

Lake Monitoring

In 2005, Bass, Crystal, Eagle, Meadow and Lower and Middle Upper Twin Lakes were monitored as part of the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP).

Volunteers monitor their designated lake sites biweekly from mid-April to mid-October. They note natural and cultural observations and general perceptions of the lakes' condition and suitability for recreation. They take a water transparency reading using a Secchi disk.

Commission's Lake Monitoring Program					
Lake	Last Monitored	Summer Average TP ($\mu\text{G/l}$)	Summer Average CLA ($\mu\text{G/l}$)	Summer Average Secchi (M)	Summer Average TKN (mg/l)
Bass	2005	65.9	48.5	1.4	1.96
Cedar Island	2003	248.6	103.6	0.5	
Crystal	2005	113.5	41.2	0.9	2.48
Eagle	2005	36.2	15.5	2.6	.77
Magda	2003	175.4	81.3	0.6	
Meadow	2005	248.9	68.8	0.5	3.70
Pike	2000	64	29	1.3	
Pomerleau	2003	69.5	62.5	1.5	
Ryan	2003	51.4	8.6	2.6	
Schmidt	2004	39.5	12.1	1.8	
Success	2003	43.0	14.9	1.0	
Lower Twin	2005	42.3	39.0	1.7	1.46
Middle Twin	2005	57.8	14.9	1.8	1.53
Upper Twin	2004	165.2	85.3	0.5	

TP=Total Phosphorus · CLA=Chlorophyll-a · TKN=Total Kjeldahl Nitrogen · 20 cm black and white Secchi disk was used

Finally, they collect a surface water sample by submersing and filling a one-gallon jug. After measuring and recording the surface water temperature, volunteers take two samples from the jug -- one each for total phosphorus (TP) and total Kjeldahl nitrogen (TKN). A Chlorophyll-a (CLA) sample taken from the jug is filtered in the field and the filter with its collected planktonic algae is stored along with the other samples until they are delivered to the laboratory. The samples are picked up by Met Council staff within 30 days of each sampling.



Data from each lake's sampling forms and lab analyses are entered into a data management and statistical analysis program called Statistical Analysis System (SAS). Various quality control methods are used throughout the program to ensure that proper sampling and data analysis techniques were used. Suspect data are excluded from the databases or conclusions.

CAMP Monitoring History Water Quality Grades																		
	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
Bass				C			C		C		C		C		C		x	
Cedar Island					F						D		F			x		
Crystal				D			D				D				D		x	
Curtis																		
Eagle	C		B			B	B	B		B		C			B	x		x
Magda									D	D			F			x		
Meadow						F			F			F			F			x
Palmer																		
Pike						C	C	D		C						x		x
Pomerleau						C			C		C		D			x		
Ryan						C		B		D		B	B				x	
Schmidt					C			C		C	C			C		x		x
Success													C			x		
Twin Lower	D		C			C		C		C			C		C		x	
Twin Middle	D					C	B		C	C			C		C		x	
Twin Upper	D		D			F		D		F		F		F		x		x

x – indicates the lake is scheduled to be monitored that year

Bass Lake

Bass Lake is located in the City of Plymouth. The lake covers an area of 194 acres and has a maximum and mean depth of 9.4 m (roughly 31 feet) and 2.9 m (9.5 feet). About 82% of the lake's area is considered littoral, the shallow (0-15 foot depth) area dominated by aquatic vegetation. The approximate volume of the lake is 1,640 acre-feet (ac-ft) and its approximate residence time (the amount of time required to completely replace the lake's current volume of water with an equal volume of "new" water) is 0.7 years. The lake's watershed of 3,100 acres translates to a rather large watershed-to-lake size ratio of 16:1. (The larger the ratio the greater the potential stress put on the lake from surface runoff.) 1990 land use estimates indicate that approximately 23.1% of the watershed is single-family residential, 1.2 % is commercial/retail, 0.4



% is industrial/manufacturing, 13.0 % is public waters/wetlands, and 62.3 % is available for potential growth (Montgomery Watson 1994).

