS being performed
Fig 3	71	Lehigh Valley Railroad	PCBs (Aroclors 1260 and 1248)	south Buffalo	remediation completed
Fig 3	79	Tonawanda City Landfill	PCBs, pesticides, PAHs	Tonawanda Cr.	Phase II completed, closure under development
Fig 3	115	Bengart & Memel, Inc.	PCB, dioxins, furans	Swan Trunk	remediation completed
Fig 3	123	Creekside Golf Course	dioxins	Tonawanda Cr.	remediation completed
Fig 3	126	Clinton-Bailey Ave.	mercury and lead	Swan Trunk	delisted
Fig 3	128	Union Road Site	low level PCBs, tar, lead, pesticides	Cayuga Cr.	remediation underway
Fig 3	141	Iroquois Gas/Westwood Pharm.	PAHs, metals	lower Scaj. Cr.	design underway
Fig 3	144	Niagara Mohawk Dewey Ave.	PCBs	Scaj. Tunnel	remediation completed
Fig 3	146	Niagara Transformer	PCBs	Sloan Drain	ROD signed, under construction
Fig 3	151	318 Urban St.	PCBs	Scaj. Tunnel	ROD issued, design underway
Fig 3	152	Saginaw - Buffalo	PCB (Aroclor 1248), lead	Scaj. Tunnel	RIFS underway
Fig 3	135	Bern Metal Corp /Universal Iron & Metal	PCBs, lead, chromium	Swan Trunk	ROD issued
Fig 3	59	Houghton Park	PCBs	south Buffalo	delisted
Fig 3		GCF Industries (HS9023)	PCBs, mercury	Babcock St.	
	Niagara County				
Fig 2	32-13	DuPont	mercury, PCB, solvents, pesticides	Gill Cr.	Gill Creek sed. cleaned in 1992 under Consent Order
Fig 2	32-18	Occidental Durez	phenol tar, dioxin,	Pettit Cove	RI/FS completed, dredging in Pettit Cove completed
Fig 2	32-99	Schreck's Scrapyard	PCBs, solvents, phenolic resin waste	North Tonawanda	RI/FS complete, contaminated soil removed

* class 3 site - no significant threat to public health or the environment.

Four inactive hazardous waste sites may affect Cayuga Creek upstream of sample position #37 but only one, Union Road Site (❖128), contains PCBs and pesticides. In 1994 two suspended solid samples were taken upstream of all inactive hazardous waste sites at Como Park (#50).

Scajaquada Creek (Figure 3)

Scajaquada Creek was sampled near its mouth at Niagara St. (#38), off Delaware Ave. (#20), 800 feet upstream inside Forest Lawn cemetery (#21), prior to its entry into the Scajaquada Drain from a Cheektowaga footbridge at the bottom of Alexander St. (#25), and in a culvert at Galleria Mall (#26). The U-Crest ditch joins Scajaquada Creek at the Galleria Mall and it too was sampled (also at map site #26).

Lower Scajaquada Creek could be affected by an inactive hazardous waste site which was found to contain PCBs, Pratt and Letchworth (❖45).

Two-Mile Creek (Figure 2)

Two-Mile Creek was sampled near its mouth on River Rd. (#31), at Fletcher Rd (#29) and at Ensminger Rd (#28). An unnamed tributary draining a trucking establishment and a petroleum refiner (neither of whom are known to harbor target chemicals) was sampled as it passes under Two-Mile Creek Rd.(#30). Other inactive hazardous waste sites affecting Two-Mile Creek are Aluminum Matchplate where mercury was suspected but not found (❖5) and Bisonite Paint which held PCB transformers (❖10).

Ellicott Creek (Figure 2)

Ellicott Creek was sampled at Delaware Ave. (#47) just prior to its convergence with Tonawanda Creek and at Niagara Falls Blvd. (#46). Two attempts to sample just below a PCB site, Columbus McKinnon (❖16) failed. Pfohl Brothers (❖43) lies along Ellicott and is a PCB and dioxin site but it is not believed to affect the creek.

Pettit Cove (Figure 2)

A single PISCES sample was taken from the Pettit Cove (#44) prior to its remediation. This sample is affected by Occidental Durez (❖32-18).

Cayuga Creek (Niagara Falls) (Figure 2)

Cayuga Creek was sampled at Lindberg Ave (#49).

Gill Creek (Figure 2)

Gill Creek (#48) was sampled off the south side of the Robert Moses Parkway bridge in October of 1992. This site is affected by DuPont (❖32-13) and has been contaminated with PCB and mercury. In 1991 two PISCES were set in Gill Creek. One had been modified by placing aluminum screening over the membrane. PISCES exposed to high water temperatures and high current velocities were often ruined and the screening was installed to reduce water movement at the membrane/water interface. The exposure in Gill Creek was an experiment to see if the screening reduced uptake. Another experiment was performed in Gill Creek in 1993 to evaluate the relative performances of four analytical laboratories. Eight PISCES were deployed for two weeks. Recovered hexane was pooled and distributed to the labs in eight aliquots. Three labs used electron capture analytical methods for PCB congener determination and one used high resolution

GC/MS. In 1992 significant amounts of contaminated sediment were removed from Gill Creek.

North Tonawanda Sewers (Figure 2)

The possibility of PCB coming from Schreck's Scrap yard (❖32-99) in North Tonawanda was addressed by downstream sampling at River Road (#33) and an upstream site at Schenck and Marion (#34).

Tonawanda Sewers (Figure 2)

Water leaving the Spaulding Fiber site (❖50) was sampled from a sewer at Gibson and Niagara (#32). Sewers upstream from the site were dry when visited.

Buffalo Sewers (Figures 3 and 4)

Buffalo River

Sewers around the Buffalo River might be confusing. **Figure 4** is a schematic diagram illustrating the relationships between the sampling points, the river and inactive hazardous waste sites.

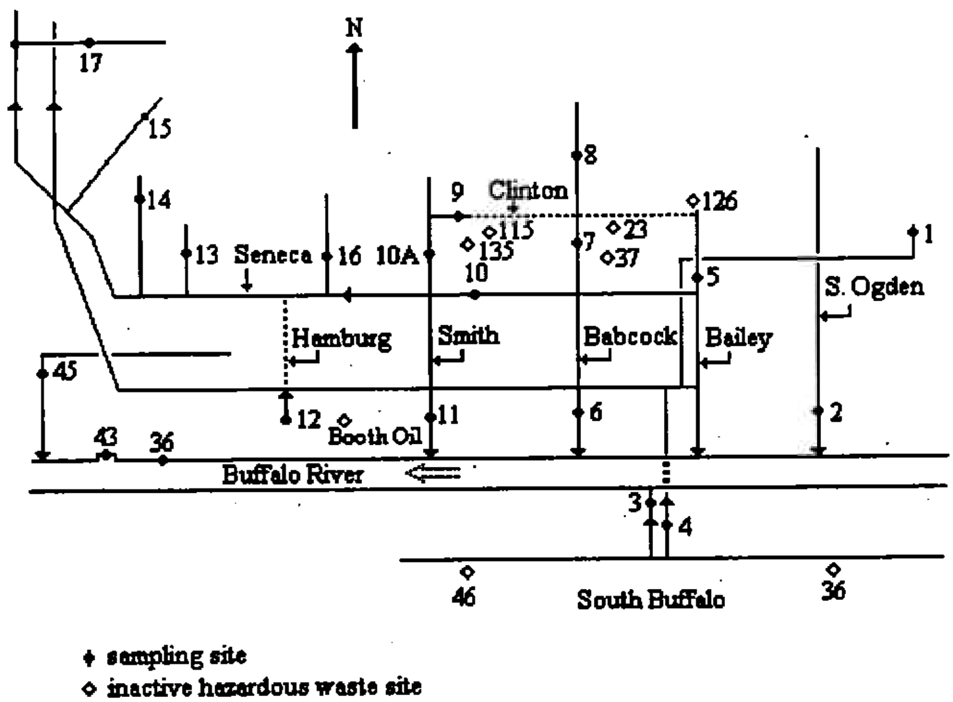

Figure 4. Schematic diagram of some sampling points in the vicinity of the Buffalo River and inactive hazardous waste sites. The double dashed line by sampling point #4 represents the south Buffalo siphon. Single dashed lines represent certain road segments not carrying sewer mains.

1) The Sloan Drain was sampled from a manhole near its junction with the Buffalo River above the right bank at S. Ogden St (#2). It was also sampled upstream of its piped section at Harlem and Blick (#27). Niagara Transformer (❖146) may have contributed PCBs to the Sloan Drain.

2) Effluent from the Erie County Sewer District No. 4 Nash Road Trunk was sampled at S. Pierce St. (#1).
3) Bailey Ave north of Littell Ave. (#5) was a general sampling site for the Bailey Ave. combined sewer. This site may have been affected by the Clinton Bailey site which is now delisted (❖126).
4) The inlet to the siphon south of the Buffalo River (#4) collects water from Buffalo south of the Buffalo River. Six inactive hazardous waste sites are located in this service area but only two were noted to have relevant chemicals.
5) Two inactive hazardous waste sites, Bengart & Memel (now remediated) and Bern Metal (❖s 115 and 135), contain PCBs. They may be affecting sampling locations at Clinton and Lewis (#9), Smith N. of Seneca (#10 A), Seneca E. of Smith (#10), and Babcock N. of Seneca (#7).
6) Two hazardous waste sites may be affecting the Babcock St. combined sewer. Houdaille Industries (❖37) may have contained PCBs but the claim is tenuous and the site is now delisted. It is unlikely that this site could have affected sampling point #7. GCF Industries (❖23)on Dorothy St. is another possible PCB source.[12]
7) Other lines going into the Swan trunk were sampled at Emslie and Seneca (#16), Swan and Pine (#13), Oak and N. Division (#14), Genesee E. of Niagara Square (#15), and Albany W. of Niagara (#17). There are no known sources in their drainages. Samples were also taken below Booth Oil (not a listed hazardous waste site; it is shown on Figure 4) at Hamburg south of Mackinaw (#12). It was not possible to sample upstream of the Booth Oil site.
8) The Hamburg Drain was sampled at the Memorial Auditorium (#45).
9) Other Buffalo River sites include a sample taken at the head of the cut to the Ohio Basin (#43), the Boone Drain (#3), and a CSO discharging to the Buffalo River on the left bank at S. Ogden (indicated on the map as #2 but distinct from the Sloan Drain). Boone Drain discharges overflow from the south Buffalo area.

Scajaquada Tunnel Sites

Scajaquada Tunnel may be affected by six inactive hazardous waste sites of which three contain PCBs. These are 318 Urban St. (❖151) which was sampled at Moselle and French (#23), Niagara Mohawk Dewey Ave (❖144) sampled at Kensington at Sisters Hospital (#22) and Saginaw - Buffalo (❖152), which was not specifically sampled. LaSalle Reservoir (❖330), now delisted, is another site. This site is noted in the Hazardous Substance Waste Disposal Site Study as having received pesticide and dibenzofuran waste but contaminants found in the groundwater may have migrated from off-site.[12]

Both dry and wet weather flow enters the Scajaquada Tunnel; wet weather overflows go the Scajaquada Drain. The Scajaquada Tunnel was sampled at Schiller Park (#24). Two attempts to sample at the Scajaquada Metering Station (Scajaquada Tunnel) on Niagara St. failed.

Hertel Ave. Trunk

The Hertel Ave. Trunk enters the North Interceptor at the point where Cornelius Creek enters the Niagara River. Overflow from the Hertel Ave. Trunk goes into the mouth of Cornelius Creek. In 1991 a PISCES was placed in the open water at the mouth of Cornelius Creek (#19). In 1993 and 1994 separate PISCES were placed in two manholes (Corn-N and Corn-S) just above the mouths at the bottom of the Hertel Ave Trunk (also called sampling site #19). Two inactive hazardous waste sites, Anaconda/American Brass (❖7) and Hertel Ave Site (❖121) lie in the drainage. Anaconda/American Brass contains PCBs (Aroclor 1254) but is a class 3 site (no significant threat) and the Hertel Ave Site contained PCBs (it has been remediated and is now delisted).

Results

PCBs

Table 3 summarizes all the PISCES derived PCB data. The table provides map numbers for site location, the name of the lab producing the data, whether the sample was from the surface or from sewers, the sampling date, estimated concentrations in ng/L, and the site name. Some samples are footnoted "[S]", samples from PISCES whose membranes had been covered by aluminum screening to reduce the risk of puncture and to reduce turbulence at the water/membrane interface. Screening reduces total PCB uptake but it does not affect the congener distribution. **Table 3** also has Aroclor designations for most samples. Where two Aroclors are listed and separated by a comma, the first is dominant. When the pair is separated by a slash, the two are roughly co-equal. "ND" means that no distinct pattern was observed. Direct comparisons between of data from different labs should not be made.

Smokes Creek

Smokes Creek was only sampled in 1991. Trichlorobiphenyls dominated at both sites (#39, 40). This is indicative of Aroclor 1242 but there is also some hexachlorobiphenyl in one of the downstream samples. This suggests some Aroclor 1260. Aqueous phase concentrations were somewhat greater upstream at Warsaw St. (#40) than below the Bethlehem Steel property (#39). Some dilution by Lake Erie was probably occurring at the downstream site. The upstream PISCES and one of the downstream PISCES were covered with screening [S] to reduce accidental puncture. PCB concentrations in Smokes Creek sites were low.

Figure 5 depicts the relative PCB homolog abundances in the Smokes Creek samples. The strong similarity between the upstream and downstream site suggests that the same source of PCB is affecting both sites.

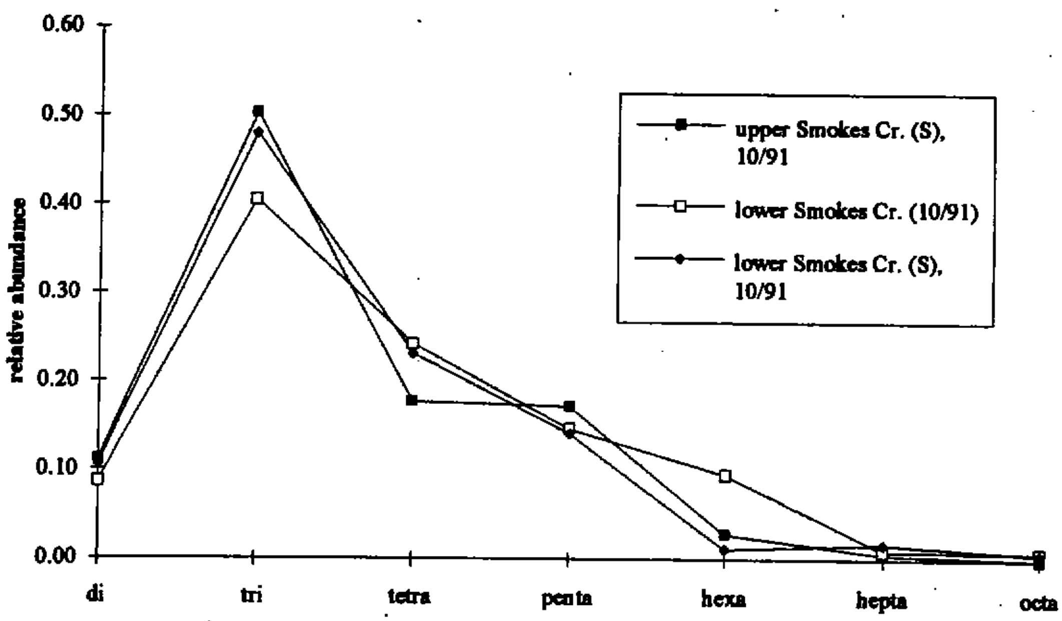

Figure 5. Relative PCB homolog abundances in Smokes Creek PISCES samples.

