Picture: Lake Keewahtin, May 16, 2009

COMFORT LAKE-FOREST LAKE WATERSHED DISTRICT 2017 WATER MONITORING SUMMARY

Prepared for:
Comfort Lake-Forest Lake Watershed District

Prepared By:
Washington Conservation District

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2017 STREAM MONITORING SUMMARY

I. EXECUTIVE SUMMARY

In 2017, at the request of the Comfort Lake-Forest Lake Watershed District (CLFLWD), the Washington Conservation District (WCD) conducted continuous discharge and stream water quality monitoring at the following sites: Tributary to Bone Lake at Bone Lake North Inlet, Tributary to Sunrise River at Bone Lake Outlet, Tributary to Sunrise River at Little Comfort Lake Inlet, Sunrise River at Forest Lake Outlet, Sunrise River at Comfort Lake Inlet, and Sunrise River at Comfort Lake Outlet (Figure 2). Automated storm composite, manual base and storm grabs, and *E. coli* samples were collected at each site. Site locations and monitoring types can be found in Table 3. This report and the accompanying data will also be provided in an electronic format. Please contact the Washington Conservation District at (651) 330-8220 or www.mnwcd.org to obtain historical data.

The Tributary to Sunrise River at Little Comfort Lake Inlet, Sunrise River at Forest Lake Outlet, Sunrise River at Comfort Lake Inlet, and Sunrise River at Comfort Lake Outlet stream monitoring sites all showed an increase in total discharge in 2017 when compared to 2016. The Tributary to Bone Lake at Bone Lake North Inlet and Tributary to Sunrise River at Bone Lake Outlet stream monitoring sites both showed a decrease in total discharge for 2017. January and February of 2017 had above average monthly precipitation. May, August, and October were well above the average for monthly precipitation while June, July, and September were far below the monthly average. Average monthly precipitation totals were derived from historic 30-year (1987-2016) averages for this region. The total precipitation for 2017, according to the State Climatology Office with data gathered from the National Weather Service station in Stillwater, was 28.62 inches while the average annual precipitation is 33.94 inches; it was a below average year for precipitation (Figure 1).

Tributary to Sunrise River at Little Comfort Lake Inlet showed an increase in total phosphorus (TP) load in 2017 as compared to 2016. Tributary to Bone Lake at Bone Lake North Inlet, Tributary to Sunrise River at Bone Lake Outlet , Sunrise River at Forest Lake Outlet, Sunrise River at Comfort Lake Inlet, and Sunrise River at Comfort Lake Outlet all showed a decrease in TP load. The total phosphorus load of the Sunrise River and from the entire Comfort Lake-Forest Lake Watershed District was estimated at 0.043 lbs./ac (1,068 lbs.) as determined by the Sunrise River at Comfort Lake Outlet site (Table 1). Table 1 provides the 2017 discharge and loading summary for each stream monitoring station. While rainfall data was collected, deficiencies with the equipment led to inaccuracies in the data, therefore no rainfall totals will be reported.

While stream monitoring has been taking place on CLFLWD streams since 2004 it should be noted that the sampling technique has changed at nearly every site. When monitoring began the automated composite sampling technique was used at most sites. This involves multiple water samples collected at various flow points by an automated device, typically during storm events. Composite samples generally capture more of the rising limb and peak of a storm event where most nutrient loading is likely to occur. Between the years of 2005 and 2009 the sampling technique changed at several sites to grab samples, which is a manually collected discrete water sample. The limitation of manual grab samples is the timing of the sample collection; it is very easy to miss the rising limb or peak of a storm event. Grab samples capture data at just one point in time during the storm event whereas a composite sample collects many samples during different points in the storm event. Composite samples can produce a more accurate loading estimate. When comparing loading estimates at sites where the sampling technique has changed it appears as though at some point there is a significant decrease in TP load. This apparent decrease correlates with the year in which the sampling technique was changed from composite to grab samples. When looking at the loading numbers it may lead to an unrealistic conclusion that phosphorus loads are decreasing. The switch in sampling techniques must be taken into consideration when

comparing loading numbers. The 2012 monitoring season brought a slight change in sampling technique for all monitored sites yet again. Grab sampling was still the technique used, however, the samples were collected using the automated sampler versus a manual grab. The reasoning was that the timing of the grab sample would be more accurate when automatically collected, during the rising limb or at the peak of the storm event. In 2013 it was decided to return to collecting automated storm composite samples in order to achieve more accurate loading numbers from sites where samples are collected. Composite sampling has continued since 2013.

The Tributary to Sunrise River at Bone Lake Outlet, Sunrise River at Forest Lake Outlet, and Sunrise River at Comfort Lake Outlet sites have each utilized three different sampling techniques. All three sites started with the automated composite sampling technique, then switched to manual grab samples, and finally switched to using in-lake TP concentrations to estimate load, with the exception of Sunrise River at Comfort Lake Outlet which has utilized automated composite sampling since 2013. At Bone Lake Outlet automated composite sampling was used from 2003-2005 and switched to manual grab samples in 2006. Monitoring was discontinued at this site from 2007 through 2012. Monitoring resumed in 2013 using in-lake TP concentrations collected in Bone Lake to estimate load, this method was used through 2014 and 2015. The monitoring method reverted back to automated composite sampling in 2016 and continued in 2017. Composite sampling was used at Forest Lake Outlet from 2003-2005 and switched to manual grab samples in 2006. Sampling ceased at the site in 2007 and all TP loads from 2007-2015 had been estimated using in-lake sample concentrations collected in the West Basin of Forest Lake. Monitoring resumed in 2016 using automated composite sampling and continued in 2017. Composite sampling was used at Comfort Lake Outlet from 2003-2005 and switched to manual grab samples in 2006. Grab samples were also collected in 2008 by the Army Corps of Engineers. In-lake TP concentrations were used to estimate load for the 2009 and 2010 monitoring seasons. In 2011, manual grab samples were again collected at this site and in 2012 automated grab samples were collected. Since 2013, automated storm composite samples have been collected. As with grab samples, using in-lake total phosphorus concentrations may lead to artificially low loading numbers. This is due to the difference in sampling technique and location (in-lake versus in-stream). More accurate loading numbers can be estimated by collecting samples at the monitoring site. The changes in sampling techniques must be taken into consideration when comparing loading numbers.

Table 1. CLFLWD 2017 Stream Discharge, Loading, and Rainfall Summary

Site	Subwatershed (acres)	Yearly Discharge (cf)	Yearly Discharge (ac-ft.)	Peak Discharge (cfs)	Yearly Total Phosphorus Load (lbs.)	Yearly Total Suspended Solids Load (lbs.)
Bone Lake North Inlet	2,479	30,382,691	698	29.494	220	5,399
Bone Lake Outlet	5,495	75,299,508	1,730	17.592	140	46,748
Little Comfort Lake Inlet	10,513	139,982,281	3,215	21.888	504	75,358
Forest Lake Outlet	8,719	335,173,369	7,699	33.017	321	82,877
Comfort Lake Inlet	13,732	519,810,626	11,939	68.593	1,525	202,161
Comfort Lake Outlet	24,558	549,144,071	12,613	83.007	1,068	145,453

The WCD and citizen volunteers also conducted monitoring on eleven lakes for CLFLWD in 2017. A map of the locations of the monitoring sites can be found in Figure 2 and a table of the locations and monitoring types can be found in Table 3. The monitored lakes were as follows: Birch Lake, Bone Lake, Comfort Lake, Forest Lake (West, Middle, and East Basins), Lake Keewahtin (formerly Sylvan/Halfbreed), Little Comfort Lake,

Moody Lake, Nielsen Lake, School Lake, Sea Lake, and Shields Lake. Lake results are discussed in the Lake Monitoring portion of this summary.

II. INTRODUCTION AND METHODS

In 2017, the Washington Conservation District (WCD) conducted continuous discharge and stream water quality monitoring at six sites: Tributary to Bone Lake at Bone Lake North Inlet, Tributary to Sunrise River at Bone Lake Outlet, Tributary to Sunrise River at Little Comfort Lake Inlet, Sunrise River at Forest Lake Outlet, Sunrise River at Comfort Lake Inlet, and Sunrise River at Comfort Lake Outlet (Figure 2). Automated storm composite, manual base and storm grab, and *E. coli* samples were collected at each site. Site locations and monitoring types can be found in Table 3. Multiple water quality parameters were monitored and analyzed at each stream site. The purpose of this monitoring was to assess and document the current water quality conditions of the streams, identify problem resources or areas, and to continue a long-term baseline monitoring program which will enable the Comfort Lake-Forest Lake Watershed District (CLFLWD) to identify trends associated with land use changes in the watershed.

Continuous stage, velocity, and discharge measurements were recorded every 15 minutes at the Tributary to Bone Lake at Bone Lake North Inlet from April 4-October 31, 2017, Tributary to Sunrise River at Bone Lake Outlet from April 4-October 31, 2017, Tributary to Sunrise River at Little Comfort Lake Inlet from April 18-September 2, 2017, Sunrise River at Forest Lake Outlet from April 4- October 31, 2017, Sunrise River at Comfort Lake Inlet from April 4-October 31, 2017, and Sunrise River at Comfort Lake Outlet from April 4-October 31, 2017. Precipitation data was also continuously collected at Tributary to Bone Lake at Bone Lake North Inlet, Tributary to Sunrise River at Little Comfort Lake Inlet, Sunrise River at Comfort Lake Inlet, and Sunrise River at Comfort Lake Outlet. While rainfall data was collected, deficiencies with the equipment lead to inaccuracies in the data, therefore no rainfall totals will be reported.

Staff gages were installed and read at each site, with the exception of Bone Lake North Inlet. Field stage measurements were taken in the stream channels by measuring the area/velocity sensor (probe) depth. Temperature, dissolved oxygen, specific conductivity, pH, and transparency tube measurements were also taken. Stage-discharge relationships were developed at three stream sites (Bone Lake Outlet, Forest Lake Outlet, and Comfort Lake Outlet) and an area-velocity relationship was used at three sites (Bone Lake North Inlet, Little Comfort Lake Inlet, and Comfort Lake Inlet) to determine discharge. Automated storm composite and manual storm and base flow grab samples were collected at all continuous stream monitoring sites. *E. coli* grab samples were also collected at all monitoring sites. There were no duplicate base and/or storm samples collected at monitored sites in 2017. The purpose of duplicate samples is to obtain information on the magnitude of errors owing to contamination, random and systematic errors, and any other variabilities that are introduced from the time of sampling until the samples arrive at the lab. When duplicate samples are collected the results are not incorporated into the report. The Metropolitan Council Environmental Services Laboratory in St. Paul analyzed all samples. A complete list of detailed Washington Conservation District water monitoring methods and standard operating procedures can be found at http://www.mnwcd.org/water-quality-water-monitoring/.

CLFLWD streams are considered to be Class 2B Waters, according to the Minnesota Pollution Control Agency (MPCA). These types of streams are described as cool- and warm-water fisheries (not protected for drinking water) and are held to certain water quality standards as set by the MPCA (https://www.revisor.mn.gov/rules/?id=7050.0222). The state standards can be found in Table 2. According to the MPCA, water quality standards are used to: "define maximum allowable levels of pollutants to protect beneficial uses, ascertain the quality of the state's water resources by comparing the standards to monitoring data, identify waters that are polluted, help establish priorities for the allocation of treatment resources and

cleanup efforts, set effluent limits and treatment requirements for dischargers in some situations, and assess risks to surface water from ground water contamination sites and help define cleanup goals." More information on water quality standards can be found at: http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/water-quality-and-pollutants/water-quality-standards.html.

It is important to track these water quality standards at each site to determine if the waters are meeting state goals and whether or not they are impaired. The MPCA is working to develop new standards for altered stream systems as part of the Tiered Aquatic Life Uses (TALU) framework (http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/tiered-aquatic-life-use-talu-framework.html).

For the purposes of identifying instances in which the 2B standards are not meeting MPCA thresholds, only discrete (grab) samples taken manually are considered in this report.

Table 2. MPCA Class 2B Water Quality Standards

Parameter	Class 2B Waters Standard
Chloride (Chronic)	> 230 mg/L
Low Dissolved Oxygen (DO)	< 5 mg/L as daily minimum
pH	< 6.5 or >8.5
Total Suspended Solids (TSS)	> 30 mg/L*
Total Phosphorus (TP)	≥ 100 ug/L

*May be exceeded no more than ten percent of the time, April 1-September 30

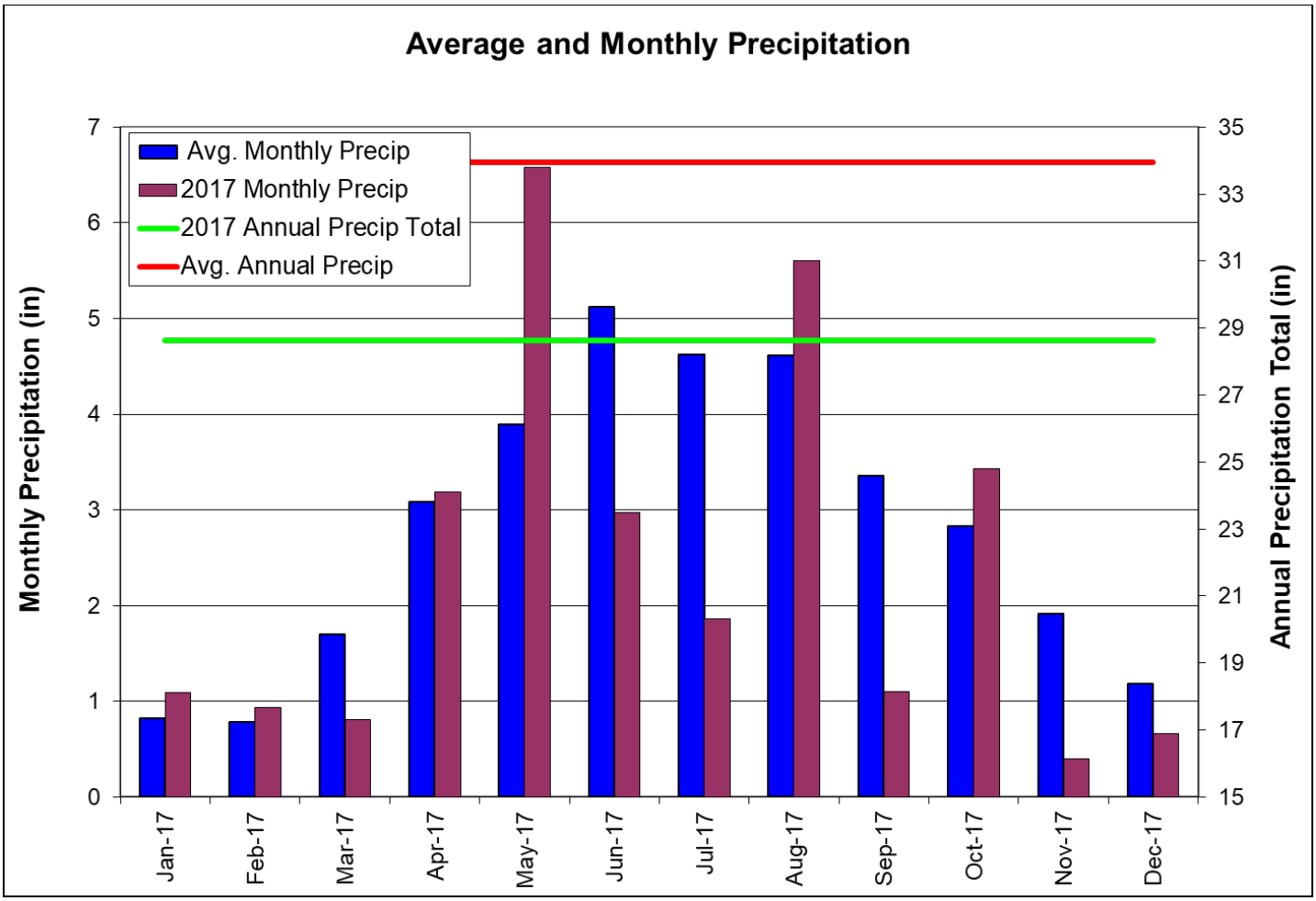


Figure 1. 2017 Monthly Precipitation and Historic 30-Year Average Monthly Precipitation

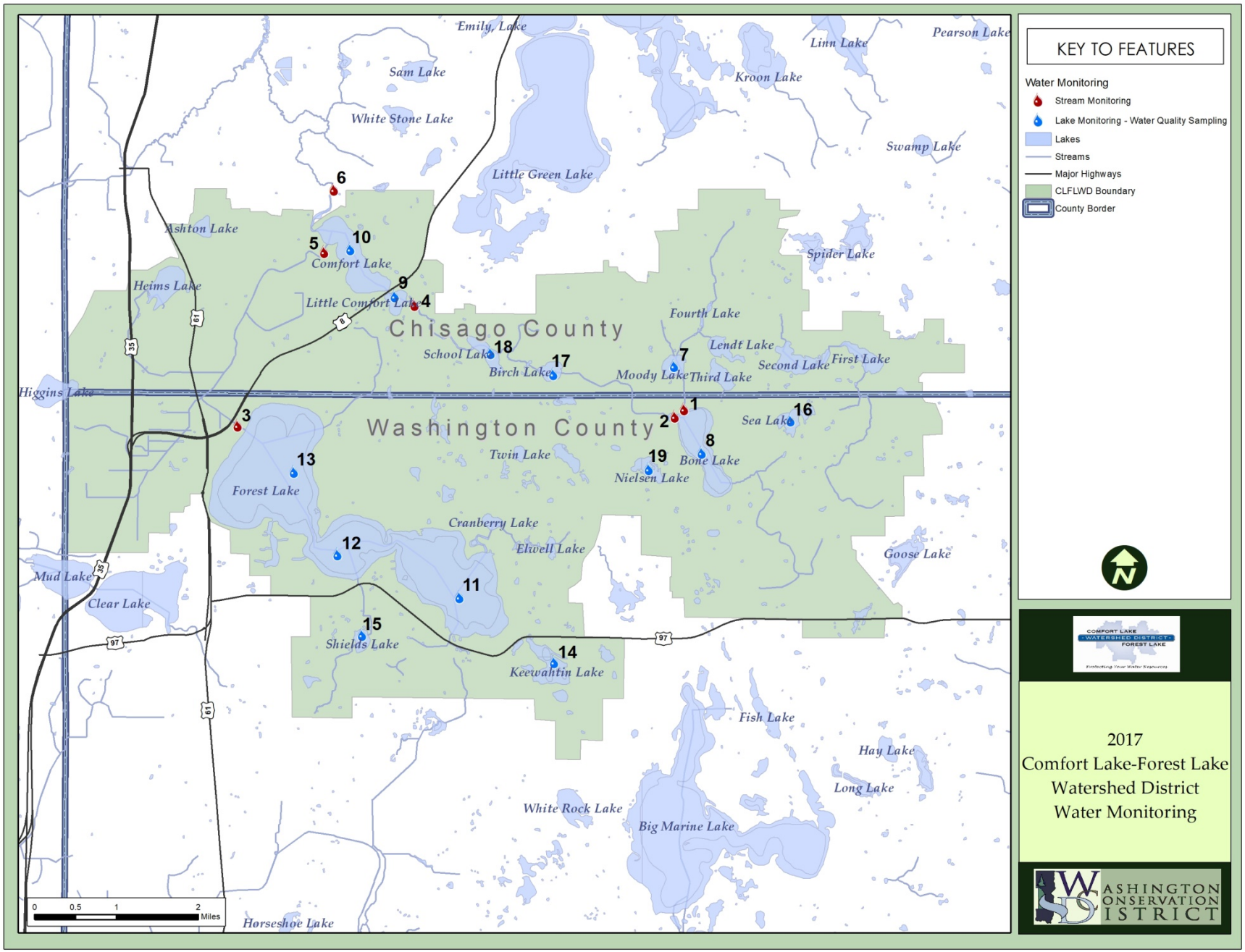


Figure 2. CLFLWD Monitoring Locations

Table 3. Monitoring Site Location and Description Summary

Site Description	Map Site ID#	Full Site Name	Summarized Site Name	General Site Location	Monitoring Site Description	Monitored Parameters
Stream Monitoring	**1**	Tributary to Bone Lake at Bone Lake North Inlet	Bone Lake North	238th Street North	Flow Monitoring Through Culvert	Discharge and Water Quality Composite Samples*
Stream Monitoring	**2**	Tributary to Sunrise River at Bone Lake Outlet	Bone Lake Outlet	Lofton Avenue North	Flow Monitoring Through Culvert	Discharge and Water Quality Composite Samples*
Stream Monitoring	**3**	Tributary to Sunrise River at Forest Lake Outlet	Forest Lake Outlet	North Shore Drive	Flow Monitoring in Natural Cross-Section	Discharge and Water Quality Composite Samples*
Stream Monitoring	**4**	Tributary to Sunrise River at Little Comfort Lake Inlet	Little Comfort Lake Inlet	Itasca Avenue	Flow Monitoring Through Culvert	Discharge and Water Quality Composite Samples*
Stream Monitoring	**5**	Sunrise River at Comfort Lake Inlet	Comfort Lake Inlet	West Comfort Drive	Flow Monitoring Through Culvert	Discharge and Water Quality Composite Samples*
Stream Monitoring	**6**	Sunrise River at Comfort Lake Outlet	Comfort Lake Outlet	Wyoming Trail	Flow Monitoring in Natural Cross-Section	Discharge and Water Quality Composite Samples*
Lake Monitoring	**7**	Moody Lake	---	Chisago Lakes Township	---	Surface Water Quality Samples**, Elevation
Lake Monitoring	**8**	Bone Lake	---	City of Scandia	---	Surface Water Quality Samples**, Elevation
Lake Monitoring	**9**	Little Comfort Lake	---	Chisago City	---	Surface Water Quality Samples**
Lake Monitoring	**10**	Comfort Lake	---	City of Wyoming	---	Surface Water Quality Samples**, Elevation
Lake Monitoring	**11**	Forest Lake – East Basin (3)	---	City of Forest Lake	---	Surface Water Quality Samples**
Lake Monitoring	**12**	Forest Lake – Middle Basin (2)	---	City of Forest Lake	---	Surface Water Quality Samples**, Elevation
Lake Monitoring	**13**	Forest Lake – West Basin (1)	---	City of Forest Lake	---	Surface Water Quality Samples**
Lake Monitoring	**14**	Keewahtin Lake	---	City of Forest Lake	---	Surface Water Quality Samples**, Benthic Iron and Ortho-P, Elevation
Lake Monitoring	**15**	Shields Lake	---	City of Forest Lake	---	Surface Water Quality Samples**, Benthic Iron and Ortho-P, Elevation
Lake Monitoring	**16**	Sea Lake	---	City of Scandia	---	Surface Water Quality Samples**, Elevation
Lake Monitoring	**17**	Birch Lake	---	Chisago City	---	Surface Water Quality Samples**, Elevation
Lake Monitoring	**18**	School Lake	---	Chisago City	---	Surface Water Quality Samples**, Benthic Iron and Ortho-P, Elevation
Lake Monitoring	**19**	Nielsen Lake	---	City of Scandia	---	Surface Water Quality Samples**, Elevation

*Stream Monitoring Water Quality Sample Parameters Include: Total Phosphorus, Dissolved Phosphorus, Total Kjeldahl Nitrogen, Nitrate, Nitrite, Ammonia Nitrogen, Total Suspended Solids, Volatile Suspended Solids, Total Chlorides, *E. coli* Bacteria

**Lake Monitoring Water Quality Sample Parameters Include: Total Kjeldahl Nitrogen, Total Phosphorus, Chlorophyll-a, Secchi Disk Transparency

III. BONE LAKE SUBWATERSHED

Bone Lake North Inlet

The station at the Bone Lake North Inlet recorded stage and velocity from April 4-October 31, 2017. Figure 3 shows the discharge for the monitoring season while the time periods outside of this were estimated using similar flow conditions. Total yearly estimated discharge was 30,382,691 cf or 698 acre-ft. Peak discharge of 29.494 cfs was recorded on May 21st due to a series of rainfall events over a short period of time, totaling more than two inches.

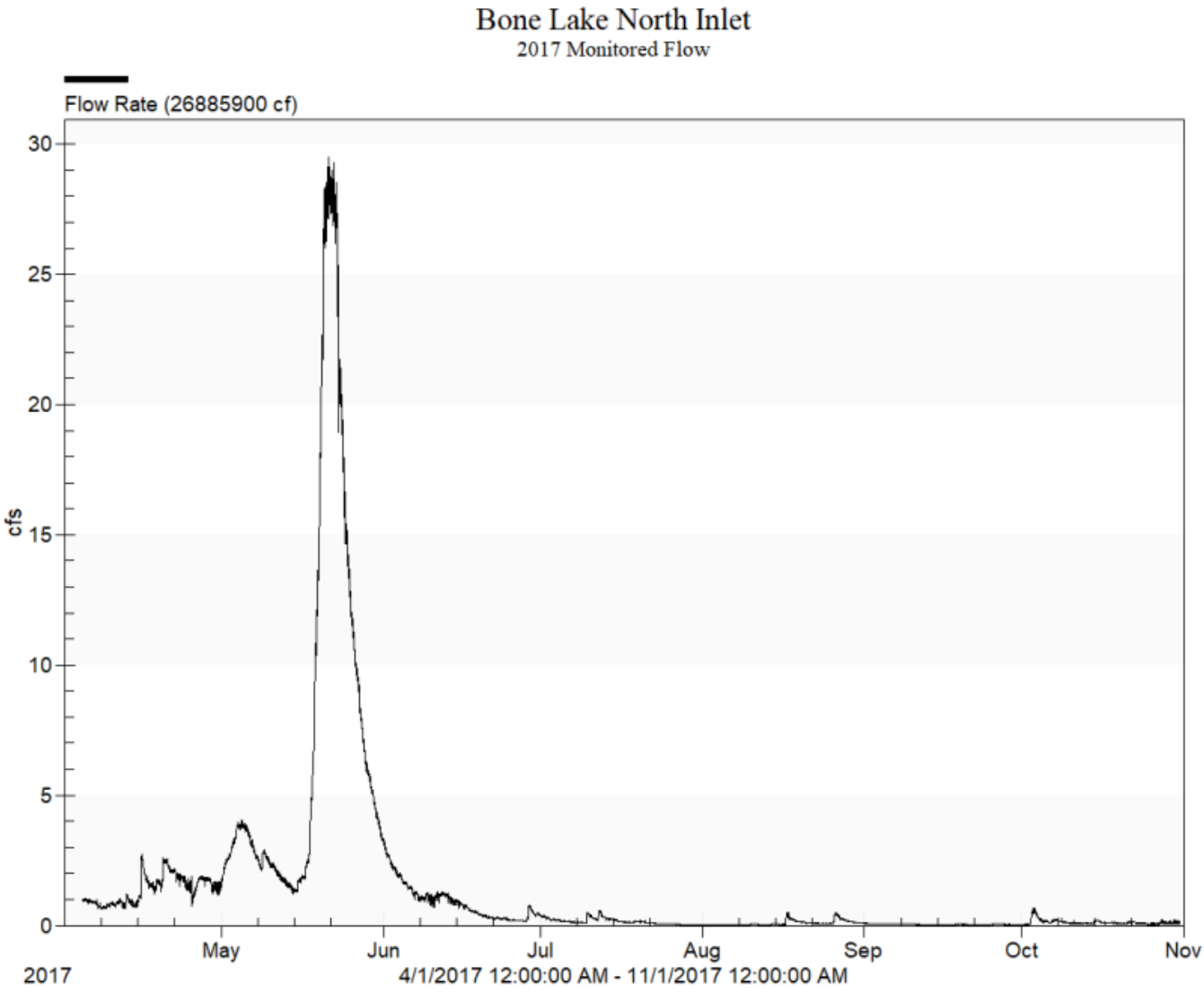


Figure 3. Bone Lake North Inlet 2017 Monitored Flow

Automated storm composite and manual base grab samples, along with *E. coli* samples, were collected at the Bone Lake North Inlet site in 2017. It should be noted that base grab samples are difficult to collect due to the low-flow conditions present at this site for the majority of the summer months. The total suspended solids (TSS), volatile suspended solids (VSS), total Kjeldahl nitrogen (TKN), total phosphorus (TP), dissolved phosphorus, chloride, nitrite, nitrate, ammonia nitrogen, and *E. coli* results from all collected samples are listed in Table 4, and field water quality measurements are listed in Table 5. The highest TSS, TKN, and TP results of 270 mg/L, 4.5 mg/L, and 1.460 mg/L respectively, came from a storm composite sample collected from October 3rd-October 4th. None of the sample chemistry results exceeded water quality standards.

Table 4. Bone Lake North Inlet 2017 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	*E. coli* (mpn/100ml)
Storm Composite	4/15/2017 17:07	4/16/2017 3:11	14	11	1.7	0.127	0.095	12.6	<0.03	0.29	0.20	
Storm Composite	5/3/2017 12:21	5/4/2017 9:13	~2	~2	4.0	0.339	<0.020	11.2	<0.03	<0.05	<0.02	
Storm Composite	5/17/2017 10:04	5/18/2017 10:20	4	3	1.4	0.221	0.151	9.6	<0.03	<0.05	0.11	
Storm Composite	8/26/2017 6:27	8/27/2017 4:57	37	21	2.9	0.826	0.103	8.5	<0.03	<0.05	0.32	
Storm Composite	10/3/2017 0:18	10/4/2017 12:57	270	117	4.5	1.460	0.119	17.2	<0.03	0.14	0.46	
Base Grab	4/27/2017 9:10	4/27/2017 9:10	<1	~1	1.0	0.068	0.057	12.0	<0.03	0.10	<0.02	68
Base Grab	5/26/2017 9:21	5/26/2017 9:21	~1	~1	0.9	0.088	0.056	11.1	<0.03	<0.05	<0.02	29

Exceeds Water Quality Standard

Table 5. Bone Lake North Inlet 2017 Field Water Quality Measurements

Date/Time	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/27/2017 9:10	6.1	3.80	178	8.4
5/26/2017 9:21	16.1	2.10		

Exceeds Water Quality Standard

Total phosphorus loading at the Bone Lake North Inlet site for 2017 was estimated at 0.09 lbs/ac or 220 lbs. (Table 1 and Appendix A). Monitoring should continue at this site in an effort to better understand the total phosphorus load entering Bone Lake.

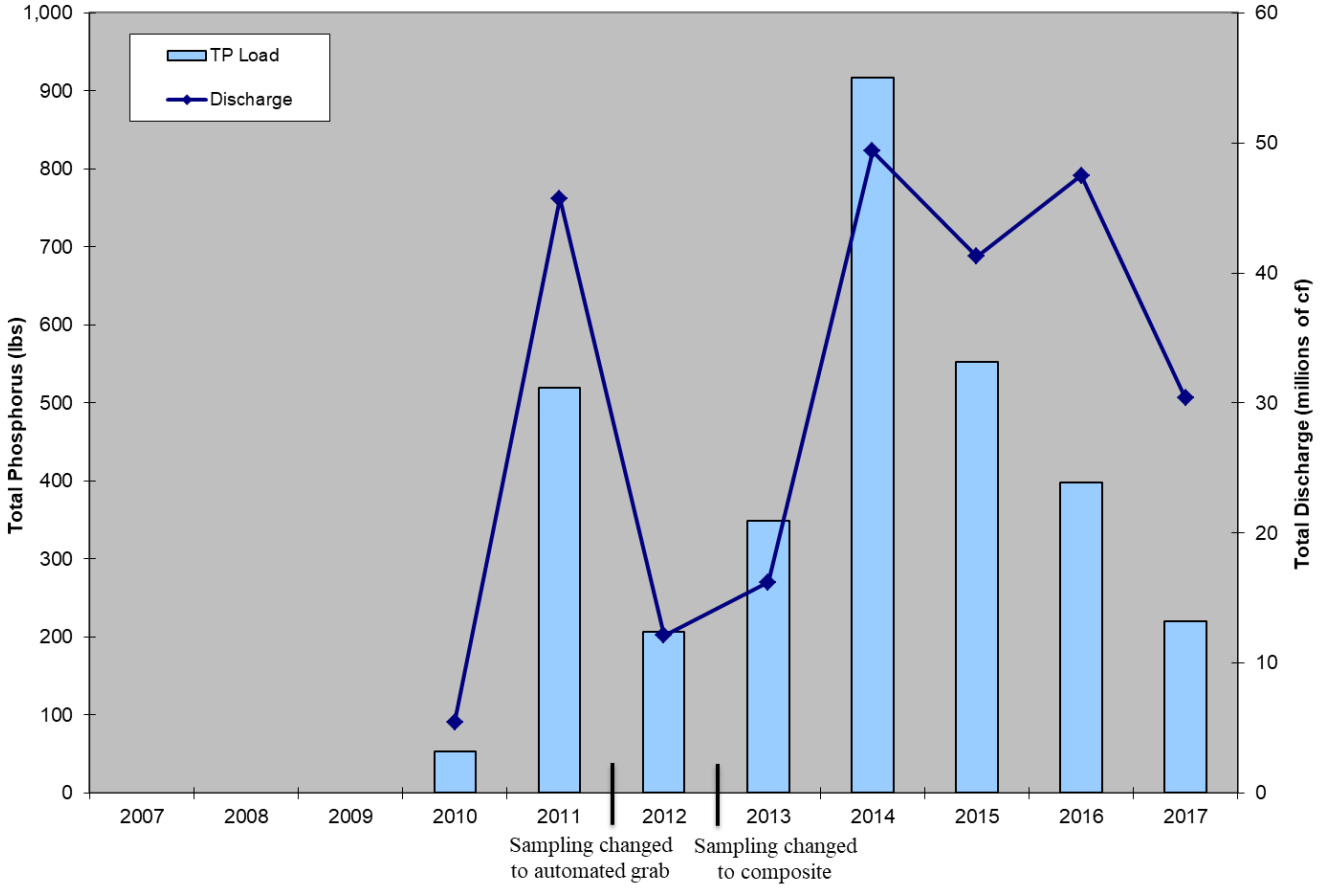


Figure 4. Bone Lake North Inlet 10-Year Annual Discharge and Total Phosphorus Load

Flow and water chemistry data have been collected at the Bone Lake North Inlet site since 2003, excluding the years 2004 and 2007-2009. Total estimated annual discharge and phosphorus loads can be found in Figure 4. When comparing year-to-year loading numbers it should be noted that the sampling technique has changed three times. Automated storm composite samples were collected when the site was first monitored, switched to manual storm grab samples in 2006, to automated storm grab samples in 2012, and back to automated storm composite samples in 2013. These changes partially explain the variation in load versus discharge, due to the refinement level of each technique. Automated storm composite samples have been collected since 2013, which allows for better comparisons to be made from year-to-year. In 2017, there was a decrease in both TP load and discharge when compared to 2016.

Total phosphorous flow weighted mean concentrations have been calculated (total load divided by total flow) in an effort to normalize phosphorus loads due to changes in flow. It allows for better comparisons to be made between years when a stream has different flow rates or between streams with different flows. Flow weighted mean concentration values can be found in Table 16.

Bone Lake Outlet

The station at the Bone Lake Outlet recorded stage and velocity from April 4-October 31, 2017. Figure 5 shows the discharge for the monitoring season while the time periods outside of this were estimated using similar flow conditions. Total yearly estimated discharge was 75,299,508 cf or 1,730 acre-ft. Peak discharge of 17.592 cfs was recorded on May 22nd due to a series of rainfall events over a short period of time, totaling more than two inches.

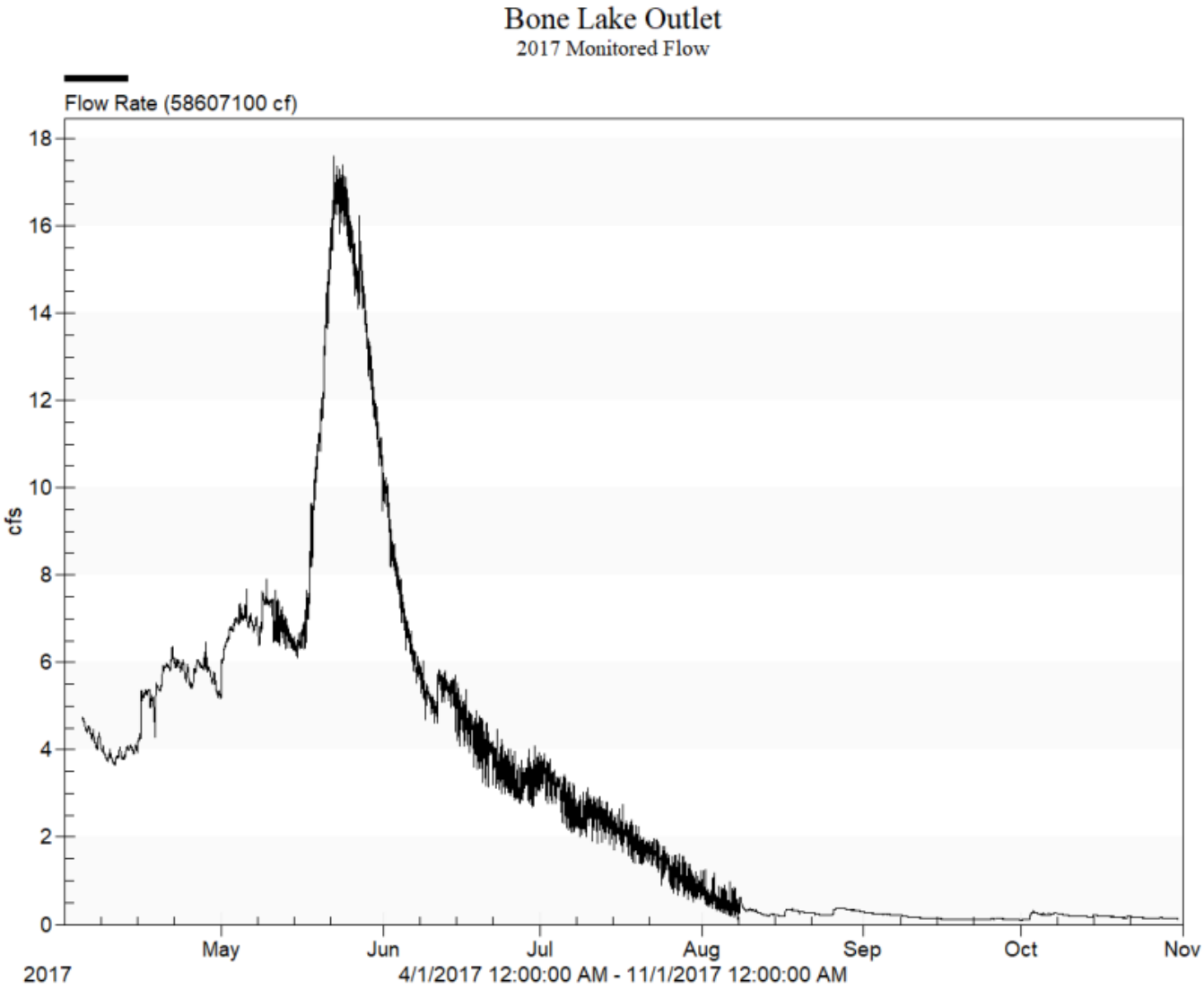


Figure 5. Bone Lake Outlet 2017 Monitored Flow

For the 2017 monitoring season, automated storm composite and manual base and storm grab samples, along with *E. coli* samples were collected at the Bone Lake Outlet site. It should be noted that the low number of samples collected is due to the difficult nature of monitoring at this site. The pond located on the downstream side of the outlet structure has a consistently high elevation which can lead to unrepresentative sample results due to mixing of lake water with pond water. The chemistry results from all collected samples are listed in Table 6 and field water quality measurements are listed in Table 7. The highest TSS result of 71 mg/L came from a storm grab collected on May 18th. The highest TKN result was 1.10 mg/L and was collected from a storm grab on May 18th, a storm composite on May 20th, and a base grab on May 26th. The highest TP result of 0.064 mg/L came from the storm composite sample on May 20th. One sample exceeded the impairment threshold for total phosphorus.

Table 6. Bone Lake Outlet 2017 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	*E. coli* (mpn/100ml)
Storm Grab	5/18/2017 10:44	5/18/2017 10:44	71	47	1.10	~0.028	<0.020	13.9	<0.03	<0.05	~0.04	
Storm Composite	5/20/2017 12:51	5/20/2017 20:31	4	3	1.10	0.064	<0.020	13.2	<0.03	<0.05	<0.02	
Base Grab	4/27/2017 9:30	4/27/2017 9:30	5	3	1.00	<0.020	<0.020	14.6	<0.03	0.13	0.11	<1
Base Grab	5/26/2017 9:28	5/26/2017 9:28	5	4	1.10	~0.045	~0.025	13.7	<0.03	<0.05	<0.02	3

Exceeds Water Quality Standard

Table 7. Bone Lake Outlet 2017 Field Water Quality Measurments

Date/Time	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/27/2017 9:30	10.5	9.60	305	8.6
5/26/2017 9:28	16.5	10.33		

Exceeds Water Quality Standard

Automated storm composite samples were collected in 2017; in the recent past, in-lake concentrations from samples collected in Bone Lake were used to calculate a total phosphorus load at this site. Total phosphorus loading at the Bone Lake Outlet site for 2017 was estimated at 0.026 lbs/ac or 140 lbs. (Table 1 and Appendix A). Automated storm composite sampling should continue at this site to more accurately determine the load leaving Bone Lake.

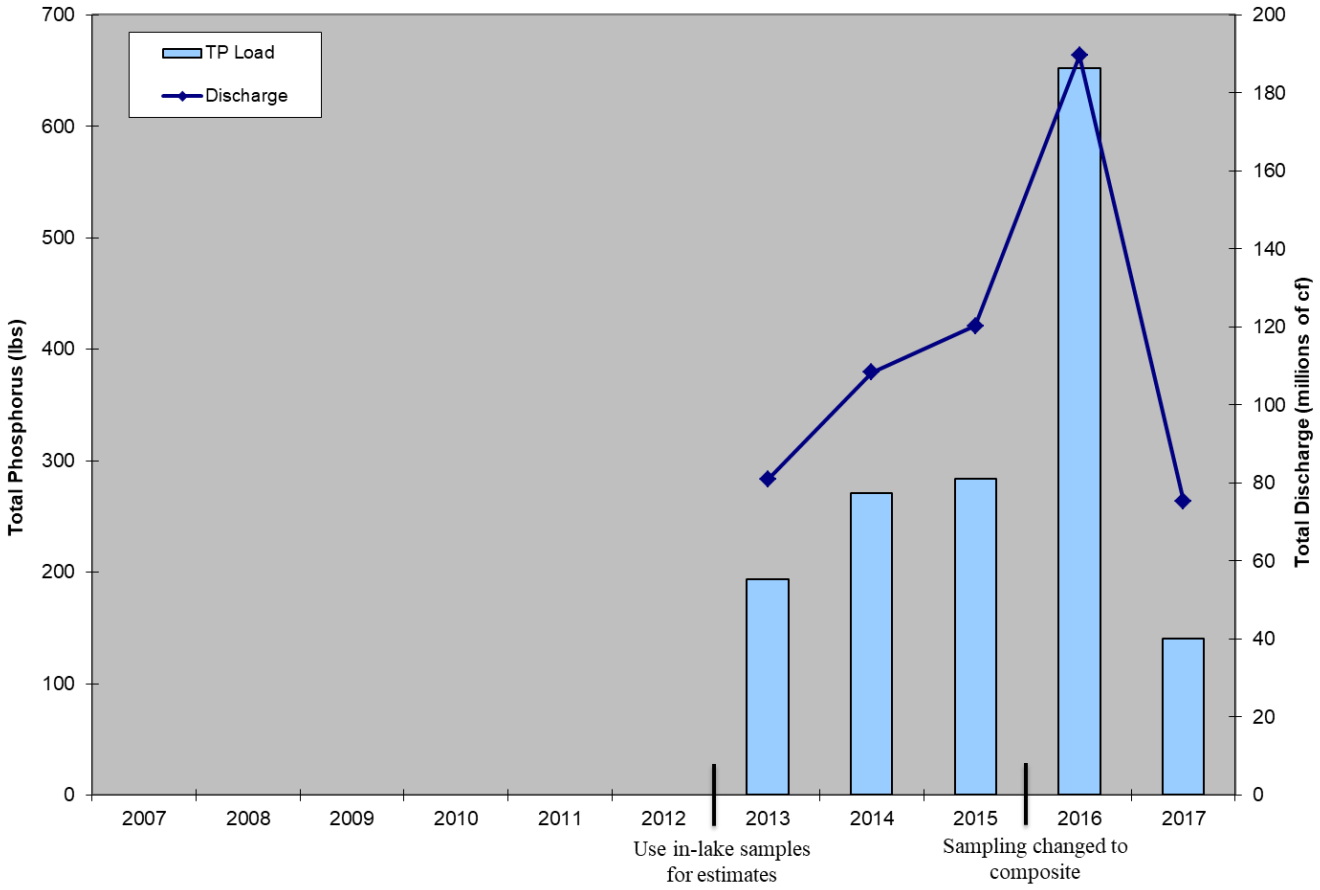


Figure 6. Bone Lake Outlet 10-Year Annual Discharge and Total Phosphorus Load

Flow and water chemistry data were collected at the Bone Lake Outlet from 2003 through 2006 and not again until 2013. Total estimated annual phosphorus loading and discharge can be found in Figure 6. It should be noted that when comparing year-to-year loading estimates, the sampling technique utilized at this site has changed. Automated storm composite sampling was used during the 2004-2005 monitoring seasons and was switched to manual grab sampling for the 2006 season. Monitoring at the site ceased in 2007 but resumed in 2013 when the sampling technique changed again. Load estimates for 2013 through 2015 were made using in-lake sample concentrations. For the 2016 season, the technique changed back to automated storm composite samples. There was a dramatic increase in both TP load and discharge from 2015 to 2016, which is mosly likely due to the shift in sampling technique. Automated storm composite samples were collected again in 2017; both TP load and discharge decreased from 2016 to 2017.

