Eighteenmile Creek Remedial Action Plan

Area of Concern Planktonic Community Study

Olcott Harbor at Eighteenmile Creek, New York

Prepared by

Joseph C. Makarewicz and Theodore W. Lewis

Environmental Science Program
Department of Biological Sciences
SUNY College at Brockport
Brockport, NY 14420-2973

Prepared for

New York State Department of Environmental Conservation
625 Broadway, Albany, NY 12233-3508
Funded by United States Environmental Protection Agency Grant, Region 2, New York

January 2002

Table of Contents

Olcott Harbor looking towards Lake Ontario

Summary

The preponderance of evidence suggests that the plankton community of Eighteenmile Creek is not impacted by contaminants. The summer zooplankton community of Eighteenmile Creek has a similar or higher species richness, a remarkably similar measure of dominance (i.e., evenness) and in July, a comparable abundance to the relatively pollution-free reference sites at Yanty, Buttonwood, and Salmon Creeks. Similarly in June, zooplankton abundance, species richness, and evenness for Eighteenmile Creek were between the values for the reference sites at Yanty Creek and Buttonwood and Salmon Creeks. Further support of this analogous comparison is provided by the phytoplankton data. Species richness, evenness, abundance, and species composition of phytoplankton are similar for Eighteenmile Creek, the unpolluted reference site at Yanty Creek, and for the AOC at the Oswego River and Harbor for the months of June and August. Seasonal changes, sample timing, and local sampling site characteristics and location can be challenging to data assessment and reference site comparison; however, substantially similar and healthy communities indicate no overall degradation or impairment in the planktonic populations in the Eighteenmile Creek AOC.

Introduction

Eighteenmile Creek is one of the six Areas of Concern (AOC) in New York State. The International Joint Commission (IJC) and Great Lakes community are working on 42 Areas of Concern in the Great Lakes basin where beneficial uses of a waterbody have been identified as impaired. AOCs include harbors, river mouths, and river segments where Remedial Acton Plans (RAPs) have been developed and are being implemented to restore and to protect beneficial uses. Fourteen use impairment indicators have been applied to define water quality parameters.

Eighteenmile Creek has been polluted by past industrial and municipal discharges, the disposal of waste and the use of pesticides. Fish consumption has been impaired by PCBs and dioxins found in the flesh of various game fish. The health of the benthos has also been impaired by PCBs and metals in creek sediments. At the mouth of Eighteenmile Creek on Lake Ontario, dredging restrictions have been placed on the disposal of dredged material from Olcott Harbor. Dredging is needed to maintain recreational boating and requires land-based confined disposal. Other use impairment indicators in the Remedial Action Plan (RAP) that require further investigation to assess impairment are: the degradation of fish and wildlife populations, fish tumors, bird or animal deformities or reproductive problems, and the degradation of plankton populations.

Plankton are small organisms, both plants (phyto) and animals (zoo), which live in the water column or are attached to substrates in aquatic and marine environments. They possess limited or no ability to swim against currents but move with the water. Phytoplankton form the base of the pelagic food web. Much of the energy captured by phytoplankton is consumed by zooplankton, which in turn are eaten by larger organisms such as larger zooplankton, benthos and fish.

The objective of this study was to determine the health of the planktonic community in the Eighteenmile Creek Area of Concern (AOC) and to establish the status of the Use Impairment Indicator in the Eighteenmile Creek Remedial Action Plan (RAP). To assess impairment, characteristics describing the plankton community structure, such as abundance, species composition, species richness and dominance are required. Such measures of the plankton community at Eighteenmnile Creek are compared to results of previously studied community structure data from several reference sites: minimally polluted creeks on the south shore of Lake Ontario (Yanty, Salmon, Buttonwood), a historically eutrophic impacted river system (Oswego River AOC), the nearshore and offshore waters of Lake Ontario, and from several habitats (submergent, pond) located in Braddock Bay and Yanty Creek marsh on Lake Ontario.

According to the International Joint Commission's (IJC) Listing and Delisting Criteria for the fourteen use impairment indicators for Great Lakes Areas of Concern, plankton are impaired when the phytoplankton or zooplankton community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, plankton will be considered impaired when relevant, field validated plankton bioassays (with appropriate quality assurance / quality controls) confirm toxicity in ambient waters. In the absence of community structure data, the beneficial use is considered restored when phytoplankton and zooplankton bioassays confirm no significant toxicity in ambient waters.

Ecologists have grappled with the concepts of biological integrity, ecosystem health, and biodiversity in trying to define the normal condition of ecosystems. The capability of the ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat in the region is most desired. If the system has this integrity, it will be healthy; however, the lack of diversity does not imply impairment. Hence, comparable sites having known healthy and unimpacted characteristics are key to such evaluations. This study has, therefore, focused on maximizing the collection of community structure data in the study area and applying this to comparable sites in order to establish a status for the use impairment indicator.

In keeping with the definitions of ecosystem health and biological integrity, we understand the beneficial use of plankton communities to be the conversion of solar energy to chemical energy (biomass), the incorporation of nutrients into biomass and the conveyance of these materials to normal, diverse fish and wildlife communities and ultimately to human populations by a plankton community that is balanced and adaptive to change. Impairment of the beneficial use is defined as a decrease in the ability of these communities to perform these functions as a result of stresses within the ecosystem caused by anthropogenic activities. Anthropogenic stresses on plankton populations can result (and range) from the addition of nutrients and toxicants to aquatic environments, fish harvesting and stocking practices, introduction of exotic species, and habitat alterations which could include changes in ultraviolet light conditions and increased temperature associated with climate change (Johannsson 1998).

Methods

Sampling Design and Rationale: Limited resources required that the sampling and analyses be focused on the Area of Concern in the collection of community structure data. The sampling was conducted during the summer months to provide the best correlation with the control / reference site data also collected in similar conditions and time of year. Representative and useful data of comparable physical and chemical characteristics at sites of desired healthy and sufficiently unimpacted conditions was preferred for this study. By applying the known and desired results of the control / reference sites, the collection of data for assessment of the study area was maximized. Bioassays were not part of the study.

Sampling Sites: Because phytoplankton and zooplankton populations are minimal during the winter, early spring and fall, samples were collected at two sites simultaneously in open waters of the Area of Concern in June, July, and August. Site 1 was chosen to represent an area likely affected by the waters of Lake Ontario, while Site 2 is still a flooded river valley but upstream from any significant Lake Ontario influence. Lower lake levels during summer sampling would support this. These two study sampling sites provide for comparison of data with control / reference site data from the undisturbed Yanty Creek, the lake influenced Creek sites (Buttonwood and Salmon) at Braddock Bay, the open lake waters of Lake Ontario, and even some data from the Oswego River / Harbor. Previous studies conducted by the Principal Investigator at the three creek sites provide data comparable to conditions in and around the Area of Concern. Sampling at all sites is performed over the summer months and is thereby designed to provide sufficient data to accomplish a use impairment assessment.

Eighteenmile Creek sampling Site 1 and Site 2 are shown below in **Figure 1** and also in photographs in Appendix 4. Samples were collected on three dates (22 June, 25 July and 31 August 2000). Site1 is in Olcott Harbor half way between the Route 18 roadway overpass and where the jetty begins. Site 2 is in the middle of Eighteenmile Creek half way between the Burt Dam and the mouth of the creek. Phytoplankton and zooplankton samples were taken on all three dates while physical data and water chemistry were sampled in July and August only.