Table 3. Summary of PISCES PCB Concentrations in the Niagara River Area, 1991-1994

site #	site name	year	month	ng/L PCB	Aroclor	source	lab
1	Nash Rd. interceptor	1994	March	42	1254	sewer	Inchcape/Aquatec
2	Sloan Drain at Buffalo River	1991	July	8	1260, 1248	sewer	Aquatec
2	Drain on S. Ogden, L bank Buffalo River	1991	October	3	1248	sewer	Aquatec
2	Sloan Drain at Buffalo River	1991	October	2	1260, 1248	sewer	Aquatec
2	Sloan Drain at Buffalo River	1994	March	35	1248	sewer	Inchcape/Aquatec
3	Boone Drain	1991	October	5	not determined	sewer	Aquatec
5	Bailey N. of Littell	1991	October	3.2 [S]	not determined	sewer	Aquatec
5	Bailey N. of Littell	1994	March	32	1260, 1254	sewer	Inchcape/Aquatec
6	Babcock S. of South Park	1991	July	6	1242	sewer	Aquatec
6	Babcock S. of South Park	1991	October	4	1242, 1254	sewer	Aquatec
6	Babcock S. of South Park	1994	March	72	1242/1248	sewer	Inchcape/Aquatec
7	Babcock N. of Seneca	1994	March	100	1242	sewer	Inchcape/Aquatec
8	Babcock N. of Clinton	1994	March	39	1242	sewer	Inchcape/Aquatec
9	Clinton and Lewis	1993	October	590	1254	sewer	Inchcape/Aquatec
9	Clinton and Lewis	1994	March	150	1254	sewer	Inchcape/Aquatec
10	Seneca E. of Smith	1994	March	130	1242	sewer	Inchcape/Aquatec
10A	Smith N. of Seneca	1993	October	300	1242	sewer	Inchcape/Aquatec
10A	Smith N. of Seneca	1994	March	60	1254, 1242	sewer	Inchcape/Aquatec
11	Smith and St. Stephens	1991	July	9	1260, 1242	sewer	Aquatec
11	Smith and St. Stephens	1991	October	5	1242	sewer	Aquatec
11	Smith and St. Stephens	1994	March	17	1242, 1260	sewer	Inchcape/Aquatec
12	Hamburg S. of Mackinaw	1993	October	29	not determined	sewer	Inchcape/Aquatec
12	Hamburg S. of Mackinaw	1994	March	170	not determined	sewer	Inchcape/Aquatec
13	Swan and Pine	1994	March	120	1254	sewer	Inchcape/Aquatec
15	Genesee E. of Niagara Square	1994	March	51	1248, 1254	sewer	Inchcape/Aquatec
16	Emslie and Seneca	1994	March	1800	1260	sewer	Inchcape/Aquatec
19	Cornelius Creek, off of Corn-N	1991	October	7	1242, 1260	surface	Aquatec
19	Cornelius Cr., N	1994	March	24	1248	sewer	Inchcape/Aquatec
19	Cornelius Cr., S	1994	March	34	1248	sewer	Inchcape/Aquatec
20	Scajaquada Cr.at Delaware Ave.	1991	October	23	1242	surface	Aquatec
21	Scajaquada at Forest Lawn	1994	March	48	1242	surface	Inchcape/Aquatec
22	Kensington at Sisters Hosp.	1993	October	31	1248, 1242	sewer	Inchcape/Aquatec
22	Kensington at Sisters Hosp.	1994	March	28	1248, 1242	sewer	Inchcape/Aquatec
23	Moselle and French	1993	October	8200	1260	sewer	Inchcape/Aquatec
23	Moselle and French	1994	March	2000	1260	sewer	Inchcape/Aquatec
24	Schiller Park	1994	March	17	1254	sewer	Inchcape/Aquatec
25	Scajaquada Cr. at Alexander	1994	March	29	1242	surface	Inchcape/Aquatec
26	U-Crest at Galleria Mall	1993	October	180	1260	surface	Inchcape/Aquatec
27	Sloan Drain at Blick and Harlem	1994	March	69	1248, 1254	surface	Inchcape/Aquatec
28	Two-Mile Cr. at Ensminger	1994	March	28	1242	surface	Inchcape/Aquatec
29	Two-Mile Cr. at Fletcher	1994	March	70	<1242	surface	Inchcape/Aquatec
30	unnamed trib. to Two-Mile Cr.	1994	March	160	1248, 1242	surface	Inchcape/Aquatec
31	Two-Mile Creek at River Rd.	1991	July	17	1248	surface	Aquatec
31	Two-Mile Creek at River Rd.	1991	October	10	1248	surface	Aquatec
31	Two-Mile Creek at River Rd.	1994	March	99	<1242	surface	Inchcape/Aquatec
32	Gibson and Niagara, Tonawanda	1994	March	840	1248	sewer	Inchcape/Aquatec
33	River Rd, N. Tonawanda	1994	March	10	1242, 1254	sewer	Inchcape/Aquatec
34	Schenck and Marion, N. Tonawanda	1994	March	24	1254, 1242	sewer	Inchcape/Aquatec
35	Buffalo River at Harlem	1991	July	1	not determined	surface	Aquatec
36	Buffalo River at Ohio St. Bridge, R bank	1991	July	6	1242, 1260	surface	Aquatec
36	Buffalo River at Ohio St. Bridge, R bank	1991	October	20 [S]	1242	surface	Aquatec
37	Cayuga Creek, Erie County, Clinton St.	1991	July	1	not determined	surface	Aquatec
38	Scajaquada Creek at Niagara	1991	July	8	1242, 1260	surface	Aquatec
38	Scajaquada Creek at Niagara	1991	October	18	1242, 1260	surface	Aquatec

Table 3. Summary of PISCES PCB Concentrations in the Niagara River Area, 1991-1994

site #	site name	year	month	ng/L PCB	Aroclor	source	lab
39	Smokes Creek at Bethlehem Steel, last bridge	1991	October	3.1 [S]	1242	surface	Aquatec
39	Smokes Creek at Bethlehem Steel, last bridge	1991	October	3	1242, 1260	surface	Aquatec
40	upper Smokes Creek at Warsaw	1991	October	5.5 [S]	1242	surface	Aquatec
41	Woods Creek, Grand Island	1991	July	1	not determined	surface	Aquatec
43	Ohio Basin, Buffalo River	1991	July	4	1242, 1260	surface	Aquatec
44	Pettit Cove, N. Tonawanda	1991	July	30	1242/1248	surface	Aquatec
45	Hamburg Drain at Mem. Aud.	1991	October	15	1242	sewer	Aquatec
46	Ellicott Creek at Niagara Falls Blvd.	1991	July	3	1242/1248	surface	Aquatec
46	Ellicott Creek at Niagara Falls Blvd.	1991	October	4	1242/1248	surface	Aquatec
47	Ellicott Creek, Delaware St.	1991	October	6.3 [S]	1242/1248	surface	Aquatec
48	Gill Cr. at south side Rbt. Moses Parkway	1991	October	17 [S]	1248	surface	Aquatec
48	Gill Cr. at south side Rbt. Moses Parkway	1991	October	370	1248	surface	Aquatec
49	Cayuga Creek, Niagara County, Lindberg Ave.	1991	July	3	1248	surface	Aquatec

Buffalo River

PISCES were deployed in Buffalo River surface waters in 1991 and analyzed by Aquatec (**Figure 6**). Upstream samples at Cayuga Creek (Erie Co.)(#37) and Buffalo Creek showed PCB levels less than 1 ng/L. PCB concentrations were greater downstream. The PISCES sample in the mouth to the extinct Ohio Basin (3.7 ng/L)(#43) and the Ohio St. bridge (6.3 ng/L, July 1991 sampling)(#36) showed dominance by trichlorobiphenyls with penta-, hexa- and even some heptachlorobiphenyls. A screened PISCES deployed from the Ohio Bridge in October 1991 found more PCB (20 ng/L) and a greater proportion of trichlorobiphenyls than the July 1991 downstream PISCES. Most of the downstream PCB appears to have been Aroclor 1242 with 1254 and 1260 in lesser amounts. The blip in heptachlorobiphenyls from the Cayuga Creek sample should be discounted because of the low total amount of PCB in the sample.

While the 1991 PISCES derived PCB concentration from Cayuga Creek at Clinton St. (#37) was very low, earlier work with pressure filtration work suggested that there may be Aroclor 1260 in Cayuga Creek suspended solids during periods of high flow.[14] This procedure was tried on two occasions at Cayuga Creek in Como Park (#50). The sample taken on 4/13/94 showed 11.1 ng/L PCB in the suspended solids phase. Dominance in pentachlorobiphenyls suggests Aroclor 1254 but there are also indications of lighter Aroclors. No sources are known but the concentrations are greater than in most

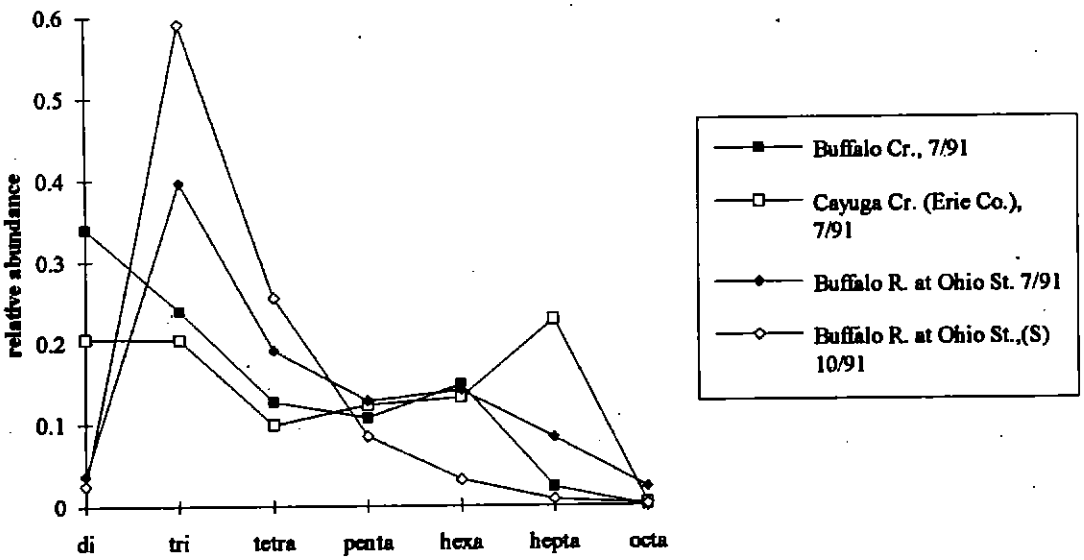

Figure 6. Relative PCB homolog abundances in Buffalo River PISCES samples.

other sites surveyed and the observation of heavy-type Aroclors was made on three separate occasions.

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14 Litten, S. and B. Anderson, 1993. An Automated Sampling System For Trace Contaminant Load Estimation - Buffalo River, Buffalo, New York. New York State Department of Environmental Conservation. Division of Water. Bureau of Monitoring and Assessment. Albany, NY.

The finding of 11 ng/L PCB from the suspended solids fraction needs to be approached with caution. The sample was taken during a time of very high flow when the creek was extremely turbid. **Table 4** helps evaluate the findings by presenting results of similarly collected data from other sites on Lake Ontario tributaries throughout 1994. Suspended solids phase PCB concentration is the PCB mass recovered from the filter (ng) divided by the number of liters of water filtered (ng/L). Concentration of the PCB on suspended particles is the mass of PCB collected on the filter (ng) divided by the product of the total suspended solids concentration (TSS) by the number of liters filtered (μg/g). This analysis suggests that while the instantaneous suspended solids phase PCB concentrations may be relatively large in rural Cayuga Creek, it is due more to a large amount of slightly contaminated solids. Localized hot spots may not be required to account for the observation.

Hamburg Drain

A single sample taken in the Hamburg Drain (#45) showed 15 ng/L of a light PCB, possibly Aroclor 1242.

Sloan Drain

PCBs appear in the Sloan Drain (Aroclor 1248 and heavier) from the 1994 sampling at both its upstream end at Blick and Harlem (#27) and at its mouth on the Buffalo River at S. Ogden St.(#2)(**Figure** 7). The 1991 sample from the lower Sloan Drain showed a pattern more consistent with a mix of Aroclors 1248 and 1260. It is possible that Niagara Transformer (❖146) is affecting the Sloan Drain.

TABLE 4. Summary of Pressure Filtration PCB Data, 1994.

site	# obs	mean ng/L	µg/g
Eighteenmile Cr. at Olcott Harbor (Niag. Co.)	13	9.8	0.71
" Olcott St. bridge (Niag. Co.)	5	7.9	0.12
" Stone Rd (Niag. Co.)	6	33	0.23
East Branch Cr. at Rt 78 (Niag. Co.)	5	1.1	0.01
Black R. at Dexter (Jefferson Co.)	13	2.0	0.51
Genesee R. at T. P. Park (Monroe Co.)	12	3.6	0.10
Oswego R. at Lock 6 (Oswego Co.)	10	0.71	0.09
Cayuga Cr. at Como Pk. (Erie Co., #50, 3/24/94)		2.6	0.12
Cayuga Cr. at Como Pk. (Erie Co., #50, 4/13/94)		11	0.05

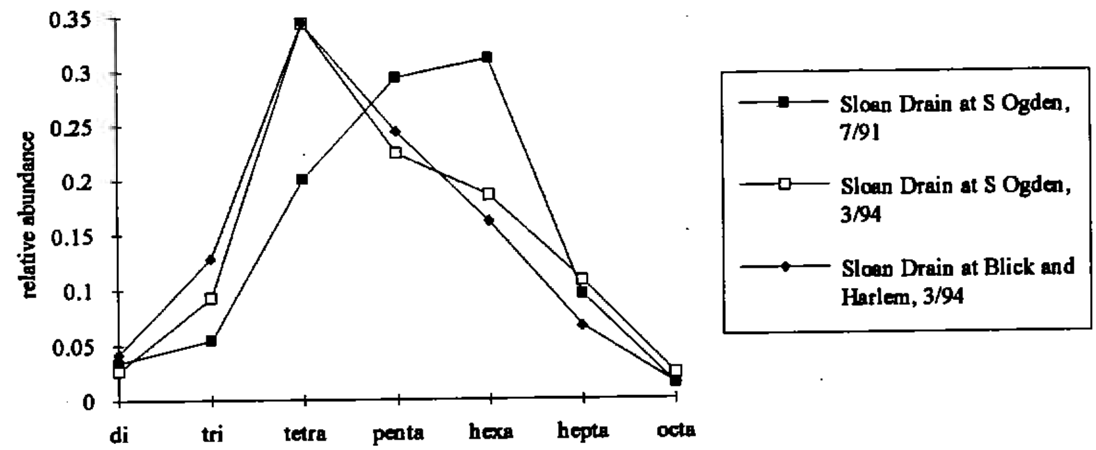

Figure 7. Relative PCB homolog abundances in Sloan Drain PISCES samples.

Babcock and Smith Drains

Lighter Aroclors were found at the end of the Babcock St. Drain south of South Park (#6)(**Figure 8**). The 1991 concentrations were 6.2 and 4.4 ng/L in July and October but the 1994 concentration was 72 ng/L. The 1991 data suggest the presence of Aroclor 1242 and a small amount of Aroclor 1254. In 1994 there may have been some Aroclor 1248.

Samples from the Smith and St. Stephens sewer had low concentrations and inconclusive homolog patterns (#11). PISCES from Bailey Ave. north of Littell (#5) taken in 1991 and 1994 revealed no outstanding concentrations. They tended to be heavier homologs such as those from Aroclors 1248, 1254, and 1260.

