

Tributary Sampling for Honeoye Lake Report of Phases I and II



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Table of Contents:

Executive Summary

Acknowledgements

List of Figures

List of Tables

Introduction

Methods

Results and Discussion

Conclusions

Literature Cited

Appendix

Executive Summary

Ongoing efforts by the Honeoye Lake Watershed Task Force and multiple project partners are focused on an updated nutrient budget for Honeoye Lake to better understand internal and external nutrient loading sources. The purpose of the Tributary Sampling for Honeoye Lake study was to enhance understanding of tributary nutrient loading within the Honeoye Lake watershed area by conducting field-based water quality measurements and storm event sampling for five major tributaries to Honeoye Lake: Affolter Gully, Cratsley Gully, Bray Gully, Briggs Gully and Honeoye Inlet. This project was completed in two summer sampling phases: Phase I during June/August 2014 (WRC Special Projects 9-2014) and Phase II during July/August 2015 (WRC Special Projects 6-2015). One baseline and two storm events were sampled during the 2014 monitoring season and three storm events were sampled during the 2015 July/August monitoring seasons.

In-situ measurements of water temperature, dissolved oxygen, percent dissolved oxygen saturation, conductivity and pH were conducted, as well as an estimation of stream discharge. All five tributary sampling locations for both Phase I and Phase II showed normal ranges for the water quality parameters tested. Stream discharge was highest at Honeoye Inlet and, secondly, at Briggs Gully.

At each of the five sampling locations, grab samples were collected and were analyzed by Life Science Laboratories, Inc. (LSL) in Syracuse, NY for nitrate, nitrite, total phosphorus (TP) and total suspended solids (TSS). Phase I and Phase II test results for nitrate concentration were below the threshold of 10 mg/L at all tributary sampling locations. Phase I and Phase II test results for nitrite concentrations in all five streams were below the laboratory testing sensitivity level of <0.1 mg/L. Honeoye Inlet was a consistently higher contributor of TP and TSS compared to Affolter Gully, Cratsley Gully, Bray Gully and Briggs Gully. As such, future efforts to reduce external loading to Honeoye Lake should continue to focus on the Honeoye Inlet subwatershed area.

Acknowledgements

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Our appreciation and thanks go to Maura Sullivan, who created the GIS map of our project sampling locations, and our project interns (pictured below, left to right), Amber Romanowski, Jason Hanselman and Eliza Crane, who assisted with multiple days of storm event sampling.



List of Figures

Figure 1. Honeoye Lake Tributary Sampling Locations

Figure 2. TP Concentration Results for Honeoye Lake Tributary Sampling

Figure 3. TSS Concentration Results for Honeoye Lake Tributary Sampling

Figure 4. Nitrate Concentration Results for Honeoye Lake Tributary Sampling

Figure 5. Nitrite Concentration Results for Honeoye Lake Tributary Sampling

List of Tables

Table 1. Honeoye Lake subwatersheds

Table 2. Baseline and storm event sampling dates and precipitation amounts

Table 3. Summary of precipitation data for the July/August 2014 and 2015 storm event sampling periods.

Table 4. YSI Water Quality Data for Honeoye Lake Tributary Sampling

Table 5. Tributary discharge estimates

Table 4. LSL grab sample analysis for Total Phosphorus, Total Suspended Solids, Nitrite and Nitrate.

Introduction

Ongoing efforts by the Honeoye Lake Watershed Task Force and multiple project partners are focused on an updated nutrient budget for Honeoye Lake to better understand internal and external nutrient loading sources. The purpose of the Tributary Sampling for Honeoye Lake study was to enhance understanding of tributary nutrient loading within the Honeoye Lake watershed area by conducting field-based water quality measurements and storm event sampling for five major tributaries to Honeoye Lake: Affolter Gully, Cratsley Gully, Bray Gully, Briggs Gully and Honeoye Inlet (Figure 1). In-situ measurements of water temperature, dissolved oxygen, percent oxygen saturation, conductivity and pH were conducted, as well as an estimation of stream discharge. Water samples were analyzed by Life Science Laboratories, Inc. in Syracuse, NY for nitrate, nitrite, total phosphorus and total suspended solids. This project was completed in two summer sampling phases: Phase I during June/August 2014 and Phase II during July/August 2015.

