2008 SUMMARY REPORT
of
Cranberry Lake

Lake County, Illinois

Prepared by the

LAKE COUNTY HEALTH DEPARTMENT
ENVIRONMENTAL HEALTH SERVICES
LAKES MANAGEMENT UNIT

3010 Grand Avenue
Waukegan, Illinois 60085

Kathleen Paap
Michael Adam
Leonard Dane
Kelly Deem

TABLE OF CONTENTS

LAKE FACTS

Lake Name:	Cranberry Lake
Historical Name:	None
Nearest Municipality:	Hainesville
Location:	T45N, R10E, Section 28
Elevation:	800.0 feet msl
Major Tributaries:	None
Watershed:	Fox River
Sub-watershed:	Squaw Creek Watershed
Receiving Waterbody:	Highland Lake
Surface Area:	16.3 acres
Shoreline Length:	0.7 miles
Maximum Depth:	19.9 feet
Average Depth:	5.4 feet (estimated)
Lake Volume:	87. 5 acre-feet (estimated)
Lake Type:	Glacial Pothole
Watershed Area:	131.3 acres
Major Watershed Land Uses:	Multi-family housing, Wetland
Bottom Ownership:	Village of Hainesville
Management Entities:	Village of Hainesville
Current and Historical Uses:	Historically used for fishing and Waterfowl hunting. Currently used for aesthetic enjoyment.
Description of Access:	No public access.

Cranberry Lake was chosen to be one of seven "sentinel" lakes in the county that the Lakes Management Unit (LMU) would monitor annually for five years beginning in 2005. This report summarizes the water quality sampling results and aquatic plant surveys conducted in 2008 on Cranberry Lake. Similar reports have been written on data collected in 2000, 2005, 2006 and 2007 and are available online or by request from the LMU. 2009 will be the final year of the annual "sentinel" lake monitoring. A comprehensive summary report detailing all five years will be completed and available for review in 2010.

SUMMARY OF WATER QUALITY

Cranberry Lake is listed as an ADID (advanced identification) wetland by the U.S. Environmental Protection Agency. This indicates the lake and the surrounding natural environment have potential for high quality aquatic resources based on water quality and hydrology values.

Water samples were taken once a month at the deepest location in the lake, from May to September (Figure 1). Two samples were taken; one from the upper water layer (epilimnion) at three feet and one from the lower water layer (hypolimnion) three feet above the bottom (Appendix A). They were analyzed for nutrients, solids concentration and other physical parameters (Appendix B). Cranberry Lake was stratified from June through August, with the strongest thermal stratification occurring in July at four feet. The size of this strongly stratified layer usually increases throughout the summer; however, in 2008, the size of the stratified layer peaked in July, decreased in August, and disappeared in September.

The average epilimnetic dissolved oxygen (DO) concentration was 9.24 mg/L (Table 1), with the highest reading in May (12.76 mg/L), and the lowest in August (6.00 mg/L). The hypolimnion experienced anoxic conditions (<1.0 mg/L DO) from July through August. In August, the lake had DO concentrations of <1.0 mg/L at 8 foot depth. Based on the 2007 bathymetric map, this translates to 4.1% of the lake experiencing anoxic conditions at that time.

Suspended solids are made up of any type of solid particles in the water column including, plant material, algal cells and sediment. The average TSS concentration in Cranberry Lake has increased slightly every year since 2005 (1.5 mg/L), 2006 (1.6 mg/L), and 2007 (1.8 mg/L). The average epilimnetic total suspended solid (TSS) concentration for Cranberry Lake during the 2008 study was 3.5 mg/L. The average TSS concentration was over four times lower than the County median of 8.2 mg/L.

The results from the August 2008 sampling indicated a concentration of 9.0 mg/L TSS (Figure 2). This high TSS concentration is likely due to pieces of Coontail that were distributed throughout the water column being captured within our sample. Further, although the average epilimnetic TSS concentration increased due to this phenomenon, the average water clarity (Secchi depth) for Cranberry Lake was not affected. As a matter of fact, the average Secchi depth in 2008 was 9.63 feet, which the deepest it has been since 2005 when the average Secchi depth was 10.52 feet. The 2008 trophic state index based on average Secchi depth for Cranberry Lake ranks it 11th out of 151 lakes that Lakes Management Unit (LMU) has monitored since 2000.

The average conductivity in 2008 was 0.5070 milliSiemens per centimeter (mS/cm) was below the county median of 0.8195 mS/cm. The 2008 average conductivity in Cranberry Lake decreased from the 2007 average of 0.5138 mS/cm and the 2006 average of 0.6019 mS/cm. The decrease in conductivity could be related to the wetter seasons that have occurred since the 2005 drought, as rain events have diluted the ions measured by conductivity. As mentioned in previous reports, the 2000 conductivity average was 0.3809 mS/cm. Chloride (Cl^-) ions are the main component of road salts which are applied in winter and enter our waterbodies (lakes and streams) mainly via stormwater and snowmelt. A correlation between conductivity and chlorides exist, this has been observed in concentrations of these two parameters in Cranberry Lake (Figure 3). A recent trend in the county lakes is Cl^- build up which subsequently increases conductivity concentrations as these parameters are correlated. Because Cranberry Lake is a unique natural resource, any increase in Cl^- concentration is concerning, it is recommended that alternatives to road salt be explored around the lake as well as county-wide.

In 2008, the average epilimnetic total phosphorus (TP) concentration in Cranberry Lake was 0.027 mg/L, which was less than 0.065 mg/L, the county median. TP concentrations have remained relatively steady since 2000. The low TP average found in Cranberry Lake was likely due to it being at the top of its watershed and the cattail fringe that surrounds the entire lake, which helps filter nutrients and solids before they enter the lake. The trophic state of Cranberry Lake in terms of its phosphorus concentration in 2008 was eutrophic ($\geq 50 < 70$), with a TSIp score of 51.9. The lake was ranked 26th out of 163 lakes in Lake County based on TP concentrations (Table 2). Cranberry Lake had a TN:TP ratio of 36:1. A TN:TP ratio of >15 indicates that phosphorus is the limiting nutrient. A TN:TP ratio of <10 indicates that nitrogen is the limiting nutrient. Therefore, Cranberry Lake was very limited by phosphorus availability and any additional phosphorus would be utilized by plants and algal species. To help keep the phosphorous level low, the LMU recommends that phosphorous-free fertilizer be used by the area residents.

TSI values along with other water quality parameters can be used to make other analyses based on use impairment indexes established by the Illinois Environmental Protection Agency (IEPA). Most water quality standard impairment assessments were listed as *None*. Furthermore, based on IEPA indices, Cranberry Lake has *Partial* support for recreational use and *Full* support for aquatic life use. Based on these indices, this lake was listed as providing *Full* overall use.

Water level fluctuations occurred over the 2008 monitoring period in Cranberry Lake. A post along the eastside cattail fringe was used to measure the water level each month. Between the May and June sampling the water level increased 0.63 inches. Water level declined approximately 1.0 inch in July and an additional 4.3 inches in August. In September the level increased 6.8 inches. This large change in water level was a result of 4.18 inches of rain falling between the August and September sampling dates. A total of 21.5 inches of rain were recorded at the Lake County Stormwater Management Commission's rain gauge in Round Lake Beach from May through September.

Figure 1. Water quality sampling point on Cranberry Lake, 2008.

Table 1. Water quality data for Cranberry Lake, 2005 - 2008.

2008	**Epilimnion**														
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
21-May	3	120	1.01	<0.1	<0.05	0.035	<0.005	85	2.3	304	65	12.30	0.5320	8.17	12.76
18-Jun	3	114	0.86	<0.1	<0.05	0.014	<0.005	80	1.4	318	88	11.19	0.5090	7.79	11.18
16-Jul	3	108	0.88	<0.1	<0.05	0.024	<0.005	80	2.5	305	85	8.37	0.4910	8.61	9.72
20-Aug	3	109	1.22	<0.1	<0.05	0.032	<0.005	84	9.0^{**}	330	100	8.20	0.5130	7.88	6.00
17-Sep	3	107	0.95	<0.1	<0.05	0.032	<0.005	78	2.5	309	91	8.11	0.4900	7.72	6.52
	Average	112	0.98	<0.1	<0.05	0.027	<0.005	82	3.5	313	86	9.63	0.5070	8.03	9.24

2007	**Epilimnion**														
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
09-May	3	139	1.05	<0.1	<0.05	0.025	<0.005	84	2.1	352	102	9.19	0.5607	8.01	9.23
13-Jun	3	127	1.04	<0.1	<0.05	0.029	<0.005	82	1.3	346	108	9.84	0.5297	8.10	8.04
11-Jul	3	120	1.00	<0.1	<0.05	0.017	<0.005	81	1.4	342	116	8.69	0.5148	7.62	5.71
08-Aug	3	111	0.99	<0.1	<0.05	0.025	<0.005	73	2.3	306	102	7.87	0.4818	7.56	3.53
12-Sep	3	120	0.98	<0.1	<0.05	0.021	<0.005	72	<1.0	315	88	9.71	0.4821	7.18	2.45
	Average	123	1.01	<0.1	<0.05	0.023	<0.005	78	1.8^{k}	332	103	9.06	0.5138	7.69	5.79

