FINAL DRAFT

Effectiveness of a 2011 Alum Treatment, Future Phosphorus Load Reductions and Associated Water Quality Monitoring for

GRAND LAKE ST. MARYS

Prepared for
STATE OF OHIO
&
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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1. INTRODUCTION

Grand Lake St. Marys (GLSM) is a large (5,000 ha), shallow (1.6 m mean depth) body of water that is highly hyper-eutrophic due to high inflows of phosphorus (P). Even with significant reductions in external nonpoint source loads of P, lake P concentrations (and associated cyanobacteria blooms) may possibly remain high for the next three or four decades. The reason to expect such a slow recovery is due to recycling of P from sediments (also known as internal loading). To partially alleviate the adverse effects of the lake's poor quality, approximately 40% of the lake area was treated with aluminum sulfate (alum) during June 2011 to remove P from the water column and inactivate mobile P and labile organic P in the bottom sediments. The aluminum sulfate application occurred in the center of the lake over an area of approximately 1,960 ha and a mean depth of approximately 2.1 meters.

To maximize the effectiveness of an alum treatment and re-establish lake ecological sustainability, external sources of P need to be sufficiently reduced to allow internal loading to become a large fraction of the remaining P supply. However, the magnitude of the water quality problem in GLSM necessitated that the lake be treated with alum in June 2011 to inactivate sediment P and reduce internal loading while continued emphasis is placed on reducing loads external P. The intent was that the alum treatment would reduce internal P loading sufficiently to mitigate the blooms of cyanobacteria for at least a year and possibly two, until water column P is restored from inflows.

The 2011 alum treatment was an incremental step toward the total lake treatment requirements. Due to funding constraints it will take several years to treat the lake at a dose considered necessary for an effective multi-year inactivation of sediment P. In 2011, an incremental dose (21 mg Al/L, 44 g/m²) was applied to the middle 40% of the lake (Figure 1). Data from post-treatment cores, in which the biogenic fraction of organic P was determined, resulted in a full dose estimate to inactivate sediment P of 93 g Al/m². The incremental dose applied in 2011 was about 40% of the recommended dose to inactivate sediment for the treatment area.

Nearshore experiments in GLSM in September 2010 showed that high algal abundance limited treatment effectiveness (Tetra Tech, 2010). Therefore, treatment of the lake during 2011 was recommended prior to the onset of early summer algal blooms. Unfortunately, a bloom was already well underway when treatment began on 2 June 2011. Due to the intensity of the bloom at the time of treatment, transparency could not be considered as a good predictor of alum effectiveness due to the extreme levels of chlorophyll *a* (chl). Transparency becomes a poor indicator of chl at very high chl concentrations, and vice versa (see Figure 2, Section 4.1). The treatment ended 29 June 2011. Despite the ongoing early bloom, nearshore experiments in April 2011 demonstrated a greater initial effectiveness (~90%) at reducing TP and chl alike at the higher dose (86 mg Al/L), than did the lower dose (32 mg/L) used in 2010 (Tetra Tech, 2011a).

1.1. REPORT PURPOSE

The purpose of this report is to provide a preliminary estimate on the impact of a partial lake P inactivation treatment through alum addition that was conducted in June 2011. This report does not address the effectiveness of current watershed Best Management Practices (BMP) activities in controlling phosphorus to the lake. Specifically, this report provides a basic understanding of the direct effect of the alum treatment on P and chl concentrations in the lake and on the indirect treatment impacts on the general water quality of the lake. Data from sediment cores collected before and after treatment are also compared to assess the treatment effects. Further, a TP mass balance model was calibrated to evaluate the relative effectiveness of sediment inactivation and external TP load reduction on lake quality.

2. LAKE SAMPLING

There were 17 water quality and sediment monitoring sites in the lake, including four YSI sonde buoys (Figure 1). Data from the 8 water column monitoring sites are considered in this report (7 monitoring sites by Ohio EPA (OEPA) and one maintained by U.S. Geological Survey (USGS), however only the 7 OEPA sites had both water column field and laboratory data). Three previously established mid-lake sites (L-1, L-2, and L-3) had been regularly sampled by OEPA since May 2010 excluding winter, and were sampled weekly from the end of March through June 2011, and every two weeks from 12 July through the beginning of October 2011. Two of the sites (L-2 and L-1) were positioned inside the treated area, while L-3 was outside (Figure 1). Water samples were collected from these sites at 0.5 m below the surface and usually near the bottom (1.4-2.2 m) and were analyzed for TP and chl. Data were unavailable due to technical issues for 6 June and 13 June at L-2 and L-3, as well as chl for 31 May for three sonde buoy sites. Phytoplankton were analyzed in 0.5 m water samples at the same sites and frequency.

In situ YSI water quality sondes monitored dissolved oxygen (DO), pH, temperature, and other variables, continuously at the surface at four locations. These locations were all outside the treated area, but near the corners of the treatment area and, thus, served as controls (Figure 1). Water samples were collected weekly from 31 May to 27 June and every two weeks from 12 July to 8 August at these four sites at surface (0.5 m) and bottom (1.4-1.9 m) and analyzed for the same constituents as at the other long-term monitoring sites. Transparency was determined at all sites with a Secchi disc. Thus, there are two test sites (L-1, L-2) and five control sites for TP, chl and transparency.

The continuous monitoring for DO, pH and temperature served to determine if there were any adverse, short-term chemical effects of the treatment, as well as to provide an additional continuous source of data from within the treatment area. Alum was buffered with sodium aluminate, so no lowering of pH to critical levels should have occurred. DO levels were used to guide the alum application, which could proceed only if DO were $\geq$ 5 mg/L. As the data will show, however, algal photosynthesis and temporary thermal stratification determined DO levels that were independent of the alum treatment activities. A fifth continuous monitoring site located inside the treated area was operated by the USGS for DO, pH and temperature at surface and bottom. Water quality grab samples were not collected by OEPA at the USGS water quality monitoring sonde.

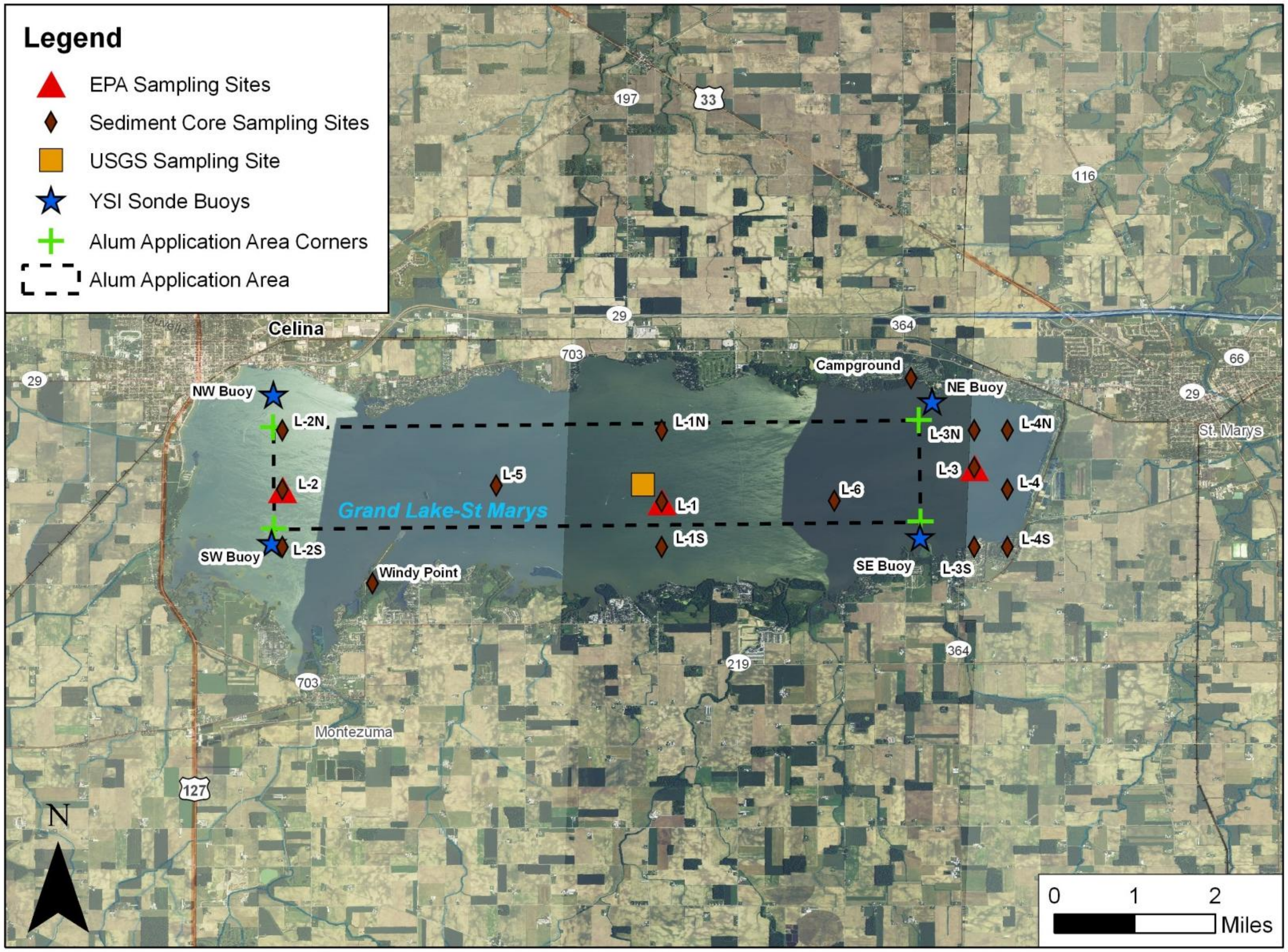

Figure 1. Location of sampling sites relative to the 2011 alum treatment application area, June 2011.

3. WATER AND PHOSPHORUS BUDGET METHODS

3.1. WATER BUDGET METHODOLOGY

A water budget for GLSM was determined for the time period from May 1st, 2010 through May 13th, 2011 on at two-week time step. Inflow from a large fraction of the watershed was not monitored continuously. The only tributary inflow which had continuous flow data available during this time period was Chickasaw Creek. Chickasaw Creek flows were obtained from the USGS gage on Chickasaw Creek south of GLSM. Chickasaw WWTP flow volumes were removed from Chickasaw Creek flow volumes so that WWTP loads into GLSM could be calculated separately. All WWTP flow and TP data were obtained from OEPA.

Inflows for the remaining tributaries into GLSM and the un-gaged portion of the watershed was calculated using the adjusted Chickasaw Creek flow volume (with WWTP flow removed) multiplied by the drainage area ratio between Chickasaw Creek drainage and the other tributary drainage areas. Determining inflows in this manner allowed us to have a continuous flow estimate for all inflows into GLSM. Groundwater inflows to GLSM were assumed to be negligible after consultation with the Ohio EPA Division of Drinking and Groundwater (OEPADDG) and confirmed through data analysis.

There were a total of 6 WWTP inflows that were included in the GLSM water budget. Two of these WWTPS are extended aeration systems that discharges continuously while the other WWTPs only discharge under certain conditions. One WWTP, the Northwood WWTP, ceased operation on May 25th, 2011, just after the time period used for the water budget.

Precipitation records were obtained from OEPA from a weather station in Celina, Ohio and were multiplied by the surface area of the lake to get a volume of direct inflow from precipitation. Monthly mean pan evaporation rates (inches) were used from the Hydrologic report for Ohio 1991 (Harstine, 1991; after Farnsworth and Thompson, 1982). There was no evaporation data for winter months. Evaporation in meters was multiplied by the surface area of the lake to obtain a volume of water lost to evaporation.

There are five methods of water loss from GLSM; evaporation, groundwater, Celina Water Treatment Plant withdrawal, and outflow from the two spillways (the west spillway which is the major outflow and the east spillway). After consultation with OEPADDG it was assumed that groundwater loss from GLSM was equivalent to 7 inches/year. This assumption was based on the productivity of the underlying aquifer. Groundwater outflow per time step in the water budget was determined so that there was more loss or recharge during the drier months, especially when there was no outflow via the west spillway, but lake level still decreased.

Daily Celina water treatment plant withdrawals were obtained by OEPA from the plant superintendent and then summed to determine a total volume of withdrawal for each two week time step. Outflows from the east spillway near St. Marys were assumed to be 10% of the outflow volume from the west spillway. This assumption was based on conversations with OEPA and former park rangers. Outflow volumes via the west spillway were determined using instantaneous flow measurements collected by OEPA during their routine sampling. There is no gage or continuous record of flow at the west spillway.

Outflow via this spillway was set to zero according to lake level data. Lake level data was collected by Ohio DNR Parks (OHDNRP) and was available for a few days per month. When the lake level reaches a level below the west spillway then outflow was assumed to be zero.

Lake volume and surface area was determined from bathymetry obtained by OHDNRP. The survey date for this bathymetry is 2004. These data were used to determine volume-depth and area-depth relationships for GLSM.

The water balance could not be balanced due to several unknowns and the amount of uncertainty associated with some of the data. Hence, the water balance had a residual, which was considered as an error term.

3.2. PHOSPHORUS BUDGET METHODOLOGY

The TP budget was determined for the same time period as the water budget on a two-week time step. Phosphorus concentrations were known for most of the inflows as well as for the lake. The TP concentration in direct precipitation was assumed to be 20 μg/L. This was based on an average areal loading rate (605 metric tons per year) at Lake Erie from 1996 to 2002 (Dolan and McGunagle, 2005).

Tributary TP concentrations used in the budget were based on samples collected by OEPA during their routine monitoring. When necessary, linear interpolation between sample dates and averages were used to fill in the data gaps. For most of the time period there was limited data available for Burntwood Creek and Little Chickasaw Creek so average concentrations from Barnes Creek and Chickasaw Creek were used because of their proximity and similar land uses. For the un-gaged portion of the basin and inflow, an average of all tributary TP concentrations was used. There are little to no TP data during the winter months so linear interpolation or averages were used for the tributary inflows depending on the data available.

Wastewater treatment plant TP, if available, was obtained from OEPA and used in the budget. If there were no TP data available for the 6 point sources a concentration of 2 mg/L was used. This concentration is based on an analysis done by OEPA on nutrient characteristics in effluent in the watershed.

All outflow TP concentrations were assumed to be the whole lake average TP concentration of the lake for that time step. Whole lake average TPs were based on monitoring data collected by OEPA for the 3 main mid-lake stations (L-1, L-2 and L-3). Linear interpolation was used to determine lake concentrations where data were lacking; including the winter months when no data were available, but there was apparently an overall decreasing trend, because TP in May 2011 was lower than in October 2010.

Using inflow volumes and TP concentrations as well as outflow volumes and TP concentrations, the total mass of TP coming into the lake and out of the lake was calculated for each time step. The residual (which is the Change in Lake Mass + Outflow Mass - Inflow Mass) was calculated for each time step. If the residual is negative there is a net sedimentation of TP during that time step. If the residual is positive there is a net internal loading of TP during that time step. The positive values during the summer were summed to determine the total amount of internal loading.

4. RESULTS AND DISCUSSION

4.1 TREATMENT EFFECTS

An alum hydroxide floc was formed as alum (and buffer, sodium aluminate) was added to the lake surface. The floc was observed to rapidly settle, producing a transparent water column. The initial white-floc took on a greenish tinge due to sorption of algae as it passed through the water column and settled on the lake bottom. The process of the aluminum hydroxide floc settling within minutes and clearing the water column is commonly observed with alum treatments, provided conditions (pH, temperature, etc.) were right for floc formation. It should be noted, however, that due to the extremely high density of algae throughout the lake during the treatment and the limited proportion of the lake surface covered by the treatment that water column clearing after the addition of alum was a temporary event. Wind and water movement transported algae from untreated portions of the lake quickly re-establishing turbidity throughout the lake.

The initial assessment of treatment effectiveness was reported in September, 2011 (Tetra Tech, 2011b). TP was observed to decrease by 56% and SRP by 100% at the only site located in the treated area – (Station L-1) (Figure 1). However, TP and chl were increasing at all sites in the lake at the time of treatment (due to internal loading of P and onset of the summer algal bloom), so choosing a control value to judge effect was problematic. Mean TP at 7 sites before the June 2 start of treatment was 115 $\pm$ 32 µg/L and during the beginning of the alum treatment, June 6-13, TP had increased to 207 $\pm$ 50 µg/L (Table 1, in Tetra Tech, 2011b).

A more realistic approach to assess treatment effectiveness is to compare summer means for 2010, before treatment, with that for 2011, now that all 2011 data are available. That comparison shows a 26% reduction in whole lake TP using stations L-1, L-2 and L-3 (Table 1). Wind probably would have mixed treated and untreated water throughout the treated and untreated portions of the open lake as the summer progressed. The observed reduction was less if data from all sampling sites (mid-lake stations and YSI stations) were used. However, three of those sites (all YSI stations) were relatively close to shore and well removed from the treated area (stars in Figure 1; Table 1). Therefore, the three regularly sampled sites should provide the best estimate of treatment effectiveness over most of the open lake.

Table 1. Comparison between 2010 and 2011 Summer Characteristics in Grand Lake St. Marys. Summer means calculated using data from June through the first week of October. No data was collected in September in 2011 hence the use of the first week of October to calculate summer means. Means are followed by standard deviation in parentheses.

Year	Summer Mean			
	Total Phosphorus (µg/L)	Chlorophyll *a* (µg/L)	Algal Biomass*** (mm^3/L)	Secchi Disk Depth (m)
2010*	187 (+/-95)	218 (+/-90)	no data	0.25 (+/-0.09)
2011*	138 (+/-54)	244 (+/-42)	37.9 (+/-19.2)	0.17 (+/-0.01)
2011** (7 sites)	162 (+/-61)	244 (+/-47)	39.6 (+/-20)	0.17 (+/-0.02)

*2010 and 2011 summer means calculated using data from the main mid-lake stations, L-1, L-2 and L-3.

**2011 summer means were also calculated using data from the main mid-lake stations as well as the four YSI stations that were installed during the 2011 alum treatment.
***Algal biomass data was only available through 8/31/2011.

That magnitude of effect (26%) is not unexpected, assuming a 50% reduction in TP in the treated area before mixing of treated and untreated lake portions. A 50% reduction was observed in two of three nearshore demonstration experiments in 2010, as well as in six other shallow lakes treated in Washington State (Tetra Tech, 2011; Cooke et al., 2005).

Chlorophyll concentrations were not reduced by the alum treatment (Table 1). Chl decreased, along with TP, by 50% in two of three nearshore experiments in 2010, but at a higher alum dose (32 mg Al/L) than applied to the open lake treated portion in 2011 (21 mg Al/L). Nevertheless, chl has typically declined in proportion to TP in other alum-treated lakes, despite even lower doses than applied to GLSM (Cooke et al., 2005). Alum floc removes particulate matter as well as sorbing soluble P, and most of lake TP would have been in algal cells during summer.

Why chl did not decrease along with TP is unclear. First, ratios of chl:TP and chl:C (Carbon) were high: 1.17 in 2010 and 1.76 in 2011 for chl:TP and 0.072 (7.2%) for chl:C in 2011 (no algae data for 2010). High chl:TP ratios are typical in hypereutrophic lakes – the average for world lakes of all trophic states is 0.35 (Welch and Jacoby, 2004). Ratios of chl:C greater than 2% also indicate no limitation by nutrients. Rather than limitation by nutrients, GLSM algae were most likely light limited, because the maximum chl possible, before the algae are self-shaded, is about 250 mg/m². The summer chl concentrations in GLSM (244 µg/L) exceeded that at 390 mg/m² (mean depth 1.6 m), although concentrations may have been higher at the 0.5 m sample depth than near the bottom, due to cell buoyancy.

The second point is that the buoyancy of cyanobacteria allows them to be distributed easily by wind. Because they accumulate near the surface, that process could redistribute algae more effectively than TP. Third, no lake with so much algae and so large an area had ever been treated with alum. Confinement of the relatively small nearshore area that was treated in 2010 may have minimized the effect of wind.

Transparency was actually greater in 2010 before, than in 2011 after treatment (Table 1). It was also greater before than after treatment in 2011 (Tetra Tech, 2011b). The increase in chl in 2011, over that in 2010, was insufficient to account for the decrease in transparency. Also, algal biomass did not increase as the summer progressed in 2011, so algae were not the reason for average transparency decreasing from 0.3 to 0.18 m (Tetra Tech, 2011b). Transparency becomes a rather poor indicator of chl at very high chl concentrations, and vice versa, as Figure 2 shows, i.e., little change occurs in transparency over a wide range at high chl. In order to see much improvement in transparency due to chl reduction, concentrations need to reach near 30 µg/L (Figure 2). Therefore, the decrease in transparency observed in 2011 was probably due to changes in other dissolved or particulate substances and possibly to algal species changes, or a difference in distribution of cyanobacteria throughout the water column.

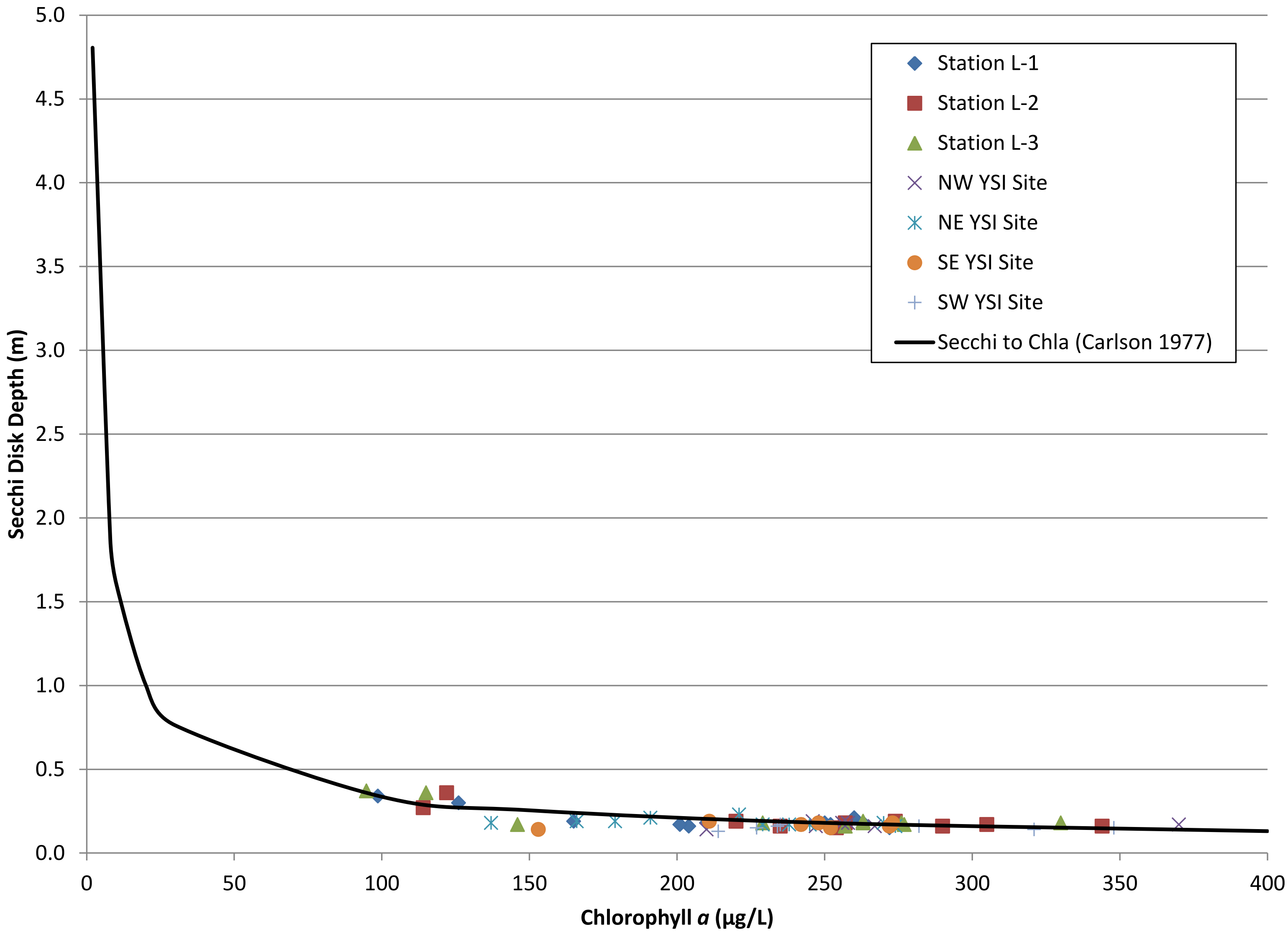

Figure 2. Secchi Disk Depth vs. Chlorophyll in Grand Lake St. Marys, 2011, as compared to Carlson (1977) relationship between Secchi disk depth and chlorophyll.

4.2. SEDIMENT CORE DATA

Sediment cores taken in July, in and near the area treated, do not show the expected increase in Al and Al-P and decrease in Fe-P observed after nearly every alum treatment studied (Cook et al., 2005; Rydin and Welch, 1999; Rydin et al., 2000; Reitzel et al., 2005). Aluminum content in the top 2 cm averaged 17 mg/g $\pm$ 23% at 9 sites before treatment and 15.5 $\pm$ 14% at 5 sites within the treated area (L-1, L-2, L-3, L-5 and L-6; Figure 1, Table 1 Appendix A). Had the alum floc remained where it was observed to settle, Al content in the top 2 cm should have increased 2.3 fold; 17 mg/g converts to 34 g/m² and 44 g/m² was added. Thus, the Al spike should have been clearly visible as it was in six of seven previously treated lakes in WA (Rydin et al., 2000). Instead, Al decreased slightly, although not statistically significant. An Al spike was clearly evident in the top 2 cm of Lake Delavan, WI, seven years after treatment at a dose of 26 g/m², about half the dose added to GLSM (Rydin and Welch, 1999).

Formed Al-P should have also increased and Fe-P should have decreased. However, Al-P was less after (0.37 mg/g $\pm$ 68%) than before (0.69 mg/g $\pm$ 45% mg/g) treatment (Table 2, Appendix A). Iron-P also averaged less after treatment (0.079 mg/g $\pm$ 37%) than before (0.095 mg/g $\pm$49%), but the slight difference was not statistically significant, given the variability. Organic-P was also greater after treatment than before – the reverse of expected (Table 2, Appendix A).

Why do the post-treatment cores fail to show the expected changes in constituents? After all, the floc was observed to quickly settle to the bottom and clarify the water column. The answer may be a combination of two processes that combined to redistribute the floc leaving much of the area barren of floc. First, the very high algal concentration at the start of treatment (189 µg/L chl, 37 mm³/L) was removed from the water column. However, nearly all of that algae was cyanobacteria, which can be buoyant and may have entrained the alum floc-algae mixture back into the water column. Second, wind mixing in shallow lakes can easily re-suspend sediment into the water column. With the added floc buoyancy contributed by cyanobacteria, wind-mixing may have redistributed the floc into patches that were easily missed by the five cores that were collected in July. Re-suspension of bottom sediment, even without the added buoyancy by cyanobacteria, is common in shallow lakes with long wind fetches (Kristensen et al., 1992; Somlyody and Koncsos, 1991; Scheffer, 1998; Sondergaard et al., 1992).

Sediment core data from before and after alum treatments to nearshore embayments reinforce the hypothesis that the buoyancy of algae caused much of the alum floc disappearance through re-suspension and dispersal. Aluminum added at 120 g/m² should have increased sediment Al 3.1 fold at Camp Lagoon and 4.4 fold at Windy Point. Observed increases from surface to 10 cm were only 1.8 and 1.7 fold, respectively. Nevertheless, there was a decided increase, in contrast to the lack of increase in the open lake treated area (Table 1, Appendix A). Also, Fe-P at Camp Lagoon decreased 46% and Al-P increased 94%, which is supposed to occur if mobile P (Fe-P) is converted to Al-P. At Windy Point, Fe-P decreased 81% and Al-P increased 269% from surface to 4 cm. The different depths to which changes are detectable (10 versus 4 cm) were likely due to the softer (more watery) sediment down to 10 cm at Camp Lagoon.

4.3. WATER AND PHOSPHROUS BUDGETS

The GLSM water budget for May 1st, 2010 through May 13th, 2011 is shown in Appendix B. Tributaries and the un-gaged portion of the basin contributed almost 94 million cubic meters (10^6 m^3) of inflow to

GLSM. Direct precipitation contributed 61.5x10^6 m^3 of inflow to GLSM. Wastewater treatment plant discharge contributed just over 2x10^6 m^3 to GLSM during this time. The lake residence time was calculated, using the total inflows for the year (5/1/2010 to 4/29/2011) and the lake volume at normal summer pool, to be 0.58 years.

Total outflow from the lake during the study period was just over 150x10^6 m^3, with over a third of that being lost via evaporation. A total of 9.36x10^6 m^3 were lost via groundwater recharge and 87x10^6 m^3 lost via the west and east spillways. The Celina water treatment plant withdrew approximately 1.8x10^6 m^3 during the study period.

The GLSM TP budget is shown in Appendix C. External loading during the study period accounted for 75% of the total TP load to the lake (Table 2). With only 8.7% of that occurring during the critical summer months. Internal loading on the other hand, contributed only 25% of the total TP load to GLSM (6 mg/m^2), but over 91% of the total summer load to GLSM (Table 2). Direct precipitation onto the lake contributes 2% of the total TP load (Table 3).

The external load into GLSM comes from both point and non-point sources. For the study period, point source loading was only accountable for 5% of the total load to GLSM while non-point sources contributed to over 67% of the total load (Table 3). Loading from non-point external sources was the largest source of TP to GLSM overall; however during the summer months internal loading is the driving contributed to TP concentrations in the lake.

Table 2. Summary of TP Loading to GLSM for 5/1/2010 through 5/13/2011.

Source	TP Phosphorus Loading (kg)	Percent of Total TP Load	Percent of Summer TP Load
Direct Precipitation	1,230	2.1%	1.4%
Chickasaw Creek	8,930	15.6%	1.0%
Chickasaw WWTP	236	0.4%	0.0%
Barnes Creek	796	1.4%	0.2%
Beaver Creek	7,996	14.0%	1.3%
Montezuma WWTP	1,332	2.3%	0.0%
Burntwood Creek	2,320	4.1%	0.5%
Coldwater Creek	10,802	18.9%	2.1%
St. Henry's WWTP	1,046	1.8%	0.6%
Little Chickasaw Creek	3,230	5.6%	0.5%
Prairie Creek	2,619	4.6%	0.5%
Ungaged Basin	1,964	3.4%	0.3%
Elks ADF	1	0.0%	0.0%
Marion Local School ADF	27	0.0%	0.0%
Northwood WWTP	162	0.3%	0.2%
Total External Load (5/1/2010 to 5/13/2011)	**42,691**	**74.6%**	--
Total External Load (6/12 to 9/17/2010)	**1,380**	--	**8.7%**
Average Volume Weighted Inflow TP Concentration = 271 µg/L			
Internal Load (6/12 to 9/17/2010)	**14,552**	**25.4%**	**91.3%**
Total P Load (5/1/2010 to 5/13/2011)	**57,243**	**100.0%**	
Total P Load (6/12 to 9/17/2010)	**15,933**	**27.8%**	

*Northwood WWTP on the north shore of the lake ceased operation on 5/25/2011.

Table 3. Projected summary of TP Loading to GLSM by Source Type for 5/1/2010 through 5/13/2011.

Source	TP Phosphorus Loading (kg)	Percent of Total TP Load	Percent of Summer TP Load
External - Point Sources (WWTP, ADF)	2,804	4.9%	0.9%
External - Non-Point Sources	38,656	67.5%	6.4%
Direct Precipitation	1,230	2.1%	1.4%
Internal	14,552	25.4%	91.3%
Total	**57,243**		

*Northwood WWTP on the north shore of the lake ceased operation on 5/25/2011.

