Reference Lake and Trend Monitoring Summary for Isanti County, Minnesota

1998

(Lakes: Florence, Francis, Blue and Green)

Minnesota Pollution Control Agency
Environmental Outcomes Division
Environmental Monitoring and Analysis Section

Steve Heiskary and Jennifer Klang

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MPCA Reference Lake and Trend Monitoring Summary for 1998
Isanti County Lakes

During the summer of 1998 the Minnesota Pollution Control Agency (MPCA) monitored four lakes in Isanti County as a part of our Reference and Trend Lake monitoring efforts. This monitoring effort is intended to supplement and complement data gathered through the Citizen Lake Monitoring Program (CLMP), Lake Assessment Program (LAP), and Clean Water Partnership (CWP) Program. The intent of this lake sampling effort is to: provide baseline water quality data, provide data for potential LAP and CWP lakes, characterize lake condition in different regions of the state, examine year-to-year variability in ecoregion-reference lakes, and provide additional trophic status data for lakes exhibiting trends in Secchi transparency. In the latter case, we attempt to determine if the trends in Secchi transparency are "real," i.e., do supporting trophic status data substantiate whether a change in trophic status has occurred. This effort also provides a means to respond to citizen concerns about protecting or improving the lake in cases where no data exists to evaluate the quality of the lake. To make for efficient sampling we tend to select geographic clusters of lakes (e.g., focus on a specific county) whenever possible.

In 1998 the MPCA monitored the following four lakes in Isanti County: Florence, Francis, Blue, and Green. Samples were collected monthly from June through September at most lakes. A summary of data from 1998 and available historical data follows. This summary will include data from 1998 as well as any data available in STORET, U.S. EPA's national water quality data bank (Appendix). Summer-mean epilimnetic (upper well-mixed layer) concentrations for each lake are compared to the "typical" range for ecoregion-reference lakes in the North Central Hardwoods Forests ecoregion (Figure 1 and Table 4). This provides a basis for placing data from these lakes in perspective relative to one another as well as other lakes in the same ecoregion. Additional bases for comparison and evaluation are provided with Tables 1 and 2. Table 1 provides the ecoregion-based *total phosphorus* (TP) criteria. In general, lakes which are at or below the criteria level will have adequate transparency and sufficiently low amounts of algae to support swimmable use throughout most of the summer. Whenever possible these lakes should be protected from increases in nutrient concentrations which would tend to stimulate algal and plant growth and reduce transparency. For lakes above the criteria level, the criteria may serve as a restoration goal for the lake, however this would need be determined by individual examination of the lake and its watershed characteristics. Table 2 represents the percentile distribution of in-lake TP concentrations for each ecoregion based on the mixing (stratification) status of the lake (dimictic, polymictic, or intermittently stratified). This distribution is created by sorting TP concentrations within each mixing type (by ecoregion) from low to high. These percentiles can provide an additional basis for comparing observed summer-mean TP and may further serve as a guide for selecting an appropriate TP goal for the lake. Lastly, Table 3 provides typical concentrations for TP and total suspended solids concentrations for streams -- should stream data be available for comparison.

The following discussion assumes familiarity with basic limnologic terms as used in a "Citizens Guide to Lake Protection" and as commonly used in MPCA LAP reports. A glossary is included in the Appendix as well.

Figure 1. Minnesota's Seven Ecoregions as Mapped by U.S. EPA

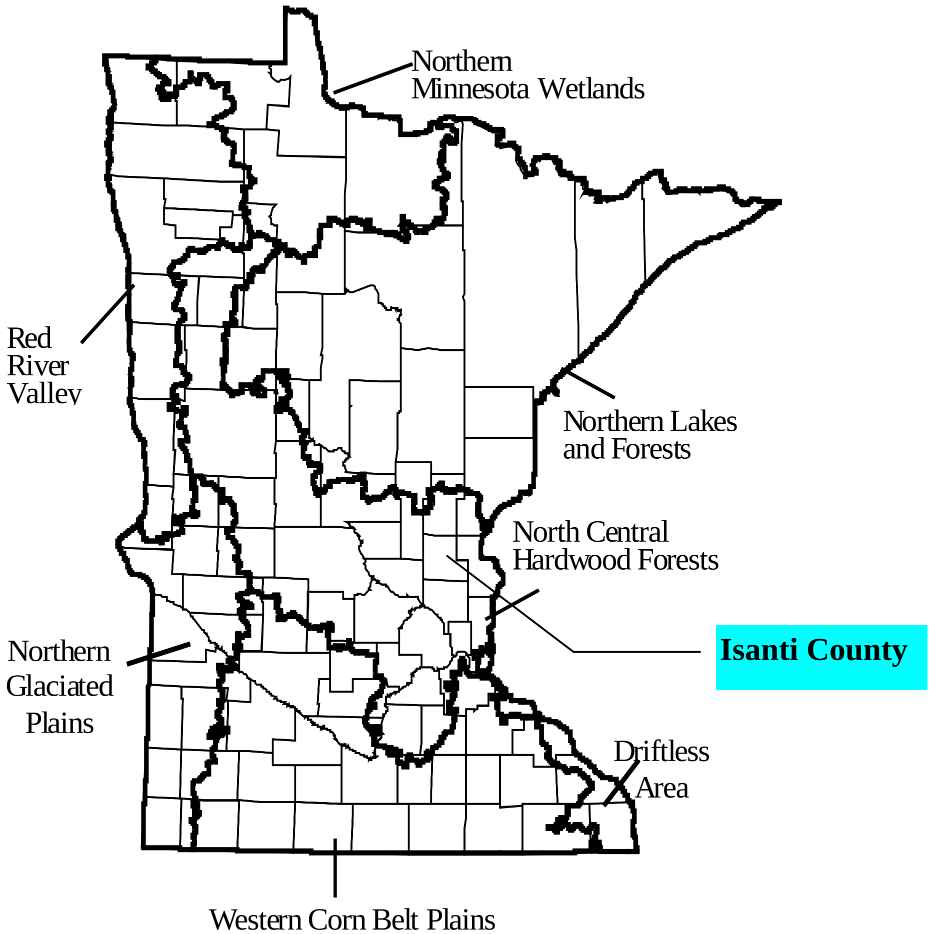


Table 1. Minnesota Lake Phosphorus Criteria (Heiskary and Wilson, 1988).

Ecoregion	Most Sensitive Use	P Criteria
Northern Lakes and Forests	drinking water supply cold water fishery primary contact recreation and aesthetics	**< 15 µg/L** **< 15 µg/L** **< 30 µg/L**
North Central Hardwood Forests	drinking water supply primary contact recreation and aesthetics	**< 30 µg/L** **< 40 µg/L**
Western Corn Belt Plains	drinking water supply primary contact recreation (*full support*) (*partial support*)	**< 40 µg/L** **< 40 µg/L** **< 90 µg/L**
Northern Glaciated Plains	primary contact recreation and aesthetics (*partial support*)	**< 90 µg/L**

Table 2. Distribution of Total Phosphorus (µg/L) Concentrations by Mixing Status and Ecoregion. Based on all assessed lakes for each ecoregion.
D = Dimictic, **I** = Intermittent, **P** = Polymictic

	Northern Lakes and Forests			North Central Hardwood Forest			Western Corn Belt Plains		
Mixing Status:	**D**	**I**	**P**	**D**	**I**	**P**	**D**	**I**	**P**
Percentile value for [TP]									
90 %	37	53	57	104	263	344	--	--	284
75 %	29	35	39	58	100	161	101	195	211
50 %	20	26	29	39	62	89	69	135	141
25 %	13	19	19	25	38	50	39	58	97
10 %	9	13	12	19	21	32	25	--	69
# of obs.	257	87	199	152	71	145	4	3	38

Table 3. Interquartile Range of Concentrations for Minimally Impacted Streams in Minnesota by Ecoregion. Data from 1970-1992 (McCollor and Heiskary, 1993; note 1 mg/L = 1 ppm = 1,000 ppb)

	Total Phosphorus (mg/L)			Total Suspended Solids (mg/L)		
Region/Percentile	**25%**	**50%**	**75%**	**25%**	**50%**	**75%**
NLF	0.02	0.04	0.05	1.8	3.3	6
NMW	0.04	0.06	0.09	4.8	8.6	16
NCHF	0.06	0.09	0.15	4.8	8.8	16
NGP	0.09	0.16	0.25	11.0	34.0	63
RRV	0.11	0.19	0.30	11.0	28.0	59
WCBP	0.16	0.24	0.33	10.0	27.0	61

TABLE 4. AVERAGE SUMMER WATER QUALITY AND TROPHIC STATUS INDICATORS
Isanti County Lakes Monitored in 1998. Based on 1998 epilimnetic data.

Parameters	Florence	Francis	Blue North	Blue South	Green	Typical Range: NCHF Ecoregion
Total Phosphorus (µg/L)	42 ± 3	455 ± 105	32 ± 3	38 ± 5	48 ± 12	**23-50**
Chlorophyll a (µg/L)[3]						
Mean	15 ± 1	263 ± 75	13 ± 2	23 ± 6	28 ± 10	**5-22**
Maximum						**7-37**
Secchi disk (feet)	3.3. ± 0.1	0.7 ± 0.1	4.3 ± 0.3	4.4 ± 0.3	4.3 ± 0.1	**4.9-10.5**
Total Kjeldahl Nitrogen (mg/l)	1.00	3.5	0.7	0.85	0.93	**0.60-1.2**
Nitrite + Nitrate-N (mg/l)						**<0.01**
Alkalinity (mg/l)						**75-150**
Color (Pt-Co Units)						**15-25**
pH (SU)						**8.6-8.8**
Chloride (mg/l)						**4-10**
Total Suspended Solids (mg/l)						**2-6**
Total Suspended Inorganic Solids						**1-2**
Turbidity (NTU)						**1-2**
Conductivity (µmhos/cm)						**300-400**
TN:TP Ratio	24:1	7:1	22:1	22:1	19:1	**25:1-35:1**

Trophic Status Indicators: 1998

		Florence	Francis	Blue - N	Blue-S	Green
TP	**TSIP =**	58	91	54	56	59
Chl a	**TSIC =**	57	83	56	60	61
Secchi	**TSIS =**	60	85	56	55	56

[1] Derived from Heiskary and Wilson (1990).