Methods

Baseline water quality data was collected on 6/19/14 at Affolter Gully, Cratsley Gully, Bray Gully, Briggs Gully and Honeoye Inlet. Storm event sampling was conducted at the same five sampling locations on 8/12/14, 8/20/14, 7/14/15, 7/30/15 and 8/11/15. In situ water quality measurements were collected using a YSI 6920 water quality sonde and 650 data logger. These data included temperature, conductivity, pH, dissolved oxygen and percent dissolved oxygen saturation. Discharge rates were estimated in the field using standard methods using a surface float. During each sampling event, two grab samples were collected from each tributary and water samples were submitted to the NELAP accredited Life Science Laboratories, Inc. (LSL) for laboratory analysis of TP, TSS, nitrite and nitrate. Pre-coded grab sample bottles were provided by LSL, one of which contained a preservative for analysis of TP. Unpreserved grab sample bottles were used for analysis of TSS, nitrite and nitrate. Grab samples were stored in a cooler on ice and delivered to the LSL office in Wayland, NY, at which time the samples were surrendered to LSL using their Chain of Custody protocol. LSL then sent the grab samples to their testing facility in Syracuse, NY for analysis. Grab samples were only able to be submitted to LSL for analysis Mondays through Thursdays, prior to 2 pm, which became a limitation for which storm events could be sampled.

Honeoye Lake Tributary Sampling Locations

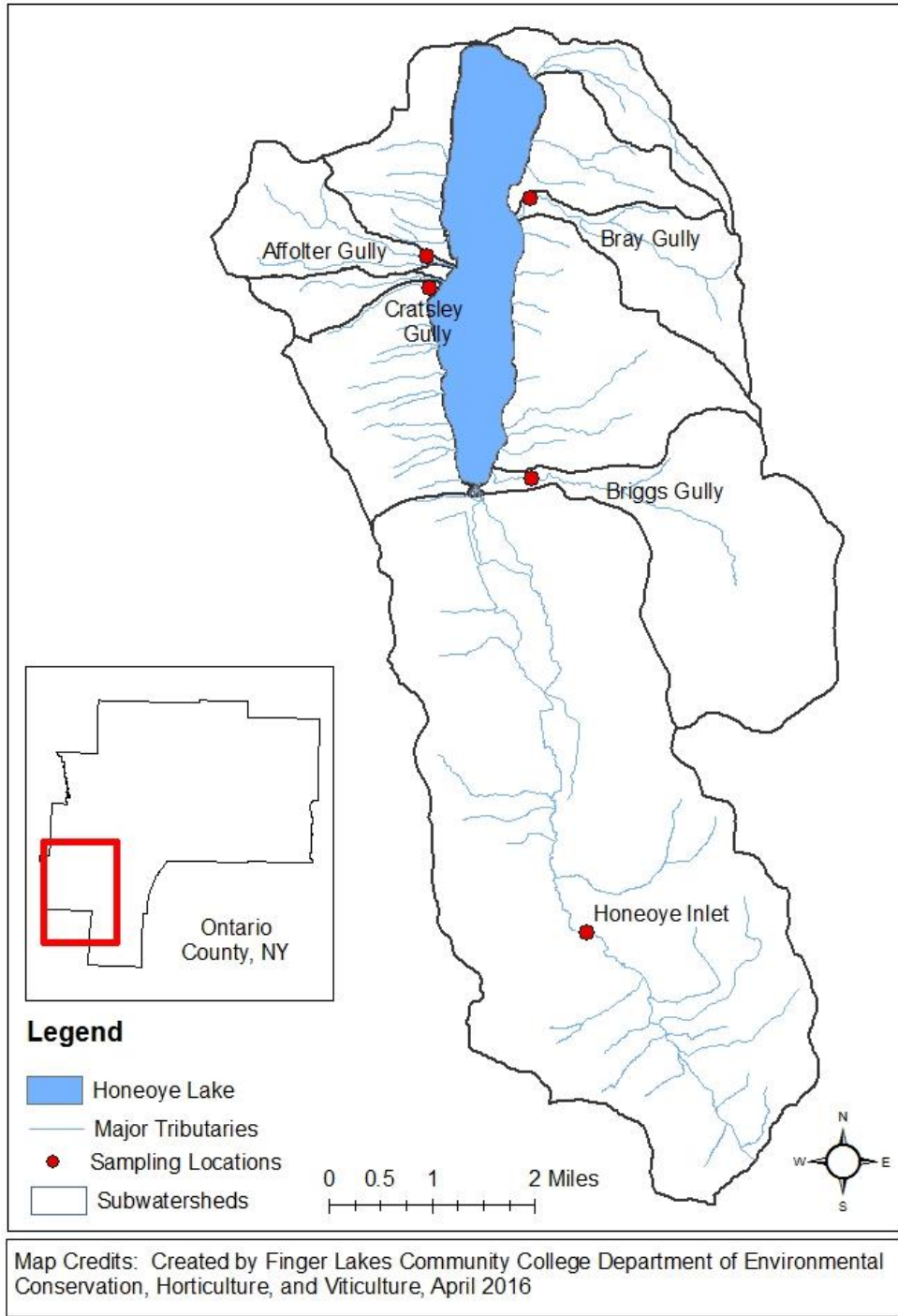


Figure 1. Honeoye Lake Tributary Sampling Locations.

