Honeoye Lake Tributary Testing in 2003
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Introduction

Honeoye Lake has historically had high levels of rooted macrophytes and experienced algae blooms in late summer. In the summer of 2002, which was very hot and dry, the lake experienced severe blue-green algae blooms where algae densities reached levels never before observed in the lake. The northern end of the lake collected wind driven concentrations of algae cell masses and filamentous algae mats.

As a result of these severe conditions the Honeoye Valley Association (HVA) hired a consultant, Princeton Hydro, to evaluate the condition of Honeoye Lake and determine the technical feasibility of various lake restoration alternatives. Princeton Hydro will develop a *"Watershed Model"* that will be able to predict nutrient flow into the lake from all tributaries based on known sub-watershed boundaries, land cover (forest, farm, etc.), slope, tributary hydraulics, and weather conditions. However, actual measurements of the flow and nutrient levels from a few representative tributaries is needed to set some of the models' parameters and verify the model. The model will also account for internally generated nutrients, and hence be able to predict the lakes eutrophic level. This *"Watershed Model"* along with other in-lake tests are necessary to prescribe any remedial action, such as application of alum to reduce algae.

The results of tributary sampling is the subject of this report.

Summary

Figure 1 shows that there are over 30 tributaries that flow into Honeoye Lake. The seven largest of these tributaries, noted on Figure 1, were monitored to measure the flow every two weeks from March until late December. In addition, on four separate occasions, one during a major storm event, samples were taken that were analyzed for nutrient levels.

Of the seven tributaries monitored, it is known that the southern Honeoye Inlet is by far the largest input to the lake. Its flow, however, could not be measured since the large wetlands to the south are spread out, and no major entry point could be chosen to measure flow. All of the monitored streams except for Honeoye Inlet and Briggs Gully quit flowing at some point during the summer. Figure 2 shows the flow for Afolter Gully, Bray Gully, and Briggs Gully, which, other than Honeoye Inlet, have the greatest flow.

Figures 3-5 show the total phosphorus, soluble reactive phosphorus, and total suspended solids respectively, carried by each of the tributaries. These figures show that during the storm event of May 11 there was a significant increase in phosphorus load and suspended solids, which when coupled with much higher flows, results in large inputs of phosphorus and solids into the lake in a short period of time. It is also interesting to note that for the largest tributaries, Honeoye Inlet,

Bray Gully, and Briggs Gully, these levels did not increase significantly during this storm event, unlike the smaller tributaries.

Methods and Measurement Techniques

For all of the tributaries sampled, except the Honeoye Inlet, flow was measured and samples taken on the downstream side of the tributary where it crossed either East or West Lake Road. Figure 8 is pictures of each tributary at its sampling location. Times Union, Trident, Cratsley, Afolter, and 159 W. Lake all have circular culverts. The water depth in the culvert is needed to calculate flow. For Bray and Briggs Gullies the water level was measured relative to a fixed string datum across the tributary and knowing the tributary cross-section the flow was calculated. For Honeoye Inlet no flow measurements were made but water samples for chemical analysis were taken from a location at the Finger Lakes Community College Muller Field Station.

The flow in each tributary with circular culverts was calculated by measuring the velocity and depth of the water. The stream velocity was measured using a Global Water Flow Probe FP101. The measurements were made in the middle of each culvert at approximately mid depth. The flow for the circular culverts was calculated as follows:

$$F = Av$$

$$A = R^2\cos^{-1}((R-d)/R) - (R-d)(d(R-d))^{1/2}$$

where F = flow in ft.^{3}/sec.

A = cross-sectional area of water in ft.^{2}

R = radius of culvert in inches

d = depth of water in ft. in the culvert

v = measured velocity in ft./sec.

For Bray and Briggs Gullies, which do not have culverts, a reference string was stretched across each tributary, and the distance from the string to the stream water level was used to determine the cross-sectional area of the flowing water and then the F = Av. To determine A, which is not a as simple as in circular culverts, it was necessary to measure the stream bed profile from the reference string, and then develop a curve that determines cross-sectional area dependent on the distance from the reference string to the water level. The stream bed profile and curve to determine the cross-sectional area are included in the attached spread sheets. The stream velocity was measured in the middle of the stream at mid-depth.

For each of the four times during the year that water samples were taken from the four tributaries the samples were sent to Life Science Laboratory in East Syracuse, NY. Each sample was analyzed for the following parameters:

Total phosphorus in mg/l

Soluble Reactive Phosphorus in mg/l

Total Suspended Solids in mg/l

Results

The attached spread sheet give the raw data and plots of flow data for all tributaries, similar to Figure 2 that presented flow for the three tributaries with the greatest flow.