[3] Chlorophyll a measurements have been corrected for pheophytin.

Figure 2. Carlson's Trophic State Index
R.E. Carlson

TSI < 30 Classical Oligotrophy: Clear water, oxygen throughout the year in the hypolimnion, salmonid fisheries in deep lakes.

TSI 30 - 40 Deeper lakes still exhibit classical oligotrophy, but some shallower lakes will become anoxic in the hypolimnion during the summer.

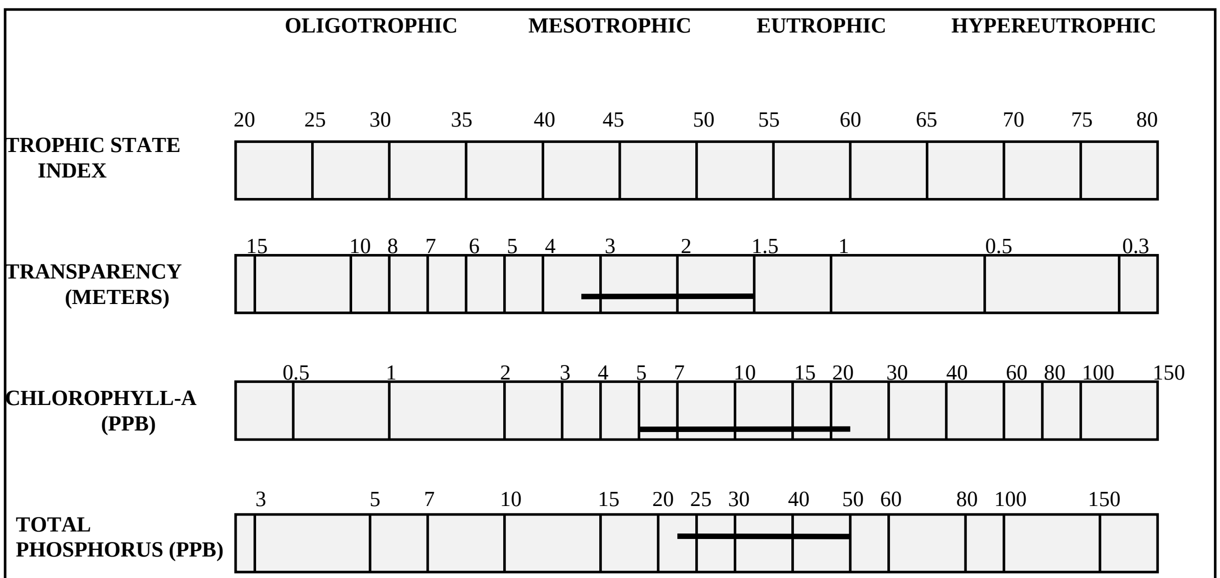
TSI 40 - 50 Water moderately clear, but increasing probability of anoxia in hypolimnion during summer.

TSI 50 - 60 Lower boundary of classical eutrophy: Decreased transparency, anoxic hypolimnia during the summer, macrophyte problems evident, warm-water fisheries only.

TSI 60 - 70 Dominance of blue-green algae, algal scums probable, extensive macrophyte problems.

TSI 70 - 80 Heavy algal blooms possible throughout the summer, dense macrophyte beds, but extent limited by light penetration. Often would be classified as hypereutrophic.

TSI > 80 Algal scums, summer fish kills, few macrophytes, dominance of rough fish.



<u>After</u> Moore, l. and K. Thornton, [Ed.]1988. Lake and Reservoir Restoration Guidance Manual. USEPA>EPA 440/5-88-002.

NCHF Ecoregion Range: ▬▬▬▬

1. Lake Florence (ID# 30-0035)

Lake Florence, at Cambridge, was sampled at the request of a lakeshore resident who was concerned about the water quality of the lake. No historic data was available in STORET for the lake. Previous sampling was planned for the county so we were able to accommodate the request.

Lake Florence is about 120 acres in size with a maximum depth of about 25 feet. The majority of the basin is 10 feet or less and as such exhibits heavy macrophyte (rooted vegetation) growth over much of the basin. There are inlets on the north and east side of the lake and an outlet on the southeast corner. Samples were taken in July, August and September over the site of maximum depth on the east side.

Lake Florence was thermally stratified at this site during the summer of 1998 as evidenced by the dissolved oxygen and temperature measurements (Appendix) and the elevated total phosphorus concentrations in the near-bottom waters (P is released from sediments as oxygen falls below 2 mg/L at the water-sediment interface). Summer-mean TP, total Kjeldahl nitrogen, and chlorophyll-a compare favorably with the ecoregion reference values, however Secchi transparency is slightly lower (Table 4). The TN:TP ratio is about 24:1 which suggests that TP is the nutrient which limits algal growth in the lake. The Carlson Trophic State Index (TSI) values based on TP, chlorophyll-a and Secchi were 58, 57, and 60 respectively and indicate mildly eutrophic conditions for the lake (Figure 2). The three TSI values correspond to one another quite well and thus indicate that Secchi transparency should provide a good indication of trophic status and trends for the lake.

Based on the 1998 data Lake Florence's TP concentration (42 µg/L) ranks near the 50^{th} percentile for dimictic lakes in the NCHF ecoregion (Table 2) and is very near the NCHF ecoregion-based P criteria value of 40 µg/L. Because of its shallowness and proximity to an urban area Lake Florence would be very susceptible to increased eutrophication with an increase in TP loading. Every effort should be made to minimize TP loading to the lake whenever possible, e.g., using properly designed sedimentation basins to treat urban stormwater. Also it would be very important to monitor the lake to assess trends over time. The CLMP is the least expensive and perhaps the best opportunity for trend assessment. Any lakeshore residents or other persons who routinely use the lake are encouraged to participate in the CLMP.

2. Lake Francis (ID # 30-0080)

There has been extensive concern regarding the water quality of Lake Francis over the past few years. Monitoring was conducted in 1996 in response to requests from the lake association. Lake Francis was sampled again in 1998 to provide more comprehensive baseline data for the lake. In addition to the in-lake monitoring, inflow measurements were collected at the main inflow to the lake -- County Ditch 10 (CD-10). Automonitoring equipment which records stage (depth in the culvert) and precipitation was installed to improve estimates of water and nutrient loading to the lake. This equipment was installed late in August so further work will be needed to characterize stage-discharge relationships and to accurately estimate loadings. Preliminary results are provided in this update.

Lake Francis is located southwest of Cambridge. It has a surface area of about 300 acres but is extremely shallow with a maximum depth of seven feet or less and average depth of about four feet. County Ditch 10 (CD-10) drains the majority of the lake's watershed and enters the lake on the northwest corner. The outlet is located on the northeast corner of the lake. There was little evidence of emergent or submergent aquatic plants in the lake throughout the summer.

Lake Francis was polymictic (well mixed) during the summer of 1998 as evidenced by the dissolved oxygen and temperature measurements (Appendix). Summer-mean TP, total Kjeldahl nitrogen, and chlorophyll-a are extremely high as compared to the ecoregion reference values (Table 4). Secchi transparency was very low throughout the summer averaging 0.7 feet. Severe nuisance blooms (chlorophyll-a >60 µg/L) of blue-green algae were common throughout the summer. The TN:TP ratio is about 7:1 which suggests that nitrogen may be the nutrient which limits algal growth in the lake. However, certain forms of blue-green algae have the ability to fix nitrogen from the atmosphere and thus N may not be limiting to those forms. The Carlson Trophic State Index (TSI) values based on TP, chlorophyll-a and Secchi were 91, 83, and 85 respectively and indicate hypereutrophic conditions for the lake (Figure 2). The Secchi and chlorophyll-a TSI values correspond to one another quite well and thus indicate that Secchi transparency should provide a good indication of trophic status. The TSI based on TP is slightly higher than the other two TSI measures but this is common in lakes with extremely high TP concentrations. Based on the 1998 data, Lake Francis's TP concentration ranks above the 90th percentile (over 90 percent of the assessed lakes had lower TP concentrations) for polymicitc lakes in the NCHF ecoregion (Table 2).

Previous data were available for comparison to 1998. Based on a comparison of means (plus or minus standard error) TP measurements in 1996 and 1998 were significantly higher than measurements from 1979 and 1980 (Figure 3). Concentrations in 1979 and 1980 were on the order of 100-150 µg/L as compared to 400 - 700 µg/L in 1996 and 1998. TP measures in 1998 tended to increase from June through September (Figure 3). A similar pattern was noted for 1979 as well. TP concentrations in 1980, however, tended to decline over the summer. Increasing TP over the summer is common in shallow, polymictic lakes and is often caused by internal recycling of phosphorus from the sediments or from the die-off of aquatic plants, such as curly-leaf pondweed, which release phosphorus as the plant material decomposes. Internal recycling is promoted by low dissolved oxygen concentrations and/or high temperatures at the sediment - water interface. Near bottom temperatures were quite high in Lake Francis (about 20-24 degrees C) throughout the summer and it is likely this helped promote internal recycling in the lake.

Summer-mean TP concentrations in 1996 and 1998 were significantly higher than summer-means from 1979 and 1980 (Figure 4). Although there were no chlorophyll-a data for 1979 and 1980 the Secchi data suggest that chlorophyll-a concentrations were measurably lower in 1979 and 1980 as compared to the 1996 - 1998 time-frame. Secchi transparency was on the order of 2.0 - 2.6 feet in 1979 -1980 as compared with 0.5 - 1.0 feet in 1996 - 1998 (Figure 5).