Table 1. Honeoye Lake Subwatersheds. Source: Honeoye Lake Watershed Management Plan 2007

Subwatershed	Subwatershed Area (Acres)
Cratsley Gully	~180
Affolter Gully	1,585
Bray Gully	1,165
Briggs Gully	3,140
Honeoye Inlet	10,676*

*Honeoye Inlet sampling location represents the upper portion of the Honeoye Inlet subwatershed, only.

Results and Discussion

Precipitation

Precipitation amounts for storm event sampling varied (Table 2). During the Phase I project period precipitation measured 0.13 inches and 0.20 inches for the 8/12/14 and 8/20/14 storm events, respectively. Based on rainfall data obtained from NOAA for Honeoye, NY (Appendix A) there were 26 precipitation events during July and August 2014 with one very significant storm event on 7/28/14 resulting in 5.50 inches of precipitation. Not including the 7/28/14 storm event, average precipitation for storm events was only 0.27 inches during the 2014 monitoring season. During the same time period in 2015, there were 19 precipitation event, no storm events with greater that 1.5 inches of precipitation and the average precipitation for storm events was 0.38 inches. The 2014 July/August storm event sampling was challenging due to lower rainfall amounts and the timing of the events relative to LSL analysis timelines. An attempt to sample during the 7/28/14 storm event was abandoned due to safety concerns and road closures. In comparison, storm events during the Phase II July/August 2015, though fewer, produced more precipitation and occurred within the appropriate time frame for submitting grab samples to LSL for analysis.

Table 2. Baseline and storm event sampling dates and precipitation amounts. Source: NOAA Climate Data Online website: <http://www.ncdc.noaa.gov/cdo-web/>

	6/19/14	8/12/14	8/20/14	7/14/15	7/30/15	8/11/15
Storm Event Precipitation	0.0 (Baseline)	0.13 inches	0.20 inches	0.68 inches	0.35 inches	1.23 inches

Table 3. Summary of precipitation data for the July/August 2014 and 2015 storm event sampling periods. Source: NOAA Climate Data Online website: <http://www.ncdc.noaa.gov/cdo-web/>

	Number of Precipitation Events	Number of Significant Storm Events (>1.5 inches)	Average Storm Event Precipitation
July & August 2014	26	1 (5.50 inches on 7/28/14)	0.27 inches*
July & August 2015	19	0	0.38 inches

* July & August 2014 average does not include 5.50 inches of precipitation on 7/28/14

Water Quality Measurements

In situ water quality measurements for temperature, conductivity, percent dissolved oxygen saturation, dissolved oxygen concentration and pH were measured using the YSI 6920 water quality sonde and 650 data logger. These parameters were measured during the baseline sampling that occurred on 6/17/14 and subsequent storm event sampling on 8/12/14, 8/20/14, 7/14/15, 7/30/15 and 8/11/15 (Table 4). Temperature measurements at all tributary sampling sites ranged from 16.15 degrees C to 21.31 degrees C, within the normal range for summer months. Conductivity varied by location but was relatively consistent for each tributary system and likely reflects the unique bedrock geology in each subwatershed. Briggs Gully on the east side of Honeoye Lake consistently had the lowest conductivity measurements ranging from a baseline of 205 $\mu\text{S}/\text{m}$ on 6/19/14 to 271 $\mu\text{S}/\text{m}$ recorded during the 8/20/14 storm event. Cratsley Gully on the west side of Honeoye Lake had a much higher conductivity ranging from 700 $\mu\text{S}/\text{m}$ measured during the 7/30/15 storm event to 960 $\mu\text{S}/\text{m}$ measured during the 8/12/14 storm event. Conductivity measurements for all five tributaries during both study periods were within the normal range for the geographic region around Honeoye Lake. Percent dissolved oxygen saturation (% DO) for Cratsley Gully, Bray Gully, Briggs Gully and Honeoye Inlet were between 83.9% DO and 100.2 % DO for the baseline and all five storm events. Similarly, the concentration of DO at Cratsley Gully, Bray Gully, Briggs Gully and Honeoye Inlet were between 8.01 mg/L and 9.62 mg/L. Although baseline sampling at Affolter Gully demonstrated % DO and DO concentrations similar to the other four monitoring locations, the storm event sampling for % DO and DO concentration were much lower at Affolter Gully (see Table 3). The final monitoring parameter measured in the field was pH, which ranged between 7.68 and 8.72 between all monitoring locations, well within the normal range. The one exception were the pH measurements during the 8/11/15 storm event sampling, which were all slightly above 10, indicating a calibration error with the probe.