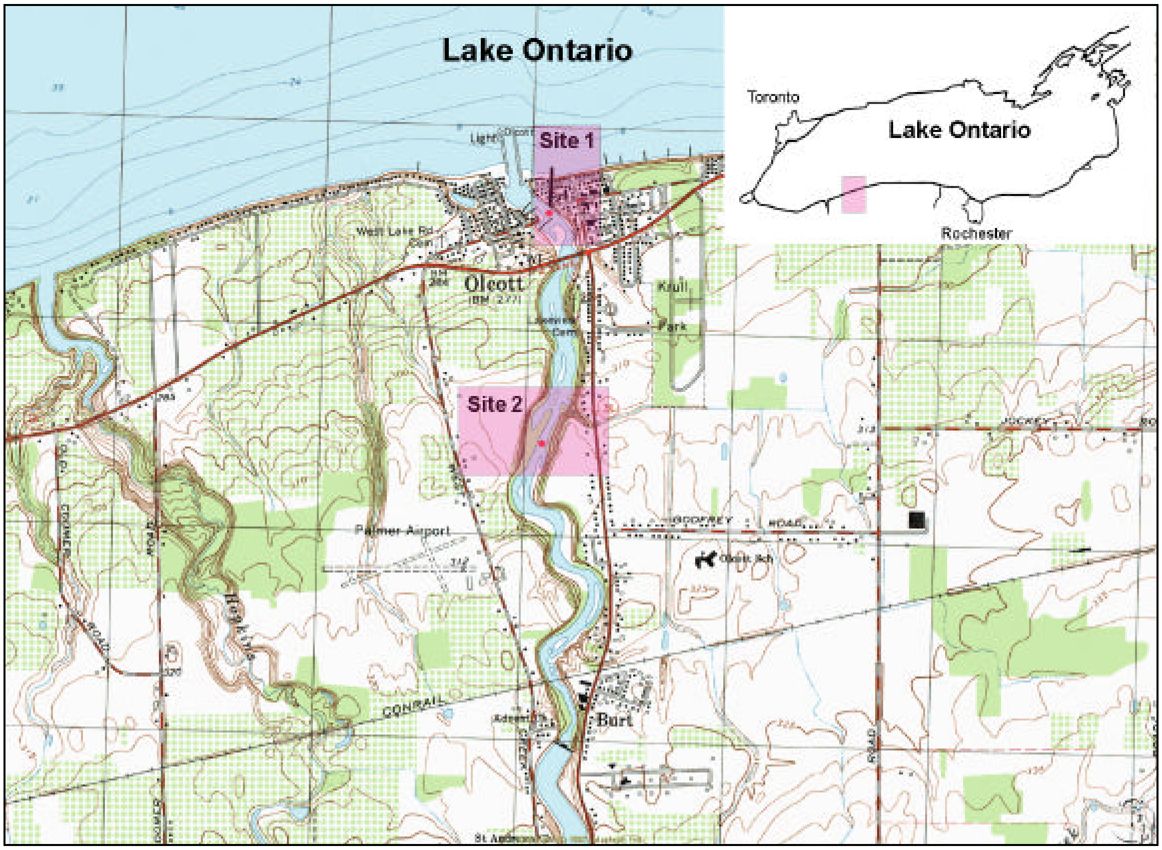

Figure 1. Plankton and water sampling sites on Eighteenmile Creek on Lake Ontario near Olcott, New York. Site1 is in Olcott Harbor half way between roadway route 18 and where the jetty begins. Site 2 is in the middle of Eighteenmile Creek half way between Burt Dam and the mouth.

Physical Field Sampling and Data: Physical and water chemical analyses were conducted in July and August. Field measurements included temperature, specific conductance (using YSI model 3000 T-L-C thermistor) and dissolved oxygen (using YSI model 58). Samples were taken from a depth of 1 meter. Secchi disk depth readings in meters were taken at each station with a standard 20-cm secchi disk.

Water Chemistry Sampling and Data: All sampling bottles were pre-coded so as to ensure exact identification of the particular sample. All sample bottles were routinely cleaned with phosphate-free RBS between sampling dates. Containers were rinsed prior to sample collection with the water being collected. In general, all procedures followed

EPA standard methods (1979) or Standard Methods for the Analysis of Water and Wastewater (1998).

Water samples were taken from a depth of one meter with high-density polyethylene dark bottles. Sample water for dissolved nutrient analyses (SRP, nitrate + nitrite) was filtered immediately with 0.45-µm MCI Magna Nylon 66 membrane and either frozen or analyzed within 24 hours of collection. Water quality parameters analyzed for include:

- **Nitrate+Nitrite:** Dissolved nitrate+nitrite nitrogen was performed by the automated (Technicon autoanalyser) cadmium reduction method (APHA 1998).
- **Soluble Reactive Phosphorus:** Sample water was filtered through a 0.45-µm membrane filter. The filtrate was analyzed for orthophosphate using the automated (Technicon) colorimetric ascorbic acid method (APHA 1998). The formation of the phosphomolybdeum blue complex was read colorimetrically at 880nm.
- **Total Phosphorus:** The persulfate digestion procedure was used prior to analysis by the automated (Technicon autoanalyser) colorimetric ascorbic acid method (APHA 1998).
- **Total Suspended Solids:** APHA (1998) Method 2540D was employed for this analysis.
- **Turbidity:** Turbidity was measured with a Turner nephelometric turbidimeter.
- **pH:** Analyses were made by electrode using a Beckman 45 pH meter, standardized using a two point calibration (4 and 9).
- **Chlorophyll a:** Chlorophyll a was measured with a fluorometer following the method of Wetzel and Likens (1994).

Phytoplankton Sampling and Data: Phytoplankton samples (100 mL) were taken just below the surface of the creek and then immediately preserved with 10 mL of gluteraldehyde. A total of six samples were taken for the study period. Phytoplankton enumeration and identifications were to the species level using the settling chamber procedure (Utermöhl 1958) at 500x. Each cell in a filament or colony was counted as an individual organism. A species list and authorities for identified phytoplankton for the Eighteenmile Creek site are presented in Appendix 3.

Zooplankton Sampling and Data: Replicated zooplankton samples (n=3) were collected from each site with a 12.0-L Plexiglass Schindler trap (35-µm mesh net) (Schindler 1969). A total of 18 samples were taken for the study period. After collection, all zooplankton samples were transferred to 250-mL sample bottles and preserved with 3 mL of 5% buffered formalin per 100 mL of sample.

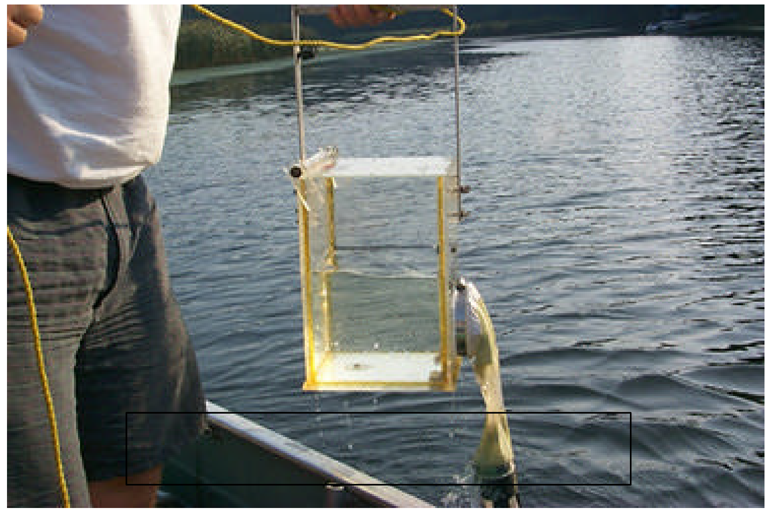

Figure 2. Schindler Trap employed for zooplankton collections

Adult Crustacea and most Rotifera were identified to species using Edmondson (1963), Balcer *et al*. (1984) and Stemberger (1979). Because of the small volume collected, each sample was entirely enumerated. Aliquots of each sample were poured into sedimentation chambers and allowed to settle for at least two hours per centimeter of sample in the sedimentation chamber. Enumeration was accomplished with a Wild-Heerbrugg inverted microscope at 100x magnification.

Quality Control

Chemistry: The Water Chemistry Laboratory at SUNY Brockport is State and Nationally certified through the New York State Department of Health's Environmental Laboratory Approval Program (ELAP - # 11439) and the National Environmental Laboratory Accreditation Conference (EPA Lab Code NY 01449). These programs include bi-annual proficiency audits, annual inspections and good laboratory practices documentation of all samples, reagents and equipment. Results of the semi-annual New

York State Environmental Assurance Program non-potable Water Chemistry Test are presented in Appendix 2.