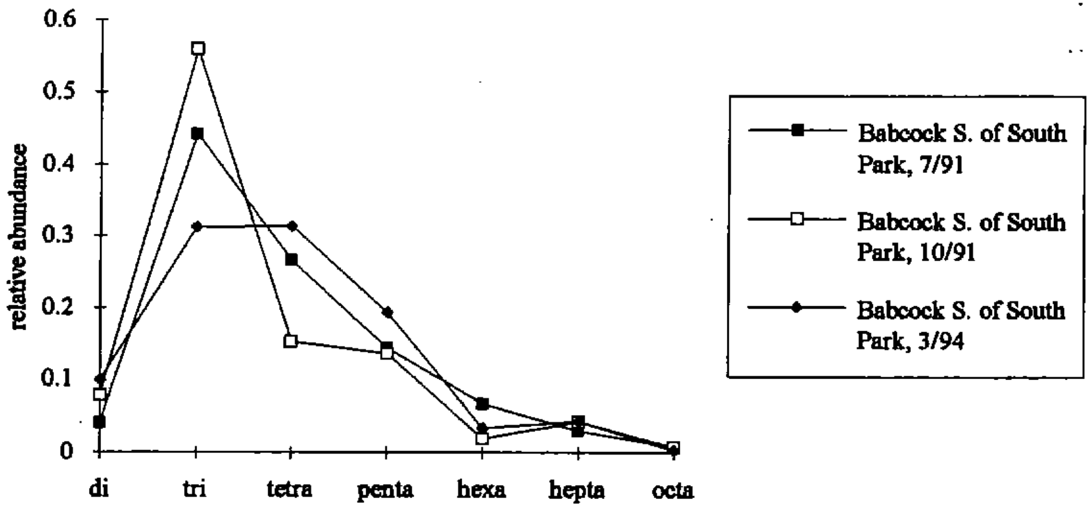

Figure 8. Relative abundances of PCB homologs in Babcock Drain PISCES samples south of South Park (#6) from three occasions.

In summary, it appears that the PCBs in the Buffalo River water column are a mixture of light and heavy Aroclors. Light Aroclors were seen in the Babcock Drain and heavier Aroclors were found in the Sloan Drain. Other sources such as sediments, bank erosion, and other discharges may have an effect. The total concentration of PCBs in the lower Buffalo River was relatively high in the October 1991 PISCES sample. PISCES samples taken in the upper river, that is above S. Ogden St. (#2), showed low PCB concentrations. The elevated PCB concentrations seen in upper Cayuga Creek suspended solids may be essentially background.

Bengart & Memel and Bern Metal

PISCES were placed around the inactive hazardous waste sites of Bengart & Memel (❖115) and Bern Metal (❖135)(**Figure 9**). The Lewis and Clinton (#9) samples (610 and 150 ng/L in 10/93 and 3/94) had an Aroclor 1254 pattern with a smaller Aroclor 1260 component. Samples taken in 1978 from Bengart & Memel and analyzed by Recra Research showed 1254 as the most abundant Aroclor in 17 soil samples and 1260 dominant in nine. Samples analyzed by the NYSDOH were richer in Aroclor 1260 on 8 occasions; Aroclor 1254 was more abundant in three samples. None of the analyses performed by Recra turned up Aroclors 1016 or 1242 but NYSDOH did see some. Our two Seneca E. of Smith (#10) samples (300 and 130 ng/L) and the Babcock N. of Seneca (#7)(100 ng/L) had a mixed pattern dominated by 1242 but with heavier Aroclors (up to Aroclor 1260) that was similar with the homologdistribution found at Babcock S. of South Park (#6). That pattern was also found at the control site, Babcock N. of Clinton (#8), but there the concentration was low (39 ng/L). Another sample from this series (not shown in **Figure 9**) taken at Smith N. of Seneca (#10A) had a pattern containing maxima in the pentas and in the trichlorobiphenyls. Its concentration was relatively low (60 ng/L) for the series. Waste water from the Bengart & Memel/Bern Metal area feeds into the Swan Trunk.

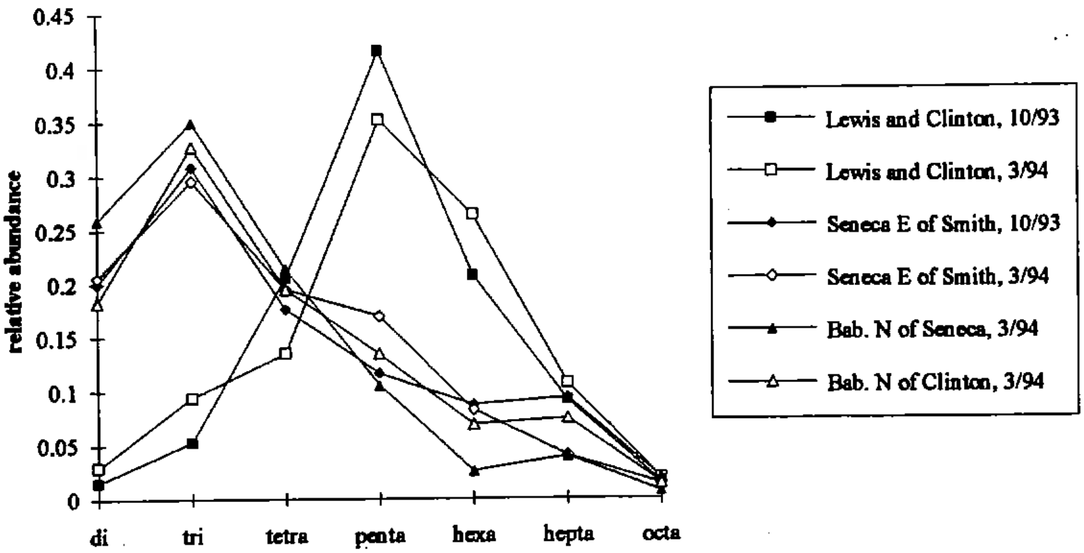

Figure 9. Relative abundances of PCB homologs in PISCES samples from sewers around the Bengart & Memel and Bern Metal sites.

Swan Trunk

The Booth Oil area was surveyed but the field crew did not find a consistent and samplable flow until they reached the manhole at Hamburg S. of Mackinaw (#12). Chromatograms from PISCES samples from this site, taken in July (Weston) and October of 1993 and March of 1994 (Inchcape/Aquatec) were poorly resolved. None of the BZ 192 or octachloronaphthalene added to the October, 1993 Hamburg S. of Mackinaw sample were recovered and only 13% of the tetrachloro-m-xylene was found. The usual distinct congener peaks were swallowed up in a broad hump of unknown material. PCB concentrations from these samples are dubious and no Aroclor-like homolog patterns result. Neighbors complained to the Buffalo Sewer Authority sampling crew of foul odors.

Two samples taken from feeders to the Swan Trunk in March of 1994 both showed unusual PCB concentrations. The heptachlorobiphenyl dominance at Emslie and Seneca (#16) site (1,900 ng/L) is unusual and suggests the presence of Aroclor 1262 (**Figure 10**). Aroclor 1262 is not among those included on the EPA Method 608 list and no Aroclor was reported from the Emslie and Seneca site using method 608 analysis. The Swan and Pine sample (#13)(120 ng/L) was more like Aroclor 1254. Swan and Pine, however, was also heavily contaminated by non-PCB substances which complicate quantitation and qualitative Aroclor assignment.

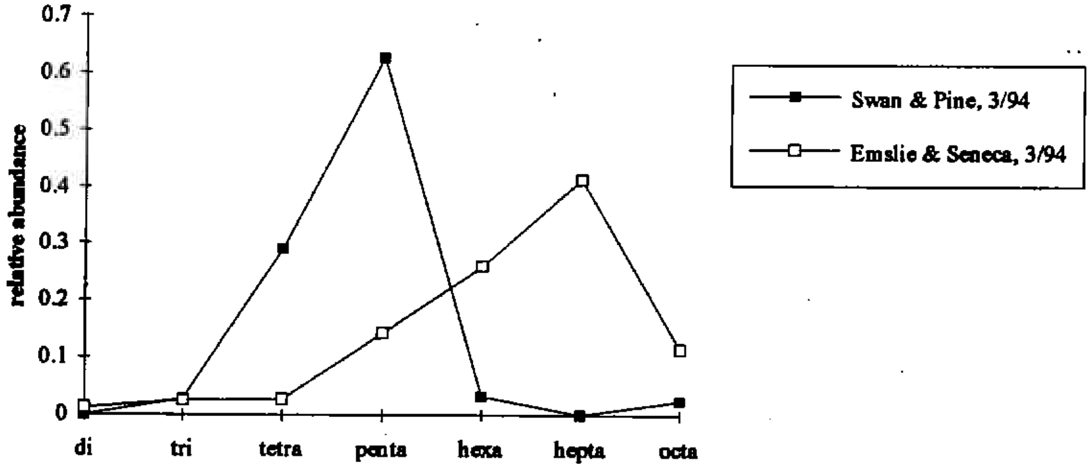

Figure 10. Relative abundances of PCB homologs from PISCES samples in Swan Trunk feeders.

Scajaquada Creek

Scajaquada Creek samples taken in 1991 at Niagara St. (#38) and at Delaware Ave. (#20) showed trichlorobiphenyls such at Aroclor 1242 dominating the homolog distribution but there was also an apparent presence of Aroclor 1260 especially at the Niagara St. location (**Figure 11**).

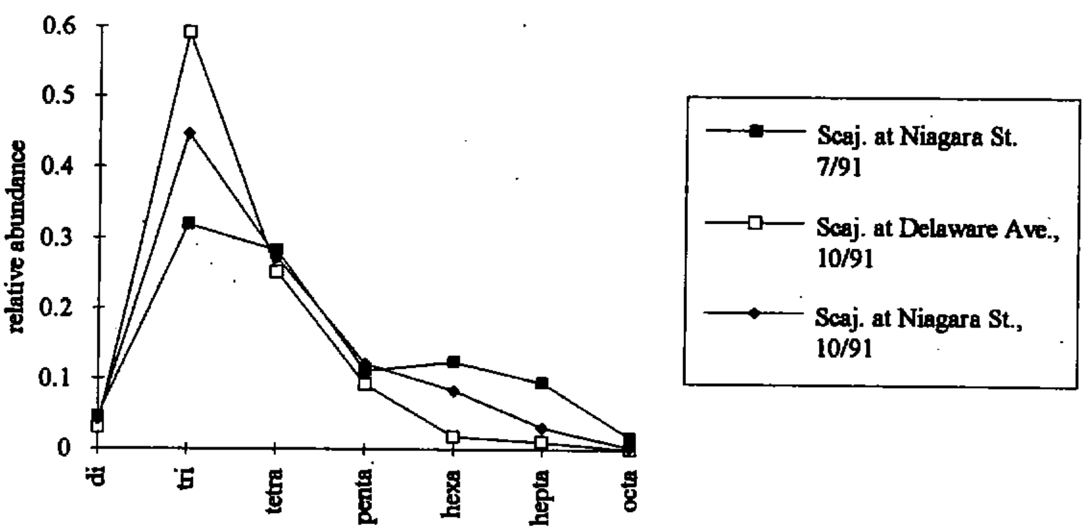

Figure 11. Relative abundances of PCB homologs in PISCES samples from Scajaquada Creek.

Aroclor 1260 was identified in sources to Scajaquada Creek, namely at French and Moselle (#23) below the 318 Urban site (2,000 and 8,200 ng/L in October 1993 and March 1994 respectively) and in the U-Crest Ditch at the Galleria Mall (#26) below Westinghouse (180 ng/L). Smaller amounts of a light Aroclor was also present in these samples, more in U-Crest (**Figure 12**).

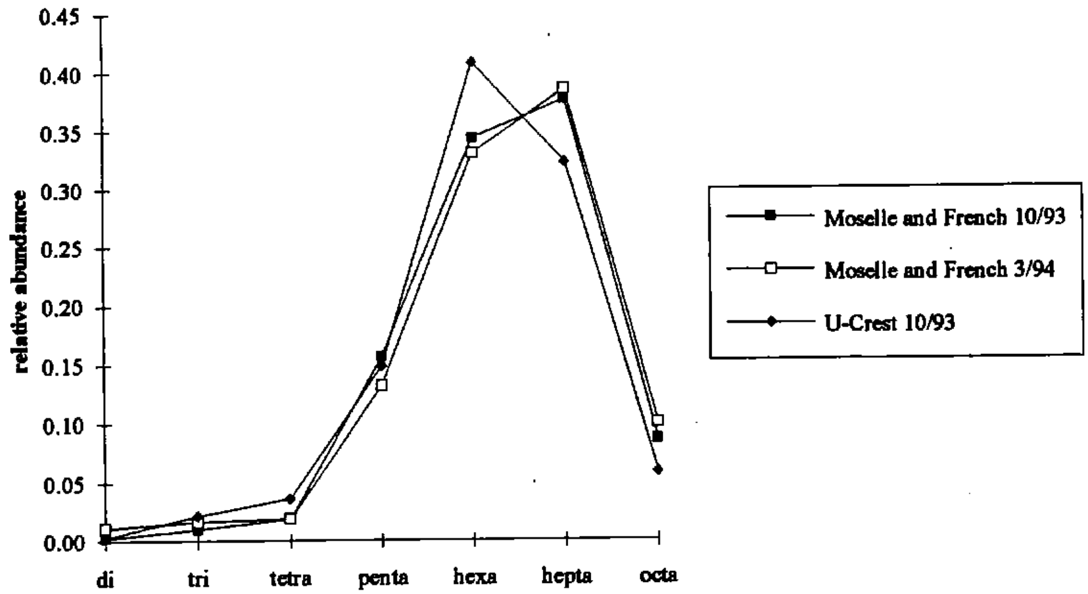

Figure 12. Relative abundances of PCB homologs from PISCES samples taken in Scajaquada Creek tributaries.

Method 608 analysis detected 2,500 ng/L of Aroclors 1260 and 1242 from the October 1993 Moselle and French site but none in 1994.

Aroclor 1260 was not seen in samples taken below U-Crest (#26) and above the Scajaquada Drain at the Alexander St. footbridge (#25)(29 ng/L total PCB) or in the tunnel at Schiller Park (#24)(17 ng/L total PCB). Water draining from the Moselle and French site normally joins the Scajaquada Tunnel below Schiller Park. Overflows go to Scajaquada Drain. Evidence of Aroclor 1260 is seen below the Scajaquada Drain at Niagara St. (#38) but scarcely at Delaware Ave.(#20) or at Forest Lawn Cemetery (48 ng/L)(**Figure 13**). Samplers from the Niagara St. metering station that would have been useful for tracing Aroclor 1260 from the tunnel were lost.

The potential for off-site migration of PCBs from the Niagara Mohawk Dewey Ave Service Station (❖144) was investigated with samples at Kensington at Sisters Hospital (#22). The Aroclor 1248-like material seen at Kensington was at unspectacular concentrations (31 ng/L in 10/93 and 28 ng/L from 3/94). Storm water from this site goes to the Scajaquada Drain.

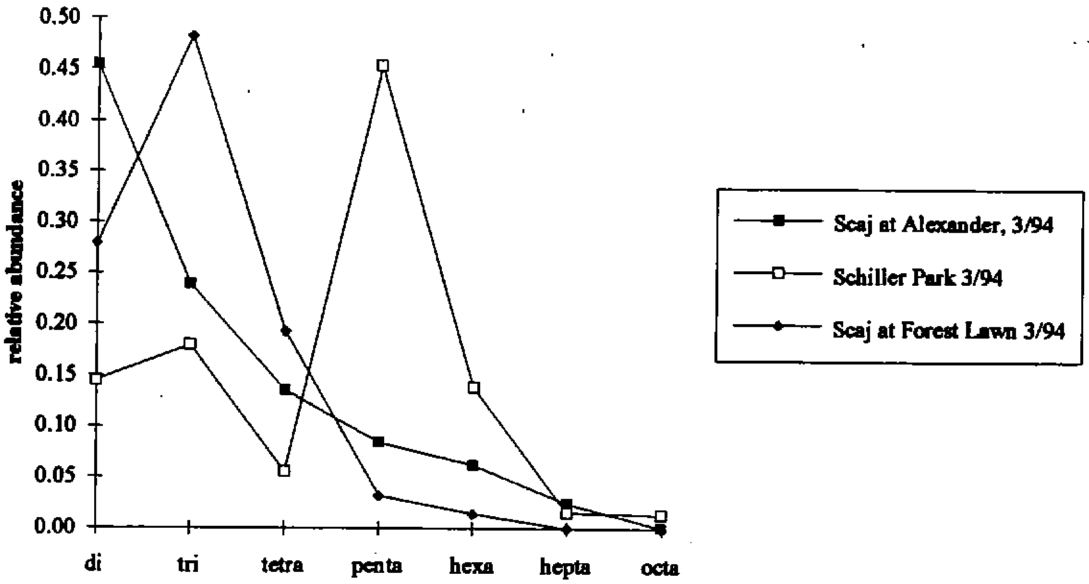

Figure 13. Relative abundances of PCB homologs from PISCES in Scajaquada Creek.