4.4. PHOSPHORUS MASS BALANCE MODEL

A mass balance model was developed that determines whole lake mean TP concentration using a two week time step (Perkins et al., 1997). External loading from the seven inflow streams, groundwater, precipitation and waste water was as shown in Table 2. Phosphorus loss was also taken from the budget that used estimated outflow volume and lake TP concentration. The model, dTP/dt = Wext + Wint – Ws – Wout, was used to predict whole lake TP concentrations, where Wext is external loading, Wint is internal loading, Ws is loss to sediments and Wout is loss through the lake outlet all in Kg/2 wk. The model was calibrated to observed lake TP concentrations, assuming a TP settling rate of 0.1 m/wk. Initially, a rate of 0.15/wk was used, in line with the rate used for Upper Klamath Lake, OR, also a large (26, 800 ha) and shallow (mean depth 2 m) hypereutrophic lake, also, subject to periods of temporary stratification, and wind-caused sediment re-suspension. The 0.1m/wk was determined by calibrating against lake concentration during May 2010 prior to the onset of TP increase due to internal loading (Figure 3). Starting with the 4th time step 6/12 – 6/25, internal loading rate was calibrated as 4.5 mg/m^2 per day for four time steps and then increased to 6 mg/m^2 per day through September to match the observed increase in lake TP due to internal loading.

There are no data between October 2010 and May 2011 so observed lake TP concentration was estimated during that time period using linear interpolation. Most of that period is under ice with no wind-caused re-suspension and with low temperature, although DO depletion could cause sediment P release as per iron-redox reactions. There are multiple mechanisms for internal loading in shallow lakes during summer (Welch and Cooke, 1995; Cooke et al., 2005). Nevertheless, little or no internal loading was assumed and settling rates were adjusted to produce a steady reduction in lake TP to meet the observed concentration in May 2011 (Figure 3). To do that, settling rate was decreased from 0.1 to 0.05 m/wk from November through January and then to 0.15 m/wk through mid April 2010 and 1.3 and 0.3 m/wk for the next two time steps due to large storm events. That at least allowed the model to run year-to-year continuously and match observed data from late spring to early fall.

Contrary to 2010, internal loading occurred earlier in 2011 when lake TP began to increase in May, versus June in 2010 (Figure 4). Also, maximum whole-lake TP concentration was nearly 100 µg/L less in 2011 than if internal loading had been the same as in 2010. Mean summer (June-September) TP was also 26% less in 2011 (Table 1). Lake TP concentrations are based on data from L-1, L-2 and L-3 only to be consistent with 2010 when only those three sites were samples. The 2011 means at the three sites were lower than the mean for all seven sites (Table 1), but three of the more distant sites were relatively nearshore.

Internal loading rate was adjusted for 2011, assuming the same settling rate (0.1 m/wk) and external loadings during May 2011-October 2011. However, for two time steps during the alum treatment, doubling the settling rate was necessary to reasonably fit the predicted concentration to observed (Figure 5). Therefore, the resulting estimated gross internal loading during 2011 was estimated at 37% less than in 2010 – apparently due to the alum treatment. Had the lake not been treated with alum, TP concentrations during summer 2011 probably would have been much higher as shown in Figure 6.

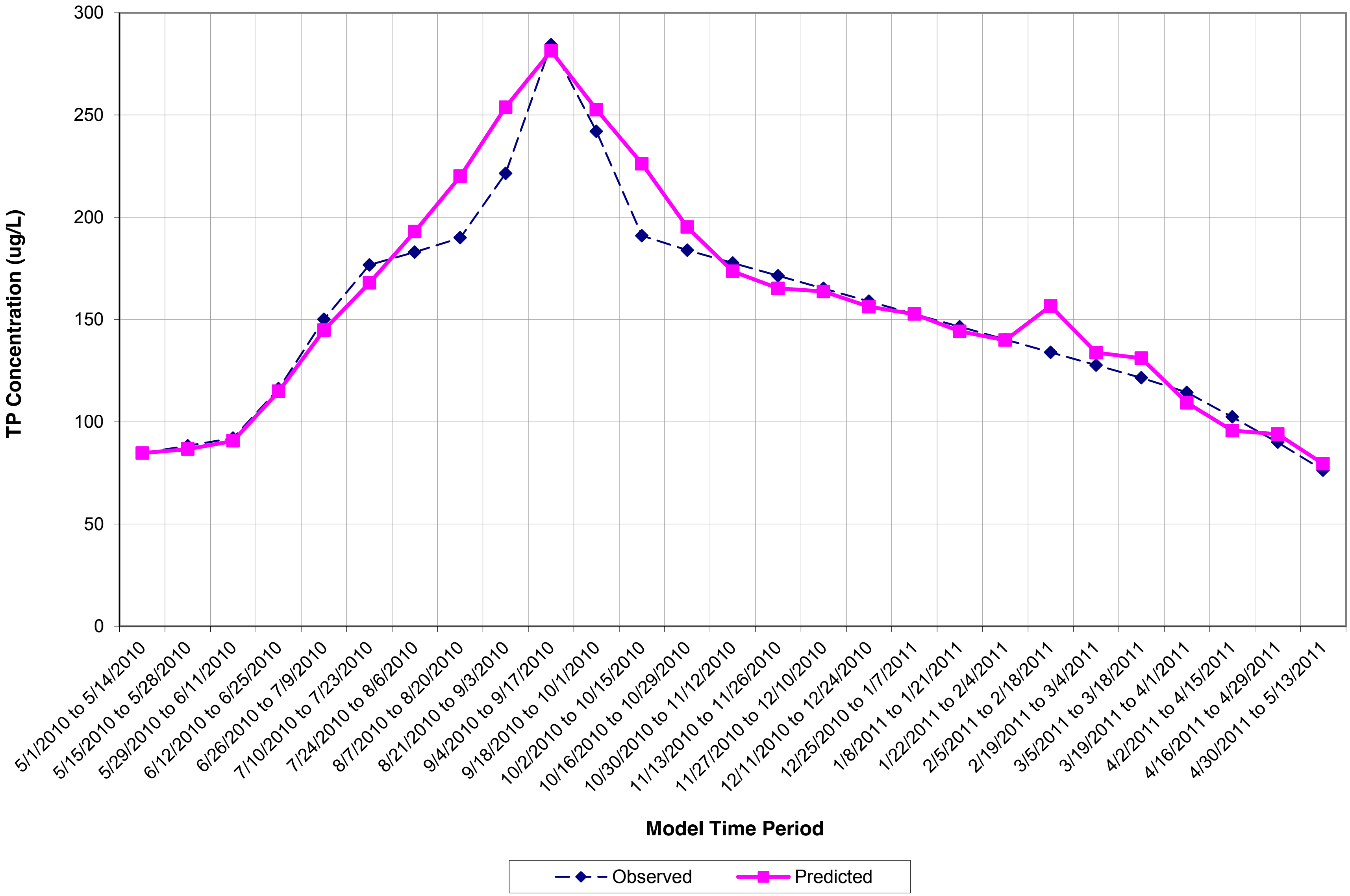

Figure 3. GLSM TP Mass Balance Model Predicted vs. Observed Whole Lake TP Concentrations (Observed Lake TP was estimated during October 2010 to May 2011).

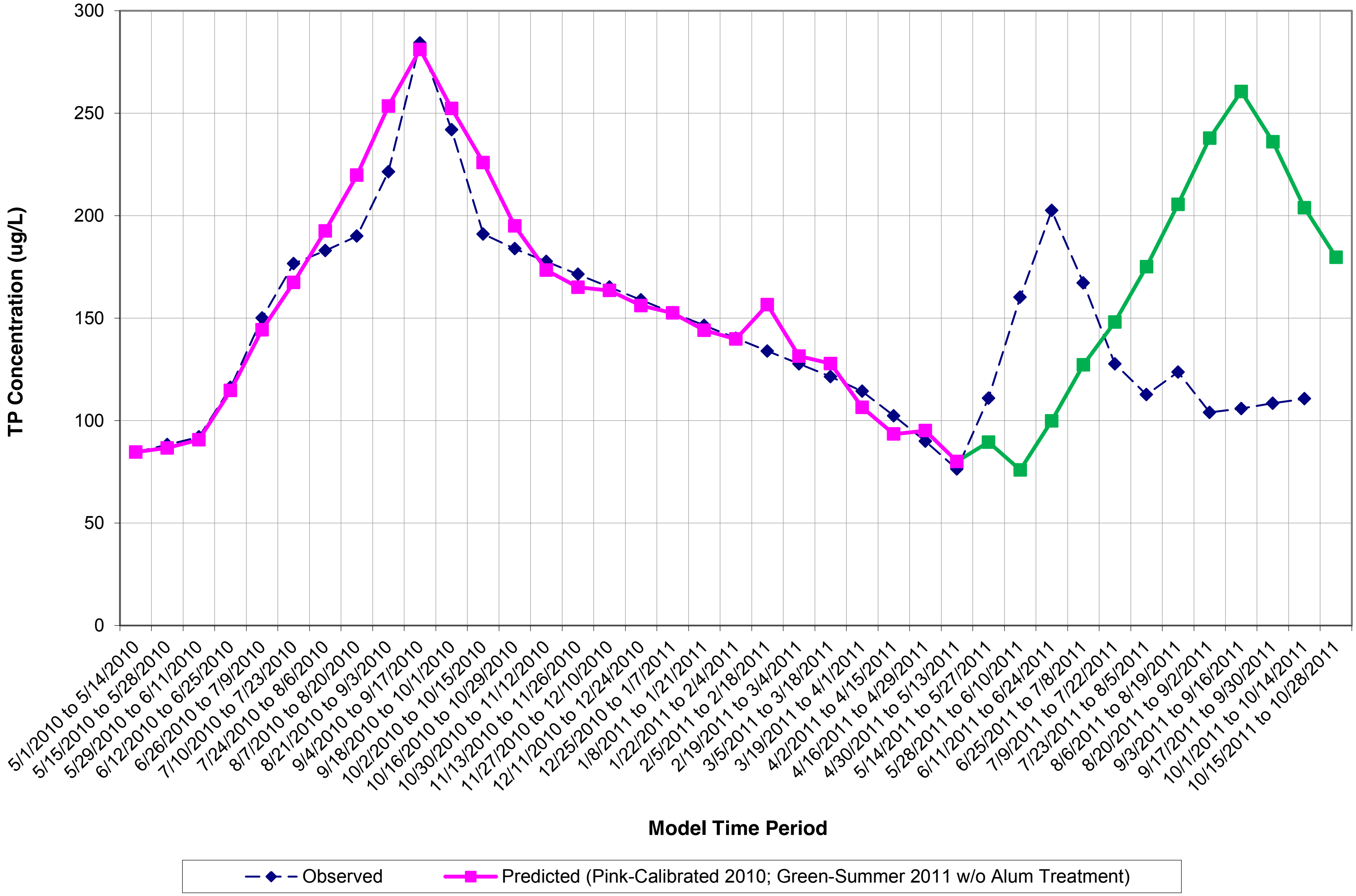

Figure 4. GLSM Predicted vs Observed TP Concentrations for May 2010 to May 2011 (Calibrated) and May 2011 to October 2011 (using calibrated parameters).

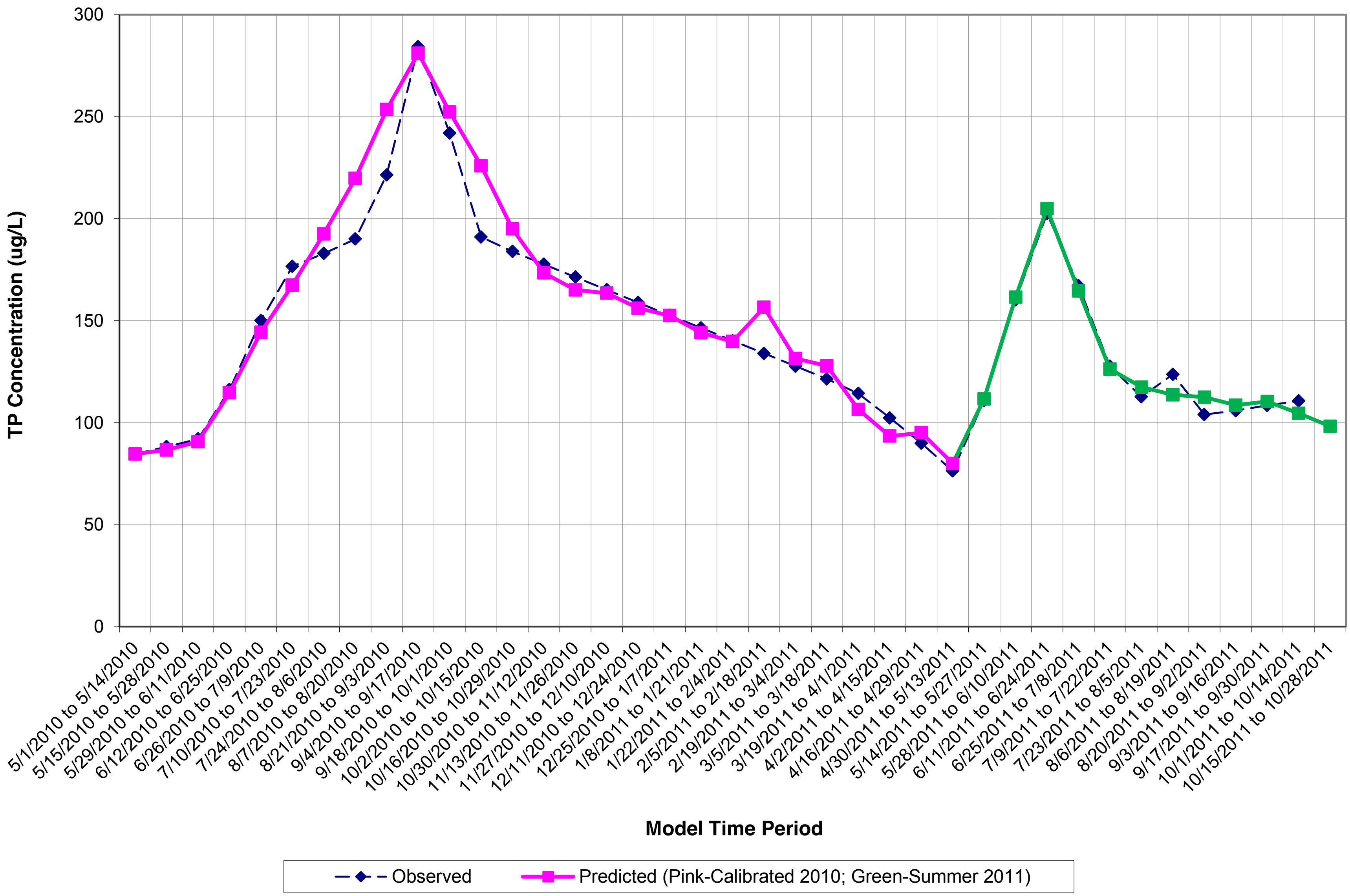

Figure 5. GLSM Predicted vs. Observed TP Concentrations from May 2010 through October 2011; adjustments made to internal loading estimates to match predicted May 2011-October 2011 values to observed TP concentrations.

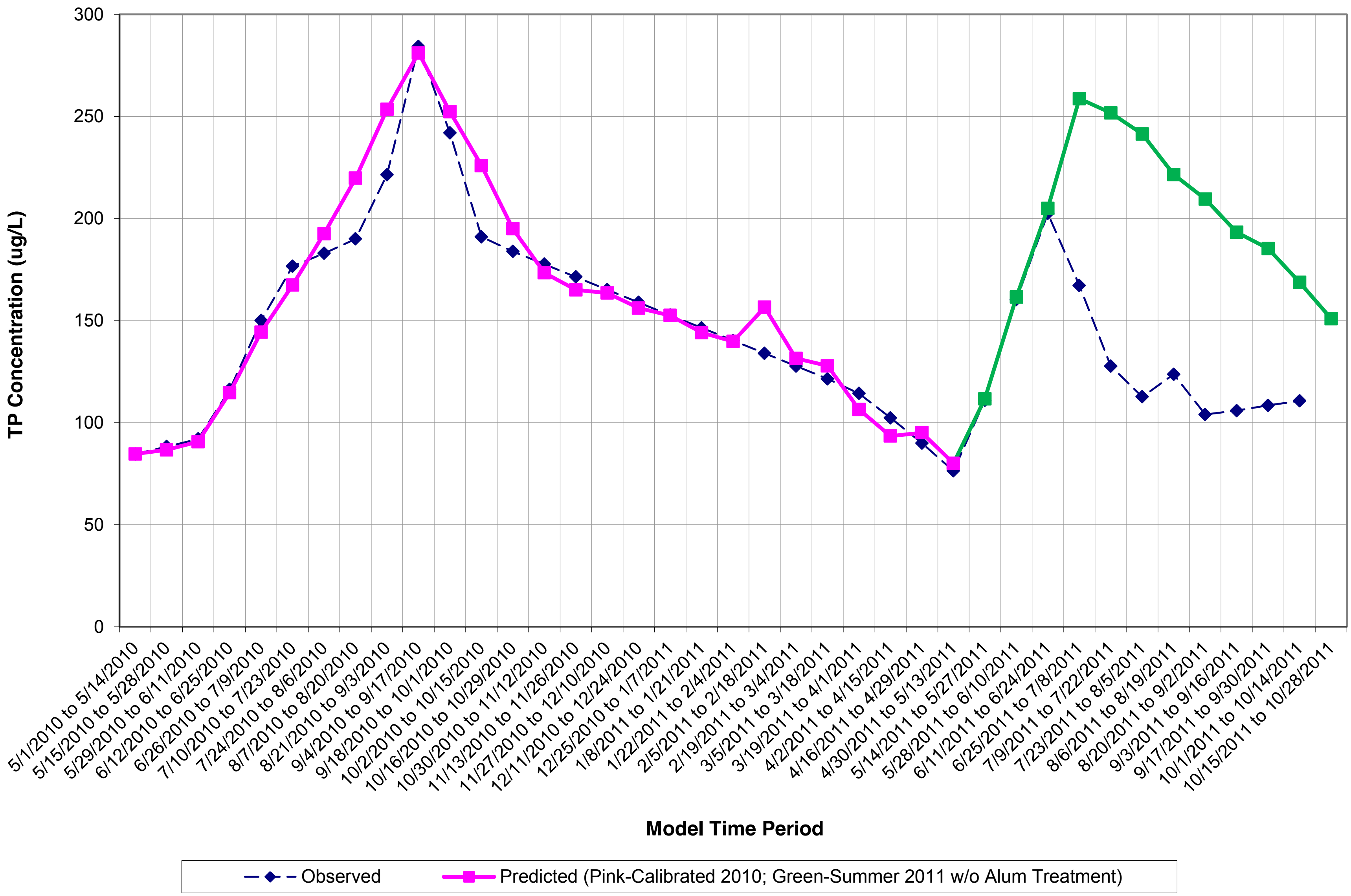

Figure 6. Whole Lake Predicted TP Concentrations in GLSM without reduction in internal loading due to the 2011 Alum Treatment.

4.5. LAKE RESPONSE TO PHOSPHORUS LOAD REDUCTION

Lake TP response to external and internal load reduction was tested using the TP mass balance model calibrated to 2010 data. Reducing internal loading would have more effect on lake TP than reducing external loading (Figures 7 and 8). However, the resulting summer mean lake concentration would still be near 100 µg/L, even if sediment inactivation were 80% effective (Table 4). Reducing both external[1] and internal by at least 80% appears to be needed to reduce summer TP to a sufficiently low level (40 µg/L; Figure 9; Table 4) to substantially improve lake quality as indicated by transparency. Note from the typical chl-transparency relation that chl has to fall below 50 µg/L to see much improvement in lake quality. Assuming a chl:TP ratio of 0.5, 40 µg/L TP would likely result in transparency approaching 1 m (although GLSM would still not be a very clear lake). Nevertheless, the magnitude of blooms and surface scums would be expected to decline in proportion to lake TP reduction, or about 50% with 80% reduction in internal loading and near 80% if both internal and external were reduced by 80% (Table 4).

Internal loading usually declines following external TP load reduction, but to realize a substantial reduction could take decades. Decreased external loading reduces the replenishment of lake sediment P producing surficial sediment lower in P, and, thus, declining sediment P recycling. For GLSM, net internal loading was 25% of external loading and that fraction of loss through the lake outlet (10.6 x 10^3 Kg/yr), or (2.65x10^3 Kg/yr), is only 0.6% of the TP in the top 10 cm of sediment (420 x 10^3 Kg). So internal loading should decline 0.6%/yr, assuming its sediment P released rate is proportional to sediment TP. Considering only sediment mobile P (1.8 g/m^2), which is 20% of TP (8.4 g/m^2), as the source of internal loading, then the 2.65 x 10^3 Kg/yr loss of internal loading through the outlet is mobile P and represents 3.2%/yr of sediment mobile P (84 x 10 ^{3} Kg). Loss of mobile P from sediments may actually be much less, because outflow is least during summer when internal loading occurs.

There is also the process of declining re-enrichment of sediment P as external loading is reduced that would result in a larger fraction of TP loss from the lake coming from internal loading. While there are models that simulate processes involved with internal loading decline following external load reductions, there is little direct evidence from actual case histories where sediment P content and sediment P release rate were measured. In Lake Sobygaard, Denmark, sediment P was observed to decline by almost 40% over a sediment depth of 25 cm in 13 years after an 80-90% TP load reduction. However, sediment release rates of 30-50 mg/m^2 per day have continued to result in no improvement in lake quality (see p. 105, Cooke et al., 2005).

Considering these possibilities and uncertainties for rates of sediment P loss and internal loading decline, a range of likely rates was used to predict lake response (Table 5). Response will be slow if internal loading decline is around 1%/year regardless of how much external loading is reduced. Even at a higher rate of decline – 5%/year – several decades would be needed to substantially improve lake quality, i.e., reach 40 µg/L TP. Therefore, internal loading control is obviously needed, as well as external load reduction, even if an optimistic internal loading reduction rate of 5%/year is assumed.

[1] Note that Ohio EPA's Total Maximum Daily Load report for the Grand Lake St. Marys watershed also recommended external load reductions of approximately 80%.

Table 4. Summer Mean Whole Lake TP Concentrations in GLSM under various treatment scenarios.

Alternative	Mean Summer TP (µg/L), June-September	
	Year 1	Year 2
Observed	**184**	--
Existing Conditions	191	193
Internal Loading Reduced 20%	166	168
Internal Loading Reduced 40%	141	144
Internal Loading Reduced 80%	91	95
External Loading Reduced 20%	186	179
External Loading Reduced 40%	181	166
External Loading Reduced 80%	171	139
Internal & External Loading Reduced 20%	161	155
Internal & External Loading Reduced 40%	131	117
Internal & External Loading Reduced 80%	71	41
External Reduced 20%; Internal Reduced 40%	136	130
External Reduced 40%; Internal Reduced 20%	156	141

Table 5. Projected Summer Mean Whole Lake TP Concentrations in GLSM under various treatment scenarios
for 75 years.

Scenario	Mean Summer TP (µg/L), June-September									
	Year 1	Year 5	Year 10	Year 20	Year 30	Year 40	Year 50	Year 60	Year 70	Year 75
External Loading Reduced 20% w/ Internal Reduced 1% each year	186	174	169	158	148	139	132	124	118	115
External Loading Reduced 20% w/ Internal Reduced 5% each year	186	156	134	103	84	73	67	63	60	59
External Loading Reduced 40% w/ Internal Reduced 1% each year	181	161	155	145	135	126	118	111	105	102
External Loading Reduced 40% w/ Internal Reduced 5% each year	181	143	121	90	71	60	53	49	47	46
External Loading Reduced 80% w/ Internal Reduced 1% each year	171	135	129	118	108	100	92	85	78	75
External Loading Reduced 80% w/ Internal Reduced 5% each year	171	117	94	63	45	33	27	23	20	20

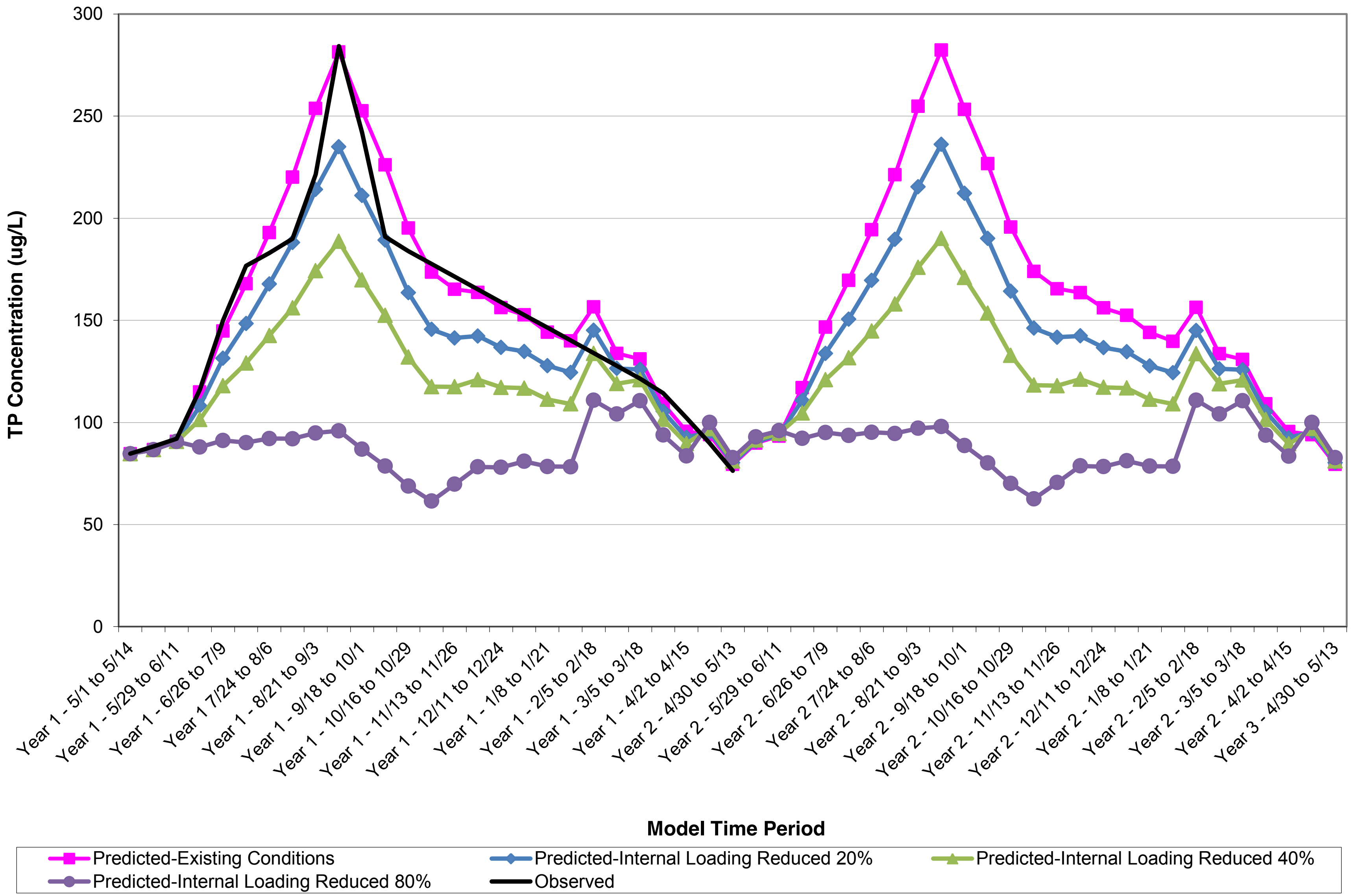

Figure 7. Whole Lake Predicted TP Concentrations in GLSM for various reductions in Internal Loading.

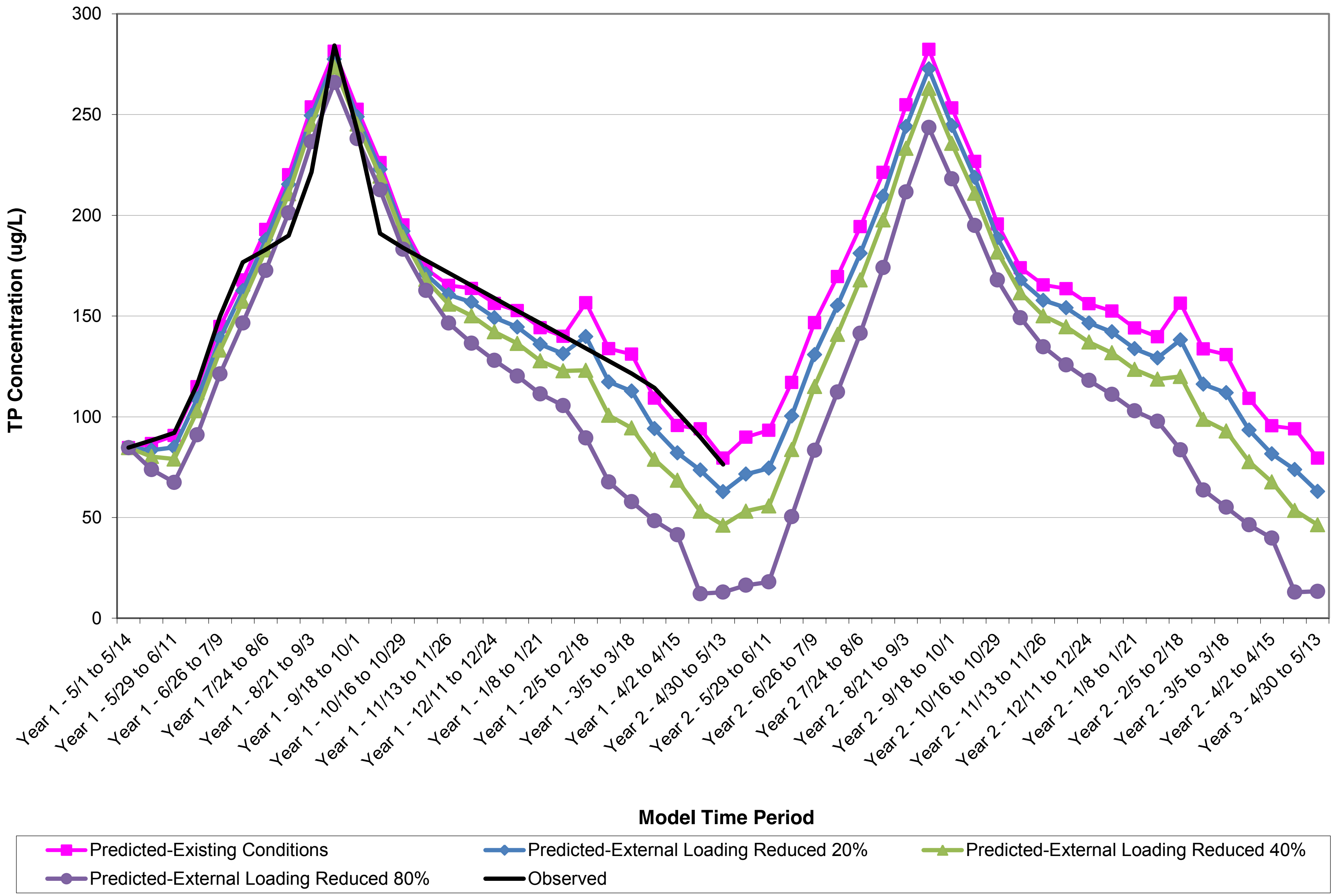

Figure 8. Whole Lake Predicted TP Concentrations in GLSM with various reductions in External Loading.