Phytoplankton and zooplankton: Replicate identifications and counts were made on every 3rd phytoplankton and every 9th zooplankton sample to determine enumeration precision within a Division/Phylum of phytoplankton and zooplankton and to establish consistency of identification. Analytical precision goals for enumerators were based on the Relative Percent Deviation (RPD = ((larger count-smaller count)/average)x100) (Csuros 1994). For example, the precision goal for replicated Bacillariophyta counts is ± 15%. Values outside this goal were rejected and the samples recounted unless a clear explanation was available: e.g., very low abundance of forms in any one division. Precision goals for plankton were achieved and are presented in Appendix 1.

Results and Discussion

Discussion: The collection of plankton community structure data focused on the Area of Concern as designed and delineated in the workplan. To the extent possible, sample conditions and the time of year were conducted to be similar to that of the control / reference sites sampling previously performed. The reference sites were selected to have useful data and be representative of comparable physical and chemical characteristics of desired healthy and sufficiently unimpacted conditions. As noted in the Sample Design and Rationale section under Methods above, by applying the known and desired results of the control / reference sites, the Principle Investigator was able to maximize the collection of data on the Eighteenmile Creek study area. This plankton study therefore benefited by making the most efficient and effective use of existing plankton study data from the selected control / reference sites. Bioassays were not a part of this plankton study and according to the IJC delisting criteria are recommended in the absence of community structure data or as follow-up to a known plankton impairment that may have a toxic cause.

Reaching a determination on whether the plankton community in the Eighteenmile Creek Area of Concern (AOC) is impaired or not was made based on data assessment and comparison to the control / reference sites. Typically, data on upstream unimpacted sites or historical data from the study area site are used as controls to determine and assess potential impacted areas. However, upstream Eighteenmile Creek segments were determined to be unsuitable as a control site because of the potential influence of contamination (based on personal communication with R. Townsend, NYSDEC, the study workplan, and known upstream contaminated sediments). In addition, historical plankton data for this area are not known to exist. Thus, a traditional approach was not possible. This issue was addressed by acknowledging that the best available databases (i.e., comparable reference site selection from the standpoint of habitat type, discharge, land use, etc., and the fact that plankton data exists) have been utilized. The selection of representative comparative sites in this study was based on the need to have data from an unimpacted water body segment of similar characteristics to the lower Eighteenmile Creek Area of Concern: thus the use of pre-selected, previously studied areas as sites for comparative purposes. In this limited funded study, the collection of sampling data has focused on the Area of Concern to best document the plankton community for the assessment of any use impairment in the Eighteenmile Creek Remedial Action Plan.

By comparison of phytoplankton and zooplankton abundance (degree of presence) and composition and through indices of community properties of several different riverine and aquatic habitats with different levels of human impact, this study is able to provide some insight on environmental health impairments to the plankton community of the Eighteenmile Creek Area of Concern. In comparison, the control / reference sites data range from essentially the unimpacted conditions indicated at Yanty Creek Park in Hamlin Beach State Park and Braddock Bay (Makarewicz *et al*. 2000) to the data indicating affected conditions in Lake Ontario (Makarewicz 1993) and in the Area of Concern at the Oswego River (Makarewicz 1985 and 1987).

Braddock Bay is on the south shore of Lake Ontario and has one of the largest wetland complexes west of Oswego, New York. This wetland complex and streams are believed to be minimally affected by pollution. Salmon Creek and Buttonwood Creeks are two small streams that drain into the Braddock Bay wetland complex whose land use are a mix of rural, suburban and a declining agricultural component. Portions of the Braddock Bay area is a NYS Wildlife Management area. Zooplankton data collected with a Schindler Trap and a specially designed device for sampling emergent vegetation are available from several habitats (emergent and submersed vegetation, open water and creek) in 1997 (Weaver 1998).

Yanty Creek is located in the Hamlin Beach State Park area and drains a watershed that is in agriculture and partially forested. Both phytoplankton and zooplankton samples were taken at several times during the year. Zooplankton were taken with a Likens-Gilbert filter (35-µm mesh net) (Likens and Gilbert 1970) while phytoplankton sampling and plankton enumeration were the same method (Makarewicz *et al*. 2000) employed in this study. Both the Yanty Creek and Braddock Bay sites are believed to be relatively unimpacted by excessive nutrient and soil loading from the watershed.

The Oswego River and Harbor is one of the 42 remaining Areas of Concern designated in the Great Lakes Basin and is located north of Syracuse where the 5,100 square miles Oswego River drainage basin enters Lake Ontario. An Area of Concern is a place where significant pollution problems have been identified as impairing the beneficial uses of the water body. Impairments include restrictions of fish and wildlife consumption, degradation of fish and wildlife populations and habitat, and eutrophication of the harbor. Historically, municipal sewage discharges, combined sewer overflows, and agricultural runoff in the basin discharged excessive nutrients into the waters, causing nuisance plant growth or eutrophication of the embayment. Pollutants of concern identified in the Remedial Action Plan for ~~in~~ the Oswego AOC are PCBs, dioxin, phosphorus, mercury, mirex, photomirex, and octachlorostyrene. Sediments contain moderately polluted levels of phosphorus. Phytoplankton samples were taken and counted by the settling chamber method (Makarewicz 1985, 1987).

Lake Ontario samples are from a nearshore (30-m depth) and offshore site (122m). Both stations are located due north of Hamlin Beach State Park. Phytoplankton and zooplankton sampling and enumeration were by similar techniques as the Eighteenmile Creek study. Although the offshore waters of Lake Ontario have improved dramatically in the past decade, it is not clear what the current status of the nearshore waters are (Makarewicz 2001).

Chemistry: Results are presented in **Table 1**. The study site was oxygenated, had relatively low levels of chlorophyll, but total phosphorus and soluble reactive phosphorus levels were high compared to the open waters of Lake Ontario. Dissolved oxygen levels were 1 (July) to 2 mg/L (August) lower upstream at site 2 than at site 1.

Phytoplankton (Tables 2 and 4): Fifty-nine species of phytoplankton were identified at both sites in Eighteenmile Creek during the study period. The Divisions Bacillariophyta, the diatoms (16 species), and Chlorophyta, the green algae (26 species), were the most diverse phyla, but the blue-green algae (Division Cyanophyta) were the dominant group of phytoplankton accounting for over 85% (range 62 to 92%) of total phytoplankton abundance at each site during each season sampled (Table 4). Phytoplankton abundance ranged from 9,547 to 36,157 cells/mL (Table 2). Average cell abundance for the two sites sampled was highest in June (27,364 cells/mL) and lowest in August (11,768 cells/mL). Average cell abundance for the study period was highest at Site 1, closer to Lake Ontario, than at Site 2 in June and July. In August, this was reversed with the upstream Site 2 sample higher in abundance than the Site 1 samples (Table 4).

In June and July, phytoplankton taxa were evenly represented at both sites (evenness range = 0.405 to 0.447) with a somewhat variable species richness (range = 19-42 species) (Table 4). Although species richness remained high (27 to 30), dominance in August was concentrated in fewer taxa at both sites (evenness range: 0.319 to 0.389). In general, non-motile blue-green algae and *Synechococcus* sp. were the dominant taxa observed (Table 2). *Cryptomonas erosa* and *Rhodomonas minuta* were the dominant Cryptophyta throughout the sampling period. *Cyclostephanos invisitatus*, a diatom, and

Stichococcus sp., a green alga, were also prevalent during the study period. The chrysophyte *Synura* sp. was also prevalent at both sites in June (Table 2). No other species was dominant or prevalent in June, July and August (Table 2).