Total phosphorous flow weighted mean concentrations have been calculated (total load divided by total flow) in an effort to normalize phosphorus loads due to changes in flow. It allows for better comparisons to be made between years when a stream has different flow rates or between streams with different flows. Flow weighted mean concentration values can be found in Table 16.

IV. LITTLE COMFORT LAKE SUBWATERSHED

Little Comfort Lake Inlet

Stage and velocity were recorded at the Little Comfort Lake Inlet site from April 18-September 2, 2017. The monitoring season was cut short at this site due to equipment failure; the area/velocity sensor was severed by an animal. The decision was made not to replace the sensor due to the short amount of time remaining in the monitoring season. Figure 7 shows the discharge for the monitoring season, while the time periods outside of this were estimated using similar flow conditions. Total yearly estimated discharge was 139,982,281 cf or 3,215 acre-ft. Peak discharge of 21.888 cfs occurred on May 22nd due to a series of rainfall events over a short period of time, totaling more than two inches.

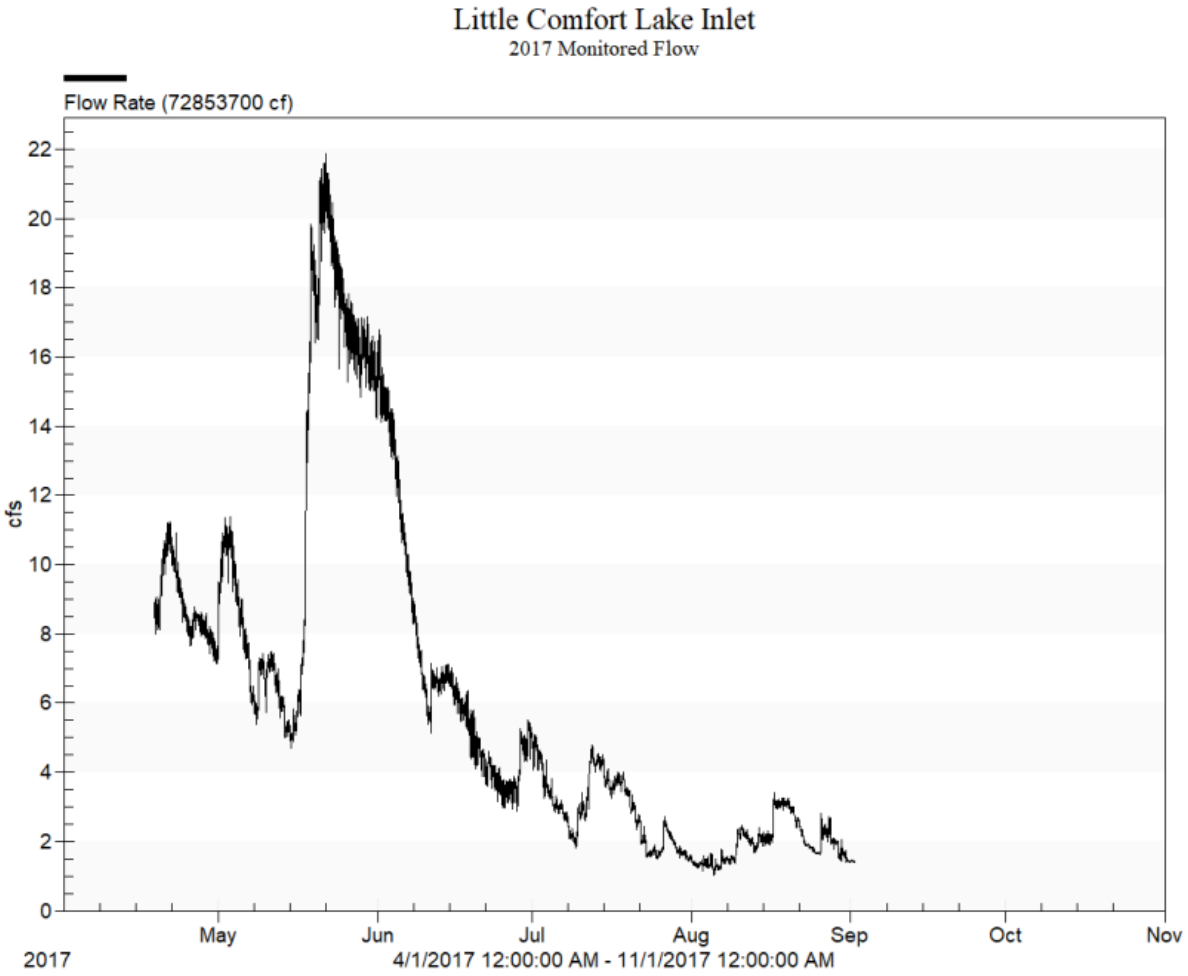


Figure 7. Little Comfort Lake Inlet 2017 Monitored Flow

Automated storm composite and manual base grab samples, along with *E. coli* samples, were collected at the Little Comfort Lake Inlet site in 2017. The chemistry results from all collected samples are listed in Table 8, and field water quality measurements are listed in Table 9. The highest concentrations of TSS, TKN, and TP were 99 mg/L, 1.60 mg/L, and 0.145 mg/L respectively, from a storm composite sample collected from May 17th-May 18th. None of the sample chemistry results exceeded water quality standards.

Table 8. Little Comfort Lake Inlet 2017 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	*E. coli* (mpn/100ml)
Storm Composite	5/17/2017 14:40	5/18/2017 22:27	99	49	1.60	0.145	~0.041	13.9	<0.03	<0.05	~0.02	
Base Grab	4/27/2017 9:45	4/27/2017 9:45	13	8	0.97	0.100	<0.020	15.8	<0.03	<0.05	<0.02	36
Base Grab	5/26/2017 10:23	5/26/2017 10:23	10	6	0.91	0.055	<0.020	14.6	<0.03	<0.05	~0.03	26
Base Grab	6/26/2017 14:35	6/26/2017 14:35	4	3	0.81	~0.031	<0.020	13.9	<0.03	0.07	~0.03	140
Base Grab	7/24/2017 11:41	7/24/2017 11:41	~2	~2	0.88	0.058	~0.047	16.5	0.06	0.21	0.14	108
Base Grab	8/30/2017 9:43	8/30/2017 9:43	5	3	0.80	~0.049	~0.030	15.7	<0.03	0.11	0.09	332
Base Grab	9/27/2017 9:15	9/27/2017 9:15	~1	~1	0.83	~0.049	~0.021	16.8	0.03	0.13	0.21	488
Base Grab	10/24/2017 14:40	10/24/2017 14:40	~1	~2	0.62	~0.037	~0.040	19.0	<0.03	0.37	0.20	73

Exceeds Water Quality Standard

Table 9. Little Comfort Lake Inlet 2017 Field Water Quality Measurements

Date/Time	Transparency (cm)	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/27/2017 9:45		8.3	8.97	359	8.5
5/26/2017 10:23		16.7	8.90		
6/26/2017 14:35		21.0	9.63	323	8.7
7/24/2017 11:41	>100	23.2	5.66		
8/30/2017 9:43		20.2	5.02	363	8.2
9/27/2017 9:15		12.9	6.65	431	8.4
10/24/2017 14:40		9.4	4.78	508	7.8

Exceeds Water Quality Standard

Total phosphorus loading at Little Comfort Lake Inlet for 2017 was estimated at 0.05 lbs/ac or 504 lbs. (Table 1 and Appendix A).

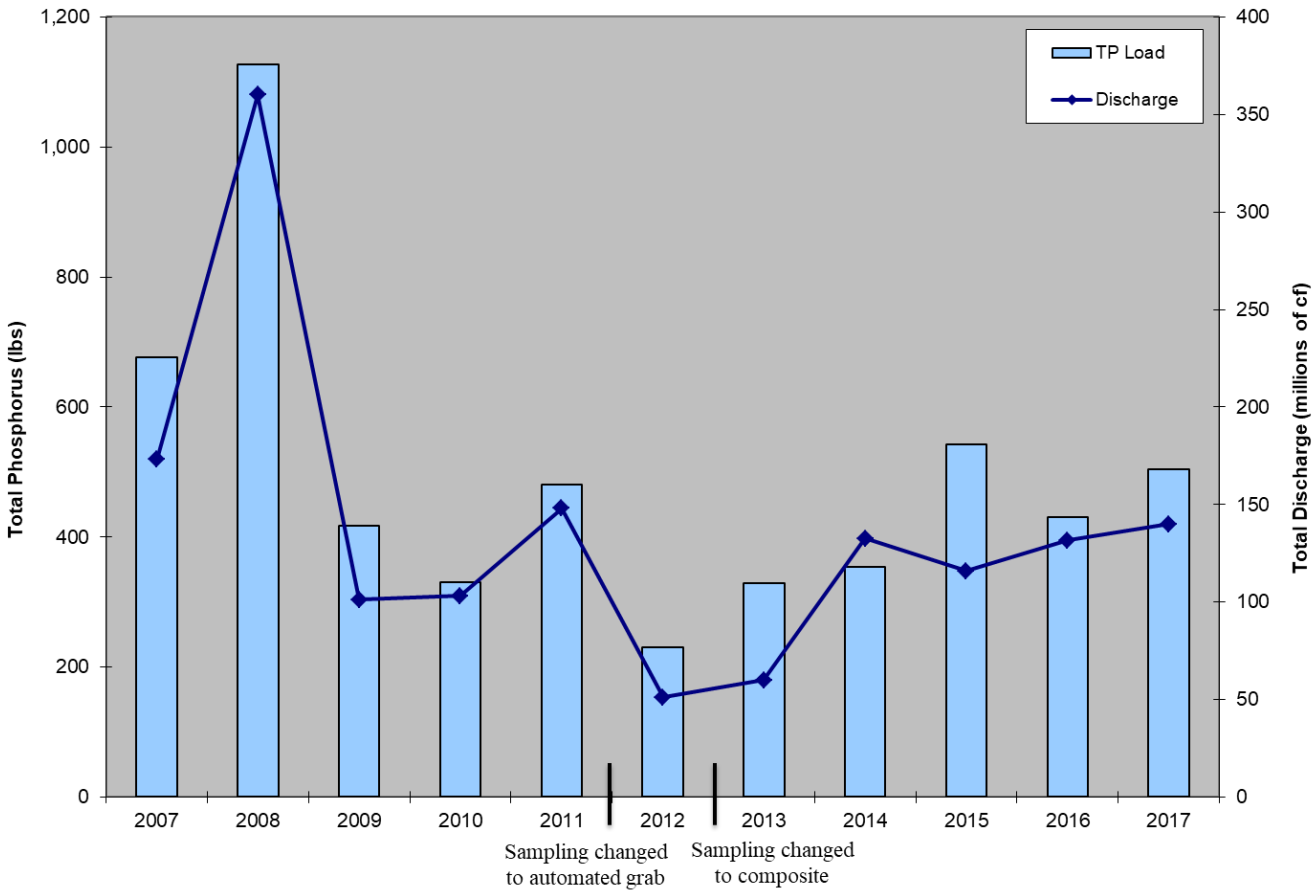


Figure 8. Little Comfort Lake Inlet 10-Year Annual Discharge and Total Phosphorus Load

Flow and water chemistry data have been collected at the Little Comfort Lake Inlet site since 2004. Total estimated annual discharge and phosphorus loads can be found in Figure 8. When comparing year-to-year loading numbers it should be noted that the sampling technique has changed three times. Automated storm composite samples were collected when the site was first monitored in 2004. The method switched to manual storm grab samples in 2007, to automated storm grab samples in 2012, and back to automated storm composite samples in 2013. These changes contribute to the variation in load versus discharge, due to the refinement level of each technique. Automated storm composite samples have been collected since 2013 which allows for better comparisons to be made from year-to-year. There was in increase in both TP load and discharge from 2016 to 2017.

Total phosphorous flow weighted mean concentrations have been calculated (total load divided by total flow) in an effort to normalize phosphorus loads due to changes in flow. It allows for better comparisons to be made between years when a stream has different flow rates or between streams with different flows. Flow weighted mean concentration values can be found in Table 16.

V. FOREST LAKE SUBWATERSHED

Forest Lake Outlet

The station at the Forest Lake Outlet site recorded stage and velocity from April 4-October 31, 2017. Figure 9 shows the discharge for the monitoring season, while the time periods outside of this were estimated using similar flow conditions. Total yearly estimated discharge was 335,173,369 cf or 7,699 acre-ft. Peak discharge of 33.017 cfs occurred on May 23rd due to a series of rainfall events over a short period of time, totaling more than two inches.

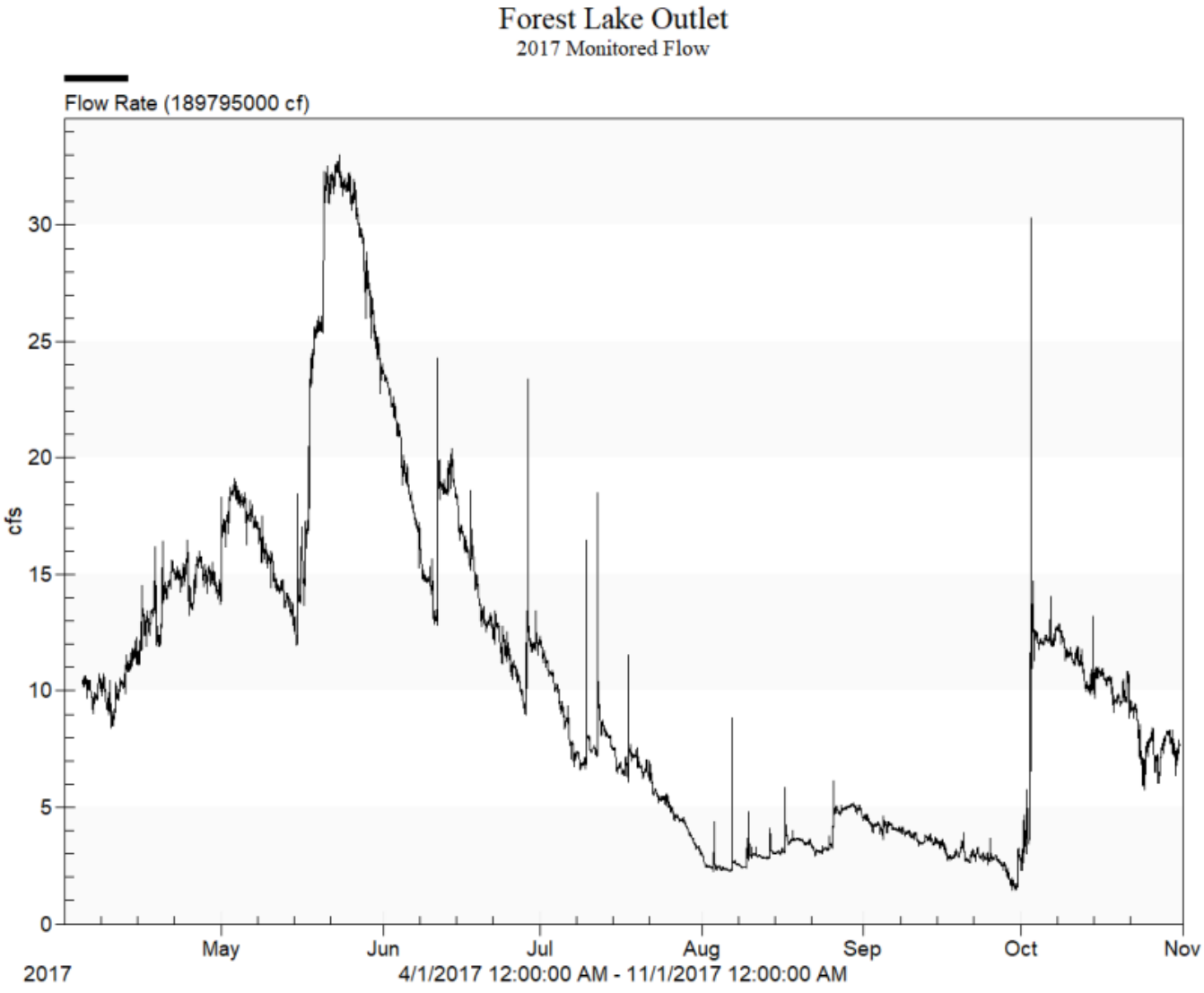


Figure 9. Forest Lake Outlet 2017 Monitored Flow

For the 2017 monitoring season automated storm composite and manual base grab samples, along with *E. coli* samples, were collected at the Forest Lake Outlet site. The chemistry results from all collected samples are listed in Table 10, and field water quality measurements are listed in Table 11. The highest concentrations of TSS, TKN, and TP were 16 mg/L, 1.50 mg/L, and 0.121 mg/L respectively, from a storm composite sample collected on August 26th. None of the sample chemistry results exceeded water quality standards. It should be noted that Zebra Mussels were found on the staff gauge and on rocks in the stream channel in the middle of July.

Table 10. Forest Lake Outlet 2017 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	*E. coli* (mpn/100ml)
Storm Composite	5/17/2017 15:36	5/18/2017 9:15	15	5	0.78	~0.047	<0.020	24.9	<0.03	<0.05	~0.05	
Storm Composite	5/20/2017 16:19	5/22/2017 1:36	6	3	0.72	~0.041	<0.020	25.5	<0.03	<0.05	<0.02	
Storm Composite	8/26/2017 3:59	8/26/2017 23:05	16	13	1.50	0.121	0.074	26.1	<0.03	0.10	<0.02	
Storm Composite	10/2/2017 16:25	10/4/2017 20:59	14	8	0.89	0.079	~0.032	24.7	<0.03	0.08	<0.02	
Base Grab	4/27/2017 10:55	4/27/2017 10:55	5	3	0.70	<0.020	<0.020	27.5	<0.03	<0.05	<0.02	4
Base Grab	5/26/2017 9:50	5/26/2017 9:50	4	~2	0.67	<0.020	<0.020	26.8	<0.03	<0.05	<0.02	56
Base Grab	6/26/2017 13:40	6/26/2017 13:40	~2	~2	0.72	<0.020	<0.020	26.1	<0.03	<0.05	~0.02	61
Base Grab	7/24/2017 12:20	7/24/2017 12:20	3	3	0.70	<0.020	<0.020	29.3	<0.03	<0.05	~0.02	111
Base Grab	8/30/2017 8:52	8/30/2017 8:52	5	4	0.78	<0.020	<0.020	29.4	<0.03	<0.05	<0.02	147
Base Grab	9/27/2017 8:53	9/27/2017 8:53	3	~2	0.73	~0.021	<0.020	29.0	<0.03	<0.05	0.06	55
Base Grab	10/24/2017 15:50	10/24/2017 15:50	4	4	0.76	~0.026	<0.020	28.2	<0.03	0.06	0.08	11

Exceeds Water Quality Standard

Table 11. Forest Lake Outlet 2017 Field Water Quality Measurements

Date/Time	Transparency (cm)	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/27/2017 10:55		10.3	10.35	360	9.0
5/26/2017 9:50		17.5	10.04		
6/26/2017 13:40		21.9	9.75	325	8.9
7/24/2017 12:20	>100	25.7	8.65		
8/30/2017 8:52		21.9	8.19	306	8.6
9/27/2017 8:53		17.5	7.62	332	8.5
10/24/2017 15:50		12.7	9.28	572	8.4

Exceeds Water Quality Standard

Automated storm composite samples and manual base grabs were collected at this site in 2017; in the recent past, in-lake concentrations from samples collected in the West Basin of Forest Lake were used to calculate a total phosphorus load at this site. Total phosphorus loading at the Forest Lake Outlet site for 2017 was estimated at 0.037 lbs/ac or 321 lbs. (Table 1 and Appendix A). Automated storm composite samples should continue to be collected to determine a more accurate loading estimate exported from Forest Lake.

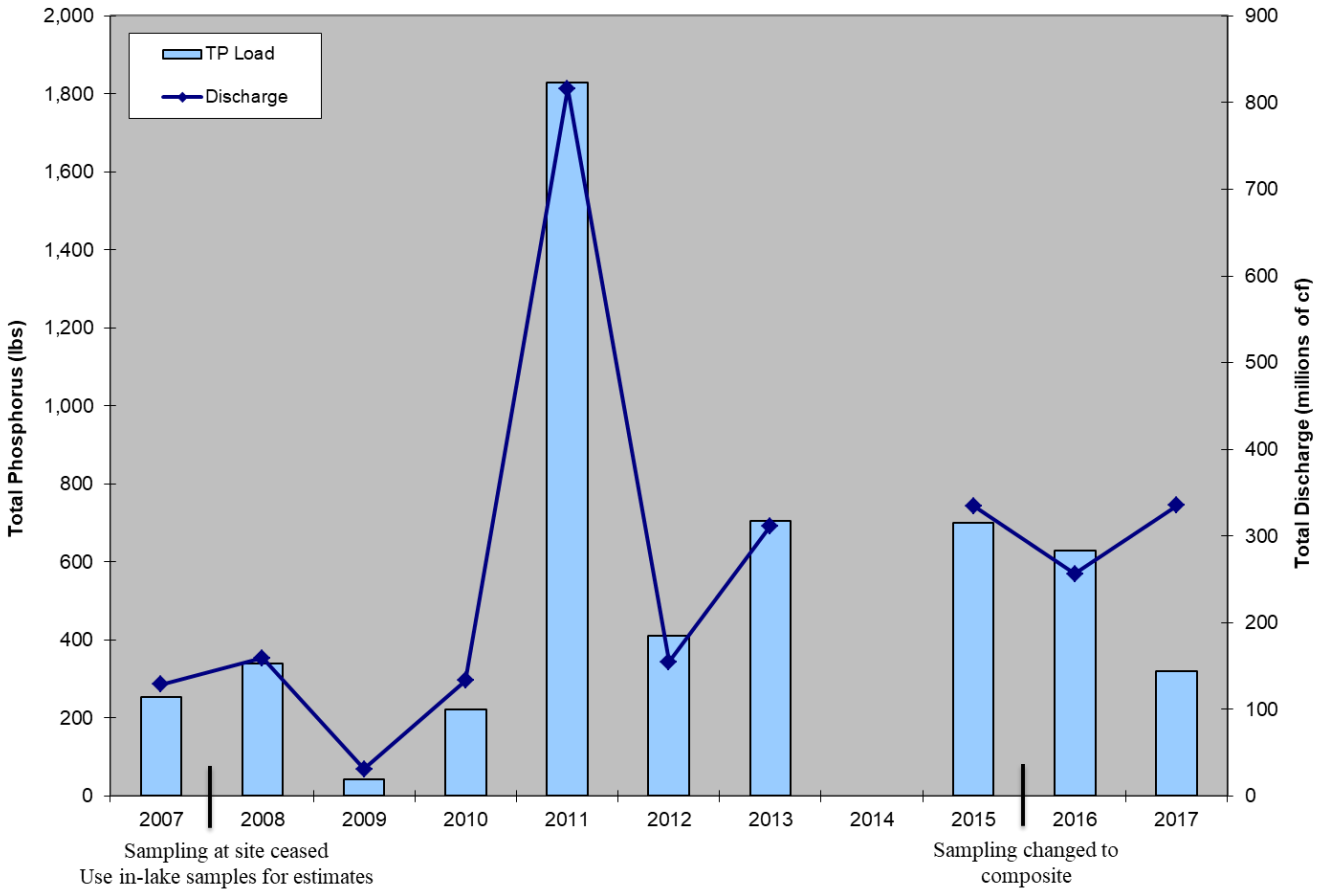


Figure 10. Forest Lake Outlet 10-Year Annual Discharge and Total Phosphorus Load

Flow and water chemistry data have been collected at the Forest Lake Outlet site since 2003. Total estimated annual phosphorus loading and discharge can be found in Figure 10, excluding 2014. The data from 2014 was not complete or reliable due to multiple equipment malfunctions. When comparing year-to-year loading estimates it should be noted that the sampling technique utilized at this site has changed three times. Automated storm composite samples were collected when the site was first monitored. The method switched to manual storm grab samples in 2006, to using in-lake samples in 2008 (no samples collected at the site), and back to automated storm composite samples in 2016. These changes contribute to the reduction in load versus discharge, due to the refinement level of each technique. In 2017, there was a decrease in TP load and an increase in discharge when compared to 2016.

Total phosphorous flow weighted mean concentrations have been calculated (total load divided by total flow) in an effort to normalize phosphorus loads due to changes in flow. It allows for better comparisons to be made between years when a stream has different flow rates or between streams with different flows. Flow weighted mean concentration values can be found in Table 16.

VI. COMFORT LAKE SUBWATERSHED

Comfort Lake Inlet

The station at Comfort Lake Inlet recorded stage and velocity from April 4-October 31, 2017, with the exception of the time period from August 18th-October 3rd due to battery malfunctions and several power failures. Figure 11 shows the discharge for the monitoring season, while the time periods outside of this were estimated using similar flow conditions. Total yearly estimated discharge was 519,810,626 cf or 11,939 acre-ft. Peak discharge of 68.593 cfs occurred on May 23rd and May 24th due to a series of rainfall events over a short period of time, totaling more than two inches.

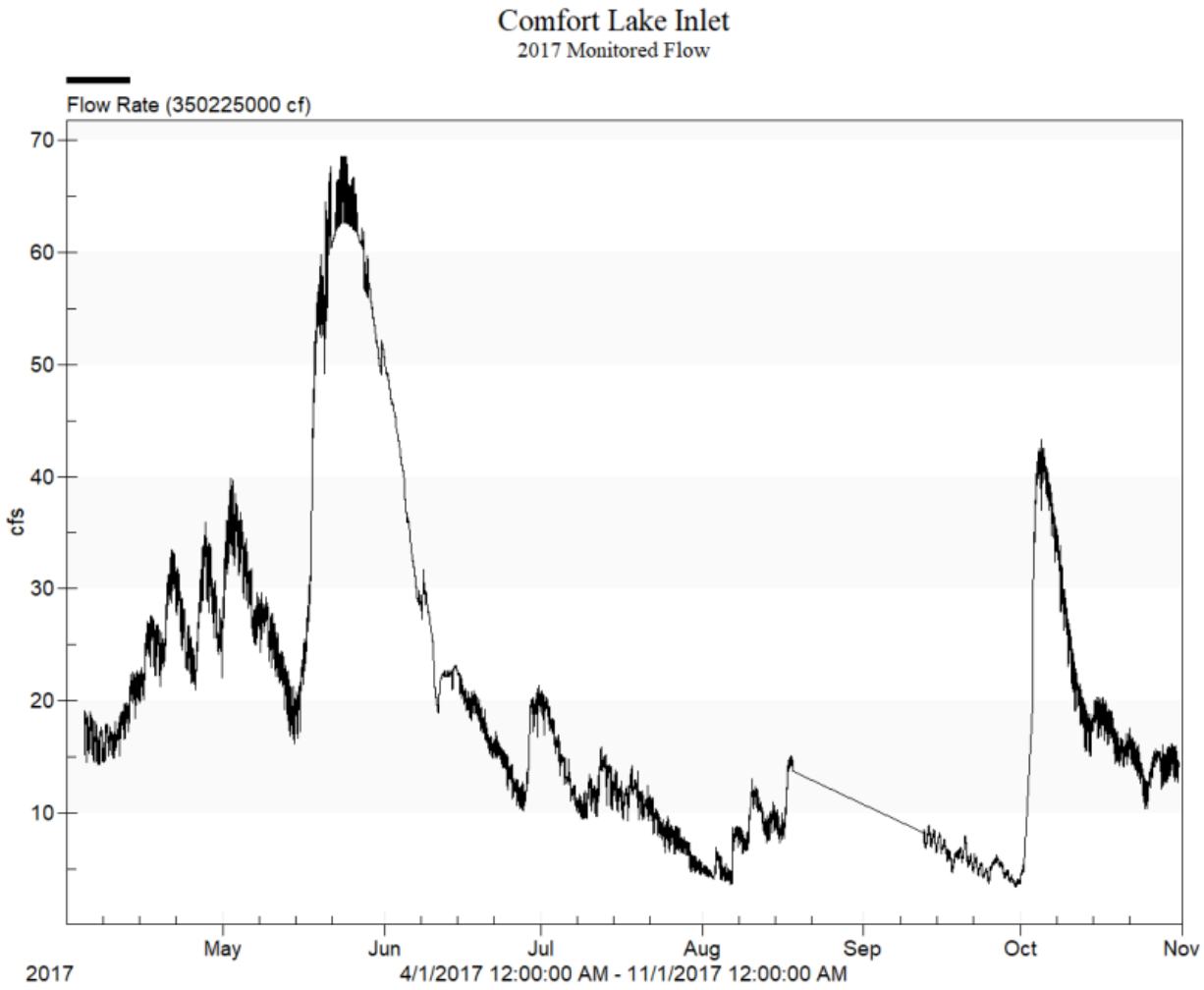


Figure 11. Comfort Lake Inlet 2017 Monitored Flow

Automated storm composite and manual base grab samples, along with *E. coli* samples, were collected at the Comfort Lake Inlet site in 2017. The chemistry results from all collected samples are listed in Table 12, and field water quality measurements are listed in Table 13. The highest TSS concentration of 14 mg/L was from a storm composite sample collected on May 17th-18th and from a base grab collected on May 26th. The highest TKN and TP concentrations of 1.50 mg/L and 0.118 mg/L, respectively, were from the storm composite sample collected on May 17th-18th. None of the sample chemistry results exceeded water quality standards.

Table 12. Comfort Lake Inlet 2017 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	*E. coli* (mpn/100ml)
Storm Composite	5/17/2017 7:57	5/18/2017 17:26	14	7	1.50	0.118	~0.048	51.2	<0.03	0.14	0.06	
Storm Composite	10/3/2017 10:53	10/3/2017 16:55	12	7	0.97	0.070	0.064	36.3	<0.03	0.07	<0.02	
Base Grab	4/27/2017 10:25	4/27/2017 10:25	5	3	1.20	~0.041	<0.020	79.3	<0.03	0.12	~0.03	161
Base Grab	5/26/2017 10:04	5/26/2017 10:04	14	6	1.20	0.057	<0.020	36.0	<0.03	0.05	~0.06	80
Base Grab	6/26/2017 14:15	6/26/2017 14:15	4	3	0.82	~0.029	<0.020	38.9	<0.03	0.18	~0.04	93
Base Grab	7/24/2017 12:02	7/24/2017 12:02	~2	~2	0.78	~0.044	~0.043	54.2	<0.03	0.23	~0.05	49
Base Grab	8/30/2017 9:11	8/30/2017 9:11	4	~2	0.97	~0.029	~0.020	53.4	<0.03	0.15	<0.02	96
Base Grab	9/27/2017 9:30	9/27/2017 9:30	~2	~2	0.90	0.051	~0.021	65.1	<0.03	0.36	0.07	162
Base Grab	10/24/2017 15:21	10/24/2017 15:21	~2	~2	0.95	~0.042	~0.043	47.8	<0.03	0.29	0.14	61

Exceeds Water Quality Standard

Table 13. Comfort Lake Inlet 2017 Field Water Quality Measurements

Date/Time	Transparency (cm)	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/27/2017 10:25		6.8	8.33	599	8.2
5/26/2017 10:04		16.2	4.50		
6/26/2017 14:15		17.8	7.25	412	8.3
7/24/2017 12:02	>100	20.8	5.21		
8/30/2017 9:11		20.0	4.35	442	7.9
9/27/2017 9:30		14.1	4.92	563	8.4
10/24/2017 15:21		8.9	6.98	457	7.5

Exceeds Water Quality Standard

Total phosphorus loading at Comfort Lake Inlet for 2017 was estimated at 0.111 lbs/ac or 1,525 lbs. (Table 1 and Appendix A). Monitoring should continue at this site in an effort to better understand the total phosphorus load entering Comfort Lake.

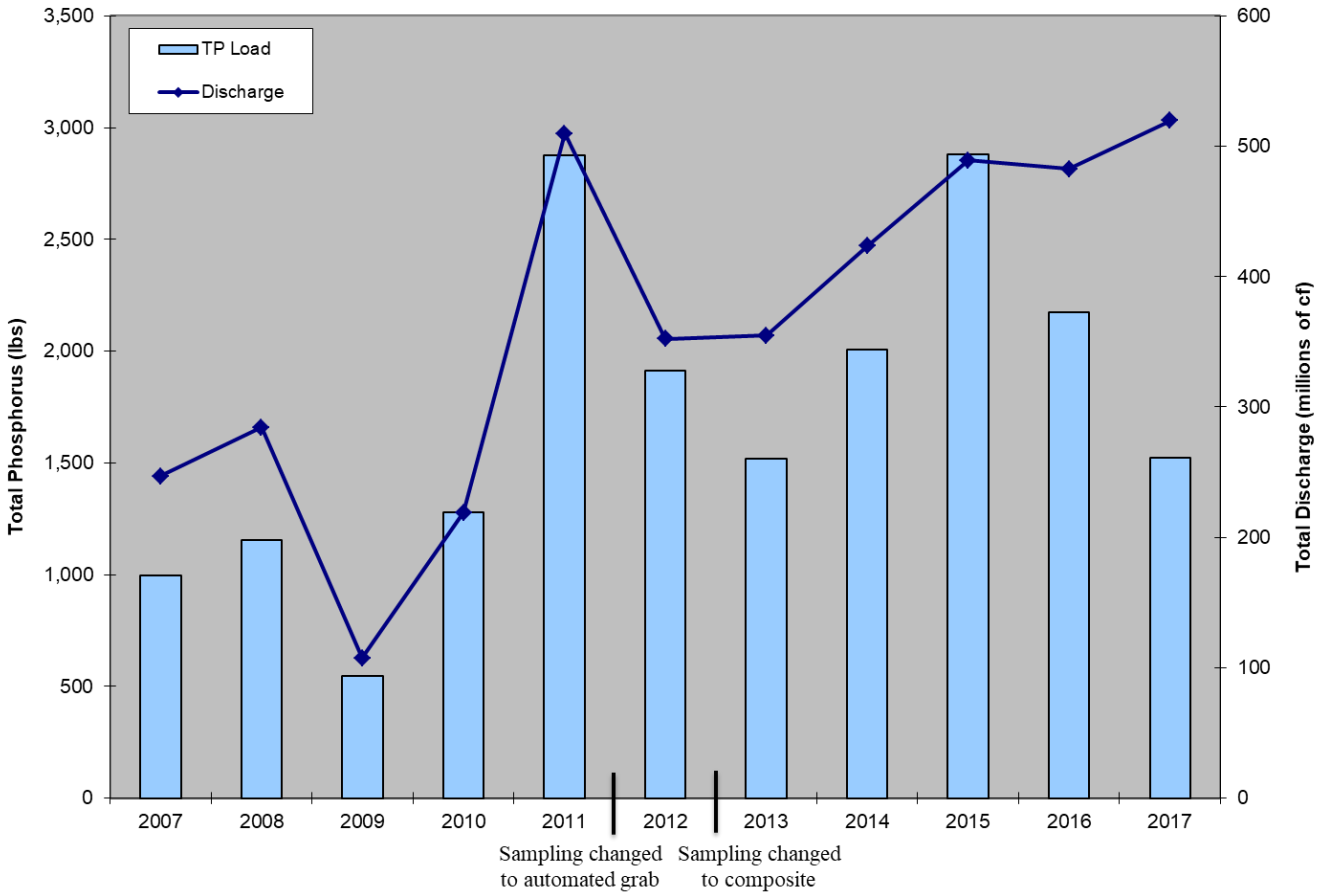


Figure 12. Comfort Lake Inlet 10-Year Annual Discharge and Total Phosphorus Load

Flow and water chemistry data have been collected at the Comfort Lake Inlet site since 2004. Estimated total annual phosphorus export and discharge can be seen in Figure 12. When making year-to-year comparisons of load estimates, it should be noted that the sampling technique changed a number of times. When the site was first monitored, automated storm composite samples were collected. The method switched to manual storm grab samples in 2007, to automated storm grabs in 2012, and back to automated storm composite samples in 2013. Automated composite samples have been collected since 2013. Unlike the other sites with historic information available, there does not seem to be as great of an impact on the overall load estimation when switching between the two sampling methods. One potential cause of this could be that the Shallow Pond wetland complex upstream of the site may be acting as a sink for nutrients, settling them out before they reach this site. In 2017, the TP load decreased and the discharge increased when compared to 2016.

Total phosphorous flow weighted mean concentrations have been calculated (total load divided by total flow) in an effort to normalize phosphorus loads due to changes in flow. It allows for better comparisons to be made between years when a stream has different flow rates or between streams with different flows. Flow weighted mean concentration values can be found in Table 16.

It should be noted that the Comfort Inlet culvert was replaced in early spring of 2011. The previous culvert was a corrugated round pipe that was 8 feet in diameter. The current culvert is a concrete box culvert that measures 7 feet by 7 feet. Discharge numbers for the years prior to 2011 may have been slightly altered due to the condition of the previous culvert. The bottom and sides of the culvert were rusted and deteriorating in areas which could have possibly influenced the area-velocity relationship. Discharge is more accurately measured within this new culvert.

Comfort Lake Outlet

The station at the Comfort Lake Outlet site recorded stage and velocity from April 4-October 31, 2017. Figure 13 shows the discharge for the monitoring season, while the time periods outside of this were estimated using similar flow conditions. Total yearly estimated discharge was 549,144,071 cf and 12,613 acre-ft. Peak discharge was 83.007 cfs on May 25th due to a series of rainfall events over a short period of time, totaling more than two inches.

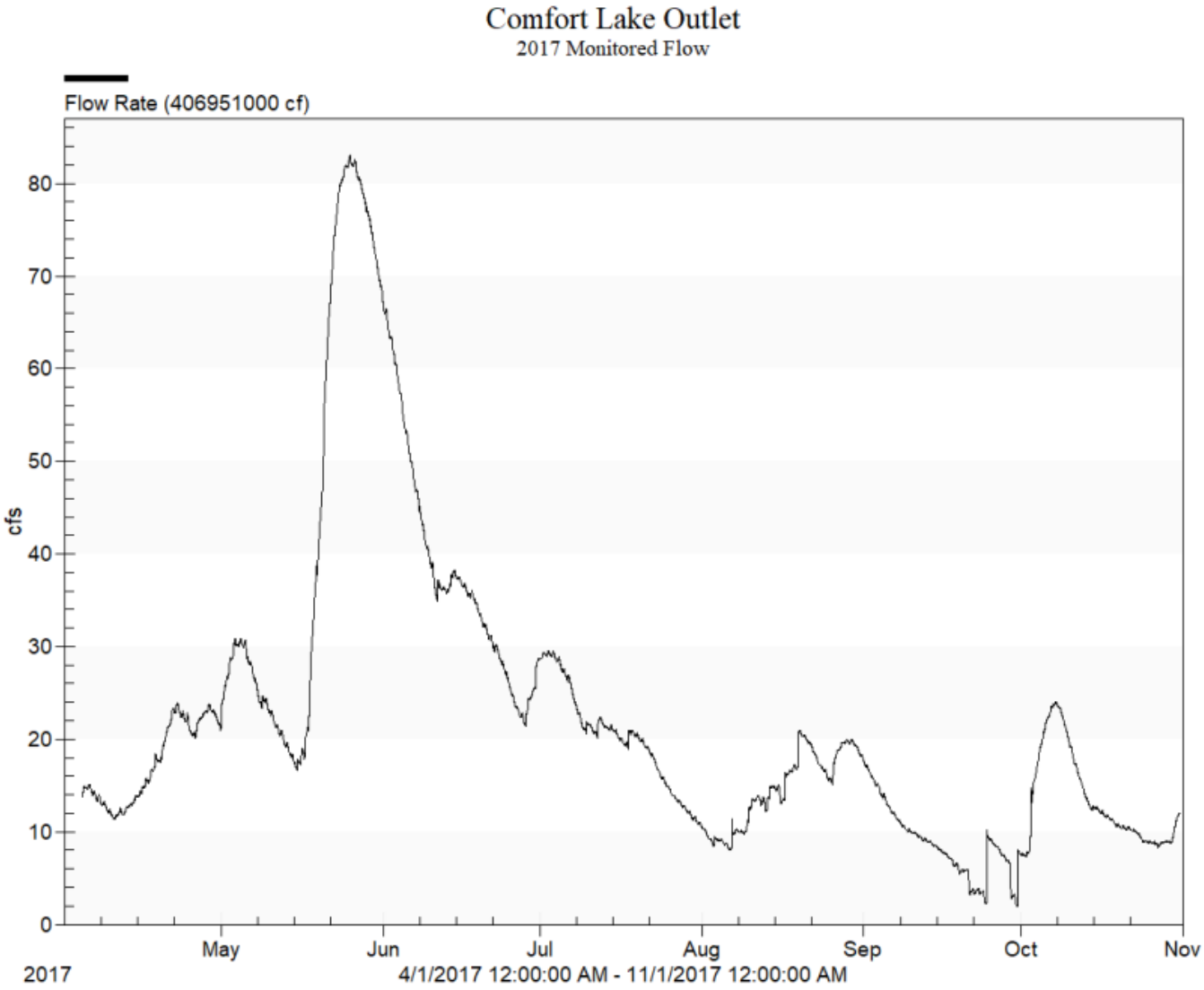


Figure 13. Comfort Lake Outlet 2017 Monitored Flow

2017 is the seventh year since 2006 that samples were collected by the WCD at the Comfort Lake Outlet site. Grab samples were collected by the Army Corps of Engineers in 2008. Automated storm composite and manual base grab samples, along with *E. coli* samples, were collected in 2017. The chemistry results from all collected samples are listed in Table 14, and field water quality measurements are listed in Table 15. The highest TSS concentration of 17 mg/L was collected from a storm composite sample from May 17th-May 19th. The highest TKN and TP concentrations collected were 1.60 mg/L and 0.149 mg/L, respectively, from a storm composite sample collected from October 2nd-October 5th. None of the sample chemistry results exceeded water quality standards.

Table 14. Comfort Lake Outlet 2017 Sample Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved TP (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Ammonia Nitrogen (mg/L)	*E. coli* (mpn/100ml)
Storm Composite	5/17/2017 20:46	5/19/2017 8:13	17	9	0.97	0.051	~0.045	40.0	<0.03	<0.05	<0.02	
Storm Composite	10/2/2017 18:40	10/5/2017 9:25	14	8	1.60	0.149	0.075	28.1	<0.03	0.55	0.10	
Base Grab	4/27/2017 10:00	4/27/2017 10:00	~2	~2	1.00	~0.033	<0.020	44.1	<0.03	0.12	0.09	18
Base Grab	5/26/2017 10:13	5/26/2017 10:13	4	~2	0.88	~0.021	~0.025	35.6	<0.03	<0.05	~0.05	27
Base Grab	6/26/2017 14:00	6/26/2017 14:00	4	3	0.97	~0.020	<0.020	32.2	<0.03	<0.05	~0.04	148
Base Grab	7/24/2017 11:52	7/24/2017 11:52	3	3	0.90	~0.040	<0.020	37.4	<0.03	<0.05	~0.03	28
Base Grab	8/30/2017 9:28	8/30/2017 9:28	3	~2	0.84	<0.020	<0.020	39.0	<0.03	0.12	~0.03	37
Base Grab	9/27/2017 9:45	9/27/2017 9:45	~1	<1	0.75	~0.021	<0.020	40.2	<0.03	<0.05	<0.02	33
Base Grab	10/24/2017 15:03	10/24/2017 15:03	~2	~2	0.95	<0.020	<0.020	39.8	0.03	0.16	0.14	28

Exceeds Water Quality Standard

Table 15. Comfort Lake Outlet 2017 Field Water Quality Measurements

Date/Time	Transparency (cm)	Water Temperature (C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
4/27/2017 10:00		9.1	8.83	483	8.5
5/26/2017 10:13		16.9	9.93		
6/26/2017 14:00		21.2	7.76	400	8.6
7/24/2017 11:52	>100	24.4	6.16		
8/30/2017 9:28		21.9	4.14	419	8.2
9/27/2017 9:45		14.4	4.00	447	8.4
10/24/2017 15:03		11.4	9.59	427	8.2

Exceeds Water Quality Standard

Total phosphorus loading at the Comfort Lake Outlet site and the entire Comfort Lake-Forest Lake Watershed for 2017 was estimated at 0.043 lbs/ac or 1,068 lbs. (Table 1 and Appendix A).