Typically, nutrient loading from the watershed is the primary contributor to the nutrient budget of the lake. Though we do not have a complete nutrient budget, the monitoring initiated in late 1998 begins to provide useful information on loading in relation to precipitation/runoff events. Table 5 provides a summary of inflow phosphorus concentrations and related information for 1998. In general, based on precipitation measured at Cambridge, precipitation was 1.3 to 1.5 inches below normal in June and July, 0.6 inches above normal in August, and 2.4 inches below normal in September. Increases in the stage (level as measured near the inlet to Lake Francis) of CD-10 is noted for most precipitation events of 0.2 inches or more. Levels tend to subside within a day or two following the event (Figure 6). TP concentrations at CD-10 ranged from a low of 86 µg/L at baseflow to a peak of 340 µg/L on July 16 which followed recent rain events. Based on the sample events in 1998 TP averaged 153 µg/L and ortho-P averaged 88 µg/L which represents about 57 percent of the TP. The average TP concentration ranks near the 75th percentile for minimally-impacted streams in the NCHF ecoregion (Table 3); however, some of the values associated with rainfall events, such as July 16 are very high. These data do not allow for an accurate estimate of loading however, since sampling was not initiated until midsummer and stage (flow) measurements were not initiated until late summer. The flow and concentration data need be combined to yield "flow-weighted" averages which then can be used in mass-balance eutrophication models to accurately describe a nutrient budget for the lake and hence help diagnose the source of the problem (i.e., is the watershed or the sediments the primary contributor to the excessive nutrient concentrations in the lake).

It would be beneficial to continue monitoring the inflow to the lake (flow and concentration) over the course of another year -- beginning with the first snowmelt so that a more accurate estimate of loading be attained. Likewise, some in-lake work may be valuable and the association should continue with the CLMP monitoring as well. It is unlikely that a LAP level of assessment would provide the needed information to diagnose the problems in Lake Francis and thus a CWP or CWP-type of study is recommended. At this point, it would be premature to recommend water quality goals for the lake without a better understanding of the relationship of in-lake water quality to watershed loading and the role and extent of internal recycling of phosphorus.