A comparison of phytoplankton from Eighteenmile Creek to a Lake Ontario nearshore and offshore site due north of Hamlin Beach State Park (Makarewicz 1985, 1987) indicates a lack of similarity between these two communities (Table 4). This is not surprising in that Eighteenmile Creek represents a small riverine habitat with seasonal high flows compared to the lentic environment of a large Great Lake. Compared to Lake Ontario (evenness = 0.64 to 0.76), dominance of taxa is concentrated (i.e., not evenly distributed) in Eighteenmile Creek (evenness = 0.32 to 0.44), while abundance is much higher at Eighteenmile Creek. For example, August average abundance in Eighteenmile creek is greater than 10,000 cells/mL compared to less than 2,000 cells/mL in the nearshore and offshore of Lake Ontario (Table 4). The higher abundance at Eighteenmile Creek suggests higher productivity at these sites.

Comparison of Eighteenmile Creek with other riverine habitats within the watershed of Lake Ontario indicates a great deal of similarity in abundance, species composition and other community indices. In August, evenness ranges from 0.31 in the Oswego River to 0.46 in Yanty Creek; evenness at Eighteenmile Creek lies between these two (Table 4). Similarly, abundance in August at Eighteenmile Creek (9,547 to 13,957 cells/mL), Yanty Creek (15,094 cells/mL) and the Oswego River (26,863 cells/mL) are probably not significantly different due to the high variability common to phytoplankton enumeration techniques. Species richness is very high at Oswego River compared to other creek sites in August. This may reflect the location of sampling at Oswego, which may represent a mix of river, harbor and lake phytoplankton communities. Similarly, Yanty Creek abundance is much higher than that of Eighteenmile Creek in June but not in August. However, species compositions were similar in June; that is, cyanopthytes were clearly dominant at all riverine habitats in both June and August.

Zooplankton (Tables 3 and 5): Thirty-eight species of zooplankton were identified in

Eighteenmile Creek with the Rotifera contributing the largest number of species (23). Average zooplankton abundance ranged from a low of 5,370 individuals/m^3 to a high of 30,238 individuals/m^3 (Table 3). Seasonally, average zooplankton abundance was always higher at Site 2 (average = 23,607/m^3) upstream from Lake Ontario, compared to Site 1 (16,385/m^3) (Table 5). Species richness (number of taxa) was similar at both sites with number of taxa being slightly higher in August compared to June and July (Table 5). Taxa were evenly represented at both sites 1 and 2 during August (evenness range: 0.70 - 0.75) compared to June (evenness range: 0.31-0.36) and July (evenness range: 0.31-0.32), when the zooplankton community was dominated by a few species. The June zooplankton community was dominated by the veliger stage of *Dreissena* (75.0% of total abundance) and the nauplius stage of the Copepoda (14.1% of the total abundance). In July, species dominance was concentrated in one cladoceran species *Bosmina longirostris* (79.4% of total abundance, Table 3). By the August sampling, no single species dominated; that is, species abundance was evenly distributed within the zooplankton community (Table 3). In August at Site 2, cladoceran species associated with wetlands, *Pleuroxus procurvus* and *Graptolebris testestudinaria*, became more prevalent in the water column. Once again, *Bosmina longirostris* was prevalent followed by the rotifer *Polyarthra major* (Table 3).

A comparison of the zooplankton communities from various creeks and habitats associated with Lake Ontario with Eighteenmile Creek suggests a strong degree of similarity in some of the communities during August (Table 5). For example, evenness is remarkably similar for Buttonwood Creek, Salmon Creek, Lake Ontario, Yanty Creek (submergent vegetation and Creek), and submergent vegetation of Braddock Bay. August species richness (S.R.), that is the number of species, was significantly higher at both sites in Eighteenmile Creek (S.R. = Site 1: 23; Site 2: 24) than in various habitats (creek [11], open water [10], submergent vegetation [9]) in Yanty Creek and Sites 1 and 2 in July at Eighteenmile Creek, significantly lower than the submergent vegetation in Braddock Bay (S.R.= 46) but similar to Buttonwood (S.R.= 23) and Salmon Creeks (S.R.=26) (Table 5). However, summer abundance (July and August, 5-30 organisms per liter) of the Eighteenmile Creek zooplankton community is lower than in Buttonwood, Salmon and Yanty Creeks, but in the same order of magnitude (Table 5).

During June, species richness, evenness and abundance were lower at Eighteenmile Creek compared to Buttonwood and Salmon Creek and in the submergent vegetation of Braddock Bay (Table 5) and somewhat similar to Yanty Creek (Table 5). For example, abundance and evenness at Eighteenmile, Yanty Creek and the open water pond at Yanty Creek are similar. However, abundance and evenness in the submergent vegetation of Yanty Creek is comparatively high compared to both sites at Eighteenmile Creek. These differences at Salmon, Buttonwood and submerged vegetation at Yanty Creek probably reflect the presence of vegetation at one location and hydrological considerations at the others.

In June at both Yanty Creek and Eighteenmile, samples were taken upstream in an area heavily influenced by high water flows from the watershed. Samples at the Buttonwood and Salmon Creek sites were taken at the mouth of the creeks at their entrance to Braddock Bay and were not as influenced by high water flows in June. That is, the June samples in Yanty and Eighteenmile Creek were from areas that would be best characterized as moderately flowing water and clearly a creek environment, while the Buttonwood and Salmon Creeks samples were in an area of slower flowing water within the mixing zone of Braddock Bay. Because zooplankton are generally "at the mercy of the currents", high flow of water in a creek would simply carry zooplankton downstream into an area of slower water movement. Because of this flow, abundance would tend to be lower because of washout.

Considering species richness, the zooplankton community in the "open water", the submergent vegetation, and the Creek habitats at Yanty Creek were relatively impoverished compared to sites in Eighteenmile Creek, submergent vegetation in Braddock Bay and compared to the open waters of Lake Ontario (Table 5). Makarewicz *et al*. (2000) attributed this result to the low water levels in the Yanty Creek ponds and the almost complete lack of vegetation or physical structure at these Yanty Creek habitats. Depths at the Yanty Creek pond sites never exceeded 0.5 meters and were often lower. Except for areas sampled in submerged vegetation, depths at other locations generally exceeded 2m.

Results: To answer the question: "Are Plankton Communities in the Eighteenmile

Creek Area of Concern Impacted?", we must weigh any "individual indications of impairment" against an overall assessment of impairment and derive a "determination of significance" based on the observed data and by comparison to the control / reference plankton communities. Three observations of such individual indications of impairment are noted below that suggest that the plankton community of Eighteenmile Creek is impacted and subsequently impaired. However, with further assessment and comparison of the sample data and the location of sites, and with sample timing considerations, the overall indication is otherwise.

1. Phytoplankton abundance at unpolluted Yanty Creek is at least twice as high than Eighteenmile Creek in June. However, since zooplankton abundance at the Eighteenmile and Yanty Creek sites are similar in June, the low abundance of phytoplankton at Eighteenmile Creek may reflect a timing issue in sampling. Samples from Eighteenmile Creek were taken in late June (25 June), while samples taken at Yanty Creek were taken in early June (8 June). It is possible that the spring phytoplankton bloom was observed in Yanty Creek and missed at Eighteenmile Creek where the June samples were taken almost three weeks later on 25 June.

2. Phytoplankton species richness at the historically eutrophic impacted site, the Oswego River, in August is almost three times as high as species richness at Eighteenmile Creek (107 vs ~30). As pointed out earlier however, the samples from the Oswego River represent a mix of harbor, lake and river samples. Thus species from three different habitats may be present. Since species richness in the unpolluted Yanty Creek and Eighteenmile Creek are similar (32 to ~30) for August, the difference in species richness observed between the Oswego site and Eighteenmile Creek site appears to be an artifact of the location of sampling sites and excess nutrients at the Oswego River site.

3. Zooplankton abundance at Eighteenmile Creek in the late summer (August) appear to be somewhat lower than other Lake Ontario habitats in the summer. However, the higher abundances at the same Eighteenmile Creek sites in July are in the same order of magnitude as other Lake Ontario locations and suggest that

the differences observed in August may simply be related to differences in timing of samples. Zooplankton and phytoplankton characteristically have dramatic population pulses or blooms during a year. Only a more intense seasonal sampling pattern could answer this question. The fact that abundance are high later in July argue for an unimpacted zooplankton community.