Hertel Ave. Trunk / Cornelius Creek

PCB concentration in the Hertel Ave. Trunk were low. The Cornelius, N manhole (#19)(not illustrated) had an indistinct pattern and a total concentration of 24 ng/L. Earlier samples from the mouth of Cornelius Creek picked up Aroclors 1242, 1254, and 1260.

Two-Mile Creek

PISCES samples were collected from Two-Mile Creek at River Rd. (#31) in July and October of 1991 (17 ng/L and 10 ng/L) and March 1994 (99 ng/L). The River Rd. samples from 1991 look like Aroclor 1248 but in 1994 Inchcape/Aquatec data showed a lighter pattern that doesn't look much like any Aroclor at the mouth (99 ng/L) and at Fletcher Rd (70 ng/L) (**Figure 14**). These odd patterns are due to excessive amounts of BZ 4 (2,2'-dichlorobiphenyl) which is not expected to comprise more than 4% of Aroclor 1016 or more than 3% of Aroclor 1242 [8]. Despite their oddity, our rules of congener calculation force their acceptance. Total PCB concentrations from the two sites calculated without BZ 4 are 48 and 32 ng/L respectively. A sample from the unnamed tributary (#30) showed the greatest Two-Mile Creek area concentration (160 ng/L). This is a large concentration for surface waters but its flow was small relative to Two-Mile Creek and it had little effect on the overall homolog pattern further downstream. A change in homolog pattern occurred between Ensminger Rd. (#28) and Fletcher Rd. (#29). It should be noted that the March, 1994 Ensminger Rd sample had a marginal surrogate recovery problem; only 58% of the tetrachloro-m-xylene spike was recovered which is below the 60% cut-off.

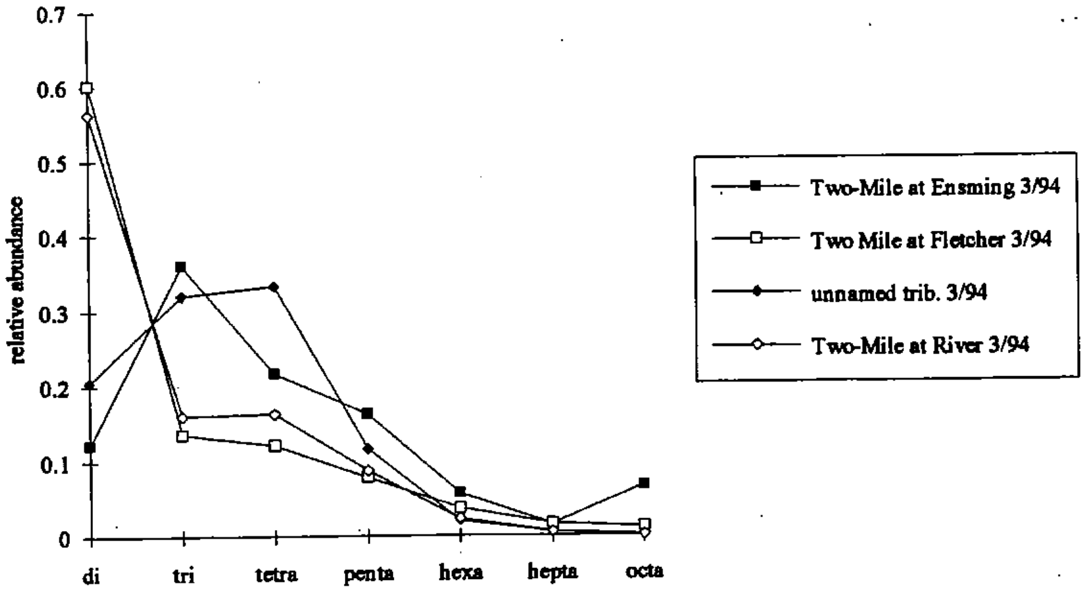

Figure 14. Relative abundances of PCB homologs from PISCES in Two-Mile Creek.

Spaulding Fiber

Two samples taken at Gibson and Niagara (#32) below Spaulding Fiber (❖50) in July of 1993 and in March of 1994 both show Aroclor 1248 at concentrations of 380 and 850 ng/L respectively (**Figure 15**). Sewers upstream from the Spaulding waste site were dry in July, 1993 and the sample site at Gibson and Niagara was dry in October of 1993.

Method 608 analysis was performed on the March 1994 sampling and revealed 1200 ng/L Aroclor 1248.

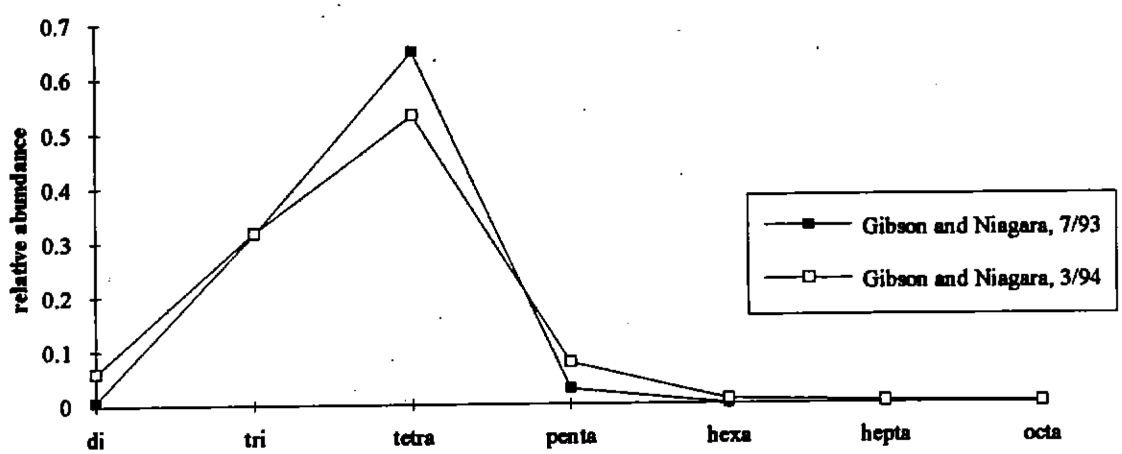

Figure 15. Relative abundances of PCB homologs from PISCES in the Tonawanda sewer at Gibson and Niagara.

North Tonawanda

Schreck's Scrap (❖32-99) was sampled upstream (#34) and downstream (#33) in July 1993 (37 [R] and 1.4 ng/L respectively) and again in March 1994 (24 and 9.8 and ng/L respectively). All three of the surrogate spikes added to the March 1994 downstream sample failed to meet the 60% recovery test. The July 1993 upstream sample taken at Schenck and Marion looks like a mixture of Aroclors 1248 and 1254. The other homolog patterns were confused but Aroclor 1254 was always present. On both sampling occasions, the upstream concentrations were greater than the downstream ones. Schreck's Scrap does not appear to be a PCB source.

Ellicott Creek, Pettit Cove, and Cayuga Creek (Niagara Co.)

PCB concentrations in Ellicott Creek at Niagara Falls Blvd. (#46) and further downstream at Delaware Ave. (#47) were low in the 1991 series (2.2 ng/L and 3.3 ng/L respectively). The Ellicott Creek homolog pattern indicates low concentrations of Aroclors 1242 and 1248. Pettit Cove (❖32-18) was sampled in the swift Tonawanda Island Little River. Even though it must have been greatly diluted, the sample still showed a substantial PCB concentration (for that sample series) of 23 ng/L (Aroclors 1242 and 1248). The Pettit Cove sample showed problematic spike recoveries; 146% for tetrachloro-m-xylene and 18% for BZ#209. Cayuga Creek (#49)(Niagara County) had a low total PCB concentration (2.3 ng/L, Aroclor 1248) **(Figure 16)**.

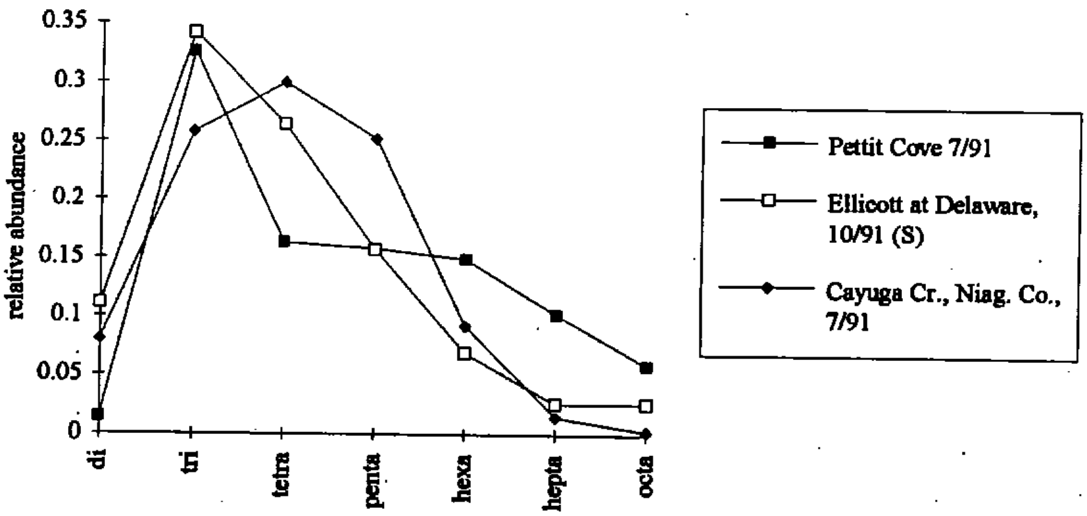

Figure 16. Relative abundance of PCB homologs in PISCES samples from Pettit Cove, Ellicott Creek, and Cayuga Creek (Niagara County).

Gill Creek

Sediments at Gill Creek had been found to be contaminated with Aroclor 1248 to as much as 10% by dry weight. PISCES samples taken from Gill Creek (#48) in 1991 saw 250 and 120 ng/L from unscreened and screened PISCES respectively. Besides indicating that screening reduced uptake by about half, PCB concentrations were high for surface waters. Between 1991 and 1993 an extensive remediation project was carried out in Gill Creek. PISCES sampling was repeated at Gill Creek in October 1993 primarily for the purposes of comparing congener analyses at different labs. Eight samplers were placed and the hexane extracts were combined and PISCES concentrations from the 1993 samples were 31, 41, and 48 ng/L as measured by a contract lab using GC/MS (IT), by Inchcape-Aquatec using GC/electron capture, and by the New York State Health Department also using GC/electron capture. **Figure 17** compares the relative homolog abundances of these post-remediation samples with each other and with pre-remediation samples collected in 1991. The homolog patterns from the five samples are similar and show a pattern most like that of Aroclor 1248 but with a greater abundance of trichlorobiphenyls.

Remediation reduced PCB levels in Gill Creek but concentrations after remediation were still very much greater than the ambient Niagara River levels of less than 1.4 ng/L as determined by PISCES placed at the site of the Four Party Fort Erie sampling intake.[15]

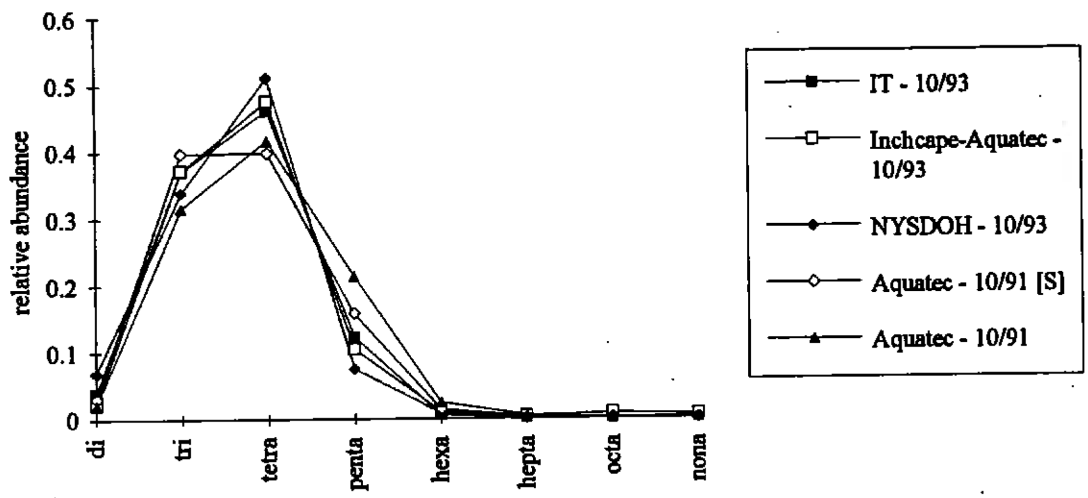

Figure 17. Comparison of relative PCB homolog abundances from Gill Creek PISCES samples analyzed by different laboratories.

Mercury

Sampling for mercury was conducted primarily to gain a better understanding of urban combined sewer mercury levels. **Table 5** displays the results of all the mercury analyses. Sites that showed mercury concentrations greater than 90 ng/L from the March 1994 round of sampling were revisited in April. These sites (Cornelius S. manhole (#19), Clinton and Lewis (#9), Swan at Pine (#13), siphon at Bailey (#4), and Babcock N. of Clinton (#8)) were all found to have mercury concentrations greater than 90 ng/L in the second round. The 90 ng/L threshold is an arbitrary choice that would distinguish a small number of sites for further investigation. It was selected on the basis of an observation of 96 ng/L seen in wastewater influent in Lockport.

During the sampling conducted in March, Teflon bottles were not available for all sites. Instead, glass bottles cleaned for high purity organic sampling were substituted for sewer sample where it was expected that mercury levels would be high. Some of the sites

15 Litten, S. 1994. Niagara River Cross Channel Homogeneity and Analysis of Upstream/Downstream Monitoring Data. New York State Department of Environmental Conservation. Division of Water; Bureau of Monitoring and Assessment. Albany, NY.

were revisited in April. One of the sites (Babcock N. of Seneca - #7) was resampled using a Teflon and a glass bottle. Results were similar.

Niagara River area sewers (median concentration of 47 ng/L) generally had mercury concentrations lower than those seen in Lockport sewers (160 ng/L) or in Rochester sewers (168 ng/L). The greatest Niagara River area concentrations occurred in the Babcock N. of Clinton sewer (#8). This site, next to Conrail yards, was chosen to be a background location for the Bengart & Memel (❖115) and Bern Metal (❖135) area PCB sampling. The mercury source here is unknown.

Mercury concentrations rarely exceed 10 ng/L in surface waters entering Lake Ontario. Concentrations in urban waste water are much greater than what is seen in streams. Sewage treatment plants are effective in reducing mercury in their aqueous effluent to concentrations of less than 10 ng/L. Average mercury removal from four sewage treatment plants (Lockport, Monroe County Northwest Quadrant, Monroe County Gates-Chili-Ogden, and Monroe County Frank E. VanLare) was 98%.