Figure 3. Lake Francis Summer Total Phosphorus: 1979, 1980, 1996, 1998

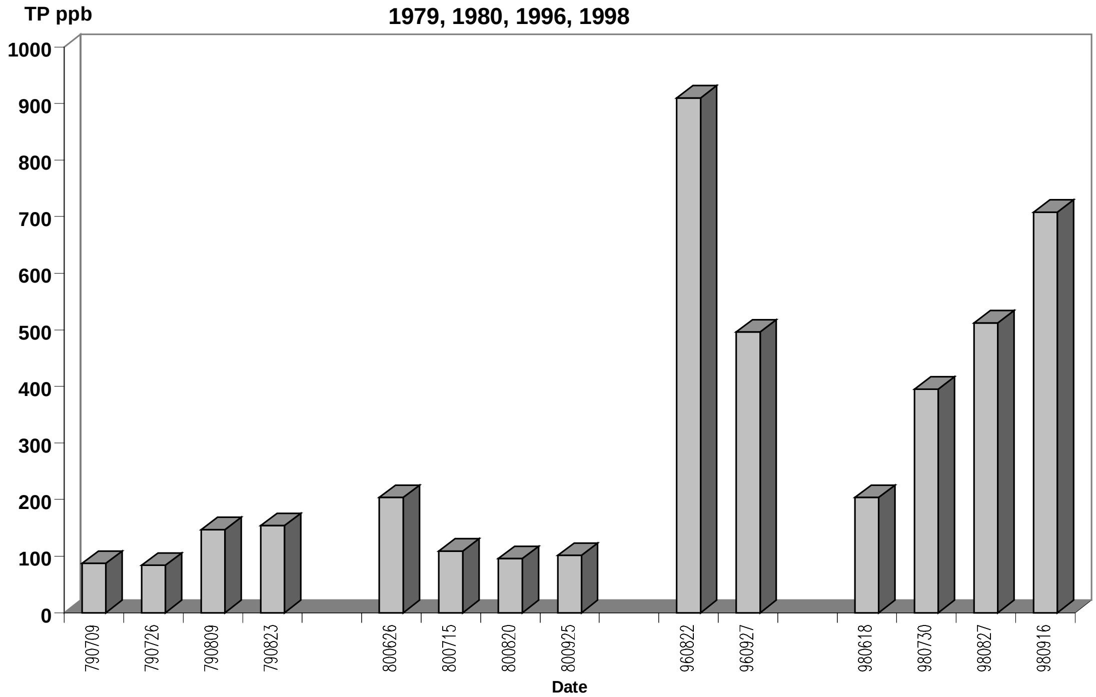


Figure 4. Lake Francis summer-mean Total Phosphorus

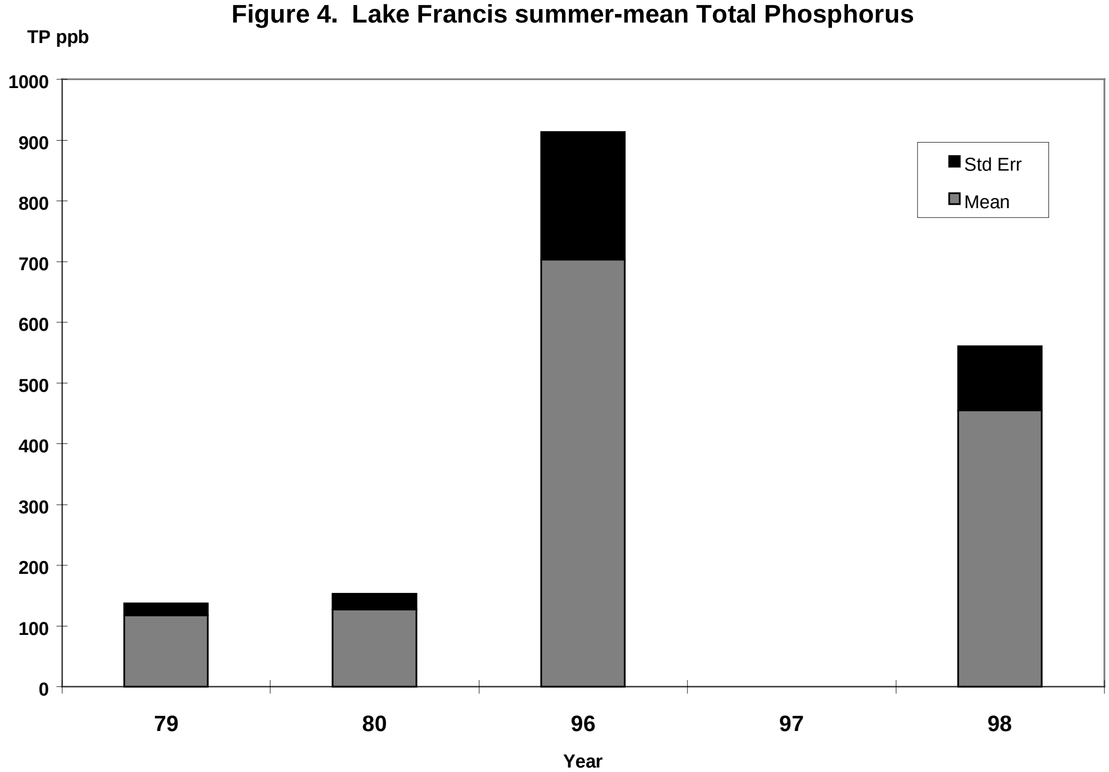


Figure 5. Lake Francis Summer-Mean Secchi Transparency

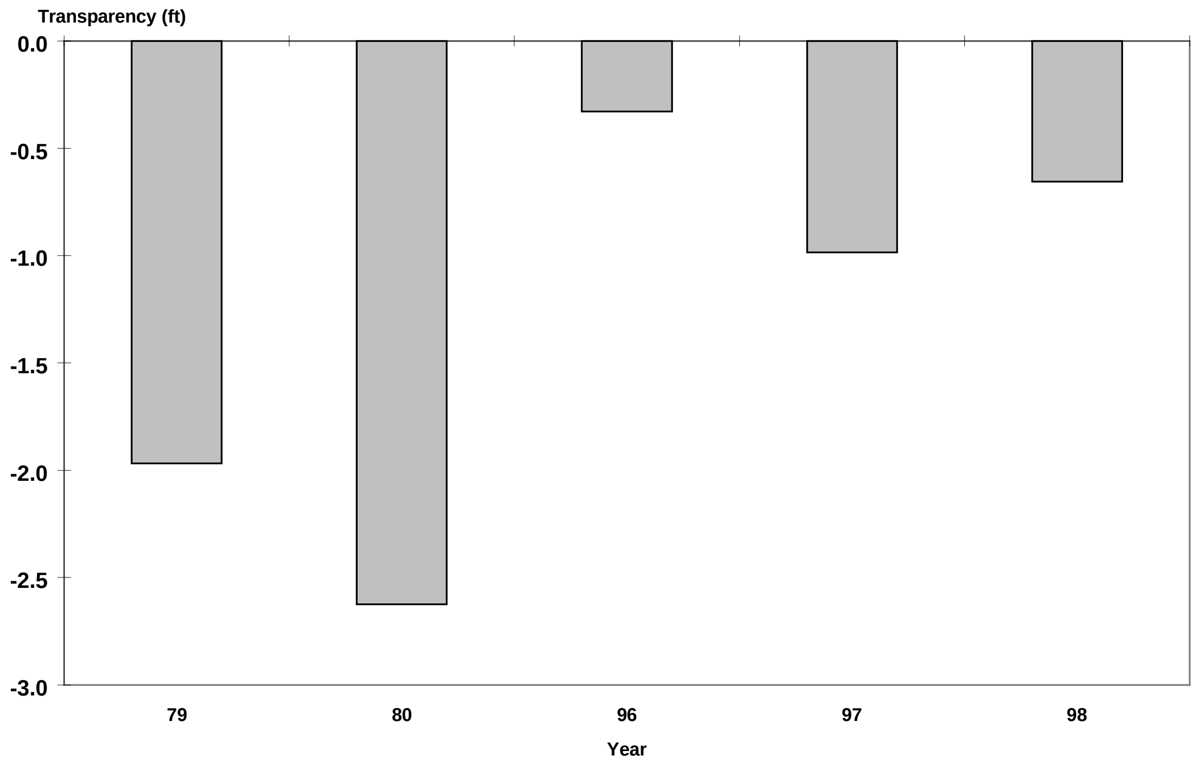
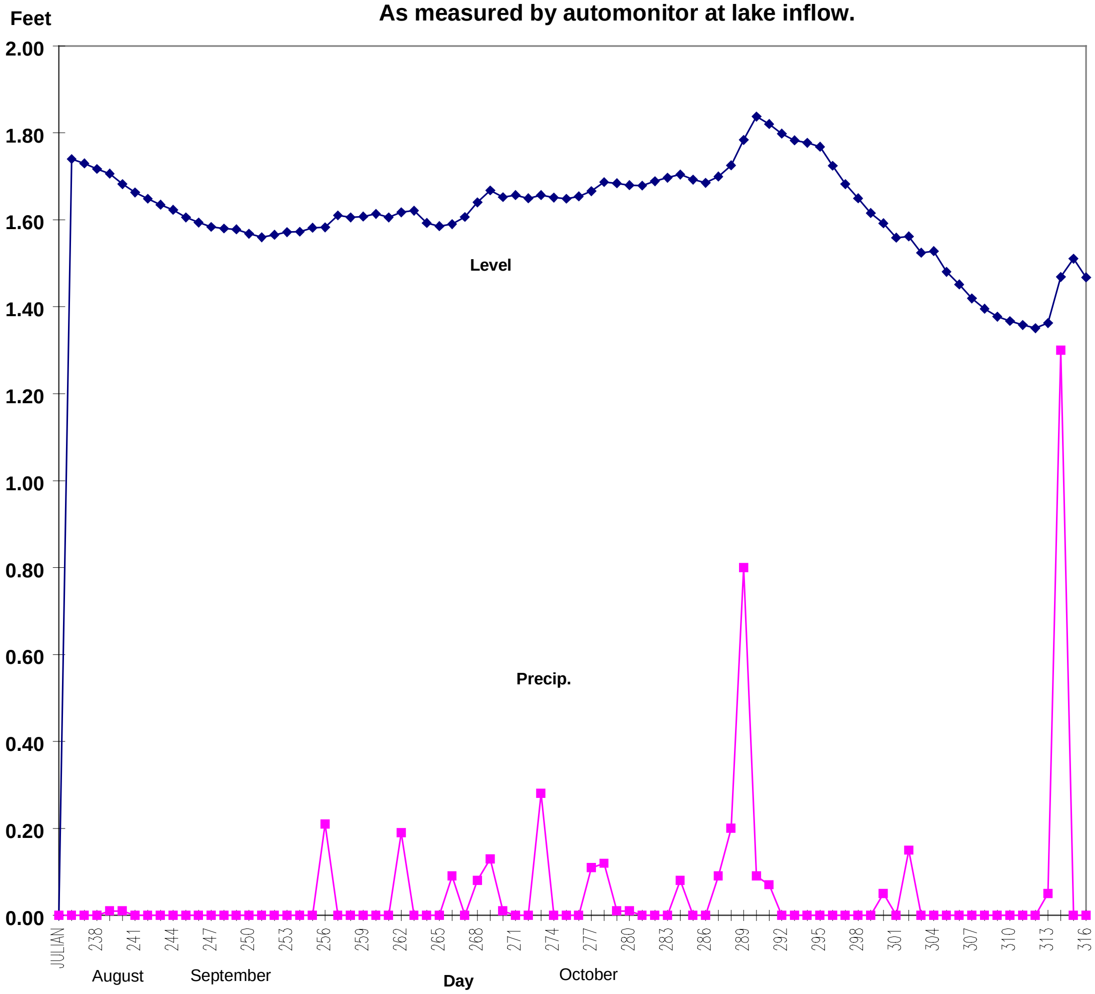


Table 5. Lake Francis Inflow and In-lake Data: 1998. Inflow as collected from County Ditch 10 at Dahlia Street near the inflow to the lake. Precipitation for sample date plus previous three days. Stage represents depth in culvert as measured by automatic monitoring equipment.

Date	Precip inches	Stage feet	Inflow TP (ppb)	Inflow Total Ortho-P (ppb)	Lake TP (ppb)
June 16	0.9				204
July 2	1.6		106	51	
July 16	1.6		340	219	
July 30	0.05				395
August 13	0.0		95		
August 27	0.0	1.71			512
September 4	0.0	1.58	86	67	
September 14	0.2	1.61	106	64	
September 16	0.0	1.61			708
September 20	0.2	1.62	277	66	
November 13	1.3	1.47	88	58	
Average			153	88	

Figure 6. Lake Francis CD 10 Level and Precipitation: August-November, 1998.
As measured by automonitor at lake inflow.



3. Blue Lake (ID# 30-0107)

Blue Lake, southwest of Cambridge, was selected for sampling in 1998 based on its extended CLMP Secchi database and lake association interest in the water quality of the lake as expressed in a recent LAP application. Blue Lake was previously sampled by MPCA in 1988 and 1989 as a part of our efforts to characterize the quality of lakes in this part of the state. These data provide an opportunity to examine recent trends in the quality of the lake.

Blue Lake is about 309 acres in size with a maximum depth of about 30 feet. The lake consists of two distinct basins and has a north-south orientation. The south basin (ID # 30-0107-02) is the larger and deeper of the two and the majority of the watershed drains in from the south. The north basin (ID# 30-0107-01) is much smaller and shallower (10 feet or less throughout). The lake outlets through the north end of this basin. Abundant macrophyte growth is common throughout both basins. Samples were taken in June, July, August and September over the site of maximum depth in each basin.

The south basin of Blue Lake was thermally stratified during the summer of 1998 as evidenced by the dissolved oxygen and temperature measurements (Appendix) and the elevated total phosphorus concentrations in the near-bottom waters (P is released from sediments as oxygen falls below 2 mg/L at the water-sediment interface). Summer-mean TP, total Kjeldahl nitrogen, and chlorophyll-a compare favorably with the ecoregion reference values, however Secchi transparency is slightly lower (Table 4). The TN:TP ratio is about 22:1 which suggests that TP is the nutrient which limits algal growth in the lake. Based on the 1998 summer-means (plus or minus standard error), there was no significant difference between the TP concentration and Secchi transparency of the two basins; however chlorophyll-a was slightly higher in the South basin. The Carlson Trophic State Index (TSI) values based on TP, chlorophyll-a and Secchi were 54, 56, and 56 (north) and 56, 60, and 55 (south), respectively, and indicate mildly eutrophic conditions for the lake (Figure 2). The three TSI values correspond to one another fairly well in both basins and thus indicate that Secchi transparency should provide a good indication of trophic status and trends for the lake.

Some data are available for assessing recent trends in the quality of Blue Lake. CLMP and MPCA Secchi data date back to 1981 but the best records are from 1987 to the present. Based on nine years of data for the north basin, summer-mean transparency averaged 1.6 meters (5.3 feet) and there is no significant trend over time. Only five years of data is available for the south basin and again no trend is evident (Figure 8). Transparency is quite similar between the two basins during most summers. Based on the limited TP data it appears that TP concentrations are lower in 1998 as compared to previous data (Figure 7) -- however this may simply be related to natural variability in precipitation and runoff between years rather than indicative of a trend.

Based on the 1998 data, Blue Lake's TP concentration ranks near the 50th percentile for dimictic lakes in the NCHF ecoregion (Table 2) and is just below the NCHF ecoregion-based P criteria value of 40 µg/L. Because of its shallowness Blue Lake would be very susceptible to increased eutrophication with an increase in TP loading. Every effort should be made to minimize TP loading to the lake whenever possible, e.g., using properly designed sedimentation basins to treat urban stormwater and best management practices on agricultural lands. Also it is very important to continue to monitor the lake through CLMP to assess trends over time.