In conclusion, the preponderance of the evidence suggests that plankton community of Eighteenmile Creek is not significantly impacted nor impaired. The summer zooplankton community of Eighteenmile Creek has a similar or higher species richness, a remarkably similar measure of dominance (i.e., evenness) and in July a comparable abundance to the relatively pollution-free reference sites at Yanty, Buttonwood and Salmon Creeks. Similarly in June, zooplankton abundance, species richness, and evenness were between values observed at the reference sites at Yanty, Buttonwood and Salmon Creeks. Further support of no significant impact or impairment is provided by the phytoplankton data. Species richness, evenness, abundance, and species composition of phytoplankton are similar for Eighteenmile Creek, the unpolluted reference site at Yanty Creek and for the AOC at the Oswego River and Harbor for the months of June and August.

Literature Cited

APHA. 1998. Standard Methods for the Examination of Waste and Wastewater. American Public Health Association, 20th ed. New York, NY. 1134p.

Balcer. M.D. et al. 1984. Zooplankton of the Great Lakes: A Guide to the Identification and Ecology of the Common Crustacean Species. Univ. of Wisconsin Press. 174pp.

Csuros, M. 1994. Environmental Sampling, and Analysis for Technicians. Boca Raton, Florida, Lewis Publishers.

Edmondson, W.T.1963. Freshwater Biology. John Wiley & Sons, Inc., New York.

EPA. 1979. Methods for Chemical Analysis of Water and Wastes. Environmental Monitoring and Support Laboratory. Environmental Protection Agency. Cincinnati, Ohio. EPA-600/4-79-020.

Johannsson, O.E. and E.S. Millard. 1998. Lake Erie Lakewide Management Plan (LaMP) Technical Report Series. Impairment Assessment of Beneficial Use: Degradation of Phytoplankton and Zooplankton Populations. Great Lakes Laboratory for Fisheries and

Aquatic Sciences. Fisheries and Oceans Canada. Burlington. Technical Report #13 prepared for the Beneficial Uses Subcommittee.

Lampman, G.G. and J.C. Makarewicz. 1999. The phytoplankton zooplankton link in the Lake Ontario food web. J. Great Lakes Res. 25:239-249.

Likens, G.E. and J. Gilbert. 1970. Notes on quantitative sampling of natural populations of planktonic rotifers. Limnol. Oceanogr. 15: 816-820.

Makarewicz, J.C. 1985. Phytoplankton composition, abundance and Distribution: Oswego River and Harbor and Niagara River Plume. IN. Limnology and phytoplankton structure in nearshore areas of Lake Ontario. Great Lakes National Program Office. EPS-905/3-85-003.

Makarewicz, J.C. 1987. Phytoplankton composition, abundance and distribution: nearshore of Lake Ontario and Oswego River and Harbor. J. Great Lakes Res. 13:55-64.

Makarewicz, J.C. 1993. Phytoplankton as indicators of environmental health: The Lake Ontario example. Verh. Internat. Verein Limnol. 25:363-365.

Makarewicz, J.C. J. M. Haynes, R. C. Dilcher, J. C. Hunter, C. J. Norment, and T. Lewis. 2000. Biological Survey of Yanty Creek Marsh at Hamlin Beach State Park. New York Office of Parks, Recreation and Historic Preservation Western District, Genesee Region, One Letchworth State Park, Castile, NY 14427-1124.

Makarewicz, J.C. 2001. New York's North Coast: A Troubled Coastline. Lake Ontario Bay Initiative. Finger Lakes - Lake Ontario Watershed Protection Alliance (FL-OWPA).

Schindler, D. 1969. Two useful devices for vertical plankton and water sampling. J. Fish. Res. Bd. Canada. 26: 1948-1955.

Stemberger, R.S.1979. A Guide to Rotifers of the Laurentian Great Lakes. U.S. Environmental Protection Agency, Rept. No. EPA 600/4-79-021.

Utermohl, H. 1958. Zur Vervollkommung der quantitativen phytoplankton-methodik. Int. Ver. Limnol. 9: 1-38.

Wetzel, R.G. and G.E. Likens. 1994. Limnological Analyses. W.B. Saunders Co., Philadephia, PA.

Weaver, K. 1998. Zooplankton beta diversity within a Great Lakes coastal M.S. Thesis. Available from Drake Library, SUNY Brockport, Brockport, NY.

List of Tables and Appendices

Tables

Table 1. Physical and chemical measurements for two sites on Eighteenmile Creek on 25 July and 31 August 2000.

Date	Units	Site 1 7/25/2000	Site 2 7/25/2000	Site 1 8/31/2000	Site 2 8/31/2000
Total phosphorus	(µg P/L)	115.8	115.8	127.6	113.6
Nitrate	(mg N/L)	0.98	1.11	0.73	0.82
Soluble reactive phosphorus	(µg P/L)	100.6	101.7	113.7	103.9
Total suspended solids	(mg/L)	1.9	1.1	0.4	1.9
Chlorphyll *a*	(µg/L)	1.1	1.1	0.9	1.5
Turbidity	(NTU)	1.23	1.03	0.94	1.15
pH		7.89	7.67	7.12	6.89
Temperature	(°C)	22.4	21.4	23.8	24.2
Secchi Disk	(m)	1.8	1.6	3.7	3.9
Dissolved Oxygen	(mg/L)	7.04	6.09	7.81	5.83
Specific Conductance	(µmhos/cm)	634	629	877	878

Table 2. Phytoplankton abundance (cells/mL) in Eighteenmile Creek, Lake Ontario, 2000. GALD=Greatest Axial Linear Dimension.