Table 4. YSI Water Quality Data for Honeoye Lake Tributary Sampling (baseline sampling on 6/19/14)**Temperature (degrees C)**

Location	6/19/2014	8/12/2014	8/20/2014	7/14/2015	7/30/2015	8/11/2015
Cratsley	17.41	17.38	17.43	18.80	21.31	18.14
Affolter	18.40	16.62	16.15	18.09	19.25	17.48
Bray	16.95	16.72	16.25	17.83	19.23	17.72
Briggs	17.73	16.73	16.35	17.97	19.1	17.29
Honeoye Inlet	17.66	17.27	17.47	18.33	19.11	17.55

Conductivity ($\mu\text{S/m}$)

Location	6/19/2014	8/12/2014	8/20/2014	7/14/2015	7/30/2015	8/11/2015
Cratsley	795	960	845	700	707	706
Affolter	511	517	561	329	395	409
Bray	432	499	547	407	488	529
Briggs	205	248	271	213	221	222
Honeoye Inlet	323	361	305	276	243	260

% Dissolved Oxygen Saturation (%)

Location	6/19/2014	8/12/2014	8/20/2014	7/14/2015	7/30/2015	8/11/2015
Cratsley	83.9	84.2	86.2	95.9	96.0	92.7
Affolter	93.3	70.8	65.1	84.9	73.5	85.7
Bray	96.1	95.4	84.3	94.4	98.8	93.3
Briggs	94.7	98.6	89.8	90.7	95.3	92.8
Honeoye Inlet	94.1	100.2	84.6	96.3	93.6	91.0

Dissolved Oxygen (mg/L)

Location	6/19/2014	8/12/2014	8/20/2014	7/14/2015	7/30/2015	8/11/2015
Cratsley	8.02	8.01	8.24	8.76	8.65	8.72
Affolter	8.75	6.89	6.39	7.88	6.77	8.19
Bray	9.26	9.32	8.34	8.93	9.12	8.95
Briggs	9.01	9.52	8.89	8.57	8.82	8.90
Honeoye Inlet	8.95	9.62	8.18	8.99	8.85	8.69

pH

Location	6/19/2014	8/12/2014	8/20/2014	7/14/2015	7/30/2015	8/11/2015
Cratsley	8.44	8.29	8.31	7.68	8.08	10.12*
Affolter	8.30	8.52	8.42	7.79	8.23	10.10*
Bray	8.44	8.41	8.72	7.83	8.31	10.18*
Briggs	8.36	8.46	8.65	7.90	8.48	10.26*
Honeoye Inlet	8.27	8.33	8.49	7.84	8.40	10.24*

* calibration error on YSI for pH meter

Estimation of Tributary Discharge Volume

Tributary discharge volume was estimated at each sampling location via the standard method using a surface float. Overall, Honeoye Inlet had the highest discharge volume of all five tributary locations. Briggs Gully had the second highest discharge volume. When comparing the tributary discharge to the land area for the surrounding subwatershed, Honeoye Inlet has the largest subwatershed area and Briggs Gully is the second largest subwatershed area within the Honeoye Lake Watershed. Affolter Gully discharge estimates during the July/August 2015 storm event sampling was performed close to a culvert pipe, which concentrated the flow and skewed the velocity of water flow, thus contributing to an overestimation of discharge volume for that particular location.

Table 5. Tributary Discharge Estimates

Location	6/19/14 Baseline	8/12/2014	8/20/2014	7/14/2015	7/30/2015	8/11/2015
Cratsley	0.42 cfs	0.09 cfs	0.94 cfs	0.54 cfs	1.87 cfs	4.67 cfs
Affolter	0.46 cfs	0.93 cfs	0.90 cfs	14.84* cfs	11.37* cfs	16.89* cfs
Bray	0.79 cfs	0.41 cfs	0.89 cfs	2.17 cfs	6.47 cfs	2.67 cfs
Briggs	11.96 cfs	6.16 cfs	5.53 cfs	9.56 cfs	25.89 cfs	12.78 cfs
Honeoye Inlet	12.44 cfs	5.80 cfs	7.27 cfs	14.65 cfs	27.83 cfs	14.61 cfs

*discharge volume estimates skewed by proximity of culvert pipe, resulting in an overestimation

Storm Event Water Sample Analysis for Total Phosphorus, Total Suspended Solids, Nitrite and Nitrate

Water samples collected during the baseline and five storm events were submitted to LSL and were analyzed for Total Phosphorus (TP), Total Suspended Solids (TSS), Nitrites and Nitrates (Table 6). A variety of variables can affect the concentrations measured: precipitation amount, how localized a storm is within different portions of the watershed, the timing of collecting the sample relative to when “peak flow” would be in a stream system, the land use and size of the subwatershed drainage area, to name a few. However, even with these many additional factors, some clear trends were identified in the data.