Bass Lake is considered a "Priority Lake" by the Metropolitan Council, due to its multi-recreational uses. Primary management concerns in the past have revolved around the lake's sizable aquatic macrophyte population and periods of low oxygen levels. Bass Lake, which was also monitored through CAMP in 1994, 1997, 1999, 2001, and 2003, was monitored 15 times from mid-April to late-October, 2005.

The lake has received identical overall grades in all six years of CAMP monitoring. 2003 represents the lake's worst monitored water quality year. The best-monitored water quality for the lake was recorded in 1997 (TP = 43.8 µg/l, CLA = 21.0 µg/l, and Secchi = 1.8 m). While the limited nature of the lake's water quality database makes any statistically significant long-term trend detection impossible, on the short-term the lake seems to consistently have water quality that is representative of a lake grade of C. However, the last three years of data (2001, 2003 and 2005) have shown a slight decrease in water quality over that recorded in the 1990's. This is especially shown in the increase in summer mean total phosphorus and chlorophyll-a concentrations.

The summertime mean physical condition was ranked 3.2 on a 1-to-5 scale (between 3 - "definite algae present" and 4 - "high algal color"). The mean suitability for recreation ranking, on a 1-to-5 scale, was 3.0 (3 - "swimming slightly impaired").

Bass Lake - 2005 summer (May-September) data summary				
<i>Parameter</i>	<i>Mean</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Grade</i>
TP (µg/l)	65.9	16.0	98.0	C
CLA (µg/l)	48.5	4.3	120.0	D
Secchi (m)	1.4	0.5	3.4	
TKN (mg/l)	1.96	0.73	3.20	
			Overall Grade	C

Crystal Lake

Crystal Lake is a 76-acre lake located in the City of Robbinsdale. The lake was first enrolled in CAMP in 1994. The lake has a maximum and mean depth of 10.4 and 3.7 m (34 and 12 feet) and an approximate volume of 917 ac-ft (Beduhn 1993). Sixty-eight percent of the lake's surface area is considered littoral zone (the 0-15 foot depth area of aquatic vegetation dominance). The lake's fishing pier and earthen public access are



located on the southeastern end of the lake. The lake, managed by the MNDNR as a warm-water game fish lake, has been stocked with muskellunge and northern pike in the past. Because of the numerous historical winter fish kills an aeration system was installed in 1973 to maintain the lake's oxygen levels. While the aerator stopped the winterkill problem it may have caused another. The aeration system may actually allow phosphorus in the sediment to circulate throughout the lake's water column by disrupting the thermocline. In fact recent summer kills have been reported because the lake's high TP concentration led to heavy algal blooms which in turn choke the lake's oxygen load.

Crystal Lake's watershed is mostly urban/developed with some undeveloped/park areas. The urban areas consist of single-family residential homes around portions of the lake as well as multi-family and commercial/industrial areas within the watershed. The majority of the undeveloped areas are associated with parkland on the shores of the lake. Eighty-nine percent of the land use within the lake's 1,272-acre watershed is urban while the remaining 11% is undeveloped (Beduhn 1993). The resulting watershed-to-lake size ratio is 10.4:1.

Crystal Lake was monitored through CAMP in 1994, 1997 and 2001, and was monitored seven times from mid-June to early-October in 2005. The summertime mean recorded physical condition was 2.7. The mean suitability for recreation ranking was also 3.1 (between 3 - "swimming slightly impaired" and 4 - "no swimming - boating ok"). The water quality database for Crystal Lake consists of nutrient and Secchi data in 1986-1988, 1992, 1994, 1997, 2001 and 2005. The lake quality grades seem to show that the lake's quality has remained rather similar from the mid-1980's through the mid-2000's.