Figure 7. Blue Lake Summer-Mean Total Phosphorus

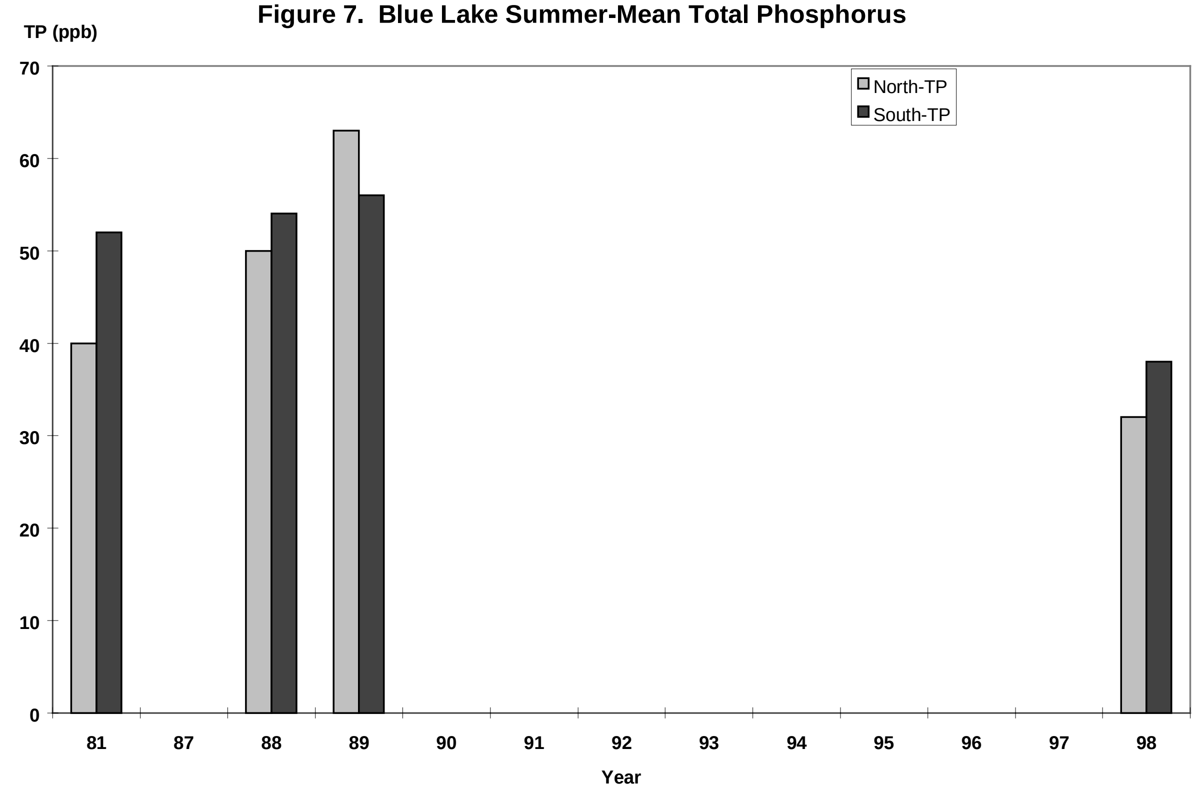
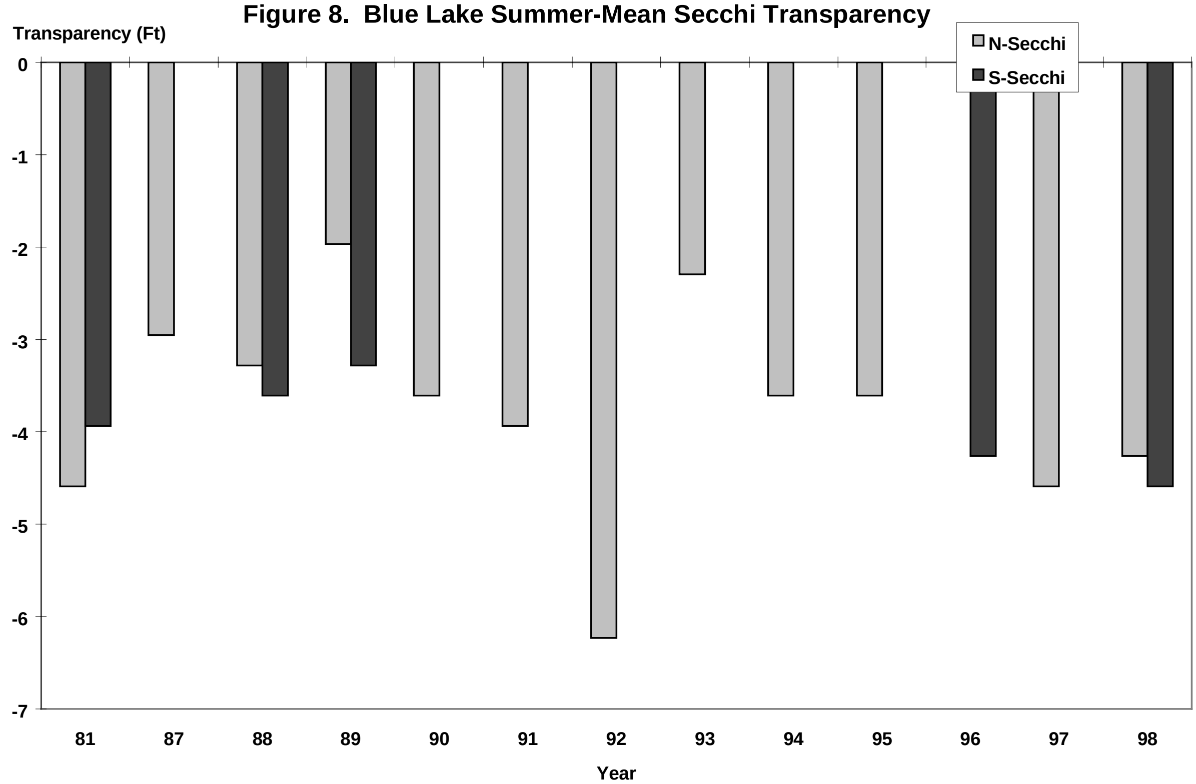


Figure 8. Blue Lake Summer-Mean Secchi Transparency



4. Green Lake (ID # 30-0136)

Green Lake, west of Cambridge, was selected for sampling in 1998 because of its extended CLMP Secchi database and previous efforts on this lake which included a LAP study in 1988 and a subsequent Phase I study. The Phase I data, however, were not in STORET and thus were not considered in this assessment. The current and historic data provide an opportunity to examine recent trends in the quality of the lake.

Green Lake is about 802 acres in size with a maximum depth of about 28 feet. There are major inlets entering the lake from the northeast and southwest. The lake outlets through the southeast corner of the lake. Samples were taken in June, July, August and September over the site of maximum depth in the western portion of the lake.

Green Lake was thermally stratified from June through August 1998 as evidenced by the dissolved oxygen and temperature measurements (Appendix) and the elevated total phosphorus concentrations in the near-bottom waters. The lake was in the process of fall mixing on the September date based on the oxygen, temperature, and phosphorus data. Summer-mean TP and total Kjeldahl nitrogen are near the upper end of the typical range for reference lakes in the NCHF (Table 4), however chlorophyll-a is above this range and Secchi transparency is slightly lower (Table 4). The TN:TP ratio is about 19:1 which suggests that TP is the nutrient which limits algal growth in the lake. The Carlson Trophic State Index (TSI) values based on TP, chlorophyll-a and Secchi were 59, 61, and 56, respectively, and indicate eutrophic conditions for the lake (Figure 2). The three TSI values correspond to one another fairly well in both basins and thus indicate that Secchi transparency should provide a good indication of trophic status and trends for the lake.

The historic and current data provide a basis for assessing recent trends in the quality of Green Lake. CLMP Secchi data date back to 1973 and MPCA data date back to the 1988 LAP study. Based on 10 years of Secchi data, summer-mean transparency averaged 1.6 meters (5.3 feet) and there is no significant trend over time (Figure 10). Based on available TP data, summer-mean concentrations range from 37 to 48 µg/L and no trend is evident (Figure 9).

Based on the 1998 data Green Lake's TP concentration ranks between the 50^{th} to 75^{th} percentile for dimictic lakes in the NCHF ecoregion (Table 2) and is just above the NCHF ecoregion-based P criteria value of 40 µg/L (Table 1). Because it is relatively shallow, Green Lake would be very susceptible to increased eutrophication with an increase in TP loading. Again, urbanization of the shoreland area and watershed in general could result in increased nutrient loading to the lake. Every effort should be made to minimize TP loading to the lake whenever possible, e.g., using properly designed sedimentation basins to treat urban stormwater. Also, it will be very important to continue to monitor the lake through CLMP to assess trends over time.

Figure 9. Green Lake Summer-Mean Total Phosphorus

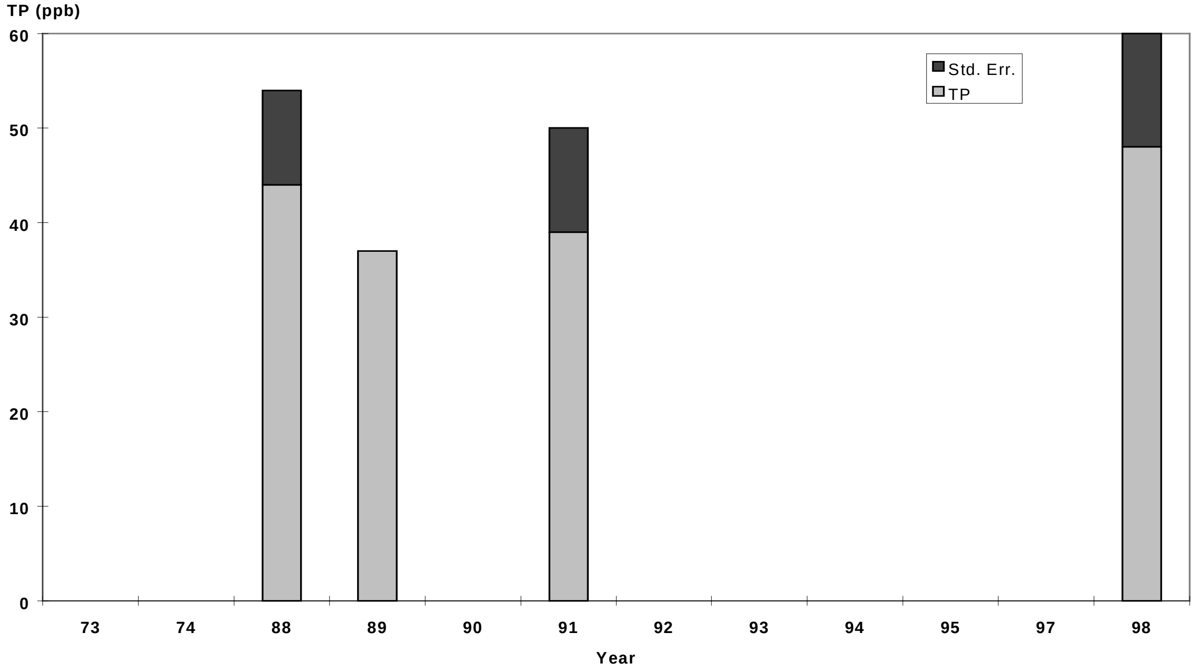
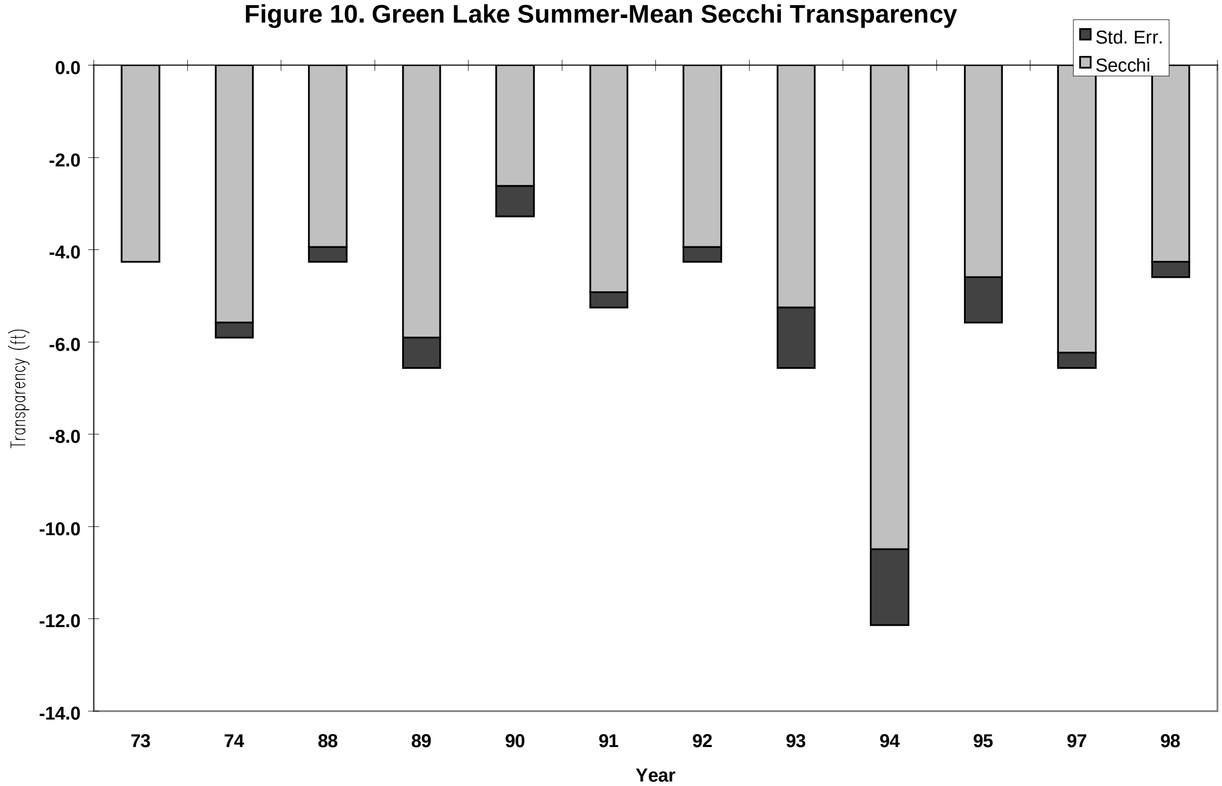