2006	**Epilimnion**														
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
16-May	3	156	1.44	<0.1	<0.05	0.039	<0.005	88	2.4	374	85	7.32	0.6001	7.74	7.47
20-Jun	3	147	1.24	<0.1	<0.05	0.024	<0.005	89	1.3	373	100	11.31	0.5994	8.35	7.75
18-Jul	3	142	1.28	<0.1	<0.05	0.018	<0.005	91	1.5	385	110	8.86	0.6034	8.05	5.94
15-Aug	3	144	1.36	<0.1	<0.05	0.021	<0.005	95	1.3	414	147	9.51	0.6154	7.60	4.31
19-Sep	3	145	1.32	<0.1	<0.05	0.018	<0.005	90	1.5	366	91	9.67	0.5914	7.66	4.76
	Average	147	1.33	<0.1	<0.05	0.024	<0.005	90	1.6	382	107	9.33	0.6019	7.88	6.05

2005	**Epilimnion**														
DATE	DEPTH	ALK	TKN	NH3-N	NO3-N	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
10-May	3	139	1.31	<0.1	<0.05	0.032	<0.005	72	2.2	320	84	8.86	0.5081	7.82	8.06
14-Jun	3	136	1.40	<0.1	<0.05	0.015	<0.005	77	1.1	334	99	11.32	0.5362	7.62	5.88
12-Jul	3	147	2.54	<0.1	<0.05	0.019	<0.005	83	1.1	399	147	12.14	0.5684	7.44	7.79
09-Aug	3	159	1.43	<0.1	<0.05	0.029	<0.005	86	1.5	384	114	9.80	0.6002	8.42	6.64
13-Sep	3	154	1.33	<0.1	<0.05	0.023	<0.005	87	<1.0	383	120	10.49	0.5994	8.25	6.65
	Average	147	1.60	<0.1	<0.05	0.024	<0.005	81	1.5^{k}	364	113	10.52	0.5625	7.91	7.00

Table 1 Continued.

2008	Hypolimnion													
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
21-May	13	119	0.94	<0.1	<0.05	0.032	0.000	84	3.0	302	58	NA	0.528	7.68	1.55
18-Jun	14	127	1.45	<0.1	<0.05	0.076	0.000	85	6.0	328	76	NA	0.550	7.32	0.14
16-Jul	17	180	5.48	4.92	<0.05	0.531	0.411	89	16.0	378	96	NA	0.671	6.72	0.08
20-Aug	14	159	4.91	2.18	<0.05	0.237	0.096	85	59.4	409	130	NA	0.632	6.60	0.10
17-Sep	15	189	6.02	5.64	<0.05	0.477	0.404	87	6.0	392	96	NA	0.673	6.77	1.10
	Average	155	3.76	4.025^{k}	<0.05	0.271	0.182	86	18.1	362	91	NA	0.611	7.02	0.59

2007	Hypolimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
09-May	14	140	1.06	<0.1	<0.05	0.025	<0.005	85	1.5	328	71	NA	0.5408	7.26	1.03
13-Jun	16	148	1.64	0.132	<0.05	0.080	<0.005	84	11.0	374	112	NA	0.5913	6.93	0.17
11-Jul	15	174	2.43	1.000	<0.05	0.105	0.021	82	7.9	386	112	NA	0.6242	6.70	0.23
08-Aug	16	202	4.8	3.910	<0.05	0.254	0.183	85	5.1	386	98	NA	0.6784	6.52	0.10
12-Sep	16	194	4.22	3.180	<0.05	0.160	0.112	83	3.8	393	99	NA	0.7023	6.42	0.12
	Average	172	2.83	2.056^{k}	<0.05	0.125	0.105^{k}	84	5.9	373	98	NA	0.6274	6.77	0.33

2006	Hypolimnion														
DATE	DEPTH	ALK	TKN	NH3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
16-May	14	157	1.55	0.152	<0.05	0.043	<0.005	88	2.9	375	91	NA	0.6098	7.25	1.36
20-Jun	15	186	3.71	1.840	<0.05	0.115	0.012	89	8.2	414	114	NA	0.6843	6.65	0.16
18-Jul	16	240	8.97	7.480	<0.05	0.503	0.458	89	6.4	448	120	NA	0.6998	6.56	0.14
15-Aug	14	215	5.81	3.620	<0.05	0.271	0.165	92	9.6	450	135	NA	0.7419	6.51	0.16
19-Sep	15	185	5.18	2.950	<0.05	0.246	0.158	93	26.0	425	122	NA	0.7564	6.67	0.19
	Average	197	5.04	3.208	<0.05	0.236	0.19825^{k}	90	10.6	422	116	NA	0.6984	6.73	0.40

2005	Hypolimnion														
DATE	DEPTH	ALK	TKN	NH3-N	NO3-N	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
10-May	14	141	1.21	<0.1	<0.05	0.020	<0.005	72	1.7	317	82	NA	0.5040	7.22	6.40
14-Jun	14	146	1.91	<0.1	<0.05	0.045	<0.005	73	8.4	335	92	NA	0.5279	6.56	0.12
12-Jul	15	164	1.32	0.205	<0.05	0.153	<0.005	71	23.0	377	123	NA	0.5788	6.54	0.18
09-Aug	15	201	3.15	1.500	<0.05	0.152	0.079	74	8.6	387	108	NA	0.6023	6.01	0.19
13-Sep	15	198	3.10	1.020	<0.05	0.120	0.031	73	10.0	392	108	NA	0.6628	6.50	0.20
	Average	170	2.14	0.908^{k}	<0.05	0.098	0.055^{k}	73	10.3	362	103	NA	0.5752	6.57	1.42

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_3-N = Nitrate nitrogen, mg/L
NO2+NO3 = Nitrite and Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
TDS = Total dissolved solids, mg/L
Cl^- = Chloride ions, mg/L
TSS = Total suspended solids, mg/L
TS = Total solids, mg/L
TVS = Total volatile solids, mg/L
SECCHI = Secchi disk depth, ft.
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

Note: "k" denotes that the actual value is known to be less than the value presented.
NA = Not Applicable
* = Prior to 2006 only Nitrate was analyzed
** = Sample compromised by plant material

Figure 2. Total suspended solid (TSS) concentrations vs. Secchi depth for Cranberry Lake, May – September 2008