Total Phosphorus (TP)

Phosphorus is the limiting nutrient for freshwater aquatic ecosystems, thus, increased availability of the nutrient phosphorus will likely result in increased algal growth. Baseline TP concentrations were relatively low, less than 0.034 mg/L at all five sampling sites. TP concentrations for storm event grab samples varied (see Figure 2). Samples collected at all five tributary locations on 8/12/14 and 8/20/14 had TP concentrations that were below a testing

sensitivity level of <0.2 mg/L. Excluding those two storm events, TP concentrations for the baseline testing and the 2015 storm events show that, overall, Honeoye Inlet consistently had the highest TP concentrations. Of the 2015 storm events, the highest TP concentration at Honeoye Inlet was 0.25 mg/L on 7/14/15. On 7/30/15 the TP concentrations at Honeoye Inlet and Cratsley Gully were 0.16 mg/L and 0.14 mg/L, respectively. In general, Cratsley Gully and Affolter Gully had slightly greater TP concentrations than Briggs Gully or Bray Gully, whereas Honeoye Inlet had much greater TP concentrations relative to the other four tributaries.

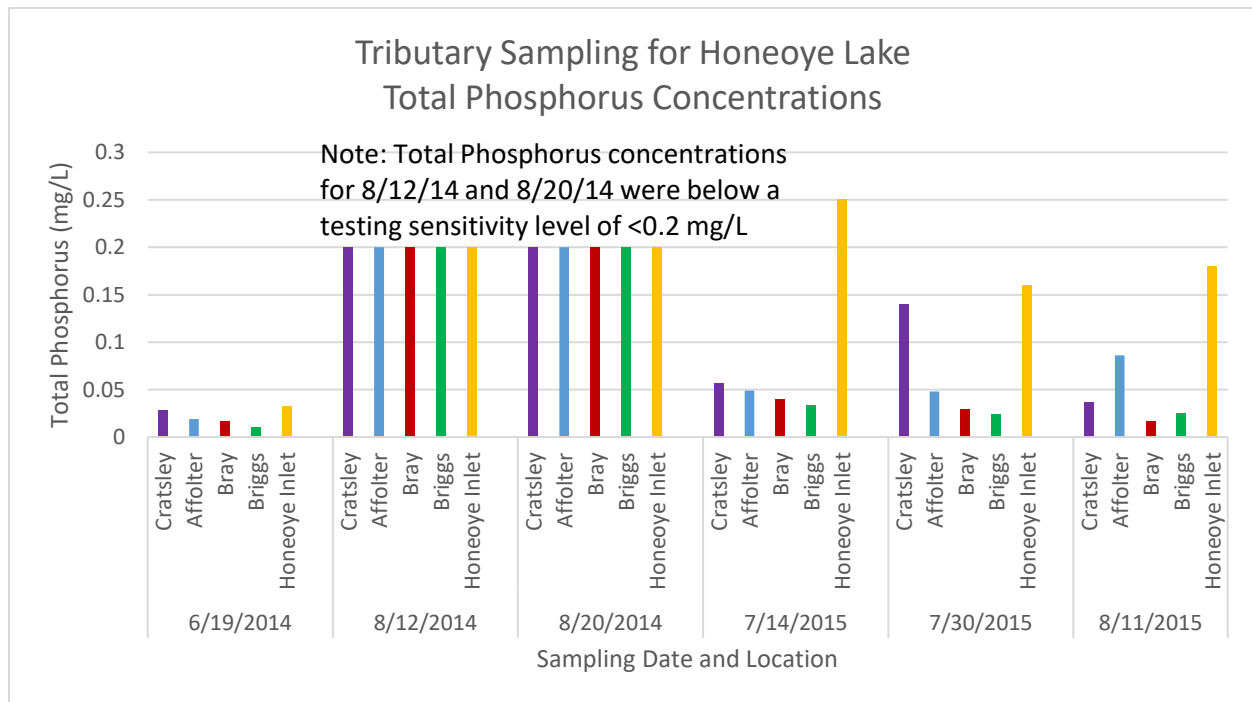
National mean

Table 6. LSL grab sample analysis for Total Phosphorus, Total Suspended Solids, Nitrite and Nitrate.