Figure 10. Green Lake Summer-Mean Secchi Transparency



Appendix

1. Glossary

2. Water Quality Data from STORET

Water Quality Data: Abbreviations and Units

DATE= yr-mo-da
SITE= sampling site ID, 100 series=MPCA, 200=CLMP, etc.
DM= sample depth in meters(0=0-2 m integrated)
TP= total phosphorus in mg/l(decimal) or ug/L as whole number
OP= total ortho-phosphorus in mg/l
DP= dissolved phosphorus in mg/l
TKN= total Kjeldahl nitrogen in mg/l
N2N3= nitrite+nitrate N in mg/l
NH4= ammonia-N in mg/l
TNTP=TN:TP ratio
PH= pH in SU (F=field, L or _=lab)
ALK= alkalinity in mg/l (lab)
TSS= total suspended solids in mg/l
TSV= total suspended volatile solids in mg/l
TSIN= total suspended inorganic solids in mg/l
TURB= turbidity in NTU (F=field)
CON= conductivity in umhos/cm (F=field, L=lab)
CL= chloride in mg/l
SI= total silica in mg/L
DO= dissolved oxygen in mg/l
TEMP= temperature in degrees centigrade
SD= Secchi disk in meters (SDF=feet)
CHLA= chlorophyll-a in ug/l
TSI= Carlson's TSI (P=TP, S=Secchi, C=Chla)
PHEO= pheophytin in ug/l
PHYS= physical appearance rating (classes=1 to 5)
REC= recreational suitability rating (classes=1 to 5)
RTP, RN2N3...= remark code; k=less than, Q=exceeded holding time

Commonly used statistical abbreviations in data printouts

NTP, NSD,....= number of observations
MTP, MSD,....= mean TP, Secchi, etc.(typically June-Sept. mean)
STP, SSD, ...= standard error of the mean for TP, Secchi, etc.
[std err = std deviation/square root of number of observations]
TPCV, SDCV, .= coefficient of variation of mean for TP, Secchi, etc.
[CV=(100*std deviation)/mean]; and is expressed as a % of the mean]

Glossary

Acid Rain: Rain with a higher than normal acid range (low pH). Caused when polluted air mixes with cloud moisture. Can make lakes devoid of fish.

Algal Bloom: An unusual or excessive abundance of algae.

Alkalinity: Capacity of a lake to neutralize acid.

Bioaccumulation: Build-up of toxic substances in fish flesh. Toxic effects may be passed on to humans eating the fish.

Biomanipulation: Adjusting the fish species composition in a lake as a restoration technique.

Dimictic: Lakes which thermally stratify and mix (turnover) once in spring and fall.

Ecoregion: Areas of relative homogeneity. EPA ecoregions have been defined for Minnesota based on land use, soils, landform, and potential natural vegetation.

Ecosystem: A community of interaction among animals, plants, and microorganisms, and the physical and chemical environment in which they live.

Epilimnion: Most lakes form three distinct layers of water during summertime weather. The epilimnion is the upper layer and is characterized by warmer and lighter water.

Eutrophication: The aging process by which lakes are fertilized with nutrients. *Natural eutrophication* will very gradually change the character of a lake. *Cultural eutrophication* is the accelerated aging of a lake as a result of human activities.

Eutrophic Lake: A nutrient-rich lake – usually shallow, "green" and with limited oxygen in the bottom layer of water.

Fall Turnover: Cooling surface waters, activated by wind action, sink to mix with lower levels of water. As in spring turnover, all water is now at the same temperature.

Hypolimnion: The bottom layer of lake water during the summer months. The water in the hypolimnion is denser and much colder than the water in the upper two layers.

Lake Management: A process that involves study, assessment of problems, and decisions on how to maintain a lake as a thriving ecosystem.

Lake Restoration: Actions directed toward improving the quality of a lake.

Lake Stewardship: An attitude that recognizes the vulnerability of lakes and the need for citizens, both individually and collectively, to assume responsibility for their care.

Limnetic Community: The area of open water in a lake providing the habitat for phytoplankton, zooplankton and fish.

Littoral Community: The shallow areas around a lake's shoreline, dominated by aquatic plants. The plants produce oxygen and provide food and shelter for animal life.

Mesotrophic Lake: Midway in nutrient levels between the eutrophic and oligotrophic lakes

Nonpoint Source: Polluted runoff – nutrients and pollution sources not discharged from a single point: e.g. runoff from agricultural fields or feedlots.

Oligotrophic Lake: A relatively nutrient- poor lake, it is clear and deep with bottom waters high in dissolved oxygen.

pH Scale: A measure of acidity.

Photosynthesis: The process by which green plants produce oxygen from sunlight, water and carbon dioxide.

Phytoplankton: Algae – the base of the lake's food chain, it also produces oxygen.

Point Sources: Specific sources of nutrient or polluted discharge to a lake: e.g. stormwater outlets.

Polymictic: A lake which does not thermally stratify in the summer. Tends to mix periodically throughout summer via wind and wave action.

Profundal Community: The area below the limnetic zone where light does not penetrate. This area roughly corresponds to the hypolimnion layer of water and is home to organisms that break down or consume organic matter.

Respiration: Oxygen consumption

Secchi Disk: A device measuring the depth of light penetration in water.

Sedimentation: The addition of soils to lakes, a part of the natural aging process, makes lakes shallower. The process can be greatly accelerated by human activities.

Spring Turnover: After ice melts in spring, warming surface water sinks to mix with deeper water. At this time of year, all water is the same temperature.

Thermocline: During summertime, the middle layer of lake water. Lying below the epilimnion, this water rapidly loses warmth.

Trophic Status: The level of growth or productivity of a lake as measured by phosphorus content, algae abundance, and depth of light penetration.

Turbidity: Particles in solution (e.g. soil or algae) which scatter light and reduce transparency.

Water Density: Water is most dense at 39 degrees F (4 degrees C) and expands (becomes less dense) at both higher and lower temperatures.

Watershed: The surrounding land area that drains into a lake, river or river system.