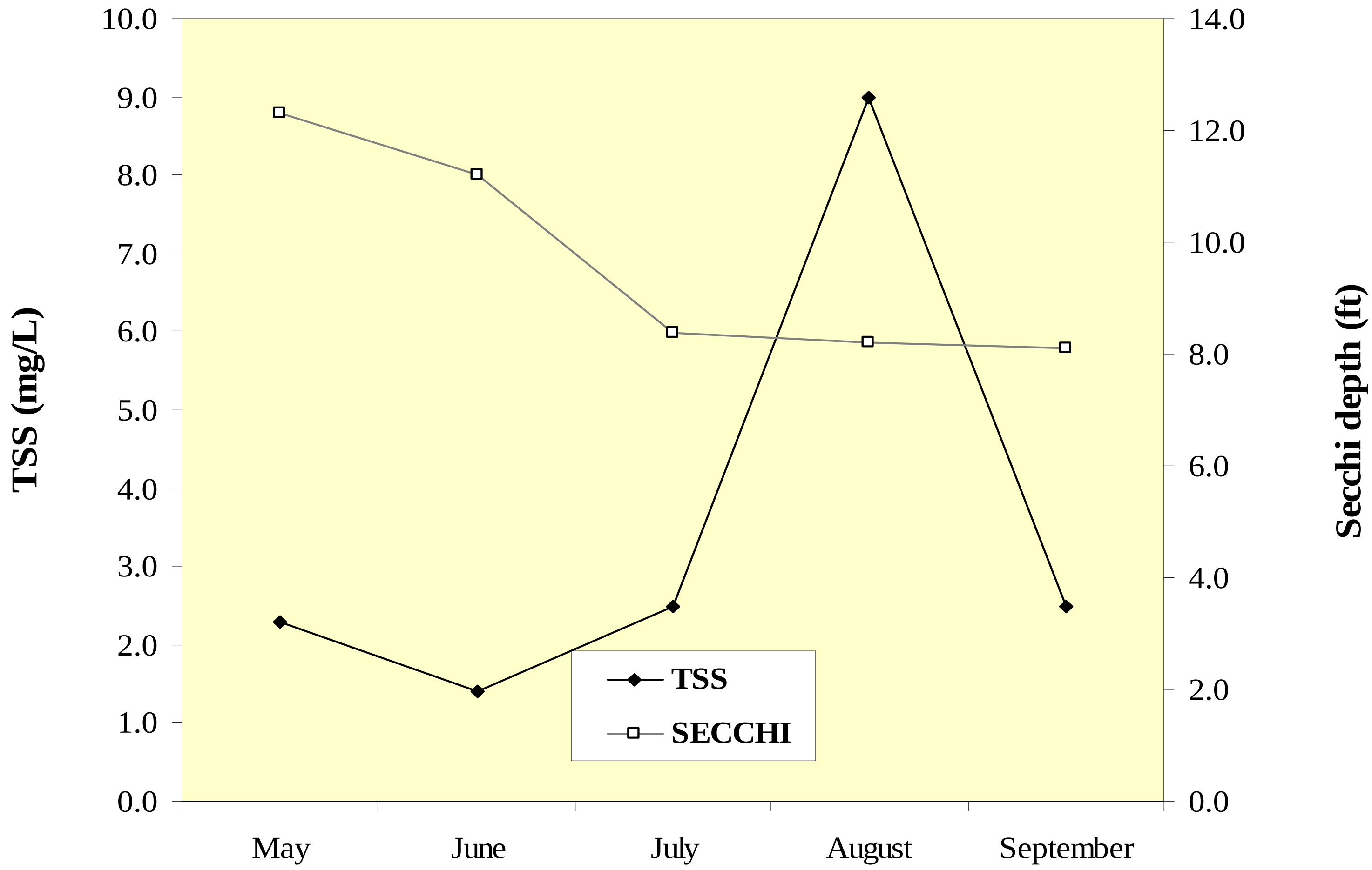

Figure 3. Chloride vs. conductivity concentrations for Cranberry Lake, 2008

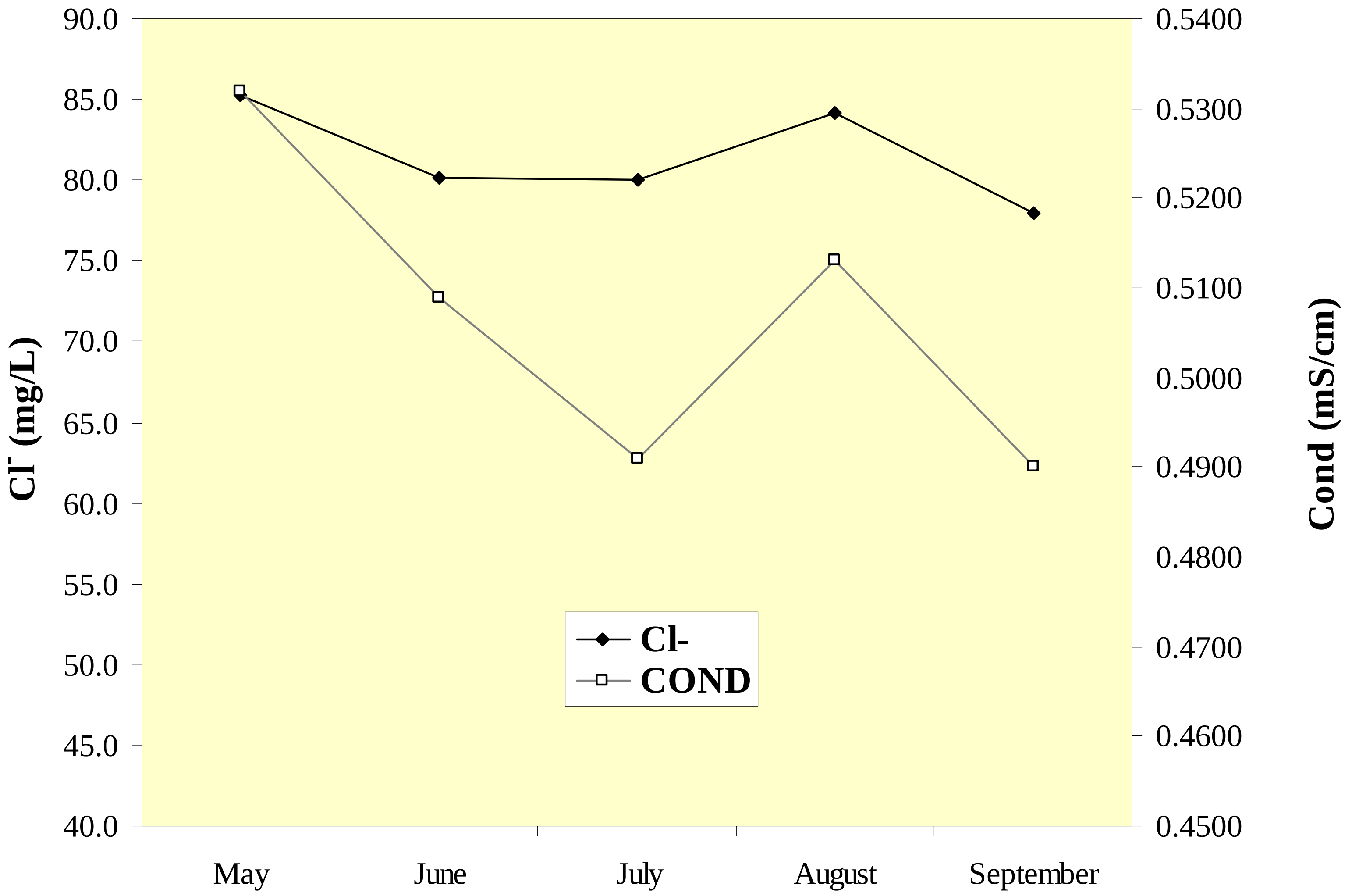

Table 2. Lake County average TSI phosphorous (TSIp) ranking 2000-2008.

RANK	LAKE NAME	TP AVE	TSIp
1	Lake Carina	0.0100	37.35
2	Sterling Lake	0.0100	37.35
3	Independence Grove	0.0135	39.24
4	Lake Zurich	0.0130	41.14
5	Sand Pond (IDNR)	0.0165	41.36
6	West Loon Lake	0.0140	42.21
7	Windward Lake	0.0158	43.95
8	Bangs Lake	0.0170	45.00
9	Pulaski Pond	0.0180	45.83
10	Timber Lake	0.0180	45.83
11	Fourth Lake	0.0182	45.99
12	Lake Kathryn	0.0200	47.35
13	Lake of the Hollow	0.0200	47.35
14	Banana Pond	0.0202	47.49
15	Lake Minear	0.0204	47.63
16	Cedar Lake	0.0220	48.72
17	Cross Lake	0.0220	48.72
18	Sun Lake	0.0220	48.72
19	Dog Pond	0.0222	48.85
20	Stone Quarry Lake	0.0230	49.36
21	Deep Lake	0.0234	49.61
22	Druce Lake	0.0244	50.22
23	Little Silver	0.0250	50.57
24	Round Lake	0.0254	50.80
25	Lake Leo	0.0256	50.91
26	**Cranberry Lake**	**0.0270**	**51.68**
27	Dugdale Lake	0.0274	51.89
28	Peterson Pond	0.0274	51.89
29	Lake Miltmore	0.0276	51.99
30	Third Lake	0.0280	52.20
31	Lake Fairfield	0.0296	53.00
32	Gray's Lake	0.0302	53.29
33	Highland Lake	0.0302	53.29
34	Hook Lake	0.0302	53.29
35	Lake Catherine (Site 1)	0.0308	53.57
36	Lambs Farm Lake	0.0312	53.76
37	Old School Lake	0.0312	53.76
38	Sand Lake	0.0316	53.94
39	Sullivan Lake	0.0320	54.13
40	Lake Linden	0.0326	54.39
41	Gages Lake	0.0338	54.92
42	Honey Lake	0.0340	55.00
43	Hendrick Lake	0.0344	55.17
44	Diamond Lake	0.0372	56.30
45	Channel Lake (Site 1)	0.0380	56.60
46	Ames Pit	0.0390	56.98

Table 2. Continued.

RANK	LAKE NAME	TP AVE	TSIp
47	White Lake	0.0408	57.63
48	Potomac Lake	0.0424	58.18
49	Duck Lake	0.0426	58.25
50	Old Oak Lake	0.0428	58.32
51	Deer Lake	0.0434	58.52
52	Schreiber Lake	0.0434	58.52
53	Nielsen Pond	0.0448	58.98
54	Turner Lake	0.0458	59.30
55	Seven Acre Lake	0.0460	59.36
56	Willow Lake	0.0464	59.48
57	Lucky Lake	0.0476	59.85
58	Davis Lake	0.0476	59.85
59	East Meadow Lake	0.0478	59.91
60	East Loon Lake	0.0490	60.27
61	College Trail Lake	0.0496	60.45
62	Lake Lakeland Estates	0.0524	61.24
63	Butler Lake	0.0528	61.35
64	West Meadow Lake	0.0530	61.40
65	Heron Pond	0.0545	61.80
66	Little Bear Lake	0.0550	61.94
67	Lucy Lake	0.0552	61.99
68	Lake Christa	0.0576	62.60
69	Lake Charles	0.0580	62.70
70	Crooked Lake	0.0608	63.38
71	Waterford Lake	0.0610	63.43
72	Lake Naomi	0.0616	63.57
73	Lake Tranquility S1	0.0618	63.62
74	Wooster Lake	0.0620	63.66
75	Countryside Lake	0.0620	63.66
76	Werhane Lake	0.0630	63.89
77	Liberty Lake	0.0632	63.94
78	Countryside Glen Lake	0.0642	64.17
79	Lake Fairview	0.0648	64.30
80	Leisure Lake	0.0648	64.30
81	Tower Lake	0.0662	64.61
82	St. Mary's Lake	0.0666	64.70
83	Mary Lee Lake	0.0682	65.04
84	Hastings Lake	0.0684	65.08
85	Spring Lake	0.0726	65.94
86	ADID 203	0.0730	66.02
87	Bluff Lake	0.0734	66.10
88	Harvey Lake	0.0766	66.71
89	Broberg Marsh	0.0782	67.01
90	Sylvan Lake	0.0794	67.23
91	Big Bear Lake	0.0806	67.45
92	Petite Lake	0.0834	67.94

Table 2. Continued.