	GALD (um)	22-Jun Site 1	26-Jul Site 1	31-Aug Site 1	22-Jun Site 2	26-Jul Site 2	31-Aug Site 2
Cyanophyta							
Aphanocapsa elachista	11	52.1	0.0	0.0	0.0	0.0	0.0
Aphanocapsa delicatissima	11	229.2	0.0	0.0	328.2	20.8	0.0
Merismopedia tenuissima	6.6	20.8	0.0	41.7	32.7	0.0	0.0
Non-motile blue-greens (<1.1 um)	0.9	10298.8	7724.1	3862.0	8,438.1	3862.0	2574.7
Non-motile blue-greens (>1 um)	1.8	13517.2	0	31.3	7,653.1	1287.4	643.7
Oscillatoria limnetica	35.2	83.3	0.0	0.0	36.8	0.0	0.0
Synechococcus sp. 1	1.8	7724.1	7724.1	3862.0	5692.1	6436.7	9655.1
Chlorophyta							
Ankistrodesmus convolutus	22	5.2	0.0	5.2	0.0	0.0	0.0
Ankistrodesmus falcatus	36.9	107.2	0.0	0.0	84.0	0.0	0.0
Apodochloris sp.	19.8	0.0	0.0	0.0	24.6	0.0	5.2
Chlamydomonas globosa	4.4	10.4	10.4	15.6	10.0	31.3	10.4
Chlamydomonas incerta	9.9	5.2	0.0	0.0	0.0	0.0	0.0
Chlamydomonas platystigma	8.8	5.2	0.0	15.6	19.4	26.0	10.4
Chlamydomonas sp.	17.6	0.0	0.0	0.0	0.0	0.0	5.2
Chloromonas chlorogoniopsis	7.3	0.0	239.6	83.3	62.0	88.5	72.9
Dictyosphaerium pulchellum	11	20.8	0.0	0.0	12.3	0.0	0.0
Micractinium pusillum	22	10.4	0.0	0.0	18.7	0.0	0.0
Monoraphidium capricornutum	3.3	15.6	20.8	0.0	14.8	0.0	0.0
Non-motile Chlorococcales-spherical	4.4	36.5	31.3	15.6	47.7	5.2	5.2
Oocystis parva	9.9	31.3	0.0	0.0	38.3	0.0	5.2
Pandorina morum	33	41.7	280.6	0.0	67.9	0.0	0.0
Scenedesmus bijuga	8.8	10.4	0.0	0.0	0.0	10.4	0.0
Scenedesmus dimorphus	14.9	26.0	0.0	0.0	10.8	0.0	0.0
Scenedesmus dispar	11	20.8	20.8	0.0	14.8	0.0	0.0
Schroederia judayi	22	5.2	0.0	5.2	0.0	0.0	0.0
Scenedesmus opoliensis v. carinatus	16.5	10.4	0.0	0.0	0.0	0.0	0.0
Scenedesmus quadricauda	23.3	87.5	0.0	0.0	104.0	20.8	0.0
Scenedesmus quadricauda v. longispina	29.3	125.0	0.0	0.0	78.4	0.0	0.0
Scenedesmus serratus	8.8	0.0	20.8	0.0	0.0	0.0	0.0
Selenastrum minutum	8.8	0.0	0.0	5.2	0.0	0.0	5.2
Sphaerellopsis sp.	17.6	5.2	0.0	0.0	0.0	0.0	0.0
Stichococcus sp.	3.3	1734.5	99.0	0.0	689.2	62.5	36.5
Stigeoclonium sp.	242	0.0	0.0	0.0	0.0	385.8	0.0
Euglenophyta							
Phacus sp.	17.6	5.2	0.0	0.0	0.0	0.0	0.0
Cryptophyta							
Cryptomonas erosa	14.7	36.5	31.3	5.2	5.2	5.2	10.4
Cryptomonas ovata	17.6	0	0.0	5.2	0.0	0.0	0.0
Cryptomonas rostratiformis	24.2	5.2	10.4	5.2	0.0	10.4	5.2
Rhodomonas minuta v.nannoplanctica	8.3	156.3	234.4	156.3	121.3	114.6	166.7
Bacillariophyta							
Achnanthes lanceolata sp. frequentissima	9.9	0.0	0.0	0.0	0.0	0.0	5.2
Achnanthes minutissima	11	0.0	0.0	15.6	0.0	0.0	20.8
Amphora pediculus	8.8	0.0	0.0	5.2	0.0	0.0	0.0
Bacillaria paradoxa	66	0.0	0.0	5.2	0.0	0.0	0.0
Cocconeis placentula v. lineata	23.9	20.8	15.6	31.3	10.3	10.4	36.5
Cyclostephanos invisitatus	4.4	208.3	182.3	67.7	86.0	203.1	15.6
Fragilaria pinnata v. pinnata	8.8	10.4	0.0	0.0	0.0	0.0	0.0
Gomphonema olivaceum	24.2	0.0	0.0	5.2	0.0	5.2	15.6
Gomphonema parvulum	15.8	0.0	0.0	0.0	0.0	15.6	0.0
Navicula sp.	17.6	5.2	0.0	0.0	34.0	0.0	0.0
Navicula lanceolata	8.8	0.0	0.0	5.2	5.2	5.2	5.2
Nitzschia gracilis	55	5.2	0.0	0.0	0.0	0.0	0.0

Table 2. (Continued).

	GALD (um)	22-Jun Site 1	26-Jul Site 1	31-Aug Site 1	22-Jun Site 2	26-Jul Site 2	31-Aug Site 2
Nitzschia inconspicua	6.6	5.2	0.0	0.0	0.0	0.0	0.0
Rhoicosphenia curvata	13.2	0.0	0.0	5.2	0.0	10.4	0.0
Stephanodiscus hantzschii	11	15.6	0.0	10.4	5.2	10.4	10.4
Synedra tenera	99	0.0	17.5	0.0	0.0	0.0	0.0
Pyrrhophyta							
Gymnodinium sp. 3	8.8	0.0	0.0	5.2	0.0	0.0	0.0
Chrysophyta							
Ochromonas sp.	8.8	0.0	0.0	5.2	0.0	0.0	0.0
Synura sp. (single)	16.5	234.4	0.0	0.0	329.5	0.0	0.0
Uroglena sp. (single)	4.4	36.5	31.3	15.6	0.0	0.0	0.0
Unidentified							
Misc. microflagellate	2.2	1145.9	625.0	1250.1	1436.7	416.7	625.0
Total		**36157**	**17345**	**9547**	**18570**	**13076**	**13957**

Table 3. Zooplankton composition and abundance (#/m^3) at Eighteenmile Creek, Lake Ontario, New York, 2000. Values are average of three samples for each site.

	22-Jun SITE 1	25-Jul SITE 1	31-Aug SITE 1	22-Jun SITE 2	25-Jul SITE 2	31-Aug SITE 2
Arthropoda						
Cladocera						
Bosmina longirostris	52.9	20661.4	264.6	185.2	24021.2	1349.2
Ceriodaphnia sp.	0.0	264.6	0.0	0.0	291.0	0.0
Ceriodaphnia reticulata?	0.0	0.0	26.5	0.0	0.0	0.0
Chydorus sphaericus	79.4	0.0	291.0	79.4	0.0	105.8
Eurycercus lamellatus	26.5	0.0	0.0	0.0	0.0	0.0
Graptolebris testestudinaria	0.0	0.0	0.0	0.0	0.0	238.1
Daphnia retrocurva	0.0	317.5	0.0	0.0	1931.2	0.0
Holopedium gibberrum	26.5	0.0	0.0	0.0	0.0	0.0
Pleuroxus procurvus	0.0	0.0	291.0	0.0	0.0	1851.9
Total Cladocera	185.2	21243.4	873.0	264.6	26243.4	3545.0
Copepoda						
Nauplius Stage	2486.8	3941.8	2513.2	4206.3	1613.8	1957.7
Calanoida						
Copepodite Stage	0.0	0.0	26.5	0.0	0.0	26.5
Diaptomus sp.	0.0	0.0	0.0	0.0	0.0	26.5
Total Calanoida	0.0	0.0	26.5	0.0	0.0	52.9
Cyclopoida						
Copepodite Stage	370.4	158.7	132.3	185.2	634.9	476.2
Cyclops vernalis	26.5	26.5	0.0	26.5	264.6	79.4
Tropocyclops prasinus	26.5	0.0	26.5	26.5	0.0	132.3
Cyclops sp. #2	0.0	0.0	0.0	0.0	0.0	0.0
Total Cyclopoida	423.3	185.2	158.7	238.1	899.5	687.8
Harpacticoida						
Canthocampus sp.	26.5	0.0	26.5	26.5	0.0	0.0
Total Harpacticoida	26.5	0.0	26.5	26.5	0.0	0.0
Rotifera						
Ascomorpha saltans	423.3	52.9	0.0	767.2	0.0	0.0
Asplanchna sp.	0.0	0.0	26.5	52.9	52.9	0.0
Brachionus angularis	0.0	26.5	158.7	79.4	26.5	0.0
Brachionus quadridentatus	158.7	0.0	0.0	158.7	0.0	0.0
Conochilus unicornis	0.0	0.0	0.0	0.0	0.0	52.9
Filinia longiseta	0.0	26.5	0.0	26.5	26.5	26.5
Gastropus sp.	0.0	0.0	79.4	0.0	0.0	26.5
Keratella cochlearis	661.4	52.9	264.6	767.2	238.1	529.1
Keratella quadrata	211.6	582.0	52.9	0.0	0.0	26.5
Keratella taurocephala	26.5	0.0	0.0	26.5	0.0	0.0
Lepadella ovalis	0.0	0.0	0.0	0.0	0.0	105.8
Notholca squamula?	52.9	0.0	52.9	79.4	52.9	105.8
Kellicottia bostonensis	1.3	0.0	0.0	0.0	0.0	0.0
Kellicottia longispina	26.5	132.3	238.1	105.8	52.9	264.6
Lecane sp.	52.9	0.0	132.3	0.0	105.8	1084.7
Lepadella ovalis	0.0	0.0	0.0	26.5	0.0	0.0
Ploesoma sp.	0.0	0.0	158.7	0.0	0.0	0.0
Polyarthra vulgaris	26.5	238.1	238.1	291.0	396.8	502.6
Polyarthra major	0.0	0.0	158.7	0.0	0.0	1798.9
Polyarthra remata	0.0	52.9	105.8	0.0	0.0	52.9
Pompholyx sp.	0.0	0.0	79.4	0.0	0.0	0.0
Rotatoria rotatoria	0.0	0.0	0.0	0.0	0.0	26.5
Trichocerca sp.	0.0	0.0	26.5	0.0	0.0	26.5
Total Rotifera	1641.5	1164.0	1772.5	2381.0	952.4	4629.6
Mollusca						
Veliger of Dreissena sp.	12460.3	26.5	0.0	23121.7	0.0	0.0
Total Mollusca	12460.3	26.5	0.0	23121.7	0.0	0.0
Total Abundance	17223.6	26560.8	5370.4	30238.1	29709.0	10873.0
Total Abundance (minus Dreissena)	4763.2	26534.4	5370.4	7116.4	29709.0	10873.0