Zooplankton: Microscopic animals

Isanti County. Summer-mean trophic status data.															
LAKEID=30-0035			**Florence**												
	Total Phosphorus				**Secchi**				**Chlorophyll-a**				**Carlson's TSI's**		
YR	**TP**	**SE**	**CV**	**NTP**	**SDM**	**SE**	**CV**	**NS**	**CHLA**	**SE**	**CV**	**NC**	**TSP**	**TSC**	**TSIS**
	ppb	**ppb**	**%**	**#**	**m**	**m**	**%**	**#**	**ppb**	**ppb**	**%**	**#**			
90	.	.	.	0	0.7	0.2	53	3	.	.	.	0	.	.	67
98	42	3	12	3	1	0.1	14	2	15	1	13	3	58	57	60
LAKEID=30-0080			**Francis**												
YR	**TP**	**SE**	**CV**	**NTP**	**SDM**	**SE**	**CV**	**NS**	**CHLA**	**SE**	**CV**	**NC**	**TSP**	**TSC**	**TSIS**
79	118	19	32	4	0.6	0	25	16	.	.	.	0	72	.	68
80	127	26	40	4	0.8	0	18	17	.	.	.	0	73	.	64
96	703	210	42	2	0.1	0	28	2	393	105	38	2	98	89	90
97	.	.	.	0	0.3	0	34	18	.	.	.	0	.	.	81
98	455	105	46	4	0.2	0	42	3	263	75	57	4	91	83	85
LAKEID=30-0107-01			**Blue (N. Bay)**												
YR	**TP**	**SE**	**CV**	**NTP**	**SDM**	**SE**	**CV**	**NS**	**CHLA**	**SE**	**CV**	**NC**	**TSP**	**TSC**	**TSIS**
81	40	.	.	1	1.4	.	.	1	18	.	.	1	57	59	55
87	.	.	.	0	0.9	0.1	31	10	.	.	.	0	.	.	63
88	50	1	4	3	1	0.2	52	13	28	9	56	3	61	62	61
89	63	.	.	1	0.6	.	.	1	44	.	.	1	64	68	67
90	.	.	.	0	1.1	0.1	32	12	.	.	.	0	.	.	59
91	.	.	.	0	1.2	0.1	28	11	.	.	.	0	.	.	58
92	.	.	.	0	1.9	0.2	26	8	.	.	.	0	.	.	51
93	.	.	.	0	0.7	0.1	31	6	.	.	.	0	.	.	66
94	.	.	.	0	1.1	0.1	31	6	.	.	.	0	.	.	59
95	.	.	.	0	1.1	0	7	8	.	.	.	0	.	.	58
97	.	.	.	0	1.4	0.1	13	9	.	.	.	0	.	.	55
98	32	3	18	4	1.3	0.1	11	3	13	2	24	4	54	56	56
LAKEID=30-0107-02			**Blue (S. Bay)**												
YR	**TP**	**SE**	**CV**	**NTP**	**SDM**	**SE**	**CV**	**NS**	**CHLA**	**SE**	**CV**	**NC**	**TSP**	**TSC**	**TSIS**
81	52	.	.	1	1.2	.	.	1	27	.	.	1	61	63	57
88	54	7	33	6	1.1	0.1	15	6	31	10	75	6	61	62	59
89	56	.	.	1	1	.	.	1	26	.	.	1	62	62	60
96	.	.	.	0	1.3	0.2	32	6	.	.	.	0	.	.	57
98	38	5	24	4	1.4	0.1	8	3	23	6	50	4	56	60	55
LAKEID=30-0136			**Green**												
YR	**TP**	**Std. E**	**TPCV**	**NTP**	**SDM**	**SSD**	**SDCV**	**NS**	**CHLA**	**SCHL**	**CCV**	**NC**	**TSP**	**TSC**	**TSIS**
73	.	.	.	0	1.3	0	6	15	.	0	.	.	.	.	57
74	.	.	.	0	1.7	0.1	30	17	.	0	.	.	.	.	53
88	44	10	53	6	1.2	0.1	23	17	97	6	57	58	57	58	57
89	37	.	.	1	1.8	0.2	33	12	10	2	56	50	56	50	52
90	.	.	.	0	0.8	0.2	40	4	.	0	.	.	.	.	65
91	39	11	79	8	1.5	0.1	25	13	20	8	52	62	52	62	55
92	.	.	.	0	1.2	0.1	19	4	.	0	.	.	.	.	58
93	.	.	.	0	1.6	0.4	55	5	.	0	.	.	.	.	55
94	.	.	.	0	3.2	0.5	34	5	.	0	.	.	.	.	44
95	.	.	.	0	1.4	0.3	31	2	.	0	.	.	.	.	56
97	.	.	.	0	1.9	0.1	6	2	.	0	.	.	.	.	51
98	48	12	54	5	1.3	0.1	18	16	83	5	59	61	59	61	56

Isanti County Lakes Monitored by MPCA in 1998. Includes all data from STORET.

Legend at end of file.

LAKEID	**=30-0035**			**Florence**																
DATE	**SITE**	**D**	**TP**	**RTI**	**TKN**	**N2N3**	**RN**	**TSS**	**TSIN**	**ALK**	**PHF**	**CL**	**CONF**	**TURB**	**COLOR**	**CHLA**	**PHEO**	**SDF**	**DO**	**TEMP**
		ft	**ppb**								**SU**		**umho**	**NTU**	**PT-CO**	**ppb**		**ft**	**ppm**	**C**
980730	101	0	48		1.15	.		9.6	2.4	94	8.9	15.0	140	.		20	17.1	2.5	3	9.0	24.6
980730	101	19	250		.	.		.	.	.	.	.	.	.	.	.	.	.	0.4	16.3
980827	101	0	41		1.00	.		8.0	1.2	82	8.8	15.0	200	.	20	15.0	0.6	.	.	.
980827	101	21	719		.	.		.	.	.	.	.	.	.	.	.	.	.	.	.
980916	101	0	38		1.00	.		6.0	0.4	98	8.7	16.0	138	.	20	13.1	1.3	3.6	9.1	23.0
LAKEID	**=30-0080**			**Francis**																
DATE	**SITE**	**D**	**TP**	**RTI**	**TKN**	**N2N3**	**RN**	**TSS**	**TSIN**	**ALK**	**PHF**	**CL**	**CONF**	**TURB**	**COLOR**	**CHLA**	**PHEO**	**SDF**	**DO**	**TEMP**
		ft	**ppb**								**SU**		**umho**	**NTU**	**PT-CO**	**ppb**		**ft**	**ppm**	**C**
790709	201	0	87		1.40	.		.	.	.	.	.	.	.	50	.	.	1.5	.	.
790726	201	0	84		1.63	.		.	.	.	.	.	.	.	45	.	.	.	.	.
790809	201	0	147		2.37	.		.	.	.	.	.	.	.	40	.	.	.	.	.
790823	201	0	154		2.42	.		.	.	.	.	.	.	.	40	.	.	.	.	.
800626	201	0	204		1.89	.		.	.	.	.	.	.	.	30	.	.	.	.	.
800715	201	0	109		1.54	.		.	.	.	.	.	.	.	30	.	.	.	.	.
800820	201	0	96		1.44	.		.	.	.	.	.	.	.	40	.	.	.	.	.
800925	201	0	101		1.70	.		.	.	.	.	.	.	.	30	.	.	.	.	.
960822	101	0	910		3.43	0.05	K	140.0	52	87	.	7.0	.	95	50	497.0	3.2	0.3	6.8	23.9
960927	101	0	496		3.64	0.05	K	86.0	26	110	.	7.4	.	68	30	288.0	16.0	0.5	7.2	13.6
980618	101	0	204		2.16	.		42.0	18	94	8.3	.	210	.	20	66.5	20.2	0.8	6.9	22.4
980730	101	0	395		4.29	.		59.0	13	78	9.5	6.5	112	.	40	275.0	17.8	0.7	8.7	23.6
980827	101	0	512		0.35	.		91.0	27	88	8.9	6.8	180	.	40	279.0	17.3	.	.	.
980916	101	0	708		7.07	.		130.0	31	110	8.5	7.4	122	.	50	431.0	16.0	0.3	6.8	21.0
LAKEID	**=30-0107-01**			**Blue**		**North**														
DATE	**SITE**	**D**	**TP**	**RTI**	**TKN**	**N2N3**	**RN**	**TSS**	**TSIN**	**ALK**	**PHF**	**CL**	**CONF**	**TURB**	**COLOR**	**CHLA**	**PHEO**	**SDF**	**DO**	**TEMP**
		ft	**ppb**								**SU**		**umho**	**NTU**	**PT-CO**	**ppb**		**ft**	**ppm**	**C**
810811	101	0	40		1.03	0.01	K	.	.	150	.	.	.	.	15	17.6	.	4.6	9.0	25.5
880517	101	0	35		0.88	0.01	K	3.6	3.1	130	.	2.2	.	2	30	4.1	2.1	8.2	11.2	17.7
880628	101	0	48		1.03	.		.	.	.	.	.	.	.	.	11.6	5.2	4.6	26.0	7.5
880727	101	0	52		1.30	0.01	K	6.0	2.2	130	.	3.8	.	5.5	30	28.8	0.8	2.6	9.4	27.7
880830	101	0	50		1.28	0.01	K	9.8	2.6	150	.	3.7	.	5	10	42.5	0.8	3.3	.	.
890516	101	0	36		0.91	0.02		3.6	1.2	120	.	3.0	240	2.4	30	7.7	1.0	3.9	12.7	22.1
890809	101	0	63		1.52	.		.	.	.	.	.	230	.	.	43.6	5.6	2	11.2	24.0
980619	101	0	31		0.65	.		4.4	2	130	9	.	250	.	20	9.8	2.9	4.9	9.5	22.4
980730	101	0	24		.	.		.	.	.	8.5	.	167	.	.	11.1	1.6	3.9	7.6	24.5
980827	101	0	37		0.81	.		4.8	0.4	150	8.6	4.1	250	.	20	16.0	2.8	.	.	.
980916	101	0	35		.	.		.	.	.	8.3	.	178	.	.	15.5	3.8	4.3	7.8	21.8
LAKEID	**=30-0107-02**			**Blue**		**South**														
DATE	**SITE**	**D**	**TP**	**RTI**	**TKN**	**N2N3**	**RN**	**TSS**	**TSIN**	**ALK**	**PHF**	**CL**	**CONF**	**TURB**	**COLOR**	**CHLA**	**PHEO**	**SDF**	**DO**	**TEMP**
		ft	**ppb**								**SU**		**umho**	**NTU**	**PT-CO**	**ppb**		**ft**	**ppm**	**C**
810811	101	0	52		1.10	0.01	K	.	.	120	.	.	.	.	15	26.8	.	3.9	9.5	24.5
880517	101	0	51		0.85	0.01	K	7.0	5.9	170	.	2.6	.	2	10	6.4	3.4	6.6	11.2	17.3