TABLE 5. Total Mercury concentrations in 1994 Niagara River Area samples.

				ng/L
4/27/94	# 50	Cayuga Cr. at Lombardy	surface	1.2
3/24/94	# 50	Cayuga Cr. at Lombardy	surface	6.9
3/23/94	# 21	lower Scajaquada Cr. at Cemetery	surface	7.6
3/23/94	# 25	upper Scajaquada Cr. at Depew	surface	9.4
3/24/94	# 30	unnamed tributary to Two-Mile Cr.	surface	11
3/23/94	# 6	Babcock S. of S. Park	sewer	11
3/23/94	# 27	Sloan Drain at Harlem and Blick	sewer	12
3/23/94	# 11	Smith and St. Stephens	sewer	12
3/24/94	# 31	Two-Mile Cr. at River Rd.	surface	13
3/23/94	# 2	Sloan drain at S. Ogden	sewer	18
3/23/94	# 16	Emslie and Seneca	sewer	19
3/23/94	# 10	Seneca E. of Smith	sewer	19
3/24/94	# 28	Two-Mile Cr. at Ensminger	surface	21
3/23/94	# 23	Moselle and French	sewer	24
3/23/94	# 10A	Smith N. of Seneca	sewer	24
3/24/94	# 33	River Rd., N. Tonawanda	sewer	29
3/24/94	# 32	Gibson and Niagara, N. Tonawanda	sewer	30
3/24/94	# 34	Schenck and Marion, N. Ton.	sewer	32
3/23/94	# 12	Hamburg S. of MacKinaw	sewer	33
3/23/94	# 22	Kennsington at Sisters Hospital	sewer	39
3/24/94	# 1	ECSD#4 at Nash Rd	sewer	39
3/23/94	# 18	Niagara St. metering station	sewer	40
3/23/94	# 19	Cornelius Cr., N. manhole	sewer	42
3/23/94	# 17	Albany St. W. of Niagara	sewer	47
3/23/94	# 5	Bailey N. of Littel	sewer	48
3/23/94	# 24	Schiller Park	sewer	53
3/23/94	# 15	Genesee E. of Niagara Sq.	sewer	62
3/23/94	# 7	Babcock N. of Seneca	sewer	77
4/27/94	# 19	Cornelius Cr., S. manhole	sewer	94
3/23/94	# 13	Swan and Pine	sewer	95
3/23/94	# 9	Lewis and Clinton	sewer	130
4/27/94	# 13	Swan at Pine	sewer	140
3/23/94	# 19	Cornelius Cr., S. manhole	sewer	150
3/23/94	# 4	siphon at Bailey Ave.	sewer	290
4/27/94	# 4	siphon at Bailey Ave.	sewer	400
4/27/94	# 9	Lewis and Clinton	sewer	500
4/27/94	# 8	Babcock N. of Clinton, glass	sewer	730
4/27/94	# 8	Babcock N. of Clinton, Teflon	sewer	760
3/23/94	# 8	Babcock N. of Clinton	sewer	1700

Conclusions

PCBs

Smokes Creek

Limited PISCES samples from 1991 do not indicate that the Lackawanna STP, the old Bethlehem Steel facility (❖9), or Lehigh Industrial Park (❖145) were significant PCB sources.

Buffalo River Area

PCBs were found at elevated levels in the Sloan Drain at S. Ogden (#2). While light PCB homologs dominated the lower river, there is also a contribution of heavier homologs. Heavier PCBs were seen in the Sloan Drain sites. The Niagara Transformer site may be affecting the Sloan Drain. A ROD was signed in December 1993 calling for remediation of soils and sediments. Design and construction are being done under state superfund. The design is complete, and construction is underway.

The 1993 Weston sample at the Buffalo River siphon (#4) shows a high PCB level which may be due to hazardous waste sites located in South Buffalo. Further sampling is to be undertaken in the South Buffalo area.

Heavier PCBs were seen in the sewer at Lewis and Clinton (#9). Light PCBs were seen in the Seneca east of Smith sewer (#10). This is not the first time this phenomenon was observed. A NYSDOH report from 1979 indicates 54,000 μg/L of Aroclors 1016/1242 at storage tank on Bengart & Memel (❖115) property. The exact location of this sample is lost but most other samples from the series found mostly Aroclors 1254 and 1260. The Bengart & Memel site is that of a former scrap metal dealer where old transformers may have been recycled. This is a listed inactive hazardous waste site that has been classified 4 (remediation has been completed). The remediation included a groundwater collection system with pumping and treatment of contaminated groundwater. The collection system is currently dry. The Aroclor patterns found in samples collected in the sewers are similar to data collected on soils at the Bengart & Memel site. Adjacent to the Bengart & Memel site is the Bern Metal (Universal Iron) site (❖ 135). Additional sampling is to be undertaken in this area.

Congener analysis showed high PCB concentrations at Emslie and Seneca (#16) but method 608 analysis from a parallel sample did not. The detection level used for the 608 analysis was high (1000 ng) and the congener analysis suggests that the Aroclor may have been one not sought by the method. Additional sampling is to be undertaken in this area.

The sewers at Hamburg, south of Mackinaw (#12) and at Swan and Pine (#13) were contaminated with unknown wastes. Chromatograms from these sites show broad humps of unknown material that masks PCBs. Laboratory reports show it to contain high concentrations of PCBs but these findings are questionable. Confirmation would require extensive sample clean-up and GC/MS analysis instead of GC/EC detection. Additional sampling will be undertaken in this area.

The presence of heavy PCBs in suspended solids was confirmed in the upper reaches of Cayuga Creek. However, the PCB concentration in suspended solids was low. Additional sampling is to be undertaken along Cayuga Creek.

Scajaquada Creek

Scajaquada Creek has a confirmed source of Aroclor 1260 in the U-Crest Ditch (#26). There is known contamination at the Westinghouse site (❖66) near the Buffalo Airport. Transformers containing PCBs were located at the site but have been removed. Manufacturing activities have stopped. The Remedial Investigation/Feasibility Study was completed in September 1995. The next step is the development of a remedial design. Additional sampling is to be undertaken in this area.

Sampling also indicated a wet weather Aroclor 1260 source at the 318 Urban site (❖151). This site was sampled in 1994. The remedial design was completed in 1995. Construction will begin in April 1996. Therefore, this sample reflects conditions before remediation.

Coring performed near the mouth of Scajaquada Creek found Aroclor 1248 in buried sediments.[16] Additional sampling performed in 1991 showed that PCBs in the lower portion of Scajaquada Creek were mostly light such as Aroclor 1242 but with a definite minor component of Aroclor 1260. While relatively low concentrations were found, several inactive hazardous waste sites may be affecting the lower portion of the creek. A consent order was signed in 1992 for the Pratt & Letchworth site (❖45). Soils contaminated with PCBs were removed. The Iroquois Gas/Westwood Pharmaceutical site (❖141) remedial design, which includes creek sediments, is scheduled to be completed in August, 1996.

Two-Mile Creek

A tributary to Two-Mile Creek is carrying Aroclor 1248 at apparently high concentrations. There may be a significant contribution of PCB to Two-Mile Creek between Ensminger (#28) and Fletcher Roads (#29) but the unusual homolog pattern and an unsampled source clouds the evidence. Additional sampling is to be undertaken in this area.

Tonawanda (C) Storm Sewers

Aroclor 1248 is in the storm sewers draining the Spaulding Fiber site (❖50). Concentrations are very high and the homolog pattern was consistent on repeated visits. A Remedial Investigation/Feasibility Study, including soils and groundwater, is scheduled for completion in November 1996.

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16 Litten, S. 1987. Niagara River Area Sediments. New York State Department of Environmental Conservation. Division of Water, Bureau of Technical Services and Research. Albany, NY.

North Tonawanda (C) Storm Sewers

PISCES sampling provides no evidence for PCBs leaving the Schreck's Scrap area (❖32-99). There may be a source upstream from Schenck and Marion (#34) but none is known. Additional sampling is to be undertaken in this area.

Gill Creek

Remediation has significantly reduced PCBs in the water column in lower Gill Creek but levels are still high for surface waters. Biological accumulation will still occur here.

Mercury

The sites with mercury concentrations greater than 90 ng/L (Cornelius Creek - S (#19), Swan and Pine (#13), siphon at Bailey (#4), Clinton and Lewis (#9), and Babcock N of Clinton (#8)) should be examined to identify the actual sources. Mercury sampling in the water column should be performed in Gill Creek. Sediments contained as much as 440 mg/kg mercury and it would be valuable to see what current levels are.

APPENDIX I

PISCES OBSERVATIONS, Tonawandas, Lackawanna, Niagara Falls, Buffalo, 1991

	Sloan Drain Jul-91	Sloan Drain Oct-91	S. Ogden L bank Oct-91	Boone Drain (S) Oct-91	Bailey N of Littell Oct-91	Babcock at Mobil Jul-91	Babcock at Mobil Oct-91	Smith & St. Steph. Jul-91	Smith & St. Steph. Oct-91	Cornelius Cr (N) Oct-91	Scaj at Del. Pk. Lk. Oct-91	Two-Mile River Rd. Jul-91	Two-Mile River Rd. Oct-91	Buffalo Cr. at Harlem Jul-91	Buffalo R. Ohio St. Jul-91	Buffalo R. Ohio St. (S) Oct-91
date in	07/10/91	10/16/91	10/16/91	10/16/91	10/16/91	06/26/91	10/16/91	06/26/91	10/16/91	10/17/91	10/16/91	07/10/91	10/16/91	06/26/91	07/10/91	10/16/91
time in	09:00	09:15	09:05	09:55	09:40	10:10	10:10	09:10	10:25	08:00	15:20	14:00	16:10	16:45		14:45
date out	07/24/91	10/30/91	10/30/91	10/30/91	10/30/91	07/10/91	10/30/91	07/10/91	10/30/91	10/29/91	10/29/91	07/24/91	10/29/91	07/10/91	07/24/91	10/30/91
time out	09:00	08:45	08:35	09:15	09:00	09:00	09:25	08:50	09:40	14:20	15:20	14:00	14:00	12:55	09:40	10:10
days in	13.63	13.98	13.98	13.97	13.97	13.95	13.97	13.99	13.97	12.26	13.00	14.00	12.91	13.84	14.00	13.81
mean temp	19	12	13.5	14	16	23	15.5	23.5	15.25	13	13	25	13.25	25.5	22.75	13
L sampled	11.52	6.79	7.66	7.97	9.35	16.00	8.98	16.66	8.81	6.46	6.85	18.65	6.94	19.13	15.76	7.27
total ng	96.21	15.72	25.30	42.92	30.26	99.12	39.48	144.94	44.82	45.15	160.53	309.36	72.17	9.38	99.47	147.81
ng/L	8.35	2.32	3.30	5.39	3.24	6.20	4.40	8.70	5.09	6.99	23.44	16.59	10.40	0.49	6.31	20.33
BZ #																
7,9	0.76			0.05	0.44	1.99			0.17	0.12		1.09	0.1		1.36	0.23
6						2.31		0.19	0.44	0.23		0.66		0.08		0.54
5,8	2.46		0.64	6.39	2.84	18.82		2.79	3.7	1.58	4.99	10.43	2.43	1.98	8.06	10.03
19	0.19			0.3		0.32	3.58	0.07	0.17	0.13	2.23	1.43	0.12	0.01	0.92	0.78
12,13		0.08	0.46	0.75	1.6	0.53	0.13	0.23	1.05	0.16		2.05	0.87			
18	1.02	0.1	0.58	1.4	1.94	9.16		2.28	2.24	2.07	49.65	13.12	1.6	0.4	10.33	19.33
15,17	1.19	0.05	1.61	1.07	1.23	0.68	1.69	2.33	2.63	2.99		12.24	8.45	1.13	7.98	14.56
24,27		0.04	0.03			0.31	9.49	0.12	0.1	0.13	1.43	0.96	0.12	0.03	0.87	0.77
16,32	0.78	0.05	0.2	0.43	0.39	2.72		1.17	0.91	0.82	10.58	6.72	1.19	0.22	3.36	7.23
23,34,54			2.33				0.82		4.94		1.22		2.73			
29	0.19		0.09			0.74	2.31	0.38	0.22	0.23	1.37	2	0.29	0.03	1.49	1.99
26,25				1.02	0.26	0.26	0.73	0.14			0.75					0.7
31,28	2.98	0.51	1.59	4.3	2.25	15.74	0.92	6.04	4.5	4.46	25.5	41.51	5.57	1.11	15.72	32.24
33,20,53		0.2	0.47	0.97	0.39	3.91	5	1.65	1.2	0.94			1.71	0.35		8.59
22,51		0.05	0.23	0.48		1.33		0.48	0.37	0.35	0.97	3.67	0.5	0.09	1.18	2.58
45				0.18		0.45	0.12			0.17	1.91	2.86	0.4			1.12
46	0.25			0.2	0.16	0.17	0.25	0.22	0.07	0.09	1.2	1.46	0.21	0.1	0.51	0.47
73,52	5.29	0.51	1.18	1.68	1.48	4.62		3.72	1.76	1.81	12.64	25.1	4.98	0.29	7.29	10.33
49	5.14	0.28	4.7			2.57	3.33	5.9	3.94	1.35		32.11	12.78			
47,75,48																
44	0.9	0.17	0.46	0.64	0.5	1.88		1.08	0.81	0.79	6.43	11.45	1.76	0.06	1.91	3.99
37,59,42		0.22	1.13			1.38	0.87		2.71	0.88	4.58		2.28		0.64	1.79
72,71,41,64			0.38	0.59	0.51	2.11	0.38	1.13	0.63	0.8	5.97	11.56	1.62	0.11	1.63	4.45
40	0.25			0.07	0.2	0.18	0.77	0.16		0.17	0.64	0.94	0.25	0.03	0.2	0.31
67	0.89					0.16	0.11					0.41				
63							0.15	0.06						0.05		0.34
74			0.27	0.24	0.35	1.7		0.75	0.33	0.44	1.26	4.39	0.59	0.11	0.44	1.26
70,76	0.96		0.72	1.45	0.74	2.9		1.6	1.58	0.98	4.07	8.64	1.43	0.22	1.81	2.99
66,80,95,93,102	7.89	0.46	1.22	2.14	1.65	3.16	0.68	4.08	1.76	1.53	5.44	17.22	3.68	0.39	3.83	3.74
55,91	1.25	0.05	0.04	0.36	0.07	0.18	1.13	0.39	0.1	0.03	0.24	1.88	0.42	0.05	0.7	0.15
56,60,92,84	1.38	0.32		0.65			0.29			0.81	2.63	9.1				3.08
89,90,101	7.58	0.49	1.08	2.42	2.41	2.95	0.48	6.18	1.77	1.27	4.12	14.82	3.31		3.74	4.5
113,99	1.33	0.07	0.19	0.77	0.39	1.14	1.15	1.61	0.24	0.19	0.98	3.59	0.56	0.08	0.7	0.75
119	0.14					0.01	0.43	0.1						0.02	0.2	0.02
83	0.06					0.1		0.17			0.09	0.39	0.07			0.07
97,86	0.35	0.04	0.15	0.12	0.24	0.36	0.09	0.48	0.14	0.13	0.48	1.98	0.4	0.06	0.34	0.36
115,87,111	1.54	0.16	0.34			1.45	0.27	1.61	0.4	0.42	0.86	6.15	1.16			
85			0.09							0.1	0.39	1.61	0.28			
136	1.49	0.05		0.25		0.1	0.39	1.11	0.13	0.09		1.16	0.19		0.26	0.26