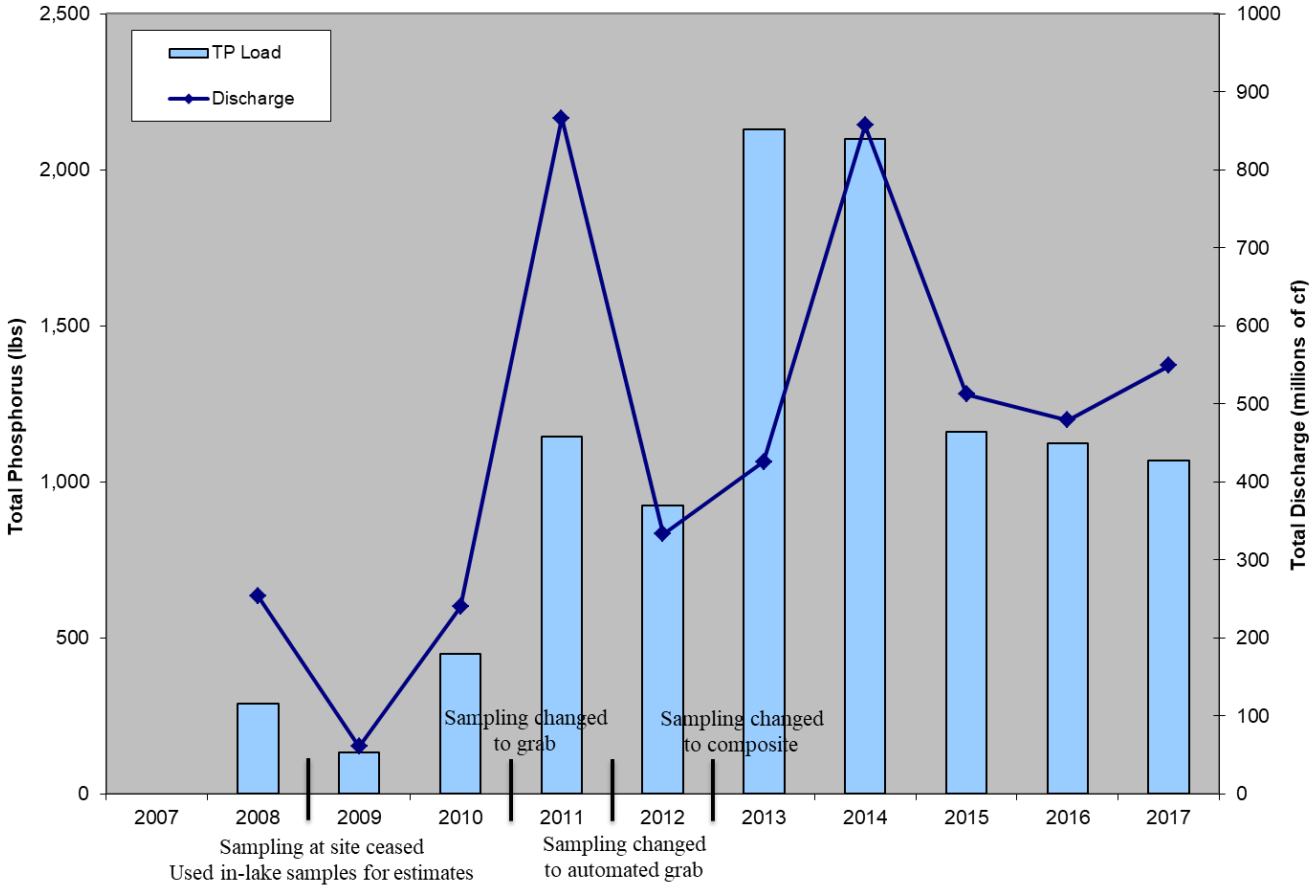


Figure 14. Comfort Lake Outlet 10-Year Annual Discharge and Total Phosphorus Load

Flow and water chemistry data have been collected at the Comfort Lake Outlet site since 2003. The equipment was installed but damaged in 2007, making load and discharge data unreliable from that year. Estimated total annual phosphorus load and discharge can be seen in Figure 14. When making year-to-year load comparisons, it should be noted that three different sampling methods have been employed at this site. Automated storm composite sampling was used in 2004-2005, and manual storm grab sampling occurred in 2006. Grab samples were taken in 2008 by the Army Corps of Engineers, where sampling was on a set schedule and was not event based. In-lake nutrient concentrations were used to develop an estimate of total phosphorus loads in 2009-2010. The sampling methods used in 2008-2010 do not necessarily characterize the full export accurately, as they do not represent the concentrations present during storm flow conditions. In 2011 and 2012, event grab samples were collected at the monitoring site and in 2013 the sampling technique was switched back to composites. Automated storm composite samples have been collected since 2013. The TP load decreased slightly and discharge increased when compared to 2016. It is recommended that event based sampling continue at this site to better understand the load that is exported from the Comfort Lake-Forest Lake Watershed.

Total phosphorous flow weighted mean concentrations have been calculated (total load divided by total flow) in an effort to normalize phosphorus loads due to changes in flow. It allows for better comparisons to be made between years when a stream has different flow rates or between streams with different flows. Flow weighted mean concentration values can be found in Table 16.

VII. WATERSHED PHOSPHORUS FLOW CHART

Figure 15. 2017 Watershed Summer Average Lake Phosphorus Concentrations and Total Phosphorus Load Water Quality Flow Chart

VIII. HISTORICAL STREAM LOADING, DISCHARGE, FLOW WEIGHTED MEAN CONCENTRATION, AND *E. coli* SUMMARY

Table 16. CLFLWD Historical Stream Discharge, Loading, Flow Weighted Mean Concentration, and Rainfall Summary

			Growing Season (June 1-Sept 30) Discharge*		Total Yearly Estimated Discharge		Growing Season (June 1-Sept 30) Load*		Total Yearly Estimated Load		Flow Weighted Mean Concentration	Monitored Rainfall
Site	Year	Monitoring Season	Cubic Feet	Acre Feet	Cubic Feet	Acre Feet	TP (lbs.)	TSS (lbs.)	TP (lbs.)	TSS (lbs.)	TP (ug/L)	Inches
Tributary to Sunrise River at Bone Lake North Inlet	2003	5/27/03-10/30/03	23,012,779	528	NA	NA	654	129,443	NA	NA	NA	12.73
Tributary to Sunrise River at Bone Lake North Inlet	2005	3/29/05-11/1/05	3,370,684	77	14,075,577	323	89	14,745	226	24,817	257	20.73
Tributary to Sunrise River at Bone Lake North Inlet	2006	5/1/06-10/25/06	1,892,891	43	9,625,678	221	74	1,085	315	5,225	524	15.67
Tributary to Sunrise River at Bone Lake North Inlet	2007											
Tributary to Sunrise River at Bone Lake North Inlet	2008											
Tributary to Sunrise River at Bone Lake North Inlet	2009											
Tributary to Sunrise River at Bone Lake North Inlet	2010	4/5/10-11/1/10	1,519,181	35	5,475,569	126	17	742	53	2,588	155	19.33
Tributary to Sunrise River at Bone Lake North Inlet	2011	4/7/11-10/31/11	9,840,224	226	45,744,150	1,051	106	2,048	519	9,390	182	14.87
Tributary to Sunrise River at Bone Lake North Inlet	2012	3/23/12-8/9/12	NA	NA	12,133,284	279	NA	NA	207	17,310	273	19.13
Tributary to Sunrise River at Bone Lake North Inlet	2013	5/13/13-11/4/13	8,995,972	207	16,205,989	372	194	8,096	349	14,512	345	14.96
Tributary to Sunrise River at Bone Lake North Inlet	2014	4/21/14-11/4/2014	14,579,955	335	49,356,921	1,134	283	9,426	917	32,910	298	19.76
Tributary to Sunrise River at Bone Lake North Inlet	2015	4/8/15-10/27/15	31,303,390	719	41,275,374	948	460	13,541	553	16,499	215	26.98
Tributary to Sunrise River at Bone Lake North Inlet	2016	4/4/16-11/1/16	25,611,578	588	47,505,660	1,091	236	6,143	398	10,536	134	No Data Available at Site
Tributary to Sunrise River at Bone Lake North Inlet	2017	4/4/17-10/31/17	5,143,741	118	30,382,691	698	29	606	220	5,399	116	No Data Available at Site
Tributary to Sunrise River at Bone Lake Outlet	2003	5/27/03-10/30/03	45,627,921	1,047	NA	NA	297	66,763	NA	NA	NA	12.35
Tributary to Sunrise River at Bone Lake Outlet	2004	3/24/04-11/2/04	27,081,226	622	66,316,511	1,522	146	14,138	339	35,283	82	18.03
Tributary to Sunrise River at Bone Lake Outlet	2005	3/29/05-11/1/05	7,753,089	178	26,115,815	600	36	30,343	97	38,776	59	18.27
Tributary to Sunrise River at Bone Lake Outlet	2006	5/1/06-10/30/06	6,821,497	157	23,460,532	539	14	1,018	49	3,158	33	14.08
Tributary to Sunrise River at Bone Lake Outlet	2007											
Tributary to Sunrise River at Bone Lake Outlet	2008											
Tributary to Sunrise River at Bone Lake Outlet	2009											
Tributary to Sunrise River at Bone Lake Outlet	2010											
Tributary to Sunrise River at Bone Lake Outlet	2011											
Tributary to Sunrise River at Bone Lake Outlet	2012											
Tributary to Sunrise River at Bone Lake Outlet	2013	4/24/13-11/4/13	37,604,427	864	80,882,661	1,858	90	NA	194	NA	38	No Data Available at Site
Tributary to Sunrise River at Bone Lake Outlet	2014	4/10/14-10/23/14	50,145,600	1,152	108,435,210	2,491	134	NA	271	NA	40	No Data Available at Site
Tributary to Sunrise River at Bone Lake Outlet	2015	4/24/15-10/27/15	82,219,072	1,888	120,324,388	2,764	193	NA	283	NA	38	No Data Available at Site
Tributary to Sunrise River at Bone Lake Outlet	2016	4/4/16-11/1/16	78,147,294	1,795	189,663,763	4,356	271	38,533	652	78,053	55	No Data Available at Site
Tributary to Sunrise River at Bone Lake Outlet	2017	4/4/17-10/31/17	25,122,756	577	75,299,508	1,730	43	8,438	140	46,748	30	No Data Available at Site
Tributary to Sunrise River at Bone Lake South Inlet	2005	4/5/05-11/1/05	4,581,651	105	23,004,776	528	117	34,695	231	41,383	161	No Data Available at Site
Tributary to Sunrise River at Bone Lake South Inlet	2006	5/1/06-10/30/06	2,278,834	52	15,794,923	363	71	4,734	229	14,324	232	No Data Available at Site
Tributary to Sunrise River at Shields Outlet/Forest Inlet	2005	4/20/05-11/1/05	11,446,896	263	27,638,328	634	237	19,188	420	79,186	243	19.63
Tributary to Sunrise River at Shields Outlet/Forest Inlet	2006	5/2/06-10/30/06	4,119,142	95	17,784,049	408	92	3,372	332	8,620	299	13.18
Forest Lake FL44 Subwatershed Drainage	2015	4/30/15-10/27/15	12,617,062	290	17,205,378	395	66	2,039	85	2,545	79	No Data Available at Site
Sunrise River at Forest Lake Outlet	2003	5/29/03-10/11/03	134,712,756	3,093	NA	NA	551	209,614	NA	NA	NA	No Data Available at Site
Sunrise River at Forest Lake Outlet	2004	3/31/04-11/2/04	93,716,849	2,151	233,100,967	5,351	598	107,761	1,235	167,533	85	No Data Available at Site
Sunrise River at Forest Lake Outlet	2005	3/24/05-11/2/05	59,097,451	1,357	187,748,294	4,310	141	27,981	457	83,383	39	No Data Available at Site
Sunrise River at Forest Lake Outlet	2006	5/2/06-10/25/06	21,006,901	482	92,349,949	2,120	41	5,738	173	24,263	30	No Data Available at Site
Sunrise River at Forest Lake Outlet	2007	3/26/07-10/29/07	5,378,189	123	128,950,817	2,960	8	NA	253	NA	31	No Data Available at Site
Sunrise River at Forest Lake Outlet	2008	4/3/08-11/3/08	41,809,187	960	159,233,702	3,656	81	NA	341	NA	34	No Data Available at Site
Sunrise River at Forest Lake Outlet	2009	4/9/09-11/2/09	373,155	9	31,187,212	716	1	NA	43	NA	22	No Data Available at Site
Sunrise River at Forest Lake Outlet	2010	3/30/10-11/2/10	65,644,741	1,507	133,406,543	3,063	117	NA	221	NA	27	No Data Available at Site
Sunrise River at Forest Lake Outlet	2011	4/5/11-10/31/11	106,740,354	2,452	816,052,697	18,744	234	NA	1,828	NA	36	No Data Available at Site
Sunrise River at Forest Lake Outlet	2012	3/23/12-11/5/12	77,082,238	1,770	155,054,646	3,561	204	NA	411	NA	43	No Data Available at Site
Sunrise River at Forest Lake Outlet	2013	4/9/13-11/3/13	77,476,102	1,780	311,584,377	7,157	175	NA	706	NA	36	No Data Available at Site
Sunrise River at Forest Lake Outlet	2014	4/16/14-11/4/14	NA	NA	NA	NA	NA	NA	NA	NA	NA	No Data Available at Site
Sunrise River at Forest Lake Outlet	2015	4/8/15-10/27/15	180,004,323	4,135	334,951,789	7,693	375	NA	701	NA	34	No Data Available at Site
Sunrise River at Forest Lake Outlet	2016	4/14/16-11/1/16	91,139,880	2,093	256,472,342	5,891	277	56,917	630	123,495	39	No Data Available at Site
Sunrise River at Forest Lake Outlet	2017	4/4/17-10/31/17	88,771,159	2,039	335,173,369	7,699	85	21,548	321	82,877	15	No Data Available at Site
Sunrise River at Bixby Park	2009	5/7/09-10/20/09	11,602,336	266	22,103,528	507	103	5,212	179	9,317	130	No Data Available at Site
Sunrise River at Bixby Park	2010	3/30/10-11/1/10	15,997,632	367	21,072,618	484	121	7,639	158	9,737	120	No Data Available at Site
Sunrise River at Bixby Park	2011	4/13/11-10/31/11	15,314,122	352	30,679,839	705	148	11,821	285	22,316	149	No Data Available at Site
Sunrise River at Bixby Park	2012	3/30/12-11/5/12	23,932,555	550	50,118,632	1,151	293	123,763	973	1,152,008	311	No Data Available at Site
Sunrise River at County Line Ditch	2007	3/27/07-10/29/07	13,265,950	305	168,125,270	3,860	420	35,317	1,212	109,981	115	20.65
Sunrise River at County Line Ditch	2008	4/3/08-11/4/08	46,128,347	1,059	167,318,507	3,841	216	67,304	650	144,481	62	16.85
Sunrise River at County Line Ditch	2009	4/3/09-11/3/09	15,225,062	350	71,188,173	1,634	45	2,364	85	5,403	19	17.52
Sunrise River at County Line Ditch	2010	3/31/10-11/1/10	104,422,088	2,397	182,196,709	4,183	524	41,009	811	69,760	71	23.86
Sunrise River at County Line Ditch	2011	5/16/11-10/31/11	174,130,314	4,000	376,243,391	8,642	858	90,682	1,792	193,402	76	12.28
Sunrise River at County Line Ditch	2012	3/30/12-11/5/12	72,141,600	1,657	158,144,746	3,632	344	163,389	930	609,889	94	22.07
Tributary to Sunrise River at Heims Lake Drainage/Hwy 61	2012	4/2/12-11/5/12	1,309,476	30	5,667,458	130	40	2,172	330	51,715	933	No Data Available at Site
Tributary to Sunrise River at Heims Lake Drainage/Hwy 61	2013	4/9/13-11/4/13	2,814,191	65	9,605,584	221	150	9,577	495	24,224	825	No Data Available at Site
Tributary to Sunrise River at Heims Lake Drainage/Hwy 61	2014	4/29/14-11/4/14	15,297,621	351	32,336,273	743	255	96,276	374	106,692	185	No Data Available at Site
Sunrise River at Greenway Avenue	2008	4/14/08-11/4/08	64,476,470	1,480	231,516,014	5,315	499	233,541	1,505	696,004	104	No Data Available at Site
Sunrise River at Greenway Avenue	2009											
Sunrise River at Greenway Avenue	2010											
Sunrise River at Greenway Avenue	2011	5/26/11-10/31/11	155,958,904	3,582	442,205,000	10,157	1,358	76,702	3,722	218,922	135	No Data Available at Site
Sunrise River at Greenway Avenue	2012	4/2/12-11/5/12	87,412,116	2,008	262,400,771	6,027	888	750,188	6,370	7,183,660	389	No Data Available at Site
Sunrise River at Greenway Avenue	2013	5/15/13-11/4/13	121,486,726	2,790	326,439,257	7,498	778	54,590	2,071	129,646	102	No Data Available at Site
Tributary to Sunrise River at Manning Trail	2008	4/21/08-11/3/08	7,613,182	175	63,196,487	1,451	41	1,232	508	7,421	129	No Data Available at Site
Tributary to Sunrise River at Manning Trail	2009	4/2/09-11/2/09	759,696	17	11,231,268	258	7	265	104	3,718	148	No Data Available at Site
Tributary to Sunrise River at July Avenue	2008	4/17/08-11/3/08	22,886,998	525	80,937,662	1,858	146	5,316	431	14,137	85	17.25
Tributary to Sunrise River at July Avenue	2009	4/2/09-11/2/09	3,759,027	86	27,127,126	623	23	1,295	151	9,112	89	17.92
Tributary to Sunrise River at Little Comfort Lake Inlet	2004	5/4/04-11/2/04	79,549,516	1,826	172,272,256	3,955	584	474,947	1,283	1,220,397	119	19.59
Tributary to Sunrise River at Little Comfort Lake Inlet	2005	3/29/05-11/2/05	56,782,372	1,304	149,011,733	3,421	461	211,373	1,023	697,890	110	21.99
Tributary to Sunrise River at Little Comfort Lake Inlet	2006	5/4/06-10/30/06	42,677,774	980	131,946,491	3,029	834	411,398	1,551	643,540	188	16.89
Tributary to Sunrise River at Little Comfort Lake Inlet	2007	4/26/07-10/30/07	54,709,030	1,256	173,218,653	3,977	202	13,620	676	43,113	63	23.65
Tributary to Sunrise River at Little Comfort Lake Inlet	2008	4/22/08-11/3/08	93,791,250	2,153	360,171,837	8,268	256	23,369	1,127	94,344	50	16.35
Tributary to Sunrise River at Little Comfort Lake Inlet	2009	4/9/09-11/2/09	26,119,773	600	101,219,564	2,324	119	12,439	418	34,444	66	17.34
Tributary to Sunrise River at Little Comfort Lake Inlet	2010	3/30/10-10/15/10	56,666,594	1,301	103,234,147	2,370	188	9,260	331	18,146	51	23.58
Tributary to Sunrise River at Little Comfort Lake Inlet	2011	4/21/11-10/31/11	65,595,117	1,507	148,136,193	3,403	223	12,635	481	29,758	52	19.14
Tributary to Sunrise River at Little Comfort Lake Inlet	2012	3/30/12-10/30/12	20,666,292	475	51,169,672	1,175	78	5,065	230	37,392	72	23.20
Tributary to Sunrise River at Little Comfort Lake Inlet	2013	5/13/13-11/4/13	39,736,345	913	60,039,577	1,379	225	43,960	330	50,187	88	13.89
Tributary to Sunrise River at Little Comfort Lake Inlet	2014	6/10/14-11/4/14	59,904,865	1,376	132,674,265	3,047	169	25,311	354	42,545	43	15.19
Tributary to Sunrise River at Little Comfort Lake Inlet	2015	4/8/15-10/27/15	63,261,310	1,453	115,884,615	2,662	312	65,641	543	120,755	75	25.89
Tributary to Sunrise River at Little Comfort Lake Inlet	2016	4/14/16-11/1/16	58,388,747	1,341	131,549,232	3,022	222	32,209	430	50,151	52	No Data Available at Site
Tributary to Sunrise River at Little Comfort Lake Inlet	2017	4/18/17-9/2/17	40,445,170	929	139,982,281	3,215	139	16,679	504	75,358	58	No Data Available at Site
Sunrise River at Comfort Lake Inlet	2004	4/5/04-11/2/04	147,834,005	3,394	422,272,825	9,694	899	255,626	1,963	403,759	74	20.97
Sunrise River at Comfort Lake Inlet	2005	3/29/05-11/2/05	93,498,873	2,146	284,332,944	6,527	392	33,117	1,119	125,039	63	22.48
Sunrise River at Comfort Lake Inlet	2006	5/2/06-10/30/06	40,363,884	927	163,858,477	3,762	913	52,781	1,887	175,089	184	18.27
Sunrise River at Comfort Lake Inlet	2007	3/26/07-10/30/07	39,591,680	909	247,038,494	5,671	242	15,064	997	63,755	65	22.42
Sunrise River at Comfort Lake Inlet	2008	4/3/08-9/24/08	109,097,724	2,505	284,321,095	6,527	482	85,171	1,153	196,267	65	18.24
Sunrise River at Comfort Lake Inlet	2009	4/3/09-11/2/09	33,167,079	761	107,548,295	2,469	155	7,325	547	21,691	81	17.80
Sunrise River at Comfort Lake Inlet	2010	3/30/10-10/30/10	113,660,642	2,609	218,947,013	5,026	874	39,921	1,278	60,721	94	22.68
Sunrise River at Comfort Lake Inlet	2011	5/4/11-11/2/11	245,003,912	5,628	509,788,473	11,709	1,506	111,184	2,876	215,478	90	13.93
Sunrise River at Comfort Lake Inlet	2012	4/5/12-11/7/12	126,038,503	2,895	352,448,988	8,095	717	46,916	1,914	150,817	87	21.14
Sunrise River at Comfort Lake Inlet	2013	5/13/13-11/4/13	126,233,743	2,899	355,022,452	8,154	545	36,696	1,519	99,754	69	15.68
Sunrise River at Comfort Lake Inlet	2014	4/16/14-10/23/14	149,568,395	3,435	423,401,380	9,725	790	97,284	2,006	253,252	76	26.60
Sunrise River at Comfort Lake Inlet	2015	4/30/15-10/27/15	302,764,431	6,954	489,382,541	11,241	1,623	107,909	2,880	145,235	94	23.36
Sunrise River at Comfort Lake Inlet	2016	5/9/16-11/1/16	171,016,963	3,928	482,492,133	11,082	1,042	205,675	2,176	305,188	72	No Data Available at Site
Sunrise River at Comfort Lake Inlet	2017	4/4/17-10/31/17	150,777,654	3,463	519,810,626	11,939	405	52,085	1,525	202,161	47	No Data Available at Site
Sunrise River at Comfort Lake Outlet	2003	5/29/03-11/3/03	361,495,072	8,299	NA	NA	1,308	285,063	NA	NA	NA	13.09
Sunrise River at Comfort Lake Outlet	2004	3/22/04-11/2/04	249,741,973	5,733	673,985,011	15,473	1,076	401,584	2,065	566,195	49	21.68
Sunrise River at Comfort Lake Outlet	2005	3/24/05-11/2/05	85,981,864	1,974	201,840,954	4,634	326	153,936	670	251,622	53	22.32
Sunrise River at Comfort Lake Outlet	2006	5/2/06-10/30/06	51,812,383	1,189	183,293,248	4,208	122	16,097	563	60,519	49	18.32
Sunrise River at Comfort Lake Outlet	2007	3/26/07-7/12/07	NA	NA	NA	NA	NA	NA	NA	NA	NA	21.42
Sunrise River at Comfort Lake Outlet	2008	5/1/08-11/3/08	73,273,609	1,682	254,442,469	5,841	99	21,762	291	62,469	18	16.53
Sunrise River at Comfort Lake Outlet	2009	4/22/09-11/2/09	17,619,711	404	61,039,355	1,401	34	NA	134	NA	35	No Data Available at Site
Sunrise River at Comfort Lake Outlet	2010	4/5/10-11/2/10	144,901,319	3,326	240,198,442	5,514	273	NA	450	NA	30	22.97
Sunrise River at Comfort Lake Outlet	2011	4/18/11-10/31/11	433,531,324	9,958	866,127,458	19,894	566	136,863	1,146	267,379	21	18.57
Sunrise River at Comfort Lake Outlet	2012	3/30/12-11/5/12	181,016,017	4,158	333,317,104	7,656	487	74,168	924	175,609	44	22.91
Sunrise River at Comfort Lake Outlet	2013	4/9/13-11/4/13	213,603,980	4,906	425,748,209	9,779	1,072	69,944	2,129	147,718	80	16.87
Sunrise River at Comfort Lake Outlet	2014	4/10/14-11/4/14	398,974,765	9,164	856,945,895	19,683	985	130,810	2,099	468,449	39	27.23
Sunrise River at Comfort Lake Outlet	2015	4/24/15-10/27/15	358,367,616	8,231	512,219,711	11,765	810	58,646	1,160	81,704	36	23.33
Sunrise River at Comfort Lake Outlet	2016	4/14/16-11/1/16	219,010,557	5,030	479,203,290	11,007	533	71,681	1,124	156,594	38	No Data Available at Site
Sunrise River at Comfort Lake Outlet	2017	4/4/17-10/31/17	244,577,121	5,618	549,144,071	12,613	369	47,015	1,068	145,543	31	No Data Available at Site

*Growing season discharge and loads include quantities estimated from just previous to and including June 1, and just post and including September 30.

E. coli

The Minnesota Pollution Control Agency (MPCA) has set water quality standards for Class 2 Waters of the State for aquatic life and recreation (https://www.revisor.mn.gov/rules/?id=7050.0222). The following is the description for the *Escherichia (E.) coli* standard:

> "Not to exceed 126 organisms per 100 milliliters as a geometric mean of not less than five samples representative of conditions within any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 1,260 organisms per 100 milliliters. The standard applies only between April 1 and October 31."

The MPCA guidance manual also states that this standard only applies to the most recent 10 years of collected data from the time of impairment determination.

Monthly Geometric Means for *E. coli* (#/100 mL)

Site	April	May	June	July	August	September	October
Bone Lake North Inlet	Insufficient Data	38	131	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Bone Lake South Inlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Bone Lake Outlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Shields Outlet/Forest Inlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
FL44 Outlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Forest Lake Outlet	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Bixby Park	Insufficient Data	Insufficient Data	Insufficient Data	815	Insufficient Data	Insufficient Data	Insufficient Data
County Line Ditch	Insufficient Data	Insufficient Data	88	161	187	Insufficient Data	Insufficient Data
Heims Lake	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Greenway Avenue	Insufficient Data	Insufficient Data	121	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Manning Trail	Insufficient Data	Insufficient Data	99	152	415	Insufficient Data	Insufficient Data
July Avenue	Insufficient Data	Insufficient Data	21	56	208	Insufficient Data	Insufficient Data
Little Comfort Inlet	Insufficient Data	65	76	132	158	223	111
Comfort Lake Inlet	Insufficient Data	71	186	131	197	180	158
Comfort Lake Outlet	Insufficient Data	25	53	19	25	41	28

Exceeds geometric mean of 126 #/100mL from not less than 5 samples in a calendar month

10% of samples taken in the last 10 years exceed 1,260 #/100mL (Doesn't necessarily exceed geometric mean standard)

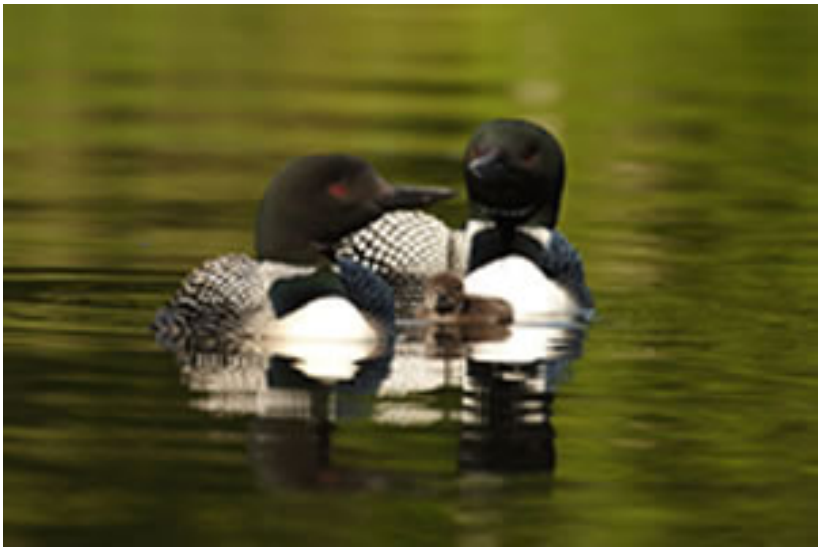
2017 LAKE MONITORING SUMMARY

I. EXECUTIVE SUMMARY

Monitoring of resources within the Comfort Lake-Forest Lake Watershed District has been a priority since the District was formed in 1999. However, some level of water quality monitoring has been conducted in the District going back to the late 1970s. Starting in the 1990s a more comprehensive approach to the monitoring of its lakes was adopted. In 2017 a total of eleven lakes (Birch, Bone, Comfort, Forest (3 basins), Keewahtin (formerly Sylvan/Halfbreed), Little Comfort, Moody, Nielsen, School, Sea, Shields) were monitored by the Washington Conservation District and citizen volunteers. These data are being used to monitor long-term water quality trends, calibrate water quality models, prioritize management actions, and assess past improvement projects.

The data tell different stories on each lake. Lake Keewahtin continues to earn top marks with its very low phosphorus and chlorophyll concentrations and excellent water clarity and in 2017 even showed a statistically significant ($p<0.05$) improving trend for both Secchi disk transparency and total phosphorus concentrations. Other lakes like Birch Lake, Bone Lake, Forest Lake, Little Comfort Lake, School Lake, and Sea Lake can be described as having average water quality but during the months of June, July, and August can exhibit algae blooms and reduced water clarity that exceed state water quality standards for phosphorus and clarity. Some lakes like Moody Lake, Nielsen Lake, and Shields Lake have very poor water quality and greatly exceed state water quality standards. The data for several lakes indicate a neutral trend, neither improving nor declining over the period of time that monitoring has been conducted. Bone Lake showed a statistically significant ($p<0.05$) improving trend for TP and for chlorophyll-a. Comfort Lake and Moody Lake showed a statistically significant ($p<0.05$) improving trend for TP. Comfort Lake and Shields Lake showed a statistically significant ($p<0.05$) declining trend for Secchi disk transparency. Little Comfort Lake had a significant declining trend for both Secchi disk transparency and for chlorophyll-a corrected for pheophytin. Lake grades and trends can be found in Figure 18 and Table 18.

The purpose of this document is to summarize water quality trends and current conditions in the Districts' main recreational lakes. The information provided here is used regularly by the Comfort Lake-Forest Lake Watershed District to guide water resource management decisions. This information is also intended be useful to the Districts' member cities and citizens alike.



II. INTRODUCTION AND METHODS

There are 19 named lakes in the Comfort Lake Forest-Lake Watershed. These lakes have significant aesthetic and recreational value. They also serve as a home to a wide variety of plants, fish, mammals, reptiles, and migratory waterfowl. The quality of water in these lakes is a key variable in how the lake is used, both by humans and animals. Poor water quality can result in decreased opportunities for recreation and loss of habitat for plants and animals. More specifically, poor water quality can lead to nuisance algae blooms, odor problems, fish kills, and shifts in fish populations toward less desirable species such as carp and bullhead. Improving and protecting lake water quality is a high priority for the Comfort Lake-Forest Lake Watershed District.

The culprit of poor water quality is often high nutrient levels, specifically phosphorus. Phosphorus is a nutrient that is required by algae to grow. In Minnesota lakes, phosphorus is often the "limiting" nutrient, meaning that the main factor limiting algae growth would be the amount of phosphorus. Therefore, the addition of phosphorus translates directly into more algae. Although phosphorus is found naturally in all lakes, the addition of phosphorus through human activities is common in urban and agricultural areas. Among other sources, phosphorus is added to lakes by urban stormwater, agricultural runoff, lakeshore erosion, and non-native plants and fish.

Regularly assessing water quality allows resource managers to compare lakes to one another, measure change over time, and prioritize management actions. Monitoring of lake water quality has been conducted in the Comfort Lake-Forest Lake Watershed District as far back as the 1970's. Water quality data over the years has been collected by a number of organizations including the Comfort Lake Forest-Lake Watershed District, the Washington Conservation District, Metropolitan Council, the MN Department of Natural Resources, the MN Pollution Control Agency, and citizen volunteers.

LAKE CLASSIFICATION AND GOALS

The Comfort Lake-Forest Lake Watershed District's *Watershed Management Plan* (2011) assigns numerical water quality goals for in lake phosphorus for each of its ten major recreational lakes; Birch, Bone, Comfort, Forest, Heims, Keewahtin, Little Comfort, Moody, School, and Shields. These standards correspond to current state water quality standards adopted in Minnesota by the MN Pollution Control Agency (MPCA). The numeric goals for phosphorus are listed in Table 17.

Table 17. In-lake Water Quality Goals for Summer Average Total Phosphorus Concentrations

Lake	2021-year In-Lake Total Phosphorus Goal (μg/L)	2031-year In-Lake Total Phosphorus Goal (μg/L)	Long Term In-Lake Total Phosphorus Goal (μg/L)
Bone	40	40	30
Birch	60	60	60
Comfort	40	40	30
Forest	<40	<40	30
Heims	40	40	40
Little Comfort	40	40	30
Moody	60	40	40
School	50	40	40
Shields	100	60	60
Keewahtin	20	20	20

WATER QUALITY PARAMETERS

This report presents data for three key water quality parameters: phosphorus (measured as total phosphorus, TP), Chlorophyll-*a* (Chl-*a*), and Secchi depth. Phosphorus is a plant nutrient that is the primary driver for algal growth. Chlorophyll-*a* is found in all photosynthesizing plant cells, including algae. By measuring the amount of chlorophyll-*a* in a lake, you are measuring the amount of algae. Secchi depth is a measure of water clarity and is measured by lowering a Secchi disk over the side of a boat. The deepest depth at which the Secchi disk is visible is the Secchi depth. Since phosphorus drives algae growth, and algae affects water clarity, these parameters are often coupled – i.e. more phosphorus = more algae (chl-*a*) = reduced water clarity. This relationship is illustrated in Figure 16. Secchi depth data is not always available for all lakes. In very shallow lakes, or in lakes with dense plant growth, a Secchi disk is not a practical tool for evaluating water clarity but at this time is the best tool available.

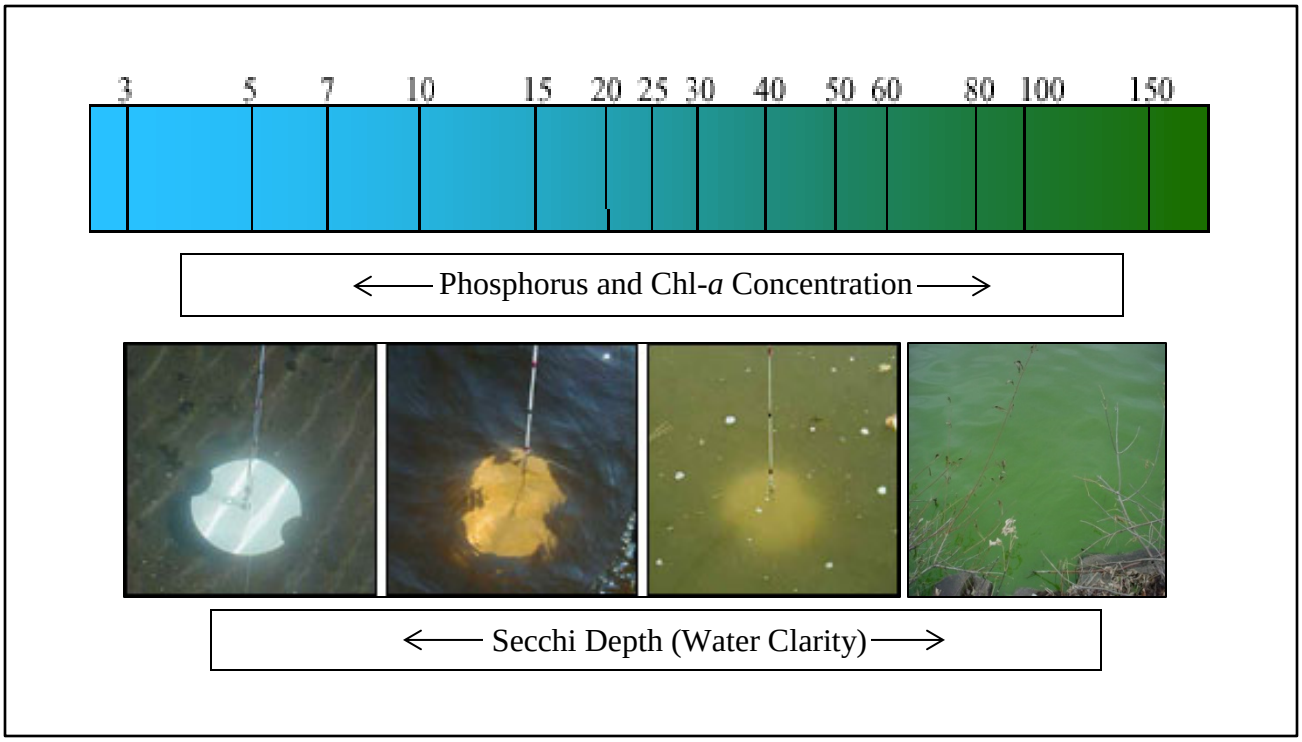


Figure 16. Relationship Between Phosphorus, Chlorophyll-*a*, and Secchi Depth

Although these parameters are usually coupled, complex biological processes can lead to a decoupling of phosphorus, chlorophyll-*a*, and clarity. When this occurs more detailed analysis is often needed to understand why the relationship has broken down. To assess these parameters a lake grading system is used, as well as a comparison to MPCA's impairment standards.

The lake water quality grading system was developed following the 1989 sampling season by Metropolitan Council. The grading curve represents percentile ranges for the May through September averages of total phosphorus concentration, uncorrected trichromatic chlorophyll-*a* concentration, and Secchi disk transparency for 119 lakes sampled from 1980 to 1988, and the ranges were re-confirmed in 2000 using more recent data. A benefit of the lake grade system is that it was developed specifically for lakes in the metro area, and serves as a convenient way to compare water quality between lakes. Current grades for each lake can be found in Table 18. In addition, comparison of June through September water quality averages (total phosphorus concentration, pheophytin-corrected chlorophyll-*a* concentration, and Secchi disk transparency) will be made to state eutrophication standards for each lake as the MPCA uses this timeframe to assess impairment status.

Water quality presented in this report is compiled from several sources, including CLFLWD databases, the state water quality database 'EQuIS', Washington Conservation District, DNR's Lake Finder, and the Metropolitan Council's lake database.

INTERPRETING WATER QUALITY GRAPHS – EXAMPLES

The example set of graphs can be used as a guide for interpreting the water quality graphs presented in this report (Figure 17).

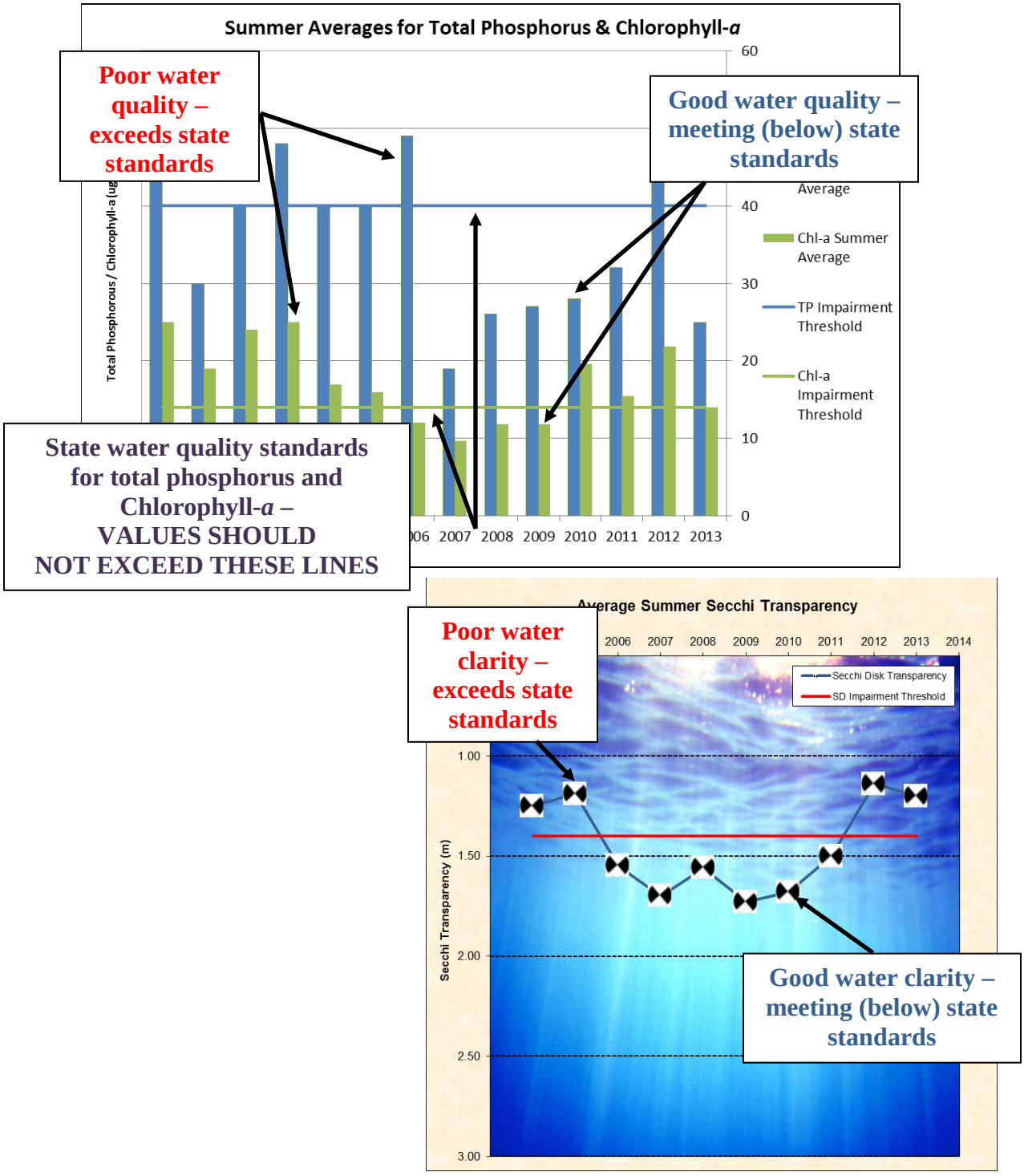


Figure 17. Example Water Quality Graphs

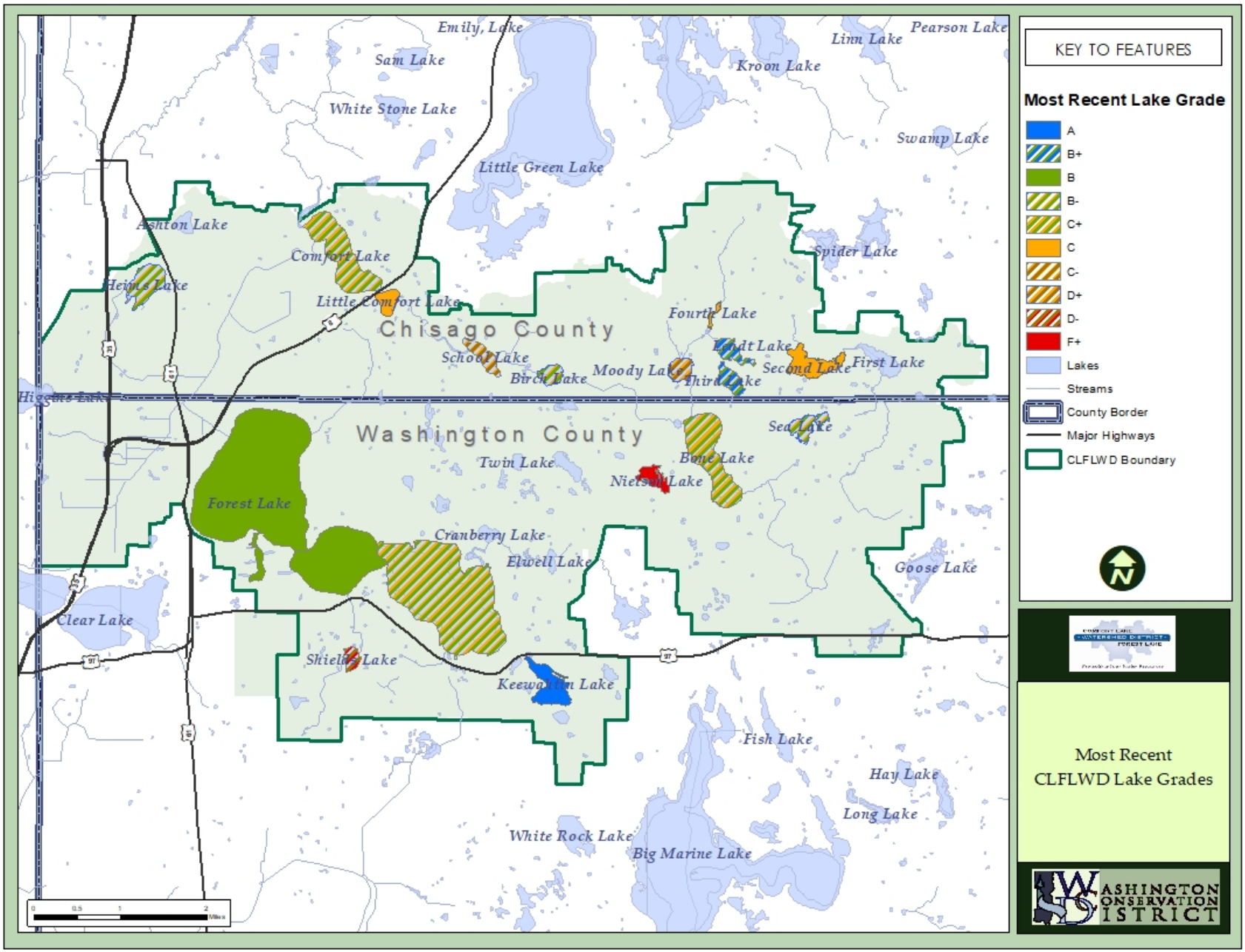


Figure 18. Lake Water Quality Grades

Table 18. Comfort Lake-Forest Lake Watershed District Lake Water Quality Summary

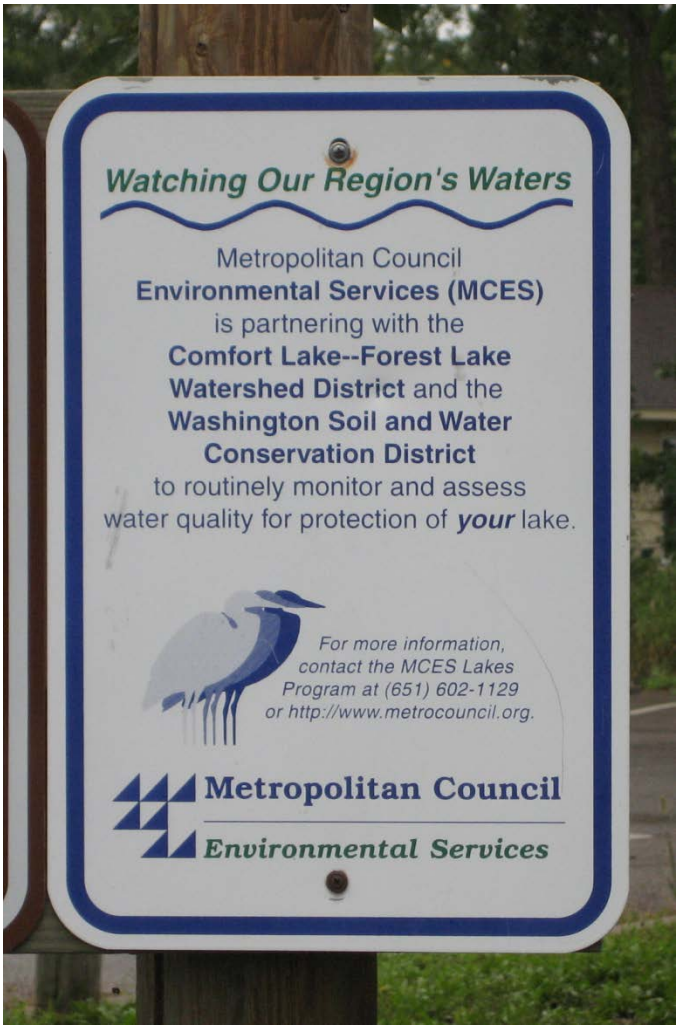
Lake	Acres	DNR ID	Most Recent Phosphorous Average (µg/L)	Most Recent Year of Data	Most Recent Grade	Listed by MPCA as Impaired for Phosphorous	Secchi Disk Water Quality Trend	Total Phosphorus Water Quality Trend	Chlorophyll-a Corrected for Pheophytin Water Quality Trend
Birch	33	13004200	72	2017	B-		NA	NA	NA
Bone	221	82005400	30	2017	C+	X	No Trend	Improving	Improving
Comfort	218	13005300	31	2017	C+	X	Declining	Improving	No Trend
Forest (West)	1,086	82015600	25	2017	B		No Trend	No Trend	No Trend
Forest (Middle)	364	82015600	34	2017	B		No Trend	No Trend	No Trend
Forest (East)	790	82015600	46	2017	C+		No Trend	No Trend	No Trend
Fourth Lake	8	13002200	63	2015	C		NA	NA	NA
Heims	90	13005600	33	2015	B-		NA	NA	NA
Keewahtin	75	82008000	14	2017	A		Improving	Improving	No Trend
Lendt Lake	42	13010300	11	2015	B+		NA	NA	NA
Little Comfort	36	13005400	43	2017	C	X	Declining	No Trend	Declining
Moody	45	13002300	104	2017	D+	X	No Trend	Improving	No Trend
Nielsen	37	82005500	102	2017	F+		NA	NA	NA
Second	75	13002500	54	2008	C	X	NA	NA	NA
School	47	13005700	51	2017	C-	X	NA	NA	NA
Sea	50	82005300	45	2017	B-		NA	NA	NA
Shields	30	82016200	191	2017	D-	X	Declining	No Trend	No Trend
Third Lake	42	13002400	17	2015	B+		NA	NA	NA

Grade
Grade is determined by averaging the three most recent individual grades for total phosphorus, chlorophyll-*a*, and Secchi depth (May-September). The scale used to assign grades is the same used by Metropolitan Council.