RANK	LAKE NAME	TP AVE	TSIp
93	Timber Lake (South)	0.0848	68.18
94	Lake Marie (Site 1)	0.0850	68.21
95	North Churchill Lake	0.0872	68.58
96	Grand Avenue Marsh	0.0874	68.61
97	Grandwood Park, Site II, Outflow	0.0876	68.65
98	North Tower Lake	0.0878	68.68
99	South Churchill Lake	0.0896	68.97
100	Rivershire Pond 2	0.0900	69.04
101	McGreal Lake	0.0914	69.26
102	International Mine and Chemical Lake	0.0948	69.79
103	Eagle Lake (Site I)	0.0950	69.82
104	Valley Lake	0.0950	69.82
105	Dunns Lake	0.0952	69.85
106	Fish Lake	0.0956	69.91
107	Lochanora Lake	0.0960	69.97
108	Owens Lake	0.0978	70.23
109	Woodland Lake	0.0986	70.35
110	Island Lake	0.0990	70.41
111	McDonald Lake 1	0.0996	70.50
112	Longview Meadow Lake	0.1024	70.90
113	Lake Barrington	0.1053	71.31
114	Redwing Slough, Site II, Outflow	0.1072	71.56
115	Lake Forest Pond	0.1074	71.59
116	Bittersweet Golf Course #13	0.1096	71.88
117	Fox Lake (Site 1)	0.1098	71.90
118	Osprey Lake	0.1108	72.04
119	Bresen Lake	0.1126	72.27
120	Round Lake Marsh North	0.1126	72.27
121	Deer Lake Meadow Lake	0.1158	72.67
122	Long Lake	0.1170	72.82
123	Taylor Lake	0.1184	72.99
124	Columbus Park Lake	0.1226	73.49
125	Nippersink Lake (Site 1)	0.1240	73.66
126	Echo Lake	0.1250	73.77
127	Grass Lake (Site 1)	0.1288	74.21
128	Lake Holloway	0.1322	74.58
129	Lakewood Marsh	0.1330	74.67
130	Summerhill Estates Lake	0.1384	75.24
131	Redhead Lake	0.1412	75.53
132	Forest Lake	0.1422	75.63
133	Antioch Lake	0.1448	75.89
134	Slocum Lake	0.1496	76.36
135	Drummond Lake	0.1510	76.50
136	Pond-a-Rudy	0.1514	76.54
137	Lake Matthews	0.1516	76.56
138	Buffalo Creek Reservoir	0.1550	76.88

Table 2. Continued.

RANK	LAKE NAME	TP AVE	TSIp
139	Pistakee Lake (Site 1)	0.1592	77.26
140	Grassy Lake	0.1610	77.42
141	Salem Lake	0.1650	77.78
142	Half Day Pit	0.1690	78.12
143	Lake Eleanor Site II, Outflow	0.1812	79.13
144	Lake Farmington	0.1848	79.41
145	Lake Louise	0.1850	79.43
146	ADID 127	0.1886	79.71
147	Dog Bone Lake	0.1990	80.48
148	Redwing Marsh	0.2072	81.06
149	Stockholm Lake	0.2082	81.13
150	Bishop Lake	0.2156	81.63
151	Hidden Lake	0.2236	82.16
152	Fischer Lake	0.2278	82.43
153	Lake Napa Suwe (Outlet)	0.2304	82.59
154	Patski Pond (outlet)	0.2512	83.84
155	Oak Hills Lake	0.2792	85.36
156	Loch Lomond	0.2954	86.18
157	McDonald Lake 2	0.3254	87.57
158	Fairfield Marsh	0.3264	87.61
159	ADID 182	0.3280	87.69
160	Slough Lake	0.4134	91.02
161	Flint Lake Outlet	0.4996	93.75
162	Rasmussen Lake	0.5025	93.84
163	Albert Lake, Site II, outflow	1.1894	106.26

SUMMARY OF AQUATIC MACROPHYTES

An aquatic plant (macrophyte) survey was conducted in August of 2008. On Cranberry Lake, there were 72 sampling sites covering the entire lake (Figure 4). Overall, there were 19 plant species and one macro-algae found (Table 3). Coontail, White Water Lily, Humped Bladderwort and Spatterdock co-dominate the lake. Flat-stemmed Pondweed and Illinois Pondweed were also found at 56% and 47% of the sample points, respectively. (Table 4a). The composition of species changed slightly from 2007. Curlyleaf Pondweed, an invasive exotic, has been found infrequently in past surveys, it was not found in 2008. This could be due to timing of sampling as two samplings occurred in 2007 and only one occurred in 2008. Species noted in 2008 but not 2007 were White Water Crowfoot, Watermeal and Small Duckweed. In August 2008, plants were found down to a depth of 18 feet, with a 1% light level depth occurring between 6 and 14 feet during the monitoring season. Plants were found at 100% of the sites in August 2008 (Table 4b). Plants need at least 1% of surface light levels in order to survive. There were three populations of Watershield present on Cranberry Lake (Figure 5). Watershield is a rare species in Lake County and was at 5% of sample sites in 2005, 12% in 2006, 9% in 2007 and 19% in 2008.

Nutrients are taken up by macrophytes, leaving a small amount for plankton growth. This results in low algal densities, which could cloud the water. An algal bloom was present on only one occasion, this was during the May sampling period. Given the aesthetic use and the high quality natural resource that Cranberry Lake is, no aquatic plant management activities are recommended at this time.

Floristic Quality Index (FQI) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. Non-native species were also included in the FQI calculations for Lake County lakes. The median FQI for 2000-2008 Lake County lakes is 12.5. Cranberry Lake had a FQI of 30.1 in 2008. It ranked 3rd out of 152 lakes that have been assessed during 2000-2008 time period (Table 5).

Figure 4. Aquatic plant sampling grid illustrating plant density on Cranberry Lake, August 2008.

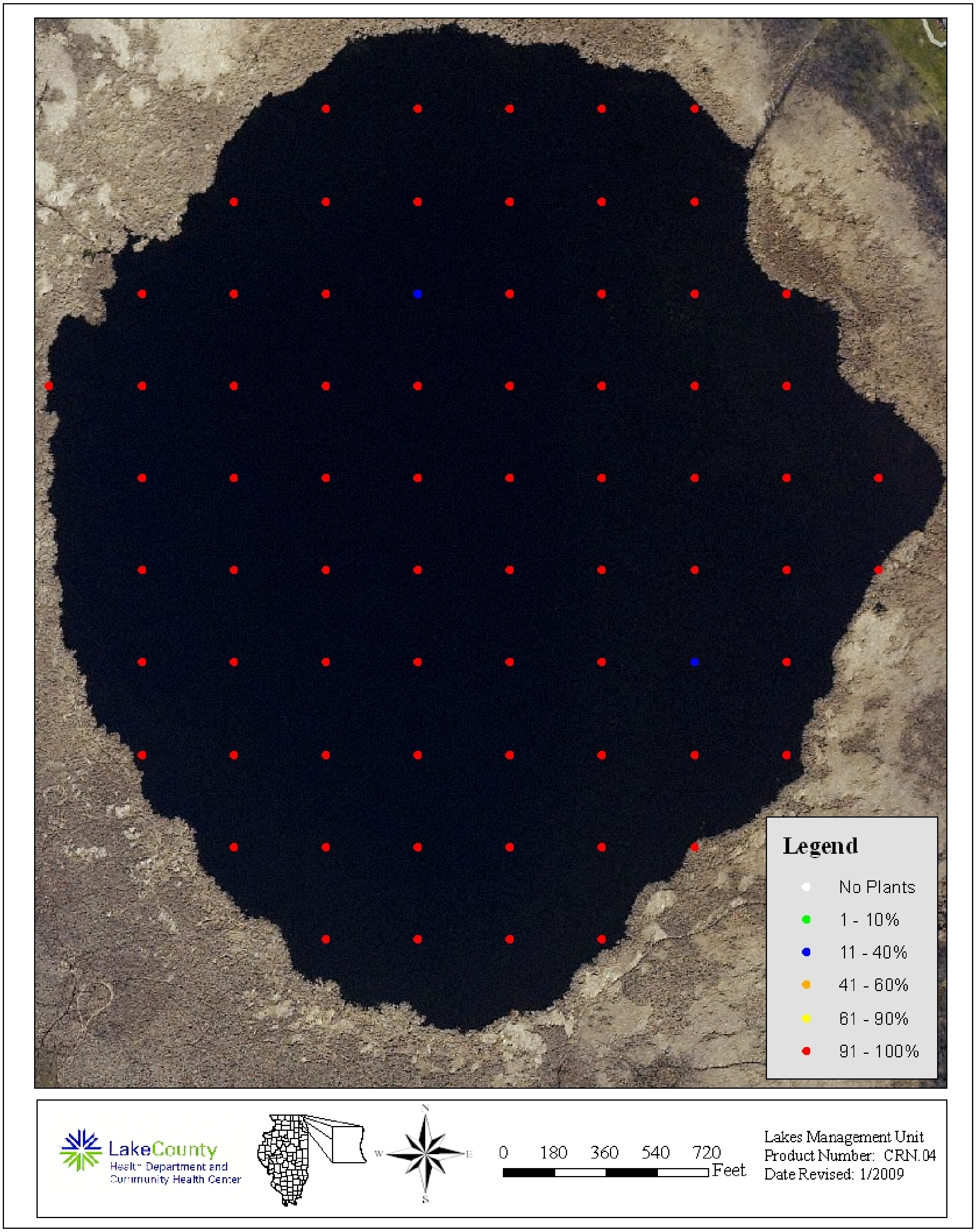

Table 3. Aquatic plant species found in Cranberry Lake, 2008.