Table 4. Comparison of phytoplankton abundance and community indices between Eighteenmile Creek, Yanty Creek, NY, Oswego River and Lake Ontario in June, July and August. Abundances are in number per mL. YC=Yanty Creek, OR=Oswego River, OH=Oswego Harbor, Hamlin= nearshore region of Lake Ontario, and LO (Sta 41) = pelagic epilimnetic of Lake Ontario. SR=Species richness. ND=No Data. Counts of *Anacystis marina* are removed from the Oswego samples. These bacteria are not generally included in traditional plankton counts. Species richness is not included for the nearshore Lake Ontario samples from Hamlin. Organisms were identified to genus only. Lake Ontario data are unpublished data and from Makarewicz (1985, 1987, 1993). Yanty Creek data from Makarewicz *et al*. (2000). Oswego River and Harbor data from Makarewicz (1981, 1985, and 1987).

	Eighteenmile Creek		**Yanty Creek**	**Oswego River**	**Inner Pond**	**Outer Pond**	**Lake Ontario Nearshore**	**Lake Ontario Offshore**	**Oswego Harbor (Site 7)**
JUNE	**Site 1**	**Site 2**	**YC**	**OR**	**YC**	**YC**	**Hamlin**	**LO (Sta41)**	**OH**
Evenness	.422	ND	.576	ND	.565	.493	.639	ND	ND
S.R.	42	31	34	ND	33	35	ND	ND	ND
Abundance	36,162	18,570	62,845	ND	42,249	59,282	3061	ND	ND
BAC	302	141	11864	ND	4503	7700	1053	ND	ND
CHR	271	329	1189	ND	289	713	0	ND	ND
CHL	2315	1297	5872	ND	3430	3143	130	ND	ND
CRY	198	127	1023	ND	1338	1209	835	ND	ND
CYA	31926	15237	39435	ND	31107	44520	1042	ND	ND
EUG	5	0	73	ND	36	73	0	ND	ND
MIS	1146	1434	3386	ND	2865	1563	0	ND	ND
PYR	0	5.2	0	ND	0	0	0.7	ND	ND
JULY	**Site 1**	**Site 2**							
Evenness	.405	.447							
S.R.	19	24							
Abundance	17,345	13,076							
BAC	242	276							
CHR	31	0							
CHL	723	631							
CRY	276	130							
CYA	15448	11607							
EUG	0	0							
MIS	625	417							
PYR	0	0							
AUGUST	**Site 1**	**Site 2**	**YC**	**OR**	**YC**	**YC**	**Hamlin**	**LO(Sta41)**	**OH**
Evenness	.389	.319	.460	.307	.251	.207	.758	.731	.417
S.R.	30	27	32	107	23	25	ND	52	116
Abundance	9,547	13,957	15,094	26,863	2,659	66,332	1459	1814	39781
BAC	156	141	266	6349	83	115	65	32	6061
CHR	21	0	0	66	0	0	0	540	319
CHL	146	167	296	8182	49	200	417	736	6973
CRY	172	182	1314	696	44	970	426	532	1047
CYA	7797	12874	9611	16,478	2001	63798	548	450	23685
EUG	0	0	7	1015	0	0	0	0	0
MIS	1250	625	3559	368	446	1215	0	0	1514
PYR	5	0	35	74	0	0	3	8	106
COL	0	0	0	**41**	**0**	0	0	16	82

Table 5. Comparison of zooplankton abundance and community indices between Eighteenmile Creek, creeks of Braddock Bay, Yanty Creek marsh and Lake Ontario, NY in June and August. Abundances are in number per liter. JS1 and JS1 = July, Eighteenmile Creek, AS1 and AS2= August, Eighteenmile Creek, YC=Yanty Creek, BC=Buttonwood Creek at Braddock Bay, SC= Salmon Creek at Braddock Bay, Open water at Yanty Creek (YC) and Lake Ontario (LO). ND=No Data. Submergent vegetation represented samples taken from areas containing submergent vegetation. SR=Species richness. Total Abun= Total abundance. Braddock Bay data from Weaver (1998). Lake Ontario data from Lampman and Makarewicz (1999). Yanty Creek data from Makarewicz *et al*. (2000).

	Creeks							**Open Water**		**Submergent Vegetation**	
JUNE	**S1**	**S2**	**YC**	**BC**	**SC**			**YC**	**LO**	**YC**	**BB**
Evenness	0.36	0.31	0.26	0.62	0.59			0.89	ND	0.91	0.56
S.R.	20	19	3	25	29			14	ND	5	34
Abundance											
Cladocera	0.19	0.26	0.0	5.7	406.6			7.4	ND	4.7	260.7
Calanoida	0.0	0.0	0.0	0.03	9.6			2.0	ND	0.0	9.8
Cyclopoida	0.42	0.24	15.1	10.8	31.8			2.0	ND	47.0	16.6
Copepoda Nauplii	2.5	4.2	15.1	37.3	52.8			6.4	ND	18.1	45.1
Rotifera	1.6	2.4	1.0	155	905.6			24.1	ND	4.7	1012
Dreissena	12.5	23.1	0.0	0.0	0.0			0	ND	0	0
Total Abun	17.2	30.2	16.2	209.7	1407			39.8	ND	75.2	1345
SUMMER	**AS1**	**AS2**	**YC**	**BC**	**SC**	**JS1**	**JS2**	**YC**	**LO**	**YC**	**BB**
Evenness	0.70	0.75	0.61	0.62	0.51	0.31	0.32	0.51	0.73	0.92	0.65
S.R.	23	24	11	23	26	15	13	10	28	9	46
Abundance											
Cladocera	0.87	3.5	6.2	7.5	32.6	21.2	26.2	0.8	19.8	5.1	22.2
Calanoida	0.03	0.06	0.00	0.4	0.03	0	0	1.1	0.6	0	10.0
Cyclopoida	0.16	0.69	17.3	3.6	3.7	0.19	0.90	12.1	41.6	25.4	53.3
Copepoda Nauplii	2.5	2.0	60.8	10.9	16.3	3.9	1.6	72.4	52.3	10.2	84.6
Rotifera	1.8	4.6	24.9	17.9	7.6	1.2	0.95	23.5	146.2	35.6	234.8
Dreissena	0	0	0	0	0	<.03	0	0	0	0	0
Total Abun	5.4	10.9	109	50.5	67.4	26.5	29.7	110	261	190	170.1

Appendices

Appendix 1. Quality Control replicated counts for phytoplankton and zooplankton. Analytical precision goals were based on the Relative Percent Deviation (RPD = ((larger count-smaller count)/average)x100) (Csuros 1994, ARCS 1994). Starred items indicate precision goals greater than ± 15%. For the two cases where this occurred for zooplankton only a few organisms were identified and none in the replicate count. Because the site 2 August phytoplankton precision goal of ± 15% was violated as the Cyanophyta RPD was greater than 15%, the entire sample was recounted. These results are reported in this study.