PISCES OBSERVATIONS, Tonawandas, Lackawanna, Niagara Falls, Buffalo, 1991

	Sloan Drain Jul-91	Sloan Drain Oct-91	S. Ogden L bank Oct-91	Boone Drain (S) Oct-91	Bailey N of Littell Oct-91	Babcock at Mobil Jul-91	Babcock at Mobil Oct-91	Smith & St. Steph. Jul-91	Smith & St. Steph. Oct-91	Cornelius Cr (N) Oct-91	Scaj at Del. Pk. Lk. Oct-91	Two-Mile River Rd. Jul-91	Two-Mile River Rd. Oct-91	Buffalo Cr. at Harlem Jul-91	Buffalo R. Ohio St. Jul-91	Buffalo R. Ohio St. (S) Oct-91
77,110	3.93	0.27	0.72	0.69	0.9	2.64		4.27	0.95	0.77	1.78	11.13	2.54	0.22	1.75	1.93
82,151	2.66	0.19	0.21	0.25	0.32	0.46	0.92	2.28	0.24	0.42	0.33	2.3	0.51	0.06	0.55	0.24
124,135,144	2					0.35	0.21	1.41				1.92		0.19		
108,107,147	0.77					0.06		0.27			0.23	0.47				
149,106,118	11.5	1.14	0.79	2.14	2			10.9	0.93	2.39	1.16	11.02	1.57	0.45	3.44	1.02
143,114,134	0.48					0.05	0.35	0.47			0.07	0.36	0.05		0.05	
122,131,133								0.03				0.05				
165	0.56		0.06	0.38	0.04	0.08		1.12	0.04	0.12	0.07	0.47	0.06	0.02	0.19	
132,153	7.14	0.45	0.71	1.69	1.16	1.36	0.04	12.49	0.5	2.92	0.38	6.24	1.16	0.23	3.45	1.11
127,168	2.28	0.45	0.35	0.67	0.5	1.04	0.18	3.49	0.04	0.64	0.48	3.87	0.81	0.15	0.83	0.84
141,179	0.9	0.02	0.05		0.09	0.32		2.87	0.07	0.39	0.16	0.78	0.16	0.03	0.42	0.09
130				0.38	0.24	0.4		0.46			0.09	0.24		0.41	0.28	0.19
137,176	0.63				0.2	0.25		0.97			0.21	0.47		0.1	0.34	0.13
160,163,164,138	6.18	0.2	0.64	1.72	1.14	2.32		12.39	0.46	2.7	0.77	6.77	1.47	0.15	3.09	0.77
178,158	0.36		0.1	0.27		0.14	0.46	0.84		0.18		0.27	0.08	0.01	0.16	
175								0.13								
182,187,129	1.61	0.14	0.24	0.67	0.22	0.35		4.91	0.25	0.97		1.21	0.22	0.03	1.06	0.15
183	0.6			0.3	0.07	0.29		1.99		0.49	0.16	0.48	0.03	0.01	0.45	
128	0.31		0.09	0.58	0.08	0.34		0.92	0.08	0.15		0.65	0.14		0.17	0.4
185	0.15			0.17		0.23		0.32		0.06		0.07			0.06	
174,181	1.5	0.13	0.12	0.45	0.19	0.14		3.15	0.25	0.76	0.44	0.87	0.24	0.03	0.95	0.08
177	0.54	0.24	0.07	0.4	0.32	0.17	0.11	1.83	0.4	0.44	0.27	0.44	0.07	0.02	0.54	0.19
156,171,202	0.28	0.05		0.17	0.02	0.03		1.24	0.06	0.21		0.47	0.04		0.33	
173,200	0.04					0.04	0.12	0.2		0.05		0.04			0.03	
192,172,197	0.19		0.1	0.34		0.36	0.13	0.89		0.16		0.14			0.17	
180,193	2.48	0.11	0.39	1.01	0.48			10.91	0.3	2.02		1.79	0.27	0.05	2.47	0.59
191		0.05					0.18	0.16	0.31	0.07		0.58		0.04		
199				0.14												
170,190	1.49	0.05	0.15	0.73		0.58	0.67	5.24	0.22	0.96	0.58	2.09	0.17	0.02	1.18	
198								0.13								
201	0.37		0.12	0.31	0.31	0.18		1.86	0.16	0.57		0.27	0.12		0.47	
196,203	0.37		0.09	0.19	1.37	0.13	0.1	2.67	0.14	0.55		0.4	0.09		0.68	0.21
189	0.04	0.08			0.03	0.03	0.06	0.11	0.09	0.03				0.01		
195,208	0.27							1.6		0.3		0.16			0.41	
207			0.04		0.24		0.17	0.05	0.32	0.11	0.64		0.21	0.02	0.06	0.32
194	0.32	0.39	0.08			0.28	0.17	3.15		0.46		0.46	0.11		0.42	
205								0.38								
206				0.35	0.3	0.11	0.05	0.62			0.09	0.18		0.13		

* Lab notes say half of sample was spilled. Total PCB amount was doubled in summation.

PISCES OBSERVATIONS, Tonawandas, Lackawanna, Niagara Falls, Buffalo, 1991

	Cayuga Cr. Clinton Jul-91	Scaj. at Niagara Jul-91	Scaj. at Niagara Oct-91	Smokes at Beth. (S) Oct-91	Smokes at Beth. Oct-91	Smokes at Warsaw Oct-91	Woods Cr. Grtand Is. Jul-91	Ohio drain Jul-91	Pettit Flume Jul-91	Hamburg Mem. Aud. Oct-91	Ellicott at Colvin Jul-91	Ellicott at Colvin Oct-91	Ellicott at Main (S) Oct-91	Gill Cr. (S) Oct-91	Gill Cr. Oct-91	Cayuga Cr. Niag. Co. Jul-91
date in	06/26/91	06/27/91	10/16/91	10/16/91	10/16/91	10/16/91	07/17/91	06/26/91	07/01/91	10/16/91	06/26/91	10/17/91	10/16/91	10/17/91	10/17/91	06/27/91
time in	17:20	10:55	15:40	12:45	12:45	13:10	14:00	11:40	09:00	11:15	20:50	10:20	16:25	09:30	09:40	09:20
date out	07/10/91	07/10/91	10/29/91	10/30/91	10/30/91	10/30/91	07/31/91	07/10/91	07/15/91	10/30/91	07/10/91	10/29/91	10/29/91	10/29/91	10/29/91	07/10/91
time out	13:10	15:00	15:05	10:35	10:35	11:00	12:50	10:00	08:50	09:55	17:20	13:25	13:40	13:15	13:20	18:20
days in	13.83	13.17	12.98	13.91	13.91	13.91	13.95	13.93	13.99	13.94	13.85	12.13	12.89	12.16	12.15	13.38
mean temp	25.5	24	12.25	16.75	16.75	11.5	23.9	22.5	22.25	15.75	24.75	13	13	19	19	23.5
L sampled	19.11	16.28	6.43	9.87	9.87	6.49	17.12	15.39	15.17	9.14	18.11	6.39	6.79	10.28	10.28	15.93
total ng	15.43	129.76	118.50	30.64	33.99	35.74	14.97	57.13	461.23	137.56	61.82	27.36	43.06	1758.04	3758.93	44.87
ng/L	0.81	7.97	18.43	3.10	3.44	5.51	0.87	3.71	30.40	15.05	3.41	4.28	6.34	171.02	365.65	2.82
BZ #																
7,9	0.04			0.06				0.14	4.55	0.99			0.44			
6	0.09	1.05	0.21			0.93		0.32	93.57	2.76			1.46	8.25	9.9	0.13
5,8	2.23	4.9	4.67	3.32		6.38	5.45	2.24	115.57	15.81	2.54	4.85	9.91	46.59	61.96	4.03
19	0.03	0.48	0.95	0.08	0.26	0.24		0.47	5.37	1.01			0.81	3.59	5.77	0.06
12,13								0.2		1.08	6.91	0.56	0.94		7	0.57
18	0.55	6.84	14.69	7.36	7.12	2.18	0.29	4.37	3.03	8.67	1.17	1.72	1.54	196.33	297.63	1.55
15,17	0.66	6.29	10.06			2.98		3.61	23.35	9.73	4.04	1.52	4.7	11.54	24.75	3.54
24,27	0.01	0.48	0.66			0.21		0.26		0.39	0.34		0.35	2.42	4.16	
16,32	0.28	3.58	4.55	0.83	0.77	0.89	0.13	1.99	1.99	4.31	0.78	0.27	1.48	33.39	56.45	0.77
23,34,54						3.07			13.69					6.97	6.12	2.07
29	0.07	1.47	1.63		0.21	0.5		0.58	5.66	1.14	0.08	0.43	0.83	22.65	31.66	0.29
26,25		0.65	0.86	0.66	0.48	0.66		0.33		0.99		0.41	0.67	11.18	13	0.03
31,28	1.73	18.97	21.51	3.98	5.07	5.72	1.29	10.82	35.11	18.38	3.14	3.99	4.16	304.48	555.47	4.12
33,20,53	0.4	3.36		1.12	0.91	0.71	0.6	2.85	7.47	6.83				87.59	154.86	1.11
22,51	0.1	1.16	0.95	0.58	0.24	0.22		0.9	1.76	1.63				19.83	38.33	0.28
45		0.73	1.47			0.24		0.5	0.46	0.76				14.45	27.06	
46		0.37	0.4		0.16			0.17	0.44	0.34		0.14	0.01	5.4	10.9	0.21
73,52	0.53	6.38	9.2	2	2.6	1.22	0.85	2.87	10.4	6.43	1.34	1.78	2.37	168.1	324.29	4.38
49		11.55							5.74		25.28			65.53	129.75	
47,75,48														49.57	109.01	
44	0.14	3.21	4.01	1.11	1.04	0.92	0.34	1.22		2.03	0.82	0.38	0.95	74.75	153.64	1.43
37,59,42		1.72	1.77		0.28	0.54		1.24		1.14				48.42	107.92	0.52
72,71,41,64	0.14	3.27	3.83	1.16	0.9	0.63	0.2	1.29	6.61	2.45	0.89	0.42	0.86	86.61	193.71	1.12
40	0.04	0.43	0.43	0.13	0.06			0.14		0.2	0.22	0.15	0.07	5.65	12.95	0.13
67														2.64	6.25	
63		0.18	0.19		0.05			0.08		0.11		0.28		8.62	20.54	0.05
74		1.49	1.31	0.29	0.56	0.11		0.55		1.32	0.42			38.7	116.13	0.56
70,76	0.32	3.1	3.32	1.08	1.7	0.83		1.47	6.38	3.98	0.77	0.66	1.18	88.12	241.09	1.18
66,80,95,93,102	0.44	4.52	5.27	1.84	2.52	1.5	1.73	2.27	4.01	6.16	1.83	1.98	1.57	92.65	237.61	2.63
55,91		0.21	0.73		0.26	0.14		0.13	7.1	0.53	0.26	0.21		8.17	23.98	0.16
56,60,92,84			2.28	0.67	0.99	0.59	0.25		0.45	1.94			1.36	37	110.52	
89,90,101	0.47	3.95	3.66	1.57	1.78	1.43	1.51	2.24	6.76	4.87	2.69	2	1.84	63.58	172.35	3.02
113,99	0.07	0.66	0.6	0.36	0.33	0.35	0.13	0.34	9.45	1.11	0.19	0.46	0.4	16.39	51.93	0.45
119	0.04	0.01	0.07	0.08	0.09	0.06			2.98				0.03	0.44	1.11	0.04
83	0.33	0.17	0.14	0.08				0.04		0.13	0.03			2.96	6.46	0.1
97,86	0.05	0.49	0.5		0.24			0.23		0.53	0.21	0.16	0.09	10.34	33.95	0.42
115,87,111		1.48	1.04			0.66		0.78	1.3	1.78			0.4	34.38	113.82	1.41
85		0.72	0.14							0.36				8.15	32.14	0.22
136		0.52	0.31					0.23		0.38	0.15					0.07

PISCES OBSERVATIONS, Tonawandas, Lackawanna, Niagara Falls, Buffalo, 1991

	Cayuga Cr. Clinton Jul-91	Scaj. at Niagara Jul-91	Scaj. at Niagara Oct-91	Smokes at Beth. (S) Oct-91	Smokes at Beth. Oct-91	Smokes at Warsaw Oct-91	Woods Cr. Grtand Is. Jul-91	Ohio drain Jul-91	Pettit Flume Jul-91	Hamburg Mem. Aud. Oct-91	Ellicott at Colvin Jul-91	Ellicott at Colvin Oct-91	Ellicott at Main (S) Oct-91	Gill Cr. (S) Oct-91	Gill Cr. Oct-91	Cayuga Cr. Niag. Co. Jul-91
77,110	0.37	3.2	2.11	0.58	0.64		0.16	1.73	6.62	3.78	1.64	0.64	0.79	40.59	123.16	2.36
82,151	0.11	0.86	0.74	0.3	0.2	0.22		0.52		0.87	0.39	0.16	0.18	6.44	20.84	0.45
124,135,144	0.17	0.73	0.46							0.64					7.36	0.26
108,107,147		0.02				0.37		0.08						1.87	5.42	0.09
149,106,118	0.51	4.39	2.97		1.46			2.32	4.29	4.71	1.22	0.54	1			0.49
143,114,134		0.14	0.13					0.06	0.26	0.17		0.06			1.37	0.07
122,131,133		0.02		0.06					2.18						0.73	0.01
165	0.01	0.2	0.16					0.07	0.6	0.24	0.11	0.19			2.26	0.05
132,153	0.62	3.97	2.75	0.24	0.56	0.15		1.38	7.09	3.56	0.85	0.4	0.3	5.94	21.81	0.9
127,168	0.24	1.54	1.37			0.2		0.7	2.07	1.65		0.04				0.76
141,179	0.03	0.57	0.19		0.14			0.19	1.83	0.39	0.14			1.19	3.94	0.13
130	0.41	1		0.04	0.12		1.35	0.92	0.54	0.27		0.24	0.08	1.56	2.06	0.44
137,176	0.19	0.69	0.24							0.24			0.08		2.18	0.17
160,163,164,138	0.25	3.66	2		0.95	0.19	0.21	1.55	9.68	3	1.17	0.43	0.53	10.95	30.01	1.16
178,158		0.22	0.18					0.15		0.36	0.21		0.02	1.06	2.49	0.04
175		0.04														
182,187,129	3.3	5.04	0.39		0.19			0.38		0.94	0.61		0.13		2.49	0.13
183		0.7	0.38	0.09				0.17		0.33			0.1		0.58	0.04
128	0.02	0.28	0.17		0.31	0.46		0.16	7.47	0.38	0.14				6.69	0.14
185	0.01	0.09	0.13	0.06						0.06				0.27		
174,181	0.03	1.02	0.62					0.29	1.65	0.56	0.22				1.79	0.08
177	0.03	0.56	0.32					0.26		0.3	0.11	0.13			1.29	0.04
156,171,202	0.02	0.3		0.04				0.15	2.02	0.24	0.09				1.3	0.03
173,200	0.01	0.05						0.02								
192,172,197		0.18		0.26				0.05	2.36	0.39						
180,193	0.07	2.18	0.88		0.16			0.47	8.28	1.69	0.46	0.31	0.5	1.9	3.45	0.09
191	0.04	0.25									0.06					0.01
199					0.3					0.36		0.74	0.57		6.48	
170,190	0.04	0.9	0.53	0.1		0.14		0.2	10.18	0.74				0.84	2.3	0.16
198		0.04	0.15	0.03				0.03	10.17	0.11			0.13			0.02
201	0.02	0.44						0.1		0.37		0.08	0.04		1.87	0.03
196,203	0.02	0.47						0.1	3.23	0.34	0.07				1.31	0.02
189	0.02	0.07						0.11	0.7							0.01
195,208		0.31	0.22	0.16												
207	0.02	0.05		0.21	0.34			0.06		0.17	0.16	0.89	0.19		0.84	
194		0.93									0.07					0.04
205																
206	0.11	0.26		0.11		0.1	0.48	0.04	6.81	0.43		0.14			0.74	