Crystal Lake - 2005 summer (May-September) data summary				
<i>Parameter</i>	<i>Mean</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Grade</i>
TP (µg/l)	113.5	80.0	136.0	D
CLA (µg/l)	41.2	17.0	110.0	C
Secchi (m)	0.9	0.5	1.7	D
TKN (mg/l)	2.48	0.80	3.20	
			<i>Overall Grade</i>	D

Eagle Lake

This was the seventh year that Eagle Lake has been enrolled in CAMP (the lake was previously involved in CAMP in 1993, 1996-1998, 2000 and 2002). The 291-acre lake is located in the City of Maple Grove and has a 3,220-acre watershed. The lake and



watershed areas translate to a watershed-to-lake area ratio of 11:1. The maximum and mean depths of the lake are 10.4 and 3.8 m (34.0 and 12.5 feet) respectively. Roughly 68% of the lake's area is considered littoral (the 0-15 foot depth area dominated by aquatic vegetation). The approximate volume of the lake is 3,667 acre-feet (ac-ft) and a public access to the lake is located on its eastern shore. Because of the lake's multi-recreational uses the lake is considered a "Priority Lake" in the Metropolitan Area. One problem that may possibly hinder future recreational activity on the lake is Eurasian Water Milfoil (*Myriophyllum spicatum*) which has been reported in the lake.

Eagle Lake was monitored six times from early-May to late-July, 2005. The data and resulting graphs show seasonal variability in TP and CLA concentrations, Secchi transparency and user perceptions. The lake's 2005 overall water quality grade is similar to those recorded in 1993, 1996-1998 and 2000 and better than those recorded in the 1980's and early 1990's.

A search for water quality data through Council, MPCA and STORET files resulted in a good amount of data. There are nutrient data available for 1980, 1983, 1986-1987, 1991, 1993, 1996-1998, 2000, 2002 and 2005. Except for a slight decline in 2002 the lake has shown some improvement in water quality since the 1980s (D in 1980, to C's in 1983-1991 and 2002 and B's in 1996-2000 and 2005).

At each monitoring event the volunteers' opinion of the lake condition was ranked on a 1-to-5 scale. The average score for physical condition was 2.0 (2 - "some algae present") and 1.5 for recreational suitability (between 1- "crystal clear" and 2 - "minor aesthetic problems").

Eagle Lake - 2005 summer (May-September) data summary				
<i>Parameter</i>	<i>Mean</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Grade</i>
TP (µg/l)	36.2	19.0	83.0	C
CLA (µg/l)	15.5	3.7	55.0	B
Secchi (m)	2.6	1.5	4.3	B
TKN (mg/l)	0.77	0.62	0.97	
			Overall Grade	B

Meadow Lake

This was the fourth year of CAMP monitoring on Meadow Lake which is located in the City of New Hope. The lake, also monitored as part of CAMP in 1996, 1999 and 2002, was monitored ten times between early-May and mid-October, 2005.



The 11-acre lake has a 440-acre immediate watershed which translates to a 40:1 watershed-to-lake size ratio (generally the larger the ratio the greater the potential stress on the lake from surface runoff). Because of the shallowness of the lake (maximum depth of 1.2 m [4 feet]), the entire area is considered littoral zone (area of aquatic plant dominance) and it does not maintain a thermocline (a density gradient owed to changing water temperatures throughout the lake's water column).

Meadow Lake's overall 2005 lake quality grade of F is identical to those recorded in 1996, 1999 and 2002. Because 2005 is only the fourth year of available data no long-term trends can be determined. In the short-term however, the lake is well represented by an overall grade of F. To better understand the quality of the lake and what direction it may be heading, more years of data collection are needed.

Throughout the monitoring period the volunteers ranked the perceived physical condition of the lake on a 1-to-5 scale. The mean perceived physical condition of Meadow Lake was 2.8 while the mean recreational suitability was 4.1 (between 4 - "no swimming - boating ok" and 5 - "no aesthetics possible").