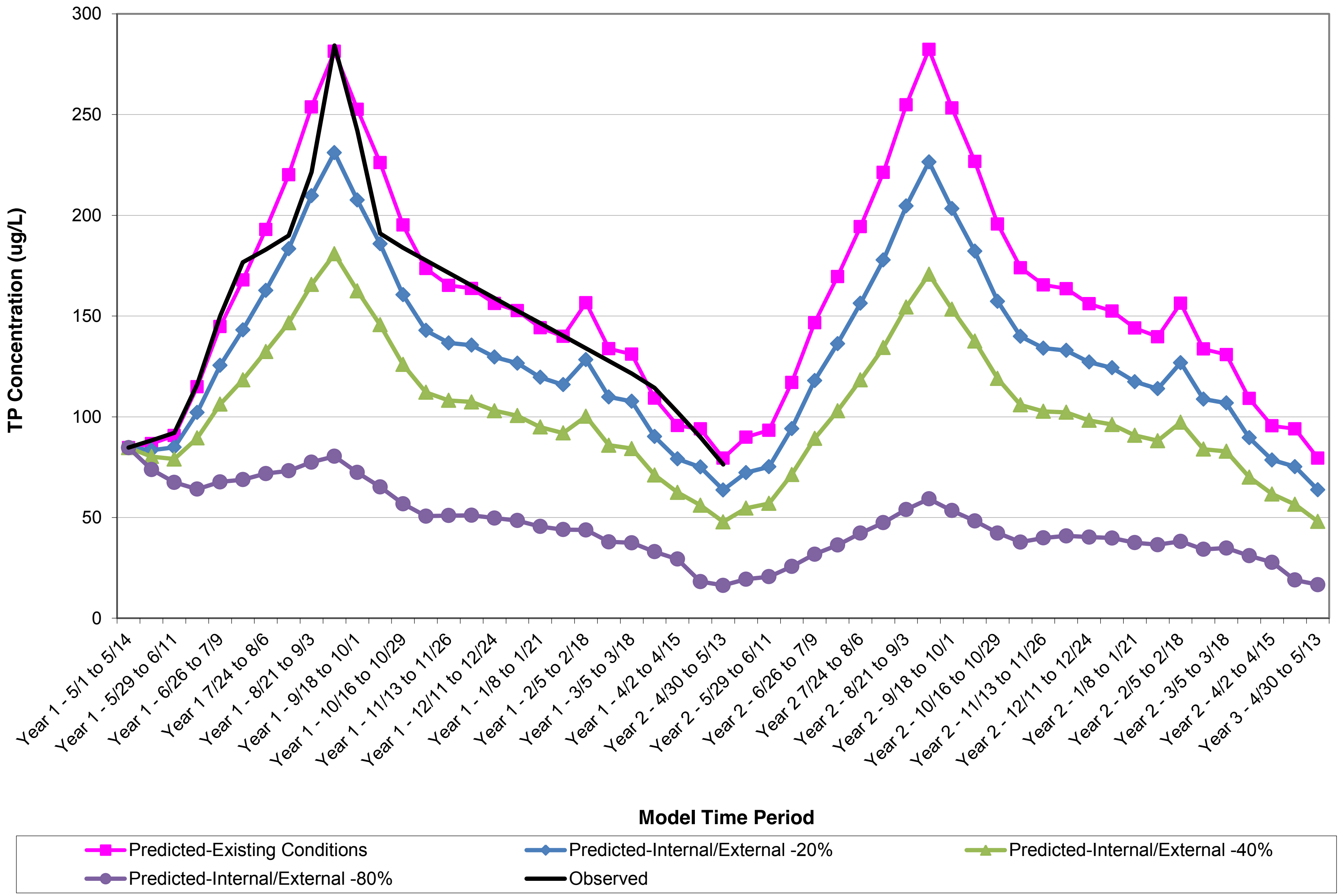

Figure 9. Whole Lake Predicted TP Concentrations in GLSM for various reductions in External and Internal Loading.

4.6. DISSOLVED OXYGEN, PH AND TEMPERATURE

Due to oxygen demand created by the cyanobacteria bloom, there was concern that the alum treatment could adversely affect DO by concentrating the oxygen demand; if it were already low and that could precipitate a fish kill. Alum might exacerbate an already critical DO problem by flocculating and settling the large algal mass to the lake bottom where it would respire, but not photosynthesize, i.e., remove DO without replacing it. Thus, treatment with alum was allowed only when DO at the surface was 5 mg/L or higher.

The extensive, continuous data for DO, pH and temperature show that critical DO conditions were caused by high algal biomass and the strength of stratification. While the lake is shallow and is usually well mixed, the water column can nevertheless stratify temporally if wind speed is low. When stratified, the buoyant cyanobacteria can remain near the surface producing DO through photosynthesis to supersaturated levels. At the same time, the respiration by algae and bacteria in the water and in the surficial sediment lowers DO at the bottom. With mixing, bottom water would frequently be aerated at the surface and DO produced would be distributed throughout the water column, minimizing either severely under or supersaturated conditions. Those effects are shown by a direct relation between RTRM and the difference between surface and bottom DO on a daily average basis (Figure 10). RTRM is relative thermal resistance to mixing, defined as:

$$(D_b - D_s)/(D_4 - D_5)$$

Where Ds is surface density, D_b is bottom density and D_4 and D_5 are densities at 4°C and 5°C. As temperature increases the density difference between successive temperatures increases, so that slight differences between surface and bottom temperatures at high temperature can result in sufficient density differences to temporarily stratify the water column, so long as wind speed is low. In Moses Lake, WA, a 1.5 m water column stratified enough that bottom DO began to decline if wind speed were < 3 m/s. Wind speed had a similar effect on RTRM and surface-to-bottom DO difference in Klamath Lake, OR (Kann and Welch, 2005).

There was also a tendency for minimum daily bottom DO to relate to water column RTRM (Figure 11). If RTRM exceeded 30, bottom DOs were almost always < 4 mg/L, but for bottom DO to exceed 4 mg/L required RTRMs well below 30 (Figure 11).

High rates of photosynthesis also raised pH to well above levels that can adversely affect aquatic animals. Most of the maximum pH levels were above 9.0 (Figure 12). Except for lower pH levels in the 8-9 range at the NW and NE YSI sonde sites, maximum daily pH levels were generally related to maximum daily DOs, showing that algal photosynthesis causes high pH and supersaturated DO to over 200% at times. Reasons for the lower pH and DO levels at the NW and NE sites (Figure 12) are not apparent. Chlorophyll a levels were lower at the NE site than SE and SW, but not at the NW site.

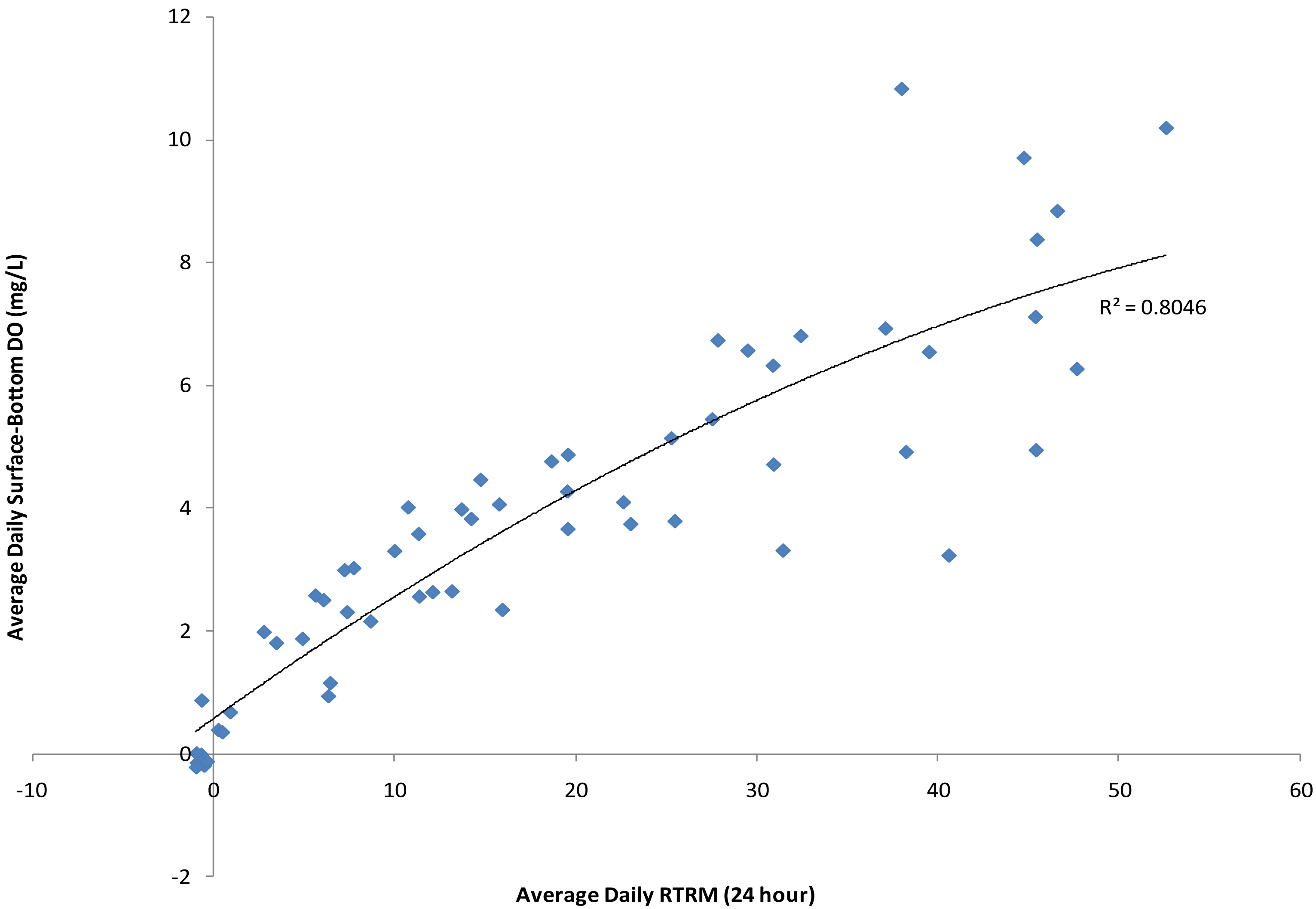

Figure 10. Relationship between Average Daily RTRM (24-hour) and Average Daily Difference between surface and bottom DO concentrations at the USGS continuous monitoring station, Grand Lake St. Marys, June/July 2011.

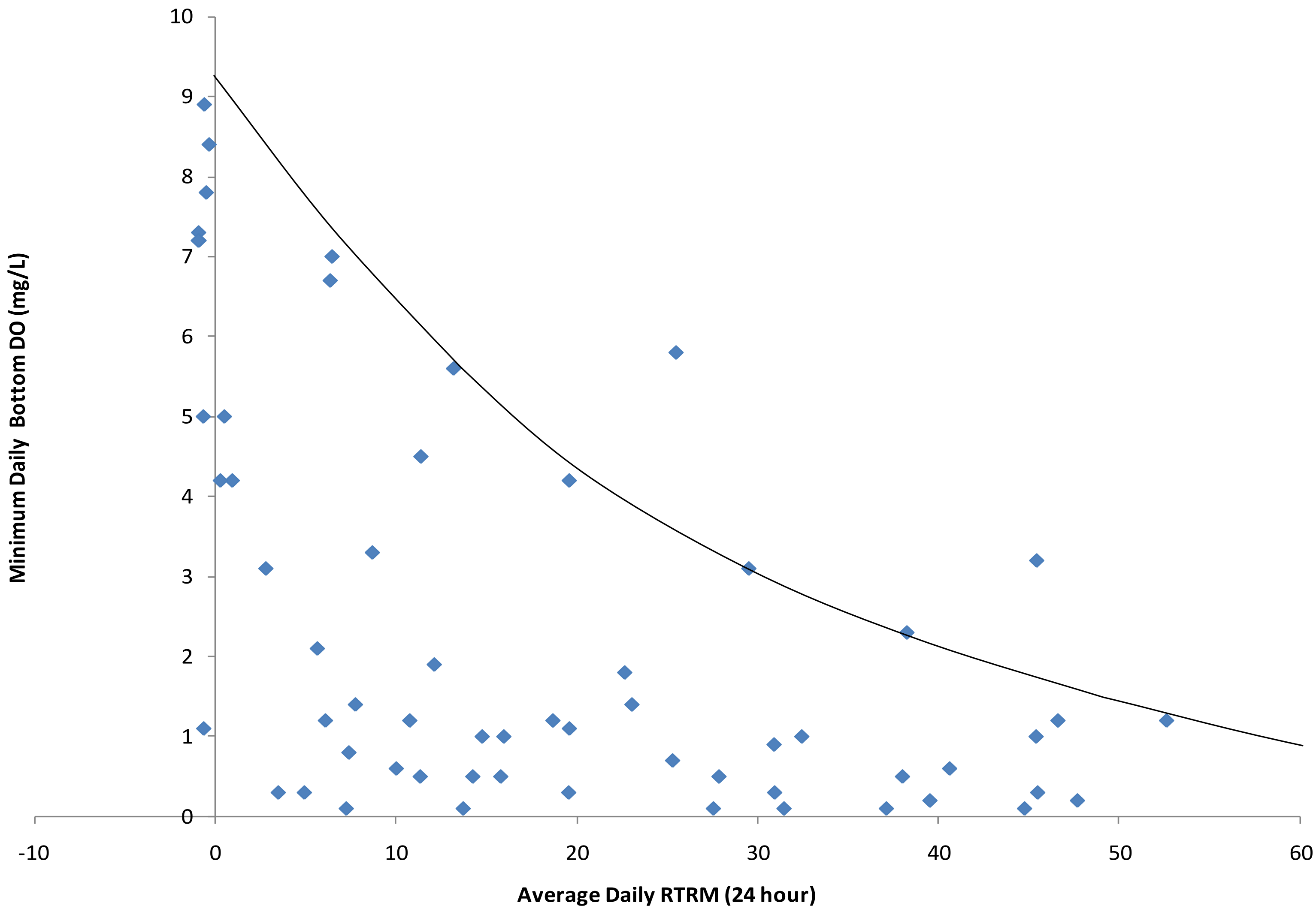

Figure 11. Average Daily RTRM (24-hour) at the USGS continuous monitoring station and minimum bottom DO concentrations for Grand Lake St. Marys, June/July 2011.

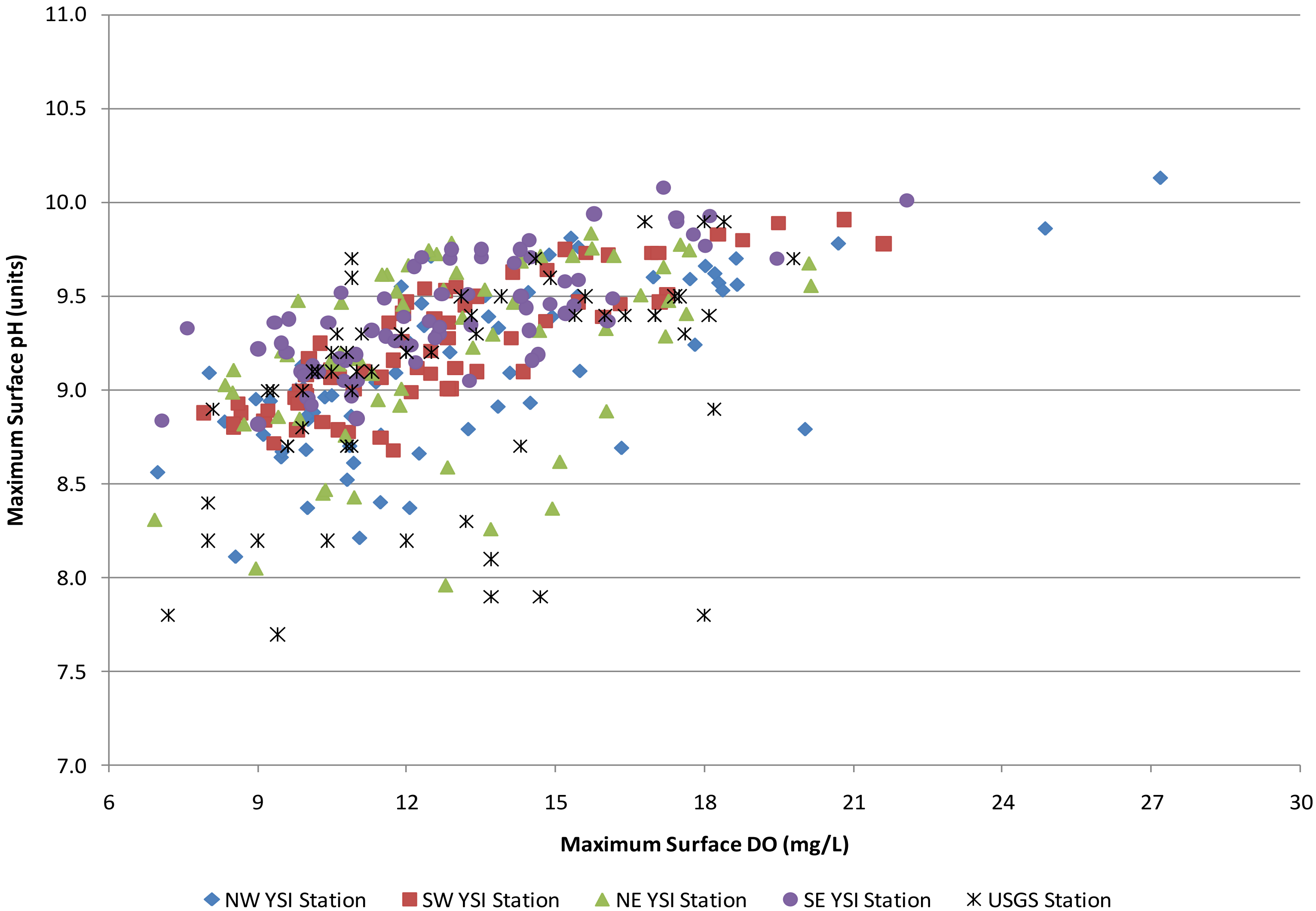

Figure 12. Maximum surface pH vs. maximum surface DO concentrations, Grand Lake St. Marys, June 1st through August 8th, 2011. USGS Station data is only from June 1st through July 31.

5. SUMMARY AND CONCLUSIONS

- GLSM is a hypereutrophic lake experiencing excess P loading resulting in primary production of algae that is at or approaching the maximum level attainable for that lake and under that geochemical setting. This means that to re-establish limnological balance of the lake environment dramatic reduction in P loading is necessary.

- The 2011 alum treatment was not conducted during optimum conditions; instead the 2011 alum treatment occurred during a period of very high algal abundance which most likely limited the effectiveness of the treatment.

- The gross internal loading during 2011 was estimated at 37% less than in 2010 as projected by the P mass balance model. This reduction is apparently due to the alum treatment. Had the lake not been treated with alum, TP concentrations during summer 2011 were expected to have been much greater. This is based on the assessment of treatment effectiveness by comparing summer means for 2010, before treatment, with that for 2011. That comparison shows a 26% reduction in whole lake TP using data from the three long-term monitoring stations L-1, L-2 and L-3 (Table 1).

- Reducing both external and internal P loading by at least 80% appears to be necessary to reduce summer TP to a sufficiently low level (40 µg/L; Figure 9; Table 4) to substantially improve lake quality as indicated by transparency. Note from the typical chl-transparency relation that chl has to fall below 50 µg/L to see much improvement in lake quality. Assuming a chl:TP ratio of 0.5, 40 µg/L TP would likely result in transparency approaching 1 m (although GLSM would still not be a very clear lake). Nevertheless, the magnitude of blooms and surface scums would be expected to decline in proportion to lake TP reduction.

- A range of likely sedimentation and internal P loading rates was used to predict lake response to external P loading controls. Lake response will be slow if internal loading decline is only around 1%/year regardless of how much external loading is reduced. Even at a higher rate of decline – 5%/year – a significant period of time would be needed to substantially improve lake quality, i.e., reach 40 µg/L TP. Therefore, internal loading control is obviously needed, as well as external load reduction, even if an optimistic internal loading reduction rate of 5%/year is assumed.

- Critical DO conditions in GLSM were caused by high algal biomass and the strength of stratification. While the lake is shallow and is usually well mixed, the water column can nevertheless stratify temporally if wind speed is low. When stratified, the buoyant cyanobacteria can remain near the surface producing DO through photosynthesis to supersaturated levels. At the same time, the respiration by algae and bacteria in the water and in the surficial sediment lowers DO at the bottom and may lead in total loss of dissolved oxygen.

- The GLSM TP budget illustrates that external loading during the study period accounted for 75% of the total TP load to the lake (Table 2), with only 8.7% of that occurring during the critical summer months. Internal loading on the other hand, contributed only 25% of the total TP load to GLSM but over 91% of the total summer load to GLSM (Table 2).

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APPENDIX A: GRAND LAKE ST. MARYS SEDIMENT DATA PRE- AND POST-ALUM TREATMENT

Table 1. Summary of Sediment Aluminum at Stations L-1, L-2, L-3 pre and post 2011 alum treatment as well as sediment aluminum at 2011 Alum Demo locations Campground Lagoon and Windy Point, pre and post alum demo.

Site	Depth (cm)	Aluminum (mg/kg)	
		Pre* (11/18/2010)	Post (10/12/2011)
GLSM L-1	0	18,629	16,523
GLSM L-1	2	18,509	17,083
GLSM L-1	4	18,180	16,934
GLSM L-1	6	18,186	17,435
GLSM L-1	8	18,413	
GLSM L-1	10	18,186	17,462
GLSM L-1	15	17,878	16,143
GLSM L-1	20	16,923	17,302
GLSM L-1	25	14,961	

Pre-Alum Aluminum concentrations are an average of Station L-1N and L-1S.

Site	Depth (cm)	Aluminum (mg/kg)	
		Pre* (11/18/2010)	Post (10/12/2011)
GLSM L-2	0	20,768	17,971
GLSM L-2	2	20,069	18,013
GLSM L-2	4	20,138	19,534
GLSM L-2	6	20,122	18,819
GLSM L-2	8	21,568	
GLSM L-2	10	21,885	18,528
GLSM L-2	15	22,057	18,970
GLSM L-2	20	22,358	19,204
GLSM L-2	25	22,630	

Pre-Alum Aluminum concentrations are an average of Station L-2N and L-2S.

Site	Depth (cm)	Aluminum (mg/kg)	
		Pre* (11/18/2010)	Post (10/12/2011)
GLSM L-3	0	14,365	12,251
GLSM L-3	2	14,518	12,524

GLSM L-3	4	14,951	13,113
GLSM L-3	6	14,541	13,264
GLSM L-3	8	14,986	
GLSM L-3	10	14,795	13,279
GLSM L-3	15	14,848	12,956
GLSM L-3	20	12,542	12,388
GLSM L-3	25	13,123	

Pre-Alum Aluminum concentrations are an average of Station L-3N and L-3S.

Site	Depth (cm)	Aluminum (mg/kg)	
		Pre (3/28/2011)	Post (10/12/2011)
GLSM CAMP LAGOON	0	10,226	16,828
GLSM CAMP LAGOON	2	7,564	16,187
GLSM CAMP LAGOON	4	11,041	17,884
GLSM CAMP LAGOON	6	13,333	25,854
GLSM CAMP LAGOON	8	13,431	
GLSM CAMP LAGOON	10	13,687	23,236
GLSM CAMP LAGOON	15	16,584	17,385
GLSM CAMP LAGOON	20	15,831	15,402
GLSM CAMP LAGOON	25	15,154	

Site	Depth (cm)	Aluminum (mg/kg)	
		Pre (3/28/2011)	Post (10/12/2011)
GLSM WINDY POINT	0	15,067	21,269
GLSM WINDY POINT	2	20,967	33,465
GLSM WINDY POINT	4	16,554	33,626
GLSM WINDY POINT	6	17,336	15,788
GLSM WINDY POINT	8	16,718	
GLSM WINDY POINT	10	16,095	16,028
GLSM WINDY POINT	15	16,339	16,125
GLSM WINDY POINT	20	17,327	16,542
GLSM WINDY POINT	25	17,528	

Table 2. Sediment characteristics at Stations L-1, L-2, and L-3 pre and post 2011 alum treatment.

Site	Depth (cm)	% SOLIDS		% WATER		TOC (%)		TOTAL-P (mg/kg)		LOOSELY BOUND P (mg/kg)		FE BOUND P (mg/kg)		AL BOUND P (mg/kg)		CA BOUND P (mg/kg)		ORGANIC P (mg/kg)	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
GLSM L-1	0	11.4%	12.9%	88.6%	87.1%	9.95	9.34	2182	1020	<2.00	<2.00	96.7	59.8	1015	260	717	144	352	555
GLSM L-1	2	18.8%	15.9%	81.2%	84.1%	7.70	8.76	1091	975	4.43	<2.00	49.0	50.8	424	246	403	153	211	523
GLSM L-1	4	17.0%	16.8%	83.0%	83.2%	11.3	8.72	686	966	<2.00	<2.00	29.3	60.0	358	241	199	153	97.3	512
GLSM L-1	6	18.5%	18.4%	81.5%	81.6%	11.6	8.97	747	928	<2.00	<2.00	64.4	75.4	305	254	235	151	141	447
GLSM L-1	8	19.6%		80.4%		8.49		491		<2.00		31.8		204		156		96.6	
GLSM L-1	10	20.4%	19.7%	79.6%	80.3%	9.52	10.2	761	907	<2.00	<2.00	46.9	54.2	261	269	311	161	140	422
GLSM L-1	15	21.8%	22.6%	78.2%	77.4%	11.5	8.76	403	768	<2.00	<2.00	20.4	55.8	117	184	183	166	81.5	361
GLSM L-1	20	26.2%	25.0%	73.8%	75.0%	11.7	9.02	394	731	<2.00	<2.00	37.5	64.4	105	175	168	157	81.0	333
GLSM L-1	25	27.1%		72.9%		14.8		416		<2.00		40.4		129		165		79.9	

Site	Depth (cm)	% SOLIDS		% WATER		TOC (%)		TOTAL-P (mg/kg)		LOOSELY BOUND P (mg/kg)		FE BOUND P (mg/kg)		AL BOUND P (mg/kg)		CA BOUND P (mg/kg)		ORGANIC P (mg/kg)	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
GLSM L-2	0	13.2%	13.3%	86.8%	86.7%	8.20	5.87	1823	1623	<2.00	<2.00	203	65	649	653	635	265	334	640
GLSM L-2	2	16.4%	17.5%	83.6%	82.5%	5.19	5.84	891	1305	8.10	<2.00	100	59	366	490	272	236	144	520

GLSM L-2	4	17.4%	19.2%	82.6%	80.8%	4.79	5.20	597	1268	5.33	<2.00	83.5	47	218	485	176	264	114	472
GLSM L-2	6	18.5%	20.2%	81.5%	79.8%	6.10	5.80	820	1169	<2.00	<2.00	51.5	31	303	440	310	249	153	449
GLSM L-2	8	20.8%		79.2%		5.44		556		<2.00		54.0		174		210		117	
GLSM L-2	10	23.3%	22.7%	76.7%	77.3%	6.16	4.86	485	1067	<2.00	<2.00	39.9	44	139	376	189	244	115	403
GLSM L-2	15	25.6%	25.2%	74.4%	74.8%	4.61	4.41	479	961	<2.00	<2.00	51.6	41	127	311	195	259	105	350
GLSM L-2	20	29.5%	31.4%	70.5%	68.6%	3.99	3.79	411	796	<2.00	<2.00	27.1	21	160	280	136	201	87.6	294
GLSM L-2	25	32.4%		67.6%		3.93		392		<2.00		19.8		151		138		83.3	

Site	Depth (cm)	% SOLIDS		% WATER		TOC (%)		TOTAL-P (mg/kg)		LOOSELY BOUND P (mg/kg)		FE BOUND P (mg/kg)		AL BOUND P (mg/kg)		CA BOUND P (mg/kg)		ORGANIC P (mg/kg)	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
GLSM L-3	0	15.1%	15.2%	84.9%	84.8%	7.81	6.62	1151	950	6.50	3.10	104	113	396	188	427	137	216	510
GLSM L-3	2	15.4%	19.3%	84.6%	80.7%	8.64	6.07	639	730	3.12	<2.00	43.1	42.1	280	159	195	153	118	375
GLSM L-3	4	20.0%	21.0%	80.0%	79.0%	5.85	6.50	628	726	2.69	<2.00	67.0	46.2	214	153	223	169	121	357
GLSM L-3	6	21.6%	23.0%	78.4%	77.0%	6.16	6.47	507	733	2.07	<2.00	48.3	46.7	160	158	196	193	100	334
GLSM L-3	8	22.8%		77.2%		7.18		515		2.13		58.1		140		201		113	
GLSM L-3	10	25.1%	24.6%	74.9%	75.4%	6.24	6.47	1486	654	2.28	<2.00	96.7	38.4	1015	150	240	181	132	285
GLSM L-3	15	30.4%	28.4%	69.6%	71.6%	6.50	5.37	343	616	<2.00	<2.00	29.3	16.5	98.0	144	146	186	69.3	269

GLSM L-3	20	34.7%	31.5%	65.3%	68.5%	6.71	5.38	310	590	<2.00	<2.00	20.4	31.6	110	143	122	176	58.1	239
GLSM L-3	25	37.0%		63.0%		7.59		483		<2.00		22.4		175		196		89.6	