Location	Date	TP (mg/L)	TSS (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)
Cratsley	6/19/2014	0.028	<4	<0.1	0.85
Affolter	6/19/2014	0.019	<4	<0.1	0.36
Bray	6/19/2014	0.016	<4	<0.1	0.23
Briggs	6/19/2014	0.01	<4	<0.1	0.079
Honeoye Inlet	6/19/2014	0.032	<4	<0.1	0.25
Cratsley	8/12/2014	<0.2	<4	<0.1	<0.5
Affolter	8/12/2014	<0.2	<4	<0.1	<0.5
Bray	8/12/2014	<0.2	<4	<0.1	<0.5
Briggs	8/12/2014	<0.2	<4	<0.1	<0.5
Honeoye Inlet	8/12/2014	<0.2	4.5	<0.1	<0.5
Cratsley	8/20/2014	<0.2	<4	<0.1	0.36
Affolter	8/20/2014	<0.2	<4	<0.1	0.27
Bray	8/20/2014	<0.2	<4	<0.1	0.1
Briggs	8/20/2014	<0.2	<4	<0.1	0.13
Honeoye Inlet	8/20/2014	<0.2	74	<0.1	0.73
Cratsley	7/14/2015	0.056	9.5	<0.1	0.46
Affolter	7/14/2015	0.049	15	<0.1	0.47
Bray	7/14/2015	0.04	32	<0.1	0.22
Briggs	7/14/2015	0.033	13	<0.1	0.18
Honeoye Inlet	7/14/2015	0.25	120	<0.1	0.6
Cratsley	7/30/2015	0.14	130	<0.1	0.62
Affolter	7/30/2015	0.048	18	<0.1	0.56
Bray	7/30/2015	0.029	17	<0.1	0.38
Briggs	7/30/2015	0.024	27	<0.1	0.22
Honeoye Inlet	7/30/2015	0.16	230	<0.1	0.47

Cratsley	8/11/2015	0.037	<4	<0.1	1.4
Affolter	8/11/2015	0.086	17	<0.1	1.3
Bray	8/11/2015	0.016	<4	<0.1	0.57
Briggs	8/11/2015	0.025	21	<0.1	0.31
Honeoye Inlet	8/11/2015	0.18	76	<0.1	0.28

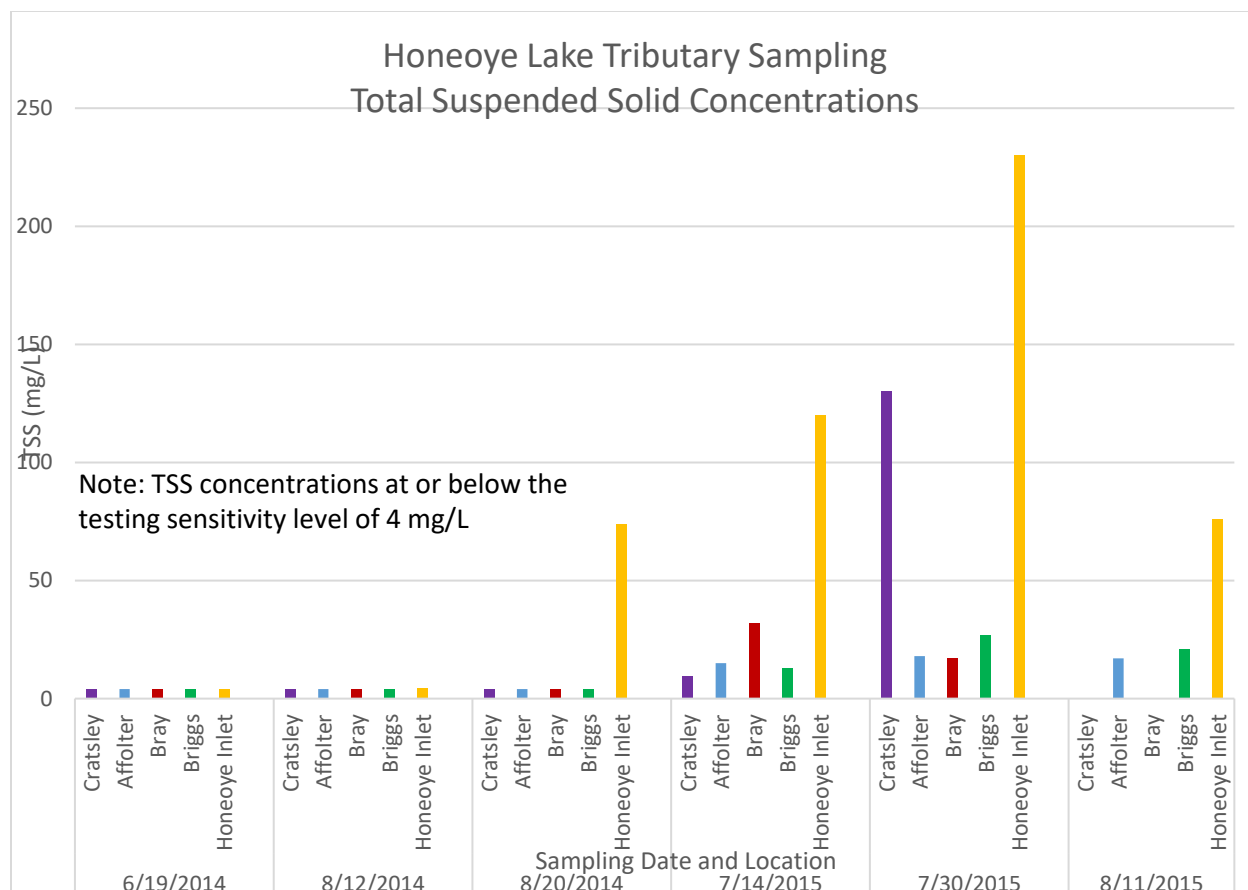
Figure 2. TP Concentration Results for Honeoye Lake Tributary Sampling