Impaired for Phosphorus
X'ed lakes are listed as impaired by the State of Minnesota for exceeding phosphorous standards. TMDL studies are required on these lakes (June-September).

Water Quality Trend
Trend was assigned by reviewing total phosphorus, chlorophyll-a corrected for pheophytin and Secchi depth averages where a 10 year record of monitoring exists (June-September).

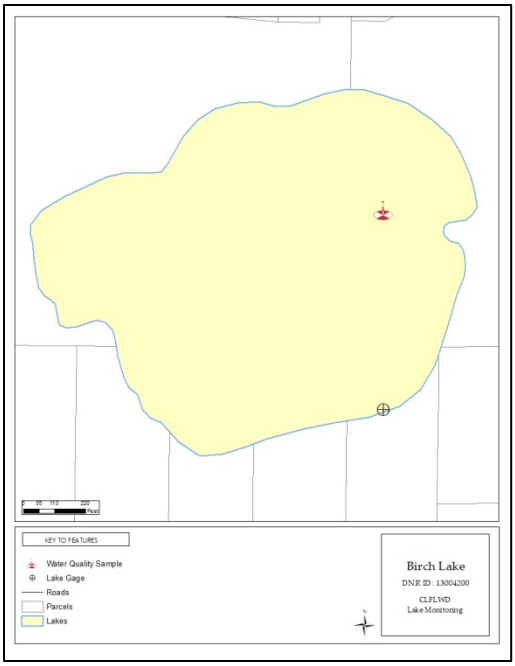
III. INDIVIDUAL LAKE WATER QUALITY SUMMARIES



Birch Lake

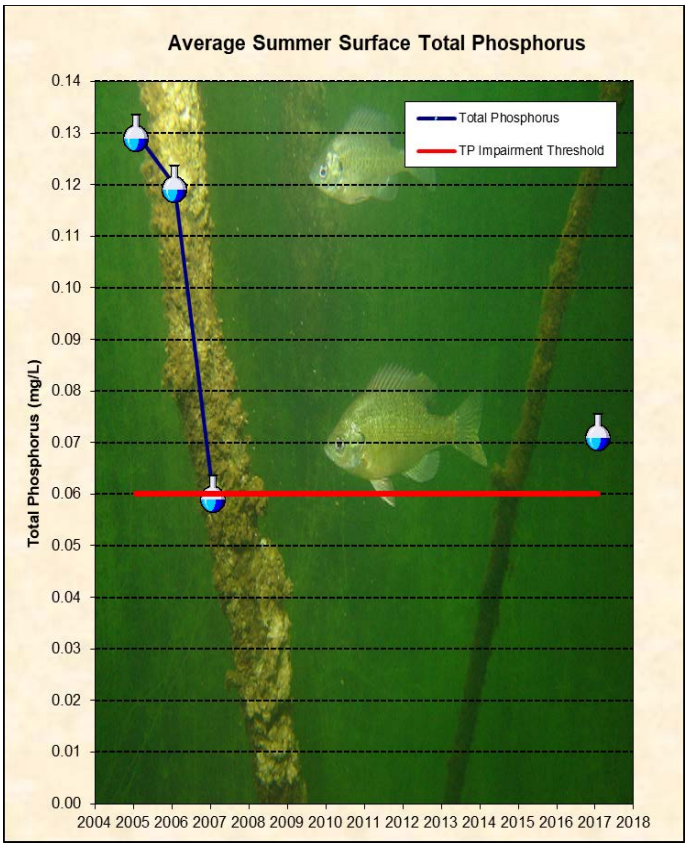
2017 Lake Grade: B-

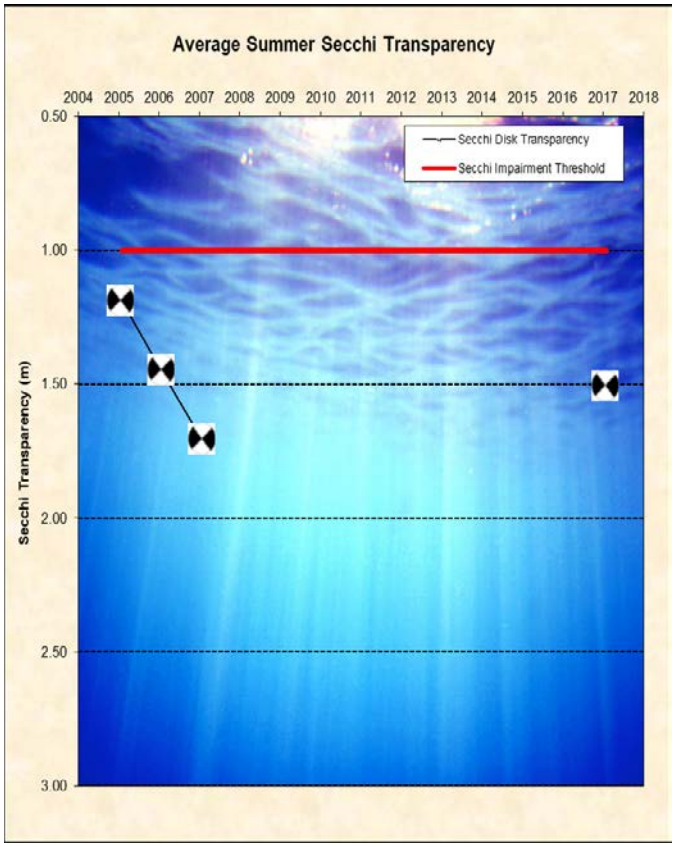
- DNR ID #: 13004200
- Municipality: City of Wyoming
- Location: Section 36 T33N-R21W
- Lake Size: 33 acres
- Maximum Depth (2017): 13 ft.
- Ordinary High Water Mark: N/A
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Birch Lake was considered eutrophic in 2017, according to the Carlson Trophic State Index.
- There are an insufficient number of years of data to determine long term water quality trends at this time.
- The major land use is rural/agricultural.
- The lake did not stratify in 2017.
- Curly-leaf pondweed (an invasive aquatic plant) is present in this lake.





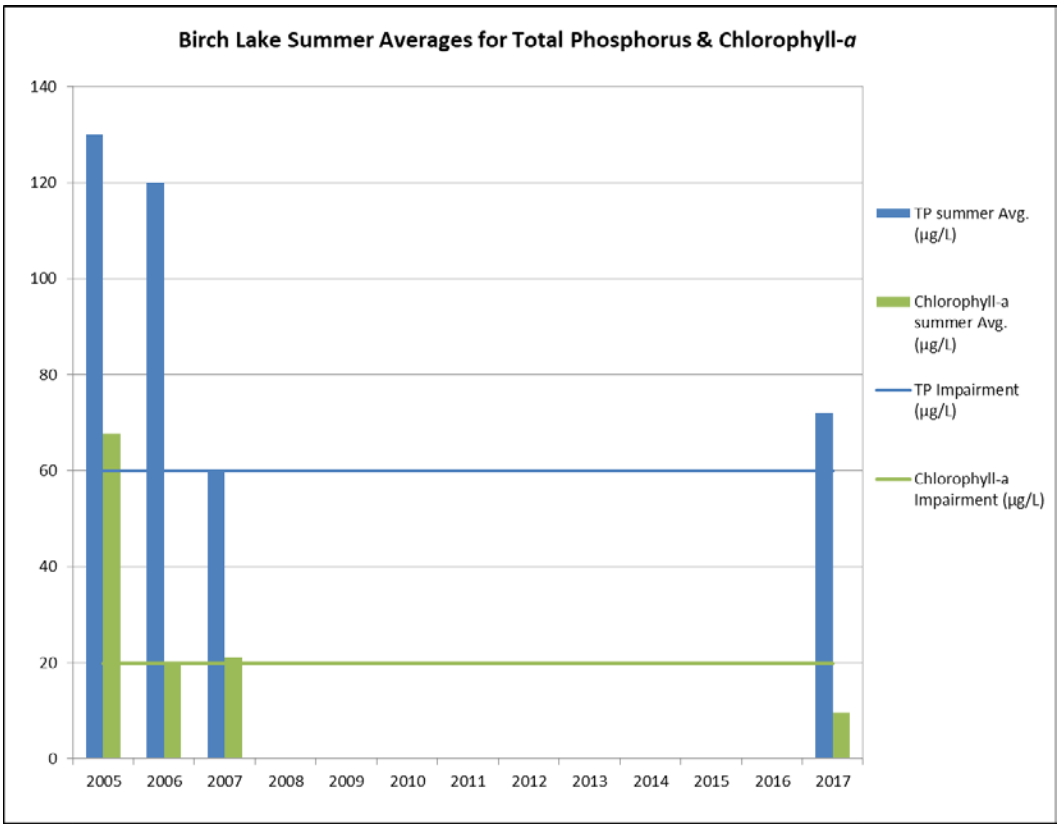
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/18/2017 11:23	0.038	11.0	9.0	0.67	1.22	12.0	9.21
5/3/2017 10:46	0.046	9.7	8.4	0.81	1.52	9.2	10.21
5/17/2017 10:07	0.040	4.0	3.5	0.87	1.68	19.7	7.44
6/1/2017 10:47	0.033	2.6	1.7	0.82	3.05	17.3	6.94
6/14/2017 12:01	0.072	3.3	2.9	1.10	1.22	23.5	6.25
6/28/2017 10:47	0.076	14.0	13.0	0.95	1.52	19.1	7.94
7/12/2017 9:05	NA	7.1	5.3	NA	0.91	23.6	4.37
7/25/2017 11:03	0.075	8.5	7.4	0.98	0.76	23.3	3.66
8/9/2017 10:32	0.109	13.0	12.0	1.50	1.22	22.3	5.62
8/21/2017 10:07	0.108	14.0	12.0	1.30	1.22	22.1	5.99
9/6/2017 12:23	0.058	20.0	18.0	1.00	1.83	18.0	5.78
9/20/2017 11:07	0.044	16.0	14.0	1.20	1.83	18.2	4.26
10/3/2017 12:01	0.042	17.0	18.0	0.94	2.29	16.3	6.57
10/19/17 10:17	0.035	9.3	7.3	0.86	2.29	11.9	7.34
2017 Average	0.060	10.7	9.5	1.00	1.61	18.3	6.54
2017 Summer Average	0.072	10.9	9.6	1.11	1.51	20.8	5.65

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	896.86	10/19/2017	896.03	8/9/2017	896.33

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	C	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorophyll-*a* (µg/L)	A	NA	NA	NA	NA	NA	NA	NA	NA	NA
Secchi depth (ft)	C	NA	NA	NA	NA	NA	NA	NA	NA	NA
Overall	**B-**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Birch Lake
Water Surface Elevation Statistics

Outlet Elevation: 894.5 ft

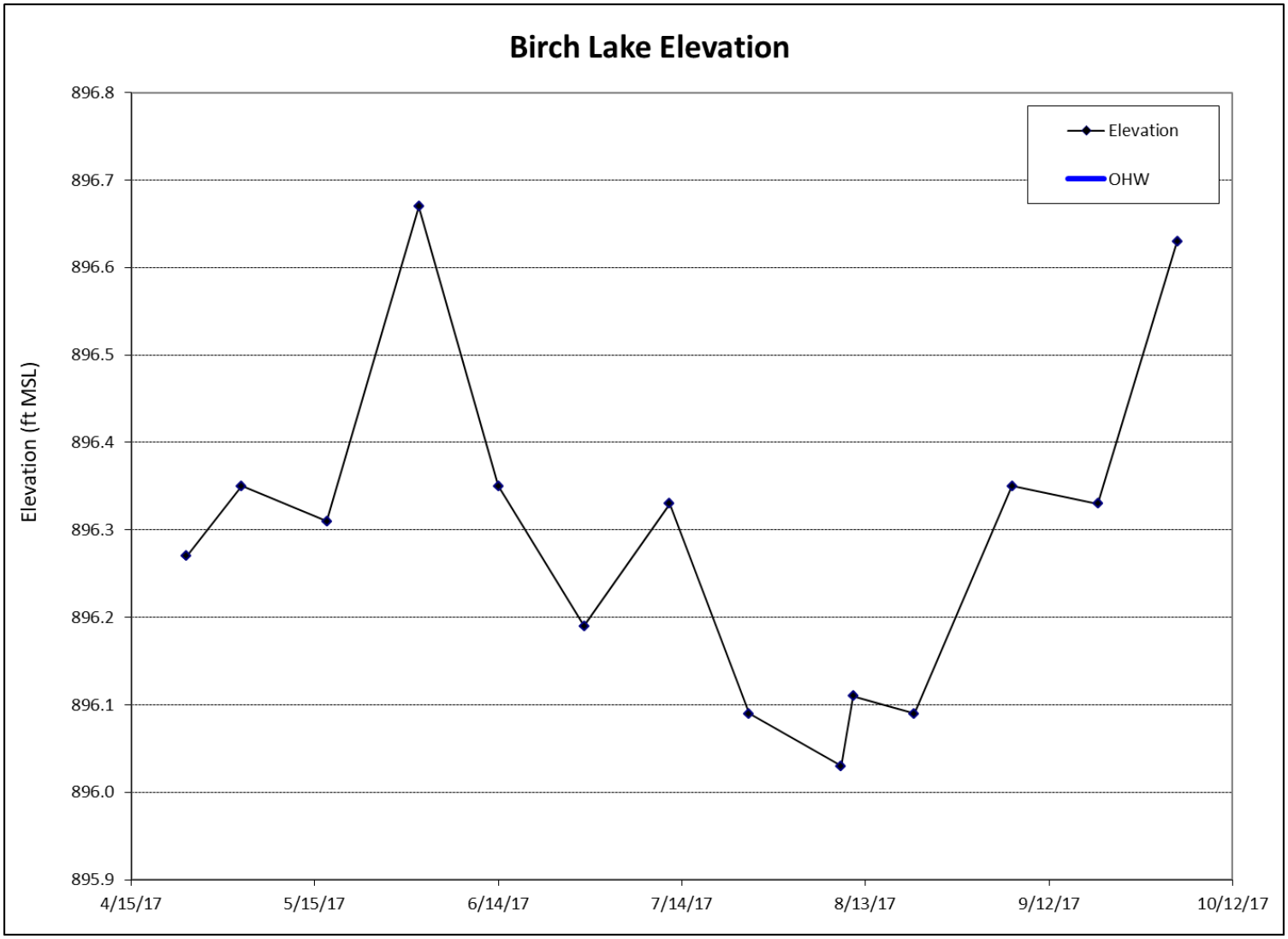
Ordinary High Water Level (OHW) Elevation: N/A

100 Year Flood Elevation (CLFLWD): 896.9 ft.

Highest Recorded Elevation: 896.86 ft. (10/19/2017)

Lowest Recorded Elevation: 896.03 ft. (8/9/2017)

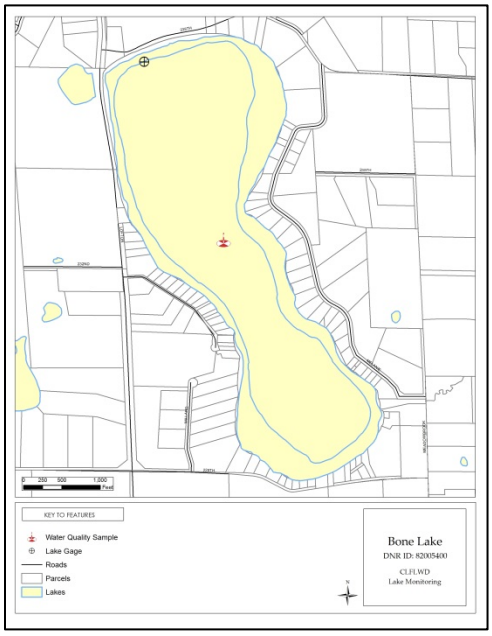
Datum: NGVD 29 (ft.)



Bone Lake

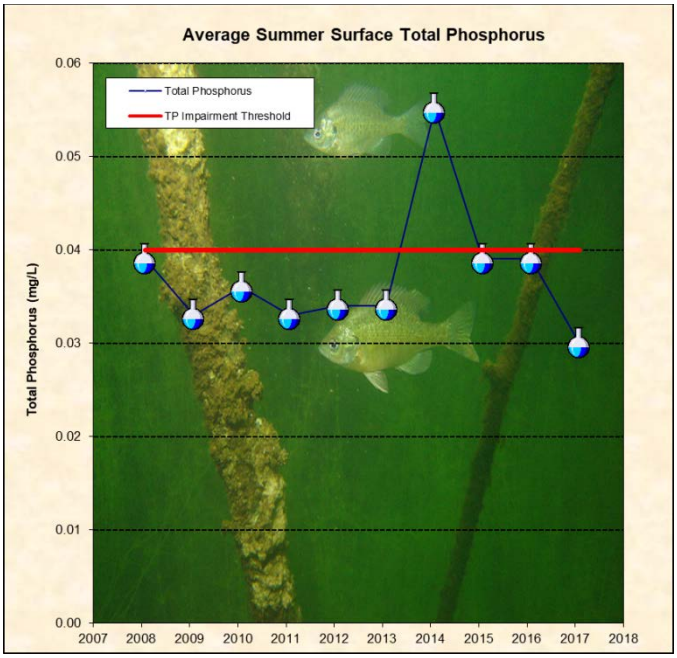
2017 Lake Grade: C+

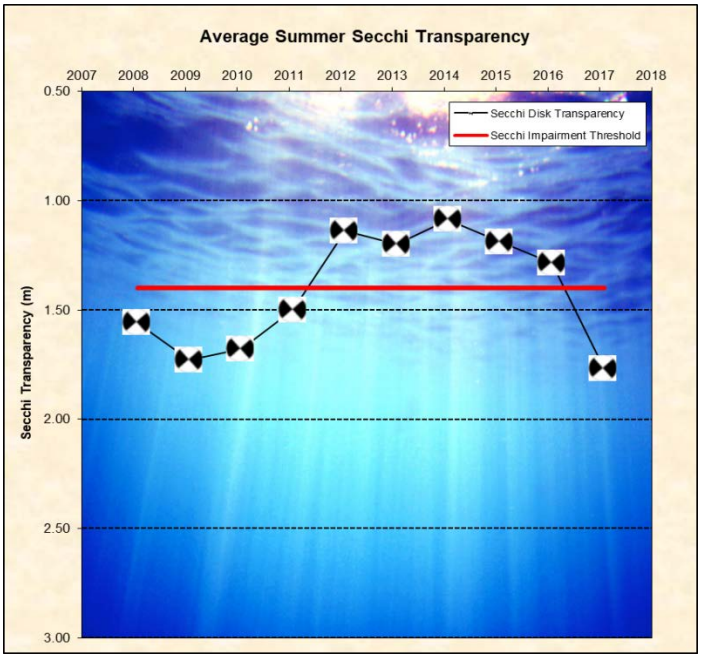
- DNR ID #: 82005400
- Municipality: City of Scandia
- Location: Section 5 T32N-R20W
- Lake Size: 221.45 acres
- Maximum Depth (2017): 32 ft.
- Ordinary High Water Mark: 909.1 ft.
- 56% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Bone Lake was considered eutrophic in 2017, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus and chlorophyll-*a* and no trend for the average Secchi transparency at this time.
- The major land use is rural/agricultural.
- The lake stratified in 2017 with the thermocline varying between 4 and 6 meters.
- Bone Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Eurasian watermilfoil and Curly-leaf pondweed (invasive aquatic plants) are present in this lake.
- Carp removal was performed in the winter of 2010.
- Low velocity fish barriers were installed at Bone Lake north inlet and Bone Lake outlet in the fall of 2012.





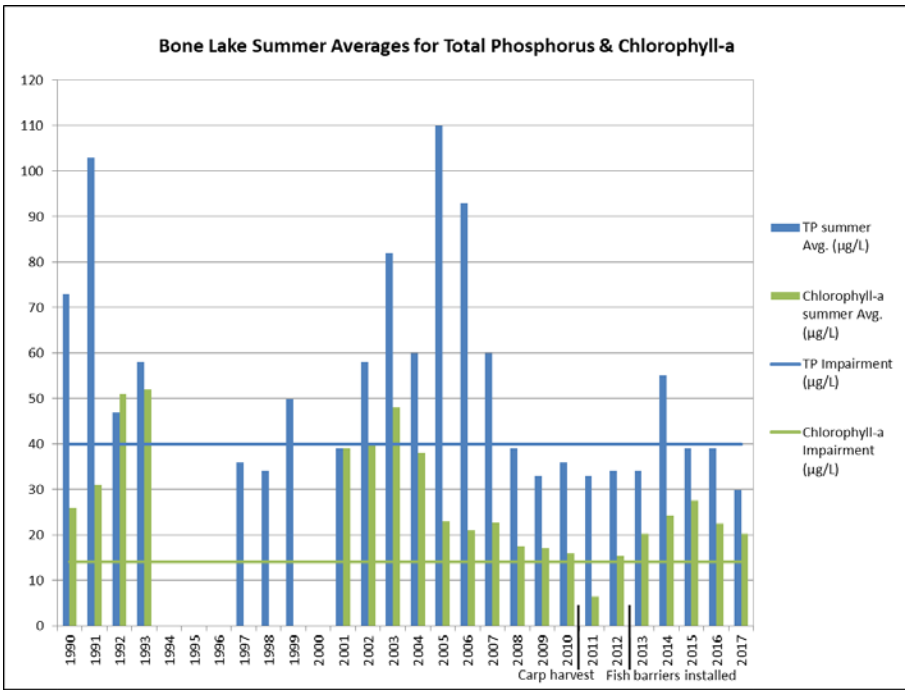
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2017 10:57	0.024	19.0	16.0	1.10	1.98	10.6	11.69
5/4/2017 10:02	0.045	16.0	14.0	1.30	2.90	11.4	11.10
5/15/2017 10:47	0.025	20.0	19.0	1.10	1.68	18.7	11.49
5/31/2017 10:30	0.018	28.0	26.0	0.60	1.52	16.3	8.99
6/13/2017 10:26	0.035	62.0	59.0	1.60	0.76	23.1	9.34
6/27/2017 11:03	0.041	16.0	15.0	1.40	1.37	20.8	7.97
7/13/2017 10:37	0.038	28.0	26.0	1.20	1.07	24.7	7.51
7/27/2017 10:28	0.028	14.0	12.0	1.00	1.37	25.6	7.42
8/8/2017 10:32	0.020	11.0	11.0	1.00	1.98	24.0	7.65
8/22/2017 10:42	0.023	9.3	7.0	0.87	2.90	22.3	7.08
9/7/2017 11:11	0.026	9.5	8.5	1.10	2.59	18.9	6.64
9/19/2017 10:11	0.023	17.0	17.0	0.95	2.13	19.4	8.42
10/5/2017 11:06	0.034	29.0	27.0	1.20	1.37	17.1	6.66
10/26/17 11:30	0.038	28.0	26.0	1.20	1.52	11.5	9.77
2017 Average	0.030	21.9	20.3	1.12	1.80	18.9	8.70
2017 Summer Average	0.030	21.8	20.3	1.15	1.77	22.4	7.75
Volunteer Data							
4/22/2017 11:45	0.019	5.9	5.0	0.81	2.40	12.6	NA
5/6/2017 16:00	0.027	9.3	9.9	0.98	2.20	15.0	NA
5/21/2017 10:00	0.031	19.0	17.0	1.00	1.40	14.4	NA
6/1/2017 10:00	0.023	23.0	21.0	1.00	1.30	19.0	NA
6/17/2017 11:00	0.030	48.0	46.0	1.30	0.90	24.7	NA
6/30/2017 13:00	0.040	20.0	18.0	0.95	1.20	22.6	NA
7/16/2017 10:00	0.061	17.0	15.0	1.00	1.20	25.0	NA
7/30/2017 12:00	0.077	9.3	8.3	0.94	1.60	28.0	NA
8/12/2017 18:00	0.023	6.6	5.3	0.86	1.70	25.5	NA
8/24/2017 18:00	0.024	6.3	5.1	0.77	1.90	23.0	NA
9/9/2017 15:00	0.024	6.4	5.2	1.00	2.30	19.4	NA
10/6/2017 10:00	0.029	27.0	26.0	1.00	1.20	17.0	NA
10/18/2017 14:00	0.024	23.0	22.0	1.10	1.70	14.3	NA
2017 Average	0.033	17.0	15.7	0.98	1.62	20.0	NA
2017 Summer Average	0.038	17.1	15.5	0.98	1.51	23.4	NA

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	910.11	5/23/2017	908.47	8/8/2017	909.07

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	B	C	C	C	C	C	C	C	C	C
Chlorophyll-*a* (µg/L)	C	C	B	C	C	B	A	B	B	B
Secchi depth (ft)	C	C	D	D	C	D	C	C	C	C
Overall	**C+**	**C**	**C**	**C-**	**C**	**C**	**C+**	**C+**	**C+**	**C+**

Bone Lake
Water Surface Elevation Statistics

Outlet Elevation (culvert): 907.3 ft.

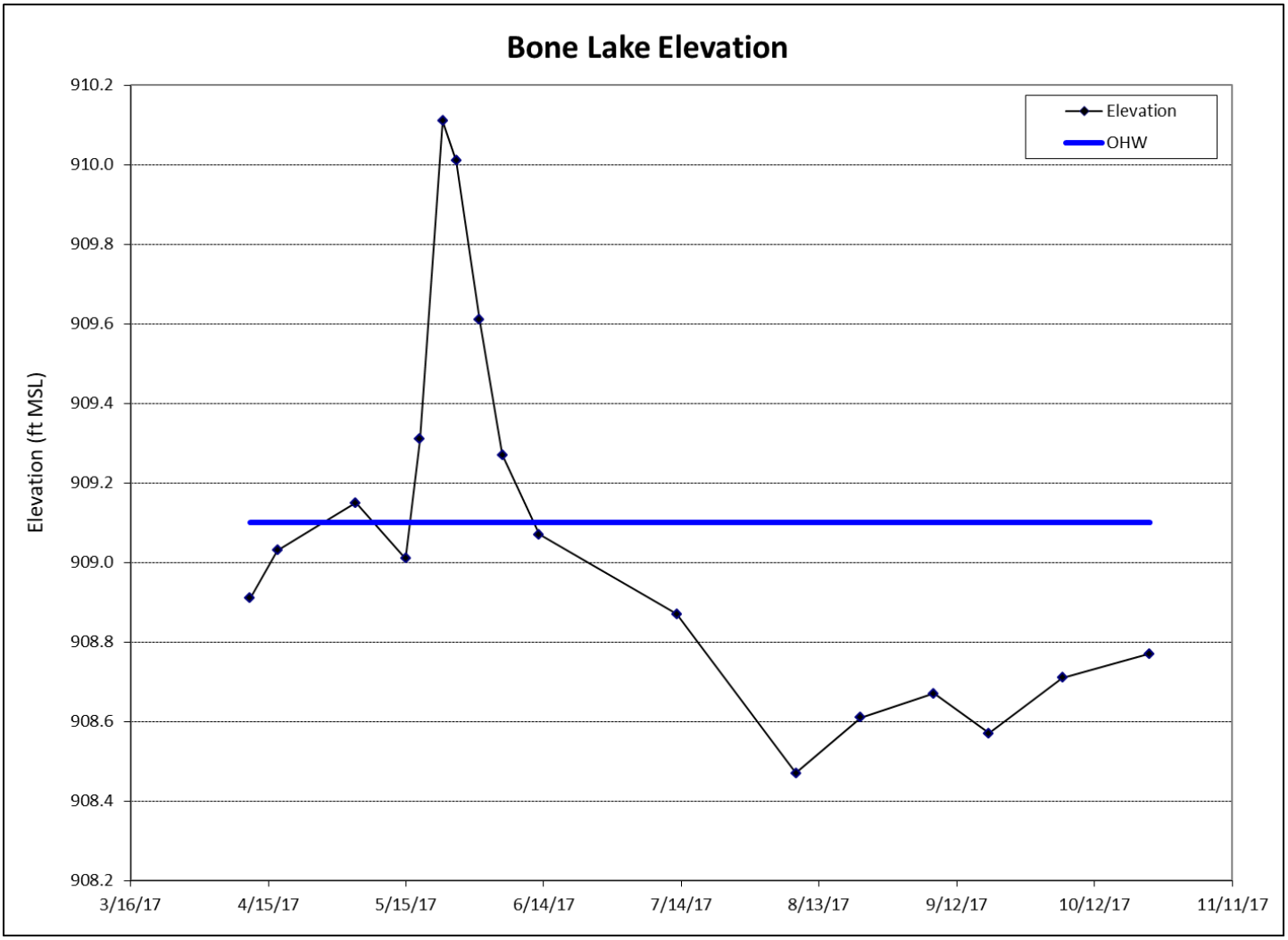
Ordinary High Water Level (OHW) Elevation: 909.1 ft.

100 Year Flood Elevation (CLFLWD): 910.6 ft.

Highest Recorded Elevation: 910.97 ft. (07/07/1975)

Lowest Recorded Elevation: 906.7 ft. (11/07/1966)

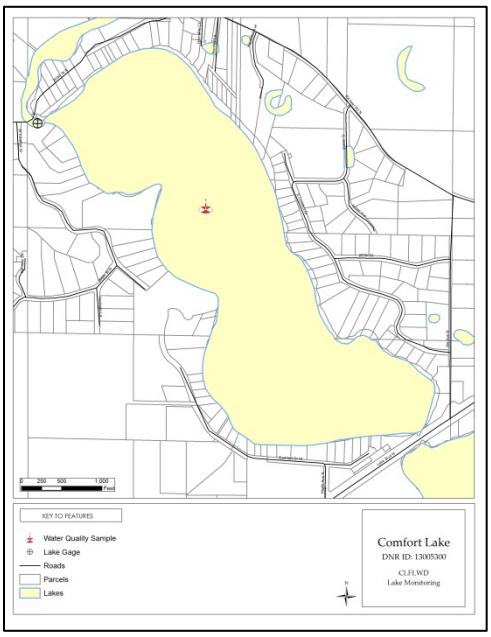
Datum: NGVD 29 (ft.)



Comfort Lake

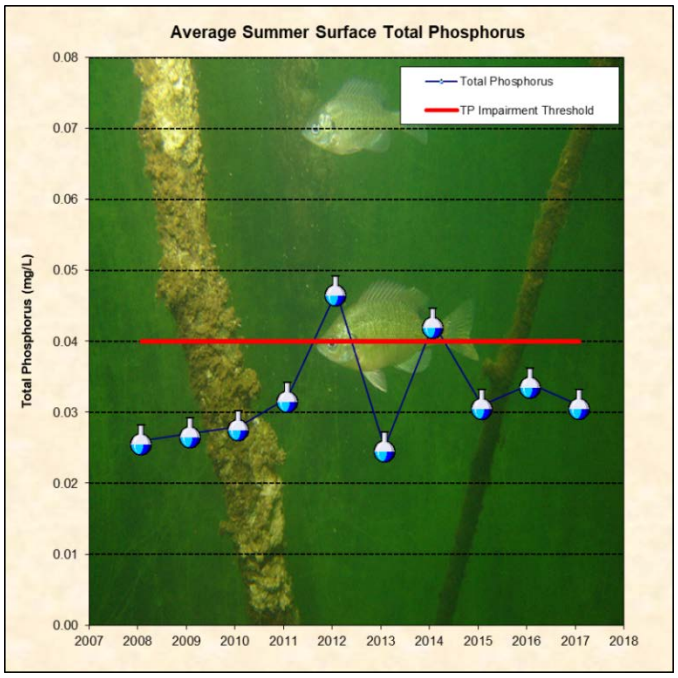
2017 Lake Grade: C+

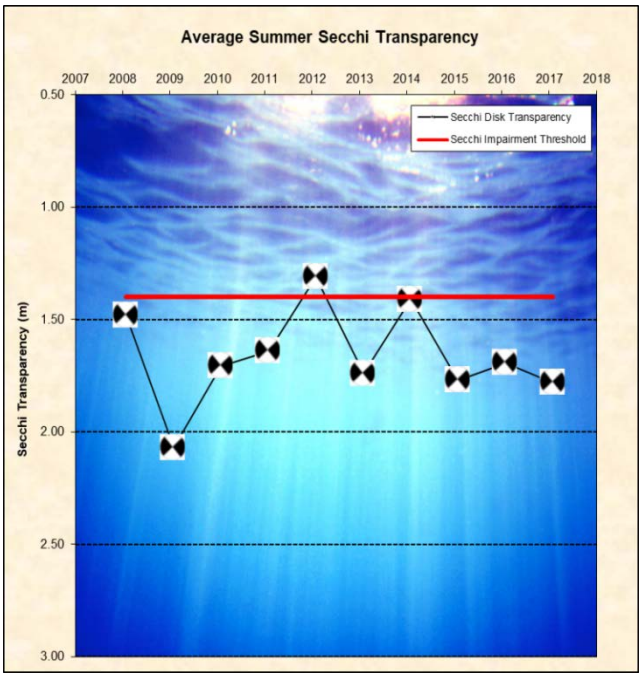
- DNR ID #: 13005300
- Municipality: City of Wyoming
- Location: Section 27 T33N-R21W
- Lake Size: 217.82 acres
- Maximum Depth (2017): 45 ft.
- Ordinary High Water Mark: 887.2 ft.
- 41% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Comfort Lake was considered eutrophic in 2017, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus and a statistically significant **declining** trend for the average Secchi transparency and no trend for chlorophyll-*a*.
- The major land use is a mix of semi-urban, rural, and agricultural.
- The lake stratified in 2017 with the thermocline around 5 meters.
- Comfort Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Eurasian watermilfoil and Curly-leaf pondweed (invasive aquatic plants) are present in this lake. Zebra mussels were discovered in 2017.





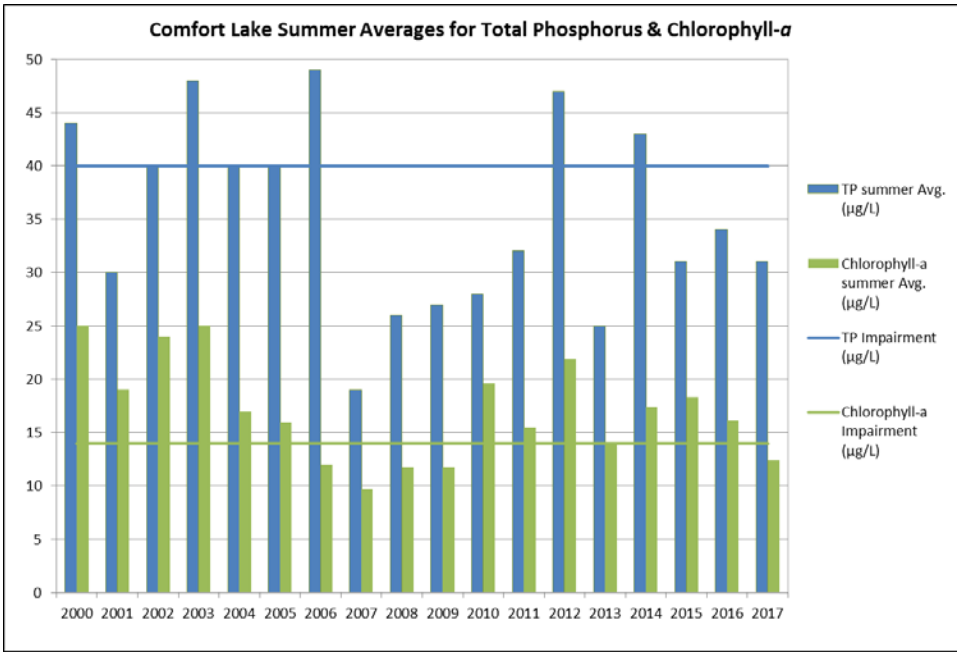
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2017 11:53	0.019	9.0	6.8	0.97	2.29	10.4	10.48
5/4/2017 10:41	0.083	10.0	9.3	1.50	3.35	11.0	10.64
5/15/2017 11:25	0.020	10.0	9.3	1.10	1.37	18.7	11.02
5/31/2017 11:11	0.030	12.0	11.0	1.10	1.83	16.4	8.59
6/13/2017 11:08	0.018	9.5	8.5	1.00	2.29	23.1	7.33
6/27/2017 11:49	0.067	2.6	1.0	1.20	1.98	20.6	8.62
7/13/2017 11:13	0.027	14.0	13.0	0.98	1.83	24.5	7.85
7/27/2017 11:13	0.055	18.0	17.0	1.30	1.37	25.6	8.03
8/8/2017 11:13	0.023	15.0	13.0	1.20	1.37	23.9	8.28
8/22/2017 11:18	0.023	15.0	13.0	0.99	1.83	22.4	7.71
9/7/2017 12:08	0.017	14.0	13.0	0.95	1.68	18.6	6.55
9/19/2017 10:50	0.018	21.0	21.0	1.20	1.83	19.3	8.67
10/5/2017 10:26	0.023	5.7	4.3	0.96	1.98	16.7	6.29
10/26/17 10:57	0.043	15.0	13.0	1.20	1.52	11.7	7.36
2017 Average	0.033	12.2	10.9	1.12	1.89	18.8	8.39
2017 Summer Average	0.031	13.6	12.4	1.10	1.78	21.6	7.96
Volunteer Data							
4/21/2017 10:20	0.022	9.0	5.2	0.89	1.80	10.3	NA
5/3/2017 11:45	0.027	12.0	11.0	1.20	2.10	10.5	NA
5/20/2017 13:30	0.030	13.0	12.0	0.99	2.40	15.7	NA
6/2/2017 12:30	0.029	4.2	3.9	1.00	1.60	21.5	NA
6/17/2017 13:00	0.022	16.0	14.0	0.99	1.50	25.5	NA
6/28/2017 13:39	0.026	18.0	16.0	1.00	1.40	21.2	NA
7/19/2017 13:30	0.075	15.0	13.0	0.97	1.60	25.9	NA
7/27/2017 13:40	0.042	15.0	15.0	1.00	1.30	28.3	NA
8/11/2017 14:10	0.020	14.0	13.0	0.98	1.35	24.1	NA
8/28/2017 14:15	0.023	16.0	14.0	0.96	1.40	21.2	NA
9/9/2017 13:00	0.028	15.0	14.0	1.10	1.50	19.1	NA
9/20/2017 14:45	0.190	23.0	21.0	0.88	1.50	21	NA
10/8/2017 15:15	0.027	12.0	11.0	0.94	1.75	18.5	NA
2017 Average	0.043	14.0	12.5	0.99	1.63	20.2	NA
2017 Summer Average	0.051	15.1	13.8	0.99	1.46	23.1	NA

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	887.40	5/25/2017	885.9	9/14/2017	886.34

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-acorrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	C	B	B	C	B	C	B	B	B	B
Chlorophyll-*a* (µg/L)	B	B	C	B	B	C	B	B-	B	A
Secchi depth (ft)	C	C	C	C	C	C	C	C	C	C
Overall	**C+**	**B-**	**C+**	**C+**	**B-**	**C**	**B-**	**B-**	**B**	**B**

Comfort Lake
Water Surface Elevation Statistics

Outlet Elevation (rock weir): 885.4 ft.

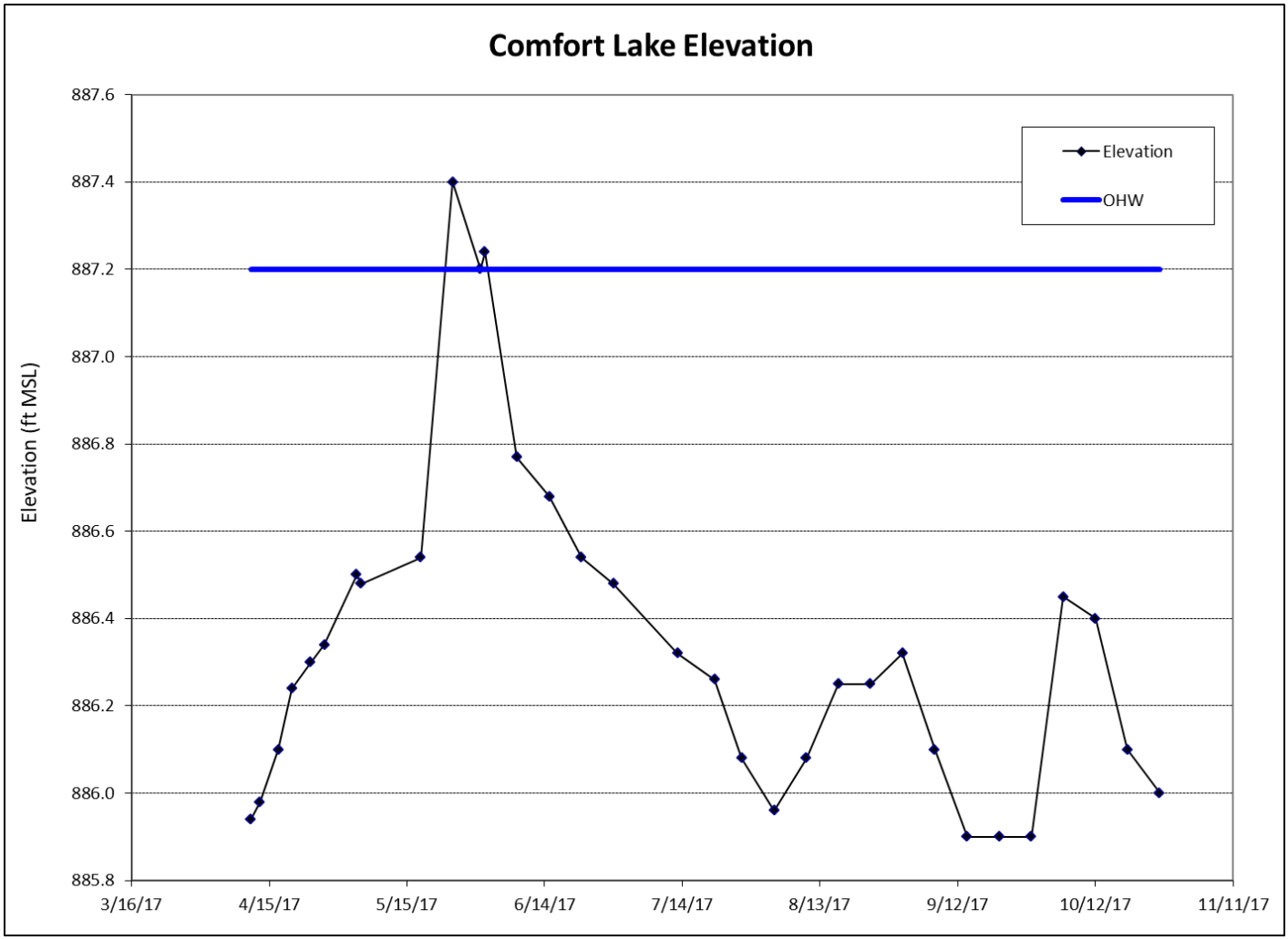
Ordinary High Water Level (OHW) Elevation: 887.2 ft.