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APPENDIX B: GRAND LAKE ST. MARYS WATER BUDGET

GLSM WATER BUDGET

Description: Water Budget based on a twice monthly timestep

Inflows + Precipitation - Outflow - Evaporation + GW = Change in Lake Storage

Water Year	Bi-Week Number	Date Range		Inflows															
		From	To	Precipitation Depth (m)	Direct Precipitation Inflow (m^3)	Chickasaw Creek Inflow (m^3)	Chickasaw WWTP Inflow (m^3)	Barnes Creek Inflow (m^3)	Beaver Creek Inflow (m^3)	Montezuma WWTP Inflow (m^3)	Burntwood Creek Inflow (m^3)	Coldwater Creek Inflow (m^3)	St. Henry's WWTP Inflow (m^3)	Little Chickasaw Creek Inflow (m^3)	Prairie Creek Inflow (m^3)	Ungaged Basin Inflow (m^3)	Elks ADF Inflow (m^3)	Marion Local School ADF Inflow (m^3)	Northwood WWTP Inflow (m^3)
WY 2011	1	5/1/2010	5/14/2010	0.0483	2,518,594	269,153	0	37,776	242,395	0	102,310	280,171	16,660	110,180	56,664	61,386	24	499	4,127
	2	5/15/2010	5/28/2010	0.0427	2,226,967	970,909	0	136,268	874,386	0	369,059	1,010,654	65,504	397,448	204,402	221,435	24	499	7,960
	3	5/29/2010	6/11/2010	0.0732	3,817,658	1,246,180	0	174,902	1,122,290	0	473,694	1,297,193	10,602	510,132	262,354	284,216	24	499	6,678
	4	6/12/2010	6/25/2010	0.0630	3,287,428	782,991	0	109,894	705,150	0	297,628	815,044	15,903	320,523	164,840	178,577	24	499	7,976
	5	6/26/2010	7/9/2010	0.0244	1,272,553	152,732	0	21,436	137,548	0	58,056	158,984	5,301	62,522	32,154	34,834	24	499	2,225
	6	7/10/2010	7/23/2010	0.0025	132,558	15,807	0	2,218	14,235	0	6,008	16,454	14,010	6,471	3,328	3,605	24	499	1,231
	7	7/24/2010	8/6/2010	0.0843	4,400,911	53,341	0	7,486	48,038	0	20,276	55,525	33,320	21,836	11,230	12,166	24	499	4,316
	8	8/7/2010	8/20/2010	0.0114	596,509	65,894	0	9,248	59,343	0	25,047	68,591	8,709	26,974	13,872	15,028	24	499	1,279
	9	8/21/2010	9/3/2010	0.0109	569,998	4,943	0	694	4,451	0	1,879	5,145	0	2,023	1,041	1,127	24	499	875
	10	9/4/2010	9/17/2010	0.0097	503,719	147	0	21	132	0	56	153	0	60	31	33	24	499	896
	11	9/18/2010	10/1/2010	0.0254	1,325,576	28,897	0	4,056	26,024	0	10,984	30,080	1,515	11,829	6,084	6,591	24	499	1,028
	12	10/2/2010	10/15/2010	0.0302	1,577,435	19,379	0	2,720	17,452	0	7,366	20,172	11,359	7,933	4,080	4,420	24	499	1,421
	13	10/16/2010	10/29/2010	0.0269	1,405,110	20,872	0	2,929	18,797	0	7,934	21,726	21,961	8,544	4,394	4,760	24	499	1,064
	14	10/30/2010	11/12/2010	0.0005	26,512	7,316	0	1,027	6,589	0	2,781	7,616	13,252	2,995	1,540	1,669	24	499	845
	15	11/13/2010	11/26/2010	0.1433	7,476,247	430,749	96,553	60,456	387,926	4,582	163,735	448,382	54,713	176,330	90,684	98,241	24	499	3,313
	16	11/27/2010	12/10/2010	0.0231	1,206,274	488,956	5,952	68,625	440,347	82,695	185,861	508,972	13,252	200,158	102,938	111,516	24	499	7,553
	17	12/11/2010	12/24/2010	0.0163	848,368	163,449	0	22,940	147,200	90,116	62,130	170,140	13,252	66,909	34,410	37,278	24	499	4,808
	18	12/25/2010	1/7/2011	0.0130	676,044	319,069	0	44,782	287,349	45,058	121,284	332,130	17,228	130,613	67,172	72,770	24	499	1,286
	19	1/8/2011	1/21/2011	0.0175	914,647	153,173	0	21,498	137,945	0	58,224	159,443	0	62,702	32,247	34,934	24	499	660
	20	1/22/2011	2/4/2011	0.0389	2,028,131	175,439	0	24,623	157,998	0	66,687	182,621	0	71,817	36,935	40,012	24	499	694
	21	2/5/2011	2/18/2011	0.0094	490,463	2,223,206	0	312,029	2,002,186	0	845,078	2,314,215	39,757	910,084	468,043	507,047	24	499	3,562
	22	2/19/2011	3/4/2011	0.1118	5,832,533	2,682,842	4,468	376,539	2,416,127	49,980	1,019,794	2,792,666	137,824	1,098,240	564,809	611,876	24	499	13,359
	23	3/5/2011	3/18/2011	0.0714	3,724,868	3,168,352	11,170	444,681	2,853,369	174,931	1,204,344	3,298,050	81,029	1,296,986	667,021	722,607	24	499	12,261
	24	3/19/2011	4/1/2011	0.0356	1,855,806	841,716	0	118,136	758,036	173,606	319,950	876,172	20,257	344,562	177,203	191,970	24	499	9,040
	25	4/2/2011	4/15/2011	0.0488	2,545,105	935,919	0	131,357	842,875	156,378	355,759	974,232	50,548	383,125	197,036	213,455	24	499	8,511
	26	4/16/2011	4/29/2011	0.1270	6,627,878	5,086,997	0	713,964	4,581,272	156,378	1,933,654	5,295,237	179,475	2,082,396	1,070,947	1,160,192	24	499	8,668
WY 2012	27	4/30/2011	5/13/2011	0.0693	3,618,822	1,490,130	0	209,141	1,341,989	11,170	566,424	1,551,130	947	609,995	313,712	339,854	24	499	8,860
	Annual Totals			**1.18**	**61,506,710**	**21,798,559**	**118,143**	**3,059,447**	**19,631,451**	**944,892**	**8,286,002**	**22,690,898**	**826,378**	**8,923,387**	**4,589,170**	**4,971,601**	**644**	**13,470**	**124,496**

$y = 3{,}438{,}582.2656x^3 - 11{,}173{,}079.5961x^2 - 526{,}854{,}903.3060x + 3{,}022{,}546{,}821.0000$

$R^2 = 1.0000$

volume equation in cubic feet

Outflows						Internal Volume				Balance	
Pan Evaporation (m)	**Surface Evaporation V (m^3)**	**Groundwater Outflow (m^3)**	**Celina Water Treatment Plant Withdrawl (m^3)**	**St. Marys Outlet (m^3)**	**Outlet (m^3)**	**Adjusted Lake Elevation at Timestep (ft)**	**Volume at Timestep (ft^3)**	**Volume at Timestep (m^3)**	**Change in Storage per Timestep (m^3)**	**(Assumed Difference is MISC. Outflow/Inflow or BUDGET ERROR) (m^3)**	**Absolute Percent Difference Between BUDGET ERROR and Lake Volume at Time Step**
0.0648	3,382,356	150,000	81,049	159,877	1,598,771	-0.50	3,282,751,180	92,967,513	-1,294,451	377,664	0.41%
0.0648	3,382,356	200,000	74,343	194,647	1,946,468	-0.83	3,451,843,570	97,756,210	4,788,696	4,100,994	4.20%
0.0769	4,015,311	400,000	62,986	239,638	2,396,384	-0.83	3,451,843,570	97,756,210	0	-2,092,102	2.14%
0.0802	4,187,935	400,000	64,677	337,254	3,372,540	-1.08	3,575,821,594	101,267,268	3,511,058	5,186,988	5.12%
0.0807	4,212,694	400,000	69,123	187,693	1,876,928	-0.58	3,325,394,355	94,175,168	-7,092,099	-2,284,529	2.43%
0.0810	4,226,448	400,000	74,393	124,542	1,245,421	-0.33	3,196,796,314	90,533,272	-3,641,897	2,212,462	2.44%
0.0768	4,005,804	500,000	70,112	74,614	746,142	-0.08	3,066,371,816	86,839,650	-3,693,622	-2,965,918	3.42%
0.0711	3,711,612	500,000	70,092	31,212	312,120	-0.08	3,066,371,816	86,839,650	0	3,734,018	4.30%
0.0676	3,530,008	500,000	73,657	0	0	0.17	2,934,443,226	83,103,432	-3,736,218	-225,250	0.27%
0.0549	2,864,127	500,000	70,776	0	0	0.33	2,845,814,422	80,593,464	-2,509,968	419,165	0.52%
0.0533	2,781,842	500,000	68,882	0	0	0.50	2,756,755,922	78,071,328	-2,522,137	-624,600	0.80%
0.0328	1,712,131	500,000	67,141	0	0	0.67	2,667,363,245	75,539,727	-2,531,601	-1,926,589	2.55%
0.0328	1,712,131	500,000	64,287	0	0	0.67	2,667,363,245	75,539,727	0	757,805	1.00%
0.0047	244,590	550,000	60,225	0	0	0.83	2,577,731,905	73,001,368	-2,538,360	-1,756,208	2.41%
0.0000	0	500,000	59,073	0	0	0.44	2,787,969,299	78,955,291	5,953,923	-2,979,438	3.77%
0.0000	0	500,000	58,624	0	0	0.25	2,890,188,506	81,850,138	2,894,848	29,850	0.04%
0.0000	0	500,000	60,962	0	0	0.17	2,934,443,226	83,103,432	1,253,294	152,731	0.18%
0.0000	0	500,000	60,870	0	0	0.08	2,978,566,645	84,353,007	1,249,575	-304,862	0.36%
0.0000	0	500,000	59,760	0	0	0.00	3,022,546,821	85,598,526	1,245,519	229,284	0.27%
0.0000	0	200,000	59,795	0	0	0.00	3,022,546,821	85,598,526	0	-2,525,685	2.95%
0.0000	0	40,000	63,842	53,478	534,783	-0.50	3,282,751,180	92,967,513	7,368,987	-2,055,102	2.21%
0.0000	0	30,000	62,173	285,870	2,858,702	-1.92	3,967,095,143	112,348,134	19,380,621	5,015,785	4.46%
0.0000	0	30,000	60,195	2,263,273	22,632,732	-1.25	3,656,941,532	103,564,584	-8,783,550	-1,457,542	1.41%
0.0034	178,511	30,000	58,535	1,029,086	10,290,856	-1.00	3,534,790,062	100,105,255	-3,459,330	2,440,680	2.44%
0.0479	2,499,152	150,000	58,790	510,349	5,103,489	-1.00	3,534,790,062	100,105,255	0	1,526,957	1.53%
0.0479	2,499,152	150,000	60,040	924,845	9,248,449	-1.42	3,736,724,372	105,824,034	5,718,780	-10,296,315	9.73%
0.0636	3,319,270	150,000	58,555	1,483,216	14,832,156	-1.17	3,616,542,731	102,420,490	-3,403,544	6,376,957	6.23%
											Average Percent
1.01	**52,465,429**	**9,280,000**	**1,752,958**	**7,899,594**	**78,995,941**	**---**	**---**		**8,158,525**	**1,067,198**	**2.50%**

APPENDIX C: GRAND LAKE ST. MARYS TP BUDGET

GLSM NUTRIENT BUDGET

Description: Nutrient loads based on a twice monthly timestep water budget and observed data

TP inputs - TP outputs = Net P Sedimentation or Net P Internal Loading

Net P Sedimentation or Net P Internal Loading = (Change in Lake TP Storage + Outflow) - (Inflows + Atmospheric TP Deposition

*** where a (+) results indicates net internal loading of P and a (-) result indicates net sedimentation of P**

Water Year	Bi-Week Number	Date Range From	Date Range To	Precipitation Depth (m)	Direct Precipitation Inflow (m³)	Atmospheric Loading (mg/L)	Direct Precip TP Load (kg/Period)	Chickasaw Creek Inflow (m³)	Chickasaw Creek TP (mg/L)	Chickasaw Creek TP Load (kg/Period)	Chickasaw WWTP Inflow (m³)	Chickasaw WWTP TP (mg/L)	Chickasaw WWTP TP Load (kg/Period)	Barnes Creek Inflow (m³)	Barnes Creek TP (mg/L)	Barnes Creek TP Load (kg/Period)	Beaver Creek Inflow (m³)	Beaver Creek TP (mg/L)	Beaver Creek TP Load (kg/Period)
	1	5/1/2010	5/14/2010	0.0483	2,518,594	0.020	50.4	269,153	0.183	49.3	0	2.00	0.0	37,776	0.373	14.1	242,395	0.376	91.0
	2	5/15/2010	5/28/2010	0.0427	2,226,967	0.020	44.5	970,909	0.318	308.7	0	2.00	0.0	136,268	0.187	25.5	874,386	0.368	321.8
	3	5/29/2010	6/11/2010	0.0732	3,817,658	0.020	76.4	1,246,180	0.251	312.8	0	2.00	0.0	174,902	0.167	29.2	1,122,290	0.207	232.3
	4	6/12/2010	6/25/2010	0.0630	3,287,428	0.020	65.7	782,991	0.111	86.9	0	2.00	0.0	109,894	0.169	18.6	705,150	0.193	136.1
	5	6/26/2010	7/9/2010	0.0244	1,272,553	0.020	25.5	152,732	0.108	16.5	0	2.00	0.0	21,436	0.171	3.7	137,548	0.268	36.8
	6	7/10/2010	7/23/2010	0.0025	132,558	0.020	2.7	15,807	0.105	1.7	0	2.00	0.0	2,218	0.139	0.3	14,235	0.268	3.8
	7	7/24/2010	8/6/2010	0.0843	4,400,911	0.020	88.0	53,341	0.398	21.2	0	2.00	0.0	7,486	0.850	6.4	48,038	0.342	16.4
	8	8/7/2010	8/20/2010	0.0114	596,509	0.020	11.9	65,894	0.425	28.0	0	2.00	0.0	9,248	0.251	2.3	59,343	0.297	17.6
	9	8/21/2010	9/3/2010	0.0109	569,998	0.020	11.4	4,943	0.454	2.2	0	2.00	0.0	694	0.251	0.2	4,451	0.248	1.1
	10	9/4/2010	9/17/2010	0.0097	503,719	0.020	10.1	147	0.387	0.1	0	2.00	0.0	21	0.251	0.0	132	0.274	0.0
	11	9/18/2010	10/1/2010	0.0254	1,325,576	0.020	26.5	28,897	0.319	9.2	0	2.00	0.0	4,056	0.251	1.0	26,024	0.274	7.1
	12	10/2/2010	10/15/2010	0.0302	1,577,435	0.020	31.5	19,379	0.401	7.8	0	2.00	0.0	2,720	0.251	0.7	17,452	0.274	4.8
WY 2011	13	10/16/2010	10/29/2010	0.0269	1,405,110	0.020	28.1	20,872	0.401	8.4	0	2.00	0.0	2,929	0.251	0.7	18,797	0.274	5.2
	14	10/30/2010	11/12/2010	0.0005	26,512	0.020	0.5	7,316	0.401	2.9	0	2.00	0.0	1,027	0.251	0.3	6,589	0.274	1.8
	15	11/13/2010	11/26/2010	0.1433	7,476,247	0.020	149.5	430,749	0.401	172.8	96,553	2.00	193.1	60,456	0.251	15.2	387,926	0.300	116.4
	16	11/27/2010	12/10/2010	0.0231	1,206,274	0.020	24.1	488,956	0.401	196.2	5,952	2.00	11.9	68,625	0.251	17.2	440,347	0.398	175.1
	17	12/11/2010	12/24/2010	0.0163	848,368	0.020	17.0	163,449	0.401	65.6	0	2.00	0.0	22,940	0.251	5.8	147,200	0.474	69.7
	18	12/25/2010	1/7/2011	0.0130	676,044	0.020	13.5	319,069	0.401	128.0	0	2.00	0.0	44,782	0.251	11.2	287,349	0.549	157.9
	19	1/8/2011	1/21/2011	0.0175	914,647	0.020	18.3	153,173	0.401	61.5	0	2.00	0.0	21,498	0.251	5.4	137,945	0.625	86.3
	20	1/22/2011	2/4/2011	0.0389	2,028,131	0.020	40.6	175,439	0.401	70.4	0	2.00	0.0	24,623	0.251	6.2	157,998	0.701	110.8
	21	2/5/2011	2/18/2011	0.0094	490,463	0.020	9.8	2,223,206	0.484	1,074.9	0	2.00	0.0	312,029	0.292	91.1	2,002,186	0.628	1,257.4
	22	2/19/2011	3/4/2011	0.1118	5,832,533	0.020	116.7	2,682,842	0.156	418.5	4,468	2.00	8.9	376,539	0.157	59.1	2,416,127	0.172	415.6
	23	3/5/2011	3/18/2011	0.0714	3,724,868	0.020	74.5	3,168,352	0.291	922.0	11,170	2.00	22.3	444,681	0.193	85.6	2,853,369	0.189	537.9
	24	3/19/2011	4/1/2011	0.0356	1,855,806	0.020	37.1	841,716	0.154	129.6	0	2.00	0.0	118,136	0.082	9.7	758,036	0.201	152.4
	25	4/2/2011	4/15/2011	0.0488	2,545,105	0.020	50.9	935,919	0.187	175.0	0	2.00	0.0	131,357	0.105	13.8	842,875	0.217	182.9
	26	4/16/2011	4/29/2011	0.1270	6,627,878	0.020	132.6	5,086,997	0.774	3,937.3	0	2.00	0.0	713,964	0.478	341.3	4,581,272	0.656	3,005.3
WY 2012	27	4/30/2011	5/13/2011	0.0693	3,618,822	0.020	72.4	1,490,130	0.485	722.7	0	2.00	0.0	209,141	0.150	31.4	1,341,989	0.635	852.2
	Annual Totals			**1.18**	**61,506,710**		**1,230**	**21,798,559**		**8,930**	**118,143**		**236**	**3,059,447**		**796**	**19,631,451**		**7,996**

Inflows																	
Montezuma WWTP Inflow (m^3)	Montezuma WWTP TP (mg/L)	Montezuma WWTP TP Load (kg/Period)	Burntwood Creek Inflow (m^3)	Burntwood Creek TP (mg/L)	Burntwood Creek TP Load (kg/Period)	Coldwater Creek Inflow (m^3)	Coldwater Creek TP (mg/L)	Coldwater Creek TP Load (kg/Period)	St. Henry's WWTP Inflow (m^3)	St. Henry's WWTP TP (mg/L)	St. Henry's WWTP TP Load (kg/Period)	Little Chickasaw Creek Inflow (m^3)	Little Chickasaw Creek TP (mg/L)	Little Chickasaw Creek TP Load (kg/Period)	Prairie Creek Inflow (m^3)	Prairie Creek TP (mg/L)	Prairie Creek TP Load (kg/Period)
0		0.0	102,310	0.278	28.4	280,171	0.574	160.7	16,660	1.27	21.1	110,180	0.278	30.6	56,664	0.244	13.8
0		0.0	369,059	0.253	93.2	1,010,654	0.578	584.2	65,504	1.27	82.9	397,448	0.253	100.4	204,402	0.308	63.0
0		0.0	473,694	0.209	99.0	1,297,193	0.422	547.4	10,602	1.27	13.4	510,132	0.209	106.6	262,354	0.326	85.5
0		0.0	297,628	0.140	41.7	815,044	0.271	220.9	15,903	1.27	20.1	320,523	0.140	44.9	164,840	0.274	45.2
0		0.0	58,056	0.140	8.1	158,984	0.273	43.4	5,301	1.27	6.7	62,522	0.140	8.7	32,154	0.226	7.3
0		0.0	6,008	0.122	0.7	16,454	0.275	4.5	14,010	1.27	17.7	6,471	0.122	0.8	3,328	0.177	0.6
0		0.0	20,276	0.624	12.7	55,525	0.427	23.7	33,320	1.27	42.2	21,836	0.624	13.6	11,230	0.587	6.6
0		0.0	25,047	0.425	10.6	68,591	0.589	40.4	8,709	1.27	11.0	26,974	0.425	11.5	13,872	0.950	13.2
0		0.0	1,879	0.454	0.9	5,145	0.768	4.0	0	1.27	0.0	2,023	0.454	0.9	1,041	1.350	1.4
0		0.0	56	0.387	0.0	153	0.904	0.1	0	1.27	0.0	60	0.387	0.0	31	1.235	0.0
0		0.0	10,984	0.319	3.5	30,080	1.040	31.3	1,515	1.27	1.9	11,829	0.319	3.8	6,084	1.120	6.8
0		0.0	7,366	0.326	2.4	20,172	1.004	20.2	11,359	1.27	14.4	7,933	0.326	2.6	4,080	0.928	3.8
0		0.0	7,934	0.326	2.6	21,726	0.957	20.8	21,961	1.27	27.8	8,544	0.326	2.8	4,394	0.928	4.1
0		0.0	2,781	0.326	0.9	7,616	0.911	6.9	13,252	1.27	16.8	2,995	0.326	1.0	1,540	0.928	1.4
4,582	1.02	4.7	163,735	0.326	53.4	448,382	0.878	393.7	54,713	1.27	69.3	176,330	0.326	57.5	90,684	0.928	84.2
82,695	1.93	159.3	185,861	0.326	60.6	508,972	0.784	398.9	13,252	1.27	16.8	200,158	0.326	65.3	102,938	0.928	95.6
90,116	1.47	132.9	62,130	0.326	20.3	170,140	0.711	120.9	13,252	1.27	16.8	66,909	0.326	21.8	34,410	0.928	31.9
45,058	1.47	66.4	121,284	0.326	39.5	332,130	0.637	211.7	17,228	1.27	21.8	130,613	0.326	42.6	67,172	0.928	62.4
0		0.0	58,224	0.326	19.0	159,443	0.564	89.9	0	1.27	0.0	62,702	0.326	20.4	32,247	0.928	29.9
0		0.0	66,687	0.326	21.7	182,621	0.491	89.6	0	1.27	0.0	71,817	0.326	23.4	36,935	0.928	34.3
0		0.0	845,078	0.388	327.7	2,314,215	0.493	1,139.8	39,757	1.27	50.3	910,084	0.388	352.9	468,043	0.737	344.7
49,980	2.50	125.1	1,019,794	0.050	51.0	2,792,666	0.636	1,776.1	137,824	1.27	174.5	1,098,240	0.054	59.3	564,809	0.476	268.6
174,931	1.49	260.6	1,204,344	0.184	221.6	3,298,050	0.255	841.0	81,029	1.27	102.6	1,296,986	0.363	470.8	667,021	0.476	317.5
173,606	1.49	258.7	319,950	0.166	53.1	876,172	0.203	178.3	20,257	1.27	25.6	344,562	0.151	51.9	177,203	0.263	46.6
156,378	0.477	74.6	355,759	0.184	65.5	974,232	0.292	284.5	50,548	1.27	64.0	383,125	0.154	59.0	197,036	0.140	27.6
156,378	1.49	233.0	1,933,654	0.505	976.5	5,295,237	0.589	3,118.9	179,475	1.27	227.2	2,082,396	0.687	1,430.6	1,070,947	0.799	855.7
11,170	1.49	16.6	566,424	0.186	105.4	1,551,130	0.290	449.8	947	1.27	1.2	609,995	0.404	246.4	313,712	0.534	167.5
944,892		**1,332**	**8,286,002**		**2,320**	**22,690,898**		**10,802**	**826,378**		**1,046**	**8,923,387**		**3,230**	**4,589,170**		**2,619**

Ungaged Basin Inflow (m^3)	Ungaged Basin TP (mg/L)	Ungaged Basin TP Load (kg/Period)	Elks ADF Inflow (m^3)	Elks ADF TP (mg/L)	Elks ADF TP Load (kg/Period)	Marion Local School ADF Inflow (m^3)	Marion Load School ADF TP (mg/L)	Marion Load School ADF TP Load (kg/Period)	Northwood WWTP Inflow (m^3)	Northwood WWTP TP (mg/L)	Northwood WWTP TP Load (kg/Period)
61,386	0.329	20.2	24	2.00	0.0	499	2.00	1.0	4,127	1.96	8.1
221,435	0.323	71.6	24	2.00	0.0	499	2.00	1.0	7,960	1.96	15.6
284,216	0.256	72.7	24	2.00	0.0	499	2.00	1.0	6,678	1.34	9.0
178,577	0.185	33.1	24	2.00	0.0	499	2.00	1.0	7,976	1.34	10.7
34,834	0.189	6.6	24	2.00	0.0	499	2.00	1.0	2,225	1.34	3.0
3,605	0.173	0.6	24	2.00	0.0	499	2.00	1.0	1,231	3.04	3.7
12,166	0.550	6.7	24	2.00	0.0	499	2.00	1.0	4,316	2.89	12.5
15,028	0.480	7.2	24	2.00	0.0	499	2.00	1.0	1,279	2.89	3.7
1,127	0.568	0.6	24	2.00	0.0	499	2.00	1.0	875	2.90	2.5
33	0.546	0.0	24	2.00	0.0	499	2.00	1.0	896	2.90	2.6
6,591	0.520	3.4	24	2.00	0.0	499	2.00	1.0	1,028	2.90	3.0
4,420	0.501	2.2	24	2.00	0.0	499	2.00	1.0	1,421	2.58	3.7
4,760	0.495	2.4	24	2.00	0.0	499	2.00	1.0	1,064	2.58	2.7
1,669	0.488	0.8	24	2.00	0.0	499	2.00	1.0	845	2.97	2.5
98,241	0.487	47.9	24	2.00	0.0	499	2.00	1.0	3,313	2.97	9.8
111,516	0.488	54.4	24	2.00	0.0	499	2.00	1.0	7,553	2.97	22.4
37,278	0.488	18.2	24	2.00	0.0	499	2.00	1.0	4,808	1.91	9.2
72,770	0.488	35.5	24	2.00	0.0	499	2.00	1.0	1,286	1.91	2.5
34,934	0.489	17.1	24	2.00	0.0	499	2.00	1.0	660	2.08	1.4
40,012	0.489	19.6	24	2.00	0.0	499	2.00	1.0	694	2.14	1.5
507,047	0.487	246.9	24	2.00	0.0	499	2.00	1.0	3,562	2.14	7.6
611,876	0.243	148.6	24	2.00	0.0	499	2.00	1.0	13,359	0.39	5.2
722,607	0.279	201.3	24	2.00	0.0	499	2.00	1.0	12,261	0.39	4.8
191,970	0.174	33.5	24	2.00	0.0	499	2.00	1.0	9,040	0.39	3.5
213,455	0.183	39.0	24	2.00	0.0	499	2.00	1.0	8,511	0.33	2.8
1,160,192	0.641	743.8	24	2.00	0.0	499	2.00	1.0	8,668	0.33	2.9
339,854	0.383	130.3	24	2.00	0.0	499	2.00	1.0	8,860	0.55	4.9
4,971,601		**1,964**	**644**		**1**	**13,470**		**27**			**162**

Whole Lake Volume Weighted Average TP f Volume
97 94261965 m3

Outflows														Lake TP			Residual
Pan Evaporation (m)	Surface Evaporation V (m^3)	Groundwater Outflow (m^3)	Groundwater TP (mg/L)	Groundwater TP Outflow Load (kg/Period)	Celina Water Treatment Plant Withdrawl (m^3)	Celina Water Treatment Plant Withdrawl TP (mg/L)	Celina Water Treatment Plant Withdrawl TP Load (kg/Period)	St. Marys Outlet (m^3)	St. Mary's Outlet TP (mg/L)	St. Mary's TP Outflow Load (kg/Period)	Outlet (m3)	Outlet TP (mg/L)	Outlet TP Load (kg/Period)	Volume at Timestep (m3)	Whole Lake TP (ug/L)	Change in Lake TP (kg/Period)	Net TP Sedimentation or Net TP Internal Loading
0.0648	3,382,356	150,000	0.08	13	81,049	0.08	7	159,877	0.08	14	1,598,771	0.08	135	92,967,513	84.67	-1243.88	-1,564
0.0648	3,382,356	200,000	0.09	18	74,343	0.09	7	194,647	0.09	17	1,946,468	0.09	172	97,756,210	88.23	753.64	-746
0.0769	4,015,311	400,000	0.09	37	62,986	0.09	6	239,638	0.09	22	2,396,384	0.09	220	97,756,210	92.00	368.68	-932
0.0802	4,187,935	400,000	0.12	46	64,677	0.12	8	337,254	0.12	39	3,372,540	0.12	392	101,267,268	116.19	2772.72	2,533
0.0807	4,212,694	400,000	0.15	60	69,123	0.15	10	187,693	0.15	28	1,876,928	0.15	282	94,175,168	150.06	2365.36	2,578
0.0810	4,226,448	400,000	0.18	71	74,393	0.18	13	124,542	0.18	22	1,245,421	0.18	220	90,533,272	176.67	1862.55	2,150
0.0768	4,005,804	500,000	0.18	91	70,112	0.18	13	74,614	0.18	14	746,142	0.18	137	86,839,650	182.96	-105.77	-102
0.0711	3,711,612	500,000	0.19	95	70,092	0.19	13	31,212	0.19	6	312,120	0.19	59	86,839,650	190.00	611.09	626
0.0676	3,530,008	500,000	0.22	111	73,657	0.22	16	0	0.22	0	0	0.22	0	83,103,432	221.44	1903.26	2,004
0.0549	2,864,127	500,000	0.28	142	70,776	0.28	20	0	0.28	0	0	0.28	0	80,593,464	284.33	4512.62	4,661
0.0533	2,781,842	500,000	0.24	121	68,882	0.24	17	0	0.24	0	0	0.24	0	78,071,328	241.91	-4029.24	-3,990
0.0328	1,712,131	500,000	0.19	96	67,141	0.19	13	0	0.19	0	0	0.19	0	75,539,727	191.00	-4458.08	-4,445
0.0328	1,712,131	500,000	0.18	92	64,287	0.18	12	0	0.18	0	0	0.18	0	75,539,727	183.87	-538.73	-542
0.0047	244,590	550,000	0.18	98	60,225	0.18	11	0	0.18	0	0	0.18	0	73,001,368	177.63	-922.27	-851
0.0000	0	500,000	0.17	86	59,073	0.17	10	0	0.17	0	0	0.17	0	78,955,291	171.39	564.88	-708
0.0000	0	500,000	0.17	83	58,624	0.17	10	0	0.17	0	0	0.17	0	81,850,138	165.15	-14.63	-1,221
0.0000	0	500,000	0.16	79	60,962	0.16	10	0	0.16	0	0	0.16	0	83,103,432	158.91	-311.61	-753
0.0000	0	500,000	0.15	76	60,870	0.15	9	0	0.15	0	0	0.15	0	84,353,007	152.67	-327.82	-1,036
0.0000	0	500,000	0.15	73	59,760	0.15	9	0	0.15	0	0	0.15	0	85,598,526	146.43	-344.01	-612
0.0000	0	200,000	0.14	28	59,795	0.14	8	0	0.14	0	0	0.14	0	85,598,526	140.19	-534.16	-917
0.0000	0	40,000	0.13	5	63,842	0.13	9	53,478	0.13	7	534,783	0.13	72	92,967,513	133.95	452.88	-4,359
0.0000	0	30,000	0.13	4	62,173	0.13	8	285,870	0.13	37	2,858,702	0.13	365	112,348,134	127.71	1894.86	-1,320
0.0000	0	30,000	0.12	4	60,195	0.12	7	2,263,273	0.12	275	22,632,732	0.12	2,749	103,564,584	121.47	-1767.98	-2,797
0.0034	178,511	30,000	0.11	3	58,535	0.11	7	1,029,086	0.11	118	10,290,856	0.11	1,177	100,105,255	114.33	-1134.12	-811
0.0479	2,499,152	150,000	0.10	15	58,790	0.10	6	510,349	0.10	52	5,103,489	0.10	522	100,105,255	102.33	-1201.26	-1,646
0.0479	2,499,152	150,000	0.09	13	60,040	0.09	5	924,845	0.09	83	9,248,449	0.09	832	105,824,034	96.34	-48.88	-14,121
0.0636	3,319,270	150,000	0.08	11	58,555	0.08	4	1,483,216	0.08	113	14,832,156	0.08	1,132	102,420,490	89.75	-1002.98	-2,544
0.94	**49,146,159**			**1,572**			**267**			**847**	**78,995,941**		**8,466**	**---**		**77**	**-31,463**

APPENDIX D: GRAND LAKE ST. MARYS WATER QUALITY DATA PRE- AND POST ALUM TREATMENT

2010 GLSM Water Quality Data

Station L-1

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
4/15/10	0.5	91	35.0	4.4	1.8	133
5/5/10	0.5	75	19.0	5.6	0.68	142
6/9/10	0.5	88	10.0	53.4	0.46	149
7/14/10	0.5	92	46.0	323	0.24	95.9
8/19/10	0.5	89	84.0	241	0.2	107
9/15/10	0.5	391	12.0	252	0.18	116
10/7/10	0.5	170	10.0	293	0.18	119

Station L-2

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
4/15/10	0.5	104	50.0	2.7	2.1	136
5/5/10	0.5	83	18.0	42.3	0.4	149
6/9/10	0.5	86	13.0	77.7	0.44	151
7/14/10	0.5	140	75.0	140	0.32	107
8/19/10	0.5	254	127.0	243	0.2	116
9/15/10	0.5	296	26.0	276	0.18	114
10/7/10	0.5	254	10.0	258	0.22	119

Station L-3

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
4/15/10	0.5	95	10.0	41.3	0.78	130
5/5/10	0.5	96	22.0	17.7	0.51	146
6/9/10	0.5	102	10.0	67.5	0.29	166
7/14/10	0.5	298	12.0	206	0.3	99.1
8/19/10	0.5	227	65.0	263	0.2	112
9/15/10	0.5	166	10.0	314	0.18	105
10/7/10	0.5	149	10.0	260	0.18	116

2011 GLSM Water Quality Data
Red numbers were Non-Detects

Station L-1

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
3/28/11	0.5	119	10.0	--	0.36	122
4/13/11	0.5	99	10.0	126	0.30	125
5/4/11	0.5	122	10.0	98.7	0.34	118
5/31/11	0.5	106	10.0	260	0.21	85.5
6/6/11	0.5	162	14.0	272	0.15	87
6/6/11	2.2	216	17.0	--	--	85.7
6/13/11	0.5	184	49.0	165	0.19	95
6/13/11	2.2	221	38.0	--	--	97.2
6/21/11	0.5	74	10.0	220	0.19	104
6/21/11	2.2	120	10.0	--	--	100
6/27/11	0.5	91	11.0	210	0.18	103
6/27/11	2.1	91	10.0	--	--	104
7/12/11	0.5	71	10.0	204	0.16	93.2
7/12/11	2.2	93	11.0			97.3
7/27/11	0.5	93	10.0	252	0.17	114
7/27/11	2	71	10.0			111
8/8/11	0.5	73	10.0	263	0.18	106
8/8/11	1.7	111	10.0			106
8/31/11	0.5	29*	10.0	201	0.17	94.2
10/6/11	0.5	131	10.0	250	0.18	103

*Data is suspect and was not included in any analyses or the model.