Water Shield	*Brasenia schreberi*
Coontail	*Ceratophyllum demersum*
Chara (Macro alga)	*Chara spp.*
Small Duckweed	*Lemna minor*
Curlyleaf Pondweed	*Potamogeton crispus*
Illinois Pondweed	*Potamogeton illinoensis*
Floating-leaf Pondweed	*Potamogeton natans*
American Pondweed	*Potamogeton nodosus*
Sago Pondweed	*Potamogeton pectinatus*
Small Pondweed	*Potamogeton pusillus*
Flatstem Pondweed	*Potamogeton zosteriformis*
Northern Watermilfoil	*Myriophyllum sibiricum*
Slender Naiad	*Najas flexilis*
Southern Naiad	*Najas guadalupensis*
Spiny Naiad	*Najas marina*
Spatterdock	*Nuphar variegata*
White Water Lily	*Nymphaea tuberosa*
Humped Bladderwort	*Utricularia gibba*
Small Bladderwort*****	*Utricularia minor*
Common Bladderwort	*Utricularia vulgaris*
White Water Crowfoot	*Ranunculus longirostis*
Vallisneria (Eel grass)	*Vallisneria Americana*
Watermeal	*Wolffia columbiana*

*** Endangered in Illinois**

Table 4a. Aquatic plant species found at the 72 sampling sites on Cranberry Lake in August, 2008. The maximum depth that plants were found was 18.0 feet.

Plant Density	American Pondweed	Common Bladderwort	Chara	Coontail	Small Duckweed	Flatstem Pondweed	Floatingleaf Pondweed	Humped Bladderwort	Illinois Pondweed	Northern Watermilfoil
Absent	67	41	59	19	71	32	65	30	38	66
Present	3	10	8	15	1	22	6	6	13	6
Common	2	11	4	7	0	14	1	27	19	0
Abundant	0	9	1	3	0	4	0	7	2	0
Dominant	0	1	0	28	0	0	0	2	0	0
% Plant Occurrence	6.9%	43.1%	18.1%	73.6%	1.4%	55.6%	9.7%	58.3%	47.2%	8.3%

Plant Density	Sago Pondweed	Small Bladderwort	Slender Naiad	Southern Naiad	Spatterdock	Spiny Naiad	White Crowfoot	Watermeal	Watershield	White Water Lily
Absent	54	48	57	68	37	71	71	71	58	26
Present	12	21	9	4	7	1	1	0	7	6
Common	5	3	4	0	9	0	0	0	4	9
Abundant	1	0	1	0	13	0	0	0	1	14
Dominant	0	0	1	0	6	0	0	1	2	17
% Plant Occurrence	25.0%	33.3%	20.8%	5.6%	48.6%	1.4%	1.4%	1.4%	19.4%	63.9%

Table 4b. Distribution of rake density across all sampled sites on Cranberry Lake.

Rake Density (Coverage)	# of Sites	%
No plants	0	0.0
>0 to 10%	0	0.0
>10 to 40%	2	2.8
>40 to 60%	0	0.0
>60 to 90%	0	0.0
>90%	70	97.2
Total Sites with Plants	72	100.0
Total # of Sites	72	100.0

Figure 5. Location of Watershield Population on Cranberry Lake, August, 2008.

Table 5. Floristic quality index (FQI) of lakes in Lake County, calculated with exotic species (w/Adventives) and with native species only (native).

RANK	LAKE NAME	FQI (w/A)	FQI (native)
1	Cedar Lake	36.3	38.4
2	East Loon Lake	30.6	32.7
3	**Cranberry Lake**	**30.1**	**31.6**
4	Deep Lake	29.7	31.2
5	Little Silver	29.6	31.6
6	Round Lake Marsh North	29.1	29.9
7	Deer Lake	28.2	29.7
8	Sullivan Lake	28.2	29.7
9	Schreiber Lake	26.8	27.6
10	Bangs Lake	25.7	27.4
11	West Loon Lake	25.7	27.3
12	Cross Lake	25.2	27.8
13	Independence Grove	24.6	27.5
14	Sterling Lake	24.5	26.9
15	Lake Zurich	24.3	27.1
16	Sun Lake	24.3	26.1
17	Lake of the Hollow	23.8	26.2
18	Lakewood Marsh	23.8	24.7
19	Round Lake	23.5	25.9
20	Honey Lake	23.3	25.1
21	Fourth Lake	23.0	24.8
22	Druce Lake	22.8	25.2
23	Countryside Glen Lake	21.9	22.8
24	Butler Lake	21.4	23.1
25	Duck Lake	21.1	22.9
26	Timber Lake (North)	20.8	22.8
27	Broberg Marsh	20.5	21.4
28	Davis Lake	20.5	21.4
29	ADID 203	20.5	20.5
30	McGreal Lake	20.2	22.1
31	Lake Kathryn	19.6	20.7
32	Fish Lake	19.3	21.2
33	Owens Lake	19.3	20.2
34	Redhead Lake	19.3	21.2
35	Turner Lake	18.6	21.2
36	Wooster Lake	18.5	20.2
37	Salem Lake	18.5	20.2
38	Lake Miltmore	18.4	20.3
39	Hendrick Lake	17.7	17.7
40	Summerhill Estates Lake	17.1	18.0
41	Seven Acre Lake	17.0	15.5
42	Gray's Lake	16.9	19.8
43	Lake Barrington	16.7	17.7
44	Bresen Lake	16.6	17.8

Table 5. Continued.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
45	Diamond Lake	16.3	17.4
46	Lake Napa Suwe	16.3	17.4
47	Windward Lake	16.3	17.6
48	Dog Bone Lake	15.7	15.7
49	Redwing Slough	15.6	16.6
50	Osprey Lake	15.5	17.3
51	Lake Fairview	15.2	16.3
52	Heron Pond	15.1	15.1
53	Lake Tranquility (S1)	15.0	17.0
54	North Churchill Lake	15.0	15.0
55	Dog Training Pond	14.7	15.9
56	Island Lake	14.7	16.6
57	Highland Lake	14.5	16.7
58	Grand Avenue Marsh	14.3	16.3
59	Taylor Lake	14.3	16.3
60	Dugdale Lake	14.0	15.1
61	Eagle Lake (S1)	14.0	15.1
62	Longview Meadow Lake	13.9	13.9
63	Ames Pit	13.4	15.5
64	Bishop Lake	13.4	15.0
65	Hook Lake	13.4	15.5
66	Long Lake	13.1	15.1
67	Buffalo Creek Reservoir	13.1	14.3
68	Mary Lee Lake	13.1	15.1
69	McDonald Lake 2	13.1	14.3
70	Old School Lake	13.1	15.1
71	Dunn's Lake	12.7	13.9
72	Old Oak Lake	12.7	14.7
73	Timber Lake (South)	12.7	14.7
74	White Lake	12.7	14.7
75	Hastings Lake	12.5	14.8
76	Sand Lake	12.5	14.8
77	Stone Quarry Lake	12.5	12.5
78	Lake Carina	12.1	14.3
79	Lake Leo	12.1	14.3
80	Lambs Farm Lake	12.1	14.3
81	Pond-A-Rudy	12.1	12.1
82	Stockholm Lake	12.1	13.5
83	Grassy Lake	12	12
84	Lake Matthews	12.0	12.0
85	Flint Lake	11.8	13.0
86	Harvey Lake	11.8	13.0
87	Rivershire Pond 2	11.5	13.3
88	Antioch Lake	11.3	13.4
89	Lake Charles	11.3	13.4
90	Lake Linden	11.3	11.3

Table 5. Continued.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
91	Lake Naomi	11.2	12.5
92	Pulaski Pond	11.2	12.5
93	Lake Minear	11.0	13.9
94	Redwing Marsh	11.0	11.0
95	Tower Lake	11.0	11.0
96	West Meadow Lake	11.0	11.0
97	Nielsen Pond	10.7	12.0
98	Lake Holloway	10.6	10.6
99	Third Lake	10.2	12.5
100	Crooked Lake	10.2	12.5
101	College Trail Lake	10.0	10.0
102	Lake Lakeland Estates	10.0	11.5
103	Valley Lake	9.9	9.9
104	Werhane Lake	9.8	12.0
105	Big Bear Lake	9.5	11.0
106	Little Bear Lake	9.5	11.0
107	Loch Lomond	9.4	12.1
108	Columbus Park Lake	9.2	9.2
109	Sylvan Lake	9.2	9.2
110	Lake Louise	9	10.4
111	Fischer Lake	9.0	11.0
112	Grandwood Park Lake	9.0	11.0
113	Lake Fairfield	9.0	10.4
114	McDonald Lake 1	8.9	10.0
115	Countryside Lake	8.7	10.6
116	East Meadow Lake	8.5	8.5
117	Lake Christa	8.5	9.8
118	Lake Farmington	8.5	9.8
119	Lucy Lake	8.5	9.8
120	South Churchill Lake	8.5	8.5
121	Bittersweet Golf Course #13	8.1	8.1
122	Woodland Lake	8.1	9.9
123	Albert Lake	7.5	8.7
124	Banana Pond	7.5	9.2
125	Fairfield Marsh	7.5	8.7
126	Lake Eleanor	7.5	8.7
127	Patski Pond	7.1	7.1
128	Rasmussen Lake	7.1	7.1
129	Slough Lake	7.1	7.1
130	Lucky Lake	7.0	7.0
131	Lake Forest Pond	6.9	8.5
132	Leisure Lake	6.4	9.0
133	Peterson Pond	6.0	8.5
134	Gages Lake	5.8	10.0
135	Slocum Lake	5.8	7.1
136	Deer Lake Meadow Lake	5.2	6.4