100 Year Flood Elevation (CLFLWD): 889.5 ft.

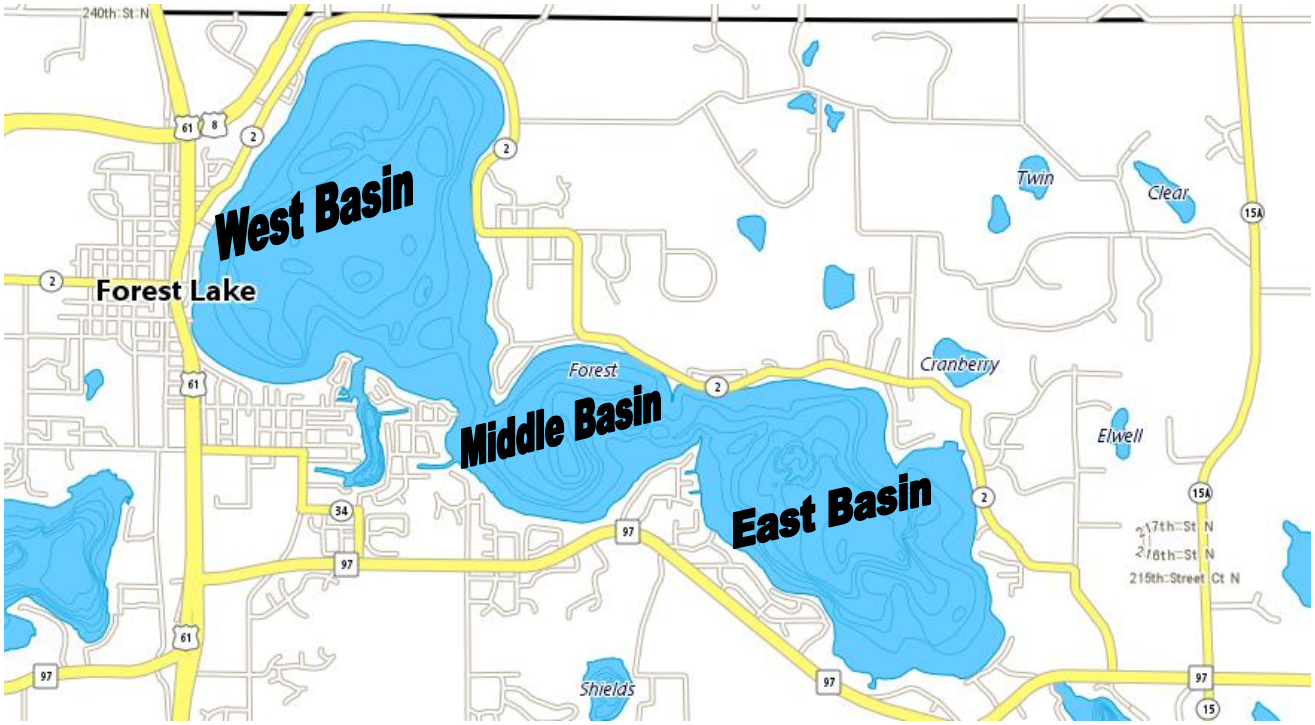
Highest Recorded Elevation: 888.32 ft. (07/02/1975)

Lowest Recorded Elevation: 884.8 ft. (10/08/1969)

Datum: NGVD 29 (ft.)



Forest Lake
2017 Water Quality Summaries

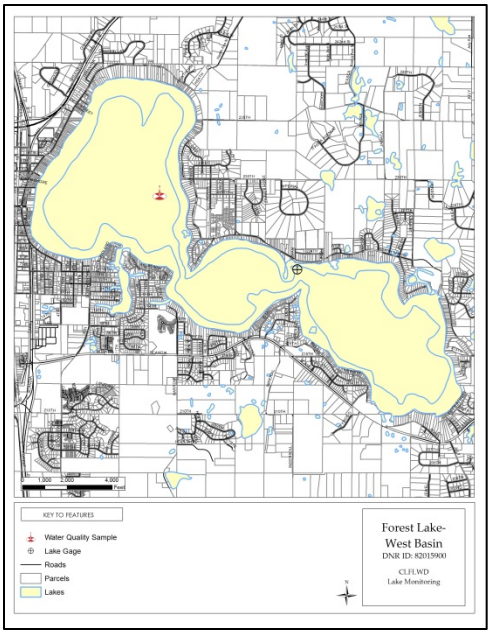


Water quality sampling for Forest Lake is conducted on each of the three basins shown above. The following pages include a summary for each of the three basins and one page on lake level statistics.

Forest Lake (West Basin)

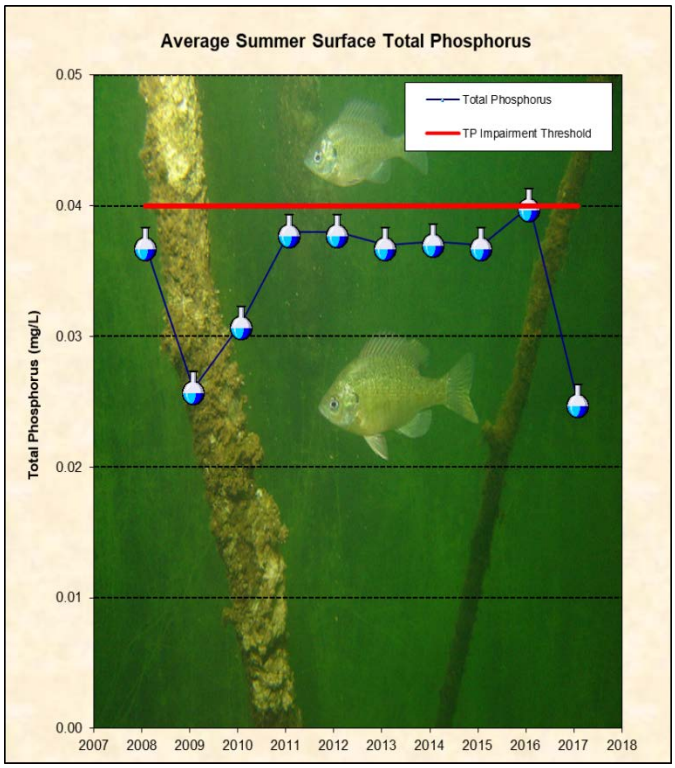
2017 Lake Grade: B

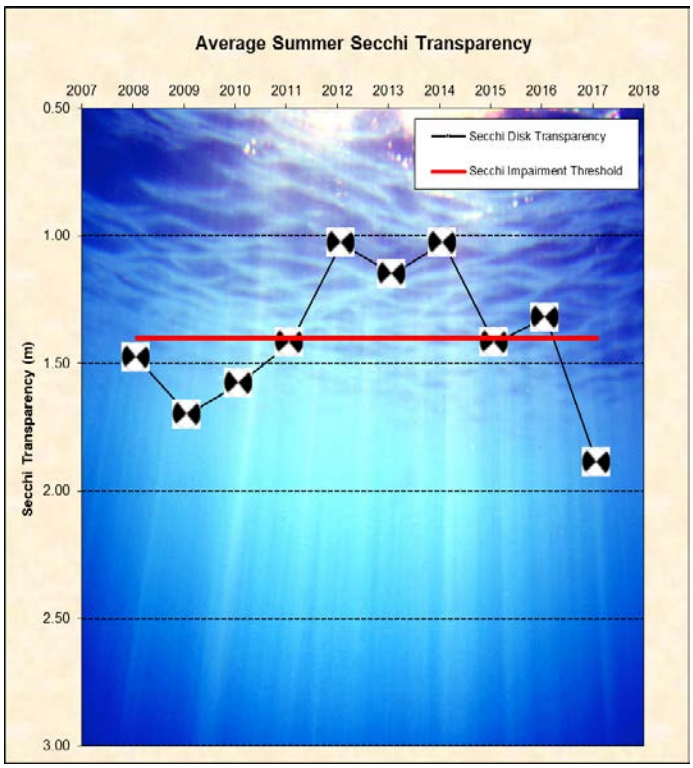
- DNR ID #: 82015900
- Municipality: City of Forest Lake
- Location: Section 9 T32N-R21W
- Lake Size: 1,086.08 acres
- Maximum Depth (2017): 21 ft.
- Ordinary High Water Mark: 901.8 ft.
- 67% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Forest Lake (West Basin) was considered mesotrophic in 2017, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p<0.05$) there is no trend for the average total phosphorus, chlorphyll-*a*, or average Secchi transparency at this time.
- The major land use is urban.
- The lake did not stratify in 2017.
- Eurasian watermilfoil, Flowering rush, Curly-leaf pondweed (invasive aquatic plants), and Zebra mussels are present in this lake.





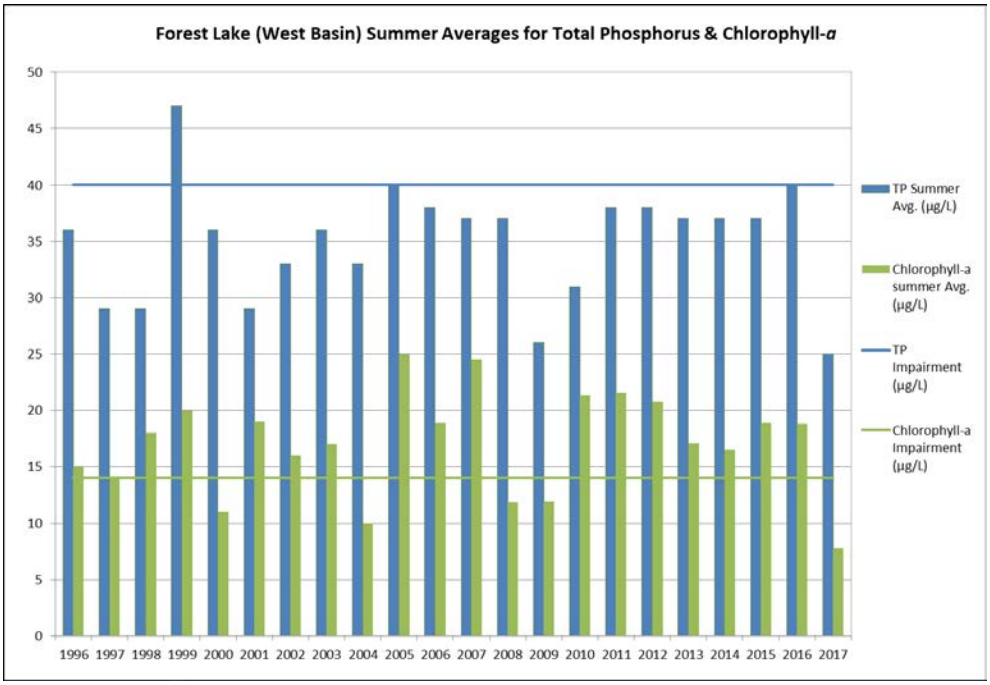
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2017 13:05	0.014	4.5	3.3	0.75	2.29	11.7	11.07
5/4/2017 11:11	0.020	4.9	4.5	0.88	1.98	10.2	11.37
5/15/2017 13:05	0.016	2.8	2.3	0.67	2.29	18.6	10.13
5/31/2017 12:10	0.023	4.7	3.9	0.86	2.29	16.2	8.29
6/13/2017 11:43	0.022	6.5	5.9	0.84	1.98	23.0	7.93
6/27/2017 13:18	0.027	8.7	7.9	0.94	1.98	20.5	8.54
7/13/2017 12:20	0.023	6.7	6.1	0.79	1.98	24.8	7.40
7/27/2017 12:28	0.028	6.4	6.2	0.95	1.68	25.8	8.20
8/8/2017 12:44	0.030	8.5	8.3	0.98	1.98	24.1	8.75
8/22/2017 12:49	0.026	10.0	9.3	0.82	1.98	22.2	8.06
9/7/2017 13:21	0.021	10.0	9.7	0.86	1.83	18.6	8.36
9/19/2017 13:03	0.025	10.0	9.3	0.84	1.68	19.3	8.05
10/5/2017 8:57	0.026	18.0	18.0	1.00	1.68	16.3	8.68
10/26/17 9:10	0.027	7.2	6.5	0.83	1.98	10.4	10.19
2017 Average	0.023	7.8	7.2	0.86	1.97	18.7	8.93
2017 Summer Average	0.025	8.4	7.8	0.88	1.89	22.3	8.16
Volunteer Data							
04/22/2017 13:00	0.022	4.1	3.5	0.81	2.15	12.2	NA
05/07/2017 13:20	0.018	2.3	2.3	0.70	1.85	14.2	NA
05/19/2017 13:45	0.018	4.8	4.4	0.72	1.85	16.3	NA
06/05/2017 12:40	0.020	3.0	3.2	0.71	2.65	21.5	NA
06/16/2017 13:30	0.022	7.0	6.3	0.78	1.55	24.0	NA
07/02/2017 13:30	0.021	4.9	5.5	0.69	1.90	24.8	NA
07/15/2017 14:51	0.021	6.4	5.6	0.70	1.55	25.5	NA
07/29/2017 09:00	0.023	6.5	6.1	0.72	1.85	26.2	NA
08/10/2017 14:00	0.031	11.0	12.0	0.78	1.45	22.9	NA
08/24/2017 13:00	0.024	11.0	10.0	0.80	1.60	21.8	NA
09/08/2017 13:00	0.026	12.0	10.0	0.75	1.45	18.7	NA
09/19/2017 12:15	0.024	11.0	9.5	0.73	1.45	19.4	NA
10/10/2017 16:00	0.033	16.0	15.0	0.89	1.60	14.6	NA
10/17/2017 15:30	0.022	9.2	8.5	0.71	1.95	12.8	NA
2017 Average	0.023	7.8	7.3	0.75	1.78	19.6	NA
2017 Summer Average	0.024	8.7	8.1	0.74	1.60	22.9	NA

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	901.88	5/31/2017	901.38	9/19/2017	901.58

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

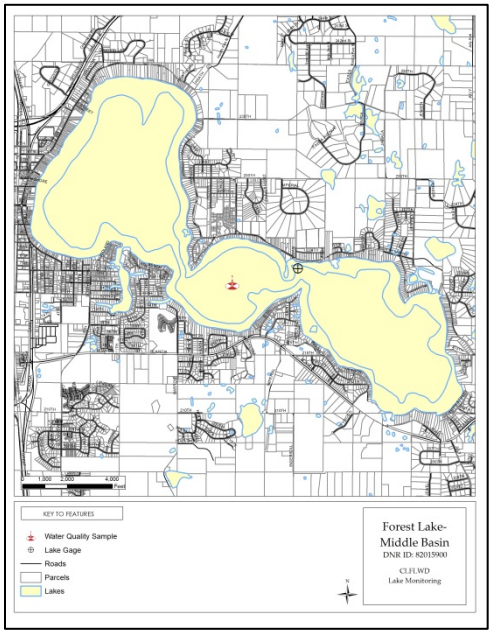


Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	B	C	C	C	C	C	C	B-	B	C
Chlorophyll-*a* (µg/L)	B	B	B	B	B	C	C	C+	B+	B
Secchi depth (ft)	B	C	C	D	D	D	B	C	C	C
Overall	**B**	**C+**	**C+**	**C**	**C**	**C-**	**C**	**C+**	**B**	**C+**

Forest Lake (Middle Basin)

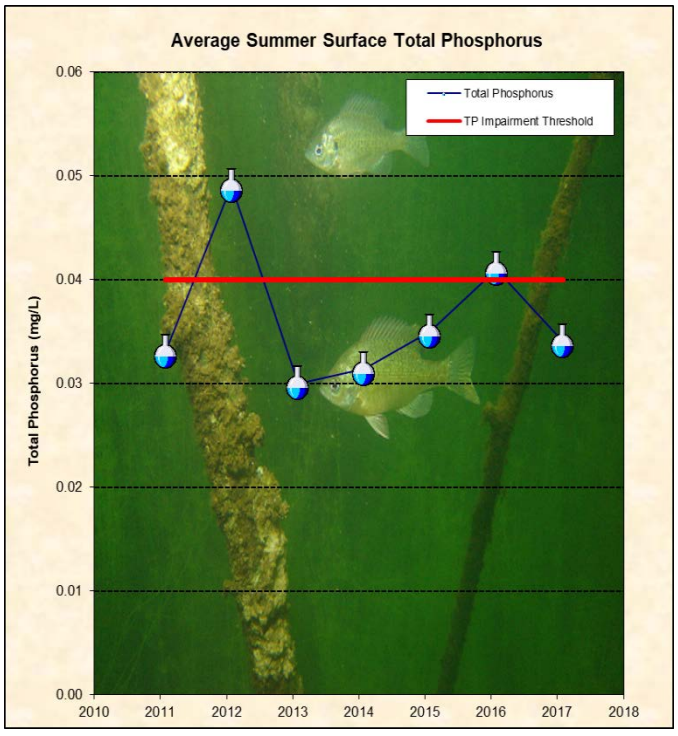
2017 Lake Grade: B

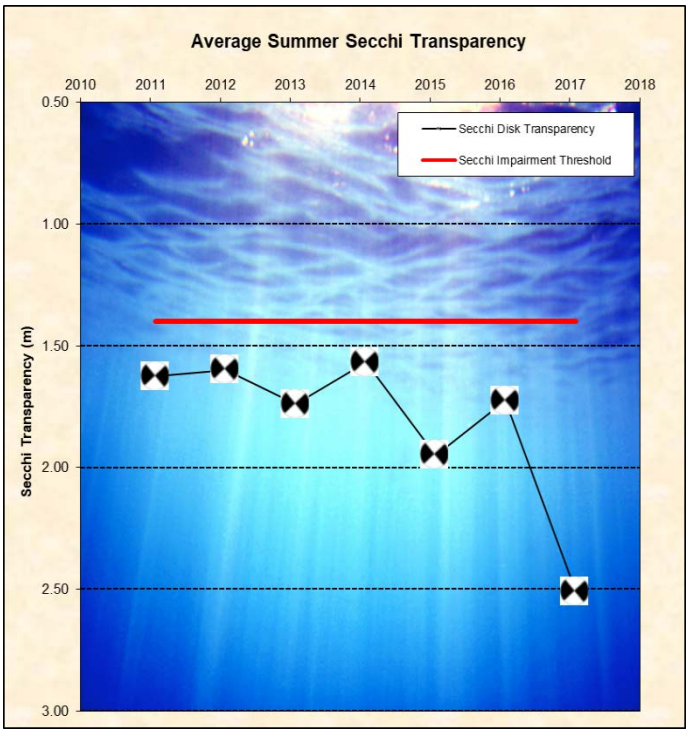
- DNR ID #: 82015900
- Municipality: City of Forest Lake
- Location: Section 9 T32N-R21W
- Lake Size: 363.80 acres
- Maximum Depth (2017): 35 ft.
- Ordinary High Water Mark: 901.8 ft.
- 67% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Forest Lake (Middle Basin) was considered eutrophic in 2017, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p<0.05$) there is no trend for the average total phosphorus, chlorophyll-*a*, and Secchi transparency at this time.
- The major land use is urban and rural/agricultural.
- The lake stratified in 2017 with the thermocline varying between 5 and 6 meters.
- Eurasian watermilfoil, Flowering rush, Curly-leaf pondweed (invasive aquatic plants), and Zebra mussels are present in this lake.





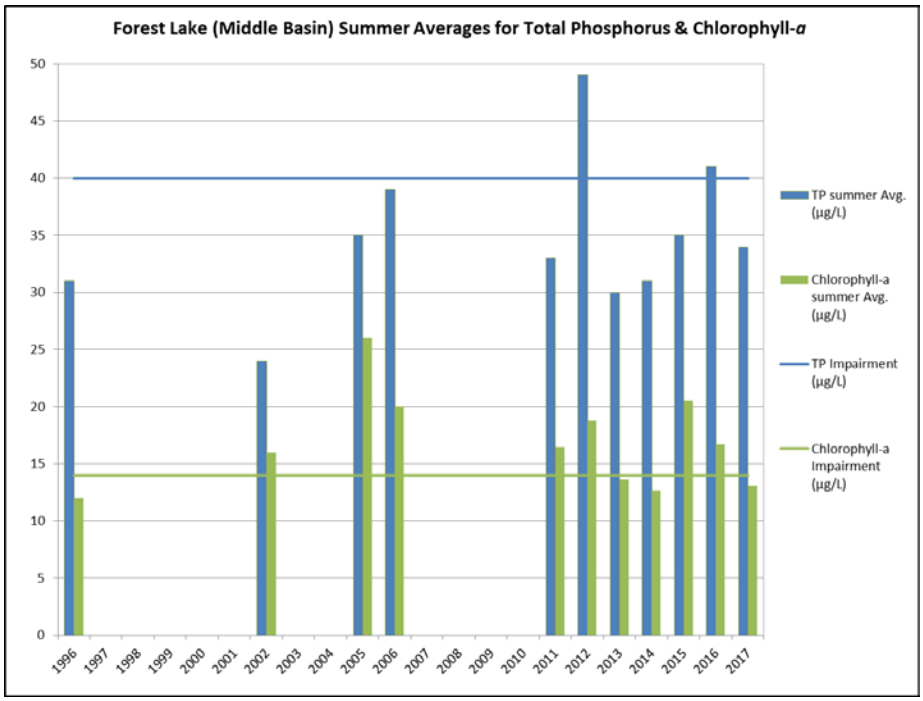
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2017 13:41	0.019	3.4	2.8	0.66	3.20	12.1	10.00
5/4/2017 13:10	0.031	2.5	2.1	0.90	3.96	11.1	10.78
5/15/2017 12:19	0.019	3.4	3.0	0.65	3.35	18.3	10.10
5/31/2017 13:06	0.020	3.4	2.6	0.82	3.81	16.0	7.85
6/13/2017 13:09	0.027	4.3	3.8	0.76	3.96	23.2	7.67
6/27/2017 13:52	0.029	10.0	9.6	0.87	2.44	20.6	8.87
7/13/2017 12:09	0.031	9.8	8.9	0.76	2.90	24.8	7.73
7/27/2017 12:43	0.025	4.8	4.5	0.92	2.90	26.3	8.32
8/8/2017 12:57	0.051	11.0	11.0	1.00	2.29	23.8	8.62
8/22/2017 13:26	0.037	24.0	23.0	0.92	1.68	22.4	8.42
9/7/2017 13:34	0.035	22.0	21.0	0.90	1.83	19.1	7.37
9/19/2017 11:45	0.035	24.0	23.0	0.91	2.13	19.4	8.20
10/5/2017 9:13	0.037	6.9	5.6	0.71	2.90	16.6	7.19
10/26/17 9:54	0.023	7.0	5.8	0.68	2.90	11.0	9.91
2017 Average	0.030	9.8	9.1	0.82	2.87	18.9	8.65
2017 Summer Average	0.034	13.7	13.1	0.88	2.51	22.5	8.15
Volunteer Data							
05/07/2017 15:00	0.020	1.5	1.0	0.70	3.60	16.3	NA
05/21/2017 18:00	0.027	2.9	2.4	0.72	3.10	15.3	NA
06/03/2017 16:30	0.052	2.5	1.8	0.66	3.50	22.0	NA
06/18/2017 18:30	0.085	7.0	6.0	0.72	2.70	22.8	NA
07/02/2017 18:00	0.020	3.5	3.0	0.62	2.70	24.5	NA
07/14/2017 18:00	0.020	5.4	3.9	0.61	2.40	26.0	NA
07/30/2017 18:30	0.050	4.6	4.3	0.65	2.90	27.8	NA
08/12/2017 15:00	0.027	16.0	14.0	0.82	2.00	25.0	NA
08/28/2017 19:00	0.043	31.0	29.0	0.91	1.50	21.2	NA
09/10/2017 16:00	0.025	15.0	13.0	0.56	1.90	19.2	NA
09/24/2017 15:00	0.031	14.0	13.0	0.70	2.20	22.9	NA
10/08/2017 14:30	0.052	6.6	5.9	0.82	3.00	17.9	NA
10/22/2017 14:30	0.023	8.4	7.0	0.69	3.40	13.5	NA
2017 Average	0.037	9.1	8.0	0.71	2.68	21.1	NA
2017 Summer Average	0.039	11.0	9.8	0.69	2.42	23.5	NA

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	901.88	5/31/2017	901.38	9/19/2017	901.58

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

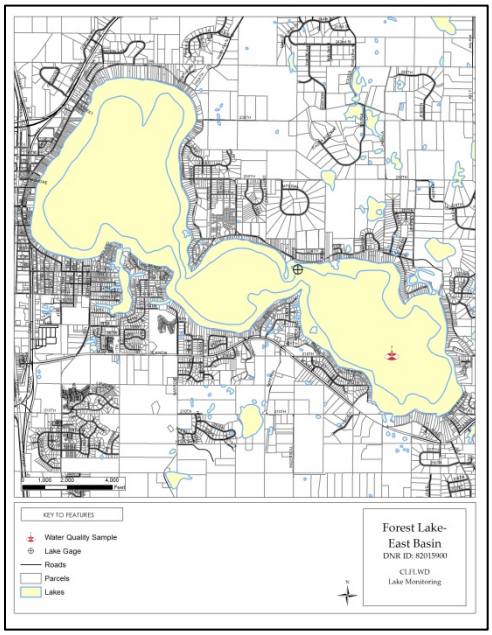


Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	B	C	C	B	B	C	C	NA	NA	NA
Chlorophyll-*a* (µg/L)	B	B	C	B	B	B	B	NA	NA	NA
Secchi depth (ft)	B	C	C	C	C	C	C	NA	NA	NA
Overall	**B**	**C+**	**C**	**B-**	**B-**	**C+**	**C+**	**NA**	**NA**	**NA**

Forest Lake (East Basin)

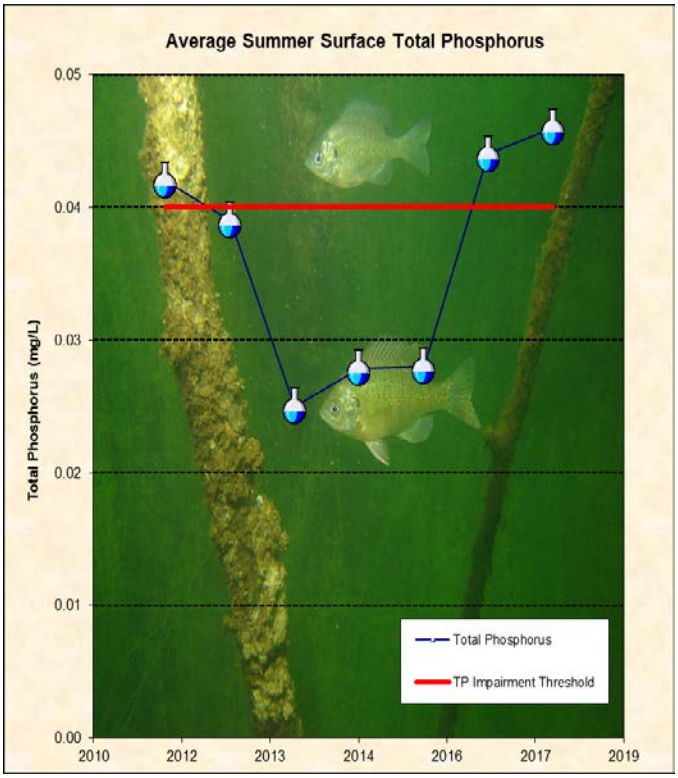
2017 Lake Grade: C+

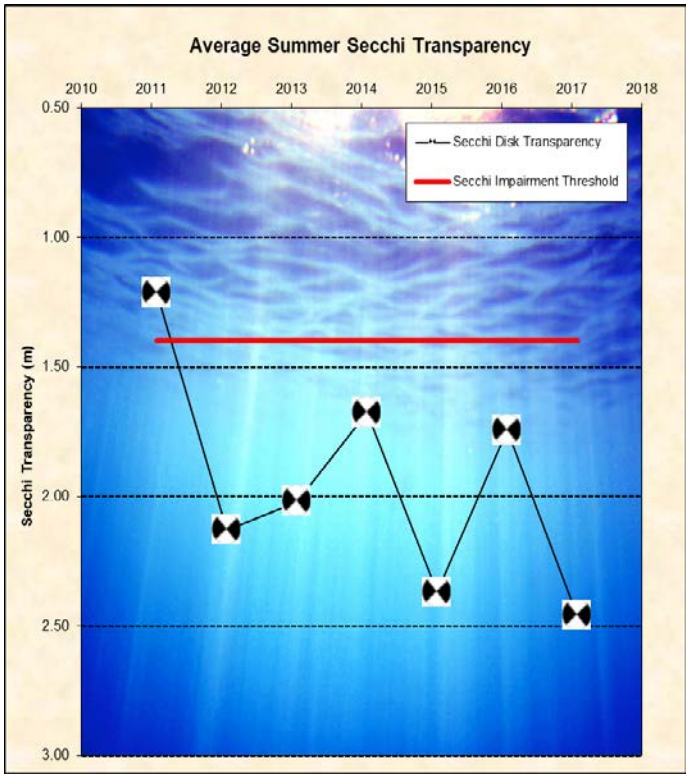
- DNR ID #: 82015900
- Municipality: City of Forest Lake
- Location: Section 9 T32N-R21W
- Lake Size: 789.58 acres
- Maximum Depth (2017): 33 ft.
- Ordinary High Water Mark: 901.8 ft.
- 67% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Forest Lake (East Basin) was considered eutrophic in 2017, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p<0.05$) there is no trend for the average total phosphorus, chlorophyll-*a*, and Secchi transparency at this time.
- The major land use is semi-urban and rural/agricultural.
- The lake stratified in 2017 with the thermocline varying between 6 and 8 meters.
- Eurasian watermilfoil, Flowering rush, Curly-leaf pondweed (invasive aquatic plants), and Zebra mussels are present in this lake.
-





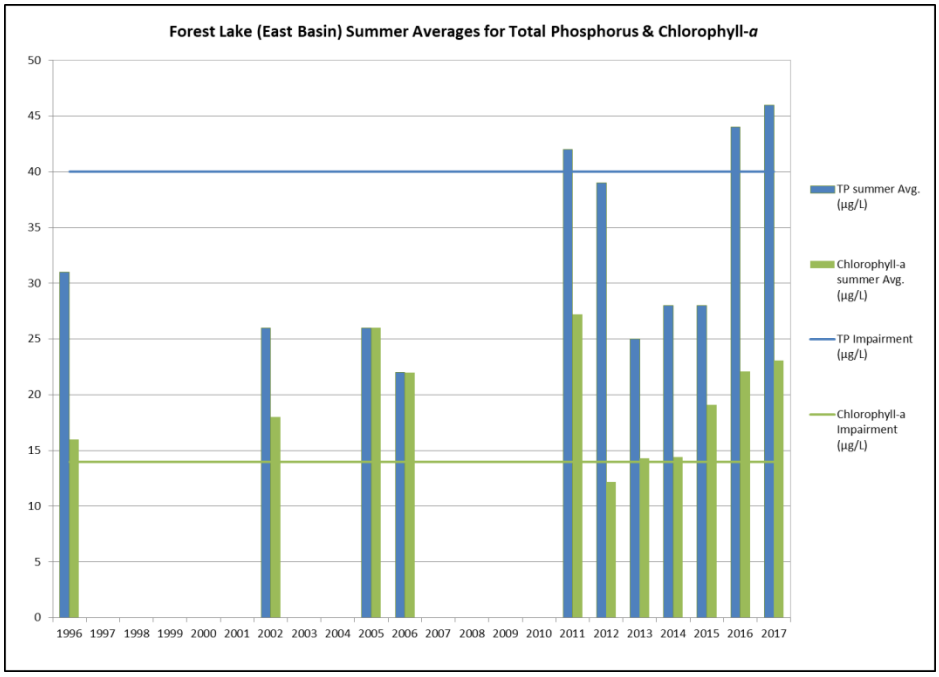
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-a (µg/L)	Pheophytin-Corrected Chlorophyll-a (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2017 14:00	0.014	4.0	2.9	0.66	3.51	11.9	10.48
5/4/2017 12:40	0.023	3.6	3.2	0.77	4.88	11.1	10.64
5/15/2017 12:32	0.021	2.9	2.3	0.62	4.27	17.8	10.32
5/31/2017 13:22	0.011	4.9	3.2	0.35	4.27	15.8	8.18
6/13/2017 13:24	0.018	7.6	6.7	0.69	4.27	22.8	8.01
6/27/2017 14:07	0.038	13.0	12.0	0.76	3.96	20.5	9.20
7/13/2017 11:54	0.046	16.0	15.0	0.78	2.59	24.7	7.77
7/27/2017 12:59	0.044	27.0	26.0	0.98	1.98	26.3	9.37
8/8/2017 13:13	0.051	28.0	25.0	1.10	1.68	23.9	10.35
8/22/2017 13:39	0.051	30.0	28.0	0.92	1.83	22.0	7.00
9/7/2017 13:48	0.053	28.0	27.0	0.97	1.83	19.2	7.42
9/19/2017 11:32	0.065	46.0	45.0	1.10	1.52	19.3	7.93
10/5/2017 9:30	0.048	8.1	6.8	0.83	3.05	16.7	5.84
10/26/17 10:09	0.034	6.6	5.2	0.65	3.35	11.1	8.87
2017 Average	0.037	16.1	14.9	0.80	3.07	18.8	8.67
2017 Summer Average	0.046	24.5	23.1	0.91	2.46	21.6	8.36
Volunteer Data							
4/17/2017 16:39	0.022	2.1	1.6	0.54	4.00	12.9	NA
5/14/2017 13:20	0.028	1.8	1.3	0.62	4.00	18.2	NA
5/27/2017 10:15	0.020	2.5	2.4	0.57		18.1	NA
6/1/2017 14:36	0.019	1.9	1.8	0.68	4.70	19.2	NA
6/17/2017 10:52	0.016	5.5	4.7	0.62	3.00	24.3	NA
7/5/2017 13:19	0.020	6.5	6.0	0.50	3.00	25.7	NA
7/6/2017 10:21	0.028	14.0	11.0	0.72			NA
7/10/2017 14:18	0.045	8.2	7.5	0.88	1.50	19.4	NA
7/15/2017 9:15	0.026	12.0	11.0	0.56	2.30	24.2	NA
7/20/2017 10:10	0.044	26.0	24.0	0.82	1.40	22.7	NA
7/24/2017 14:44	0.031	11.0	10.0	0.67	1.60	26.2	NA
8/6/2017 10:21					1.50	23.6	NA
9/21/2017 14:42	0.042	28.0	26.0	0.81	1.50	20.5	NA
10/8/2017 12:12	0.038	7.6	6.9	0.66	3.30	17.7	NA
2017 Average	0.029	9.8	8.8	0.67	2.65	21.0	NA
2017 Summer Average	0.030	12.6	11.3	0.70	2.28	22.9	NA

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	901.88	5/31/2017	901.38	9/19/2017	901.58

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	C	C	B	B	B	C	C	NA	NA	NA
Chlorophyll-*a* (µg/L)	C	C	B	B	B	B	C	NA	NA	NA
Secchi depth (ft)	B	C	B	C	C	C	C	NA	NA	NA
Overall	**C+**	**C**	**B**	**B-**	**B-**	**C+**	**C**	**NA**	**NA**	**NA**

Forest Lake
Water Surface Elevation Statistics

Outlet Elevation (dam): 901.4 ft.

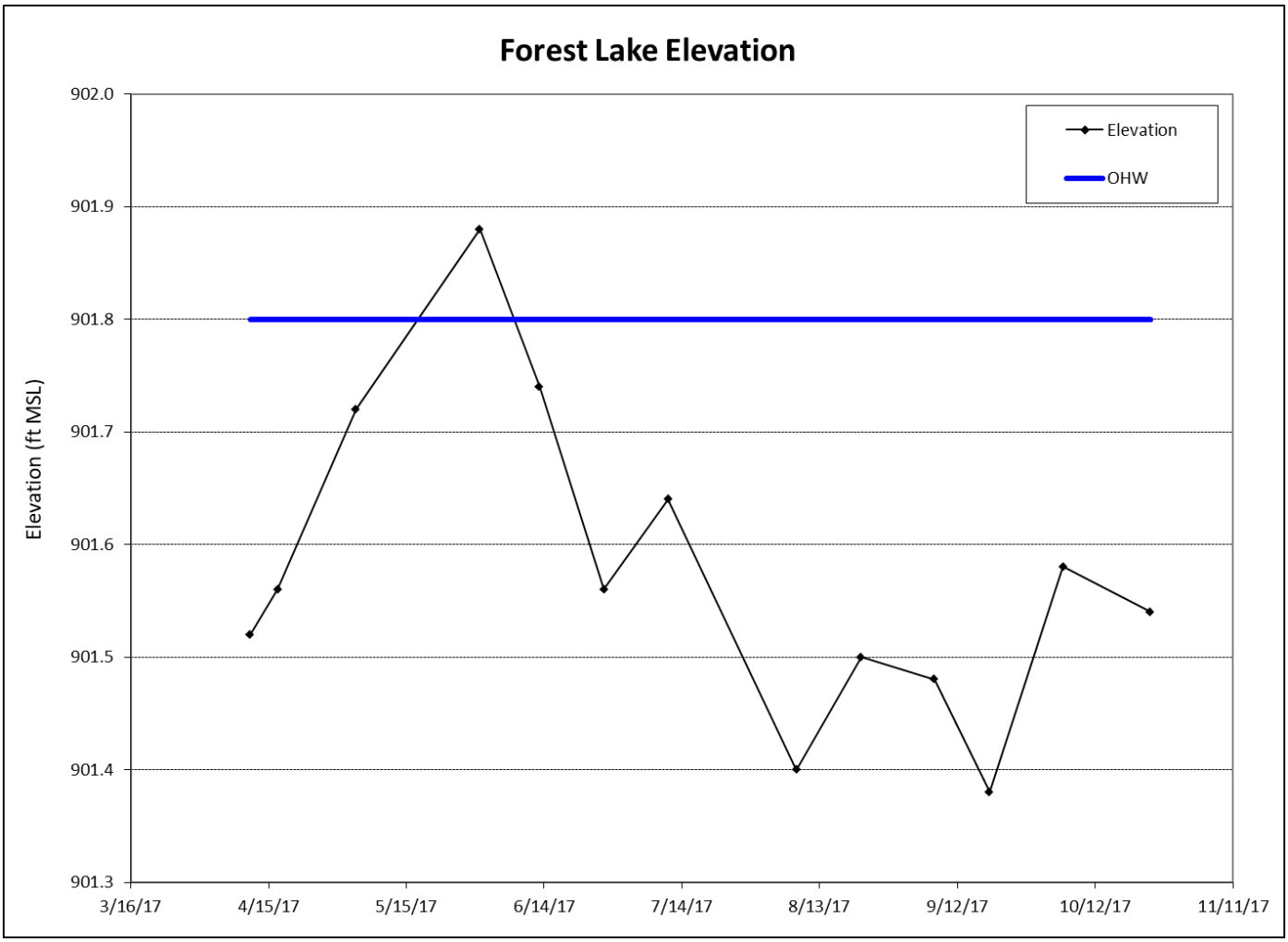
Ordinary High Water Level (OHW) Elevation: 901.8 ft.

100 Year Flood Elevation (CLFLWD): 902.4 ft.

Highest Recorded Elevation: 902.23 ft. (06/24/1993)

Lowest Recorded Elevation: 899.45 ft. (10/07/1969)

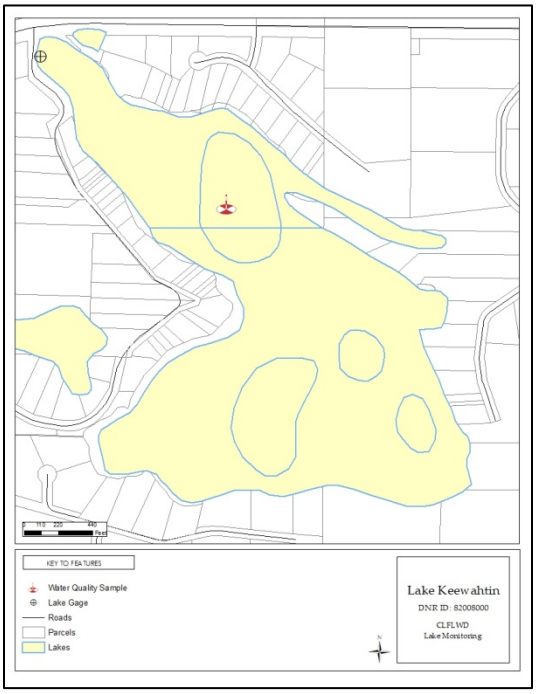
Datum: NGVD 29 (ft.)



Lake Keewahtin

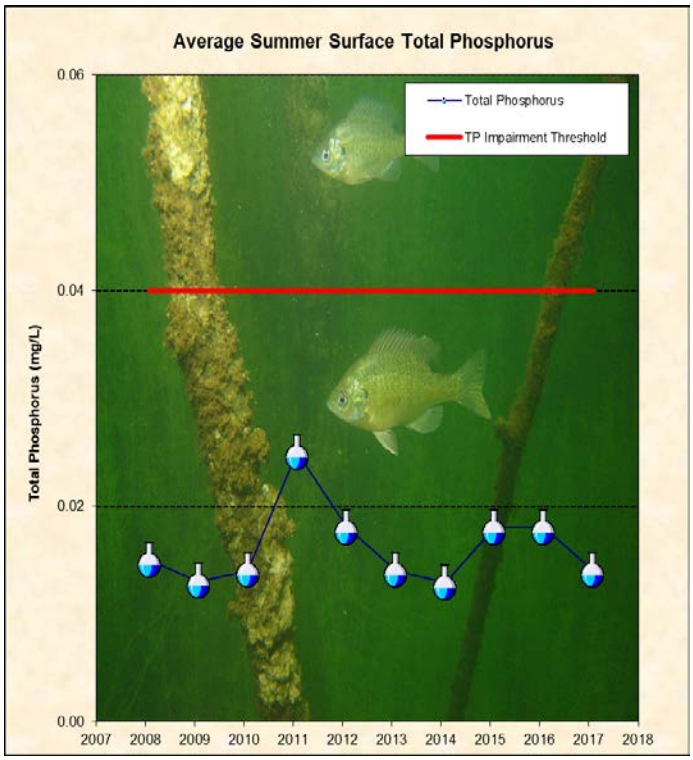
2017 Lake Grade: A

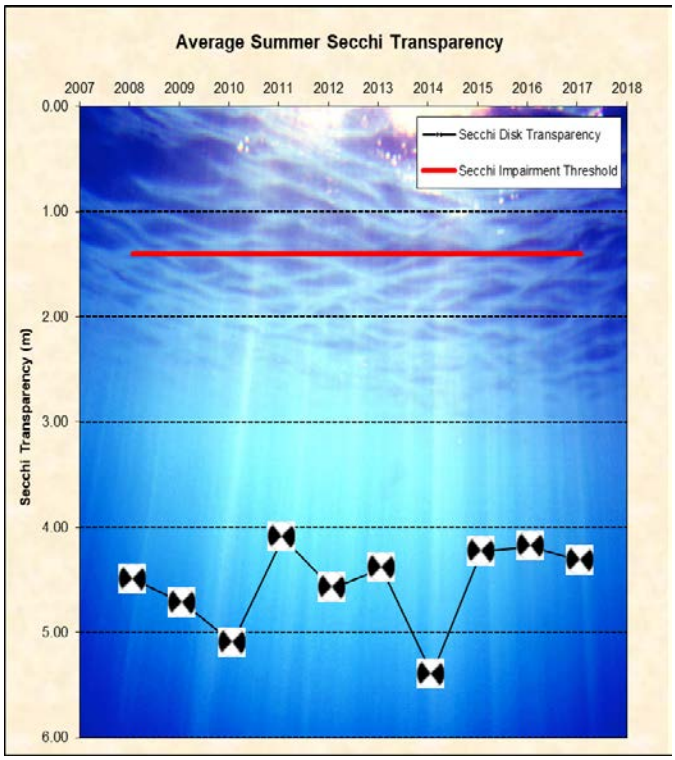
- DNR ID #: 82008000
- Municipality: City of Forest Lake
- Location: Section 24 T32N-R21W
- Lake Size: 74.50 acres
- Maximum Depth (2017): 42 ft.
- Ordinary High Water Mark: 937.1 ft.
- 90% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Lake Keewahtin was considered mesotrophic in 2017, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus and a statistically significant **improving** trend for the average Secchi transparency and no trend for chlorophyll-*a* at this time.
- The major land use is semi-urban and rural/agricultural.
- The lake stratified in 2017 with the thermocline varying between 5 and 7 meters.
- Curly-leaf pondweed (an invasive aquatic plant) is present in this lake.