Station L-2

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
3/28/11	0.5	116	10.0	--	0.38	124
4/13/11	0.5	91	10.0	114	0.27	130
5/4/11	0.5	58	10.0	122	0.36	117
5/31/11	0.5	158	10.0	305	0.17	99.3
6/6/11	--	--	--	--	--	--
	--	--	--	--	--	--
6/13/11	--	--	--	--	--	--
	--	--	--	--	--	--
6/21/11	0.5	311	83.0	220	0.19	109

	--	--	--	--	--	--
6/27/11	0.5	158	10.0	344	0.16	109
	2	152	10.0	--	--	108
7/12/11	0.5	189	74.0	235.0	0.16	101
	1.7	156	61.0			105
7/27/11	0.5	144	42.0	290	0.16	113
7/27/11	1.7	150	50.0			115
8/8/11	0.5	137	41.0	274	0.19	111
8/8/11	1.5	172	41.0			113
8/31/11	0.5	10*	10.0	254	0.15	104
10/6/11	0.5	93	10.0	257	0.18	108

*Data is suspect and was not included in any analyses or the model.

Station L-3

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
3/28/11	0.5	108	10.0	--	0.36	119
4/13/11	0.5	117	10.0	115	0.36	121
5/4/11	0.5	49	10.0	94.8	0.37	115
5/31/11	0.5	130	10.0	330	0.18	97.1
6/6/11	--	--	--	--	--	--
	--	--	--	--	--	--
6/13/11	--	--	--	--	--	--
	--	--	--	--	--	--
6/21/11	0.5	254	72.0	229	0.18	102
	--	--	--	--	--	--
6/27/11	0.5	115	22.0	263	0.19	105
	1.7	184	21.0	--	--	108
7/12/11	0.5	135	29.0	146.0	0.17	95.5
	1.4	122	32.0			95.2
7/27/11	0.5	119	19.0	257	0.16	110
7/27/11	1.4	99	18.0			111
8/8/11	0.5	156	10.0	277	0.17	97
8/8/11	1.4	93	10.0			97.1
8/31/11	0.5	104	10.0	263	0.18	100
10/6/11	0.5	108	10.0	276	0.18	108

Station NW YSI Sonde

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
5/31/11	0.5	136	10.0	--	0.19	93.8
5/31/11	1.9	135	10.0	--	--	94.5
6/6/11	0.5	143	24.0	247	0.16	81.6
6/6/11	1.8	247	26.0	--	--	90.8
6/13/11	0.5	248	81.0	267	0.16	96.4
6/13/11	1.7	328	84.0	--	--	94.1
6/21/11	0.5	146	53.0	246	0.19	106
6/21/11	1.7	143	52.0	--	--	103
6/27/11	0.5	140	10.0	370	0.17	107
6/27/11	1.8	81	10.0	--	--	106
7/12/11	0.5	162	71.0	210	0.14	102
7/12/11	1.6	173	82.0			106
7/27/11	0.5	206	86.0	258	0.18	110
7/27/11	1.6	185	87.0			112
8/8/11	0.5	144	49.0	256	0.18	114
8/8/11	1.5	161	49.0			113

Station NE YSI Sonde

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
5/31/11	0.34	120	10.0	221	0.23	80
5/31/11	1.6	134	10.0	293	--	81
6/6/11	0.38	266	20.0	229	0.17	86.1
6/6/11	1.5	132	27.0	--	--	88.4
6/13/11	0.2	190	75.0	166	0.19	93.9
6/13/11	1.5	238	74.0	--	--	93.8
6/21/11	0.5	220	51.0	191	0.21	107
6/21/11	1.5	139	55.0	--	--	101
6/27/11	0.5	208	10.0	179	0.19	99.3
6/27/11	1.5	130	10.0	--	--	103
7/12/11	0.5	105	18.0	137	0.18	94.4
7/12/11	1.4	102	17.0			95.5
7/27/11	0.5	128	29.0	245	0.17	103

7/27/11	1.2	110	32.0			111
8/8/11	0.47	310	10.0	274	0.16	101
8/8/11	1.2	96	10.0			96.9
8/31/11	0.5	85	10.0	270	0.18	95.6
10/6/11	0.5	118	10.0	238	0.17	104

Station SE YSI Sonde

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
5/31/11	0.5	87	10.0	--	0.19	95
5/31/11	1.5	182	10.0	--	--	98
6/6/11	0.5	221	10.0	272	0.16	89.8
6/6/11	1.5	185	14.0	--	--	88.7
6/13/11	0.5	137	49.0	211	0.19	95.5
6/13/11	1.5	159	46.0	--	--	99
6/21/11	0.5	253	59.0	248	0.18	109
6/21/11	1.5	143	58.0	--	--	108
6/27/11	0.5	196	28.0	242	0.17	109
6/27/11	1.5	139	29.0	--	--	107
7/12/11	0.5	189	57.0	153	0.14	98.3
7/12/11	1.3	170	57.0			97.7
7/27/11	0.5	119	31.0	252	0.15	107
7/27/11	1.2	124	28.0			110
8/8/11	0.5	92	24.0	273	0.18	103
8/8/11	1.2	238	22.0			103

Station SW YSI Sonde

Date	Depth	Total Phosphorus (µg/L as P)	Ortho-Phosphorus (µg/L as P)	Chlorophyll *a* (µg/L)	Secchi Disk (m)	Alkalinity (mg/L)
5/31/11	0.5	84	10.0	--	0.2	107
5/31/11	2	149	10.0	--	--	104
6/6/11	0.5	267	30.0	321	0.14	96.8
6/6/11	1.7	204	31.0	--	--	98.6
6/13/11	0.5	212	92.0	214	0.13	106
6/13/11	1.9	189	95.0	--	--	107

6/21/11	0.5	351	72.0	282	0.16	112
6/21/11	1.9	152	73.0	--	--	107
6/27/11	0.5	191	26.0	348	0.15	111
6/27/11	1.7	114	25.0	--	--	117
7/12/11	0.5	203	104.0	227	0.15	104
7/12/11	1.6	236	116.0			107
7/27/11	0.5	203	93.0	234	0.16	117
7/27/11	1.5	197	93.0			113
8/8/11	0.5	149	61.0	235	0.17	113
8/8/11	1.5	160	59.0			115

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APPENDIX E: GRAND LAKE ST. MARYS PHYTOPLANKTON DATA 2011

5/31/2011 Phytoplankton Data

STATION	SAMPLE DATE	SAMPLE DEPTH	SAMPLE ALIQUOT (mL)	FIELDS	GENUS	DIVISION	TALLY REP 1	DENSITY (cells/L) REP 1	cells/mL	TOTAL BV um^3/L	mm^3/L
203761 L-1	5/31/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	17	6.17E+05	6.17E+02	1.33E+08	0.13
203761 L-1	5/31/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	1	3.63E+04	3.63E+01	1.45E+07	0.01
203761 L-1	5/31/2011	0.50	1	8	Stephanodiscus hantzschii	Bacillariophyta	2	5.35E+05	5.35E+02	2.54E+08	0.25
203761 L-1	5/31/2011	0.50	1	8	Closteriopsis acicularis	Chlorophyta	1	2.67E+05	2.67E+02	7.10E+07	0.07
203761 L-1	5/31/2011	0.50	1	1	Oocystis parva	Chlorophyta	4	1.45E+05	1.45E+02	1.05E+07	0.01
203761 L-1	5/31/2011	0.50	1	8	Rhodomonas sp.	Cryptophyta	10	2.67E+06	2.67E+03	2.27E+08	0.23
203761 L-1	5/31/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	12260	3.28E+09	3.28E+06	3.09E+10	30.88
					TOTAL		12295	3.28E+09	3.28E+06	3.16E+10	31.59
203753 L-2	5/31/2011	0.50	1	12	Aulacoseira granulata	Bacillariophyta	104	1.85E+07	1.85E+04	4.73E+09	4.73
203753 L-2	5/31/2011	0.50	1	12	Nitzschia palea	Bacillariophyta	1	1.78E+05	1.78E+02	3.34E+07	0.03
203753 L-2	5/31/2011	0.50	1	1	Cryptomonas sp.	Cryptophyta	1	2.00E+03	2.00E+00	3.40E+05	0.00
203753 L-2	5/31/2011	0.50	1	12	Rhodomonas sp.	Cryptophyta	8	1.43E+06	1.43E+03	1.21E+08	0.12
203753 L-2	5/31/2011	0.50	1	12	Planktothrix agardhii	Cyanobacteria	6172	1.10E+09	1.10E+06	1.04E+10	10.36
					TOTAL		6286	1.12E+09	1.12E+06	1.52E+10	15.25
203764 L-3	5/31/2011	0.50	1	8	Aulacoseira granulata	Bacillariophyta	10	2.67E+06	2.67E+03	3.02E+08	0.30
203764 L-3	5/31/2011	0.50	1	1	Discostella pseudostelligera	Bacillariophyta	1	3.63E+04	3.63E+01	5.48E+06	0.01
203764 L-3	5/31/2011	0.50	1	8	Closteriopsis acicularis	Chlorophyta	3	8.02E+05	8.02E+02	3.66E+08	0.37
203764 L-3	5/31/2011	0.50	1	8	Rhodomonas sp.	Cryptophyta	4	1.07E+06	1.07E+03	1.11E+08	0.11
203764 L-3	5/31/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	9904	2.65E+09	2.65E+06	1.66E+10	16.63
					TOTAL		9922	2.65E+09	2.65E+06	1.74E+10	17.41

6/1/2011 Phytoplankton Data

STATION	SAMPLE	DEPTH	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE		ALIQUOT (mL)				REP 1	REP 1	cells/ml	um^3/L	mm^3/L
L-1	6/1/2011	0.5	1	20	Aulacoseira ambigua	Bacillariophyta	20	2.14E+06	2.14E+03	1.08E+09	1.08
L-1	6/1/2011	0.5	1	1	Aulacoseira granulata	Bacillariophyta	20	4.00E+04	4.00E+01	1.13E+07	0.01
L-1	6/1/2011	0.5	1	1	Cymatopleura solea	Bacillariophyta	1	2.00E+03	2.00E+00	8.51E+06	0.01
L-1	6/1/2011	0.5	1	1	Stephanocyclus meneghiniana	Bacillariophyta	3	1.09E+05	1.09E+02	6.42E+06	0.01
L-1	6/1/2011	0.5	1	1	Synedra sp.	Bacillariophyta	2	7.26E+04	7.26E+01	8.99E+07	0.09
L-1	6/1/2011	0.5	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	2.48E+07	0.02
L-1	6/1/2011	0.5	1	1	Staurastrum sp.	Chlorophyta	1	2.00E+03	2.00E+00	8.05E+07	0.08
L-1	6/1/2011	0.5	1	1	Rhodomonas minuta	Cryptophyta	8	2.91E+05	2.91E+02	3.01E+07	0.03
L-1	6/1/2011	0.5	1	1	Aphanocapsa incerta	Cyanobacteria	3866	7.73E+06	7.73E+03	3.24E+07	0.03
L-1	6/1/2011	0.5	1	20	Planktothrix agardhii	Cyanobacteria	13594	1.45E+09	1.45E+06	5.14E+10	51.38
					Total		17516	1.46E+09	1.46E+06	5.27E+10	52.74
301484 NW	6/1/2011	0.5	1	14	Aulacoseira granulata	Bacillariophyta	39	5.96E+06	5.96E+03	1.85E+09	1.85
301484 NW	6/1/2011	0.5	1	14	Discostella pseudostelligera	Bacillariophyta	2	3.06E+05	3.06E+02	4.61E+07	0.05
301484 NW	6/1/2011	0.5	1	14	Stephanocyclus meneghiniana	Bacillariophyta	2	3.06E+05	3.06E+02	4.33E+08	0.43
301484 NW	6/1/2011	0.5	1	14	Stephanodiscus hantzschii	Bacillariophyta	7	1.07E+06	1.07E+03	2.52E+08	0.25
301484 NW	6/1/2011	0.5	1	14	Stephanodiscus parvus	Bacillariophyta	2	3.06E+05	3.06E+02	2.59E+07	0.03
301484 NW	6/1/2011	0.5	1	14	Closteriopsis acicularis	Chlorophyta	2	3.06E+05	3.06E+02	3.19E+08	0.32
301484 NW	6/1/2011	0.5	1	1	Gonium sociale	Chlorophyta	4	8.00E+03	8.00E+00	2.16E+05	0.00
301484 NW	6/1/2011	0.5	1	14	Pyramimonas tetrarhynchus	Chlorophyta	2	3.06E+05	3.06E+02	6.14E+07	0.06
301484 NW	6/1/2011	0.5	1	14	Ochromonas variabilis	Chrysophyta	2	3.06E+05	3.06E+02	6.34E+07	0.06
301484 NW	6/1/2011	0.5	1	14	Rhodomonas sp.	Cryptophyta	27	4.13E+06	4.13E+03	2.16E+08	0.22
301484 NW	6/1/2011	0.5	1	14	Planktothrix agardhii	Cyanobacteria	12584	1.92E+09	1.92E+06	4.08E+10	40.78
301484 NW	6/1/2011	0.5	1	1	Gymnodinium discoidale	Pyrrophyta	1	2.00E+03	2.00E+00	5.76E+05	0.00
					Total		12674	1.94E+09	1.94E+06	4.40E+10	44.05
301485 NE-1	6/1/2011		1	1	Aulacoseira granulata	Bacillariophyta	29	1.05E+06	1.05E+03	2.27E+08	0.23
301485 NE-1	6/1/2011		1	1	Navicula trivialis	Bacillariophyta	1	3.63E+04	3.63E+01	5.28E+07	0.05
301485 NE-1	6/1/2011		1	14	Pseudostaurosira pseudoconstruens	Bacillariophyta	2	3.06E+05	3.06E+02	1.30E+07	0.01
301485 NE-1	6/1/2011		1	14	Staurosira elliptica	Bacillariophyta	4	6.11E+05	6.11E+02	1.58E+08	0.16
301485 NE-1	6/1/2011		1	1	Stephanodiscus hantzschii	Bacillariophyta	4	1.45E+05	1.45E+02	4.14E+07	0.04
301485 NE-1	6/1/2011		1	1	Ulnaria delicatissima var. angustissima	Bacillariophyta	1	3.63E+04	3.63E+01	5.90E+07	0.06
301485 NE-1	6/1/2011		1	14	Closteriopsis acicularis	Chlorophyta	2	3.06E+05	3.06E+02	2.02E+08	0.20
301485 NE-1	6/1/2011		1	1	Staurastrum sp.	Chlorophyta	1	2.00E+03	2.00E+00	4.05E+07	0.04
301485 NE-1	6/1/2011		1	1	Ochromonas variabilis	Chrysophyta	1	2.00E+03	2.00E+00	4.90E+05	0.00
301485 NE-1	6/1/2011		1	14	Rhodomonas sp.	Cryptophyta	20	3.06E+06	3.06E+03	2.59E+08	0.26
301485 NE-1	6/1/2011		1	1	Anabaena sp.	Cyanobacteria	132	4.79E+06	4.79E+03	1.69E+08	0.17
301485 NE-1	6/1/2011		1	14	Planktothrix agardhii	Cyanobacteria	10704	1.64E+09	1.64E+06	3.47E+10	34.69
					Total		10901	1.65E+09	1.65E+06	3.59E+10	35.91
301485 NE-2	6/1/2011		1	14	Aulacoseira granulata	Bacillariophyta	2	3.06E+05	3.06E+02	7.80E+07	0.08
301485 NE-2	6/1/2011		1	14	Fragilaria crotonensis	Bacillariophyta	2	3.06E+05	3.06E+02	1.47E+08	0.15
301485 NE-2	6/1/2011		1	1	Stephanocyclus meneghiniana	Bacillariophyta	1	2.00E+03	2.00E+00	9.50E+05	0.00
301485 NE-2	6/1/2011		1	14	Stephanodiscus parvus	Bacillariophyta	4	6.11E+05	6.11E+02	1.54E+07	0.02
301485 NE-2	6/1/2011		1	1	Closteriopsis acicularis	Chlorophyta	1	2.00E+03	2.00E+00	1.10E+06	0.00
301485 NE-2	6/1/2011		1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	2.00E+03	2.00E+00	1.44E+06	0.00
301485 NE-2	6/1/2011		1	14	Rhodomonas sp.	Cryptophyta	12	1.83E+06	1.83E+03	3.99E+08	0.40
301485 NE-2	6/1/2011		1	14	Planktothrix agardhii	Cyanobacteria	10902	1.67E+09	1.67E+06	3.53E+10	35.33
301485 NE-2	6/1/2011		1	1	Gymnodinium discoidale	Pyrrophyta	1	3.63E+04	3.63E+01	1.26E+07	0.01
					Total		10926	1.67E+09	1.67E+06	3.60E+10	35.98
301485 NE-3	6/1/2011		1	1	Aulacoseira alpigena	Bacillariophyta	3	6.00E+03	6.00E+00	5.09E+05	0.00
301485 NE-3	6/1/2011		1	1	Stephanocyclus meneghiniana	Bacillariophyta	2	4.00E+03	4.00E+00	4.54E+06	0.00
301485 NE-3	6/1/2011		1	1	Stephanodiscus hantzschii	Bacillariophyta	2	4.00E+03	4.00E+00	9.42E+05	0.00
301485 NE-3	6/1/2011		1	1	Stephanodiscus niagarae	Bacillariophyta	1	2.00E+03	2.00E+00	1.61E+07	0.02
301485 NE-3	6/1/2011		1	1	Closteriopsis acicularis	Chlorophyta	5	1.00E+04	1.00E+01	2.96E+07	0.03
301485 NE-3	6/1/2011		1	1	Pediastrum duplex	Chlorophyta	29	5.80E+04	5.80E+01	4.21E+08	0.42
301485 NE-3	6/1/2011		1	14	Pyramimonas tetrarhynchus	Chlorophyta	2	3.06E+05	3.06E+02	1.01E+08	0.10
301485 NE-3	6/1/2011		1	14	Rhodomonas sp.	Cryptophyta	12	1.83E+06	1.83E+03	1.56E+08	0.16
301485 NE-3	6/1/2011		1	14	Planktothrix agardhii	Cyanobacteria	8916	1.36E+09	1.36E+06	2.89E+10	28.89
301485 NE-3	6/1/2011		1	1	Phacus sp.	Euglenophyta	1	2.00E+03	2.00E+00	3.20E+06	0.00
301485 NE-3	6/1/2011		1	14	Gymnodinium sp.	Pyrrophyta	1	1.53E+05	1.53E+02	1.25E+08	0.13
					Total		8974	1.36E+09	1.36E+06	2.97E+10	29.75
301487 SE	6/1/2011	0.5	1	1	Aulacoseira granulata	Bacillariophyta	42	1.53E+06	1.53E+03	9.97E+08	1.00
301487 SE	6/1/2011	0.5	1	1	Aulacoseira sp.	Bacillariophyta	52	1.89E+06	1.89E+03	1.87E+08	0.19
301487 SE	6/1/2011	0.5	1	1	Craticula sp.	Bacillariophyta	1	3.63E+04	3.63E+01	1.28E+07	0.01
301487 SE	6/1/2011	0.5	1	14	Discostella pseudostelligera	Bacillariophyta	2	3.06E+05	3.06E+02	4.61E+07	0.05
301487 SE	6/1/2011	0.5	1	14	Stephanocyclus meneghiniana	Bacillariophyta	2	3.06E+05	3.06E+02	1.74E+08	0.17
301487 SE	6/1/2011	0.5	1	1	Stephanodiscus hantzschii	Bacillariophyta	1	3.63E+04	3.63E+01	1.04E+07	0.01
301487 SE	6/1/2011	0.5	1	1	Surirella angusta	Bacillariophyta	1	2.00E+03	2.00E+00	4.46E+06	0.00
301487 SE	6/1/2011	0.5	1	1	Ulnaria delicatissima var. angustissima	Bacillariophyta	3	1.09E+05	1.09E+02	1.59E+08	0.16
301487 SE	6/1/2011	0.5	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	1.30E+07	0.01
301487 SE	6/1/2011	0.5	1	14	Pediastrum duplex	Chlorophyta	30	4.58E+06	4.58E+03	4.35E+10	43.52
301487 SE	6/1/2011	0.5	1	14	Pyramimonas tetrarhynchus	Chlorophyta	2	3.06E+05	3.06E+02	1.56E+08	0.16
301487 SE	6/1/2011	0.5	1	14	Rhodomonas sp.	Cryptophyta	14	2.14E+06	2.14E+03	4.66E+08	0.47
301487 SE	6/1/2011	0.5	1	14	Planktothrix agardhii	Cyanobacteria	9434	1.44E+09	1.44E+06	3.06E+10	30.57
					Total		9585	1.45E+09	1.45E+06	7.63E+10	76.32
301487 SW	6/1/2011	0.5	1	18	Aulacoseira granulata	Bacillariophyta	15	1.78E+06	1.78E+03	2.24E+08	0.22
301487 SW	6/1/2011	0.5	1	18	Discostella pseudostelligera	Bacillariophyta	2	2.38E+05	2.38E+02	5.60E+07	0.06
301487 SW	6/1/2011	0.5	1	1	Nitzschia acicularis	Bacillariophyta	1	3.63E+04	3.63E+01	8.83E+06	0.01
301487 SW	6/1/2011	0.5	1	18	Stephanocyclus meneghiniana	Bacillariophyta	4	4.75E+05	4.75E+02	1.36E+08	0.14
301487 SW	6/1/2011	0.5	1	18	Stephanodiscus hantzschii	Bacillariophyta	2	2.38E+05	2.38E+02	1.13E+08	0.11
301487 SW	6/1/2011	0.5	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	1.28E+08	0.13
301487 SW	6/1/2011	0.5	1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	2.00E+03	2.00E+00	5.28E+05	0.00
301487 SW	6/1/2011	0.5	1	1	Scenedesmus dimorphus	Chlorophyta	4	8.00E+03	8.00E+00	3.77E+05	0.00
301487 SW	6/1/2011	0.5	1	18	Rhodomonas sp.	Cryptophyta	33	3.92E+06	3.92E+03	8.54E+08	0.85
301487 SW	6/1/2011	0.5	1	18	Planktothrix agardhii	Cyanobacteria	11644	1.38E+09	1.38E+06	2.93E+10	29.35
					Total		11707	1.39E+09	1.39E+06	3.09E+10	30.87

6/6/2011 Phytoplankton Data

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH (mL)	ALIQUOT (mL)				REP 1	REP 1	cells/ml	um^3/L	mm^3/L
203761 L-1	6/6/2011	0.05	1	1	Aulacoseira ambigua	Bacillariophyta	22	7.99E+05	7.99E+02	2.26E+08	0.23
203761 L-1	6/6/2011	0.05	1	10	Aulacoseira granulata	Bacillariophyta	24	5.13E+06	5.13E+03	1.11E+09	1.11
203761 L-1	6/6/2011	0.05	1	1	Cyclotella ocellata	Bacillariophyta	1	3.63E+04	3.63E+01	3.08E+06	0.00
203761 L-1	6/6/2011	0.05	1	1	Navicula gregaria	Bacillariophyta	1	2.00E+03	2.00E+00	1.02E+06	0.00
203761 L-1	6/6/2011	0.05	1	1	Nitzschia sp.	Bacillariophyta	1	3.63E+04	3.63E+01	2.25E+07	0.02
203761 L-1	6/6/2011	0.05	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	2.04E+07	0.02
203761 L-1	6/6/2011	0.05	1	10	Rhodomonas sp.	Cryptophyta	10	2.14E+06	2.14E+03	2.22E+08	0.22
203761 L-1	6/6/2011	0.05	1	1	Anabaena sp.	Cyanobacteria	150	5.45E+06	5.45E+03	5.35E+08	0.53
203761 L-1	6/6/2011	0.05	1	1	Aphanizomenon sp.	Cyanobacteria	59	2.14E+06	2.14E+03	4.54E+07	0.05
203761 L-1	6/6/2011	0.05	1	10	Planktothrix agardhii	Cyanobacteria	13586	2.91E+09	2.91E+06	6.16E+10	61.64
					TOTAL		13855	2.92E+09	2.92E+06	6.38E+10	63.82
301484 NW	6/6/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	3	1.09E+05	1.09E+02	3.29E+07	0.03
301484 NW	6/6/2011	0.50	1	1	Planothidium sp.	Bacillariophyta	1	2.00E+03	2.00E+00	4.52E+05	0.00
301484 NW	6/6/2011	0.50	1	1	Actinastrum hantzschii	Chlorophyta	7	1.40E+04	1.40E+01	1.58E+06	0.00
301484 NW	6/6/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	2.89E+07	0.03
301484 NW	6/6/2011	0.50	1	1	Aphanizomenon flos-aquae	Cyanobacteria	88	3.20E+06	3.20E+03	1.13E+08	0.11
301484 NW	6/6/2011	0.50	1	16	Planktothrix agardhii	Cyanobacteria	16800	2.25E+09	2.25E+06	4.76E+10	47.64
					TOTAL		16900	2.25E+09	2.25E+06	4.78E+10	47.81
301485 NE	6/6/2011		1	1	Aulacoseira granulata	Bacillariophyta	9	3.27E+05	3.27E+02	1.02E+08	0.10
301485 NE	6/6/2011		1	8	Discostella pseudostelligera	Bacillariophyta	2	5.35E+05	5.35E+02	4.54E+07	0.05
301485 NE	6/6/2011		1	8	Stephanocyclus meneghiniana	Bacillariophyta	2	5.35E+05	5.35E+02	6.07E+08	0.61
301485 NE	6/6/2011		1	1	Stephanodiscus hantzschii	Bacillariophyta	1	3.63E+04	3.63E+01	1.45E+07	0.01
301485 NE	6/6/2011		1	1	Ulnaria delicatissima	Bacillariophyta	1	3.63E+04	3.63E+01	6.50E+07	0.07
301485 NE	6/6/2011		1	1	Closteriopsis acicularis	Chlorophyta	3	1.09E+05	1.09E+02	5.97E+07	0.06
301485 NE	6/6/2011		1	1	Oocystis parva	Chlorophyta	2	7.26E+04	7.26E+01	6.54E+06	0.01
301485 NE	6/6/2011		1	1	Pediastrum duplex	Chlorophyta	8	2.91E+05	2.91E+02	7.67E+08	0.77
301485 NE	6/6/2011		1	1	Pyramimonas tetrarhynchus	Chlorophyta	2	4.00E+03	4.00E+00	4.90E+05	0.00
301485 NE	6/6/2011		1	1	Scenedesmus quadricauda	Chlorophyta	2	7.26E+04	7.26E+01	2.74E+06	0.00
301485 NE	6/6/2011		1	1	Aphanizomenon sp.	Cyanobacteria	27	9.81E+05	9.81E+02	3.47E+07	0.03
301485 NE	6/6/2011		1	8	Planktothrix agardhii	Cyanobacteria	13248	3.54E+09	3.54E+06	7.51E+10	75.13
					TOTAL		13307	3.55E+09	3.55E+06	7.68E+10	76.83
301486 SE	6/6/2011	0.50	1	8	Aulacoseira granulata	Bacillariophyta	71	1.90E+07	1.90E+04	1.74E+09	1.74
301486 SE	6/6/2011	0.50	1	8	Cyclotella ocellata	Bacillariophyta	3	8.02E+05	8.02E+02	1.21E+08	0.12
301486 SE	6/6/2011	0.50	1	8	Discostella pseudostelligera	Bacillariophyta	4	1.07E+06	1.07E+03	9.07E+07	0.09
301486 SE	6/6/2011	0.50	1	1	Navicula gregaria	Bacillariophyta	1	3.63E+04	3.63E+01	1.64E+07	0.02
301486 SE	6/6/2011	0.50	1	8	Stephanodiscus hantzschii	Bacillariophyta	6	1.60E+06	1.60E+03	6.39E+08	0.64
301486 SE	6/6/2011	0.50	1	8	Synedra sp.	Bacillariophyta	4	1.07E+06	1.07E+03	1.18E+09	1.18
301486 SE	6/6/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	8.16E+06	0.01
301486 SE	6/6/2011	0.50	1	1	Dictyosphaerium pulchellum	Chlorophyta	8	1.60E+04	1.60E+01	1.81E+06	0.00
301486 SE	6/6/2011	0.50	1	1	Anabaena sp.	Cyanobacteria	18	6.54E+05	6.54E+02	1.39E+07	0.01
301486 SE	6/6/2011	0.50	1	8	Aphanizomenon sp.	Cyanobacteria	262	7.01E+07	7.01E+04	2.48E+09	2.48
301486 SE	6/6/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	8774	2.35E+09	2.35E+06	4.98E+10	49.76
					TOTAL		9152	2.44E+09	2.44E+06	5.61E+10	56.05
301487 SW	6/6/2011	0.50	1	1	Aulacoseira ambigua	Bacillariophyta	62	1.24E+05	1.24E+02	3.51E+07	0.04
301487 SW	6/6/2011	0.50	1	14	Aulacoseira granulata	Bacillariophyta	12	1.83E+06	1.83E+03	5.18E+08	0.52
301487 SW	6/6/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	1	2.00E+03	2.00E+00	1.33E+06	0.00
301487 SW	6/6/2011	0.50	1	14	Stephanodiscus hantzschii	Bacillariophyta	7	1.07E+06	1.07E+03	3.05E+08	0.30
301487 SW	6/6/2011	0.50	1	14	Ulnaria delicatissima	Bacillariophyta	2	3.06E+05	3.06E+02	7.13E+08	0.71
301487 SW	6/6/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	2	4.00E+03	4.00E+00	2.47E+06	0.00
301487 SW	6/6/2011	0.50	1	1	Oocystis parva	Chlorophyta	8	1.60E+04	1.60E+01	1.44E+06	0.00
301487 SW	6/6/2011	0.50	1	1	Cryptomonas sp.	Cryptophyta	1	2.00E+03	2.00E+00	6.03E+05	0.00
301487 SW	6/6/2011	0.50	1	14	Aphanizomenon sp.	Cyanobacteria	296	4.52E+07	4.52E+04	9.59E+08	0.96
301487 SW	6/6/2011	0.50	1	14	Planktothrix agardhii	Cyanobacteria	11284	1.72E+09	1.72E+06	3.66E+10	36.57
					TOTAL		11675	1.77E+09	1.77E+06	3.91E+10	39.10