Table 5. Continued.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
137	ADID 127	5.0	5.0
138	Drummond Lake	5.0	7.1
139	IMC Lake	5.0	7.1
140	Liberty Lake	5.0	5.0
141	Oak Hills Lake	5.0	5.0
142	Forest Lake	3.5	5.0
143	Sand Pond (IDNR)	3.5	5.0
144	Half Day Pit	2.9	5.0
145	Lochanora Lake	2.5	5.0
146	Echo Lake	0.0	0.0
147	Hidden Lake	0.0	0.0
148	North Tower Lake	0.0	0.0
149	Potomac Lake	0.0	0.0
150	St. Mary's Lake	0.0	0.0
151	Waterford Lake	0.0	0.0
152	Willow Lake	0.0	0.0
	Mean	**13.6**	**14.9**
	Median	**12.5**	**14.3**

APPENDIX A. METHODS FOR FIELD DATA COLLECTION AND LABORATORY ANALYSES

Water Sampling and Laboratory Analyses

Two water samples were collected once a month from May through September. Sample locations were at the deepest point in the lake (see sample site map), three feet below the surface, and 3 feet above the bottom. Samples were collected with a horizontal Van Dorn water sampler. Approximately three liters of water were collected for each sample for all lab analyses. After collection, all samples were placed in a cooler with ice until delivered to the Lake County Health Department lab, where they were refrigerated. Analytical methods for the parameters are listed in Table A1. Except nitrate nitrogen, all methods are from the Eighteenth Edition of Standard Methods, (eds. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 1992). Methodology for nitrate nitrogen was taken from the 14th edition of Standard Methods. Dissolved oxygen, temperature, conductivity and pH were measured at the deep hole with a Hydrolab DataSonde® 4a. Photosynthetic Active Radiation (PAR) was recorded using a LI-COR® 192 Spherical Sensor attached to the Hydrolab DataSonde® 4a. Readings were taken at the surface and then every two feet until reaching the bottom.

Plant Sampling

In order to randomly sample each lake, mapping software (ArcMap 9.3) overlaid a grid pattern onto an aerial photo of Lake County and placed points 60 or 30 meters apart, depending on lake size. Plants were sampled using a garden rake fitted with hardware cloth. The hardware cloth surrounded the rake tines and is tapered two feet up the handle. A rope was tied to the end of the handle for retrieval. At designated sampling sites, the rake was tossed into the water, and using the attached rope, was dragged across the bottom, toward the boat. After pulling the rake into the boat, plant coverage was assessed for overall abundance. Then plants were individually identified and placed in categories based on coverage. Plants that were not found on the rake but were seen in the immediate vicinity of the boat at the time of sampling were also recorded. Plants difficult to identify in the field were placed in plastic bags and identified with plant keys after returning to the office. The depth of each sampling location was measured either by a hand-held depth meter, or by pushing the rake straight down and measuring the depth along the rope or rake handle. One-foot increments were marked along the rope and rake handle to aid in depth estimation.

Wildlife Assessment

Species of wildlife were noted during visits to each lake. When possible, wildlife was identified to species by sight or sound. However, due to time constraints, collection of quantitative information was not possible. Thus, all data should be considered anecdotal.
Some of the species on the list may have only been seen once, or were spotted during their migration through the area.

Table A1. Analytical methods used for water quality parameters.

Parameter	***Method***
Temperature	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Dissolved oxygen	Hydrolab DataSonde ®4a or YSI 6600 Sonde®
Nitrate and Nitrite nitrogen	USEPA 353.2 rev. 2.0 EPA-600/R-93/100 Detection Limit = 0.05 mg/L
Ammonia nitrogen	SM 18th ed. Electrode method, #4500 NH_3-F Detection Limit = 0.1 mg/L
Total Kjeldahl nitrogen	SM 18th ed, 4500-N_{org} C Semi-Micro Kjeldahl, plus 4500 NH_3-F Detection Limit = 0.5 mg/L
pH	Hydrolab DataSonde® 4a, or YSI 6600 Sonde® Electrometric method
Total solids	SM 18th ed, Method #2540B
Total suspended solids	SM 18th ed, Method #2540D Detection Limit = 0.5 mg/L
Chloride	SM 18th ed, Method #4500C1-D
Total volatile solids	SM 18th ed, Method #2540E, from total solids
Alkalinity	SM 18th ed, Method #2320B, patentiometric titration curve method
Conductivity	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Total phosphorus	SM 18th ed, Methods #4500-P B 5 and #4500-P E Detection Limit = 0.01 mg/L
Soluble reactive phosphorus	SM 18th ed, Methods #4500-P B 1 and #4500-P E Detection Limit = 0.005 mg/L
Clarity	Secchi disk
Color	Illinois EPA Volunteer Lake Monitoring Color Chart
Photosynthetic Active Radiation (PAR)	Hydrolab DataSonde® 4a or YSI 6600 Sonde®, LI-COR® 192 Spherical Sensor

APPENDIX B. MULTI-PARAMETER DATA FOR LONG LAKE IN 2008.

Cranberry Lake 2007 Multiparameter data

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.266
5212008	0	0.506	15.52	12.87	129.2	0.532	8.69	3521.8	Surface	100%	
5212008	1	1.000	15.53	12.81	128.6	0.532	8.22	3452.1	Surface	100%	
5212008	2	2.005	15.53	12.78	128.4	0.532	8.20	1313.0	0.34	37%	2.886
5212008	3	2.996	15.53	12.76	128.1	0.532	8.17	1019.5	1.33	29%	0.191
5212008	4	3.996	15.52	12.76	128.2	0.532	8.13	572.6	2.33	16%	0.248
5212008	5	5.014	15.51	12.70	127.5	0.532	8.12	379.6	3.34	11%	0.123
5212008	6	6.002	15.49	12.68	127.2	0.533	8.08	453.1	4.33	13%	-0.041
5212008	7	7.021	15.49	12.63	126.8	0.532	8.06	243.2	5.35	7%	0.116
5212008	8	7.972	15.47	12.45	124.9	0.532	8.04	166.6	6.30	5%	0.060
5212008	9	8.981	15.45	12.38	124.2	0.533	8.02	164.0	7.31	5%	0.002
5212008	10	10.013	15.22	11.35	113.2	0.534	7.97	122.5	8.34	3%	0.035
5212008	11	11.000	14.37	8.32	81.5	0.529	7.90	97.5	9.33	3%	0.024
5212008	12	12.023	13.20	4.16	39.7	0.528	7.77	76.1	10.35	2%	0.024
5212008	13	12.998	12.64	1.55	14.6	0.528	7.68	58.9	11.33	2%	0.023
5212008	14	13.995	11.83	0.55	5.1	0.533	7.56	17.1	12.33	0.5%	0.100
5212008	15	14.994	11.23	0.33	3.0	0.540	7.39	11.1	13.32	0.3%	0.032
5212008	16	16.069	10.56	0.27	2.4	0.554	7.22	1.0	14.40	0.03%	0.167

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.497
6182008	0	0.499	21.87	10.61	121.3	0.508	7.96	3031.0	Surface	100%	
6182008	1	0.994	21.88	11.01	125.8	0.509	7.87	3007.5	Surface	100%	
6182008	2	1.998	21.83	11.08	126.4	0.509	7.83	912.9	0.33	30%	3.635
6182008	3	3.022	21.81	11.18	127.6	0.509	7.79	585.5	1.35	19%	0.329
6182008	4	4.015	21.78	11.20	127.7	0.509	7.77	408.1	2.35	14%	0.154
6182008	5	4.902	21.74	11.25	128.2	0.509	7.75	300.3	3.23	10%	0.095
6182008	6	6.043	21.71	11.32	128.9	0.509	7.72	233.7	4.37	8%	0.057

6182008	7	6.979	21.52	9.11	103.4	0.512	7.69	160.2	5.31	5%	0.071
6182008	8	7.995	20.69	7.55	84.2	0.521	7.64	117.6	6.33	4%	0.049
6182008	9	8.964	19.79	8.56	93.9	0.528	7.61	86.2	7.29	3%	0.043
6182008	10	10.056	18.06	6.29	66.7	0.530	7.59	60.8	8.39	2%	0.042
6182008	11	10.978	16.95	1.41	14.6	0.532	7.53	40.9	9.31	1.4%	0.043
6182008	12	12.001	15.67	0.35	3.5	0.534	7.48	34.4	10.33	1.1%	0.017
6182008	13	13.025	14.63	0.17	1.7	0.540	7.41	21.8	11.36	0.7%	0.040
6182008	14	14.028	13.94	0.14	1.3	0.550	7.32	12.4	12.36	0.4%	0.046
6182008	15	14.997	13.16	0.14	1.3	0.563	7.21	6.3	13.33	0.2%	0.051
6182008	16	15.984	12.25	0.11	1.1	0.582	7.12	2.5	14.31	0.1%	0.065
6182008	17	17.004	11.55	0.10	1.0	0.622	6.91	0.8	15.33	0.03%	0.074