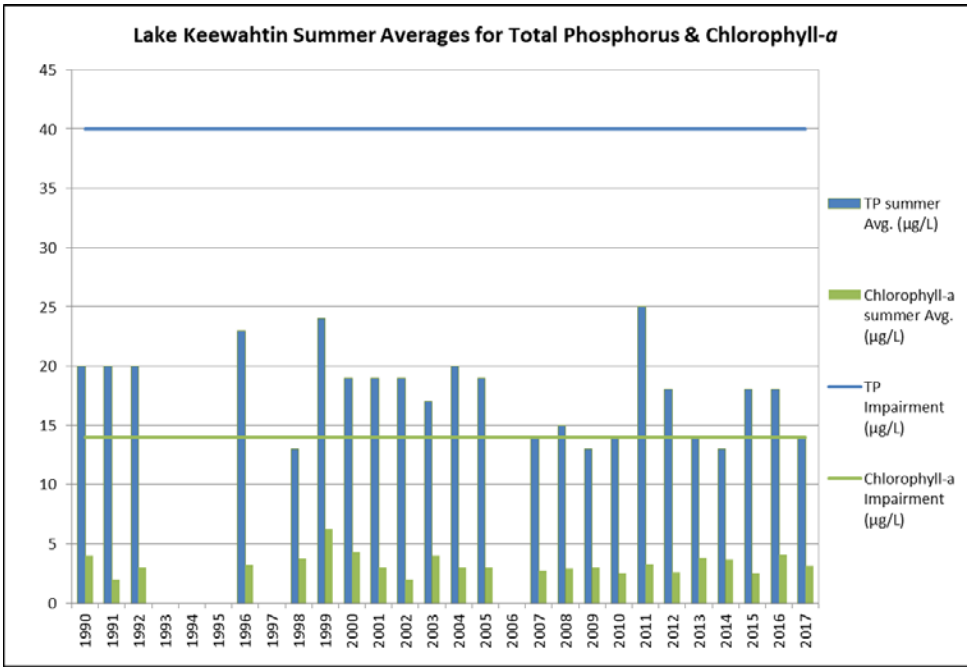
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/19/2017 13:45	0.018	3.4	2.7	0.50	3.66	12.4	9.41
5/3/2017 11:17	0.015	1.9	1.3	0.43	5.18	10.9	9.85
5/17/2017 10:43	NA	3.0	2.6	NA	4.27	19.8	8.26
6/1/2017 8:23	0.012	3.0	2.9	0.51	4.72	17.7	8.64
6/15/2017 9:24	0.021	2.9	2.9	0.64	3.96	24.6	7.22
6/28/2017 11:17	0.011	3.5	2.7	0.50	3.96	20.6	8.35
7/12/2017 11:10	0.007	2.6	2.5	0.36	3.96	26.2	7.93
7/26/2017 9:43	0.015	2.9	2.3	0.59	4.27	26.0	7.57
8/9/2017 8:15	0.015	2.5	2.6	0.83	4.57	23.5	8.76
8/21/2017 12:05	0.017	2.3	1.7	0.54	4.57	23.7	8.42
9/7/2017 10:54	0.017	4.9	3.8	0.61	4.42	18.6	7.26
9/20/2017 13:43	0.012	8.7	6.7	0.54	4.42	20.1	7.31
10/4/2017 10:19	0.010	5.5	4.7	0.51	4.27	16.7	7.48
10/19/17 13:45	0.014	5.7	5.1	0.49	4.11	12.8	8.56
2017 Average	0.014	3.8	3.2	0.54	4.31	19.5	8.22
2017 Summer Average	0.014	3.7	3.1	0.57	4.32	22.3	7.94
Volunteer Data							
5/3/2017 15:00	0.009	2	1.8	0.4	6.2	12.6	NA
5/14/2017 11:00	0.012	2.4	1.3	0.44	4	18.4	NA
6/20/2017 8:35	0.006	4.4	3.7	0.46	4.9	22.5	NA
7/15/2017 15:10	0.014	2.1	1.6	0.45	5	25.4	NA
8/1/2017 12:40	0.019	1.6	1.3	0.46	4.3	27.6	NA
8/8/2017 11:50	0.011	3.1	2.5	0.46	5.8	17.8	NA
8/14/2017 15:40	0.009	1.5	1.2	0.49	5.3	22.8	NA
9/27/2017 14:00	0.013	2.9	2.7	0.45	4.9	19.8	NA
2017 Average	0.012	2.5	2.0	0.45	5.05	20.9	NA
2017 Summer Average	0.012	2.6	2.2	0.46	5.03	22.7	NA

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	937.39	6/1/2017	936.79	9/20/2017	937.09

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	A	A	A	A	A	A	B	A	A	A
Chlorophyll-*a* (µg/L)	A	A	A	A	A	A	A	A	A	A
Secchi depth (ft)	A	A	A	A	A	A	A	A	A	A
Overall	**A**	**A**	**A**	**A**	**A**	**A**	**A-**	**A**	**A**	**A**

Lake Keewahtin
Water Surface Elevation Statistics

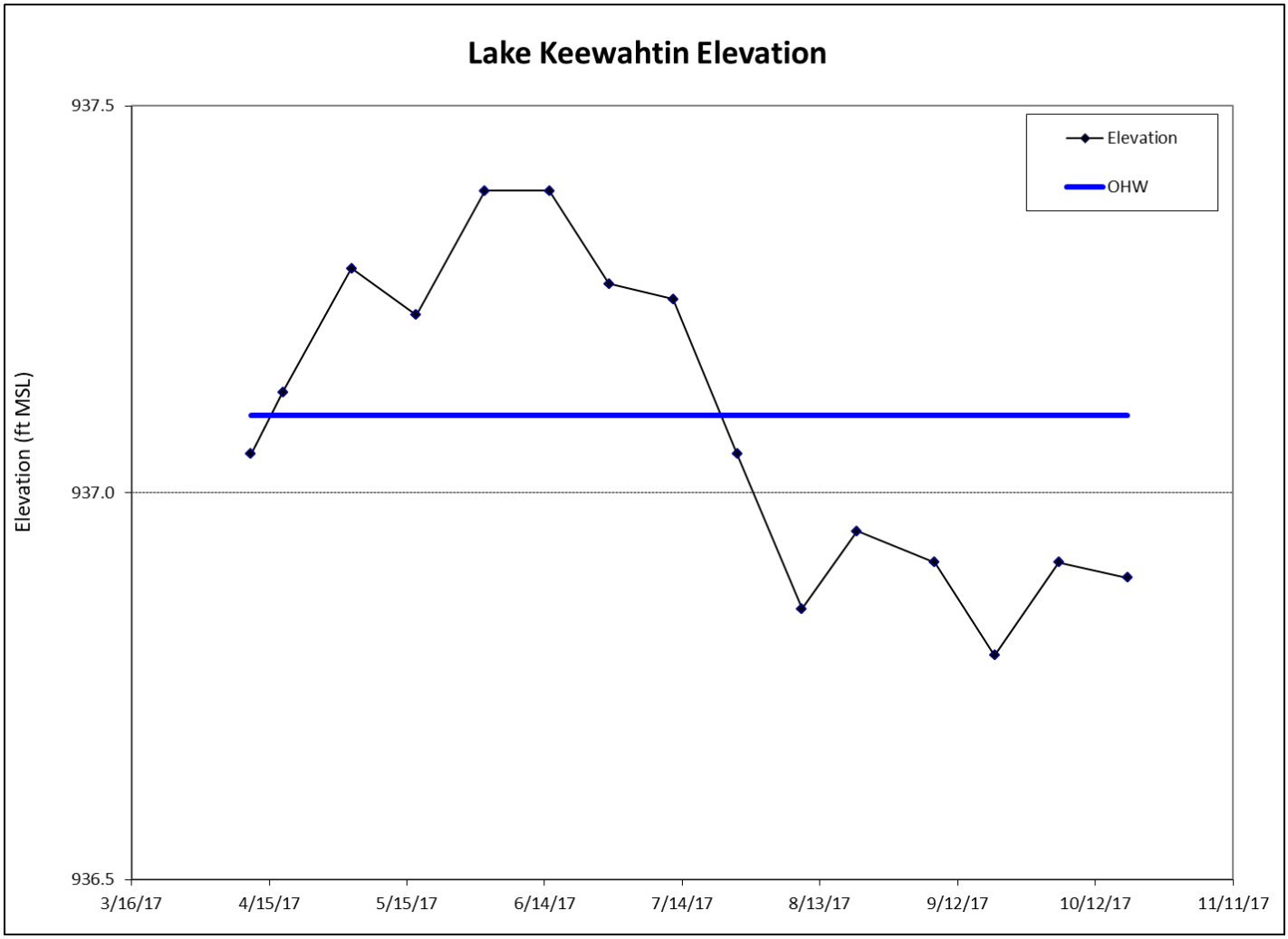
Outlet Elevation: N/A (landlocked)

Ordinary High Water Level (OHW) Elevation: 937.1 ft.

Highest Recorded Elevation: 938.00 ft. (07/03/2003)

Lowest Recorded Elevation: 934.52 ft. (11/22/1990)

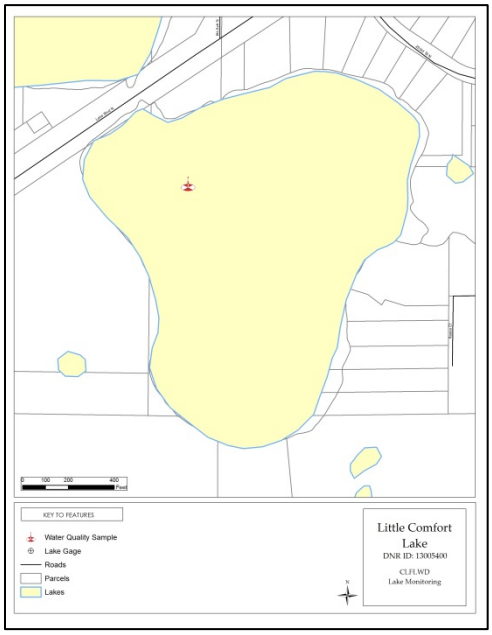
Datum: NGVD 29 (ft.)



Little Comfort Lake

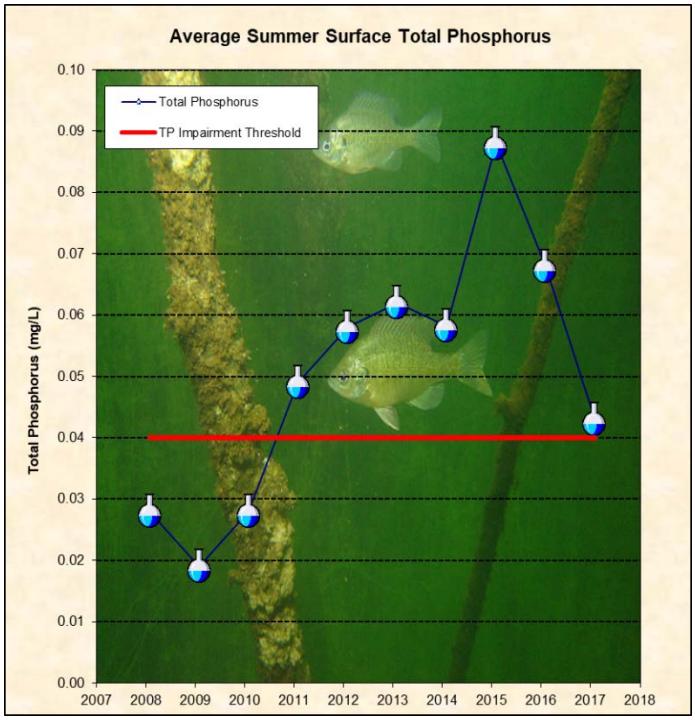
2017 Lake Grade: C

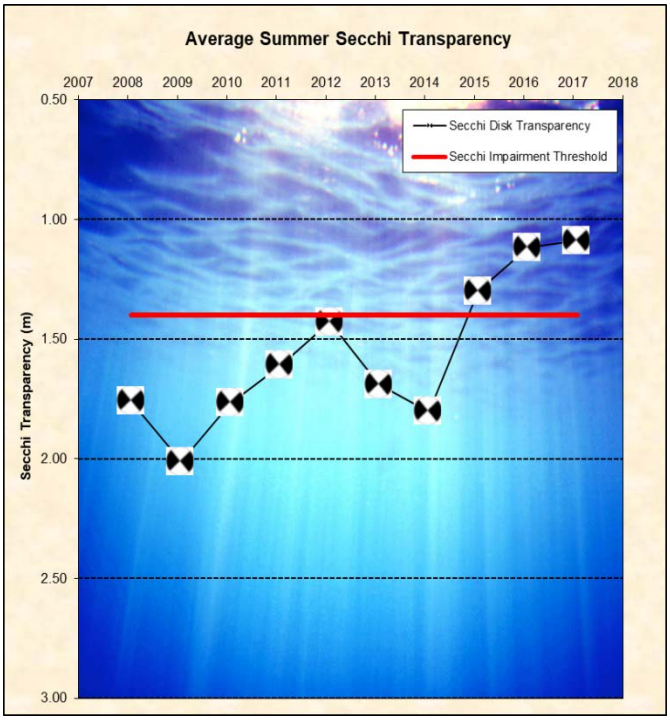
- DNR ID #: 13005400
- Municipality: Chisago City
- Location: Section 27 T33N-R21W
- Lake Size: 36 acres
- Maximum Depth (2017): 54 ft.
- Ordinary High Water Mark: 887.2 ft.
- 44% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Little Comfort Lake was considered eutrophic in 2017, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p<0.05$) there is a statsically significant **declining** trend for the average Secchi transparency at this time and average chlorophyll-*a* and no trend for the average total phosphorus.
- The major land use is rural/agricultural.
- The lake stratified in 2017 with the thermocline varying between 3 and 5 meters.
- Little Comfort Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Curly-leaf pondweed (invasive aquatic plant) is present in this lake. A report has been made of the presence of Eurasian watermilfoil but that has yet to be verified.





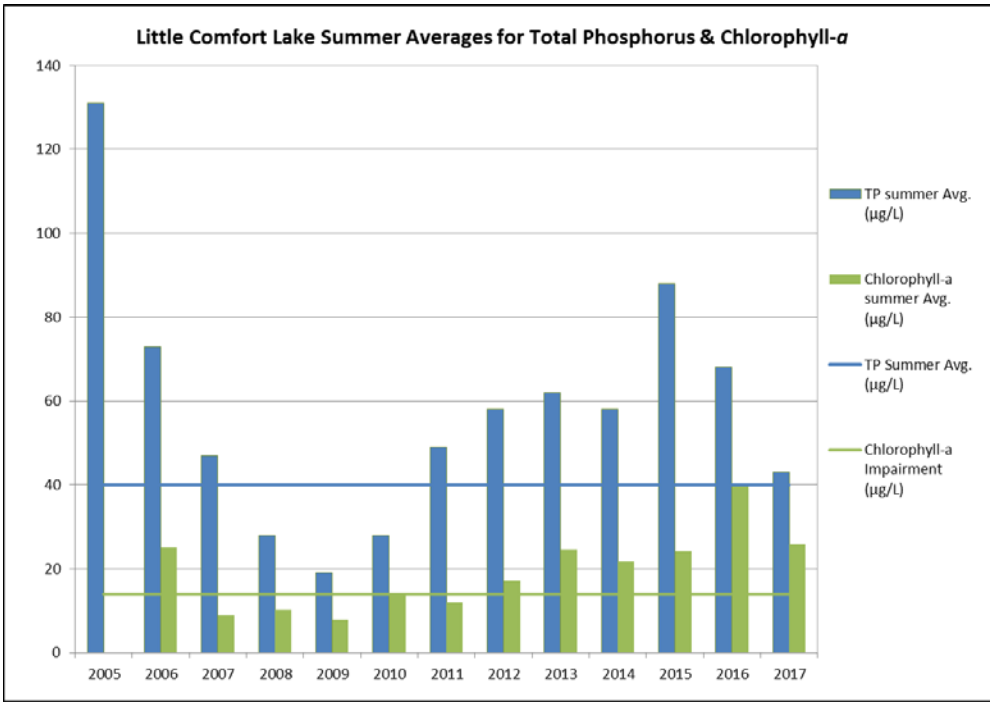
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/19/2017 11:51	0.055	30.0	26.0	1.00	1.07	11.7	9.96
5/3/2017 9:08	0.037	11.0	7.6	0.86	1.68	9.9	9.81
5/17/2017 8:36	0.031	12.0	11.0	0.90	2.13	19.5	8.44
5/31/2017 14:49	0.030	11.0	10.0	0.86	1.68	17.3	8.28
6/14/2017 11:31	0.019	31.0	29.0	0.62	1.07	24.1	8.25
6/28/2017 9:26	0.042	28.0	26.0	1.20	0.91	20.3	8.01
7/12/2017 9:38	0.026	46.0	44.0	1.10	0.46	25.7	8.77
7/25/2017 10:13	0.063	30.0	28.0	1.20	0.61	24.5	7.28
8/9/2017 9:35	0.071	20.0	20.0	1.30	0.91	23.2	8.37
8/21/2017 10:37	0.034	24.0	23.0	1.10	1.07	23.7	8.80
9/5/2017 12:58	0.036	20.0	19.0	0.97	1.52	19.6	7.14
9/20/2017 11:34	0.050	18.0	17.0	0.92	2.13	19.6	7.21
10/3/2017 11:07	0.035	5.5	4.0	1.00	1.98	17.1	7.57
10/19/17 11:02	0.046	15.0	13.0	1.10	1.52	12.5	7.15
2017 Average	0.041	21.5	19.8	1.01	1.34	19.2	8.22
2017 Summer Average	0.043	27.1	25.8	1.05	1.09	22.6	7.98
Volunteer Data							
05/07/2017 15:00	0.046	8.1	5.3	0.81	0.90	16.4	NA
05/17/2017 13:00	0.027	7.6	6.2	0.84	0.90	17.6	NA
06/07/2017 11:00	0.040	14.0	13.0	1.20	0.90	21.4	NA
06/21/2017 13:00	0.047	23.0	22.0	1.10	1.00	24.1	NA
07/10/2017 14:00	0.028	14.0	14.0	0.98	1.20	28.5	NA
07/24/2017 13:00	0.052	16.0	14.0	1.20	1.20	29.2	NA
08/14/2017 15:00	0.022	10.0	8.5	0.84	1.50	28.7	NA
08/24/2017 13:00	0.028	7.5	6.4	0.82	1.90	24.9	NA
09/07/2017 14:00	0.023	7.4	5.7	0.81	2.00	24.2	NA
09/21/2017 13:00	0.032	5.6	4.8	0.70	2.10	21.7	NA
10/15/2017 14:00	0.031	8.7	7.3	0.94	3.20		NA
2017 Average	0.034	11.1	9.7	0.93	1.53	23.7	NA
2017 Summer Average	0.027	7.8	6.5	0.82	1.48	25.3	NA

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	NA	NA	NA	NA	NA

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	C	C	D	C	C	C	C	B	A	B
Chlorophyll-*a* (µg/L)	C	C	C	C	C	B	B	B	A	C
Secchi depth (ft)	C	C	C	C	C	C	C	C	C	C
Overall	**C**	**C**	**C-**	**C**	**C**	**C+**	**C+**	**B-**	**B+**	**B-**

Little Comfort Lake
Water Surface Elevation Statistics

Outlet Elevation: 885.7 ft.

Ordinary High Water Level (OHW) Elevation: 887.2 ft.

100 Year Flood Elevation (CLFLWD): 892.1 ft.

Highest Recorded Elevation: 887.81 ft. (05/08/2001)

Lowest Recorded Elevation: 885.41 ft. (09/05/2003)

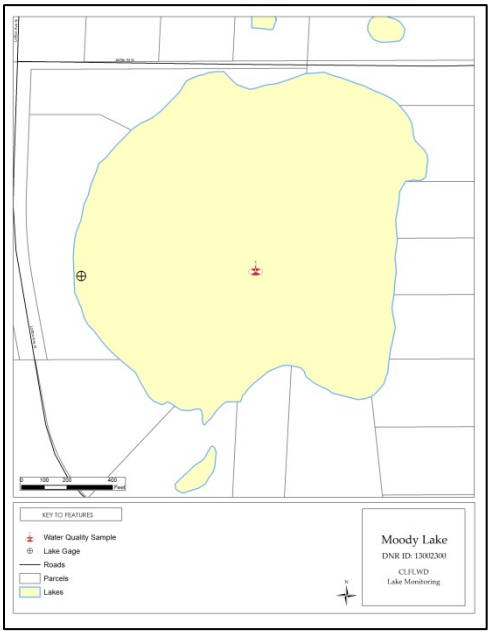
Datum: NGVD 29 (ft.)

*Elevation data has not been recorded on this lake since 2004.

Moody Lake

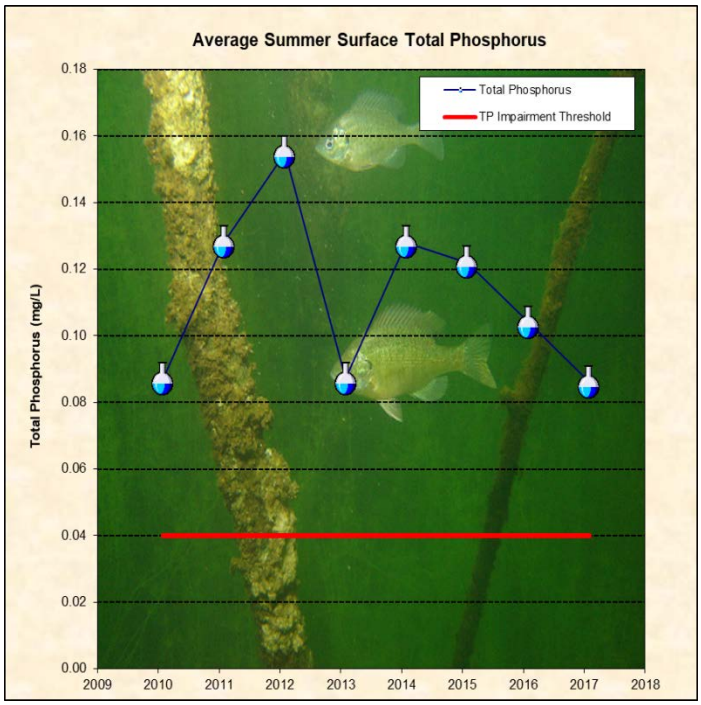
2017 Lake Grade: D+

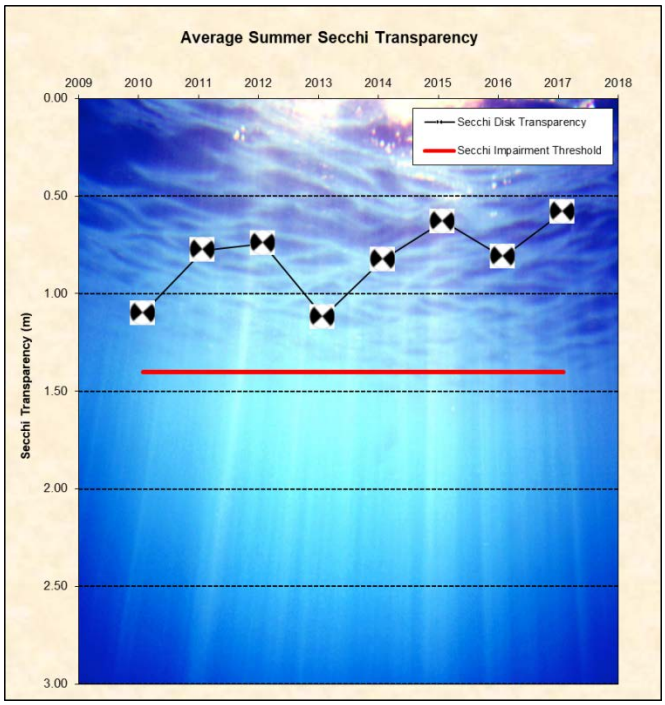
- DNR ID #: 13002300
- Municipality: Chisago Lakes Township
- Location: $SW^{1/4}$ Section 32 T33N-R20W
- Lake Size: 45.33 acres
- Maximum Depth (2017): 49 ft.
- Ordinary High Water Mark: N/A
- 49% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Moody Lake was considered eutrophic in 2017, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus and no trend for the average Secchi transparency or average chlorophyll-*a* at this time.
- The major land use is rural/agricultural.
- The lake stratified in 2017 with the thermocline varying between 3 and 4 meters.
- Moody Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Curly-leaf pondweed (an invasive aquatic plant) is present in this lake.





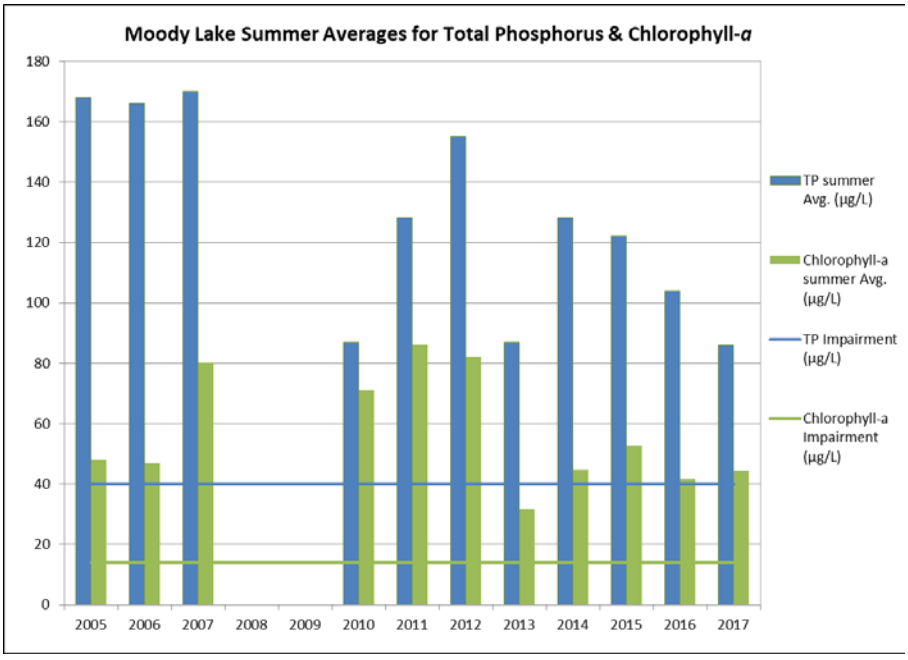
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/19/2017 10:57	0.073	21.0	17.0	1.20	1.22	11.7	9.96
5/3/2017 8:25	0.071	12.0	10.0	1.20	1.68	10.1	10.03
5/16/2017 13:41	0.047	9.0	8.0	1.00	1.22	19.0	9.12
5/31/2017 14:08	0.069	20.0	18.0	1.10	1.07	16.6	8.67
6/14/2017 10:54	0.101	24.0	22.0	1.70	1.22	23.6	5.91
6/27/2017 13:21	0.107	82.0	80.0	2.30	0.30	21.3	12.27
7/11/2017 12:00	0.152	69.0	66.0	2.30	0.38	26.8	9.54
7/25/2017 9:38	0.063	84.0	72.0	0.97	0.46	24.6	5.20
8/8/2017 14:15	0.068	38.0	34.0	1.90	0.46	24.6	9.72
8/21/2017 9:00	0.072	30.0	27.0	1.40	0.61	23.4	7.61
9/6/2017 11:46	0.071	35.0	30.0	1.30	0.61	18.8	6.14
9/20/2017 10:33	0.054	28.0	24.0	1.10	0.61	19.7	6.36
10/4/2017 12:33	0.065	19.0	16.0	1.10	1.07	16.5	7.28
10/19/17 9:28	0.055	25.0	22.0	1.10	1.07	12.2	7.26
2017 Average	0.076	35.4	31.9	1.41	0.85	19.2	8.22
2017 Summer Average	0.086	48.8	44.4	1.62	0.58	22.9	7.84
Volunteer Data							
04/23/2017 17:30	0.052	4.8	2.7	1.10	2.00	11.9	NA
05/07/2017 17:30	0.043	4.1	4.6	1.00	2.40	17.7	NA
05/21/2017 09:00	0.061	12.0	9.4	1.10	1.70	17.6	NA
06/04/2017 09:00	0.082	57.0	55.0	1.70	0.80	22.3	NA
06/18/2017 19:00	0.107	58.0	53.0	1.60	0.70	23.9	NA
07/02/2017 17:00	0.125	190.0	190.0	3.00	0.40	27.5	NA
07/16/2017 17:30	0.105	99.0	88.0	1.90	0.50	26.9	NA
07/30/2017 19:00	0.073	48.0	47.0	1.60	0.60	27.6	NA
08/13/2017 15:00	0.073	30.0	23.0	1.40	0.90	22.7	NA
08/27/2017 17:30	0.076	42.0	36.0	1.20	0.60	20.1	NA
09/10/2017 17:00	0.037	24.0	20.0	0.94	0.80	19.7	NA
09/24/2017 16:30	0.046	19.0	15.0	1.20	0.90	24.6	NA
10/08/2017 17:00	0.051	18.0	13.0	1.20	1.10	17.3	NA
10/22/2017 08:30	0.182	33.0	30.0	1.40	1.10	12.3	NA
2017 Average	0.080	45.6	41.9	1.45	1.04	20.9	NA
2017 Summer Average	0.080	63.0	58.6	1.62	0.69	23.9	NA

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	912.00	5/3/2017	911.32	9/20/2017	911.60

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	D	D	D	D	D	F	D	D	NA	NA
Chlorophyll-*a* (µg/L)	C	C	D	C	C	F	F	D	NA	NA
Secchi depth (ft)	D	D	F	D	D	D	D	D	NA	NA
Overall	**D+**	**D+**	**D-**	**D+**	**D+**	**F+**	**D-**	**D**	**NA**	**NA**

Moody Lake
Water Surface Elevation Statistics

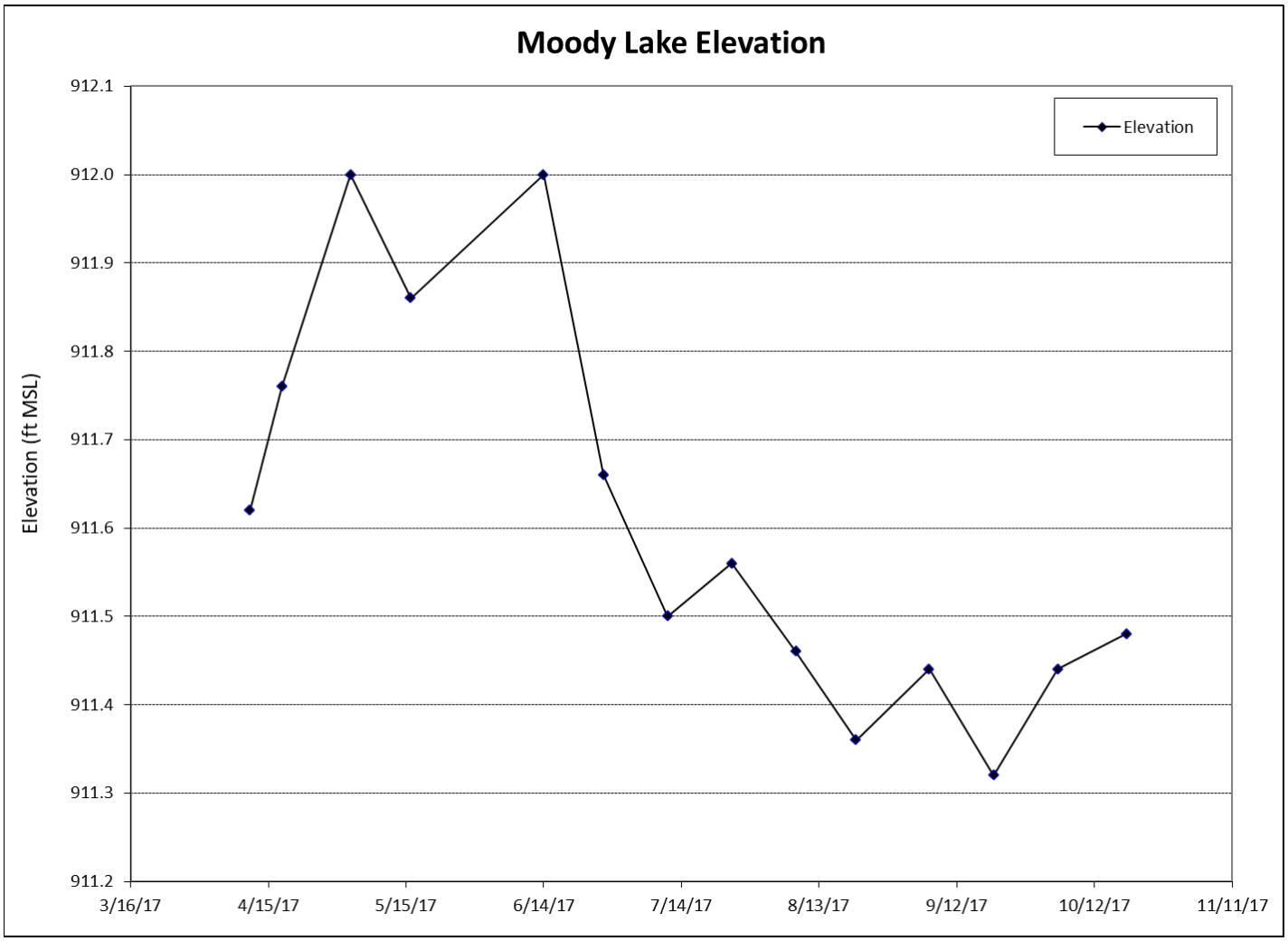
Ordinary High Water Level (OHW) Elevation: N/A

100 Year Flood Elevation (CLFLWD): 892.1 ft.

Highest Recorded Elevation: 913.32 ft. (09/22/2015)

Lowest Recorded Elevation: 911.32 ft. (9/20/2017)

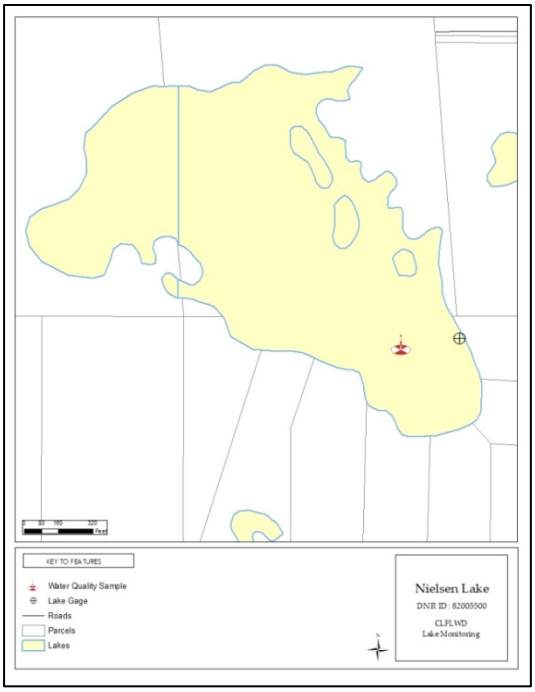
Datum: NGVD 29 (ft.)



Nielsen Lake

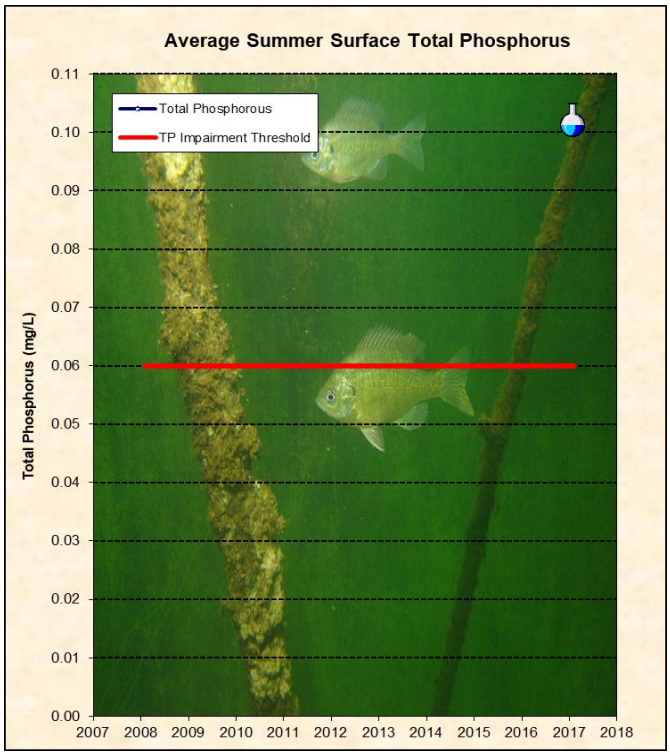
2017 Lake Grade: F+

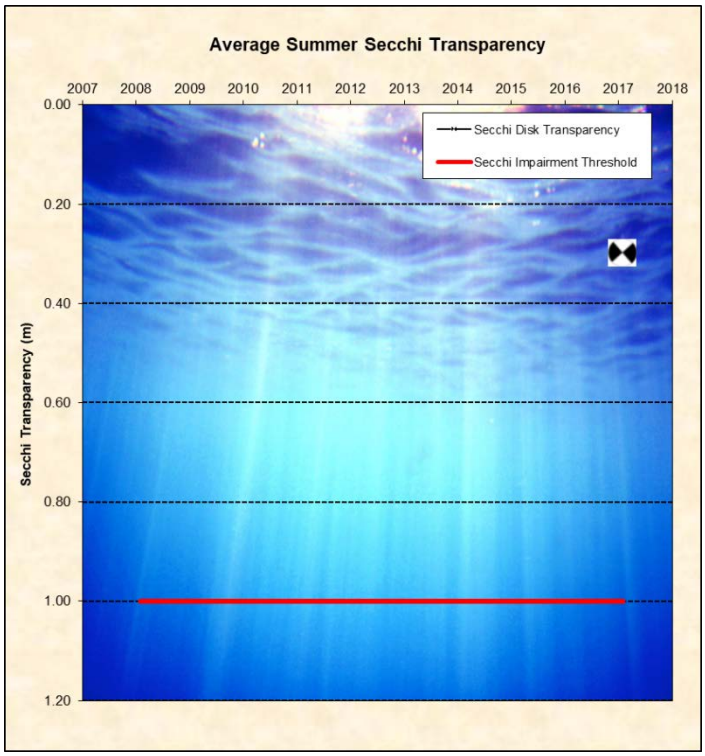
- DNR ID #: 82005500
- Municipality: New Scandia Township
- Location: SW$^{1/4}$ Section 5 T32N-R19&20W
- Lake Size: 37 acres
- Maximum Depth (2017): 12 ft.
- Ordinary High Water Mark: 928.7 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Nielsen Lake was considered hypereutrophic in 2017, according to the Carlson Trophic State Index.
- There are an insufficient number of years of data to determine long term water quality trends at this time.
- The major land use is rural/agricultural.
- The lake stratified in 2017 with the thermocline around 2 meters.





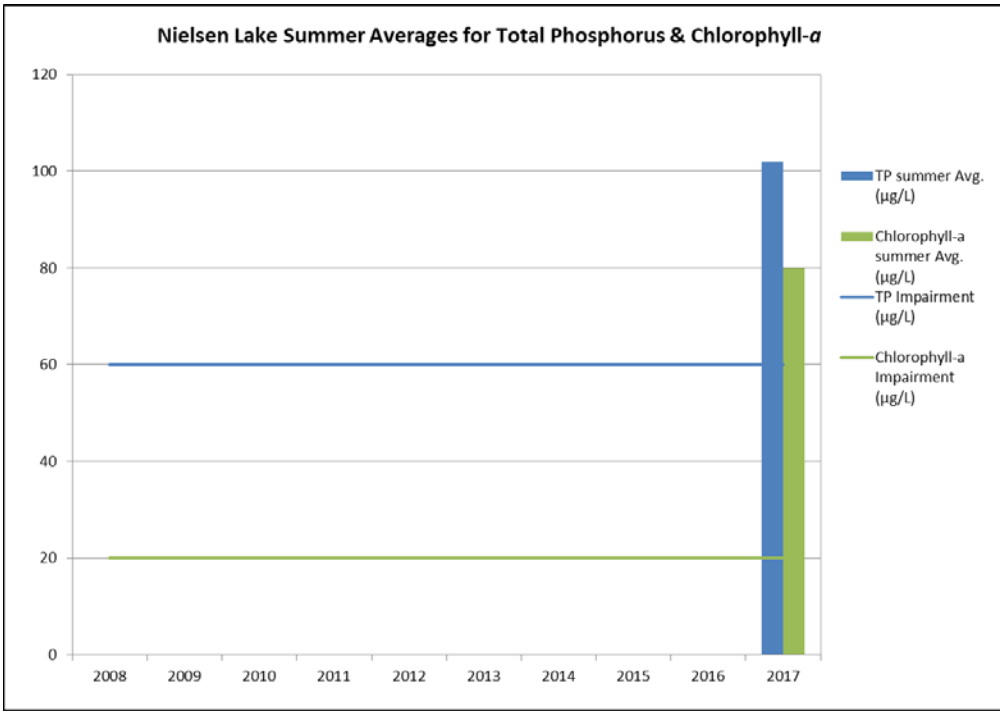
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/18/2017 9:57	0.096	93.0	85.0	2.60	0.30	12.5	11.22
5/2/2017 14:23	0.119	110.0	95.0	2.60	0.30	10.2	10.47
5/16/2017 13:04	0.090	45.0	38.0	2.10	0.46	19.3	7.48
5/31/2017 13:04	0.082	51.0	44.0	2.10	0.91	16.9	7.72
6/14/2017 10:26	0.107	26.0	23.0	2.40	0.46	24.1	7.08
6/27/2017 14:24	0.103	78.0	75.0	2.30	0.30	22.8	10.24
7/11/2017 13:41	0.078	71.0	66.0	2.20	0.30	26.7	10.20
7/25/2017 8:40	0.097	93.0	86.0	2.70	0.30	24.5	4.96
8/8/2017 13:21	0.090	94.0	90.0	3.00	0.15	25.3	11.96
8/21/2017 8:33	0.116	100.0	98.0	3.00	0.15	23.2	8.69
9/6/2017 10:48	0.129	110.0	110.0	3.00	0.46	18.7	5.69
9/20/2017 9:32	0.098	96.0	91.0	2.80	0.30	19.3	4.99
10/4/2017 11:39	0.096	110.0	100.0	2.90	0.30	16.8	7.55
10/19/17 8:25	0.087	100.0	98.0	2.90	0.30	12.4	8.44
2017 Average	0.099	84.1	78.5	2.61	0.36	19.5	8.34
2017 Summer Average	0.102	83.5	79.9	2.68	0.30	23.1	7.98

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	929.00	5/31/2017	928.16	10/19/2017	928.56

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	D	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorophyll-*a* (µg/L)	F	NA	NA	NA	NA	NA	NA	NA	NA	NA
Secchi depth (ft)	F	NA	NA	NA	NA	NA	NA	NA	NA	NA
Overall	**F+**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Nielsen Lake
Water Surface Elevation Statistics

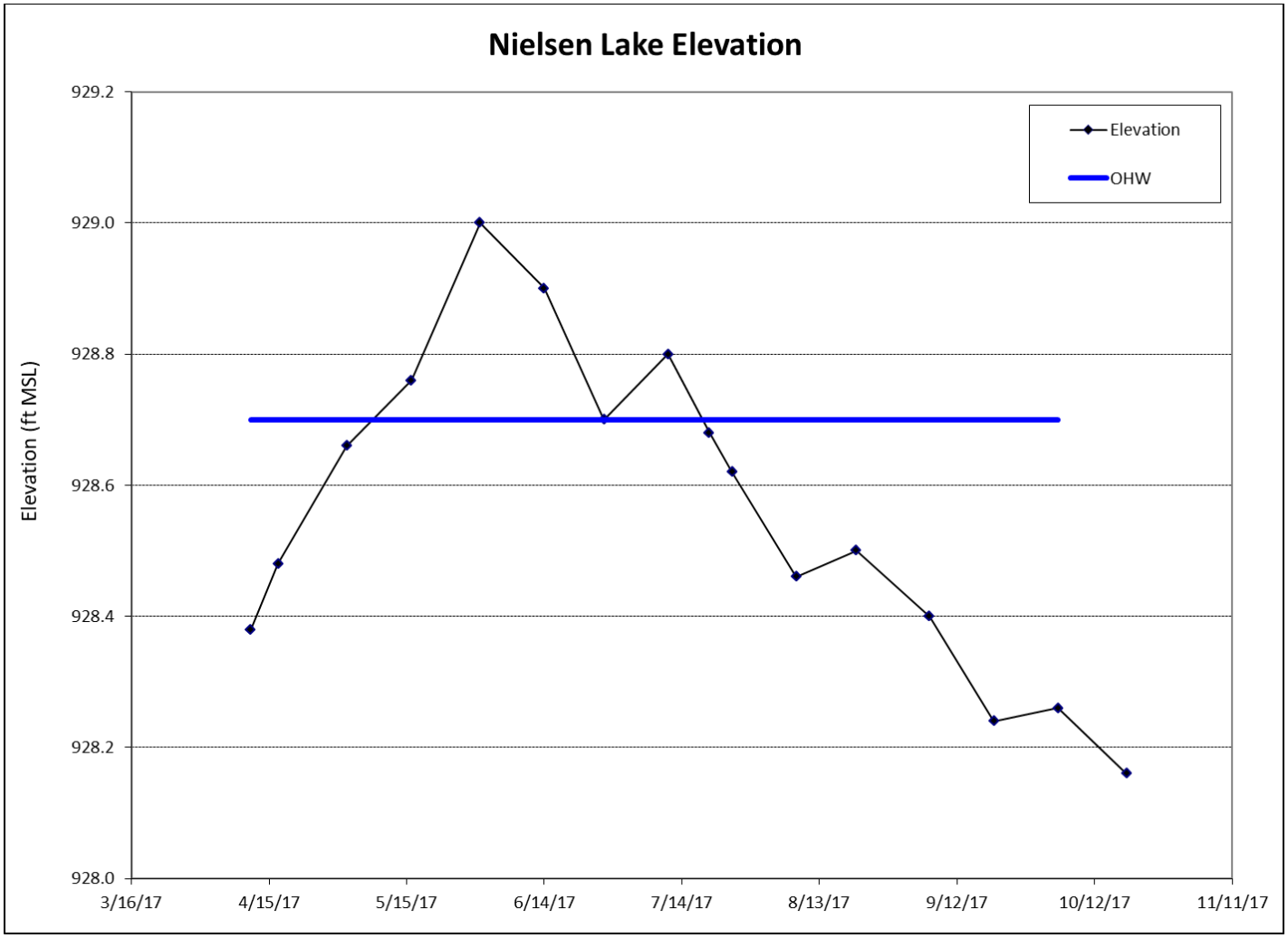
Ordinary High Water Level (OHW) Elevation: 928.7 ft.