6/13/2011 Phytoplankton Data

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH (mL)	ALIQUOT (mL)				REP 1	REP 1	cells/ml	um^3/L	mm^3/L
203761 L-1	6/13/2011	0.50	1	22	Aulacoseira granulata	Bacillariophyta	21	2.04E+06	2.04E+03	7.50E+08	0.75
203761 L-1	6/13/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	1	2.00E+03	2.00E+00	2.01E+06	0.00
203761 L-1	6/13/2011	0.50	1	22	Stephanodiscus hantzschii	Bacillariophyta	6	5.83E+05	5.83E+02	2.77E+08	0.28
203761 L-1	6/13/2011	0.50	1	1	Ulnaria delicatissima	Bacillariophyta	1	3.63E+04	3.63E+01	6.80E+07	0.07
203761 L-1	6/13/2011	0.50	1	22	Rhodomonas sp.	Cryptophyta	10	9.72E+05	9.72E+02	1.01E+08	0.10
203761 L-1	6/13/2011	0.50	1	22	Planktothrix agardhii	Cyanobacteria	13252	1.29E+09	1.29E+06	2.73E+10	27.33
					TOTAL		13291	1.29E+09	1.29E+06	2.85E+10	28.53
301484 NW	6/13/2011	0.50	1	10	Aulacoseira granulata	Bacillariophyta	18	3.85E+06	3.85E+03	1.42E+09	1.42
301484 NW	6/13/2011	0.50	1	10	Discostella pseudostelligera	Bacillariophyta	3	6.42E+05	6.42E+02	3.78E+07	0.04
301484 NW	6/13/2011	0.50	1	1	Nitzschia acicularis	Bacillariophyta	1	3.63E+04	3.63E+01	1.11E+07	0.01
301484 NW	6/13/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	3	1.09E+05	1.09E+02	1.10E+08	0.11
301484 NW	6/13/2011	0.50	1	1	Stephanodiscus hantzschii	Bacillariophyta	1	3.63E+04	3.63E+01	1.04E+07	0.01
301484 NW	6/13/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	2.00E+03	2.00E+00	4.06E+06	0.00
301484 NW	6/13/2011	0.50	1	10	Mallomonas sp.	Chrysophyta	1	2.14E+05	2.14E+02	9.32E+07	0.09
301484 NW	6/13/2011	0.50	1	10	Rhodomonas sp.	Cryptophyta	16	3.42E+06	3.42E+03	3.55E+08	0.35
301484 NW	6/13/2011	0.50	1	1	Aphanizomenon sp.	Cyanobacteria	82	1.64E+05	1.64E+02	5.80E+06	0.01
301484 NW	6/13/2011	0.50	1	10	Planktothrix agardhii	Cyanobacteria	11558	2.47E+09	2.47E+06	5.24E+10	52.44
					TOTAL		11684	2.48E+09	2.48E+06	5.45E+10	54.48
301485 NE	6/13/2011		1	12	Aulacoseira granulata	Bacillariophyta	48	8.56E+06	8.56E+03	6.59E+09	6.59
301485 NE	6/13/2011		1	1	Stephanocyclus meneghiniana	Bacillariophyta	2	7.26E+04	7.26E+01	5.59E+07	0.06
301485 NE	6/13/2011		1	12	Stephanodiscus hantzschii	Bacillariophyta	3	5.35E+05	5.35E+02	2.13E+08	0.21
301485 NE	6/13/2011		1	1	Synedra sp.	Bacillariophyta	1	2.00E+03	2.00E+00	1.84E+06	0.00
301485 NE	6/13/2011		1	1	Pediastrum duplex	Chlorophyta	36	1.31E+06	1.31E+03	5.96E+09	5.96
301485 NE	6/13/2011		1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	3.63E+04	3.63E+01	1.20E+07	0.01
301485 NE	6/13/2011		1	12	Rhodomonas sp.	Cryptophyta	6	1.07E+06	1.07E+03	2.33E+08	0.23
301485 NE	6/13/2011		1	1	Aphanizomenon sp.	Cyanobacteria	71	2.58E+06	2.58E+03	5.47E+07	0.05
301485 NE	6/13/2011		1	12	Planktothrix agardhii	Cyanobacteria	9212	1.64E+09	1.64E+06	3.48E+10	34.83
					TOTAL		9380	1.66E+09	1.66E+06	4.79E+10	47.95
301486 SE	6/13/2011	0.50	1	10	Aulacoseira granulata	Bacillariophyta	41	8.77E+06	8.77E+03	5.00E+09	5.00
301486 SE	6/13/2011	0.50	1	1	Cyclotella ocellata	Bacillariophyta	1	3.63E+04	3.63E+01	5.48E+06	0.01
301486 SE	6/13/2011	0.50	1	10	Ulnaria delicatissima	Bacillariophyta	1	2.14E+05	2.14E+02	1.68E+08	0.17
301486 SE	6/13/2011	0.50	1	1	Actinastrum hantzschii	Chlorophyta	7	2.54E+05	2.54E+02	3.41E+07	0.03
301486 SE	6/13/2011	0.50	1	10	Oocystis parva	Chlorophyta	4	8.56E+05	8.56E+02	1.23E+08	0.12
301486 SE	6/13/2011	0.50	1	10	Tetraedron minimum	Chlorophyta	1	2.14E+05	2.14E+02	1.60E+07	0.02
301486 SE	6/13/2011	0.50	1	10	Rhodomonas sp.	Cryptophyta	2	4.28E+05	4.28E+02	9.32E+07	0.09
301486 SE	6/13/2011	0.50	1	10	Planktothrix agardhii	Cyanobacteria	8928	1.91E+09	1.91E+06	4.05E+10	40.50
					TOTAL		8985	1.92E+09	1.92E+06	4.59E+10	45.94
301487 SW	6/13/2011	0.50	1	12	Aulacoseira granulata	Bacillariophyta	4	7.13E+05	7.13E+02	2.22E+08	0.22
301487 SW	6/13/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	4	8.00E+03	8.00E+00	6.16E+06	0.01
301487 SW	6/13/2011	0.50	1	12	Stephanodiscus hantzschii	Bacillariophyta	2	3.56E+05	3.56E+02	8.40E+07	0.08
301487 SW	6/13/2011	0.50	1	12	Stephanodiscus niagarae	Bacillariophyta	3	5.35E+05	5.35E+02	1.13E+09	1.13
301487 SW	6/13/2011	0.50	1	1	Ulnaria delicatissima	Bacillariophyta	1	2.00E+03	2.00E+00	8.91E+05	0.00
301487 SW	6/13/2011	0.50	1	12	Oocystis parva	Chlorophyta	10	1.78E+06	1.78E+03	8.02E+07	0.08
301487 SW	6/13/2011	0.50	1	1	Cryptomonas ovata	Cryptophyta	1	2.00E+03	2.00E+00	3.14E+06	0.00
301487 SW	6/13/2011	0.50	1	12	Rhodomonas sp.	Cryptophyta	16	2.85E+06	2.85E+03	2.96E+08	0.30
301487 SW	6/13/2011	0.50	1	12	Planktothrix agardhii	Cyanobacteria	9342	1.67E+09	1.67E+06	3.53E+10	35.32
					TOTAL		9383	1.67E+09	1.67E+06	3.71E+10	37.14

6/21/2011 Phytoplankton Data

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	ALIQUOT (mL)				REP 1	REP 1	cells/mL	um^3/L	mm^3/L
203761 L-1	6/21/2011	0.50	1	21	Aulacoseira granulata	Bacillariophyta	5	5.09E+05	5.09E+02	8.00E+07	0.08
203761 L-1	6/21/2011	0.50	1	21	Stephanodiscus hantzschii	Bacillariophyta	1	1.02E+05	1.02E+02	4.70E+07	0.05
203761 L-1	6/21/2011	0.50	1	21	Stephanodiscus parvus	Bacillariophyta	4	4.07E+05	4.07E+02	9.60E+07	0.10
203761 L-1	6/21/2011	0.50	1	21	Rhodomonas sp.	Cryptophyta	14	1.43E+06	1.43E+03	3.11E+08	0.31
203761 L-1	6/21/2011	0.50	1	21	Anabaena sp.	Cyanobacteria	92	9.37E+06	9.37E+03	3.31E+08	0.33
203761 L-1	6/21/2011	0.50	1	21	Planktothrix agardhii	Cyanobacteria	11776	1.20E+09	1.20E+06	2.54E+10	25.44
					TOTAL		11892	1.21E+09	1.21E+06	2.63E+10	26.31
L-2	6/21/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	27	9.81E+05	9.81E+02	2.50E+08	0.25
L-2	6/21/2011	0.50	1	16	Cyclotella ocellata	Bacillariophyta	6	8.02E+05	8.02E+02	1.21E+08	0.12
L-2	6/21/2011	0.50	1	1	Discostella pseudostelligera	Bacillariophyta	3	1.09E+05	1.09E+02	2.57E+07	0.03
L-2	6/21/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	2	7.26E+04	7.26E+01	2.07E+07	0.02
L-2	6/21/2011	0.50	1	16	Stephanodiscus hantzschii	Bacillariophyta	2	2.67E+05	2.67E+02	6.30E+07	0.06
L-2	6/21/2011	0.50	1	1	Surirella angusta	Bacillariophyta	1	3.63E+04	3.63E+01	2.74E+07	0.03
L-2	6/21/2011	0.50	1	1	Kirchneriella contorta	Chlorophyta	4	1.45E+05	1.45E+02	1.83E+06	0.00
L-2	6/21/2011	0.50	1	1	Pyramimonas tetrarhynchus	Chlorophyta	5	1.82E+05	1.82E+02	8.22E+07	0.08
L-2	6/21/2011	0.50	1	1	Mallomonas alpina	Chrysophyta	1	3.63E+04	3.63E+01	2.56E+07	0.03
L-2	6/21/2011	0.50	1	16	Rhodomonas sp.	Cryptophyta	46	6.15E+06	6.15E+03	6.38E+08	0.64
L-2	6/21/2011	0.50	1	16	Planktothrix agardhii	Cyanobacteria	12382	1.66E+09	1.66E+06	3.51E+10	35.11
					TOTAL		12479	1.66E+09	1.66E+06	3.64E+10	36.36
L-3	6/21/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	40	1.45E+06	1.45E+03	5.84E+08	0.58
L-3	6/21/2011	0.50	1	20	Navicula cryptocephala	Bacillariophyta	1	1.07E+05	1.07E+02	7.66E+07	0.08
L-3	6/21/2011	0.50	1	20	Stephanocyclus meneghiniana	Bacillariophyta	10	1.07E+06	1.07E+03	8.23E+08	0.82
L-3	6/21/2011	0.50	1	20	Stephanodiscus sp.	Bacillariophyta	4	4.28E+05	4.28E+02	2.03E+08	0.20
L-3	6/21/2011	0.50	1	1	Ulnaria delicatissima	Bacillariophyta	1	2.00E+03	2.00E+00	2.24E+06	0.00
L-3	6/21/2011	0.50	1	20	Pyramimonas tetrarhynchus	Chlorophyta	2	2.14E+05	2.14E+02	7.06E+07	0.07
L-3	6/21/2011	0.50	1	1	Scenedesmus opoliensis	Chlorophyta	4	1.45E+05	1.45E+02	1.83E+06	0.00
L-3	6/21/2011	0.50	1	20	Rhodomonas sp.	Cryptophyta	44	4.71E+06	4.71E+03	1.02E+09	1.02
L-3	6/21/2011	0.50	1	20	Planktothrix agardhii	Cyanobacteria	10236	1.09E+09	1.09E+06	1.03E+10	10.31
					TOTAL		10342	1.10E+09	1.10E+06	1.31E+10	13.10
301485 NE	6/21/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	28	1.02E+06	1.02E+03	3.39E+08	0.34
301485 NE	6/21/2011	0.50	1	24	Cyclotella ocellata	Bacillariophyta	2	1.78E+05	1.78E+02	2.69E+07	0.03
301485 NE	6/21/2011	0.50	1	24	Nitzschia acicularis	Bacillariophyta	1	8.91E+04	8.91E+01	2.37E+07	0.02
301485 NE	6/21/2011	0.50	1	24	Nitzschia sp.	Bacillariophyta	2	1.78E+05	1.78E+02	3.53E+07	0.04
301485 NE	6/21/2011	0.50	1	24	Stephanocyclus meneghiniana	Bacillariophyta	2	1.78E+05	1.78E+02	8.40E+07	0.08
301485 NE	6/21/2011	0.50	1	24	Stephanodiscus hantzschii	Bacillariophyta	6	5.35E+05	5.35E+02	1.26E+08	0.13
301485 NE	6/21/2011	0.50	1	24	Stephanodiscus niagarae	Bacillariophyta	4	3.56E+05	3.56E+02	8.13E+08	0.81
301485 NE	6/21/2011	0.50	1	24	Stephanodiscus parvus	Bacillariophyta	2	1.78E+05	1.78E+02	8.40E+07	0.08
301485 NE	6/21/2011	0.50	1	1	Ulnaria delicatissima	Bacillariophyta	1	3.63E+04	3.63E+01	2.85E+07	0.03
301485 NE	6/21/2011	0.50	1	1	Oocystis sp.	Chlorophyta	2	7.26E+04	7.26E+01	3.27E+06	0.00
301485 NE	6/21/2011	0.50	1	1	Pediastrum duplex	Chlorophyta	3	6.00E+03	6.00E+00	5.68E+07	0.06
301485 NE	6/21/2011	0.50	1	1	Mallomonas sp.	Chrysophyta	1	3.63E+04	3.63E+01	2.31E+07	0.02
301485 NE	6/21/2011	0.50	1	1	Cryptomonas sp.	Cryptophyta	1	2.00E+03	2.00E+00	2.30E+06	0.00
301485 NE	6/21/2011	0.50	1	24	Rhodomonas sp.	Cryptophyta	10	8.91E+05	8.91E+02	9.24E+07	0.09
301485 NE	6/21/2011	0.50	1	24	Aphanizomenon sp.	Cyanobacteria	288	2.57E+07	2.57E+04	9.07E+08	0.91
301485 NE	6/21/2011	0.50	1	24	Planktothrix agardhii	Cyanobacteria	14042	1.25E+09	1.25E+06	1.18E+10	11.79
					TOTAL		14395	1.28E+09	1.28E+06	1.44E+10	14.43

6/27/2011 Phytoplankton Data

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	ALIQUOT (mL)				REP 1	REP 1	cells/ml	um^3/L	mm^3/L
203758 L-2	6/27/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	3	1.09E+05	1.09E+02	5.78E+07	0.06
203758 L-2	6/27/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	1	3.63E+04	3.63E+01	3.86E+07	0.04
203758 L-2	6/27/2011	0.50	1	8	Stephanodiscus hantzschii	Bacillariophyta	4	1.07E+06	1.07E+03	7.10E+08	0.71
203758 L-2	6/27/2011	0.50	1	1	Ulnaria delicatissima	Bacillariophyta	1	2.00E+03	2.00E+00	2.83E+06	0.00
203758 L-2	6/27/2011	0.50	1	8	Pyramimonas tetrarhynchus	Chlorophyta	4	1.07E+06	1.07E+03	4.48E+08	0.45
203758 L-2	6/27/2011	0.50	1	1	Cryptomonas sp.	Cryptophyta	1	2.00E+03	2.00E+00	3.04E+06	0.00
203758 L-2	6/27/2011	0.50	1	8	Rhodomonas sp.	Cryptophyta	6	1.60E+06	1.60E+03	1.66E+08	0.17
203758 L-2	6/27/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	6950	1.86E+09	1.86E+06	1.75E+10	17.50
					TOTAL		6970	1.86E+09	1.86E+06	1.89E+10	18.93
203761 L-1	6/27/2011	0.50	1	6	Aulacoseira granulata	Bacillariophyta	20	7.13E+06	7.13E+03	2.02E+09	2.02
203761 L-1	6/27/2011	0.50	1	1	Nitzschia sp.	Bacillariophyta	2	7.26E+04	7.26E+01	1.05E+07	0.01
203761 L-1	6/27/2011	0.50	1	6	Stephanocyclus meneghiniana	Bacillariophyta	1	3.56E+05	3.56E+02	8.40E+07	0.08
203761 L-1	6/27/2011	0.50	1	6	Stephanodiscus hantzschii	Bacillariophyta	3	1.07E+06	1.07E+03	5.08E+08	0.51
203761 L-1	6/27/2011	0.50	1	1	Stephanodiscus parvus	Bacillariophyta	3	1.09E+05	1.09E+02	9.24E+06	0.01
203761 L-1	6/27/2011	0.50	1	1	Ulnaria delicatissima	Bacillariophyta	2	7.26E+04	7.26E+01	1.64E+08	0.16
203761 L-1	6/27/2011	0.50	1	1	Actinastrum hantzschii	Chlorophyta	8	2.91E+05	2.91E+02	1.19E+07	0.01
203761 L-1	6/27/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	1.38E+08	0.14
203761 L-1	6/27/2011	0.50	1	1	Dictyosphaerium pulchellum	Chlorophyta	52	1.04E+05	1.04E+02	1.47E+06	0.00
203761 L-1	6/27/2011	0.50	1	6	Pediastrum duplex	Chlorophyta	12	4.28E+06	4.28E+03	2.13E+10	21.29
203761 L-1	6/27/2011	0.50	1	6	Pyramimonas tetrarhynchus	Chlorophyta	4	1.43E+06	1.43E+03	2.51E+08	0.25
203761 L-1	6/27/2011	0.50	1	1	Scenedesmus communis	Chlorophyta	4	1.45E+05	1.45E+02	4.11E+06	0.00
203761 L-1	6/27/2011	0.50	1	6	Rhodomonas sp.	Cryptophyta	10	3.56E+06	3.56E+03	7.77E+08	0.78
203761 L-1	6/27/2011	0.50	1	6	Planktothrix agardhii	Cyanobacteria	9050	3.23E+09	3.23E+06	6.84E+10	68.43
					TOTAL		9172	3.24E+09	3.24E+06	9.37E+10	93.69
203764 L-3	6/27/2011	0.50	1	12	Aulacoseira granulata	Bacillariophyta	117	2.09E+07	2.09E+04	5.32E+09	5.32
203764 L-3	6/27/2011	0.50	1	12	Stephanocyclus meneghiniana	Bacillariophyta	4	7.13E+05	7.13E+02	8.09E+08	0.81
203764 L-3	6/27/2011	0.50	1	12	Stephanodiscus hantzschii	Bacillariophyta	2	3.56E+05	3.56E+02	1.02E+08	0.10
203764 L-3	6/27/2011	0.50	1	1	Stephanodiscus parvus	Bacillariophyta	1	3.63E+04	3.63E+01	3.08E+06	0.00
203764 L-3	6/27/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	2.00E+03	2.00E+00	1.01E+06	0.00
203764 L-3	6/27/2011	0.50	1	1	Dictyosphaerium pulchellum	Chlorophyta	15	3.00E+04	3.00E+01	2.83E+06	0.00
203764 L-3	6/27/2011	0.50	1	1	Pediastrum duplex	Chlorophyta	7	1.40E+04	1.40E+01	3.64E+07	0.04
203764 L-3	6/27/2011	0.50	1	1	Pyramimonas tetrarhynchus	Chlorophyta	3	1.09E+05	1.09E+02	2.60E+07	0.03
203764 L-3	6/27/2011	0.50	1	1	Scenedesmus dimorphus	Chlorophyta	4	1.45E+05	1.45E+02	4.26E+06	0.00
203764 L-3	6/27/2011	0.50	1	1	Staurastrum sp.	Chlorophyta	1	2.00E+03	2.00E+00	4.83E+07	0.05
203764 L-3	6/27/2011	0.50	1	12	Rhodomonas sp.	Cryptophyta	20	3.56E+06	3.56E+03	3.70E+08	0.37
203764 L-3	6/27/2011	0.50	1	1	Aphanizomenon sp.	Cyanobacteria	63	1.26E+05	1.26E+02	4.45E+06	0.00
203764 L-3	6/27/2011	0.50	1	1	Merismopedia sp.	Cyanobacteria	31	6.20E+04	6.20E+01	2.60E+05	0.00
203764 L-3	6/27/2011	0.50	1	12	Planktothrix agardhii	Cyanobacteria	10736	1.91E+09	1.91E+06	4.06E+10	40.59
203764 L-3	6/27/2011	0.50	1	1	Trachelomonas varians	Euglenophyta	1	2.00E+03	2.00E+00	1.42E+06	0.00
					TOTAL		11006	1.94E+09	1.94E+06	4.73E+10	47.32
301484 NW	6/27/2011	0.50	1	1	Aulacoseira ambigua	Bacillariophyta	114	4.14E+06	4.14E+03	2.08E+09	2.08
301484 NW	6/27/2011	0.50	1	4	Cyclotella ocellata	Bacillariophyta	2	1.07E+06	1.07E+03	9.07E+07	0.09
301484 NW	6/27/2011	0.50	1	4	Stephanocyclus meneghiniana	Bacillariophyta	2	1.07E+06	1.07E+03	5.04E+08	0.50
301484 NW	6/27/2011	0.50	1	4	Stephanodiscus hantzschii	Bacillariophyta	1	5.35E+05	5.35E+02	2.13E+08	0.21
301484 NW	6/27/2011	0.50	1	4	Oocystis parva	Chlorophyta	4	2.14E+06	2.14E+03	9.63E+07	0.10
301484 NW	6/27/2011	0.50	1	4	Pyramimonas tetrarhynchus	Chlorophyta	4	2.14E+06	2.14E+03	5.82E+08	0.58
301484 NW	6/27/2011	0.50	1	4	Tetraedron minimum	Chlorophyta	2	1.07E+06	1.07E+03	2.89E+07	0.03
301484 NW	6/27/2011	0.50	1	4	Cryptomonas sp.	Cryptophyta	1	5.35E+05	5.35E+02	6.72E+08	0.67
301484 NW	6/27/2011	0.50	1	4	Rhodomonas sp.	Cryptophyta	6	3.21E+06	3.21E+03	3.33E+08	0.33
301484 NW	6/27/2011	0.50	1	4	Planktothrix agardhii	Cyanobacteria	9414	5.03E+09	5.03E+06	1.07E+11	106.77
					TOTAL		9550	5.05E+09	5.05E+06	1.11E+11	111.37

6/27/2011 Phytoplankton Data (Continued…)

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	ALIQUOT (mL)				REP 1	REP 1	cells/ml	um^3/L	mm^3/L
301485 NE	6/27/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	11	4.00E+05	4.00E+02	4.52E+07	0.05
301485 NE	6/27/2011	0.50	1	1	Nitzschia acicularis	Bacillariophyta	1	3.63E+04	3.63E+01	1.03E+07	0.01
301485 NE	6/27/2011	0.50	1	18	Stephanocyclus meneghiniana	Bacillariophyta	8	9.51E+05	9.51E+02	5.42E+08	0.54
301485 NE	6/27/2011	0.50	1	18	Stephanodiscus hantzschii	Bacillariophyta	6	7.13E+05	7.13E+02	1.68E+08	0.17
301485 NE	6/27/2011	0.50	1	1	Stephanodiscus niagarae	Bacillariophyta	2	7.26E+04	7.26E+01	5.70E+08	0.57
301485 NE	6/27/2011	0.50	1	18	Stephanodiscus parvus	Bacillariophyta	1	1.19E+05	1.19E+02	1.01E+07	0.01
301485 NE	6/27/2011	0.50	1	1	Ulnaria delicatissima	Bacillariophyta	1	3.63E+04	3.63E+01	8.13E+07	0.08
301485 NE	6/27/2011	0.50	1	1	Actinastrum hantzschii	Chlorophyta	8	1.60E+04	1.60E+01	5.53E+05	0.00
301485 NE	6/27/2011	0.50	1	1	Oocystis parva	Chlorophyta	4	8.00E+03	8.00E+00	7.20E+05	0.00
301485 NE	6/27/2011	0.50	1	18	Pyramimonas tetrarhynchus	Chlorophyta	6	7.13E+05	7.13E+02	2.13E+08	0.21
301485 NE	6/27/2011	0.50	1	18	Scenedesmus subspicatus	Chlorophyta	2	2.38E+05	2.38E+02	2.49E+06	0.00
301485 NE	6/27/2011	0.50	1	18	Rhodomonas sp.	Cryptophyta	12	1.43E+06	1.43E+03	1.21E+08	0.12
301485 NE	6/27/2011	0.50	1	1	Aphanizomenon sp.	Cyanobacteria	92	3.34E+06	3.34E+03	1.18E+08	0.12
301485 NE	6/27/2011	0.50	1	18	Planktothrix agardhii	Cyanobacteria	16582	1.97E+09	1.97E+06	1.86E+10	18.56
					TOTAL		16736	1.98E+09	1.98E+06	2.04E+10	20.44
301486 SE	6/27/2011	0.50	1	8	Aulacoseira granulata	Bacillariophyta	20	5.35E+06	5.35E+03	1.97E+09	1.97
301486 SE	6/27/2011	0.50	1	1	Nitzschia sp.	Bacillariophyta	1	3.63E+04	3.63E+01	3.81E+06	0.00
301486 SE	6/27/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	4	1.45E+05	1.45E+02	1.79E+08	0.18
301486 SE	6/27/2011	0.50	1	8	Stephanodiscus hantzschii	Bacillariophyta	2	5.35E+05	5.35E+02	5.08E+08	0.51
301486 SE	6/27/2011	0.50	1	1	Stephanodiscus parvus	Bacillariophyta	3	1.09E+05	1.09E+02	9.24E+06	0.01
301486 SE	6/27/2011	0.50	1	1	Ulnaria delicatissima	Bacillariophyta	1	3.63E+04	3.63E+01	4.85E+07	0.05
301486 SE	6/27/2011	0.50	1	1	Actinastrum hantzschii	Chlorophyta	8	1.60E+04	1.60E+01	5.53E+05	0.00
301486 SE	6/27/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	2.00E+03	2.00E+00	8.98E+05	0.00
301486 SE	6/27/2011	0.50	1	1	Dictyosphaerium pulchellum	Chlorophyta	12	4.36E+05	4.36E+02	6.16E+06	0.01
301486 SE	6/27/2011	0.50	1	1	Oocystis parva	Chlorophyta	2	7.26E+04	7.26E+01	6.54E+06	0.01
301486 SE	6/27/2011	0.50	1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	3.63E+04	3.63E+01	9.70E+06	0.01
301486 SE	6/27/2011	0.50	1	1	Radiococcus planktonicus	Chlorophyta	4	1.45E+05	1.45E+02	9.51E+06	0.01
301486 SE	6/27/2011	0.50	1	1	Staurastrum sp.	Chlorophyta	1	3.63E+04	3.63E+01	1.36E+09	1.36
301486 SE	6/27/2011	0.50	1	1	Cryptomonas sp.	Cryptophyta	1	3.63E+04	3.63E+01	7.36E+07	0.07
301486 SE	6/27/2011	0.50	1	8	Rhodomonas sp.	Cryptophyta	21	5.61E+06	5.61E+03	5.82E+08	0.58
301486 SE	6/27/2011	0.50	1	1	Aphanizomenon sp.	Cyanobacteria	14	5.08E+05	5.08E+02	1.80E+07	0.02
301486 SE	6/27/2011	0.50	1	1	Aphanocapsa sp.	Cyanobacteria	222	4.44E+05	4.44E+02	2.31E+05	0.00
301486 SE	6/27/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	8478	2.27E+09	2.27E+06	2.14E+10	21.35
					TOTAL		8796	2.28E+09	2.28E+06	2.61E+10	26.13
301487 SW	6/27/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	24	8.72E+05	8.72E+02	2.46E+08	0.25
301487 SW	6/27/2011	0.50	1	1	Nitzschia palea	Bacillariophyta	1	3.63E+04	3.63E+01	2.78E+06	0.00
301487 SW	6/27/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	2	7.26E+04	7.26E+01	4.82E+07	0.05
301487 SW	6/27/2011	0.50	1	10	Stephanodiscus hantzschii	Bacillariophyta	4	8.56E+05	8.56E+02	6.50E+08	0.65
301487 SW	6/27/2011	0.50	1	1	Stephanodiscus parvus	Bacillariophyta	3	1.09E+05	1.09E+02	9.24E+06	0.01
301487 SW	6/27/2011	0.50	1	10	Actinastrum hantzschii	Chlorophyta	6	1.28E+06	1.28E+03	6.45E+07	0.06
301487 SW	6/27/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	4.43E+07	0.04
301487 SW	6/27/2011	0.50	1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	2.00E+03	2.00E+00	4.78E+05	0.00
301487 SW	6/27/2011	0.50	1	1	Radiococcus planktonicus	Chlorophyta	3	1.09E+05	1.09E+02	7.13E+06	0.01
301487 SW	6/27/2011	0.50	1	10	Scenedesmus abundans	Chlorophyta	2	4.28E+05	4.28E+02	4.48E+06	0.00
301487 SW	6/27/2011	0.50	1	1	Cryptomonas sp.	Cryptophyta	1	3.63E+04	3.63E+01	5.75E+07	0.06
301487 SW	6/27/2011	0.50	1	10	Rhodomonas sp.	Cryptophyta	28	5.99E+06	5.99E+03	3.14E+08	0.31
301487 SW	6/27/2011	0.50	1	1	Anabaena sp.	Cyanobacteria	47	9.40E+04	9.40E+01	3.99E+06	0.00
301487 SW	6/27/2011	0.50	1	10	Planktothrix agardhii	Cyanobacteria	11994	2.57E+09	2.57E+06	2.42E+10	24.17
301487 SW	6/27/2011	0.50	1	1	Raphidiopsis curvata	Cyanobacteria	3	1.09E+05	1.09E+02	1.71E+06	0.00
					TOTAL		12120	2.58E+09	2.58E+06	2.56E+10	25.62