The results of the nutrient analysis is summarized in Figures 3-5 which show that large amounts of total phosphorus and solids (silt) are washed into the lake in short periods of time during storm events, particularly for the smaller tributaries. Figures 6-7 show the total loads per unit time. The larger tributaries are less affected by storm events but supply nutrients and solids on a more continuous basis at lower levels. It is also apparent from these figures that the soluble reactive phosphorus is not significantly affected by storm events, since most of the additional phosphorus carried into the lake is in the form of solid materials.

Since only a small fraction of all tributaries to Honeoye Lake were sampled it was not possible from this data to calculate the total nutrient loading to the lake. The *"Watershed Model"*, which will be developed by Princeton Hydro using data collected and reported in this report, will be able to predict the total loading, which will then be used to prescribe remedial action and guide a watershed management plan.

Acknowledgment

I would like to thank Steve Souza for specifying the types of measurement that were made, LifeSciences Laboratory for the chemical analysis, and Dave Beckwith for assisting in the data collection.

Figure 1
Honeoye Lake Tributaries

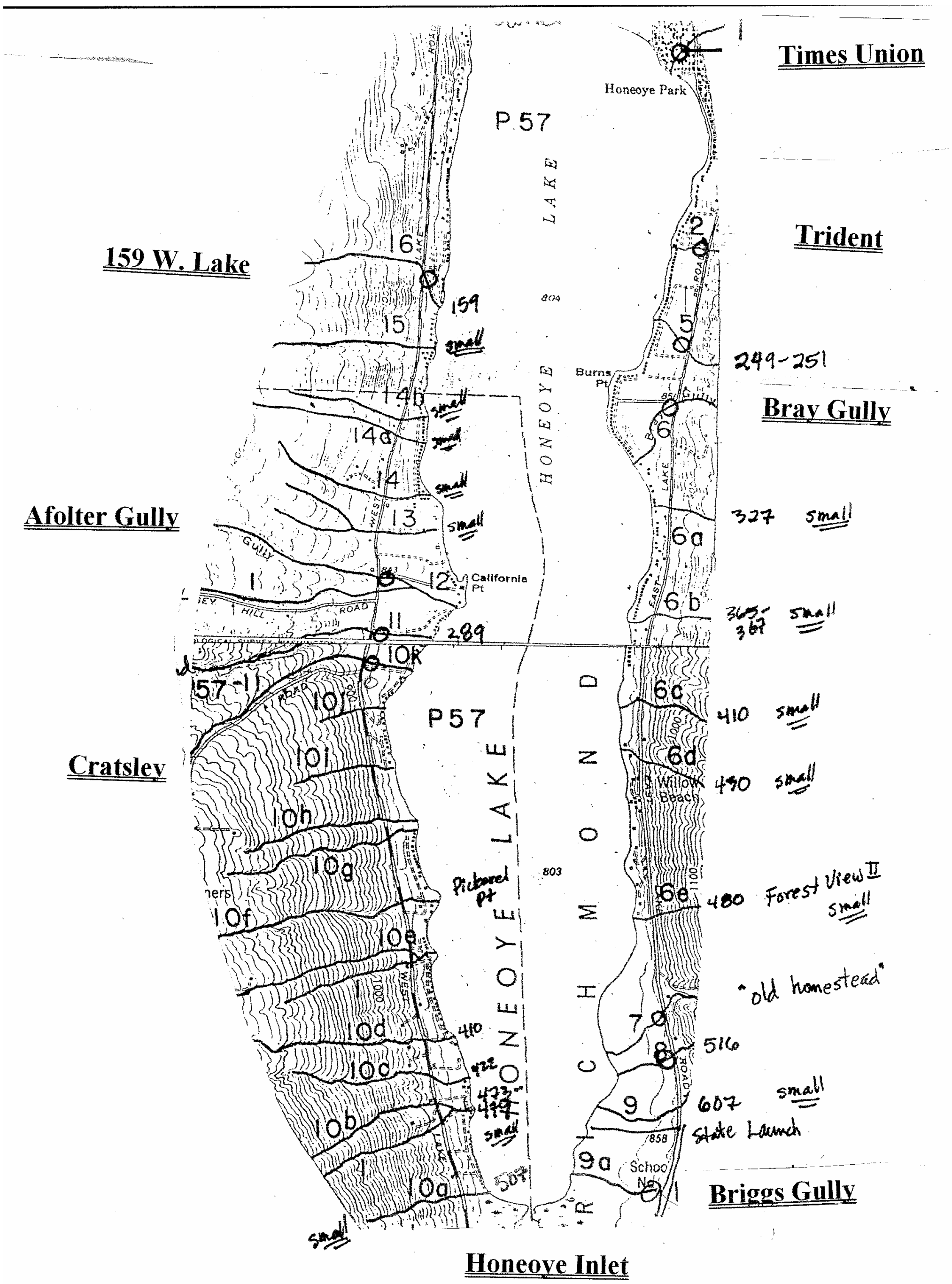

Figure 2

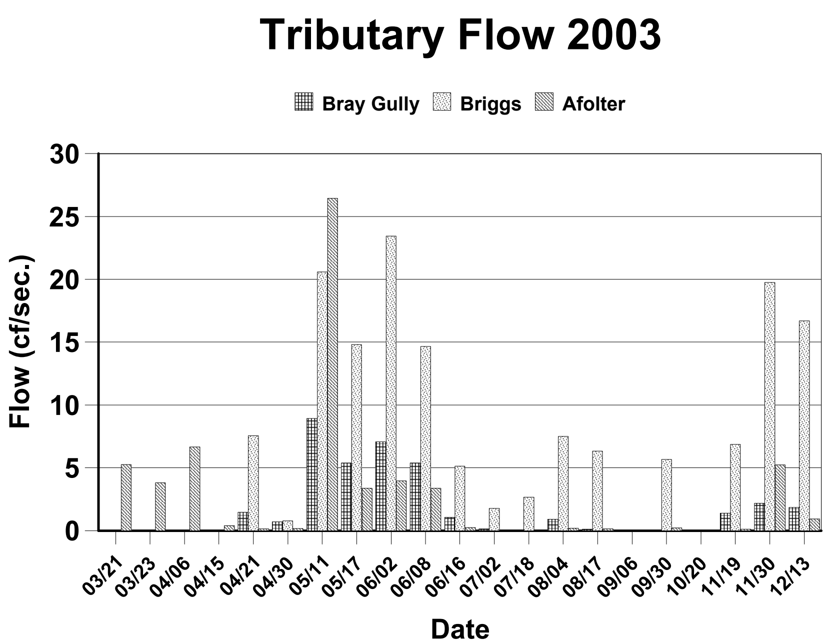

Figure 3

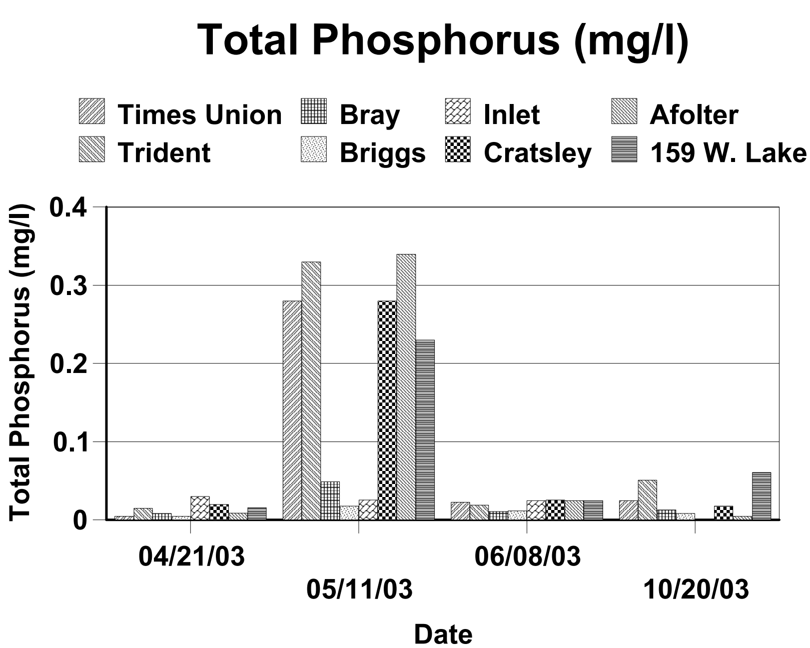

Figure 4

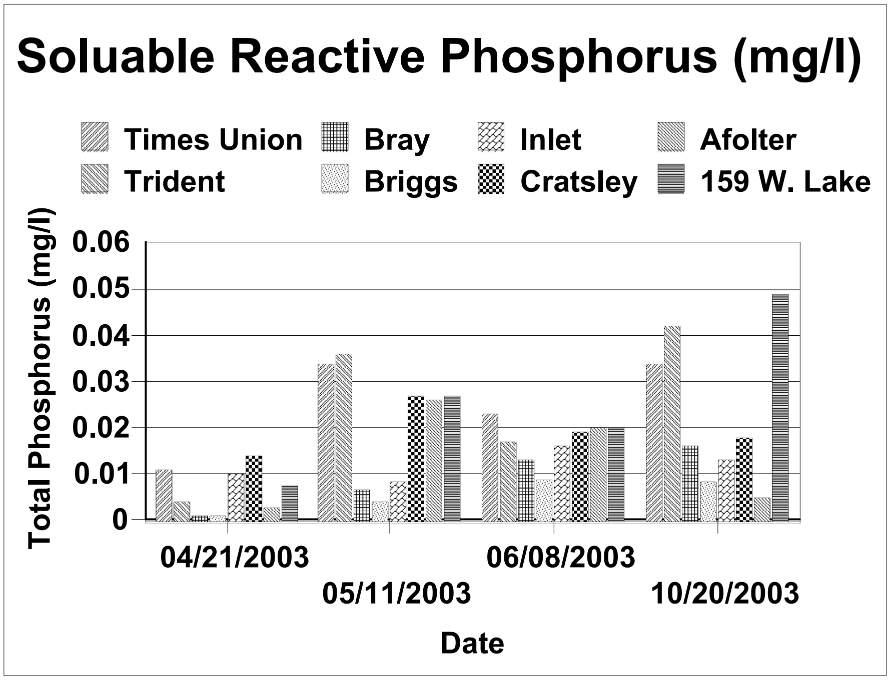

Figure 5

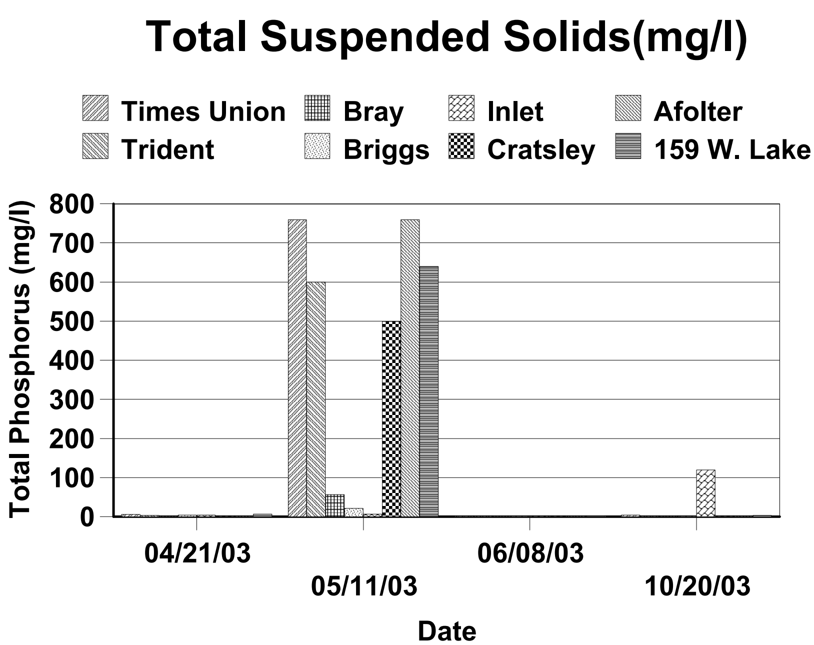

Figure 6

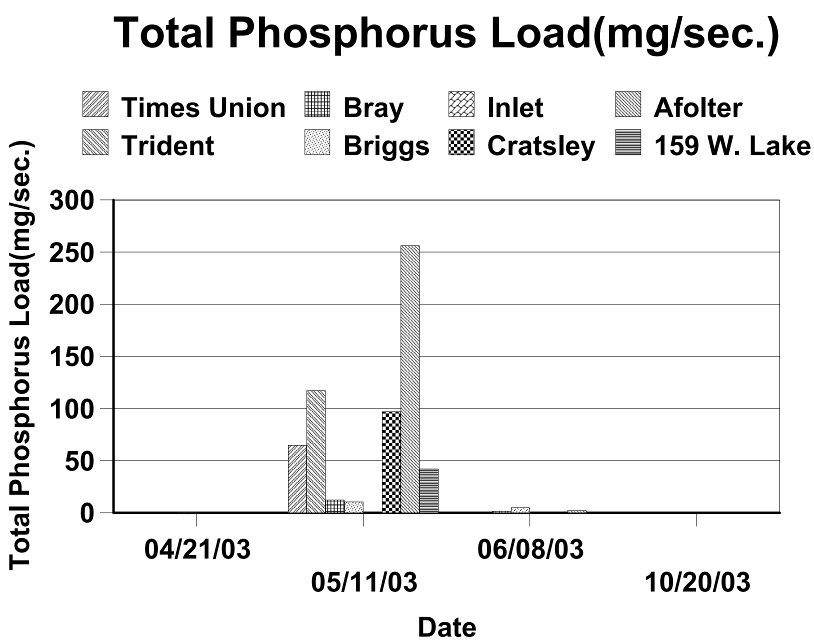

Figure 7