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.565
7162008	0	0.533	25.14	9.59	116.5	0.492	8.54	3241.0	Surface		
7162008	1	1.001	25.11	9.63	117.0	0.491	8.57	3141.7	Surface	100%	
7162008	2	1.986	25.07	9.67	117.3	0.491	8.60	963.1	0.32	31%	3.742
7162008	3	2.990	25.03	9.72	117.9	0.491	8.61	745.4	1.32	24%	0.194
7162008	4	3.967	24.16	7.24	86.4	0.496	8.32	484.8	2.30	15%	0.187
7162008	5	5.003	23.63	6.64	78.5	0.497	8.20	294.5	3.33	9%	0.150
7162008	6	6.005	23.14	3.40	39.9	0.500	8.01	205.1	4.34	7%	0.083
7162008	7	6.982	22.83	1.67	19.4	0.503	7.81	139.9	5.31	4.5%	0.072
7162008	8	8.046	22.43	1.15	13.3	0.508	7.74	101.6	6.38	3.2%	0.050
7162008	9	9.014	21.64	0.54	6.1	0.517	7.66	75.4	7.34	2.4%	0.041
7162008	10	10.036	20.40	0.40	4.4	0.529	7.62	47.6	8.37	1.5%	0.055
7162008	11	11.011	18.97	0.28	3.1	0.529	7.52	27.4	9.34	0.9%	0.059
7162008	12	12.071	17.64	0.26	2.7	0.548	7.43	9.7	10.40	0.3%	0.100
7162008	13	13.040	16.04	0.24	2.4	0.559	7.31	3.0	11.37	0.1%	0.103
7162008	14	14.015	14.36	0.19	1.8	0.574	7.08	0.6	12.35	0.0%	0.130
7162008	15	15.078	13.16	0.13	1.3	0.598	6.91	0.3	13.41	0.0%	0.052
7162008	16	16.032	12.22	0.10	1.0	0.631	6.82	0.2	14.36	0.0%	0.028
7162008	17	17.016	11.37	0.08	0.8	0.671	6.72	0.2	15.35	0.0%	0.000
7162008	18	18.055	10.79	0.06	0.6	0.709	6.64	0.2	16.39	0.0%	0.000

7162008	19	19.014	10.59	0.04	0.4	0.750	6.57	0.2	17.34	0.0%	0.000
7162008	20	20.078	9.92	0.02	0.2	0.821	6.46	0.2	18.41	0.0%	0.000

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.957
8202008	0	0.481	23.32	7.81	91.7	0.510	8.24	2638.3	Surface		
8202008	1	1.176	23.33	7.39	86.8	0.510	8.10	2651.8	Surface	100%	
8202008	2	2.042	23.26	6.93	81.3	0.512	7.97	541.5	0.37	20%	4.271
8202008	3	3.093	23.23	6.00	70.4	0.513	7.88	377.4	1.42	14%	0.254
8202008	4	4.129	23.18	4.87	57.0	0.513	7.76	295.4	2.46	11%	0.100
8202008	5	5.087	23.08	3.38	39.5	0.513	7.69	42.5	3.42	2%	0.567
8202008	6	5.958	22.89	1.89	22.0	0.513	7.64	5.7	4.29	0.2%	0.469
8202008	7	7.049	22.68	1.12	13.0	0.515	7.59	3.7	5.38	0.1%	0.080
8202008	8	8.083	21.79	0.30	3.4	0.523	7.44	0.0	6.41		
8202008	9	8.963	21.35	0.23	2.6	0.527	7.29	0.0	7.29		
8202008	10	10.004	20.02	0.19	2.1	0.548	7.09	0.0	8.33		
8202008	11	10.949	18.74	0.15	1.6	0.564	6.91	0.0	9.28		
8202008	12	12.032	17.14	0.12	1.2	0.585	6.79	0.0	10.36		
8202008	13	13.100	16.08	0.11	1.1	0.603	6.70	0.0	11.43		
8202008	14	14.047	14.81	0.10	1.0	0.632	6.60	0.0	12.38		
8202008	15	15.106	13.94	0.08	0.8	0.657	6.53	0.0	13.44		
8202008	16	15.916	13.30	0.08	0.7	0.674	6.46	0.0	14.25		
8202008	17	17.030	12.73	0.07	0.6	0.726	6.39	0.0	15.36		

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.340
9172008	0	0.516	18.38	6.72	71.6	0.489	8.25	3106.6	Surface		
9172008	1	1.002	18.37	6.58	70.2	0.489	7.97	3023.8	Surface	100%	
9172008	2	1.998	18.37	6.49	69.1	0.490	7.84	768.2	0.33	25%	4.177
9172008	3	2.962	18.37	6.52	69.5	0.490	7.72	446.7	1.29	15%	0.420
9172008	4	3.993	18.35	6.71	71.5	0.490	7.69	244.3	2.32	8%	0.260

9172008	5	4.999	18.34	6.77	72.1	0.490	7.64	220.2	3.33	7%	0.031
9172008	6	6.006	18.31	6.42	68.3	0.491	7.61	135.7	4.34	4%	0.112
9172008	7	7.003	18.04	2.21	23.4	0.491	7.56	96.6	5.33	3%	0.064
9172008	8	8.009	17.89	1.53	16.1	0.488	7.54	66.0	6.34	2%	0.060
9172008	9	9.014	17.74	0.82	8.6	0.484	7.51	42.7	7.34	1.4%	0.059
9172008	10	10.022	17.61	0.32	3.3	0.506	7.44	27.6	8.35	0.9%	0.052
9172008	11	11.009	17.47	0.22	2.3	0.530	7.36	19.0	9.34	0.6%	0.040
9172008	12	12.026	17.29	0.16	1.7	0.557	7.23	13.6	10.36	0.4%	0.032
9172008	13	13.002	16.67	0.15	1.5	0.613	7.02	10.0	11.33	0.3%	0.027
9172008	14	14.012	15.95	0.15	1.5	0.646	6.92	7.2	12.34	0.2%	0.027
9172008	15	15.005	15.16	0.11	1.1	0.673	6.77	5.2	13.34	0.2%	0.024
9172008	16	16.011	14.23	0.11	1.1	0.692	6.70	3.6	14.34	0.1%	0.026
9172008	17	17.014	13.45	0.08	0.8	0.744	6.60	2.5	15.34	0.1%	0.024
9172008	18	18.008	13.26	0.08	0.8	0.763	6.54	0.0	16.34		

APPENDIX C. INTERPRETING YOUR LAKE'S WATER QUALITY DATA

Lakes possess a unique set of physical and chemical characteristics that will change over time. These in-lake water quality characteristics, or parameters, are used to describe and measure the quality of lakes, and they relate to one another in very distinct ways. As a result, it is virtually impossible to change any one component in or around a lake without affecting several other components, and it is important to understand how these components are linked.

The following pages will discuss the different water quality parameters measured by Lake County Health Department staff, how these parameters relate to each other, and why the measurement of each parameter is important. The median values (the middle number of the data set, where half of the numbers have greater values, and half have lesser values) of data collected from Lake County lakes from 2000-2008 will be used in the following discussion.

Temperature and Dissolved Oxygen:

Water temperature fluctuations will occur in response to changes in air temperatures, and can have dramatic impacts on several parameters in the lake. In the spring and fall, lakes tend to have uniform, well-mixed conditions throughout the water column (surface to the lake bottom). However, during the summer, deeper lakes will separate into distinct water layers. As surface water temperatures increase with increasing air temperatures, a large density difference will form between the heated surface water and colder bottom water. Once this difference is large enough, these two water layers will separate and generally will not mix again until the fall. At this time the lake is thermally stratified. The warm upper water layer is called the ***epilimnion***, while the cold bottom water layer is called the ***hypolimnion***. In some shallow lakes, stratification and destratification can occur several times during the summer. If this occurs the lake is described as polymictic. Thermal stratification also occurs to a lesser extent during the winter, when warmer bottom water becomes separated from ice-forming water at the surface until mixing occurs during spring ice-out.

Monthly temperature profiles were established on each lake by measuring water temperature every foot (lakes ≤ 15 feet deep) or every two feet (lakes > 15 feet deep) from the lake surface to the lake bottom. These profiles are important in understanding the distribution of chemical/biological characteristics and because increasing water temperature and the establishment of thermal stratification have a direct impact on dissolved oxygen (DO) concentrations in the water column. If a lake is shallow and easily mixed by wind, the DO concentration is usually consistent throughout the water column. However, shallow lakes are typically dominated by either plants or algae, and increasing water temperatures during the summer speeds up the rates of photosynthesis and decomposition in surface waters. When many of the plants or algae die at the end of the growing season, their decomposition results in heavy oxygen consumption and can lead to an oxygen crash. In deeper, thermally stratified lakes, oxygen production is greatest in the top portion of the lake, where sunlight drives photosynthesis, and oxygen consumption is greatest near the bottom of a lake, where sunken organic matter accumulates and decomposes. The oxygen difference between the top and bottom water layers can be dramatic, with plenty of oxygen near the surface, but practically none near the bottom. The oxygen profiles measured during the water quality study can illustrate if this is occurring. This is important because the absence of oxygen (anoxia) near the lake bottom can have adverse effects in eutrophic lakes resulting in the chemical release of phosphorus from lake sediment and the production of hydrogen sulfide (rotten egg smell) and other gases in the bottom waters. Low oxygen conditions in the upper water of a lake can also be problematic since all aquatic organisms need oxygen to live. Some oxygen may be present in the water, but at too low a concentration to sustain aquatic life. Oxygen is needed by all plants, virtually all algae and for many chemical reactions that are important in lake functioning. Most adult sport-fish such as largemouth bass and bluegill require at least 3 mg/L of DO in the water to survive. However, their offspring require at least 5 mg/L DO as they are more sensitive to DO stress. When DO concentrations drop below 3 mg/L, rough fish such as carp and green sunfish are favored and over time will become the dominant fish species.