Total Suspended Solids (TSS)

Baseline TSS concentrations for all five sampling locations were below the detection limit of <4 mg/L. Honeoye Inlet had the greatest storm event TSS concentrations for all five 2014 and 2015 storm events (see Figure 3). TSS concentrations for Cratsley, Affolter, Bray and Briggs Gullies during the 8/12/14 and 8/21/14 storm events were below <4 mg/L while TSS concentrations for Honeoye Inlet measured 4.5 mg/L and 74 mg/L, respectively. Results for the 2015 storm event sampling were similar in that the Honeoye Inlet had much greater TSS concentrations compared to the other four tributaries. One exception was Cratsley Gully on 7/30/15 which had a TSS concentration of 130 mg/L compared to Honeoye Inlet which was 230 mg/L. On the same date, Affolter Gully, Briggs Gully and Bray Gully all had TSS concentrations below 30 mg/L. Based on these results, Honeoye Inlet appears to consistently contribute greater TSS than the other four tributaries included in this study.

Figure 3. TSS Concentration Results for Honeoye Lake Tributary Sampling



Nitrate/Nitrite

Nitrate/Nitrite concentrations are important measurements of inorganic nitrogen present in the aquatic ecosystem. While a limiting nutrient in the terrestrial ecosystem, nitrogen is typically not a limiting factor in freshwater aquatic ecosystems. The EPA threshold for nitrate in drinking water is 10 mg/L (U.S. EPA 2016). Baseline sampling and all storm event sampling in all five tributaries were well below this threshold (Figure 4). The greatest nitrate concentrations were 1.4 mg/L at Cratsley Gully on 8/11/15 and 1.3 mg/L at Affolter Gully, also on 8/11/15. Similarly, nitrite concentrations for baseline and storm event sampling were all below the detection limit of <0.1 mg/L for all five tributaries (Figure 5). Cratsley Gully had the highest baseline nitrate concentration of 0.85 mg/L, which was elevated compared to the other four tributaries. Based on these data, it appears that external loading of nitrate/nitrite is relatively low in the five subwatershed that were part of this study. This is consistent with findings of an earlier study (Zhu 2009) of external nutrient loading in the Honeoye Lake Watershed.