100 Year Flood Elevation (CLFLWD): 932.6 ft.

Highest Recorded Elevation: 929.0 ft. (5/31/2017)

Lowest Recorded Elevation: 928.16 ft. (10/19/2017)

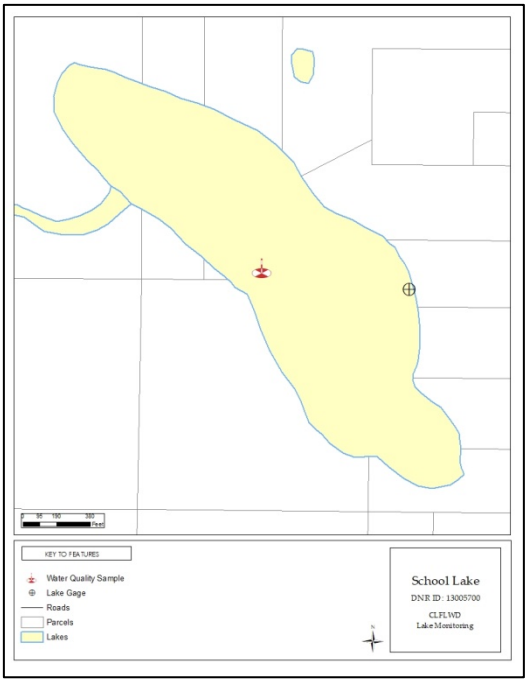
Datum: NGVD 29 (ft.)



School Lake

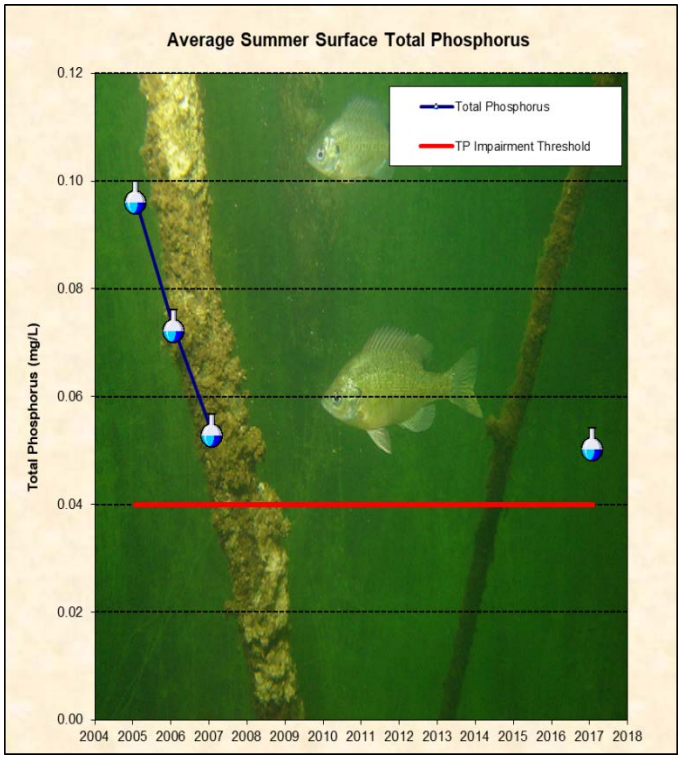
2017 Lake Grade: C-

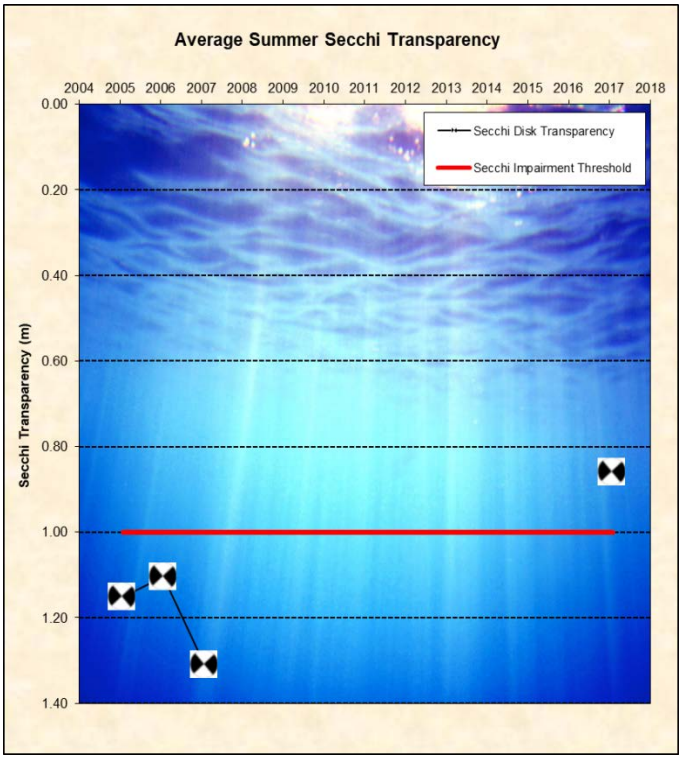
- DNR ID #: 13005700
- Municipality: City of Wyoming
- Location: SE$^{1/4}$ Section 35 T33N-R21W
- Lake Size: 49 acres
- Maximum Depth (2017): 24.5 ft.
- Ordinary High Water Mark: 891.6 ft.
- 66% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results School Lake was considered hypereutrophic in 2017, according to the Carlson Trophic State Index.
- There are an insufficient number of years of data to determine long term water quality trends at this time.
- The major land use is rural/agricultural.
- The lake stratified in 2017 with the thermocline varying between 3 and 5 meters.
- School Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Curly-leaf pondweed (an invasive aquatic plant) is present in this lake.





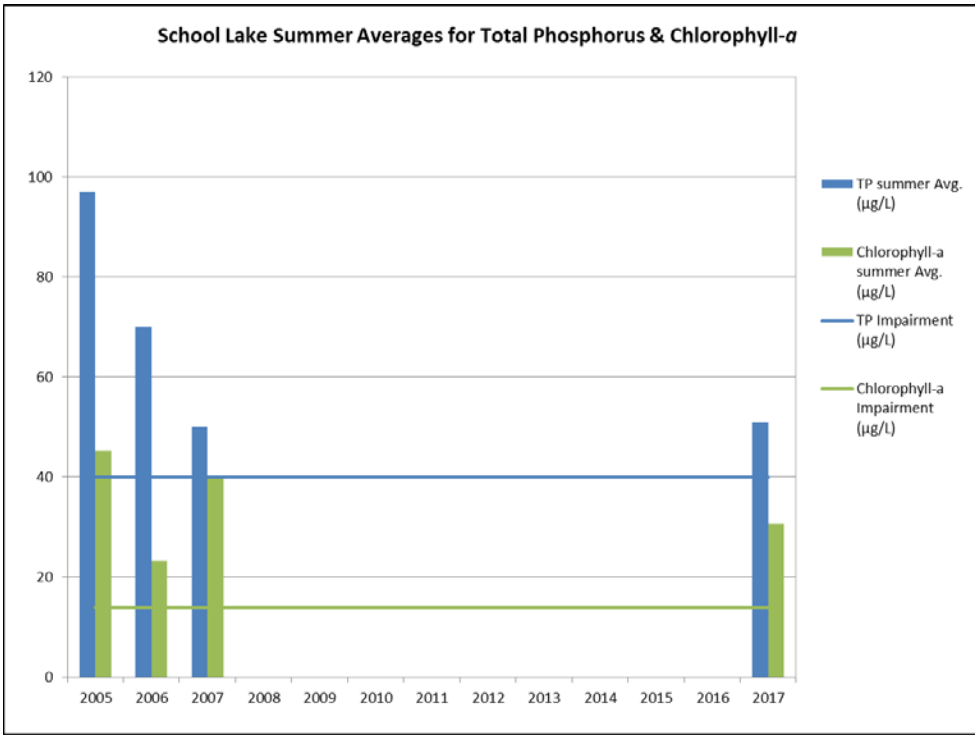
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/18/2017 10:40	0.046	34.0	32.0	0.84	1.22	11.5	10.64
5/3/2017 9:52	0.052	15.0	10.0	0.86	1.37	10.2	9.20
5/17/2017 9:29	NA	14.0	13.0	NA	1.83	19.5	9.04
6/1/2017 10:08	0.033	16.0	14.0	0.93	1.07	17.3	9.07
6/15/2017 10:12	0.054	25.0	24.0	1.20	1.37	24.3	8.86
6/28/2017 10:14	0.053	44.0	42.0	1.40	0.76	20.4	9.05
7/12/2017 10:30	0.041	64.0	61.0	1.40	0.30	26.0	8.32
7/26/2017 8:44	0.059	59.0	56.0	1.70	0.46	24.7	7.15
8/9/2017 10:00	0.034	21.0	19.0	1.20	0.91	23.5	8.00
8/21/2017 11:26	0.031	20.0	19.0	1.00	1.07	23.8	8.56
9/7/2017 8:36	0.116	39.0	38.0	1.00	0.91	18.4	6.61
9/20/2017 13:02	0.040	3.5	3.2	1.10	0.91	19.9	7.56
10/4/2017 9:43	0.075	35.0	33.0	1.20	0.76	16.6	5.29
10/19/17 11:37	0.048	34.0	33.0	1.40	1.07	13.0	6.77
2017 Average	0.052	30.3	28.4	1.17	1.00	19.2	8.15
2017 Summer Average	0.051	32.4	30.7	1.21	0.86	22.0	8.13

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	892.14	6/1/2017	891.30	9/7/2017	891.62

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	C	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorophyll-*a* (µg/L)	C	NA	NA	NA	NA	NA	NA	NA	NA	NA
Secchi depth (ft)	D	NA	NA	NA	NA	NA	NA	NA	NA	NA
Overall	**C-**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

School Lake
Water Surface Elevation Statistics

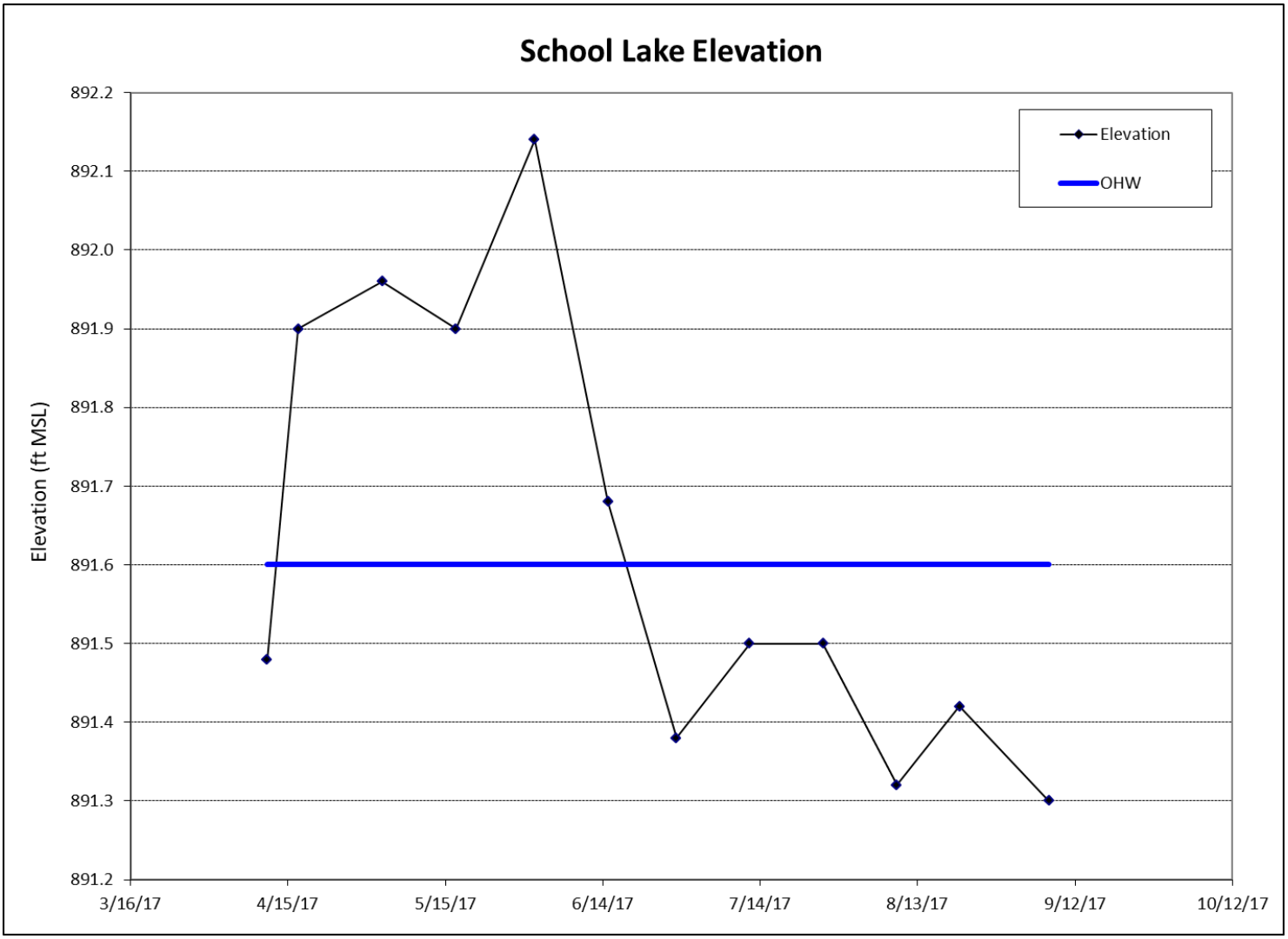
Ordinary High Water Level (OHW) Elevation: 891.6 ft.

100 Year Flood Elevation (CLFLWD): 891.1 ft.

Highest Recorded Elevation: 892.14 ft. (6/1/2017)

Lowest Recorded Elevation: 891.30 ft. (9/7/2017)

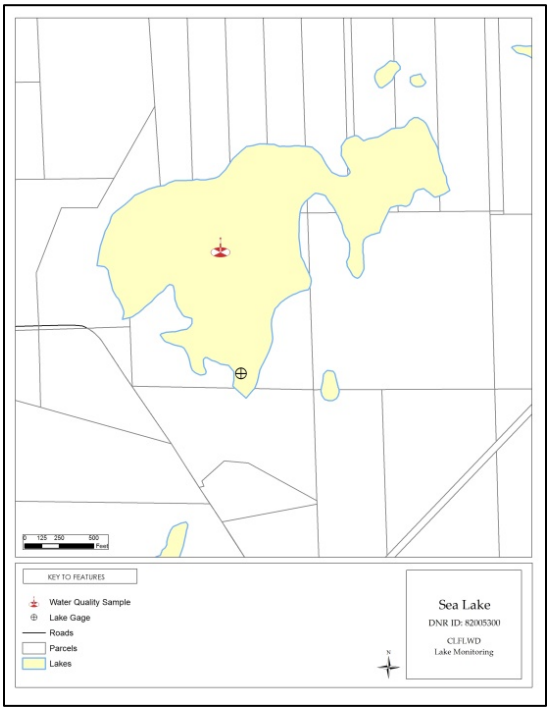
Datum: NGVD 29 (ft.)



Sea Lake

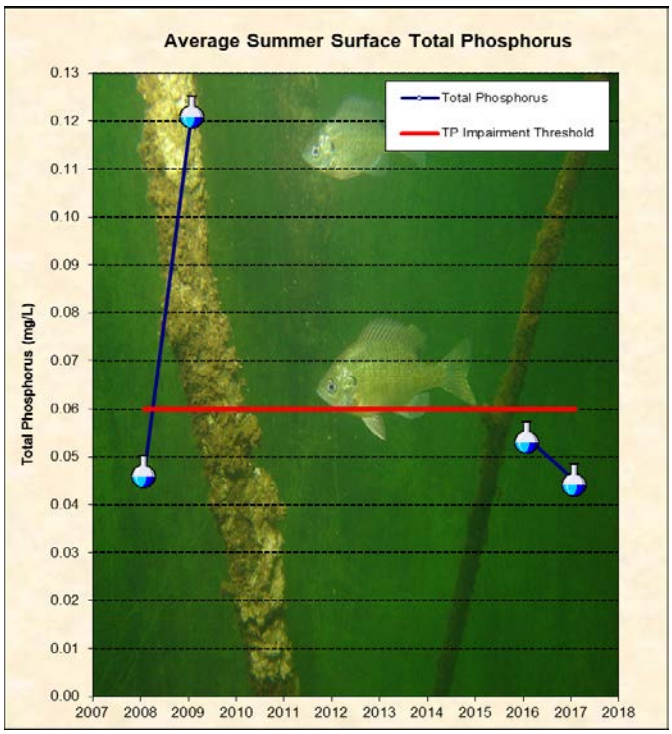
2017 Lake Grade: B-

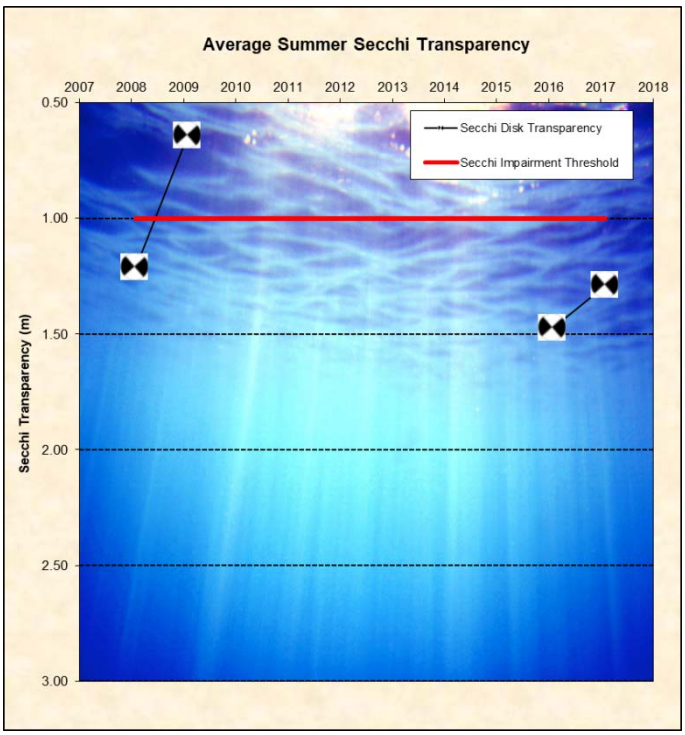
- DNR ID #: 82005300
- Municipality: City of Scandia
- Location: NE$^{1/4}$Section 4 T32N-R20W
- Lake Size: 50 acres
- Maximum Depth (2017): 7.5 ft.
- Ordinary High Water Mark: N/A
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Sea Lake was considered eutrophic in 2017, according to the Carlson Trophic State Index.
- There are an insufficient number of years of data to determine long term water quality trends at this time.
- The major land use is rural/agricultural.
- The lake did not stratify in 2017.
- Curly-leaf pondweed (invasive aquatic plant) is present in this lake.





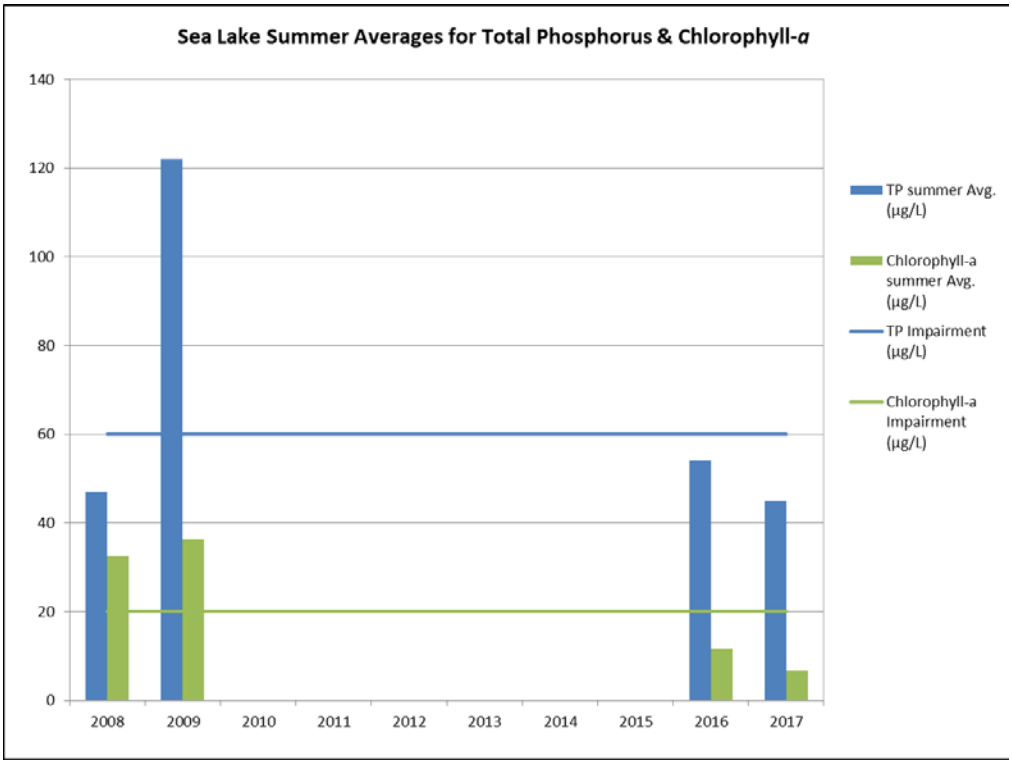
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/19/2017 10:25	0.040	7.9	5.7	0.78	1.98	12.6	9.08
5/2/2017 13:50	0.032	8.8	7.3	0.88	1.52	9.6	10.71
5/16/2017 14:22	0.046	9.1	7.9	0.75	1.22	20.1	9.87
5/31/2017 13:34	0.039	21.0	20.0	0.89	1.22	18.4	9.35
6/15/2017 10:55	0.046	4.0	3.7	0.95	1.98	25.0	7.64
6/27/2017 13:55	0.036	4.1	3.2	0.84	1.68	22.1	8.40
7/11/2017 13:06	0.035	4.6	4.8	0.87	1.91	27.1	8.69
7/25/2017 9:09	0.096	27.0	23.0	1.10	1.07	24.7	5.57
8/8/2017 13:47	0.042	7.3	6.3	0.78	1.22	24.4	9.62
8/21/2017 9:28	0.030	5.3	4.8	0.72	0.76	22.9	9.49
9/6/2017 11:16	0.026	4.3	3.0	0.66	0.91	18.5	7.23
9/20/2017 10:03	0.047	5.0	4.4	0.72	0.76	19.8	8.06
10/4/2017 12:04	0.019	3.1	2.6	0.73	1.37	16.1	7.97
10/19/17 8:58	0.014	3.3	2.6	0.61	1.68	12.1	9.33
2017 Average	0.039	8.2	7.1	0.81	1.38	19.5	8.64
2017 Summer Average	0.045	7.7	6.7	0.83	1.29	23.1	8.09

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	922.86	5/31/2017	922.20	4/11/2017	922.51

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	C	C	NA	NA	NA	NA	NA	NA	D	C
Chlorophyll-*a* (µg/L)	A	B	NA	NA	NA	NA	NA	NA	C	B
Secchi depth (ft)	C	C	NA	NA	NA	NA	NA	NA	F	C
Overall	**B-**	**C+**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**D**	**C+**

Sea Lake
Water Surface Elevation Statistics

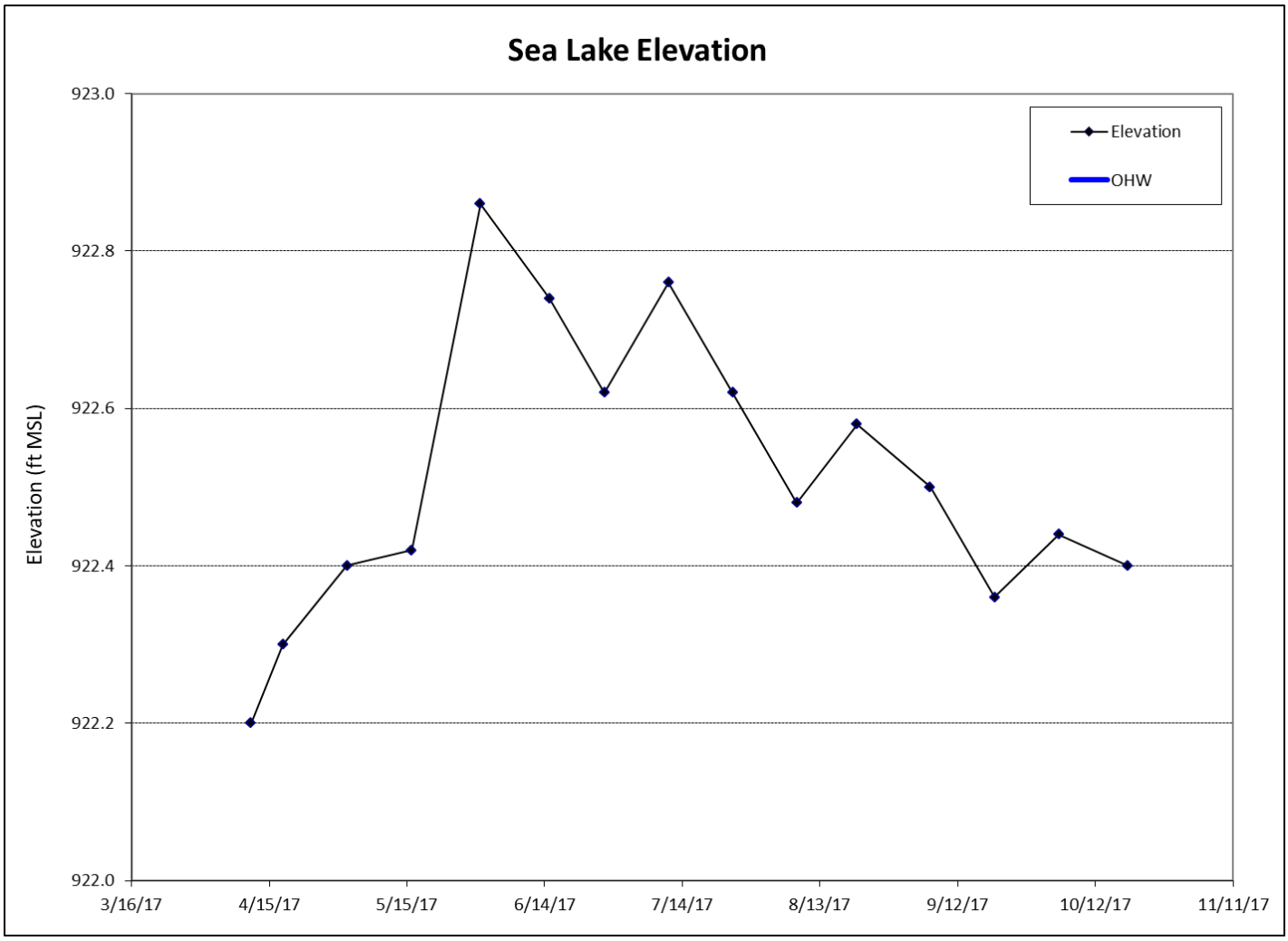
Ordinary High Water Level (OHW) Elevation: N/A

100 Year Flood Elevation (CLFLWD): N/A

Highest Recorded Elevation: 922.86 ft. (5/31/2017)

Lowest Recorded Elevation: 922.00 ft. (05/02/16)

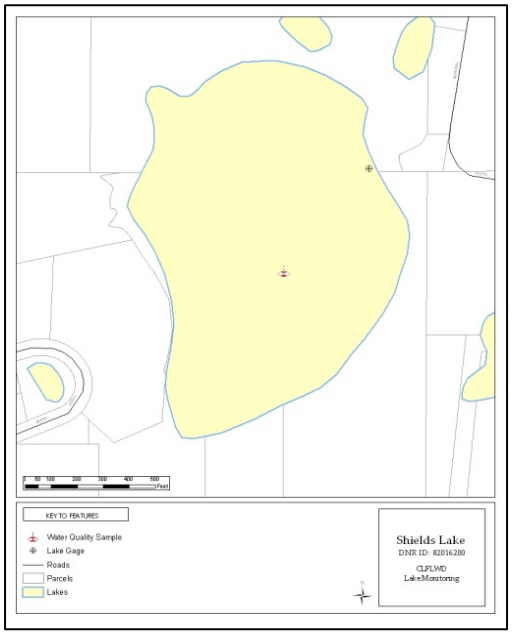
Datum: NGVD 29 (ft.)



Shields Lake

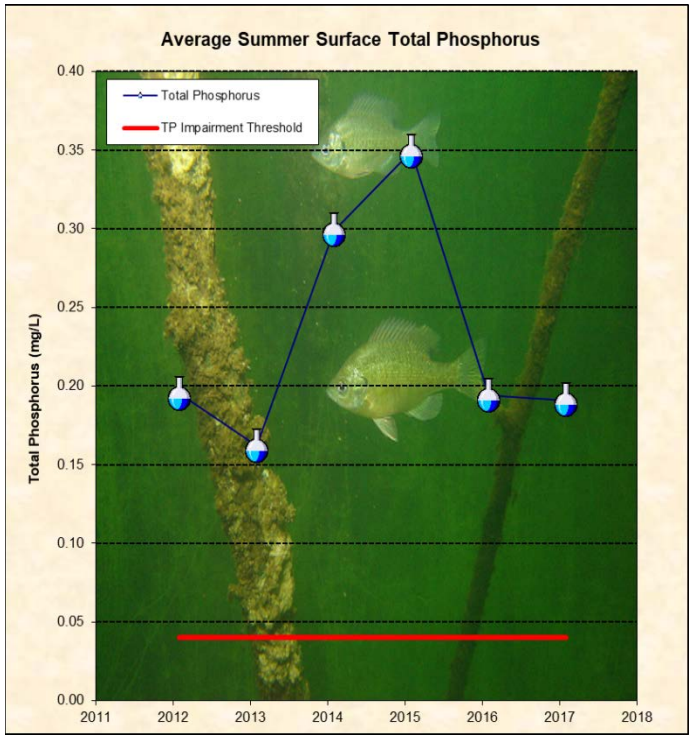
2017 Lake Grade: D-

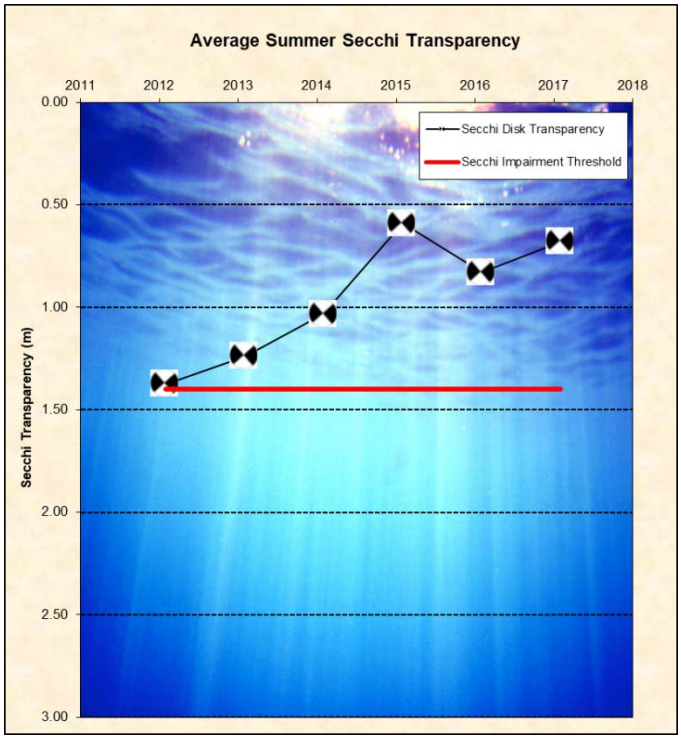
- DNR ID #: 82016200
- Municipality: City of Forest Lake
- Location: NE$^{1/4}$ Section 22 T32N-R21W
- Lake Size: 29.58 Acres
- Maximum Depth (2017): 27 ft.
- Ordinary High Water Mark: 902.5 ft.
- 74% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on the chlorophyll-*a* results Shields Lake was considered eutrophic in 2017, according to the Carlson Trophic State Index.
- Using the 2-tailed Kendall Tau correlation test ($p<0.05$) there is a statistically significant **declining** trend for the average Secchi transparency and no trend for average total phosphorus and average chlorophyll-*a*.
- The major land use is a mix of semi-urban and rural/agricultural.
- The lake stratified in 2017 with the thermocline varying between 3 and 5 meters.
- Shields Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Curly-leaf Pondweed (an invasive aquatic plant) is extensive in this lake.





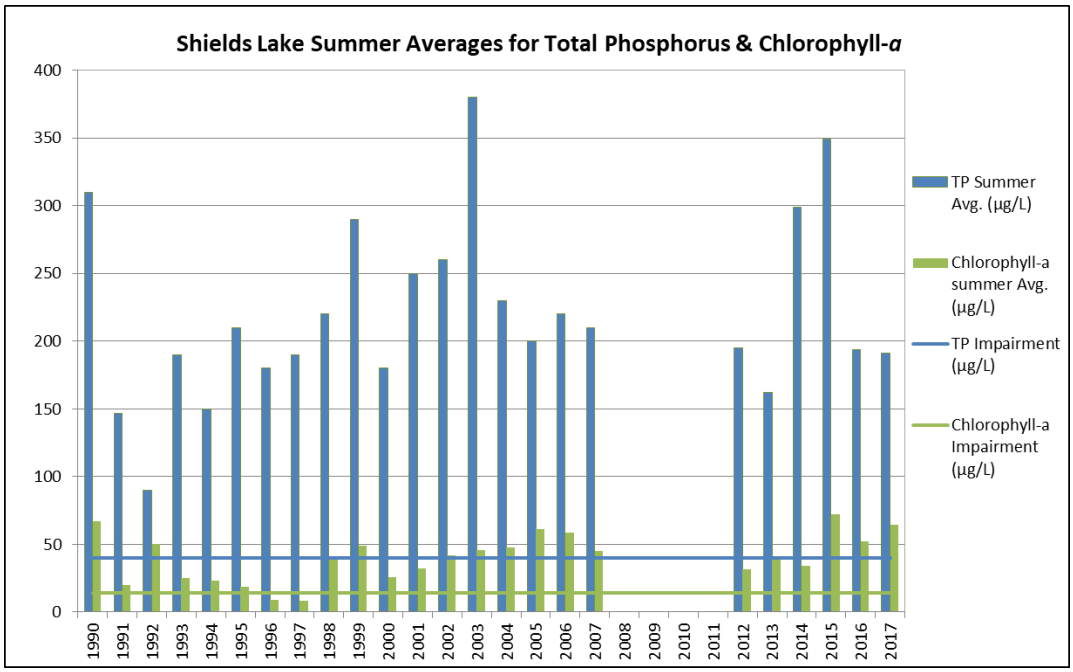
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (µg/L)	Pheophytin-Corrected Chlorophyll-*a* (µg/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/19/2017 14:10	0.040	13.0	12.0	1.20	1.22	12.6	11.22
5/3/2017 11:56	0.052	8.2	7.7	1.00	1.98	10.3	11.57
5/17/2017 11:39	NA	7.3	6.3	NA	3.05	18.9	8.60
6/1/2017 9:05	0.074	7.4	6.5	1.20	1.98	16.3	8.52
6/15/2017 8:50	0.170	36.0	35.0	1.90	1.37	23.7	7.89
6/28/2017 11:49	0.262	160.0	160.0	3.00	0.30	20.7	9.95
7/12/2017 11:47	0.300	97.0	97.0	2.80	0.30	27.4	10.64
7/26/2017 10:30	0.203	94.0	92.0	2.40	0.46	25.5	6.54
8/9/2017 8:57	0.226	56.0	55.0	2.60	0.46	23.6	7.08
8/21/2017 13:03	0.190	62.0	58.0	2.20	0.30	24.5	10.68
9/7/2017 10:20	0.118	41.0	39.0	1.90	0.61	18.5	4.87
9/20/2017 14:14	0.177	36.0	36.0	2.20	0.30	21.3	7.72
10/4/2017 10:52	0.193	32.0	30.0	1.90	0.76	16.4	4.53
10/19/17 13:10	0.378	14.0	12.0	3.10	1.68	12.7	4.11
2017 Average	0.183	47.4	46.2	2.11	1.06	19.5	8.14
2017 Summer Average	0.191	65.5	64.3	2.24	0.68	22.4	8.21

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2017 Elevation (ft)	903.14	5/3/2017	902.38	8/9/2017	902.71

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades									
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Total Phosphorus (mg/L)	F	F	F	F	F	F	NA	NA	NA	NA
Chlorophyll-*a* (µg/L)	D	D	D	C	C	C	NA	NA	NA	NA
Secchi depth (ft)	D	D	F	D	C	C	NA	NA	NA	NA
Overall	**D-**	**D-**	**F+**	**D**	**D+**	**D+**	**NA**	**NA**	**NA**	**NA**

Shields Lake
Water Surface Elevation Statistics

Outlet Elevation (culvert): 900.0 ft.

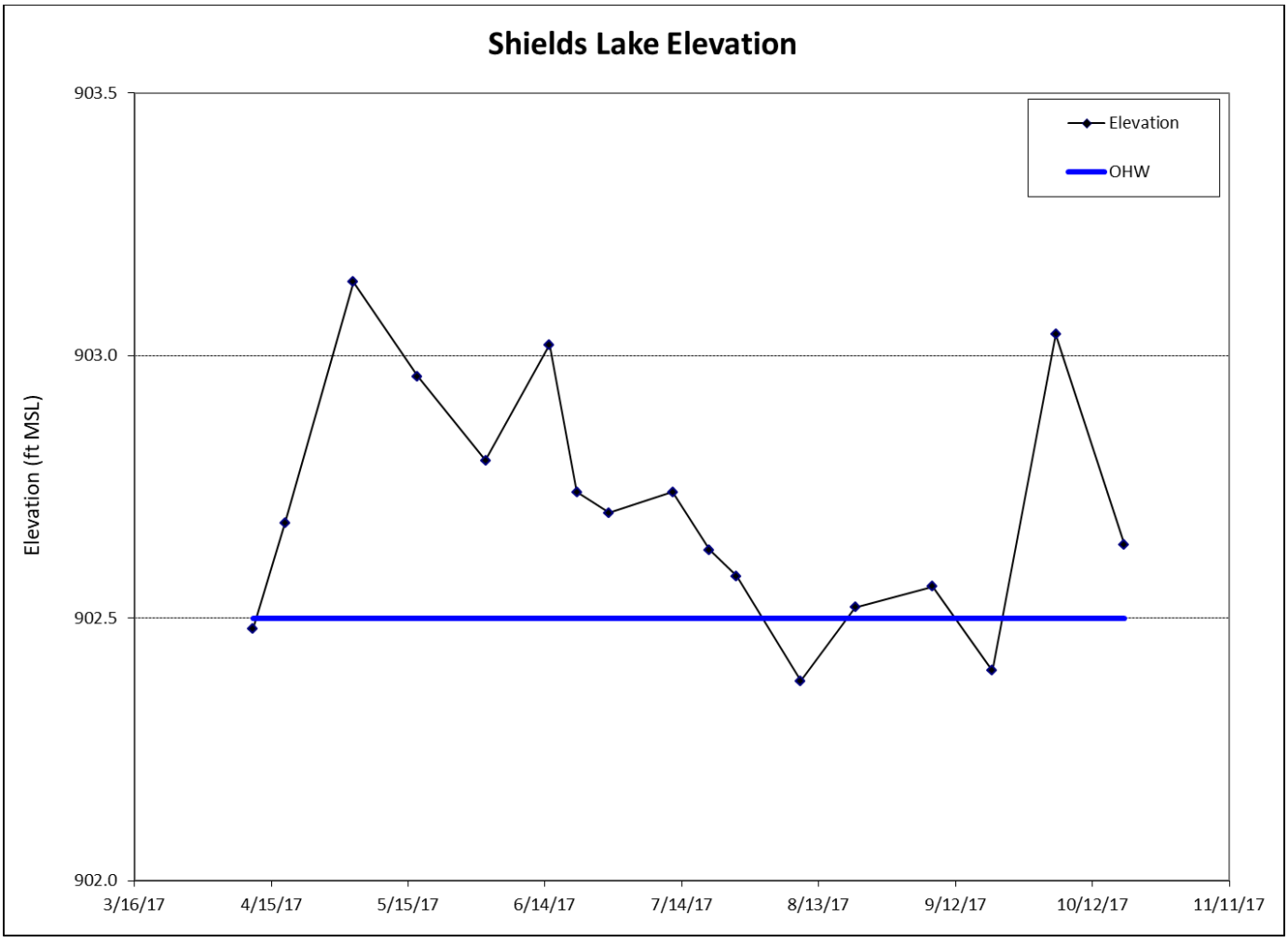
Ordinary High Water Level (OHW) Elevation: 902.5 ft.

100 Year Flood Elevation (FEMA): 904.5 ft.

Highest Recorded Elevation: 903.99 ft. (06/27/2003)

Lowest Recorded Elevation: 899.77 ft. (10/02/2006)

Datum: NGVD 29 (ft.)