APPENDIX II

PISCES OBSERVATIONS, Tonawandas and Buffalo, 1993-1994 (ng recovered)

map #	1	2	5	6	7	8	9	9	10	10	10 A	11	12	12	13	15	16
	Nash Rd.	Sloan	Bailey at	Babcock	Bab. N of	Bab. N of	Lewis &	Lewis &	Seneca E	Seneca E	Smith N of	Smith &	Hamburg	Hamburg	Swan	Gen. E	Emslie &
	intercep.	Drain	Littell	at Mobil	Seneca	Clinton	Clinton	Clinton	of Smith	of Smith	Seneca	St. Steph.	S of Mack	S of Mack	& Pine	of Niag.	Swan
date in	3/9/94	3/8/94	3/8/94	3/8/94	3/8/94	3/8/94	9/22/93	3/8/94	3/8/94	9/22/93	3/8/94	3/8/94	9/22/93	3/9/94	3/9/94	3/9/94	3/8/94
date out	3/24/94	3/23/94	3/23/94	3/23/94	3/23/94	3/23/94	10/5/93	3/23/94	3/23/94	10/5/93	3/23/94	3/23/94	10/5/93	3/23/94	3/23/94	3/23/94	3/23/94
total ng	197.18	111.93	128.76	206.59	386.56	152.11	5728.60	550.44	466.44	2471.29	226.62	47.84	332.56	729.77	390.88	236.02	5962.32
mean temp	7.5	3	5.5	1.75	5	5.25	18.35	4.75	4	16.25	5	1.5	20.5	7.1	4.5	8.25	3.75
days in	15.02	15.08	15.06	14.99	15.00	15.01	12.95	15.03	14.95	12.95	14.95	14.94	12.95	13.95	13.89	13.86	14.92
L sampled	4.71	3.22	3.99	2.87	3.81	3.89	9.74	3.73	3.48	8.26	3.79	2.80	11.49	4.23	3.38	4.63	3.40
ng/L, PCB	41.89	34.74	32.31	71.93	101.55	39.09	588.15	147.42	133.95	299.17	59.76	17.07	28.94	172.64	115.77	51.02	1753.56
sample vol. (mL)	174	166	162	165	164	172	177	180	173	151	162	186	155	173	156	153	160
bottle #	31	29	29	29	29	29	22	29	29	22	29	29	23	31	31	31	30
pesticides																	
alpha-BHC											30					28	28
beta-BHC		31			68		45			30							
gamma-BHC	140	29						34	75	44	65		260	56	53	47	110
heptachlor								60			45		1100			49	45
aldrin							110			26							
heptachlor epox.											45			76	36		38
dieldrin							35										
endosulfan I	42		160		220	120		75	100		83				88	130	52
4,4'-DDE																	
endrin																	
endosulfan II							68			59							
endosulfan sulfate																	
4,4'-DDT							120										
alpha chlordane	90	39	98		56			92			52				71	99	
gamma chlordane	55							44									
Aroclor 1242										2100							
Aroclor 1248																	
Aroclor 1254							5300										
Aroclor 1260							1600			540							
BZ #																	
4	33				32.96	11.79	35.32		50.4	202.25	0	7.24				16.67	2.67
5				1.67	15.3	0.6		3.7			3.1						
6					0.4		10.5		12.5	77	2.4	5.8		27.1			7
7							3.1			10.4			46.724				
8	7.1	1.9	3.5	9.7	16	5.5	19.6	4.7	23.1	136.6	10	2.8	37			14.2	34
9	4.2	0.1	1.3		2	0.8	2.04		2.7	16.7		0.3					
10			5.6		1.6	0.9				6.65	5.8	0.4				4	11.6
12						4	4.17	4.3		1.94		0.3		16.7			
15		1		9.2	32	4.2	10.9	3.4	7	41.4	6.7						17.5
16				4.2	11.4	2.1	15.4	2.8	18.8	51.2	7.656	0.8		11.5		12.2	13.7
17		0		0.9	0	0.89	3.8	1.72	5.56	31.11							
18	3.4	2.1	10.1	13.9	20.7	9.8	41.2	9.3	27.3	177	8.5	1.7					33.1
19			0.988			2.9	7.3		5.8	32.5	0.2					17.8	16.5

PISCES OBSERVATIONS, Tonawandas and Buffalo, 1993-1994 (ng recovered)

map #	1	2	5	6	7	8	9	9	10	10	10 A	11	12	12	13	15	16
	Nash Rd.	Sloan	Bailey at	Babcock	Bab. N of	Bab. N of	Lewis &	Lewis &	Seneca E	Seneca E	Smith N of	Smith &	Hamburg	Hamburg	Swan	Gen. E	Emslie &
	intercep.	Drain	Littell	at Mobil	Seneca	Clinton	Clinton	Clinton	of Smith	of Smith	Seneca	St. Steph.	S of Mack	S of Mack	& Pine	of Niag.	Swan
20				3.84	18.2	0.79	0.43	1.47	1.45	15.7	1.57	0		0			7.39
22	4.5			5.2	8.1	2.6	11.2	2.1	6.1	39.1	2.8	0.4					
23							0			0	0	0	0				
24	1.6				0.53	0.6	2.26			1.4074							
25	1.7				1.6		37.4	?110	5.8	17.1							1.7
26		1.1			4.4	1.5	57.9	4.6	6.1	35.2		3.5			10.9		6.4
27										11.9							
28	10	2.5		14.4	24.4	7.3	42.1	5.5	18.4	121	7.4	1.3		18			20.7
29				3.2	2.6	1.8	0.59										
31					17.3	5.4	44.9	2.9	14.5	107	4.9	1.1	10.22	22.4			13.8
32	5.13	1.97		4.88	9.6	5.85	11.3	3.7	11.02	59.65	5.4	0.5					17.67
33	2			6.3	13.2	5.1	12.5	2.8	10	41.4	5.5	0.48				0	9.1
34		2.1		1.5	3	1.6			4	0.1475		0.5					
35										0.2366							
37		0.04		6.19		1.34	7.81	14.9	2.31	14.91		0.17				4.76	5.19
39		0.55		0.12	0.29	0.22	4.02		0.62	4.89	1.01	0.23					7.01
40				1.36	2.4	0.79	8.49		1.39	5.78	0.6	0.1					2.7
41				1.1	1.3	0.4	2.8			7.31	1						
42		1			3.1	1.2	34.7	3.2	3.8	15.6		0.2				4.2	5.3
44		0.9	21.1	8.9	10.7	4.7	146	11.2	13.8	50.7	4.8	0.5	67.8				25
45		0.4		2.1	2.2	0.9	8.76		1.9	9.65							2.9
46																	
47	1	10.8		4.3	0.9	1.4	57		6.3	30.9	1.9				10.6	4.4	17.3
48	1						5.85			7.43							
49		5.64			7.44	3.57	171.67	7.9	10.19	46.01	3.37	0.66			19.7	2.94	22.43
51		4			1.2	0.6	6.10		1.9	11.56		1.1				1.7	
52	6.8	3.1			10.5	4	303	19.4	16.9	67.4	7.7	0.4			14.4	5.4	38.5
53		7.8		5.5	7	0.8	26.5	4.6	5.9	31.2	0			27.8		47.6	
56		0.4		7	3.7	1.2	24.4	1.8	3.2	11.53						2.5	
57					0							0					
58																	
59					3.9		0	6.73		0				19	17.9		
60		0.1		0.8	0.3		1.50			4.65							
63							2.51			2.00					11.8	2.7	
64	2	1.8		4.6	5.5	1.8	39.05		5	16.39	2.2	1.3	27.27	7	8.4	2.4	6.3
66	3.83	1.1		10.6	7.1	2.4	104	7.6	8.1	41.90		0.5			13.82	6.71	17.4
67	10.2						20.9		0.7	1.13				2.27			
69				0.9										7.9			
70		0.9		11.2	9.7	3.5	170	9.6	8.7	47.7	3.9			16.7		4.8	14.7
72	0	0					0	0		0		0					
74				5.8	3.8	1.7	31.7	2.1	2.5	19.4	0.6					4.1	7.4
75	1	0.5			1.2	0.6	8			1.24			47.68	18.8		2.6	
77				0.6	0.6				0.5	5.67	0.5				16.5	1.7	
82				0.7			18.6	1.9		5.79	1.3			17.3			
83					0.4		26.6	3.8	0.8	2.49	0.5						2.6

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PISCES OBSERVATIONS, Tonawandas and Buffalo, 1993-1994 (ng recovered)

map #	1	2	5	6	7	8	9	9	10	10	10 A	11	12	12	13	15	16
	Nash Rd. intercep.	Sloan Drain	Bailey at Littell	Babcock at Mobil	Bab. N of Seneca	Bab. N of Clinton	Lewis & Clinton	Lewis & Clinton	Seneca E of Smith	Seneca E of Smith	Smith N of Seneca	Smith & St. Steph.	Hamburg S of Mack	Hamburg S of Mack	Swan & Pine	Gen. E of Niag.	Emslie & Swan
84		0.4		2.2		0.8	121	32.1	4	11.5	3.2	0.2			50	1.4	12.5
85	1.8	0.4	10	2.1	0.9	0.6	25.3	2.7	1.6	6.17	0.5	0.2				1.4	8.4
87	3.25	1.09		2.51	1.1	0.3	53.89	8.6	4.46	13.91	2.112	0		28.4	26.37	6.69	18.85
88		0.4			0.1		6.19		0.30	0.19			8.77				
91		2.8		1.3	0.8	0.5	56.9	5.3	2.2	6.85	0.4	0.4					7.1
92		1			1.8	0.8	89.7	7.9	2.5	11.3	2.3		11.8	23.7	27.2		69.7
95	6.2	5.1		1.6	4.6	1.8	434.01	30.5	9.5	39.7	10.5	0.72			19.3		188
96		0.4	4.5			0.2	1.66	0.6	0.5	1.07		0.2					2
97	2.9	0.5		1.9	2.2	0.8	116	7	3.2	11.5	1.2			15.6	17.4	1.5	11.2
99	3.6	1.3		2.3	3	1.3	230		5	20.5	3.6						86.8
100							5.63			1.14				12.2			
101	10.6	4		4.7	6.4	2.2	407	30.5	13.2	53.7	6.1	1.2			82.8	5.8	233
104							0										0
105	4.4	0.1	8.7	5.3	2.9	1.4	38.7	4.9	3.8	13.8	3.1			20.5		1.7	9.5
107					0.4	1.2	34	1.5	1.9	4.17	1.2						10.5
110	10.431	2.8		8.4	9.06	3.7	437.84	33	14.4	48.56	12.7	1.3			21.69	10.82	110.01
114	0.3	0.1	0.9			0.2	1.45	0.9	0.3	0.49	0.3	0.1					
115	1.5	0.5		1.3	0.8	0.7	4.72	1.6	1.1	1.21	1.2	0.4					2.5
118	6.9	0.7		3.1	5.5	1.9	235.73	16.7	6.7	31.37	5.7	0.3		26.8		3.5	60
119	3					2	30.1			2	2						16.7
122								3.69			4.72					6.31	0
123	0.2			0.6					1.5					178			
126		3.4	5.1	2.1	0.8			0.4	1.8		0.3			45.9			
128	0.4	0.6				0.4	39.7	3.9	1.7	7	1.4	0.7				2.3	28
129			1	0.4	0.7	0.3	9.16	1.1	0.2	2.14	0.4						6.3
130	0.4	0.1			0.2		11.64	0.7		1.75	0.3						23.9
131										1.27	0.5					0.8	7.6
132	0	0.77	7.1	0	1.6	0	109.89	8.6	0	14.78	0					3.6	135.1
134	1.4	0.6	3			0.2	2.4404	1.3	1.3	1.80	1.6	0.5					17.7
135	1.24	2.83		0.3		2.3	53.31	6.63	2	9.84		5.15	11.91				108.62
136		1.2					52.2	22.5	2	8.82	5.9					3.5	92.4
137			7.9				15.9			2.04							
138	10.4	3.9				2.8	314	27.5	10.4	72.3	10.6	0.4				7.8	576
140		0							0							0	
141	1.6	0.8			0.8	0.5	33.6	4.3	1.4	12.9	1.4			38		1.2	95.5
143																	
144		0		0			0	0	0	0	0						0
146	0.4	0.4	1.6	0.4			43.8096	3.4	0.6	7.292							116
149	4.41	3.42		1.7	3.2	1.26	319	29	6.63		3.45	0.12				0	0
151	0.5	2.3		0.1	1.4	0.3	70.2	7.6	2.3		2.9		22.693				177
153	5.88	3.42	22.8	1.83	0.28	1.31	60.88	22.05	6.05	60.02	6.52	0.17			12.5	5.07	79.03
156 &157	0.6				0.9	0.5	9.6299	1.1	1.2	1.944	0.1						8.7
																	3.6
158	1.8			0.4	0.8	0.6	26.9	4.1	2.3	7.13	1.8					2.6	52.1
160				0.6						0.1652							

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PISCES OBSERVATIONS, Tonawandas and Buffalo, 1993-1994 (ng recovered)

map #	1	2	5	6	7	8	9	9	10	10	10 A	11	12	12	13	15	16
	Nash Rd. intercep.	Sloan Drain	Bailey at Littell	Babcock at Mobil	Bab. N of Seneca	Bab. N of Clinton	Lewis & Clinton	Lewis & Clinton	Seneca E of Smith	Seneca E of Smith	Smith N of Seneca	Smith & St. Steph.	Hamburg S of Mack	Hamburg S of Mack	Swan & Pine	Gen. E of Niag.	Emslie & Swan
162		0		0	0											0	0
165		0.2								0.198		0.1					
167			0.3	1.2			14.5	1.3	0.3	3.41							17.7
168																	
169		0.2															
170	2.2	1.5	3.6	1.3	1.4	0.6	63.2	6.7	2.6	26	3.1						307
171 & 200	0.2		8.5		0.8		26.5			15.4							75.2
172		0.1	0.7	0.3	0.1		7.2401	0.7	0.1	2.518	0.2						26.1
173																	1.6
174	2.1	1.4				0.4	63.4	8.2	2.1	27.9	2.17	0.9					307
175						0.5		0.5	0.3								24
176		0.2			0.5	6.5	14	0.9		4.67	0.3	2.3		100			44.4
177	1.3	0.6					38	4.3	1.2	15.7	1.6						176
178		2.2	0.474	4.9	7.2												
179		0.7				0.5	30.1	2.8		11	1.1						132
180		2.7		2.1	4.3	1.5	159	19.5	5.9	73.8	6.1			28.2		1.6	772
183	0.61	0.2					21.49	2.85	1.92	10.78	1.74						110.85
184							0			0							0
185					0.2	0.2	4.82	1	0.8	3.12	1.5						33.4
187	1.8	1.9				0.6	74.3	9.7	2.9	31.7	2.1	0.2				2.2	369
189										0.441						0.9	11
190	1.6	0.3		0.2	0.6	0.5	12.4	1.5	0.6	3.52	1.7						61.7
191							3.28			0.792							10.8
193							6.95			2.52			40.7				
194	1.2	0.4			0.3		19	2.2	1.7	10.7	1.1						141
195	0.3	0.2				0.5	12.5	1.4		5.41	0.7						69.4
196	0.8	0.2			0.4	0.4	13.3	1.7	0.9	7.53	0.9						85.4
197									0.4						9.6	0.8	4.5
198	0.2	0.8				1	0.816	0.4		1.25							12.5
199					1.2		3.38			2.12							18.8
200																	135
201	1.2	0.9		0.39		0	20	2.7	1.14	11	1.6					1.15	143
202					0.3		3.16	0.7	0.5	2.18	0.2						24.3
203	0.5	0.1		0.2	0.3	0.2	7.3644	1.1	1.7	4.1312	0.6						37.7
205																	7.3
206	0.6			0.2		0.3	3.51	0.7	0.2	2.77	0.4						32.9
207									0.1								3.9
208						0.4	0.44	0.2		0.597	0.2						5
209					0.2												