7/12/2011 Phytoplankton Data

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	ALIQUOT (mL)				REP 1	REP 1	cells/mL	um^3/L	mm^3/L
203758 L-2	7/12/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	9	1.80E+04	1.80E+01	6.62E+06	0.01
203758 L-2	7/12/2011	0.50	1	1	Discostella pseudostelligera	Bacillariophyta	2	7.26E+04	7.26E+01	1.10E+07	0.01
203758 L-2	7/12/2011	0.50	1	8	Stephanocyclus meneghiniana	Bacillariophyta	2	5.35E+05	5.35E+02	2.13E+08	0.21
203758 L-2	7/12/2011	0.50	1	8	Dictyosphaerium pulchellum	Chlorophyta	13	3.48E+06	3.48E+03	2.27E+08	0.23
203758 L-2	7/12/2011	0.50	1	1	Oocystis parva	Chlorophyta	4	1.45E+05	1.45E+02	3.49E+06	0.00
203758 L-2	7/12/2011	0.50	1	8	Pyramimonas tetrarhynchus	Chlorophyta	2	5.35E+05	5.35E+02	3.39E+08	0.34
203758 L-2	7/12/2011	0.50	1	8	Scenedesmus quadricauda	Chlorophyta	4	1.07E+06	1.07E+03	5.04E+07	0.05
203758 L-2	7/12/2011	0.50	1	8	Aphanizomenon sp.	Cyanobacteria	66	1.76E+07	1.76E+04	6.24E+08	0.62
203758 L-2	7/12/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	9652	2.58E+09	2.58E+06	5.47E+10	54.74
203758 L-2	7/12/2011	0.50	1	1	Euglena sp.	Euglenophyta	1	2.00E+03	2.00E+00	1.56E+06	0.00
					TOTAL		9755	2.60E+09	2.60E+06	5.62E+10	56.21
203761 L-1	7/12/2011	0.50	1	8	Stephanocyclus meneghiniana	Bacillariophyta	2	5.35E+05	5.35E+02	2.13E+08	0.21
203761 L-1	7/12/2011	0.50	1	1	Stephanodiscus hantzschii	Bacillariophyta	1	3.63E+04	3.63E+01	1.73E+07	0.02
203761 L-1	7/12/2011	0.50	1	1	Actinastrum hantzschii	Chlorophyta	8	2.91E+05	2.91E+02	2.26E+07	0.02
203761 L-1	7/12/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	1.99E+07	0.02
203761 L-1	7/12/2011	0.50	1	1	Pediastrum duplex	Chlorophyta	24	4.80E+04	4.80E+01	2.83E+08	0.28
203761 L-1	7/12/2011	0.50	1	1	Pyramimonas tetrarhynchus	Chlorophyta	2	7.26E+04	7.26E+01	1.55E+07	0.02
203761 L-1	7/12/2011	0.50	1	8	Rhodomonas sp.	Cryptophyta	21	5.61E+06	5.61E+03	2.94E+08	0.29
203761 L-1	7/12/2011	0.50	1	1	Aphanizomenon sp.	Cyanobacteria	17	3.40E+04	3.40E+01	1.20E+06	0.00
203761 L-1	7/12/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	7160	1.91E+09	1.91E+06	4.06E+10	40.60
					TOTAL		7236	1.92E+09	1.92E+06	4.15E+10	41.47
203764 L-3	7/12/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	10	2.00E+04	2.00E+01	6.22E+06	0.01
203764 L-3	7/12/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	2	4.00E+03	4.00E+00	1.90E+06	0.00
203764 L-3	7/12/2011	0.50	1	1	Actinastrum gracilimum	Chlorophyta	9	3.27E+05	3.27E+02	1.44E+07	0.01
203764 L-3	7/12/2011	0.50	1	1	Characium sp.	Chlorophyta	1	2.00E+03	2.00E+00	2.73E+05	0.00
203764 L-3	7/12/2011	0.50	1	1	Pyramimonas tetrarhynchus	Chlorophyta	5	1.82E+05	1.82E+02	2.91E+07	0.03
203764 L-3	7/12/2011	0.50	1	1	Scenedesmus sp.	Chlorophyta	3	6.00E+03	6.00E+00	2.28E+06	0.00
203764 L-3	7/12/2011	0.50	1	10	Rhodomonas sp.	Cryptophyta	8	1.71E+06	1.71E+03	6.72E+08	0.67
203764 L-3	7/12/2011	0.50	1	10	cf. Anabaena circinalis	Cyanobacteria	162	3.47E+07	3.47E+04	1.22E+09	1.22
203764 L-3	7/12/2011	0.50	1	10	Aphanizomenon sp.	Cyanobacteria	384	8.21E+07	8.21E+04	8.06E+09	8.06
203764 L-3	7/12/2011	0.50	1	10	Aphanocapsa sp.	Cyanobacteria	76	1.63E+07	1.63E+04	6.81E+07	0.07
203764 L-3	7/12/2011	0.50	1	10	Planktothrix agardhii	Cyanobacteria	7252	1.55E+09	1.55E+06	1.46E+10	14.61
203764 L-3	7/12/2011	0.50	1	1	Trachelomonas sp.	Euglenophyta	1	3.63E+04	3.63E+01	2.22E+06	0.00
					TOTAL		7913	1.69E+09	1.69E+06	2.47E+10	24.70
301484 NW	7/12/2011	0.50	1	8	Aulacoseira granulata	Bacillariophyta	8	2.14E+06	2.14E+03	6.65E+08	0.67
301484 NW	7/12/2011	0.50	1	8	Discostella pseudostelligera	Bacillariophyta	1	2.67E+05	2.67E+02	6.30E+07	0.06
301484 NW	7/12/2011	0.50	1	1	Stephanodiscus hantzschii	Bacillariophyta	2	7.26E+04	7.26E+01	2.07E+07	0.02
301484 NW	7/12/2011	0.50	1	8	Closteriopsis acicularis	Chlorophyta	2	5.35E+05	5.35E+02	3.12E+08	0.31
301484 NW	7/12/2011	0.50	1	1	Oocystis parva	Chlorophyta	12	4.36E+05	4.36E+02	1.96E+07	0.02
301484 NW	7/12/2011	0.50	1	8	Pyramimonas tetrarhynchus	Chlorophyta	4	1.07E+06	1.07E+03	2.55E+08	0.26
301484 NW	7/12/2011	0.50	1	8	Rhodomonas sp.	Cryptophyta	1	2.67E+05	2.67E+02	2.13E+08	0.21
301484 NW	7/12/2011	0.50	1	1	Aphanizomenon sp.	Cyanobacteria	109	3.96E+06	3.96E+03	1.40E+08	0.14
301484 NW	7/12/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	10276	2.75E+09	2.75E+06	2.59E+10	25.88
					TOTAL		10415	2.76E+09	2.76E+06	2.76E+10	27.57
301485 NE	7/12/2011	0.50	1	1	Discostella pseudostelligera	Bacillariophyta	1	3.63E+04	3.63E+01	3.08E+06	0.00
301485 NE	7/12/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	1	3.63E+04	3.63E+01	2.89E+07	0.03
301485 NE	7/12/2011	0.50	1	10	Actinastrum gracilimum	Chlorophyta	14	2.99E+06	2.99E+03	4.58E+08	0.46
301485 NE	7/12/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	2.00E+03	2.00E+00	3.30E+05	0.00
301485 NE	7/12/2011	0.50	1	1	Pediastrum tetras	Chlorophyta	4	8.00E+03	8.00E+00	3.19E+06	0.00
301485 NE	7/12/2011	0.50	1	10	Pyramimonas tetrarhynchus	Chlorophyta	4	8.56E+05	8.56E+02	1.13E+08	0.11
301485 NE	7/12/2011	0.50	1	10	cf. Anabaena circinalis	Cyanobacteria	14	2.99E+06	2.99E+03	1.06E+08	0.11
301485 NE	7/12/2011	0.50	1	10	Aphanizomenon sp.	Cyanobacteria	123	2.63E+07	2.63E+04	9.30E+08	0.93
301485 NE	7/12/2011	0.50	1	10	Planktothrix agardhii	Cyanobacteria	8748	1.87E+09	1.87E+06	3.97E+10	39.69
301485 NE	7/12/2011	0.50	1	1	Trachelomonas hispida	Euglenophyta	1	2.00E+03	2.00E+00	3.49E+06	0.00
301485 NE	7/12/2011	0.50	1	1	Trachelomonas sp.	Euglenophyta	1	3.63E+04	3.63E+01	1.15E+07	0.01
					TOTAL		8912	1.90E+09	1.90E+06	4.13E+10	41.34

7/12/2011 Phytoplankton Data (Continued…)

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	ALIQUOT (mL)				REP 1	REP 1	cells/mL	um^3/L	mm^3/L
301486 SE	7/12/2011	0.50	1	12	Aulacoseira granulata	Bacillariophyta	4	7.13E+05	7.13E+02	1.96E+08	0.20
301486 SE	7/12/2011	0.50	1	12	Discostella pseudostelligera	Bacillariophyta	2	3.56E+05	3.56E+02	5.38E+07	0.05
301486 SE	7/12/2011	0.50	1	12	Nitzschia acicularis	Bacillariophyta	1	1.78E+05	1.78E+02	6.02E+07	0.06
301486 SE	7/12/2011	0.50	1	1	Nitzschia amphibia	Bacillariophyta	1	3.63E+04	3.63E+01	2.72E+06	0.00
301486 SE	7/12/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	2	7.26E+04	7.26E+01	3.35E+07	0.03
301486 SE	7/12/2011	0.50	1	1	Actinastrum gracilimum	Chlorophyta	32	6.40E+04	6.40E+01	3.58E+06	0.00
301486 SE	7/12/2011	0.50	1	1	Dictyosphaerium pulchellum	Chlorophyta	23	4.60E+04	4.60E+01	6.50E+05	0.00
301486 SE	7/12/2011	0.50	1	1	Oocystis parva	Chlorophyta	16	3.20E+04	3.20E+01	2.88E+06	0.00
301486 SE	7/12/2011	0.50	1	12	Pyramimonas tetrarhynchus	Chlorophyta	4	7.13E+05	7.13E+02	1.79E+08	0.18
301486 SE	7/12/2011	0.50	1	1	Scenedesmus dimorphus	Chlorophyta	4	1.45E+05	1.45E+02	4.26E+06	0.00
301486 SE	7/12/2011	0.50	1	12	Rhodomonas sp.	Cryptophyta	1	1.78E+05	1.78E+02	3.29E+07	0.03
301486 SE	7/12/2011	0.50	1	1	cf. Anabaena circinalis	Cyanobacteria	31	6.20E+04	6.20E+01	6.09E+06	0.01
301486 SE	7/12/2011	0.50	1	12	Aphanizomenon sp.	Cyanobacteria	14	2.50E+06	2.50E+03	5.29E+07	0.05
301486 SE	7/12/2011	0.50	1	1	Aphanocapsa sp.	Cyanobacteria	557	2.02E+07	2.02E+04	1.05E+07	0.01
301486 SE	7/12/2011	0.50	1	12	Planktothrix agardhii	Cyanobacteria	10932	1.95E+09	1.95E+06	1.84E+10	18.36
301486 SE	7/12/2011	0.50	1	12	Lepocinclis sp.	Euglenophyta	1	1.78E+05	1.78E+02	9.80E+07	0.10
301486 SE	7/12/2011	0.50	1	1	Peridinium umbonatum	Pyrrophyta	1	3.63E+04	3.63E+01	1.67E+07	0.02
					TOTAL		11626	1.97E+09	1.97E+06	1.91E+10	19.11
301482 SW	7/12/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	8	1.60E+04	1.60E+01	4.40E+06	0.00
301482 SW	7/12/2011	0.50	1	1	Stephanocyclus meneghiniana	Bacillariophyta	1	3.63E+04	3.63E+01	1.45E+07	0.01
301482 SW	7/12/2011	0.50	1	12	Closteriopsis acicularis	Chlorophyta	1	1.78E+05	1.78E+02	2.02E+08	0.20
301482 SW	7/12/2011	0.50	1	1	Gonium sociale	Chlorophyta	4	1.45E+05	1.45E+02	3.92E+06	0.00
301482 SW	7/12/2011	0.50	1	12	Kirchneriella contorta	Chlorophyta	5	8.91E+05	8.91E+02	1.12E+07	0.01
301482 SW	7/12/2011	0.50	1	12	Pyramimonas tetrarhynchus	Chlorophyta	2	3.56E+05	3.56E+02	7.28E+07	0.07
301482 SW	7/12/2011	0.50	1	1	Cryptomonas sp.	Cryptophyta	1	3.63E+04	3.63E+01	3.53E+07	0.04
301482 SW	7/12/2011	0.50	1	12	Rhodomonas sp.	Cryptophyta	1	1.78E+05	1.78E+02	9.33E+06	0.01
301482 SW	7/12/2011	0.50	1	1	Aphanizomenon sp.	Cyanobacteria	66	2.40E+06	2.40E+03	8.47E+07	0.08
301482 SW	7/12/2011	0.50	1	12	Planktothrix agardhii	Cyanobacteria	12150	2.17E+09	2.17E+06	2.04E+10	20.40
					TOTAL		12239	2.17E+09	2.17E+06	2.08E+10	20.84

7/27/2011 Phytoplankton Data

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	ALIQUOT (mL)				REP 1	REP 1	cells/mL	um^3/L	mm^3/L
L-2	7/27/2011	0.50	1	4	Achnanthidium minutissimum	Bacillariophyta	1	5.35E+05	5.35E+02	2.77E+07	0.03
L-2	7/27/2011	0.50	1	1	Asterionella formosa	Bacillariophyta	10	2.00E+04	2.00E+01	2.10E+07	0.02
L-2	7/27/2011	0.50	1	4	Discostella pseudostelligera	Bacillariophyta	3	1.60E+06	1.60E+03	2.42E+08	0.24
L-2	7/27/2011	0.50	1	4	Stephanocyclus meneghiniana	Bacillariophyta	1	5.35E+05	5.35E+02	2.54E+08	0.25
L-2	7/27/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	2	4.00E+03	4.00E+00	8.13E+06	0.01
L-2	7/27/2011	0.50	1	4	Dictyosphaerium pulchellum	Chlorophyta	12	6.42E+06	6.42E+03	6.45E+08	0.65
L-2	7/27/2011	0.50	1	4	Anabaena circinalis	Cyanobacteria	13	6.95E+06	6.95E+03	6.82E+08	0.68
L-2	7/27/2011	0.50	1	4	Aphanizomenon flos-aquae	Cyanobacteria	56	2.99E+07	2.99E+04	1.06E+09	1.06
L-2	7/27/2011	0.50	1	4	Planktothrix agardhii	Cyanobacteria	6680	3.57E+09	3.57E+06	3.36E+10	33.65
					TOTAL		6778	3.62E+09	3.62E+06	3.66E+10	36.59
L-1	7/27/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	28	1.02E+06	1.02E+03	1.01E+08	0.10
L-1	7/27/2011	0.50	1	8	Cyclotella ocellata	Bacillariophyta	1	2.67E+05	2.67E+02	2.27E+07	0.02
L-1	7/27/2011	0.50	1	8	Discostella pseudostelligera	Bacillariophyta	1	2.67E+05	2.67E+02	6.30E+07	0.06
L-1	7/27/2011	0.50	1	1	Nitzschia acicularis	Bacillariophyta	1	3.63E+04	3.63E+01	1.77E+07	0.02
L-1	7/27/2011	0.50	1	8	Stephanocyclus meneghiniana	Bacillariophyta	1	2.67E+05	2.67E+02	1.27E+08	0.13
L-1	7/27/2011	0.50	1	1	Actinastrum gracilimum	Chlorophyta	15	5.45E+05	5.45E+02	3.05E+07	0.03
L-1	7/27/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	1.86E+07	0.02
L-1	7/27/2011	0.50	1	1	Dictyosphaerium pulchellum	Chlorophyta	16	3.20E+04	3.20E+01	2.09E+06	0.00
L-1	7/27/2011	0.50	1	8	Scenedesmus dimorphus	Chlorophyta	4	1.07E+06	1.07E+03	1.06E+08	0.11
L-1	7/27/2011	0.50	1	8	Anabaena sp.	Cyanobacteria	102	2.73E+07	2.73E+04	2.68E+09	2.68
L-1	7/27/2011	0.50	1	8	Aphanizomenon flos-aquae	Cyanobacteria	139	3.72E+07	3.72E+04	1.58E+09	1.58
L-1	7/27/2011	0.50	1	8	Aphanocapsa sp.	Cyanobacteria	225	6.02E+07	6.02E+04	2.52E+08	0.25
L-1	7/27/2011	0.50	1	8	Cylindrospermopsis raciborskii	Cyanobacteria	175	4.68E+07	4.68E+04	4.41E+08	0.44
L-1	7/27/2011	0.50	1	1	Limnothrix redekei	Cyanobacteria	36	1.31E+06	1.31E+03	3.09E+06	0.00
L-1	7/27/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	7951	2.13E+09	2.13E+06	2.00E+10	20.03
L-1	7/27/2011	0.50	1	1	Raphidiopsis curvata	Cyanobacteria	15	5.45E+05	5.45E+02	1.29E+06	0.00
					TOTAL		8711	2.30E+09	2.30E+06	2.55E+10	25.46
L-3	7/27/2011	0.50	1	1	Actinocyclus normanii	Bacillariophyta	1	3.63E+04	3.63E+01	3.65E+07	0.04
L-3	7/27/2011	0.50	1	8	Aulacoseira granulata	Bacillariophyta	16	4.28E+06	4.28E+03	1.33E+09	1.33
L-3	7/27/2011	0.50	1	1	Discostella pseudostelligera	Bacillariophyta	2	7.26E+04	7.26E+01	1.71E+07	0.02
L-3	7/27/2011	0.50	1	8	Nitzschia palea	Bacillariophyta	1	2.67E+05	2.67E+02	9.22E+07	0.09
L-3	7/27/2011	0.50	1	8	Stephanocyclus meneghiniana	Bacillariophyta	1	2.67E+05	2.67E+02	6.30E+07	0.06
L-3	7/27/2011	0.50	1	1	Actinastrum gracilimum	Chlorophyta	22	7.99E+05	7.99E+02	5.11E+07	0.05
L-3	7/27/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	4.16E+06	0.00
L-3	7/27/2011	0.50	1	1	Dictyosphaerium pulchellum	Chlorophyta	13	2.60E+04	2.60E+01	3.68E+05	0.00
L-3	7/27/2011	0.50	1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	3.63E+04	3.63E+01	6.28E+06	0.01
L-3	7/27/2011	0.50	1	1	Scenedesmus dimorphus	Chlorophyta	4	1.45E+05	1.45E+02	4.26E+06	0.00
L-3	7/27/2011	0.50	1	1	Staurastrum sp.	Chlorophyta	1	2.00E+03	2.00E+00	1.39E+07	0.01
L-3	7/27/2011	0.50	1	8	Anabaena circinalis	Cyanobacteria	442	1.18E+08	1.18E+05	1.16E+10	11.60
L-3	7/27/2011	0.50	1	8	Anabaena sp.	Cyanobacteria	44	1.18E+07	1.18E+04	5.91E+08	0.59
L-3	7/27/2011	0.50	1	8	Aphanizomenon flos-aquae	Cyanobacteria	297	7.94E+07	7.94E+04	2.81E+09	2.81
L-3	7/27/2011	0.50	1	8	Aphanocapsa sp.	Cyanobacteria	108	2.89E+07	2.89E+04	1.50E+07	0.02
L-3	7/27/2011	0.50	1	8	Cylindrospermopsis raciborskii	Cyanobacteria	95	2.54E+07	2.54E+04	2.39E+08	0.24
L-3	7/27/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	6497	1.74E+09	1.74E+06	1.64E+10	16.36
L-3	7/27/2011	0.50	1	1	Pseudanabaena sp.	Cyanobacteria	39	1.42E+06	1.42E+03	2.22E+06	0.00
L-3	7/27/2011	0.50	1	1	Raphidiopsis curvata	Cyanobacteria	13	2.60E+04	2.60E+01	2.45E+05	0.00
					TOTAL		7598	2.01E+09	2.01E+06	3.32E+10	33.24
NW	7/27/2011	0.50	1	1	Actinastrum gracilimum	Chlorophyta	4	1.45E+05	1.45E+02	7.84E+06	0.01
NW	7/27/2011	0.50	1	8	Characium sp.	Chlorophyta	2	5.35E+05	5.35E+02	7.31E+07	0.07
NW	7/27/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	2.00E+03	2.00E+00	4.30E+05	0.00
NW	7/27/2011	0.50	1	1	Oocystis parva	Chlorophyta	4	1.45E+05	1.45E+02	2.18E+07	0.02
NW	7/27/2011	0.50	1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	3.63E+04	3.63E+01	5.48E+06	0.01
NW	7/27/2011	0.50	1	1	Scenedesmus dimorphus	Chlorophyta	4	1.45E+05	1.45E+02	1.44E+07	0.01
NW	7/27/2011	0.50	1	8	Anabaena circinalis	Cyanobacteria	24	6.42E+06	6.42E+03	6.30E+08	0.63
NW	7/27/2011	0.50	1	8	Anabaena sp.	Cyanobacteria	3	8.02E+05	8.02E+02	7.87E+07	0.08
NW	7/27/2011	0.50	1	1	Aphanizomenon flos-aquae	Cyanobacteria	118	4.29E+06	4.29E+03	1.51E+08	0.15
NW	7/27/2011	0.50	1	8	Cylindrospermopsis raciborskii	Cyanobacteria	48	1.28E+07	1.28E+04	1.21E+08	0.12
NW	7/27/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	7497	2.00E+09	2.00E+06	7.08E+10	70.84
NW	7/27/2011	0.50	1	1	Raphidiopsis curvata	Cyanobacteria	5	1.82E+05	1.82E+02	4.29E+05	0.00
					TOTAL		7711	2.03E+09	2.03E+06	7.19E+10	71.94

7/27/2011 Phytoplankton Data (Continued…)

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	ALIQUOT (mL)				REP 1	REP 1	cells/mL	um^3/L	mm^3/L
NE	7/27/2011	SONDE DEPTH	1	1	Asterionella formosa	Bacillariophyta	1	3.63E+04	3.63E+01	1.63E+07	0.02
NE	7/27/2011	SONDE DEPTH	1	1	Aulacoseira granulata	Bacillariophyta	8	2.91E+05	2.91E+02	7.42E+07	0.07
NE	7/27/2011	SONDE DEPTH	1	1	Nitzschia palea	Bacillariophyta	1	2.00E+03	2.00E+00	7.35E+05	0.00
NE	7/27/2011	SONDE DEPTH	1	12	Stephanocyclus meneghiniana	Bacillariophyta	6	1.07E+06	1.07E+03	4.26E+08	0.43
NE	7/27/2011	SONDE DEPTH	1	1	Actinastrum gracilimum	Chlorophyta	8	2.91E+05	2.91E+02	1.16E+07	0.01
NE	7/27/2011	SONDE DEPTH	1	1	Closteriopsis acicularis	Chlorophyta	2	7.26E+04	7.26E+01	9.47E+06	0.01
NE	7/27/2011	SONDE DEPTH	1	1	Dictyosphaerium pulchellum	Chlorophyta	15	3.00E+04	3.00E+01	1.96E+06	0.00
NE	7/27/2011	SONDE DEPTH	1	1	Pyramimonas tetrarhynchus	Chlorophyta	2	7.26E+04	7.26E+01	1.10E+07	0.01
NE	7/27/2011	SONDE DEPTH	1	12	Anabaena circinalis	Cyanobacteria	80	1.43E+07	1.43E+04	1.40E+09	1.40
NE	7/27/2011	SONDE DEPTH	1	1	Anabaenopsis elenkinii	Cyanobacteria	23	8.35E+05	8.35E+02	2.95E+07	0.03
NE	7/27/2011	SONDE DEPTH	1	1	Aphanizomenon flos-aquae	Cyanobacteria	155	5.63E+06	5.63E+03	1.99E+08	0.20
NE	7/27/2011	SONDE DEPTH	1	12	Cylindrospermopsis raciborskii	Cyanobacteria	104	1.85E+07	1.85E+04	6.55E+08	0.66
NE	7/27/2011	SONDE DEPTH	1	12	Planktothrix agardhii	Cyanobacteria	7524	1.34E+09	1.34E+06	2.84E+10	28.45
NE	7/27/2011	SONDE DEPTH	1	1	Euglena sp.	Euglenophyta	1	3.63E+04	3.63E+01	1.92E+07	0.02
					TOTAL		7930	1.38E+09	1.38E+06	3.13E+10	31.30
SE	7/27/2011	0.50	1	10	Aulacoseira granulata	Bacillariophyta	14	2.99E+06	2.99E+03	1.96E+09	1.96
SE	7/27/2011	0.50	1	10	Cyclotella ocellata	Bacillariophyta	1	2.14E+05	2.14E+02	5.04E+07	0.05
SE	7/27/2011	0.50	1	10	Discostella pseudostelligera	Bacillariophyta	4	8.56E+05	8.56E+02	2.02E+08	0.20
SE	7/27/2011	0.50	1	10	Nitzschia sp.	Bacillariophyta	2	4.28E+05	4.28E+02	7.96E+07	0.08
SE	7/27/2011	0.50	1	10	Stephanocyclus meneghiniana	Bacillariophyta	8	1.71E+06	1.71E+03	2.42E+08	0.24
SE	7/27/2011	0.50	1	1	Stephanodiscus niagarae	Bacillariophyta	1	3.63E+04	3.63E+01	6.86E+08	0.69
SE	7/27/2011	0.50	1	1	Actinastrum gracilimum	Chlorophyta	24	8.72E+05	8.72E+02	4.88E+07	0.05
SE	7/27/2011	0.50	1	1	Dictyosphaerium pulchellum	Chlorophyta	24	8.72E+05	8.72E+02	2.05E+07	0.02
SE	7/27/2011	0.50	1	1	Oocystis parva	Chlorophyta	4	8.00E+03	8.00E+00	4.32E+05	0.00
SE	7/27/2011	0.50	1	10	Pyramimonas tetrarhynchus	Chlorophyta	1	2.14E+05	2.14E+02	2.62E+07	0.03
SE	7/27/2011	0.50	1	1	Scenedesmus dimorphus	Chlorophyta	8	2.91E+05	2.91E+02	3.42E+07	0.03
SE	7/27/2011	0.50	1	1	Scenedesmus quadricauda	Chlorophyta	6	2.18E+05	2.18E+02	6.16E+06	0.01
SE	7/27/2011	0.50	1	10	Anabaena circinalis	Cyanobacteria	142	3.04E+07	3.04E+04	2.98E+09	2.98
SE	7/27/2011	0.50	1	10	Anabaena sp.	Cyanobacteria	76	1.63E+07	1.63E+04	5.74E+08	0.57
SE	7/27/2011	0.50	1	1	Anabaenopsis elenkinii	Cyanobacteria	52	1.89E+06	1.89E+03	6.67E+07	0.07
SE	7/27/2011	0.50	1	10	Aphanizomenon flos-aquae	Cyanobacteria	162	3.47E+07	3.47E+04	1.22E+09	1.22
SE	7/27/2011	0.50	1	10	Cylindrospermopsis raciborskii	Cyanobacteria	212	4.53E+07	4.53E+04	1.60E+09	1.60
SE	7/27/2011	0.50	1	10	Limnothrix redekei	Cyanobacteria	380	8.13E+07	8.13E+04	1.92E+08	0.19
SE	7/27/2011	0.50	1	10	Planktothrix agardhii	Cyanobacteria	10322	2.21E+09	2.21E+06	4.68E+10	46.83
SE	7/27/2011	0.50	1	1	Trachelomonas volvocina	Euglenophyta	1	3.63E+04	3.63E+01	1.84E+07	0.02
					TOTAL		11444	2.43E+09	2.43E+06	5.68E+10	56.84
SW	7/27/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	23	8.35E+05	8.35E+02	2.13E+08	0.21
SW	7/27/2011	0.50	1	1	Discostella pseudostelligera	Bacillariophyta	5	1.82E+05	1.82E+02	2.74E+07	0.03
SW	7/27/2011	0.50	1	8	Stephanocyclus meneghiniana	Bacillariophyta	4	1.07E+06	1.07E+03	1.51E+08	0.15
SW	7/27/2011	0.50	1	1	Actinastrum gracilimum	Chlorophyta	8	2.91E+05	2.91E+02	1.86E+07	0.02
SW	7/27/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	1.42E+07	0.01
SW	7/27/2011	0.50	1	1	Scenedesmus dimorphus	Chlorophyta	4	1.45E+05	1.45E+02	4.26E+06	0.00
SW	7/27/2011	0.50	1	8	Aphanizomenon flos-aquae	Cyanobacteria	84	2.25E+07	2.25E+04	9.52E+08	0.95
SW	7/27/2011	0.50	1	8	Limnothrix redekei	Cyanobacteria	126	3.37E+07	3.37E+04	5.29E+07	0.05
SW	7/27/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	11032	2.95E+09	2.95E+06	2.78E+10	27.79
					TOTAL		11287	3.01E+09	3.01E+06	2.92E+10	29.22

8/8/2011 Phytoplankton Data

STATION	SAMPLE	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	TIME	ALIQUOT (mL)				REP 1	REP 1	cells/mL	um^3/L	mm^3/L
L-2	8/8/2011	0.50		1	6	Aulacoseira granulata	Bacillariophyta	36	1.28E+07	1.28E+04	3.99E+09	3.99
L-2	8/8/2011	0.50		1	6	Aulacoseira sp.	Bacillariophyta	3	1.07E+06	1.07E+03	4.54E+07	0.05
L-2	8/8/2011	0.50		1	6	Cyclotella ocellata	Bacillariophyta	4	1.43E+06	1.43E+03	2.15E+08	0.22
L-2	8/8/2011	0.50		1	6	Discostella pseudostelligera	Bacillariophyta	1	3.56E+05	3.56E+02	1.40E+08	0.14
L-2	8/8/2011	0.50		1	1	Nitzschia fruticosa	Bacillariophyta	4	1.45E+05	1.45E+02	4.36E+07	0.04
L-2	8/8/2011	0.50		1	6	Stephanocyclus meneghiniana	Bacillariophyta	3	1.07E+06	1.07E+03	1.61E+08	0.16
L-2	8/8/2011	0.50		1	1	Actinastrum gracilimum	Chlorophyta	15	5.45E+05	5.45E+02	3.05E+07	0.03
L-2	8/8/2011	0.50		1	1	Coelastrum microporum	Chlorophyta	8	2.91E+05	2.91E+02	4.11E+06	0.00
L-2	8/8/2011	0.50		1	1	Dictyosphaerium pulchellum	Chlorophyta	32	1.16E+06	1.16E+03	7.61E+07	0.08
L-2	8/8/2011	0.50		1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	3.63E+04	3.63E+01	9.13E+06	0.01
L-2	8/8/2011	0.50		1	1	Scenedesmus dimorphus	Chlorophyta	4	1.45E+05	1.45E+02	6.39E+06	0.01
L-2	8/8/2011	0.50		1	6	Rhodomonas sp.	Cryptophyta	8	2.85E+06	2.85E+03	2.96E+08	0.30
L-2	8/8/2011	0.50		1	6	Anabaena circinalis	Cyanobacteria	134	4.78E+07	4.78E+04	4.69E+09	4.69
L-2	8/8/2011	0.50		1	6	Anabaena sp.	Cyanobacteria	52	1.85E+07	1.85E+04	1.82E+09	1.82
L-2	8/8/2011	0.50		1	1	Aphanizomenon sp.	Cyanobacteria	128	4.65E+06	4.65E+03	1.64E+08	0.16
L-2	8/8/2011	0.50		1	1	Aphanocapsa sp.	Cyanobacteria	192	6.97E+06	6.97E+03	2.92E+07	0.03
L-2	8/8/2011	0.50		1	6	Cylindrospermopsis raciborskii	Cyanobacteria	34	1.21E+07	1.21E+04	1.14E+08	0.11
L-2	8/8/2011	0.50		1	1	Microcystis sp.	Cyanobacteria	16	5.81E+05	5.81E+02	8.22E+06	0.01
L-2	8/8/2011	0.50		1	6	Planktothrix agardhii	Cyanobacteria	3051	1.09E+09	1.09E+06	6.83E+09	6.83
L-2	8/8/2011	0.50		1	6	Pseudanabaena sp.	Cyanobacteria	104	3.71E+07	3.71E+04	3.49E+08	0.35
						TOTAL		3830	1.24E+09	1.24E+06	1.90E+10	19.02
L-1	8/8/2011	0.50		1	14	Aulacoseira granulata	Bacillariophyta	4	6.11E+05	6.11E+02	1.68E+08	0.17
L-1	8/8/2011	0.50		1	14	Discostella pseudostelligera	Bacillariophyta	1	1.53E+05	1.53E+02	6.00E+07	0.06
L-1	8/8/2011	0.50		1	14	Nitzschia sp.	Bacillariophyta	3	4.58E+05	4.58E+02	1.24E+08	0.12
L-1	8/8/2011	0.50		1	14	Stephanocyclus meneghiniana	Bacillariophyta	6	9.17E+05	9.17E+02	3.60E+08	0.36
L-1	8/8/2011	0.50		1	1	Actinastrum gracilimum	Chlorophyta	11	4.00E+05	4.00E+02	2.56E+07	0.03
L-1	8/8/2011	0.50		1	1	Closteriopsis sp.	Chlorophyta	1	3.63E+04	3.63E+01	7.93E+06	0.01
L-1	8/8/2011	0.50		1	1	Pediastrum tetras	Chlorophyta	4	1.45E+05	1.45E+02	4.14E+07	0.04
L-1	8/8/2011	0.50		1	1	Scenedesmus dimorphus	Chlorophyta	3	1.09E+05	1.09E+02	5.70E+06	0.01
L-1	8/8/2011	0.50		1	14	Rhodomonas sp.	Cryptophyta	10	1.53E+06	1.53E+03	8.00E+07	0.08
L-1	8/8/2011	0.50		1	14	Anabaena circinalis	Cyanobacteria	238	3.64E+07	3.64E+04	3.57E+09	3.57
L-1	8/8/2011	0.50		1	14	Aphanizomenon sp.	Cyanobacteria	426	6.51E+07	6.51E+04	1.38E+09	1.38
L-1	8/8/2011	0.50		1	14	Aphanocapsa sp.	Cyanobacteria	164	2.51E+07	2.51E+04	1.30E+07	0.01
L-1	8/8/2011	0.50		1	14	Cylindrospermopsis raciborskii	Cyanobacteria	682	1.04E+08	1.04E+05	9.82E+08	0.98
L-1	8/8/2011	0.50		1	14	Merismopedia sp.	Cyanobacteria	16	2.44E+06	2.44E+03	1.27E+06	0.00
L-1	8/8/2011	0.50		1	14	Planktothrix agardhii	Cyanobacteria	8484	1.30E+09	1.30E+06	1.22E+10	12.21
L-1	8/8/2011	0.50		1	14	Pseudanabaena sp.	Cyanobacteria	370	5.65E+07	5.65E+04	5.33E+08	0.53
L-1	8/8/2011	0.50		1	1	Raphidiopsis curvata	Cyanobacteria	3	1.09E+05	1.09E+02	1.71E+06	0.00
						TOTAL		10426	1.59E+09	1.59E+06	1.96E+10	19.56
L-3	8/8/2011	0.50		1	10	Aulacoseira granulata	Bacillariophyta	17	3.64E+06	3.64E+03	1.34E+09	1.34
L-3	8/8/2011	0.50		1	1	Nitzschia acicularis	Bacillariophyta	1	3.63E+04	3.63E+01	9.37E+06	0.01
L-3	8/8/2011	0.50		1	10	Nitzschia sp.	Bacillariophyta	1	2.14E+05	2.14E+02	7.38E+07	0.07
L-3	8/8/2011	0.50		1	10	Stephanocyclus meneghiniana	Bacillariophyta	6	1.28E+06	1.28E+03	7.32E+08	0.73
L-3	8/8/2011	0.50		1	10	Actinastrum gracilimum	Chlorophyta	30	6.42E+06	6.42E+03	2.82E+08	0.28
L-3	8/8/2011	0.50		1	1	Closteriopsis acicularis	Chlorophyta	2	7.26E+04	7.26E+01	2.85E+07	0.03
L-3	8/8/2011	0.50		1	1	Dictyosphaerium pulchellum	Chlorophyta	10	2.00E+04	2.00E+01	4.71E+05	0.00
L-3	8/8/2011	0.50		1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	3.63E+04	3.63E+01	9.89E+06	0.01
L-3	8/8/2011	0.50		1	1	Scenedesmus dimorphus	Chlorophyta	7	2.54E+05	2.54E+02	2.64E+07	0.03
L-3	8/8/2011	0.50		1	10	Anabaena circinalis	Cyanobacteria	502	1.07E+08	1.07E+05	1.05E+10	10.54
L-3	8/8/2011	0.50		1	1	Aphanizomenon sp.	Cyanobacteria	430	1.56E+07	1.56E+04	5.52E+08	0.55
L-3	8/8/2011	0.50		1	1	Aphanocapsa sp.	Cyanobacteria	468	1.70E+07	1.70E+04	8.84E+06	0.01
L-3	8/8/2011	0.50		1	10	Cylindrospermopsis raciborskii	Cyanobacteria	898	1.92E+08	1.92E+05	1.21E+09	1.21
L-3	8/8/2011	0.50		1	10	Planktothrix agardhii	Cyanobacteria	8816	1.89E+09	1.89E+06	1.18E+10	11.84
L-3	8/8/2011	0.50		1	10	Pseudanabaena sp.	Cyanobacteria	56	1.20E+07	1.20E+04	1.13E+08	0.11
L-3	8/8/2011	0.50		1	1	Raphidiopsis curvata	Cyanobacteria	5	1.82E+05	1.82E+02	1.14E+06	0.00
						TOTAL		11250	2.24E+09	2.24E+06	2.68E+10	26.76
NW	8/8/2011	0.50		1	10	Aulacoseira granulata	Bacillariophyta	24	5.13E+06	5.13E+03	1.01E+09	1.01
NW	8/8/2011	0.50		1	1	Nitzschia acicularis	Bacillariophyta	2	7.26E+04	7.26E+01	2.19E+07	0.02
NW	8/8/2011	0.50		1	1	Nitzschia fruticosa	Bacillariophyta	3	1.09E+05	1.09E+02	2.35E+07	0.02
NW	8/8/2011	0.50		1	10	Nitzschia sp.	Bacillariophyta	1	2.14E+05	2.14E+02	3.08E+07	0.03
NW	8/8/2011	0.50		1	10	Stephanocyclus meneghiniana	Bacillariophyta	2	4.28E+05	4.28E+02	1.08E+08	0.11
NW	8/8/2011	0.50		1	1	Actinastrum gracilimum	Chlorophyta	8	1.60E+04	1.60E+01	8.32E+05	0.00
NW	8/8/2011	0.50		1	1	Dictyosphaerium pulchellum	Chlorophyta	31	1.13E+06	1.13E+03	7.07E+06	0.01
NW	8/8/2011	0.50		1	1	Oocystis parva	Chlorophyta	2	7.26E+04	7.26E+01	3.27E+06	0.00
NW	8/8/2011	0.50		1	1	Pediastrum duplex	Chlorophyta	9	3.27E+05	3.27E+02	3.50E+09	3.50
NW	8/8/2011	0.50		1	1	Scenedesmus dimorphus	Chlorophyta	4	8.00E+03	8.00E+00	9.42E+05	0.00
NW	8/8/2011	0.50		1	10	Anabaena circinalis	Cyanobacteria	321	6.87E+07	6.87E+04	6.74E+09	6.74
NW	8/8/2011	0.50		1	10	Aphanizomenon sp.	Cyanobacteria	394	8.43E+07	8.43E+04	2.98E+09	2.98
NW	8/8/2011	0.50		1	10	Aphanocapsa sp.	Cyanobacteria	822	1.76E+08	1.76E+05	9.14E+07	0.09
NW	8/8/2011	0.50		1	10	Cylindrospermopsis raciborskii	Cyanobacteria	432	9.24E+07	9.24E+04	5.80E+08	0.58
NW	8/8/2011	0.50		1	10	Planktothrix agardhii	Cyanobacteria	7862	1.68E+09	1.68E+06	1.58E+10	15.84
						TOTAL		9917	2.11E+09	2.11E+06	3.09E+10	30.94