Figure 4. Nitrate Concentrations of Honeoye Lake Tributary Sampling

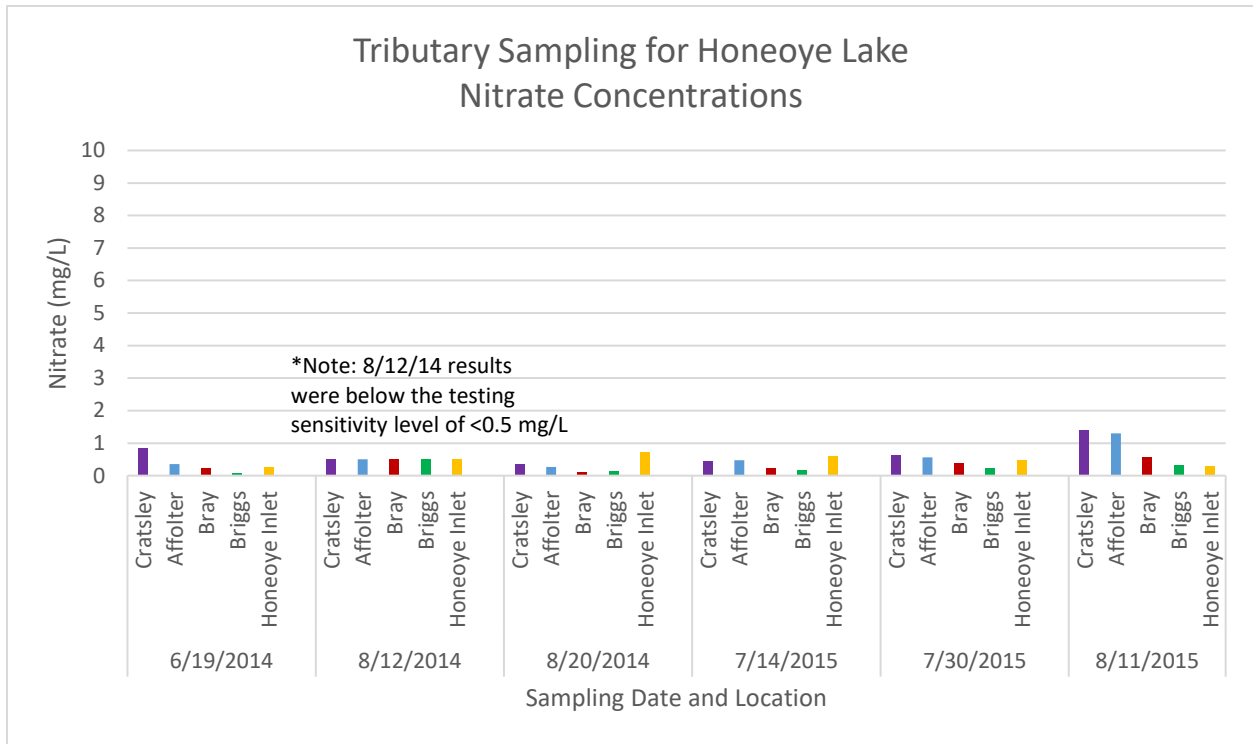
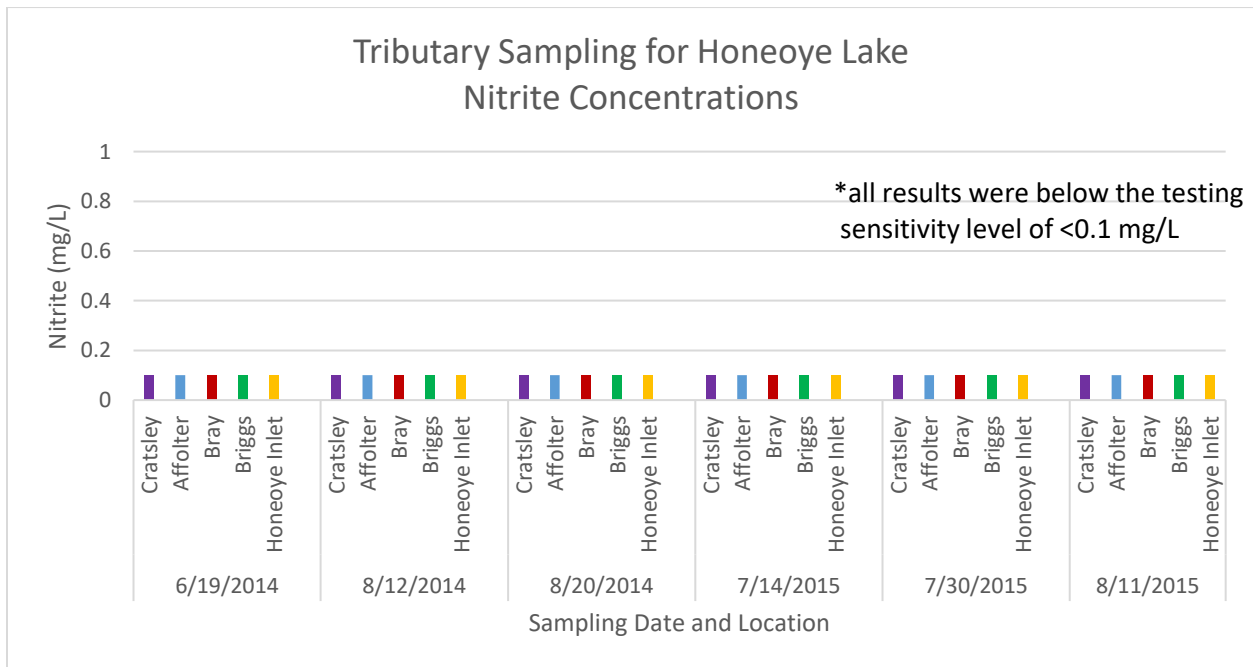


Figure 5. Nitrite concentrations of Honeoye Lake Tributary Sampling



Conclusions

The objective of the Tributary Sampling for Honeoye Lake study was to obtain water quality information and storm event data that could be incorporated in the update of the nutrient budget for Honeoye Lake. The nutrient analysis conducted by LSL has shown that nitrate and nitrite concentrations are very low for storm event sampling of all five tributaries. With respect to total phosphorus (TP) and total suspended solids (TSS), Honeoye Inlet contributed the greatest concentrations of TP and TSS during the study period. As such, our recommendation is to continue to focus restoration projects and implementation of best management practices by landowners, businesses and municipalities on the Honeoye Inlet subwatershed area.

References

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