PISCES OBSERVATIONS, Tonawandas and Buffalo, 1993-1994 (ng recovered)

map #	19	19	21	22	22	23	23	24	25	26	27	28	29	30	31	32	33	34
	Corn-N	Corn-S	Forest	Kensing.	Kensing.	Moselle	Moselle	Schiller	Scaj. at	U-Crest	Blick &	Two-Mile	Two-Mile	Rattle.	Two-Mile	Gibson	River Rd.	Schenck
			Lawn	at Sisters	at Sisters	& French	& French	Park	Alex.	at Gall.	Harlem	Ensimg.	Fletcher		at River	Niagara	N Ton.	Marion
date in	3/8/94	3/8/94	3/8/94	9/22/93	3/8/94	9/22/93	3/8/94	3/8/94	3/8/94	9/22/93	3/8/94	3/9/94	3/9/94	3/9/94	3/9/94	3/9/94	3/9/94	3/9/94
date out	3/23/94	3/23/94	3/23/94	10/5/93	3/23/94	10/5/93	3/23/94	3/23/94	3/23/94	10/5/93	3/23/94	3/24/94	3/24/94	3/24/94	3/24/94	3/24/94	3/24/94	3/24/94
total ng	111.89	167.53	183.26	323.28	101.77	81849	8542	75.85	114.89	1140.63	255.42	103.73	243.37	446.24	313.77	2817.68	50.03	112.50
mean temp	7.5	8	5	19.25	4.5	18.6	6.25	7	5.5	13.15	4.75	4.5	4	1.5	3	3.5	8.5	7.5
days in	14.97	14.96	14.98	12.97	14.98	12.95	14.98	14.98	14.97	12.73	14.93	15.00	14.98	14.94	14.89	14.96	15.00	15.00
L sampled	4.69	4.89	3.80	10.45	3.64	9.93	4.23	4.50	3.96	6.34	3.71	3.65	3.49	2.80	3.18	3.34	5.11	4.70
ng/L, PCB	23.85	34.27	48.21	30.93	27.95	8242	2021	16.85	29.00	179.83	68.87	28.44	69.78	159.27	98.61	844.38	9.79	23.93
sample vol. (mL)	171	151	173	167	150	145	174	165	167	137	166	172	149	175	173	161	163	162
bottle #	28	28	30	22	28	22	28	28	30	23	30	30	30	31	31	30	30	30
pesticides																		
alpha-BHC									27			44				32		25
beta-BHC		110		130	62	160				NA		41	NA		NA			
gamma-BHC	48	52		60	31		24	110		NA			NA		NA		96	55
heptachlor					40			110	46	NA			NA		NA			29
aldrin				150		72				NA			NA		NA	68		
heptachlor epox.				50					28	NA			NA		NA	28		
dieldrin										NA			NA		NA			
endosulfan I	56	67			80		89	71	160	NA	62		NA	29	NA		42	
4,4'-DDE								54		NA			NA		NA			
endrin										NA			NA		NA		58	57
endosulfan II						720				NA			NA		NA			
endosulfan sulfate									110	NA			NA		NA			
4,4'-DDT						900	110		110	NA			NA		NA			
alpha chlordane		62					140		150	NA		37	NA		NA	72		
gamma chlordane										NA			NA		NA			
Aroclor 1242						2300				NA			NA		NA			
Aroclor 1248										NA			NA	800	NA	4000		
Aroclor 1254										NA			NA		NA			
Aroclor 1260						23000				NA			NA		NA			
BZ #																		
4	9.33		26				0		45.6		33.44		131	66.4	161	124		
5	1.6	1		21.7		6.42	29.1				2.9							
6	2.7	3	8.1			21	1.1	1.6	0.8	0.674		2.1	0.9	5	1.1	4.6		
7				2.2		10.3												
8	3.9	8.7	10.4	9.72	2.8	101	30.3	7.3	2.9	2.43	0.7	5.7	2.6	8.6	2.8	20.7	1.5	2.2
9		0.5	0.3	0.988								1.18		0.5				
10	2.8		1.6	1.03			13.7		0.8		0.7		9.4	6.5	8.9	2.7		
12	0.9			0.774							5					4	0.8	3.4
15	2	6.4	4.7	5.52	5.54	40.9	20.7	2.1	2.7			3.7	2.5	4.6	2.3	10.2	1.7	1.6
16	3.1	14.1	7.4	5.4	1.7	45.9	24.2		1.4	5.21	0.5	5.6	2.6	7.3	3.2	40.2	0.7	
17	1.93	1.38	1.43						0		0.33	0.16		5.07		19.12		
18	2.8	6.8	25.6	14.9	2.8	143	42.5	1	3.3	2.86	2.4	6	6.3	30.8	7.6	167	1.6	1.1
19			6.7	9.57	3				2.1	0.53	0.6	2.9	2.2	13.4	4	56.2		

PISCES OBSERVATIONS, Tonawandas and Buffalo, 1993-1994 (ng recovered)

map #	19	19	21	22	22	23	23	24	25	26	27	28	29	30	31	32	33	34
	Corn-N	Corn-S	Forest Lawn	Kensing. at Sisters	Kensing. at Sisters	Moselle & French	Moselle & French	Schiller Park	Scaj. at Alex.	U-Crest at Gall.	Blick & Harlem	Two-Mile Ensimg.	Two-Mile Fletcher	Rattle.	Two-Mile at River	Gibson Niagara	River Rd. N Ton.	Schenck Marion
20	0	0	1.65		0			2.94	3.25	1.47	4.59				1.14	13.62		
22		3.5	3.4	6.48		45.7	9.4			0.997		2.8	2.1	8	2.7	62.7		2
23	0	0	0		0									0		0		
24			0.03	1.6182	0.09	6.3253	0		0.5	0.0743	0.03	0.5	0.5	0.46	0.29	0		0.1
25			2.2	1.91	5	14.6	2.4		0.2	1.45		1.9		1.6		5.2	0.9	0.5
26			3.6	1.51	0.7	35.4	8	2	2.2	1.96	4.3			6		19.2	0.5	1.3
27			1.8							0.38				3.6	1.2		1	
28	3.4	8.8	10.4	18.9	4	186	20.7	1.8	7.1	3.49	6.2	6.3	5.4	19.8	8.3	195	6.7	10.3
29					0.3					0.667					2.2		1.6	1.4
31	1	4.6	9.6	8.1	1.8	180.83			2.6	3.02	0.8		2.72	14.9	6.7	112		
32	0.12	0.09	7.13	11.97	5.27	32.79	13.82	3.81	2.34	0	5.5	2.22	2.68	23.23	6.28	146.9		1.66
33	0	0	5	1.48	1	83	8	2.1		1.35		2.6	0		1.4	17.9	1.2	3.24
34			1						2.8		2.4	5.6	6.2		4.5		0.108	0.267
35							1.9											
37	0		1.41	2.72	0.86	24.69	7.8			0.681		0.8	2.2	5.5	0.7	23.1	0.55	0
39	0.39				2.5	13.37	2.74			0.27	0.81			3.13		18.3	4	2.5
40	0.33		0.78	1.05	0.62	5.54	3.5			0.4	0.2	0.64	0.6	2.7	0.4	0.5	0.22	0.41
41			0.4	2.63		13.8				0.105	0.3			4.5	1.3	71		
42	1.2	1.2	1.4	2.7	0.7	38	6.3		0.5	0.966	1.5	0.9	1.4	6.1	2.2	54.5		1.8
44	1.4	7.2	5.7	10.4	2.5	129	20.9		2.2	4.13	1.4			28.4	9.3	261	1.3	
45		1.2	2.5	3.45	4.6	16	3.2				0.5	0.8		11.7		74.3		
46		0.7			8.4							2.8	1.7		2.6			
47	2.1		3.3	3.57	3.1	168		1.4	1.8	4.59	24.9			13.5		42.2	1.1	2.6
48		5.9											3	0.4	1.1	38.9		
49	1.08		4.14	6.66	1.75	260.21	22.29	0	1.83	5.01	10.61	2.93	0.97	16.06	3.51	117.07		1.79
51			0.8	2.4453		34.4153			0.6	2.926	11.7	0.9	0.6	2.3	2.1	9.9		
52	2.3	7	6.1	9.7		297	44.9		3.1	9.73	5.6	3.9	6.2	31.8	10.4	275	1.7	2.8
53	12.8	30.5	3.4	14.6	5.6	32			0.7	3.29	14.7	1.1	5.9		5.4	78.7		
56		3.8	1.1	4.59	0.8	51.5		0.4	0.2	0				4	1.4	58		
57				0						0	0		0			0		
58												0.4						
59		4.86				14.1			0.6			1.9	2.12	0.18	2.87	0		
60		0.2	0.1		0.2				0.2	0.2953	0.2					19		
63				2.4001		3.0776								0.1				
64	1.3	3.1	2.4	4.7516	1.6	40.6982		1	2	1.756		1.9	2.3	8	2.9	108.1	0.5	1.1
66	1.3		2	7.62	2.54	169	22.1	1.4	1	2.43	1.5	1.8	2.7	7.7	2.8	131	0.6	1.9
67				0.6	0.48					0.9057						3.4	0	0.67
69													0.3				1.3	
70				8.63	1.2	186	20.9		0.5	2.95	1.3	2.5	1.7	7.1	2.8	91.7	0.9	1.9
72	0	0		0		0											0	0
74		2.8	1.2	3.61	0.9	56.1	8.9			1.33				3.9		58.4		
75	3	6.6		0.344		4.84			0.5	0.47	1.5					2.2		
77	0.2		0.1	0.889			7.5				0.4					8.8		
82	0.4			0.404		565				1.71		0.3		0.8	0.3	8.8		0.6
83					0.2	64.9	2.2	0.3		1.26		0.6	0.6			2.8		0.2

PISCES OBSERVATIONS, Tonawandas and Buffalo, 1993-1994 (ng recovered)

map #	19	19	21	22	22	23	23	24	25	26	27	28	29	30	31	32	33	34
	Corn-N	Corn-S	Forest Lawn	Kensing. at Sisters	Kensing. at Sisters	Moselle & French	Moselle & French	Schiller Park	Scaj. at Alex.	U-Crest at Gall.	Blick & Harlem	Two-Mile Ensing.	Two-Mile Fletcher	Rattle.	Two-Mile at River	Gibson Niagara	River Rd. N Ton.	Schenck Marion
84			1.7	11.4	0.9	126	16.5		3.3	6.39	1.7	0.229		4.1	7.1	24.1	1.8	
85	0.2			1.23	0.4	198	11.3	1.8		2.08	0.3	0.3	0.6	0.8	0.7	7.7	0.5	0.6
87				1.33	1.01	72.14	22.34	2.23	0.91	6.37	0.55		0.2		0.2	11.6		
88	0.9		0.2										0.2					
91	0.4		0.6	0.279	0.2	76.4	8.6		1	3.8	6.4	0.7	0.5	1.2	0.4	8.7		
92	0.4			0.992		1300	92.3			7.98	2.9		0.6	1.2		3.8		
95	3.2		0.8	1.4		2420	250	1.33	1.4	44.53	10.2	4.1	5.1	11	5.8	8.9	1.44	3.7
96			0.1				2.1	2.5		0.1077	1.6		0.2	0.1		2.4		
97				1.51		115	14.9	2.2		3.76	0.9	0.6	0.9	1.8	0.9	12.6	0.5	1.1
99					0.6	1810	114	8.4		8.94	2.8	0.5	1.5	2.4		18.6	0.4	1.4
100						31.3981	0.9			0.4215	2.1	0.2	0.7		0.5		0.5	0.3
101	1.8		1.4	17.5	2.4	3230	311	0.7	1.6	34	9.4			7.7	2.8	28.5	3.3	8.5
104							0	0										
105		5.1		1.7	0.8	69.5	11.9			2.79	0.6	0.5		0.9		9.9		1.4
107	1.2					424	14.3	0.5			0.5					2.8		
110	4.1		0.9	5.85	0.91	1440.35	144.6	11.43	1.18	30.65	5.12	2.4	3.77	7.1	3.69	37.6	1.69	3.78
114			0.1	0.20	0.1			0.1		0.15						0.4		0.1
115	1.4			0.141	0.5		2.8		0.2	0.37	1.3	0.6		0.5	0.4	3		3.6
118	0.9			3.54	1.2	423	80.5			10.1	0.7	0.3	0.64	2	1.1	14.92	0.5	1.6
119					3	381	25.7			3.21	1.1	5.5	3.4	10.3	3.4	9	2.9	4
122		4.8		0.67		29.36	0		0.2	0	1					1.41	0.1	0.54
123	0.1			0.48				2.9		0.67								
126	0.9	1.4			0.3						4.8							0.8
128	1.3			1.19		288	41.4	2.7	0.2	7.81	0.4		0.3	0.2		0.8		0.6
129				0.55		50.2	8.3			1.51	0.3	0.4				0.5		0.4
130				0.2182		399.1197	32.2			2.16	0.3					0.2		0.1
131							9.8			1.67	0.6							
132		1.8	0.5	0	1	2220.786	179.2		0.24	26.67	0.9	0		0		1.9		
134			0.7		0.6		26.9		0.8		0.4	0.7	1.2		1.8	1.1	0.6	1
135	9.42			5.3	1.11	1562.43	128		1.77	16.3	2.81		1.93	1.56	0.9	3.29		
136	1.7				0.7	1190	123	1.4	0.3	17.5	1.9	1		0.6		0.7		0.8
137		2.1				14				1.91			0.2					
138	3.7	5.5	0.9	7.86	2.6	6700	775	2.9	2.8	109	6.9	1.6	2.5		1.8	3.7	0.8	4.2
140	0					0												
141	0.4			1.01	0.4	855	124			20.7	1.3	0.2	0.2	0.5	0.2	1.3	0.2	0.9
143		0									0							
144	0			0	0	0	0	0		0	0			0	0			
146				0.2234		2784.752	149.9			12.9764	0.6			0.1		0.3		0.2
149	3.1		0	6.58	1.5	9180	808		0.77	106	7.91	0	1.38	1.55	0	2.32	0	2.16
151	1			1.82	0.5	1960	238		0.3	30.9	3.7	0.8		1.1	1.1			
153	2.49		0.29	3.77	1.56	200	84.845	1.21		93.73	6.22	0.97	1.19	2.54	1.29	1.1	0.52	3.09
156 &157				0.3009		96.2995	13.6	0.7		1.8026	0.4			0.1		1.7	1.1	
158		0.7		0.898		436	57.4	1.5		9.91	1			0.7		0.8	0.4	0.9
160										0.2986	0.1							

PISCES OBSERVATIONS, Tonawandas and Buffalo, 1993-1994 (ng recovered)

map #	19	19	21	22	22	23	23	24	25	26	27	28	29	30	31	32	33	34
	Corn-N	Corn-S	Forest Lawn	Kensing. at Sisters	Kensing. at Sisters	Moselle & French	Moselle & French	Schiller Park	Scaj. at Alex.	U-Crest at Gall.	Blick & Harlem	Two-Mile Ensimg.	Two-Mile Fletcher	Rattle.	Two-Mile at River	Gibson Niagara	River Rd. N Ton.	Schenck Marion
162	0						0		0		0							0
165	0.1		0.2	0.107	0.2					0.285	0.1	0.2				0.6		
167				0.455		182	25.4			4.26						0.5		1.4
168																		
169				0.2752														
170	1	1.1		2.14	1	3430	397	0.8		47.7	1.9	0.5	1	0.6	1	1.3	0.8	1.9
171 & 200		0.4		8.56		1380	107			19.1								
172				0.1969	0.1	420.8532	33.7			4.1015	0.3							0.1
173						23.1086	2.2			0.2577								
174		0.1		0	0.8	3800	414			45.7	1.9	0.7	0.5	0.5	0	0		1.4
175		0.6					27.2						1.9					
176						659	58.1			7.15								0.3
177	0.7			0.817	0.4	2470	239			24.5	0.8			0.2	0.1	0.4		0.9
178		1.4														2.6		0.1
179	0.2			0.8	0.3	1850	176	0.4		18.6	1.4					0.3		0.5
180	3	4.1		3.58	1.9	9190	1010		0.5	114	4.7			1		1.3		
183		1		1.93	0.43	1340.33	153.09			15.83	0.5		0.27	0.16	0.3	1.93		0.89
184						0	0		0	0	0					0		
185				0.321		347	44.5			5.55								0.3
187	1.7			3.62	1.1	5350	492		0.9	49.1	2.3			0.1		0.9	0.1	1.5
189						101	15.4			1.28								
190	0.5	1.4		0.793	0.2		79.8		0.1	9.25	0.6	0.4	0.3		0.3	0.8	0.9	0.8
191				0.161		107	14.3			2.2	0.3							
193						364	29.8			3.74								5.4
194	0.8					1860	185	0.2		16.7	0.4					0.8		0.5
195				0.513		920	88.2	0.8		8.63	1.1							0.4
196	0.7			0.419	0.2	1140	111		0.1	10.5	0.5				0.3			1
197							6											
198					0.3	102	18.7			1.61		5.5					0.4	0.6
199				0.752		220	24.2			1.87								
200		2.1					136						2.8			1.1		
201	0.7			1.77	0	1710	189			18.69	0.7	0				0.7		0.5
202	0.2					314	31.6			2.52		1.4						
203	0.3			0.3926		692.8177	49.5			5.0037	0.2							0.2
205						81	10.6			0.759	0.3					0.9		
206				0.203		465	39.9			2.45							0.1	0.3
207						48	5.3											
208						58.6	6.2			0.366								0.4
209											0.2							