Hypolimnetic Sample Results by Lake

Keewahtin Hypolimnetic Sample Results				
Date/Time	Sample Depth (m)	At-Depth Total Iron (mg/L)	At-Depth Dissolved Ortho Phosphorus (mg/L)	Surface Total Phosphorus (mg/L)
4/19/2017 13:45	11.0	0.15	0.005	0.018
5/3/2017 11:17	12.0	NA	0.005	0.015
5/17/2017 10:43	12.0	NA	0.005	NA
6/1/2017 8:23	11.0	0.26	0.005	0.012
6/15/2017 9:24	11.0	0.25	0.005	0.021
6/28/2017 11:17	13.0	7.20	0.005	0.011
7/12/2017 11:10	12.0	4.90	0.005	0.007
7/26/2017 9:43	13.0	7.70	0.005	0.015
8/9/2017 8:15	11.0	4.60	0.005	0.015
8/21/2017 12:05	12.0	14.10	0.005	0.017
9/7/2017 10:54	11.0	7.70	0.005	0.017
9/20/2017 13:43	10.0	1.40	0.005	0.012
10/4/2017 10:19	12.0	16.70	0.005	0.010
10/19/17 13:45	12.0	19.70	0.005	0.014
2017 Average	11.6	7.06	0.005	0.014
2017 Summer Average	11.6	5.35	0.005	0.014

School Hypolimnetic Sample Results				
Date/Time	Sample Depth (m)	At-Depth Total Iron (mg/L)	At-Depth Dissolved Ortho Phosphorus (mg/L)	Surface Total Phosphorus (mg/L)
4/18/2017 10:40	6.0	0.47	0.005	0.046
5/3/2017 9:52	6.0	NA	0.005	0.052
5/17/2017 9:29	7.0	NA	0.014	NA
6/1/2017 10:08	7.0	6.4	0.070	0.033
6/15/2017 10:12	7.0	6.4	0.038	0.054
6/28/2017 10:14	6.0	5.7	0.056	0.053
7/12/2017 10:30	7.0	6.9	0.075	0.041
7/26/2017 8:44	7.0	7.3	0.042	0.059
8/9/2017 10:00	7.0	11	0.032	0.034
8/21/2017 11:26	7.0	11.6	0.028	0.031
9/7/2017 8:36	7.0	13.4	0.012	0.116
9/20/2017 13:02	7.0	12.9	0.012	0.040
10/4/2017 9:43	7.0	12.4	0.015	0.075
10/19/17 11:37	7.0	0.54	0.005	0.048
2017 Average	6.8	7.92	0.029	0.052
2017 Summer Average	6.9	9.07	0.041	0.051

Shields Hypolimnetic Sample Results				
Date/Time	Sample Depth (m)	At-Depth Total Iron (mg/L)	At-Depth Dissolved Ortho Phosphorus (mg/L)	Surface Total Phosphorus (mg/L)
4/19/2017 14:10	8.0	4.4	0.109	0.040
5/3/2017 11:56	7.0	NA	0.206	0.052
5/17/2017 11:39	7.0	NA	0.165	NA
6/1/2017 9:05	7.0	4.9	0.02	0.074
6/15/2017 8:50	8.0	4.9	0.19	0.170
6/28/2017 11:49	7.0	5.8	0.364	0.262
7/12/2017 11:47	7.0	4.5	0.373	0.300
7/26/2017 10:30	7.0	4.2	0.426	0.203
8/9/2017 8:57	7.0	5.4	0.411	0.226
8/21/2017 13:03	7.0	5.9	0.54	0.190
9/7/2017 10:20	7.0	8.3	0.307	0.118
9/20/2017 14:14	7.0	9.3	0.162	0.177
10/4/2017 10:52	7.0	8.9	0.269	0.193
10/19/17 13:10	7.0	NA	0.051	0.378
2017 Average	7.1	6.05	0.257	0.183
2017 Summer Average	7.1	5.91	0.310	0.191

Appendix A –Stream Data

Table 1: Bone North Inlet 2017 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval Volume (ac-ft)**	**Interval TSS (lb)**	**Interval TP (lb)**
*Base**			*1*	*0.078*	*1/1/17 0:00*	*4/4/17 11:30*	*3,230,640*	*74.20*	*151.3*	*15.73*
Base			*1*	*0.078*	*4/4/17 11:30*	*4/15/17 15:30*	*833,650*	*19.15*	*39.0*	*4.06*
Storm Composite	4/15/2017 17:07	4/16/2017 3:11	14	0.127	4/15/17 15:30	4/16/17 4:30	112,307	2.58	98.2	0.89
Base			*1*	*0.078*	*4/16/17 4:30*	*4/19/17 18:30*	*507,646*	*11.66*	*23.8*	*2.47*
Storm			*7*	*0.229*	*4/19/17 18:30*	*4/19/17 23:30*	*42,159*	*0.97*	*17.5*	*0.60*
Base			*1*	*0.078*	*4/19/17 23:30*	*4/26/17 12:30*	*1,032,270*	*23.71*	*48.3*	*5.03*
Base Grab	4/27/2017 9:10	4/27/2017 9:10	0.50	0.068	4/26/17 12:30	4/28/17 12:30	309,298	7.10	9.7	1.31
Base			*1*	*0.078*	*4/28/17 12:30*	*5/1/17 0:30*	*331,612*	*7.62*	*15.5*	*1.61*
Storm			*7*	*0.229*	*5/1/17 0:30*	*5/3/17 11:30*	*533,120*	*12.25*	*221.9*	*7.62*
Storm Composite	5/3/2017 12:21	5/4/2017 9:13	2	0.339	5/3/17 11:30	5/4/17 10:30	300,479	6.90	37.5	6.36
Storm			*7*	*0.229*	*5/4/17 10:30*	*5/6/17 1:30*	*533,684*	*12.26*	*222.1*	*7.63*
Base			*1*	*0.078*	*5/6/17 1:30*	*5/8/17 19:30*	*675,689*	*15.52*	*31.6*	*3.29*
Storm			*7*	*0.229*	*5/8/17 19:30*	*5/9/17 7:30*	*118,071*	*2.71*	*49.1*	*1.69*
Base			*1*	*0.078*	*5/9/17 7:30*	*5/15/17 13:30*	*1,033,820*	*23.75*	*48.4*	*5.03*
Storm			*7*	*0.229*	*5/15/17 13:30*	*5/17/17 2:30*	*236,370*	*5.43*	*98.4*	*3.38*
Storm Composite	5/17/2017 10:04	5/18/2017 10:20	4	0.221	5/17/17 2:30	5/18/17 12:30	415,899	9.55	103.9	5.74
Storm			*7*	*0.229*	*5/18/17 12:30*	*5/20/17 4:30*	*1,809,230*	*41.56*	*753.0*	*25.86*
Base			*1*	*0.078*	*5/20/17 4:30*	*5/22/17 16:30*	*5,852,780*	*134.43*	*274.0*	*28.50*
Storm			*7*	*0.229*	*5/22/17 16:30*	*5/23/17 14:30*	*2,024,430*	*46.50*	*842.5*	*28.94*
Base			*1*	*0.078*	*5/23/17 14:30*	*5/25/17 14:30*	*2,916,650*	*66.99*	*136.6*	*14.20*
Base Grab	5/26/2017 9:21	5/26/2017 9:21	1	0.088	5/25/17 14:30	5/27/17 14:30	1,806,530	41.49	112.8	9.92
Base			*1*	*0.078*	*5/27/17 14:30*	*6/28/17 6:30*	*4,254,660*	*97.72*	*199.2*	*20.72*
Storm			*7*	*0.229*	*6/28/17 6:30*	*6/29/17 7:30*	*45,678*	*1.05*	*19.0*	*0.65*
Base			*1*	*0.078*	*6/29/17 7:30*	*7/9/17 21:30*	*211,468*	*4.86*	*9.9*	*1.03*
Storm			*7*	*0.229*	*7/9/17 21:30*	*7/10/17 10:30*	*19,187*	*0.44*	*8.0*	*0.27*
Base			*1*	*0.078*	*7/10/17 10:30*	*7/12/17 2:30*	*39,830*	*0.91*	*1.9*	*0.19*
Storm			*7*	*0.229*	*7/12/17 2:30*	*7/12/17 15:30*	*23,256*	*0.53*	*9.7*	*0.33*
Base			*1*	*0.078*	*7/12/17 15:30*	*8/3/17 7:30*	*184,379*	*4.23*	*8.6*	*0.90*
Storm			*154*	*1.143*	*8/3/17 7:30*	*8/4/17 0:30*	*1,001*	*0.02*	*9.6*	*0.07*
Base			*1*	*0.078*	*8/4/17 0:30*	*8/6/17 17:30*	*3,489*	*0.08*	*0.2*	*0.02*
Storm			*154*	*1.143*	*8/6/17 17:30*	*8/7/17 2:30*	*819*	*0.02*	*7.8*	*0.06*
Base			*1*	*0.078*	*8/7/17 2:30*	*8/9/17 15:30*	*3,983*	*0.09*	*0.2*	*0.02*
Storm			*154*	*1.143*	*8/9/17 15:30*	*8/10/17 19:30*	*4,648*	*0.11*	*44.5*	*0.33*
Base			*1*	*0.078*	*8/10/17 19:30*	*8/14/17 0:30*	*9,228*	*0.21*	*0.4*	*0.04*
Storm			*154*	*1.143*	*8/14/17 0:30*	*8/14/17 11:30*	*2,101*	*0.05*	*20.1*	*0.15*
Base			*1*	*0.078*	*8/14/17 11:30*	*8/16/17 20:30*	*9,476*	*0.22*	*0.4*	*0.05*
Storm			*154*	*1.143*	*8/16/17 20:30*	*8/17/17 9:30*	*15,605*	*0.36*	*149.5*	*1.11*
Base			*1*	*0.078*	*8/17/17 9:30*	*8/25/17 23:30*	*93,029*	*2.14*	*4.4*	*0.45*
Storm Composite	8/26/2017 6:27	8/27/2017 4:57	37	0.826	8/25/17 23:30	8/27/17 6:30	40,308	0.93	93.1	2.08
Base			*1*	*0.078*	*8/27/17 6:30*	*9/12/17 10:30*	*124,380*	*2.86*	*5.8*	*0.61*
Base			*1*	*0.078*	*9/12/17 10:30*	*9/25/17 2:30*	*32,573*	*0.75*	*1.5*	*0.16*
Storm			*154*	*1.143*	*9/25/17 2:30*	*9/25/17 10:30*	*1,169*	*0.03*	*11.2*	*0.08*
Base			*1*	*0.078*	*9/25/17 10:30*	*10/2/17 2:30*	*23,475*	*0.54*	*1.1*	*0.11*
Storm			*154*	*1.143*	*10/2/17 2:30*	*10/2/17 15:30*	*2,103*	*0.05*	*20.2*	*0.15*
Storm Composite	10/3/2017 0:18	10/4/2017 12:57	270	1.460	10/2/17 15:30	10/4/17 13:30	67,849	1.56	1143.6	6.18
Base			*1*	*0.078*	*10/4/17 13:30*	*10/6/17 15:30*	*28,533*	*0.66*	*1.3*	*0.14*
Storm			*154*	*1.143*	*10/6/17 15:30*	*10/7/17 9:30*	*10,996*	*0.25*	*105.4*	*0.78*
Base			*1*	*0.078*	*10/7/17 9:30*	*10/14/17 18:30*	*69,752*	*1.60*	*3.3*	*0.34*
Storm			*154*	*1.143*	*10/14/17 18:30*	*10/15/17 15:30*	*12,222*	*0.28*	*117.1*	*0.87*
Base			*1*	*0.078*	*10/15/17 15:30*	*10/21/17 6:30*	*48,523*	*1.11*	*2.3*	*0.24*
Storm			*154*	*1.143*	*10/21/17 6:30*	*10/21/17 18:30*	*5,133*	*0.12*	*49.2*	*0.37*
Base			*1*	*0.078*	*10/21/17 18:30*	*10/31/17 9:15*	*71,330*	*1.64*	*3.3*	*0.35*
*Base**			*1*	*0.078*	*10/31/17 9:15*	*1/1/18 0:00*	*266,175*	*6.11*	*12.5*	*1.30*
Base Average			1	0.078						
January-July Storm Average			7	0.229						
August-December Storm Average			154	1.143						
All Average			47	0.447						
Total							**30,382,691**	**698**	**5,399**	**220**
CLFLWD Major Subwatershed Total Acres							2,479			
Total Load										
Total TSS/TP (lbs/ac/yr)									**2.18**	**0.09**

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes were estimated using similar flow conditions.

Table 2: Bone Lake Outlet 2017 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval Volume (ac-ft)**	**Interval TSS (lb)**	**Interval TP (lb)**
*Base**			*5*	*0.028*	*1/1/17 0:00*	*4/4/17 12:00*	*16,156,800*	*371.10*	*5,043*	*27.74*
Base			*5*	*0.028*	*4/4/17 12:00*	*4/15/17 15:00*	*3,908,910*	*89.78*	*1,220*	*6.71*
Storm			*38*	*0.046*	*4/15/17 15:00*	*4/15/17 19:00*	*72,020*	*1.65*	*169*	*0.21*
Base			*5*	*0.028*	*4/15/17 19:00*	*4/26/17 14:00*	*5,251,080*	*120.61*	*1,639*	*9.01*
Base Grab	4/27/2017 9:30	4/27/2017 9:30	5	0.010	4/26/17 14:00	4/28/17 14:00	1,024,880	23.54	320	0.64
Base			*5*	*0.028*	*4/28/17 14:00*	*4/30/17 23:00*	*1,131,150*	*25.98*	*353*	*1.94*
Storm			*38*	*0.046*	*4/30/17 23:00*	*5/1/17 3:00*	*82,244*	*1.89*	*193*	*0.24*
Base			*5*	*0.028*	*5/1/17 3:00*	*5/8/17 19:00*	*4,508,060*	*103.54*	*1,407*	*7.74*
Storm			*38*	*0.046*	*5/8/17 19:00*	*5/8/17 23:00*	*105,629*	*2.43*	*247*	*0.30*
Base			*5*	*0.028*	*5/8/17 23:00*	*5/15/17 14:00*	*3,957,300*	*90.89*	*1,235*	*6.79*
Storm			*38*	*0.046*	*5/15/17 14:00*	*5/15/17 18:00*	*92,542*	*2.13*	*217*	*0.27*
Base			*5*	*0.028*	*5/15/17 18:00*	*5/17/17 20:00*	*1,220,190*	*28.03*	*381*	*2.09*
Storm Grab	5/18/2017 10:44	5/18/2017 10:44	71	0.028	5/17/17 20:00	5/20/17 10:00	2,263,390	51.99	10,032	3.96
Storm Composite	5/20/2017 12:51	5/20/2017 20:31	4	0.064	5/20/17 10:00	5/20/17 23:00	588,297	13.51	147	2.35
Storm			*38*	*0.046*	*5/20/17 23:00*	*5/25/17 10:00*	*6,196,310*	*142.32*	*14,505*	*17.79*
Base Grab	5/26/2017 9:28	5/26/2017 9:28	5	0.045	5/25/17 10:00	5/27/17 10:00	2,627,460	60.35	820	7.38
Base			*5*	*0.028*	*5/27/17 10:00*	*6/11/17 9:00*	*11,174,800*	*256.67*	*3,488*	*19.18*
Storm			*38*	*0.046*	*6/11/17 9:00*	*6/11/17 12:00*	*57,226*	*1.31*	*134*	*0.16*
Base			*5*	*0.028*	*6/11/17 12:00*	*6/28/17 6:00*	*6,135,480*	*140.92*	*1,915*	*10.53*
Storm			*38*	*0.046*	*6/28/17 6:00*	*6/28/17 19:00*	*158,828*	*3.65*	*372*	*0.46*
Base			*5*	*0.028*	*6/28/17 19:00*	*7/9/17 22:00*	*2,929,620*	*67.29*	*914*	*5.03*
Storm			*38*	*0.046*	*7/9/17 22:00*	*7/10/17 1:00*	*28,803*	*0.66*	*67*	*0.08*
Base			*5*	*0.028*	*7/10/17 1:00*	*7/12/17 2:00*	*459,917*	*10.56*	*144*	*0.79*
Storm			*38*	*0.046*	*7/12/17 2:00*	*7/12/17 4:00*	*17,548*	*0.40*	*41*	*0.05*
Base			*5*	*0.028*	*7/12/17 4:00*	*8/16/17 20:00*	*3,356,780*	*77.10*	*1,048*	*5.76*
Storm			*38*	*0.046*	*8/16/17 20:00*	*8/17/17 12:00*	*17,889*	*0.41*	*42*	*0.05*
Base			*5*	*0.028*	*8/17/17 12:00*	*8/26/17 0:00*	*192,971*	*4.43*	*60*	*0.33*
Storm			*38*	*0.046*	*8/26/17 0:00*	*8/26/17 12:00*	*13,479*	*0.31*	*32*	*0.04*
Base			*5*	*0.028*	*8/26/17 12:00*	*10/2/17 16:00*	*579,415*	*13.31*	*181*	*0.99*
Storm			*38*	*0.046*	*10/2/17 16:00*	*10/3/17 16:00*	*20,979*	*0.48*	*49*	*0.06*
Base			*5*	*0.028*	*10/3/17 16:00*	*10/14/17 18:00*	*206,444*	*4.74*	*64*	*0.35*
Storm			*38*	*0.046*	*10/14/17 18:00*	*10/15/17 7:00*	*9,644*	*0.22*	*23*	*0.03*
Base			*5*	*0.028*	*10/15/17 7:00*	*10/21/17 7:00*	*90,662*	*2.08*	*28*	*0.16*
Storm			*38*	*0.046*	*10/21/17 7:00*	*10/21/17 16:00*	*5,702*	*0.13*	*13*	*0.02*
Base			*5*	*0.028*	*10/21/17 16:00*	*10/31/17 0:15*	*121,471*	*2.79*	*38*	*0.21*
*Base**			*5*	*0.028*	*10/31/17 0:15*	*1/1/18 0:00*	*535,590*	*12.30*	*167*	*0.92*
Base Average			5	0.028						
Storm Average			38	0.046						
All Average			21	0.037						
Total							**75,299,508**	**1,730**	**46,748**	**140**
CLFLWD Major Subwatershed Total Acres							5,495			
Total Load										
Total TSS/TP (lbs/ac/yr)									**8.51**	**0.026**

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes were estimated using similar flow conditions.

Table 3: Little Comfort Inlet 2017 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval Volume (ac-ft)**	**Interval TSS (lb)**	**Interval TP (lb)**
*Base**			*5*	*0.054*	*1/1/17 0:00*	*4/18/2017 14:45*	*55,787,400*	*1,281.37*	*17,910.5*	*188.56*
Base			*5*	*0.054*	*4/18/17 14:45*	*4/26/2017 14:45*	*6,422,050*	*147.51*	*2,061.8*	*21.71*
Base Grab	4/27/2017 9:45	4/27/2017 9:45	13	0.100	4/26/17 14:45	4/28/17 14:45	1,442,730	33.14	1,170.8	9.01
Base			*5*	*0.054*	*4/28/17 14:45*	*4/30/17 23:45*	*1,586,830*	*36.45*	*509.4*	*5.36*
Storm			*99*	*0.145*	*4/30/17 23:45*	*5/1/17 6:45*	*227,171*	*5.22*	*1,404.0*	*2.06*
Base			*5*	*0.054*	*5/1/17 6:45*	*5/17/17 1:45*	*10,073,700*	*231.38*	*3,234.1*	*34.05*
Storm Composite	5/17/2017 14:40	5/18/2017 22:27	99	0.145	5/17/17 1:45	5/19/17 0:45	1,903,450	43.72	11,763.7	17.23
Storm			*99*	*0.145*	*5/19/17 0:45*	*5/20/17 9:45*	*2,150,440*	*49.39*	*13,290.1*	*19.47*
Base			*5*	*0.054*	*5/20/17 9:45*	*5/25/17 9:45*	*8,347,290*	*191.73*	*2,679.9*	*28.21*
Base Grab	5/26/2017 10:23	5/26/2017 10:23	10	0.055	5/25/17 9:45	5/27/17 14:45	3,218,850	73.93	2,009.4	11.05
Base			*5*	*0.054*	*5/27/17 14:45*	*6/15/17 14:45*	*18,152,600*	*416.94*	*5,827.9*	*61.35*
Base			*5*	*0.054*	*6/15/17 14:45*	*6/25/17 9:45*	*4,081,510*	*93.75*	*1,310.4*	*13.80*
Base Grab	6/26/2017 14:35	6/26/2017 14:35	4	0.031	6/25/17 9:45	6/27/17 9:45	605,559	13.91	151.2	1.17
Base			*5*	*0.054*	*6/27/17 9:45*	*6/28/17 14:45*	*377,960*	*8.68*	*121.3*	*1.28*
Storm			*99*	*0.145*	*6/28/17 14:45*	*6/28/17 22:45*	*139,296*	*3.20*	*860.9*	*1.26*
Base			*5*	*0.054*	*6/28/17 22:45*	*6/30/17 3:45*	*500,243*	*11.49*	*160.6*	*1.69*
Storm			*99*	*0.145*	*6/30/17 3:45*	*6/30/17 9:45*	*110,847*	*2.55*	*685.1*	*1.00*
Base			*5*	*0.054*	*6/30/17 9:45*	*7/9/17 21:45*	*2,797,290*	*64.25*	*898.1*	*9.45*
Storm			*99*	*0.145*	*7/9/17 21:45*	*7/10/17 2:45*	*51,349*	*1.18*	*317.3*	*0.46*
Base			*5*	*0.054*	*7/10/17 2:45*	*7/12/17 1:45*	*499,716*	*11.48*	*160.4*	*1.69*
Storm			*99*	*0.145*	*7/12/17 1:45*	*7/12/17 7:45*	*85,274*	*1.96*	*527.0*	*0.77*
Base			*5*	*0.054*	*7/12/17 7:45*	*7/23/17 7:45*	*3,302,470*	*75.85*	*1,060.3*	*11.16*
Base Grab	7/24/2017 11:41	7/24/2017 11:41	2	0.058	7/23/17 7:45	7/25/17 7:45	288,580	6.63	36.0	1.04
Base			*5*	*0.054*	*7/25/17 7:45*	*8/9/17 12:45*	*2,088,540*	*47.97*	*670.5*	*7.06*
Storm			*99*	*0.145*	*8/9/17 12:45*	*8/10/17 3:45*	*102,013*	*2.34*	*630.5*	*0.92*
Base			*5*	*0.054*	*8/10/17 3:45*	*8/16/17 20:45*	*1,210,340*	*27.80*	*388.6*	*4.09*
Storm			*99*	*0.145*	*8/16/17 20:45*	*8/17/17 4:45*	*86,810*	*1.99*	*536.5*	*0.79*
Base			*5*	*0.054*	*8/17/17 4:45*	*8/26/17 0:45*	*1,889,770*	*43.41*	*606.7*	*6.39*
Storm			*99*	*0.145*	*8/26/17 0:45*	*8/26/17 10:45*	*81,563*	*1.87*	*504.1*	*0.74*
Base			*5*	*0.054*	*8/26/17 10:45*	*8/29/17 10:45*	*561,472*	*12.90*	*180.3*	*1.90*
Base Grab	8/30/2017 9:43	8/30/2017 9:43	5	0.049	8/29/17 10:45	8/31/17 10:45	277,208	6.37	86.5	0.85
Base			*5*	*0.054*	*8/31/17 10:45*	*9/2/17 0:00*	*190,880*	*4.38*	*61.3*	*0.65*
*Base**			*5*	*0.054*	*9/2/17 0:00*	*9/26/17 13:00*	*2,756,520*	*63.31*	*885.0*	*9.32*
Base Grab*	9/27/2017 9:15	9/27/2017 9:15	1	0.049	9/26/17 13:00	9/28/17 13:00	207,360	4.76	12.9	0.63
*Base**			*5*	*0.054*	*9/28/17 13:00*	*10/23/17 13:00*	*2,376,000*	*54.57*	*762.8*	*8.03*
Base Grab*	10/24/2017 14:40	10/24/2017 14:40	1	0.037	10/23/17 13:00	10/25/17 13:00	172,800	3.97	10.8	0.40
*Base**			*5*	*0.054*	*10/25/17 13:00*	*1/1/18 0:00*	*5,828,400*	*133.87*	*1,871.2*	*19.70*
Base Average			5	0.054						
Storm Average			99	0.145						
All Average			17	0.066						
Total							**139,982,281**	**3,215**	**75,358**	**504**
CLFLWD Major Subwatershed Total Acres							10,513			
Total Load										
Total TSS/TP (lbs/ac/yr)									**7.17**	**0.05**

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes were estimated using similar flow conditions.

Table 4: Forest Lake Outlet 2017 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval Volume (ac-ft)**	**Interval TSS (lb)**	**Interval TP (lb)**
*Base**			*4*	*0.014*	*1/1/17 0:00*	*4/4/17 11:30*	*72,689,400*	*1669.6*	*16,854*	*62.9*
Base			*4*	*0.014*	*4/4/17 11:30*	*4/19/17 17:30*	*14,522,500*	*333.6*	*3,367*	*12.6*
Storm			*13*	*0.072*	*4/19/17 17:30*	*4/19/17 20:30*	*155,210*	*3.6*	*124*	*0.7*
Base			*4*	*0.014*	*4/19/17 20:30*	*4/26/17 12:30*	*8,477,090*	*194.7*	*1,966*	*7.3*
Base Grab	4/27/2017 10:55	4/27/2017 10:55	5	0.010	4/26/17 12:30	4/28/17 12:30	2,626,970	60.3	820	1.6
Base			*4*	*0.014*	*4/28/17 12:30*	*4/30/17 23:30*	*3,122,570*	*71.7*	*724*	*2.7*
Storm			*13*	*0.072*	*4/30/17 23:30*	*5/1/17 2:30*	*180,264*	*4.1*	*143*	*0.8*
Base			*4*	*0.014*	*5/1/17 2:30*	*5/15/17 13:30*	*20,235,000*	*464.8*	*4,692*	*17.5*
Storm			*13*	*0.072*	*5/15/17 13:30*	*5/15/17 16:30*	*161,478*	*3.7*	*129*	*0.7*
Base			*4*	*0.014*	*5/15/17 16:30*	*5/16/17 5:30*	*663,957*	*15.3*	*154*	*0.6*
Storm			*13*	*0.072*	*5/16/17 5:30*	*5/16/17 14:30*	*514,405*	*11.8*	*409*	*2.3*
Base			*4*	*0.014*	*5/16/17 14:30*	*5/17/17 14:30*	*1,358,460*	*31.2*	*315*	*1.2*
Storm Composite	5/17/2017 15:36	5/18/2017 9:15	15	0.047	5/17/17 14:30	5/18/17 11:30	1,633,930	37.5	1,530	4.8
Base			*4*	*0.014*	*5/18/17 11:30*	*5/20/17 11:30*	*4,383,040*	*100.7*	*1,016*	*3.8*
Storm Composite	5/20/2017 16:19	5/22/2017 1:36	6	0.041	5/20/17 11:30	5/22/17 2:30	4,387,810	100.8	1,643	11.2
Base			*4*	*0.014*	*5/22/17 2:30*	*5/25/17 2:30*	*8,295,600*	*190.5*	*1,923*	*7.2*
Base Grab	5/26/2017 9:50	5/26/2017 9:50	4	0.010	5/25/17 2:30	5/27/17 2:30	5,409,090	124.2	1,351	3.4
Base			*4*	*0.014*	*5/27/17 2:30*	*6/11/17 8:30*	*27,862,900*	*640.0*	*6,461*	*24.1*
Storm			*13*	*0.072*	*6/11/17 8:30*	*6/11/17 15:30*	*475,656*	*10.9*	*379*	*2.1*
Base			*4*	*0.014*	*6/11/17 15:30*	*6/17/17 18:30*	*9,483,260*	*217.8*	*2,199*	*8.2*
Storm			*13*	*0.072*	*6/17/17 18:30*	*6/17/17 22:30*	*234,001*	*5.4*	*186*	*1.1*
Base			*4*	*0.014*	*6/17/17 22:30*	*6/25/17 12:30*	*8,540,510*	*196.2*	*1,980*	*7.4*
Base Grab	6/26/2017 13:40	6/26/2017 13:40	2	0.010	6/25/17 12:30	6/28/17 5:30	2,425,850	55.7	303	1.5
Storm			*13*	*0.072*	*6/28/17 5:30*	*6/28/17 9:30*	*149,671*	*3.4*	*119*	*0.7*
Base			*4*	*0.014*	*6/28/17 9:30*	*6/28/17 15:30*	*223,889*	*5.1*	*52*	*0.2*
Storm			*13*	*0.072*	*6/28/17 15:30*	*6/28/17 18:30*	*165,047*	*3.8*	*131*	*0.7*
Base			*4*	*0.014*	*6/28/17 18:30*	*7/9/17 21:30*	*9,336,840*	*214.5*	*2,165*	*8.1*
Storm			*13*	*0.072*	*7/9/17 21:30*	*7/10/17 0:30*	*98,008*	*2.3*	*78*	*0.4*
Base			*4*	*0.014*	*7/10/17 0:30*	*7/12/17 2:30*	*1,364,910*	*31.4*	*316*	*1.2*
Storm			*13*	*0.072*	*7/12/17 2:30*	*7/12/17 5:30*	*114,498*	*2.6*	*91*	*0.5*
Base			*4*	*0.014*	*7/12/17 5:30*	*7/17/17 20:30*	*3,663,530*	*84.1*	*849*	*3.2*
Storm			*13*	*0.072*	*7/17/17 20:30*	*7/17/17 22:30*	*56,670*	*1.3*	*45*	*0.3*
Base			*4*	*0.014*	*7/17/17 22:30*	*7/23/17 12:30*	*3,206,440*	*73.6*	*743*	*2.8*
Base Grab	7/24/2017 12:20	7/24/2017 12:20	3	0.010	7/23/17 12:30	7/25/17 12:30	926,087	21.3	173	0.6
Base			*4*	*0.014*	*7/25/17 12:30*	*8/3/17 6:30*	*2,807,940*	*64.5*	*651*	*2.4*
Storm			*13*	*0.072*	*8/3/17 6:30*	*8/3/17 10:30*	*42,035*	*1.0*	*33*	*0.2*
Base			*4*	*0.014*	*8/3/17 10:30*	*8/6/17 17:30*	*675,308*	*15.5*	*157*	*0.6*
Storm			*13*	*0.072*	*8/6/17 17:30*	*8/6/17 20:30*	*39,576*	*0.9*	*31*	*0.2*
Base			*4*	*0.014*	*8/6/17 20:30*	*8/9/17 12:30*	*581,827*	*13.4*	*135*	*0.5*
Storm			*13*	*0.072*	*8/9/17 12:30*	*8/9/17 17:30*	*53,081*	*1.2*	*42*	*0.2*
Base			*4*	*0.014*	*8/9/17 17:30*	*8/9/17 23:30*	*61,298*	*1.4*	*14*	*0.1*
Storm			*13*	*0.072*	*8/9/17 23:30*	*8/10/17 3:30*	*48,004*	*1.1*	*38*	*0.2*
Base			*4*	*0.014*	*8/10/17 3:30*	*8/13/17 23:30*	*963,127*	*22.1*	*223*	*0.8*
Storm			*13*	*0.072*	*8/13/17 23:30*	*8/14/17 4:30*	*61,096*	*1.4*	*49*	*0.3*
Base			*4*	*0.014*	*8/14/17 4:30*	*8/16/17 20:30*	*708,827*	*16.3*	*164*	*0.6*
Storm			*13*	*0.072*	*8/16/17 20:30*	*8/17/17 1:30*	*73,813*	*1.7*	*59*	*0.3*
Base			*4*	*0.014*	*8/17/17 1:30*	*8/26/17 0:30*	*2,633,850*	*60.5*	*611*	*2.3*
Storm Composite	8/26/2017 3:59	8/26/2017 23:05	16	0.121	8/26/17 0:30	8/26/17 23:30	399,947	9.2	399	3.0
Base			*4*	*0.014*	*8/26/17 23:30*	*8/29/17 12:30*	*1,081,020*	*24.8*	*251*	*0.9*
Base Grab	8/30/2017 8:52	8/30/2017 8:52	5	0.010	8/29/17 12:30	8/31/17 12:30	860,576	19.8	269	0.5
Base			*4*	*0.014*	*8/31/17 12:30*	*9/26/17 12:30*	*7,969,010*	*183.0*	*1,848*	*6.9*
Base Grab	9/27/2017 8:53	9/27/2017 8:53	3	0.021	9/26/17 12:30	9/28/17 12:30	433,686	10.0	81	0.6
Base			*4*	*0.014*	*9/28/17 12:30*	*10/2/17 15:30*	*949,371*	*21.8*	*220*	*0.8*
Storm Composite	10/2/2017 16:25	10/4/2017 20:59	14	0.079	10/2/17 15:30	10/4/17 21:30	2,261,370	51.9	1,976	11.2
Base			*4*	*0.014*	*10/4/17 21:30*	*10/14/17 18:30*	*9,928,700*	*228.1*	*2,302*	*8.6*
Storm			*13*	*0.072*	*10/14/17 18:30*	*10/14/17 21:30*	*119,286*	*2.7*	*95*	*0.5*
Base			*4*	*0.014*	*10/14/17 21:30*	*10/23/17 12:30*	*7,456,140*	*171.3*	*1,729*	*6.4*
Base Grab	10/24/2017 15:50	10/24/2017 15:50	4	0.026	10/23/17 12:30	10/25/17 12:30	1,239,450	28.5	309	2.0
Base			*4*	*0.014*	*10/25/17 12:30*	*10/31/17 11:45*	*3,891,090*	*89.4*	*902*	*3.4*
*Base**			*4*	*0.014*	*10/31/17 11:45*	*1/1/18 0:00*	*72,689,400*	*1669.6*	*16,854*	*62.9*
Base Average			4	0.014						
Storm Average			13	0.072						
All Average			7	0.035						
Total							**335,173,369**	**7,699**	**82,877**	**321**
CLFLWD Major Subwatershed Total Acres							8,719			
Total Load										
Total TSS/TP (lbs/ac/yr)									**9.51**	**0.037**

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes from were estimated using similar flow conditions.

Table 5: Comfort Lake Inlet 2017 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval Volume (ac-ft)**	**Interval TSS (lb)**	**Interval TP (lb)**
*Base**			*5*	*0.040*	*1/1/17 0:00*	*4/4/17 10:00*	*104,925,600*	*2,410.02*	*33,842.2*	*264.19*
Base			*5*	*0.040*	*4/4/17 10:00*	*4/11/17 11:00*	*10,045,800*	*230.74*	*3,240.1*	*25.29*
Storm			*13*	*0.094*	*4/11/17 11:00*	*4/12/17 3:00*	*1,048,740*	*24.09*	*851.1*	*6.15*
Base			*5*	*0.040*	*4/12/17 3:00*	*4/16/17 6:00*	*7,420,880*	*170.45*	*2,393.5*	*18.68*
Storm			*13*	*0.094*	*4/16/17 6:00*	*4/16/17 23:00*	*1,576,090*	*36.20*	*1,279.1*	*9.25*
Base			*5*	*0.040*	*4/16/17 23:00*	*4/17/17 12:00*	*1,228,400*	*28.21*	*396.2*	*3.09*
Storm			*13*	*0.094*	*4/17/17 12:00*	*4/17/17 22:00*	*940,882*	*21.61*	*763.6*	*5.52*
Base			*5*	*0.040*	*4/17/17 22:00*	*4/19/17 22:00*	*4,254,150*	*97.71*	*1,372.1*	*10.71*
Storm			*13*	*0.094*	*4/19/17 22:00*	*4/22/17 2:00*	*5,654,050*	*129.87*	*4,588.5*	*33.18*
Base			*5*	*0.040*	*4/22/17 2:00*	*4/26/17 2:00*	*8,858,540*	*203.47*	*2,857.2*	*22.30*
Base Grab	4/27/2017 10:25	4/27/2017 10:25	5	0.041	4/26/17 2:00	4/28/17 2:00	5,252,740	120.65	1,639.5	13.44
Base			*5*	*0.040*	*4/28/17 2:00*	*5/1/17 0:00*	*7,096,600*	*163.00*	*2,288.9*	*17.87*
Storm			*13*	*0.094*	*5/1/17 0:00*	*5/3/17 4:00*	*6,374,260*	*146.41*	*5,173.0*	*37.40*
Base			*5*	*0.040*	*5/3/17 4:00*	*5/17/17 1:00*	*31,397,900*	*721.17*	*10,126.9*	*79.06*
Storm Composite	5/17/2017 7:57	5/18/2017 17:26	14	0.118	5/17/17 1:00	5/20/17 12:00	13,597,500	312.32	11,883.8	100.16
Storm			*13*	*0.094*	*5/20/17 12:00*	*5/21/17 19:00*	*6,755,680*	*155.17*	*5,482.5*	*39.64*
Base			*5*	*0.040*	*5/21/17 19:00*	*5/25/17 19:00*	*22,295,500*	*512.10*	*7,191.1*	*56.14*
Base Grab	5/26/2017 10:04	5/26/2017 10:04	14	0.057	5/25/17 19:00	5/27/17 19:00	10,729,200	246.44	9,377.0	38.18
Base			*5*	*0.040*	*5/27/17 19:00*	*6/12/17 11:00*	*53,351,700*	*1,225.43*	*17,207.8*	*134.33*
Base			*5*	*0.040*	*6/12/17 11:00*	*6/25/17 19:00*	*21,239,500*	*487.85*	*6,850.5*	*53.48*
Base Grab	6/26/2017 14:15	6/26/2017 14:15	4	0.029	6/25/17 19:00	6/28/17 6:00	2,484,540	57.07	620.4	4.50
Storm			*13*	*0.094*	*6/28/17 6:00*	*7/1/17 1:00*	*4,453,390*	*102.29*	*3,614.1*	*26.13*
Base			*5*	*0.040*	*7/1/17 1:00*	*7/12/17 2:00*	*13,328,900*	*306.15*	*4,299.0*	*33.56*
Storm			*13*	*0.094*	*7/12/17 2:00*	*7/12/17 21:00*	*952,779*	*21.88*	*773.2*	*5.59*
Base			*5*	*0.040*	*7/12/17 21:00*	*7/23/17 21:00*	*11,065,700*	*254.17*	*3,569.1*	*27.86*
Base Grab	7/24/2017 12:02	7/24/2017 12:02	2	0.044	7/23/17 21:00	7/25/17 21:00	1,459,040	33.51	182.2	4.01
Base			*5*	*0.040*	*7/25/17 21:00*	*8/6/17 18:00*	*5,886,320*	*135.20*	*1,898.5*	*14.82*
Storm			*13*	*0.094*	*8/6/17 18:00*	*8/7/17 0:00*	*158,009*	*3.63*	*128.2*	*0.93*
Base			*5*	*0.040*	*8/7/17 0:00*	*8/9/17 23:00*	*1,994,930*	*45.82*	*643.4*	*5.02*
Storm			*13*	*0.094*	*8/9/17 23:00*	*8/10/17 21:00*	*863,076*	*19.82*	*700.4*	*5.06*
Base			*5*	*0.040*	*8/10/17 21:00*	*8/16/17 21:00*	*4,950,000*	*113.70*	*1,596.5*	*12.46*
Storm			*13*	*0.094*	*8/16/17 21:00*	*8/18/17 10:45*	*1,801,920*	*41.39*	*1,462.3*	*10.57*
*Base**			*5*	*0.040*	*8/18/17 10:45*	*8/29/17 10:00*	*8,529,300*	*195.91*	*2,751.0*	*21.48*
Base Grab*	8/30/2017 9:11	8/30/2017 9:11	4	0.029	8/29/17 10:00	8/31/17 10:00	1,382,400	31.75	345.2	2.50
*Base**			*5*	*0.040*	*8/31/17 10:00*	*9/12/17 10:00*	*7,257,600*	*166.70*	*2,340.8*	*18.27*
Base			*5*	*0.040*	*9/12/17 10:00*	*10/1/17 18:30*	*9,618,550*	*220.93*	*3,102.3*	*24.22*
*Storm**			*13*	*0.094*	*10/1/17 18:30*	*10/3/17 10:30*	*4,176,000*	*95.92*	*3,389.0*	*24.51*
Storm Composite	10/3/2017 10:53	10/3/2017 16:55	12	0.070	10/3/17 10:30	10/6/17 8:30	9,939,860	228.31	7,446.1	43.44
Base			*5*	*0.040*	*10/6/17 8:30*	*10/14/17 18:30*	*19,082,400*	*438.30*	*6,154.7*	*48.05*
Storm			*13*	*0.094*	*10/14/17 18:30*	*10/15/17 22:30*	*1,891,750*	*43.45*	*1,535.2*	*11.10*
Base			*5*	*0.040*	*10/15/17 22:30*	*10/23/17 12:30*	*11,034,700*	*253.45*	*3,559.1*	*27.78*
Base Grab	10/24/2017 15:21	10/24/2017 15:21	2	0.042	10/23/17 12:30	10/25/17 12:30	2,256,660	51.83	281.7	5.92
Base			*5*	*0.040*	*10/25/17 12:30*	*10/31/17 10:00*	*7,349,490*	*168.81*	*2,370.5*	*18.50*
*Base**			*5*	*0.040*	*10/31/17 10:00*	*1/1/18 0:00*	*63,849,600*	*1,466.55*	*20,593.7*	*160.76*
Base Average			5	0.040						
Storm Average			13	0.094						
All Average			7	0.054						
Total							**519,810,626**	**11,939**	**202,161**	**1,525**
CLFLWD Major Subwatershed Total Acres							13,732			
Total Load										
Total TSS/TP (lbs/ac/yr)									**14.72**	**0.111**

Italics indicate estimated concentrations based on average base and storm flow concentrations.
*Interval volumes from were estimated using similar flow conditions.

Table 6: Comfort Lake Outlet 2017 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval Volume (ac-ft)**	**Interval TSS (lb)**	**Interval TP (lb)**
*Base**			*3*	*0.022*	*1/1/17 0:00*	*4/4/17 11:00*	*104,972,400*	*2,411.10*	*17,786.8*	*145.10*
Base			*3*	*0.022*	*4/4/17 11:00*	*4/26/17 11:00*	*31,067,300*	*713.58*	*5,264.1*	*42.94*
Base Grab	4/27/2017 10:00	4/27/2017 10:00	2	0.033	4/26/17 11:00	4/28/17 11:00	3,888,340	89.31	485.5	8.01
Base			*3*	*0.022*	*4/28/17 11:00*	*4/30/17 23:00*	*4,895,120*	*112.44*	*829.4*	*6.77*
Storm			*16*	*0.100*	*4/30/17 23:00*	*5/3/17 23:00*	*7,058,280*	*162.12*	*6,829.6*	*44.06*
Base			*3*	*0.022*	*5/3/17 23:00*	*5/17/17 17:00*	*27,364,900*	*628.54*	*4,636.8*	*37.83*
Storm Composite	5/17/2017 20:46	5/19/2017 8:13	17	0.051	5/17/17 17:00	5/19/17 10:00	4,641,830	106.62	4,926.1	14.78
Storm			*16*	*0.100*	*5/19/17 10:00*	*5/25/17 11:00*	*35,219,200*	*808.94*	*34,078.3*	*219.86*
Base Grab	5/26/2017 10:13	5/26/2017 10:13	4	0.021	5/25/17 11:00	5/27/17 11:00	14,142,400	324.83	3,531.4	18.54
Base			*3*	*0.022*	*5/27/17 11:00*	*6/12/17 14:00*	*78,841,900*	*1,810.91*	*13,359.2*	*108.98*
Base			*3*	*0.022*	*6/12/17 14:00*	*6/25/17 11:00*	*36,929,400*	*848.23*	*6,257.4*	*51.05*
Base Grab	6/26/2017 14:00	6/26/2017 14:00	4	0.020	6/25/17 11:00	6/28/17 6:00	5,600,180	128.63	1,398.4	6.99
Storm			*16*	*0.100*	*6/28/17 6:00*	*6/28/17 21:00*	*1,252,380*	*28.77*	*1,211.8*	*7.82*
Base			*3*	*0.022*	*6/28/17 21:00*	*6/30/17 4:00*	*2,780,900*	*63.87*	*471.2*	*3.84*
Storm			*16*	*0.100*	*6/30/17 4:00*	*6/30/17 9:00*	*492,998*	*11.32*	*477.0*	*3.08*
Base			*3*	*0.022*	*6/30/17 9:00*	*7/12/17 2:00*	*25,887,000*	*594.59*	*4,386.4*	*35.78*
Storm			*16*	*0.100*	*7/12/17 2:00*	*7/12/17 9:00*	*549,707*	*12.63*	*531.9*	*3.43*
Base			*3*	*0.022*	*7/12/17 9:00*	*7/17/17 21:00*	*9,860,040*	*226.47*	*1,670.7*	*13.63*
Storm			*16*	*0.100*	*7/17/17 21:00*	*7/18/17 9:00*	*892,559*	*20.50*	*863.6*	*5.57*
Base			*3*	*0.022*	*7/18/17 9:00*	*7/23/17 9:00*	*8,378,150*	*192.44*	*1,419.6*	*11.58*
Base Grab	7/24/2017 11:52	7/24/2017 11:52	3	0.040	7/23/17 9:00	7/25/17 9:00	2,743,650	63.02	513.8	6.85
Base			*3*	*0.022*	*7/25/17 9:00*	*8/6/17 16:00*	*11,683,100*	*268.35*	*1,979.6*	*16.15*
Storm			*16*	*0.100*	*8/6/17 16:00*	*8/6/17 22:00*	*210,789*	*4.84*	*204.0*	*1.32*
Base			*3*	*0.022*	*8/6/17 22:00*	*8/16/17 20:00*	*10,774,900*	*247.49*	*1,825.7*	*14.89*
Storm			*16*	*0.100*	*8/16/17 20:00*	*8/17/17 4:00*	*443,975*	*10.20*	*429.6*	*2.77*
Base			*3*	*0.022*	*8/17/17 4:00*	*8/19/17 10:00*	*3,235,020*	*74.30*	*548.1*	*4.47*
Storm			*16*	*0.100*	*8/19/17 10:00*	*8/19/17 21:00*	*818,253*	*18.79*	*791.7*	*5.11*
Base			*3*	*0.022*	*8/19/17 21:00*	*8/26/17 0:00*	*9,548,370*	*219.32*	*1,617.9*	*13.20*
Storm			*16*	*0.100*	*8/26/17 0:00*	*8/27/17 4:00*	*1,797,880*	*41.30*	*1,739.6*	*11.22*
Base			*3*	*0.022*	*8/27/17 4:00*	*8/29/17 12:00*	*3,933,890*	*90.36*	*666.6*	*5.44*
Base Grab	8/30/2017 9:28	8/30/2017 9:28	3	0.010	8/29/17 12:00	8/31/17 12:00	3,309,850	76.02	619.9	2.07
Base			*3*	*0.022*	*8/31/17 12:00*	*9/26/17 12:00*	*21,213,800*	*487.26*	*3,594.5*	*29.32*
Base Grab	9/27/2017 9:45	9/27/2017 9:45	1	0.021	9/26/17 12:00	9/28/17 12:00	1,301,190	29.89	81.2	1.71
Base			*3*	*0.022*	*9/28/17 12:00*	*10/2/17 16:00*	*2,097,240*	*48.17*	*355.4*	*2.90*
Storm Composite	10/2/2017 18:40	10/5/2017 9:25	14	0.149	10/2/17 16:00	10/5/17 11:00	3,925,460	90.16	3,430.7	36.51
Storm			*16*	*0.100*	*10/5/17 11:00*	*10/8/17 19:00*	*6,627,860*	*152.23*	*6,413.2*	*41.38*
Base			*3*	*0.022*	*10/8/17 19:00*	*10/23/17 19:00*	*17,405,800*	*399.79*	*2,949.3*	*24.06*
Base Grab	10/24/2017 15:03	10/24/2017 15:03	2	0.010	10/23/17 19:00	10/25/17 19:00	1,561,970	35.88	195.0	0.98
Base			*3*	*0.022*	*10/25/17 19:00*	*10/31/17 11:00*	*4,575,690*	*105.10*	*775.3*	*6.32*
*Base**			*3*	*0.022*	*10/31/17 11:00*	*1/1/18 0:00*	*37,220,400*	*854.91*	*6,306.7*	*51.45*
Base Average			3	0.022						
Storm Average			16	0.100						
All Average			6	0.039						
Total							**549,144,071**	**12,613**	**145,453**	**1,068**
CLFLWD Major Subwatershed Total Acres							24,558			
Total Load										
Total TSS/TP (lbs/ac/yr)									**5.92**	**0.043**

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes were estimated using similar flow conditions.

APPENDIX B –

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

BMP	Best Management Practice
CAMP	Citizen-Assisted Monitoring Program
cfs	cubic feet per second
cf	cubic feet
Chl-*a*	Chlorophyll-*a*
CLFLWD	Comfort Lake-Forest Lake Watershed District
Composite Sample	Multiple water samples collected at various flow points by automated device
DO	Dissolved Oxygen
EQuIS	Environmental Quality Information System
Grab Sample	Manually collected discrete water sample
E. coli	*Escherichia coli*
mg/L	milligrams per liter
MPCA	Minnesota Pollution Control Agency
MPN	Most Probable Number
OHW	Ordinary High Water level
TALU	Tiered Aquatic Life Uses
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
µg/L	micrograms per liter
VSS	Volatile Suspended Solids
WCD	Washington Conservation District