Twin Lake Lower Basin

This was the fourth year that the lower basin of Twin Lake, located in the City of Robbinsdale, was monitored as part of CAMP. The lake has also been monitored by Council-staff in the past. As part of the volunteer monitoring program the lower basin of Twin Lake was sampled eight times from late-April to early-August, 2005. The entire 212-acre lake has maximum and mean depth of 14.0 and 2.1 m (46 and 7 feet), respectively. The acreage of each basin is as follows: lower basin = 46 acres, middle basin = 69 acres and the upper basin = 137 acres.

Meadow Lake - 2005 summer (May-September) data summary				
<i>Parameter</i>	<i>Mean</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Grade</i>
TP (µg/l)	248.9	101.0	502.0	F
CLA (µg/l)	68.8	1.4	190.0	D
Secchi (m)	0.5	0.2	0.9	F
TKN (mg/l)	3.70	1.50	6.70	
			<i>Overall Grade</i>	F



The lower basin itself has a mean and maximum depth of 7.0 m and 1.2 m (23 and 4 feet). The total volume of the whole lake is approximately 1,490 ac-ft (175 ac-ft is contained within the lower basin). About 81% of the whole lake's area is considered littoral (the 0-15 foot depth area dominated by aquatic vegetation). Access to the lake can be obtained at two locations, the southern end of the lake and the lake's eastern shoreline. The lake's 2005 overall grade of C is identical to those recorded in 1993, 1996, 1998, 2000 and 2003, and better than the D recorded in 1991. No statistically significant long-term trend is evident from the lake's water quality database. However, in the short-term the lake's quality seems well represented by an overall grade of C. To better understand the quality of the lake and what direction it may be heading, continued monitoring is suggested.

Throughout the summer the volunteer ranked the lake's perceived physical condition on a 1-to-5 scale. The mean physical condition ranking was 2.2 while the mean recreational suitability ranking was 2.0 (2 - "minor aesthetic problem").

Lower Twin Lake - 2005 summer (May-September) data summary				
<i>Parameter</i>	<i>Mean</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Grade</i>
TP (AO)	42.3	29.0	60.0	C
CLA (µg/l)	39.0	7.0	160.0	C
Secchi (m)	1.7	0.9	3.3	
TKN (mg/l)	1.46	0.83	2.20	
			Overall Grade	C

Twin Lake Middle Basin

The middle basin itself has a mean and maximum depth of 14.0 m and 4.9 m (46 and 16 feet). The total volume of the whole lake is approximately 1,490 ac-ft (918 ac-ft of which is contained within the middle basin).

2005 was the fourth year that the middle basin of Twin Lake, located in the City of Crystal, was monitored as part of CAMP. Between late-April and early-August, 2005, the middle basin of Twin Lake was monitored eight times. On each monitoring event the lake was monitored for TP, CLA, TKN, Secchi transparency and the lake's perceived physical condition and recreational suitability. The lake was also enrolled in CAMP in 1997, 1999 and 2003.

The lake's 2005 overall grade of C is identical to those recorded in 1996, 1999 and 2000, better than the D recorded in 1991 and worse than the B recorded in 1985 and 1997. The mean physical condition ranking was 2.4 while the mean recreational suitability ranking was 2.2.

Because of the sporadic and limited nature of lake's database no statistically significant long-



Middle Twin Lake - 2005 summer (May-September) data summary				
<i>Parameter</i>	<i>Mean</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Grade</i>
TP (µg/l)	57.8	37.0	70.0	C
CLA (µg/l)	14.9	5.3	34.0	B
Secchi (m)	1.8	0.9	3.20	
TKN (mg/l)	1.53	1.30	1.90	
<i>Overall Grade</i>				C

term or short-term trend can be determined. To better understand the quality of the lake and what direction it may be heading, continued monitoring is suggested.

Metropolitan Council's 2005 Study of the Water Quality of Metropolitan Area Lakes can be viewed at <http://www.metrocouncil.org/environment/RiversLakes/Lakes/campLakes.htm>. For more information, contact Randy Anhorn at (651) 602-8743 or randy.anhorn@metc.state.mn.us.