880628	101	0	38		0.91	0.01	K	4.4	1.6	150	.	2.0	.	3	10	7.5	2.1	4.6	25.6	8.4
880628	101	22	124		1.90	.		.	.	.	.	.	.	.	.	.	.	.	14.4	0.1
880628	102	0	42		0.85	.		.	.	.	.	.	.	.	.	15.0	1.6	3.9	.	.
880727	101	0	41		1.02	0.01	K	5.4	3.2	140	.	3.0	.	5	10	20.8	0.8	3.6	8.8	26.2
880727	101	22	247		2.22	.		.	.	.	.	.	.	.	.	.	.	.	0.1	17.2
880727	102	0	51		1.00	.		.	.	.	.	.	.	.	.	23.1	0.6	3.6	.	.
880830	101	0	70		1.04	0.01	K	8.8	2	150	.	3.0	.	6.5	5	57.7	0.8	3	7.1	21.9
880830	101	26	70		1.19	.		.	.	.	.	.	.	.	.	.	.	.	0.3	20.4
880830	102	0	82		1.28	.		.	.	.	.	.	.	.	.	64.1	0.8	3.3	8.2	21.8
890516	101	0	37		0.73	0.01	K	2.0	0.8	130	.	2.2	260	1.8	20	3.8	0.3	6.2	12.5	21.1
890516	101	27	57		0.89	0.01	K	.	.	.	.	.	.	.	.	.	.	.	.	.
890516	102	0	39		0.91	0.01	K	.	.	.	.	.	260	.	.	4.2	0.6	4.9	.	.
890809	101	0	56		1.13	0.01	K	7.6	2.2	120	.	4.1	220	6.1	10	25.6	9.6	3.3	10.8	25.2
890809	101	19	152		1.26	.		.	.	.	.	.	.	.	.	.	.	.	0.3	16.6
980619	101	0	29		0.68	.		4.4	1.6	130	9	.	265	.	10	12.4	2.4	4.9	9.1	21.8
980619	101	26	533		.	.		.	.	.	.	.	.	.	.	.	.	.	0.1	12.3
980730	101	0	35		0.88	.		5.6	1.2	140	8.4	3.9	180	.	20	15.7	1.0	4.3	6.9	24.4
980730	101	22	515		.	.		.	.	.	.	.	.	.	.	.	.	.	0.1	14.8
980827	101	0	39		0.81	.		8.4	1.4	140	8.7	4.0	250	.	20	26.1	1.2	.	.	.
980827	101	26	1510		.	.		.	.	.	.	.	.	.	.	.	.	.	.	.
980916	101	0	51		0.98	.		5.2	0	190	8.4	4.1	180	.	20	37.7	1.6	4.9	8.8	21.6
980916	101	26	785		4.40	.		.	.	.	7	.	281	.	.	.	.	.	0.6	14.6
LAKEID	**=30-0136**			**Green**																
DATE	**SITE**	**D**	**TP**	**RTI**	**TKN**	**N2N3**	**RN**	**TSS**	**TSIN**	**ALK**	**PHF**	**CL**	**CONF**	**TURB**	**COLOR**	**CHLA**	**PHEO**	**SDF**	**DO**	**TEMP**
		ft	**ppb**								**SU**		**umho**	**NTU**	**PT-CO**	**ppb**		**ft**	**ppm**	**C**
880517	101	0	40		1.02	0.30		4.2	1.9	130	.	5.2	.	1.5	10	5.0	1.7	10.2	9.4	15.4
880628	101	0	29		0.74	0.01	K	3.8	1.2	120	.	5.0	.	3.5	20	8.3	1.9	4.6	7.4	23.6
880628	101	19	42		1.03	.		.	.	.	.	.	.	.	.	.	.	.	0.0	19.8
880628	102	0	28		0.63	.		.	.	.	.	.	.	.	.	7.4	1.0	4.6	.	.
880727	101	0	32		0.80	0.01	K	5.0	2.8	110	.	6.2	.	3	10	10.4	4.0	4.3	8.6	25.7
880727	101	21	36		0.91	.		.	.	.	.	.	.	.	.	.	.	.	.	.
880727	102	0	28		0.80	.		.	.	.	.	.	.	.	.	12.8	3.2	4.3	.	.
880830	101	0	80		1.32	0.01	K	11.0	4	120	.	5.8	.	6	10	64.1	2.4	2.6	9.6	20.7
880830	101	19	70		1.15	.		.	.	.	.	.	.	.	.	.	.	.	7.1	20.5
880830	102	0	68		1.15	.		.	.	.	.	.	.	.	.	44.1	3.2	3	7.5	20.8
890516	101	0	30		0.75	0.12		0.5	-0.3	120	.	7.0	235	0.9	10	6.1	1.9	5.6	15.3	18.8
890516	101	22	49		1.07	0.24		.	.	.	.	.	.	.	.	.	.	.	3.7	8.7
890516	102	0	26		0.84	0.11		.	.	.	.	.	235	.	.	5.1	1.9	4.9	.	.
890809	101	0	37		0.75	0.01		3.6	1.4	110	.	7.5	220	1.7	20	7.4	0.6	9.5	8.0	24.7
890809	101	19	26		0.76	.		.	.	.	.	.	.	.	.	.	.	.	2.2	22.3
890809	102	0			.	.		.	.	.	.	.	230	.	.	6.4	1.3	6.9	.	.
910429	101	0	57		1.06	0.38		9.2	4.2	140	8.6	5.3	250	2	40	33.6	1.6	4.9	12.1	11.3
910429	101	19	66		1.01	.		.	.	.	.	.	.	.	.	.	.	.	11.1	11.0
910603	101	0	52		1.17	0.21		5.6	1.6	130	.	5.8	230	3.5	20	23.2	0.2	5.9	9.4	22.5
910603	101	19	92		1.79	.		.	.	.	.	.	.	.	.	.	.	.	5.5	13.6
910603	102	0	64		1.25	.		.	.	.	.	.	235	.	.	20.3	0.2	6.6	9.2	24.1
910701	101	0	95		1.36	0.03		12.0	6.2	110	8.8	7.7	230	0.5	20	30.1	0.4	3.3	8.2	22.7
910701	101	26	213		2.98	.		.	.	.	.	.	.	.	.	.	.	.	0.4	12.2
910701	102	0	29		1.47	.		.	.	.	8.8	.	230	.	.	32.5	0.2	3.3	8.3	23.0

910701	102	26	29		.	.		.	.	.	.	.	.	.	.	.	0.2	.	0.3	11.9
910805	101	0	10	K	0.96	0.01	K	7.2	1.2	130	8.8	5.2	235	4.3	30	28.8	0.2	4.9	9.0	22.6
910805	101	26	721		5.00	.		.	.	.	.	.	.	.	.	.	.	.	0.8	14.1
910805	102	0	10	K	1.10	.		.	.	.	8.8	.	230	.	.	26.6	0.2	4.9	9.4	23.1
910910	101	0	10	K	1.26	0.03		5.4	2	130	7.8	5.2	262	15	20	21.7	1.5	4.9	5.6	20.9
910910	101	25	64		1.41	.		.	.	.	.	.	.	.	.	.	.	.	5.5	20.5
910910	102	0	42		1.20	.		.	.	.	7.9	.	260	.	.	19.0	1.4	5.6	4.8	20.9
980619	101	0	33		0.76	.		5.6	1.2	140	9	.	250	.	20	12.9	3.1	5.7	9.0	21.2
980619	101	22	34		.	.		.	.	.	.	.	.	.	.	.	.	.	0.2	17.0
980619	102	0	33		0.81	.		4.0	0.8	140	9.1	.	240	.	20	13.7	2.9	4.9	8.9	21.9
980619	102	24	38		.	.		.	.	.	.	.	.	.	.	.	.	.	.	.
980730	102	0	36		0.82	.		7.6	2	110	8.6	6.7	161	.	10	14.0	10.6	3.6	8.7	24.2
980730	102	22	435		.	.		.	.	.	.	.	.	.	.	.	.	.	0.4	19.4
980827	102	0	45		0.88	.		6.8	0.8	130	8.9	6.9	230	.	10	32.6	1.9	.	.	.
980827	102	24	276		.	.		.	.	.	.	.	.	.	.	.	.	.	.	.
980916	102	0	94		1.44	.		8.4	0	120	8.8	7.2	160	.	20	66.9	3.1	3.9	11.4	22.3
980916	102	22	71		.	.		.	.	.	7.6	.	176	.	.	.	.	.	1.6	20.7

Water Quality Data Abbreviations and Units

DATE= yr-mo-da
SITE= sampling site ID, 100 series=MPCA, 200=CLMP, etc.
DM= sample depth in meters(0=0-2 m integrated)
TP= total phosphorus in mg/l(decimal) or ug/L as whole number
OP= total ortho-phosphorus in mg/l
DP= dissolved phosphorus in mg/l
TKN= total Kjeldahl nitrogen in mg/l
N2N3= nitrite+nitrate N in mg/l
NH4= ammonia-N in mg/l
TNTP=TN:TP ratio
PH= pH in SU (F=field, L or _=lab)
ALK= alkalinity in mg/l (lab)
TSS= total suspended solids in mg/l
TSV= total suspended volatile solids in mg/l
TSIN= total suspended inorganic solids in mg/l
TURB= turbidity in NTU (F=field)
CON= conductivity in umhos/cm (F=field, L=lab)
CL= chloride in mg/l
SI= total silica in mg/L
DO= dissolved oxygen in mg/l
TEMP= temperature in degrees centigrade
SD= Secchi disk in meters (SDF=feet)
CHLA= chlorophyll-a in ug/l
TSI= Carlson's TSI (P=TP, S=Secchi, C=Chla)
PHEO= pheophytin in ug/l
PHYS= physical appearance rating (classes=1 to 5)
REC= recreational suitability rating (classes=1 to 5)
RTP, RN2N3...= remark code; k=less than, Q=exceeded holding time

Commonly used statistical abbreviations in data printouts

NTP, NSD,....=number of observations
MTP, MSD,....=mean TP, Secchi, etc.(typically June-Sept. mean)
STP, SSD, ...=standard error of the mean for TP, Secchi, etc.
[std err=std deviation/square root of number of observations]
TPCV, SDCV, .=coefficient of variation of mean for TP, Secchi, etc.
[CV=(100*std deviation)/mean]; and is expressed as a % of the mean