8/8/2011 Phytoplankton Data (Continued…)

STATION	SAMPLE	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	TIME	ALIQUOT (mL)				REP 1	REP 1	cells/mL	um^3/L	mm^3/L
NE	8/8/2011	Sonde Depth		1	12	Aulacoseira granulata	Bacillariophyta	31	5.53E+06	5.53E+03	1.72E+09	1.72
NE	8/8/2011	Sonde Depth		1	1	Discostella pseudostelligera	Bacillariophyta	5	1.82E+05	1.82E+02	4.28E+07	0.04
NE	8/8/2011	Sonde Depth		1	12	Nitzschia acicularis	Bacillariophyta	6	1.07E+06	1.07E+03	3.69E+08	0.37
NE	8/8/2011	Sonde Depth		1	1	Stephanocyclus meneghiniana	Bacillariophyta	2	7.26E+04	7.26E+01	1.10E+07	0.01
NE	8/8/2011	Sonde Depth		1	1	Actinastrum gracilimum	Chlorophyta	25	9.08E+05	9.08E+02	5.08E+07	0.05
NE	8/8/2011	Sonde Depth		1	12	Ankyra judayi	Chlorophyta	1	1.78E+05	1.78E+02	3.11E+07	0.03
NE	8/8/2011	Sonde Depth		1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	1.91E+07	0.02
NE	8/8/2011	Sonde Depth		1	1	Dictyosphaerium pulchellum	Chlorophyta	14	2.80E+04	2.80E+01	3.96E+05	0.00
NE	8/8/2011	Sonde Depth		1	1	Kirchneriella contorta	Chlorophyta	8	2.91E+05	2.91E+02	3.04E+06	0.00
NE	8/8/2011	Sonde Depth		1	1	Oocystis parva	Chlorophyta	4	1.45E+05	1.45E+02	2.61E+06	0.00
NE	8/8/2011	Sonde Depth		1	1	Quadrigula closterioides	Chlorophyta	10	2.00E+04	2.00E+01	6.91E+05	0.00
NE	8/8/2011	Sonde Depth		1	12	Scenedesmus dimorphus	Chlorophyta	6	1.07E+06	1.07E+03	1.26E+08	0.13
NE	8/8/2011	Sonde Depth		1	1	Tetraedron sp.	Chlorophyta	1	2.00E+03	2.00E+00	5.18E+06	0.01
NE	8/8/2011	Sonde Depth		1	12	Ochromonas sp.	Chrysophyta	8	1.43E+06	1.43E+03	2.69E+08	0.27
NE	8/8/2011	Sonde Depth		1	12	Anabaena circinalis	Cyanobacteria	24	4.28E+06	4.28E+03	1.51E+08	0.15
NE	8/8/2011	Sonde Depth		1	12	Aphanizomenon sp.	Cyanobacteria	151	2.69E+07	2.69E+04	9.51E+08	0.95
NE	8/8/2011	Sonde Depth		1	1	Aphanocapsa sp.	Cyanobacteria	57	2.07E+06	2.07E+03	8.67E+06	0.01
NE	8/8/2011	Sonde Depth		1	12	Cylindrospermopsis raciborskii	Cyanobacteria	1030	1.84E+08	1.84E+05	1.73E+09	1.73
NE	8/8/2011	Sonde Depth		1	12	Planktothrix agardhii	Cyanobacteria	7114	1.27E+09	1.27E+06	1.19E+10	11.94
NE	8/8/2011	Sonde Depth		1	12	Pseudanabaena sp.	Cyanobacteria	244	4.35E+07	4.35E+04	4.10E+08	0.41
NE	8/8/2011	Sonde Depth		1	1	Euglena sp.	Euglenophyta	2	4.00E+03	4.00E+00	2.76E+06	0.00
						TOTAL		8744	1.54E+09	1.54E+06	1.78E+10	17.85
SE	8/8/2011	0.50		1	6	Aulacoseira granulata	Bacillariophyta	52	1.85E+07	1.85E+04	6.81E+09	6.81
SE	8/8/2011	0.50		1	1	Discostella pseudostelligera	Bacillariophyta	1	3.63E+04	3.63E+01	3.08E+06	0.00
SE	8/8/2011	0.50		1	6	Nitzschia acicularis	Bacillariophyta	1	3.56E+05	3.56E+02	6.74E+07	0.07
SE	8/8/2011	0.50		1	1	Nitzschia fruticosa	Bacillariophyta	2	7.26E+04	7.26E+01	1.44E+07	0.01
SE	8/8/2011	0.50		1	6	Stephanocyclus meneghiniana	Bacillariophyta	15	5.35E+06	5.35E+03	9.07E+08	0.91
SE	8/8/2011	0.50		1	1	Actinastrum gracilimum	Chlorophyta	8	2.91E+05	2.91E+02	1.86E+07	0.02
SE	8/8/2011	0.50		1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	2.32E+07	0.02
SE	8/8/2011	0.50		1	6	Crucigenia quadrata	Chlorophyta	32	1.14E+07	1.14E+04	3.42E+08	0.34
SE	8/8/2011	0.50		1	1	Dictyosphaerium pulchellum	Chlorophyta	4	1.45E+05	1.45E+02	1.37E+07	0.01
SE	8/8/2011	0.50		1	1	Kirchneriella contorta	Chlorophyta	17	6.17E+05	6.17E+02	6.46E+06	0.01
SE	8/8/2011	0.50		1	6	Oocystis parva	Chlorophyta	8	2.85E+06	2.85E+03	1.54E+08	0.15
SE	8/8/2011	0.50		1	1	Pediastrum duplex	Chlorophyta	21	4.20E+04	4.20E+01	6.68E+07	0.07
SE	8/8/2011	0.50		1	1	Pyramimonas tetrarhynchus	Chlorophyta	1	3.63E+04	3.63E+01	7.76E+06	0.01
SE	8/8/2011	0.50		1	1	Scenedesmus dimorphus	Chlorophyta	7	2.54E+05	2.54E+02	3.23E+07	0.03
SE	8/8/2011	0.50		1	1	Scenedesmus quadricauda	Chlorophyta	4	8.00E+03	8.00E+00	2.26E+05	0.00
SE	8/8/2011	0.50		1	6	Ochromonas sp.	Chrysophyta	3	1.07E+06	1.07E+03	2.62E+08	0.26
SE	8/8/2011	0.50		1	6	Cryptomonas sp.	Cryptophyta	6	2.14E+06	2.14E+03	6.85E+08	0.69
SE	8/8/2011	0.50		1	6	Anabaena circinalis	Cyanobacteria	124	4.42E+07	4.42E+04	4.34E+09	4.34
SE	8/8/2011	0.50		1	6	Aphanizomenon sp.	Cyanobacteria	174	6.20E+07	6.20E+04	2.19E+09	2.19
SE	8/8/2011	0.50		1	1	Aphanocapsa sp.	Cyanobacteria	248	9.01E+06	9.01E+03	4.68E+06	0.00
SE	8/8/2011	0.50		1	6	Cylindrospermopsis raciborskii	Cyanobacteria	696	2.48E+08	2.48E+05	2.34E+09	2.34
SE	8/8/2011	0.50		1	6	Merismopedia sp.	Cyanobacteria	280	9.98E+07	9.98E+04	5.19E+07	0.05
SE	8/8/2011	0.50		1	6	Planktothrix agardhii	Cyanobacteria	3378	1.20E+09	1.20E+06	1.13E+10	11.34
SE	8/8/2011	0.50		1	6	Pseudanabaena sp.	Cyanobacteria	36	1.28E+07	1.28E+04	3.03E+07	0.03
SE	8/8/2011	0.50		1	1	Raphidiopsis curvata	Cyanobacteria	38	1.38E+06	1.38E+03	1.30E+07	0.01
SE	8/8/2011	0.50		1	1	Euglena sp.	Euglenophyta	2	7.26E+04	7.26E+01	2.74E+07	0.03
						TOTAL		5159	1.72E+09	1.72E+06	2.98E+10	29.76
SW	8/8/2011	0.50		1	8	Discostella pseudostelligera	Bacillariophyta	4	1.07E+06	1.07E+03	1.61E+08	0.16
SW	8/8/2011	0.50		1	8	Nitzschia acicularis	Bacillariophyta	4	1.07E+06	1.07E+03	5.37E+08	0.54
SW	8/8/2011	0.50		1	8	Nitzschia fruticosa	Bacillariophyta	6	1.60E+06	1.60E+03	3.68E+08	0.37
SW	8/8/2011	0.50		1	8	Stephanocyclus meneghiniana	Bacillariophyta	10	2.67E+06	2.67E+03	1.05E+09	1.05
SW	8/8/2011	0.50		1	1	Actinastrum gracilimum	Chlorophyta	5	1.82E+05	1.82E+02	7.99E+06	0.01
SW	8/8/2011	0.50		1	8	Ankyra judayi	Chlorophyta	6	1.60E+06	1.60E+03	1.21E+08	0.12
SW	8/8/2011	0.50		1	1	Dictyosphaerium pulchellum	Chlorophyta	24	4.80E+04	4.80E+01	6.79E+05	0.00
SW	8/8/2011	0.50		1	1	Scenedesmus dimorphus	Chlorophyta	4	1.45E+05	1.45E+02	6.39E+06	0.01
SW	8/8/2011	0.50		1	8	Ochromonas sp.	Chrysophyta	2	5.35E+05	5.35E+02	1.31E+08	0.13
SW	8/8/2011	0.50		1	8	Rhodomonas sp.	Cryptophyta	6	1.60E+06	1.60E+03	6.10E+09	6.10
SW	8/8/2011	0.50		1	8	Aphanizomenon sp.	Cyanobacteria	198	5.29E+07	5.29E+04	1.87E+09	1.87
SW	8/8/2011	0.50		1	8	Aphanocapsa sp.	Cyanobacteria	842	2.25E+08	2.25E+05	1.17E+08	0.12
SW	8/8/2011	0.50		1	8	Aphanothece sp.	Cyanobacteria	20	5.35E+06	5.35E+03	3.36E+07	0.03
SW	8/8/2011	0.50		1	8	Cylindrospermopsis raciborskii	Cyanobacteria	626	1.67E+08	1.67E+05	1.58E+09	1.58
SW	8/8/2011	0.50		1	8	Planktothrix agardhii	Cyanobacteria	6982	1.87E+09	1.87E+06	1.76E+10	17.59
SW	8/8/2011	0.50		1	8	Phacus sp.	Euglenophyta	1	2.67E+05	2.67E+02	8.16E+08	0.82
						TOTAL		8740	2.33E+09	2.33E+06	3.05E+10	30.48

8/31/2011 Phytoplankton Data

STATION	SAMPLE	SAMPLE	SAMPLE	FIELDS	GENUS	DIVISION	TALLY	DENSITY (cells/L)		TOTAL BV	
	DATE	DEPTH	ALIQUOT (mL)				REP 1	REP 1	cells/mL	um^3/L	mm^3/L
L-1	8/31/2011	0.50	1	1	Actinocyclus normanii	Bacillariophyta	1	2.00E+03	2.00E+00	1.32E+07	0.01
L-1	8/31/2011	0.50	1	1	Aulacoseira alpigena	Bacillariophyta	6	1.20E+04	1.20E+01	6.79E+05	0.00
L-1	8/31/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	33	1.20E+06	1.20E+03	1.36E+08	0.14
L-1	8/31/2011	0.50	1	8	Cyclotella ocellata	Bacillariophyta	2	5.35E+05	5.35E+02	8.06E+07	0.08
L-1	8/31/2011	0.50	1	1	Discostella pseudostelligera	Bacillariophyta	2	7.26E+04	7.26E+01	6.16E+06	0.01
L-1	8/31/2011	0.50	1	1	Nitzschia sp.	Bacillariophyta	6	2.18E+05	2.18E+02	3.14E+07	0.03
L-1	8/31/2011	0.50	1	8	Stephanocyclus meneghiniana	Bacillariophyta	2	5.35E+05	5.35E+02	2.52E+08	0.25
L-1	8/31/2011	0.50	1	1	Actinastrum gracilimum	Chlorophyta	12	4.36E+05	4.36E+02	5.10E+07	0.05
L-1	8/31/2011	0.50	1	1	Ankyra sp.	Chlorophyta	1	3.63E+04	3.63E+01	4.68E+06	0.00
L-1	8/31/2011	0.50	1	8	Closteriopsis acicularis	Chlorophyta	1	2.67E+05	2.67E+02	1.29E+08	0.13
L-1	8/31/2011	0.50	1	1	Coelastrum astroideum	Chlorophyta	16	5.81E+05	5.81E+02	8.22E+06	0.01
L-1	8/31/2011	0.50	1	1	Pediastrum duplex	Chlorophyta	3	6.00E+03	6.00E+00	7.24E+06	0.01
L-1	8/31/2011	0.50	1	1	Cryptomonas sp.	Cryptophyta	2	4.00E+03	4.00E+00	1.88E+06	0.00
L-1	8/31/2011	0.50	1	8	Rhodomonas sp.	Cryptophyta	8	2.14E+06	2.14E+03	4.66E+08	0.47
L-1	8/31/2011	0.50	1	8	Anabaena circinalis	Cyanobacteria	16	4.28E+06	4.28E+03	4.20E+08	0.42
L-1	8/31/2011	0.50	1	8	Anabaena sp.	Cyanobacteria	114	3.05E+07	3.05E+04	6.46E+08	0.65
L-1	8/31/2011	0.50	1	1	Aphanizomenon sp.	Cyanobacteria	979	3.56E+07	3.56E+04	1.26E+09	1.26
L-1	8/31/2011	0.50	1	8	Cylindrospermopsis raciborskii	Cyanobacteria	614	1.64E+08	1.64E+05	1.55E+09	1.55
L-1	8/31/2011	0.50	1	8	Planktothrix agardhii	Cyanobacteria	8374	2.24E+09	2.24E+06	4.75E+10	47.49
					TOTAL		10192	2.48E+09	2.48E+06	5.25E+10	52.55
L-2	8/31/2011	0.50	1	6	Aulacoseira granulata	Bacillariophyta	66	2.35E+07	2.35E+04	6.01E+09	6.01
L-2	8/31/2011	0.50	1	1	Discostella pseudostelligera	Bacillariophyta	2	7.26E+04	7.26E+01	1.10E+07	0.01
L-2	8/31/2011	0.50	1	1	Nitzschia acicularis	Bacillariophyta	2	7.26E+04	7.26E+01	2.12E+07	0.02
L-2	8/31/2011	0.50	1	1	Nitzschia fruticosa	Bacillariophyta	3	1.09E+05	1.09E+02	1.34E+07	0.01
L-2	8/31/2011	0.50	1	6	Stephanocyclus meneghiniana	Bacillariophyta	9	3.21E+06	3.21E+03	1.52E+09	1.52
L-2	8/31/2011	0.50	1	6	Actinastrum gracilimum	Chlorophyta	10	3.56E+06	3.56E+03	5.45E+08	0.55
L-2	8/31/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	2.00E+03	2.00E+00	8.34E+06	0.01
L-2	8/31/2011	0.50	1	1	Pediastrum duplex	Chlorophyta	32	6.40E+04	6.40E+01	2.12E+08	0.21
L-2	8/31/2011	0.50	1	1	Scenedesmus sp.	Chlorophyta	2	4.00E+03	4.00E+00	1.51E+05	0.00
L-2	8/31/2011	0.50	1	1	Anabaena circinalis	Cyanobacteria	54	1.08E+05	1.08E+02	1.06E+07	0.01
L-2	8/31/2011	0.50	1	6	Anabaena sp.	Cyanobacteria	376	1.34E+08	1.34E+05	4.74E+09	4.74
L-2	8/31/2011	0.50	1	6	Aphanizomenon sp.	Cyanobacteria	423	1.51E+08	1.51E+05	5.33E+09	5.33
L-2	8/31/2011	0.50	1	6	Cylindrospermopsis raciborskii	Cyanobacteria	69	2.46E+07	2.46E+04	2.32E+08	0.23
L-2	8/31/2011	0.50	1	1	Merismopedia sp.	Cyanobacteria	16	5.81E+05	5.81E+02	2.43E+06	0.00
L-2	8/31/2011	0.50	1	6	Planktothrix agardhii	Cyanobacteria	10086	3.60E+09	3.60E+06	3.39E+10	33.87
L-2	8/31/2011	0.50	1	1	Trachelomonas volvocina	Euglenophyta	1	2.00E+03	2.00E+00	5.76E+05	0.00
					TOTAL		11152	3.94E+09	3.94E+06	5.25E+10	52.52
L-3	8/31/2011	0.50	1	1	Aulacoseira granulata	Bacillariophyta	52	1.89E+06	1.89E+03	1.87E+08	0.19
L-3	8/31/2011	0.50	1	1	Discostella pseudostelligera	Bacillariophyta	1	3.63E+04	3.63E+01	8.56E+06	0.01
L-3	8/31/2011	0.50	1	1	Fragilaria goulardii	Bacillariophyta	2	7.26E+04	7.26E+01	9.24E+07	0.09
L-3	8/31/2011	0.50	1	10	Nitzschia acicularis	Bacillariophyta	7	1.50E+06	1.50E+03	4.58E+08	0.46
L-3	8/31/2011	0.50	1	10	Stephanocyclus meneghiniana	Bacillariophyta	2	4.28E+05	4.28E+02	6.88E+08	0.69
L-3	8/31/2011	0.50	1	10	Stephanodiscus hantzschii	Bacillariophyta	2	4.28E+05	4.28E+02	1.70E+08	0.17
L-3	8/31/2011	0.50	1	10	Actinastrum gracilimum	Chlorophyta	41	8.77E+06	8.77E+03	2.81E+08	0.28
L-3	8/31/2011	0.50	1	1	Closteriopsis acicularis	Chlorophyta	1	3.63E+04	3.63E+01	2.27E+07	0.02
L-3	8/31/2011	0.50	1	1	Dictyosphaerium pulchellum	Chlorophyta	43	1.56E+06	1.56E+03	3.68E+07	0.04
L-3	8/31/2011	0.50	1	1	Oocystis parva	Chlorophyta	4	8.00E+03	8.00E+00	4.32E+05	0.00
L-3	8/31/2011	0.50	1	1	Pediastrum duplex	Chlorophyta	20	7.26E+05	7.26E+02	4.27E+09	4.27
L-3	8/31/2011	0.50	1	1	Scenedesmus dimorphus	Chlorophyta	4	8.00E+03	8.00E+00	3.18E+05	0.00
L-3	8/31/2011	0.50	1	1	Ochromonas sp.	Chrysophyta	1	3.63E+04	3.63E+01	9.58E+06	0.01
L-3	8/31/2011	0.50	1	1	Anabaena circinalis	Cyanobacteria	156	5.67E+06	5.67E+03	5.56E+08	0.56
L-3	8/31/2011	0.50	1	10	Anabaena sp.	Cyanobacteria	91	1.95E+07	1.95E+04	6.88E+08	0.69
L-3	8/31/2011	0.50	1	10	Aphanizomenon sp.	Cyanobacteria	428	9.15E+07	9.15E+04	1.94E+09	1.94
L-3	8/31/2011	0.50	1	10	Cylindrospermopsis raciborskii	Cyanobacteria	588	1.26E+08	1.26E+05	1.18E+09	1.18
L-3	8/31/2011	0.50	1	10	Planktothrix agardhii	Cyanobacteria	7844	1.68E+09	1.68E+06	1.58E+10	15.80
L-3	8/31/2011	0.50	1	1	Euglena sp.	Euglenophyta	1	3.63E+04	3.63E+01	1.60E+07	0.02
L-3	8/31/2011	0.50	1	1	Trachelomonas sp.	Euglenophyta	1	2.00E+03	2.00E+00	5.76E+05	0.00
					TOTAL		9289	1.94E+09	1.94E+06	2.64E+10	26.42
NE	8/31/2011	Sonde Depth	1	8	Aulacoseira granulata	Bacillariophyta	48	1.28E+07	1.28E+04	2.18E+09	2.18
NE	8/31/2011	Sonde Depth	1	1	Cyclotella ocellata	Bacillariophyta	1	3.63E+04	3.63E+01	8.56E+06	0.01
NE	8/31/2011	Sonde Depth	1	8	Discostella pseudostelligera	Bacillariophyta	8	2.14E+06	2.14E+03	3.23E+08	0.32
NE	8/31/2011	Sonde Depth	1	1	Nitzschia acicularis	Bacillariophyta	2	7.26E+04	7.26E+01	2.22E+07	0.02
NE	8/31/2011	Sonde Depth	1	8	Nitzschia fruticosa	Bacillariophyta	2	5.35E+05	5.35E+02	1.06E+08	0.11
NE	8/31/2011	Sonde Depth	1	8	Stephanocyclus meneghiniana	Bacillariophyta	2	5.35E+05	5.35E+02	3.55E+08	0.35
NE	8/31/2011	Sonde Depth	1	1	Actinastrum gracilimum	Chlorophyta	8	1.60E+04	1.60E+01	4.48E+05	0.00
NE	8/31/2011	Sonde Depth	1	8	Characium sp.	Chlorophyta	1	2.67E+05	2.67E+02	1.22E+07	0.01
NE	8/31/2011	Sonde Depth	1	1	Closteriopsis acicularis	Chlorophyta	1	2.00E+03	2.00E+00	9.12E+05	0.00
NE	8/31/2011	Sonde Depth	1	8	Dictyosphaerium pulchellum	Chlorophyta	52	1.39E+07	1.39E+04	3.28E+08	0.33
NE	8/31/2011	Sonde Depth	1	8	Oocystis parva	Chlorophyta	8	2.14E+06	2.14E+03	1.16E+08	0.12
NE	8/31/2011	Sonde Depth	1	1	Pediastrum duplex	Chlorophyta	16	3.20E+04	3.20E+01	3.38E+08	0.34
NE	8/31/2011	Sonde Depth	1	1	Quadrigula lacustris	Chlorophyta	8	2.91E+05	2.91E+02	1.10E+07	0.01
NE	8/31/2011	Sonde Depth	1	1	Scenedesmus dimorphus	Chlorophyta	4	1.45E+05	1.45E+02	1.30E+07	0.01
NE	8/31/2011	Sonde Depth	1	8	Rhodomonas sp.	Cryptophyta	28	7.49E+06	7.49E+03	1.63E+09	1.63
NE	8/31/2011	Sonde Depth	1	8	Anabaena circinalis	Cyanobacteria	210	5.61E+07	5.61E+04	5.51E+09	5.51
NE	8/31/2011	Sonde Depth	1	8	Anabaena sp.	Cyanobacteria	30	8.02E+06	8.02E+03	2.83E+08	0.28
NE	8/31/2011	Sonde Depth	1	8	Aphanizomenon sp.	Cyanobacteria	522	1.40E+08	1.40E+05	4.93E+09	4.93
NE	8/31/2011	Sonde Depth	1	1	Aphanocapsa sp.	Cyanobacteria	128	4.65E+06	4.65E+03	2.42E+06	0.00
NE	8/31/2011	Sonde Depth	1	8	Cylindrospermopsis raciborskii	Cyanobacteria	552	1.48E+08	1.48E+05	1.39E+09	1.39
NE	8/31/2011	Sonde Depth	1	8	Planktothrix agardhii	Cyanobacteria	7976	2.13E+09	2.13E+06	2.01E+10	20.09
NE	8/31/2011	Sonde Depth	1	1	Euglena sp.	Euglenophyta	1	3.63E+04	3.63E+01	1.51E+07	0.02
					TOTAL		9608	2.53E+09	2.53E+06	3.77E+10	37.67

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APPENDIX F: FURTHER ANALYSIS OF INTERNAL LOADING AND ALUM IMPACTS

Data presented in Figures 5 and 6 contain more detailed information about the alum treatment and GLSM water quality than what was described in the main body of the report. The following is a description of this information.

Actual TP loading to GLSM, through October, was used in the model to predict TP concentrations in 2011. In Figure 5, the internal loading rate was adjusted so that predicted TP matched observed from the 4/30-5/13 time step through the 6/10-6/24 time step, while holding settling at the rate in 2010 (0.1 m/wk). That required internal loading rates of 3, 9 and 9 mg/m^2 per day as TP increased. Little or no internal loading (0 to 1 mg/m^2 per day) was needed to calibrate to observed TP the rest of the summer, but settling rate had to increase to 0.2 m/wk for two time steps, 6/25 to 7/22, then remained at 0.1 m/wk for the remainder of the summer. As a result, the calculated total summer gross internal loading in 2011 was 37% less than in 2010.

In Figure 6, the internal loading rate was continued at 9 mg/m^2 per day to the peak TP concentration, one time step further – 6/25-7/8. From that point on internal loading was adjusted to restore the 37% less gross internal loading in 2011 than occurred in 2010. Without the alum treatment, and reduced internal loading, lake TP probably would have continued to increase as it had in 2010, although the start of TP increase in 2011 was about a month sooner than in 2010. Beyond the peak, lake TP concentration was determined by proportionally adding back the 37% missing internal loading than occurred in 2010, thus providing an approximation of summer lake TP without the alum treatment.

External loading from May to October, 2011, was two-thirds greater than for that time frame in 2010 (Table F-1). Also, the inflow TP concentration for that period was higher than in 2010 although by only 7%. Inflow concentration is a more accurate indicator of the effect of external input than mass loading, because it represents the expected lake concentration without in-lake settling loss or internal loading. Thus, average external input should have increased lake TP in 2011 over that in 2010, although only slightly, according to the higher inflow concentration. That means the 37% reduction in internal loading may be an under estimate. On the other hand, the 56% more water entering the lake in 2011 may have had a diluting effect on internal loading, which means that the 37% reduction would be an over estimate. An over estimate of internal load reduction may seem likely given the shorter lake water residence time during May through October than in 2010 (Table F-2). However, there was much less difference during June through October, the period of greatest difference between observed and expected TP in 2011 (Table F-2, Figure 6). Moreover, lake TP increased in May-early June, 2011 (before alum), similar to that in 2010, due largely to high rates of internal loading, despite high volume inflows and a short retention time. Therefore, the observed reduction in TP during June through October was probably due largely to the alum treatment's effect in reducing internal loading.

Table F-1. External TP loading and average volume-weighted Inflow concentrations during May through October of each year.

	2010	**2011**
Total External TP Load (kg)	5,416	9,019
Total Inflow volume (m^3)	39,538,180	61,789,714
Average Inflow TP Concentration (ug/L)	137	146
Average Lake TP Concentration (ug/L)	170	144

Table F-2. Inflow volumes and residence times for periods indicated.

Year	Time Period	Inflow volume (m^3)	Inflow Volume (m^3) Per Month	Residence Time (months)
2010	May - October	39,538,180	6,589,697	13
	June - October	29,352,725	5,870,545	15
2011	May - October	61,789,714	10,298,286	8
	June- October	35,963,335	7,192,667	12