Zooplankton

	26-Jul			31-Aug		
	SITE 1	SITE 1		SITE 2	SITE 2	
	Rep 1	Rep 2	RPD	Rep 1	Rep 2	RPD
Total Cladocera	21243	20255.0	4.8	3545	3667	3.4
Total Copepoda nauplius	3942	3861.0	2.1	1958	2110	7.5
Total Calanoida	0	0.0	0.0	53*	0	200.0
Total Cyclopoida	185	160.0	14.5	688	655	4.9
Total Harpacticoida	0	0.0	0.0	0	0	0.0
Total Rotifera	1164	1301.0	11.1	4630	4320	6.9
Total Mollusca (veliger)	27*	0.0	200.0	0	0	0

Phytoplankton

	July			August		
	Site 1	Site 1		Site 1	Site 1	RPD
	Rep 1	Rep 2	RPD	Rep 1	Rep 2	
Bacillariophyta	242	221	9.1	156	163	4.4
Chlorophyta	31*	0	200.0	21*	0	200.0
Chlorophyta	723	836	14.5	146	161	9.8
Cryptophyta	276	316	13.5	172	155	10.4
Cyanophyta	15448	14889	3.7	7797	8903	13.2
Euglenophyta	0	0	0.0	0	0	0.0
Pyrrhophyta	0	0	0.0	5*	0	200.0

Appendix 2. Results of the semi-annual New York State Environmental Laboratory Assurance Program (ELAP Lab # 11439, SUNY Brockport) Non-Potable Water Chemistry Proficiency Test, July 2000. Score Definition: Satisfactory, or Unsatisfactory.

WADSWORTH CENTER

NEW YORK STATE DEPARTMENT OF HEALTH

ENVIRONMENTAL LABORATORY APPROVAL PROGRAM

Proficiency Test Report

Lab 11439 SUNY BROCKPORT EPA Lab Id NY01449 Page 1 of 1

WATER LAB LENNON HALL

BROCKPORT, NY 14420

Shipment 233 Non Potable Water Chemistry

Shipment Date: 24-Jul-2000 Approval Category : **Non Potable Water**

Analyte	Sample ID	Result	Mean/Target	Satisfactory Limits	Method	Score
Sample: **Residue**						
Solids, Total Suspended 343 passed out of 361 reported results.	3302	64.5	59.9	49.8 - 70	SM18 2540D	Satisfactory
Sample: **Organic Nutrients**						
Kjeldahl Nitrogen, Total 131 passed out of 136 reported results.	3304	5.25	6.09	4.24 – 7.95	EPA 351.3	Satisfactory
Phosphorus, Total 144 passed out of 160 reported results.	3304	7.30	7.03	5.54 – 8.52	SM18 4500-PB,E	Satisfactory
Sample: **Inorganic Nutrients**						
Nitrate (as N) 123 passed out of 127 reported results.	3307	25.54	26	20.9 – 31.2	SM18 4500-NO3 F	Satisfactory
Orthophosphate (as P) 106 passed out of 116 reported results.	3307	2.74	2.74	2.32 – 3.16	SM18 4500-P F	Satisfactory
Sample: **Metals I and II**						
Sodium, Total 122 passed out of 142 reported results.	3311	27.52	24.8	22 – 27.6	ASTM D-1688-95 C	Satisfactory

Appendix 3. Phytoplankton species list with authorities.

Taxa	Division	Authority
Achnanthes lanceolata ssp. frequentissima	Bacillariophyta	Lange-Bertalot
Achnanthes minutissima	Bacillariophyta	Kützing
Amphora pediculus	Bacillariophyta	(Kützing) Grunow
Bacillaria paradoxa	Bacillariophyta	Gmelin
Cocconeis placentula v. lineata	Bacillariophyta	(Ehrenberg) Van Heurck
Cyclostephanos invisitatus	Bacillariophyta	(Hohn & Hel.) Ther., Stoerm. & Håkansson
Fragilaria pinnata v. pinnata	Bacillariophyta	Ehrenberg
Gomphonema olivaceum	Bacillariophyta	(Hornemann) de Brébisson
Gomphonema parvulum	Bacillariophyta	(Kützing) Kützing
Navicula lanceolata	Bacillariophyta	(Agardh) Ehrenberg
Navicula sp.	Bacillariophyta	Bory
Nitzschia gracilis	Bacillariophyta	Hantzsch
Nitzschia inconspicua	Bacillariophyta	Grunow
Nitzschia intermedia	Bacillariophyta	Hantzsch
Nitzschia palea	Bacillariophyta	(Kützing) W. Smith
Rhoicosphenia curvata	Bacillariophyta	(Kützing) Grunow
Stephanodiscus Hantzschii 22um	Bacillariophyta	Grunow
Stephanodiscus hantzschii 8-11um	Bacillariophyta	Grunow
Synedra tenera	Bacillariophyta	W. Smith
Ankistrodesmus convolutus	Chlorophyta	Corda
Ankistrodesmus falcatus	Chlorophyta	(Corda) Ralfs
Apodochloris sp.	Chlorophyta	Komárek
Chlamydomonas globosa	Chlorophyta	Snow
Chlamydomonas incerta	Chlorophyta	Pascher
Chlamydomonas platystigma	Chlorophyta	(Korshikoff) Pascher
Chlamydomonas sp.	Chlorophyta	Ehrenberg
Chloromonas chlorogoniopsis	Chlorophyta	Ettl
Cyst (Chlorophyte)	Chlorophyta	N/A
Dictyosphaerium pulchellum	Chlorophyta	Wood
Micractinium pusillum	Chlorophyta	Fresenius
Monoraphidium capricornutum	Chlorophyta	(Printz) Nygaard
Non-motile Chlorococcales-spherical	Chlorophyta	N/A
Oocystis parva	Chlorophyta	West & West
Pandorina morum	Chlorophyta	(Müller) Bory
Scenedesmus bijuga	Chlorophyta	(Turpin) Lagerheim
Scenedesmus dimorphus	Chlorophyta	(Turpin) Kützing
Scenedesmus dispar	Chlorophyta	(Brébisson) Rabenhorst
Scenedesmus opoliensis v. carinatus	Chlorophyta	Lemmermann
Scenedesmus quadricauda	Chlorophyta	(Turpin) de Brébisson
Scenedesmus quadricauda v. longispina	Chlorophyta	(Chodat) G.M. Smith
Scenedesmus serratus	Chlorophyta	(Corda) Bohlin

Schroederia judayi	Chlorophyta	G.M. Smith
Appendix 2. (Continued).		
Selenastrum minutum	Chlorophyta	(Nägeli) Collins
Sphaerellopsis sp.	Chlorophyta	Korschikov
Stichococcus sp.	Chlorophyta	Nägeli
Stigeoclonium sp.	Chlorophyta	Kützing
Gymnodinium sp. 3	Chrysophyta	Stein
Ochromonas sp.	Chrysophyta	Wyssotzki
Synura sp. (single)	Chrysophyta	Ehrenberg
Uroglena sp. (single)	Chrysophyta	Ehrenberg
Cryptomonas erosa	Cryptophyta	Ehrenberg
Cryptomonas ovata	Cryptophyta	Ehrenberg
Cryptomonas rostratiformis	Cryptophyta	Skuja
Rhodomonas minuta v. nannoplanctica	Cryptophyta	Skuja
Aphanocapsa delicatissima	Cyanophyta	West & West
Aphanocapsa elachista	Cyanophyta	West & West
Merismopedia tenuissima	Cyanophyta	Lemmermann
Non-motile blue-greens (<1.1 UM)	Cyanophyta	N/A
Non-motile blue-greens (>1 UM)	Cyanophyta	N/A
Oscillatoria limnetica	Cyanophyta	Lemmermann
Synechococcus sp. 1	Cyanophyta	(Nägeli) Elenkin
Phacus sp.	Euglenophyta	Dujardin
Misc. microflagellate	Miscellaneous	N/A

Appendix 4. Plankton Sampling Sites 1 and 2, Eighteenmile Creek, August, 2000. Site1 is in Olcott Harbor half way between roadway route 18 and where the jetty begins. Site 2 is in the middle of Eighteenmile Creek half way between Burt Dam and the mouth of the creek