External pollution in the form of oxygen-demanding organic matter (i.e., sewage, lawn clippings, soil from shoreline erosion, and agricultural runoff) or nutrients that stimulate the growth of excessive organic matter (i.e., algae and plants) can reduce average DO concentrations in the lake by increasing oxygen consumption. This can have a detrimental impact on the fish community, which may be squeezed into a very small volume of water as a result of high temperatures in the epilimnion and low DO levels in the hypolimnion.

Nutrients:

Phosphorus:

For most Lake County lakes, phosphorus is the nutrient that limits plant and algae growth. This means that any addition of phosphorus to a lake will typically result in algae blooms or high plant densities during the summer. The source of phosphorus to a lake can be external or internal (or both). External sources of phosphorus enter a lake through point (i.e., storm pipes and wastewater discharge) and non-point runoff (i.e., overland water flow). This runoff can pick up large amounts of phosphorus from agricultural fields, septic systems or impervious surfaces before it empties into the lake.

Internal sources of phosphorus originate within the lake and are typically linked to the lake sediment. In lakes with high oxygen levels (oxic), phosphorus can be released from the sediment through plants or sediment resuspension. Plants take up sediment-bound phosphorus through their roots, releasing it in small amounts to the water column throughout their life cycles, and in large amounts once they die and begin to decompose. Sediment resuspension can occur through biological or mechanical means. Bottom-feeding fish, such as common carp and black bullhead can release phosphorus by stirring up bottom sediment during feeding activities and can add phosphorus to a lake through their fecal matter. Sediment resuspension, and subsequent phosphorus release, can also occur via wind/wave action or through the use of artificial aerators, especially in shallow lakes. In lakes that thermally stratify, internal phosphorus release can occur from the sediment through chemical means. Once oxygen is depleted (anoxia) in the hypolimnion, chemical reactions occur in which phosphorus bound to iron complexes in the sediment becomes soluble and is released into the water column. This phosphorus is trapped in the hypolimnion and is unavailable to algae until fall turnover, and can cause algae blooms once it moves into the sunlit surface water at that time. Accordingly, many of the lakes in Lake County are plagued by dense algae blooms and excessive, exotic plant coverage, which negatively affect DO levels, fish communities and water clarity.

Lakes with an average phosphorus concentration greater than 0.05 mg/L are considered nutrient rich. The median near surface total phosphorus (TP) concentration in Lake County lakes from 2000-2008 is 0.065 mg/L and ranged from a non-detectable minimum of <0.010 mg/L on five lakes to a maximum of 3.880 mg/L on Albert Lake. The median anoxic TP concentration in Lake County lakes from 2000-2008 was 0.181 mg/L and ranged from a minimum of 0.012 mg/L in Independence Grove Lake to a maximum of 3.880 mg/L in Taylor Lake.

The analysis of phosphorus also included soluble reactive phosphorus (SRP), a dissolved form of phosphorus that is readily available for plant and algae growth. SRP is not discussed in great detail in most of the water quality reports because SRP concentrations vary throughout the season depending on how plants and algae absorb and release it. It gives an indication of how much phosphorus is available for uptake, but, because it does not take all forms of phosphorus into account, it does not indicate how much phosphorus is truly present in the water column. TP is considered a better indicator of a lake's nutrient status because its concentrations remain more stable than soluble reactive phosphorus. However, elevated SRP levels are a strong indicator of nutrient problems in a lake.

Nitrogen:

Nitrogen is also an important nutrient for plant and algae growth. Sources of nitrogen to a lake vary widely, ranging from fertilizer and animal wastes, to human waste from sewage treatment plants or failing septic systems, to groundwater, air and rainfall. As a result, it is very difficult to control or reduce nitrogen inputs to a lake. Different forms of nitrogen are present in a lake under different oxic conditions. NH_4^+ (ammonium) is released from decomposing organic material under anoxic conditions and accumulates in the hypolimnion of thermally stratified lakes. If NH_4^+ comes into contact with oxygen, it is immediately converted to NO_2 (nitrite) which is then oxidized to NO_3^- (nitrate). Therefore, in a thermally stratified lake, levels of NH_4^+ would only be elevated in the hypolimnion and levels of NO_3^- would only be elevated in the epilimnion. Both NH_4^+ and NO_3^- can be used as a nitrogen source by aquatic plants and algae. Total Kjeldahl nitrogen (TKN) is a measure of organic nitrogen plus ammonium. Adding the concentrations of TKN and nitrate together gives an indication of the amount of total nitrogen present in the water column. If inorganic nitrogen (NO_3^-, NO_2^-, NH_4^+) concentrations exceed 0.3 mg/L in spring, sufficient nitrogen is available to support summer algae blooms. However, low nitrogen levels do not guarantee limited algae growth the way low phosphorus levels do. Nitrogen gas in the air can dissolve in lake water and blue-green algae can "fix" atmospheric nitrogen, converting it into a usable form. Since other types of algae do not have the ability to do this, nuisance blue-green algae blooms are typically associated with lakes that are nitrogen limited (i.e., have low nitrogen levels).

The ratio of TKN plus nitrate nitrogen to total phosphorus (TN:TP) can indicate whether plant/algae growth in a lake is limited by nitrogen or phosphorus. Ratios of less than 10:1

suggest a system limited by nitrogen, while lakes with ratios greater than 20:1 are limited by phosphorus. It is important to know if a lake is limited by nitrogen or phosphorus because any addition of the limiting nutrient to the lake will, likely, result in algae blooms or an increase in plant density.

Solids:

Although several forms of solids (total solids, total suspended solids, total volatile solids, total dissolved solids) were measured each month by the Lakes Management Staff, total suspended solids (TSS) and total volatile solids (TVS) have the most impact on other variables and on the lake as a whole. TSS are particles of algae or sediment suspended in the water column. High TSS concentrations can result from algae blooms, sediment resuspension, and/or the inflow of turbid water, and are typically associated with low water clarity and high phosphorus concentrations in many lakes in Lake County. Low water clarity and high phosphorus concentrations, in turn, exacerbate the high TSS problem by leading to reduced plant density (which stabilize lake sediment) and increased occurrence of algae blooms. The median TSS value in epilimnetic waters in Lake County is 8.2 mg/L, ranging from below the 0.1 mg/L detection limit to 165 mg/L in Fairfield Marsh.

TVS represents the fraction of total solids that are organic in nature, such as algae cells, tiny pieces of plant material, and/or tiny animals (zooplankton) in the water column. High TVS values indicate that a large portion of the suspended solids may be made up of algae cells. This is important in determining possible sources of phosphorus to a lake. If much of the suspended material in the water column is determined to be resuspended sediment that is releasing phosphorus, this problem would be addressed differently than if the suspended material was made up of algae cells that were releasing phosphorus. The median TVS value was 132.8 mg/L, ranging from 34.0 mg/L in Pulaski Pond to 298.0 mg/L in Fairfield Marsh.

Total dissolved solids (TDS) are the amount of dissolved substances, such as salts or minerals, remaining in water after evaporation. These dissolved solids are discussed in further detail in the *Alkalinity* and *Conductivity* sections of this document. TDS concentrations were measured in Lake County lakes prior to 2004, but was discontinued due to the strong correlation of TDS to conductivity and chloride concentrations.

Water Clarity:

Water clarity (transparency) is not a chemical property of lake water, but is often an indicator of a lake's overall water quality. It is affected by a lake's water color, which is a reflection of the amount of total suspended solids and dissolved organic chemicals. Thus, transparency is a measure of particle concentration and is measured with a Secchi disk. Generally, the lower the clarity or Secchi depth, the poorer the water quality. A decrease in Secchi depth during the summer occurs as the result of an increase in suspended solids (algae or sediment) in the water column. Aquatic plants play an important role in the level of water clarity and can, in turn, be negatively affected by low clarity levels. Plants increase clarity by competing with algae for resources and by stabilizing sediments to prevent sediment resuspension. A lake with a healthy plant community will almost always have higher water clarity than a lake without plants. Additionally, if the plants in a lake are removed (through herbicide treatment or the stocking of grass carp), the lake will probably become dominated by algae and Secchi depth will decrease. This makes it very difficult for plants to become re-established due to the lack of available sunlight and the lake will, most likely, remain turbid. Turbidity will be accelerated if the lake is very shallow and/or common carp are present. Shallow lakes are more susceptible to sediment resuspension through wind/wave action and are more likely to experience clarity problems if plants are not present to stabilize bottom sediment.

Common Carp are prolific fish that feed on invertebrates in the sediment. Their feeding activities stir up bottom sediment and can dramatically decrease water clarity in shallow lakes. As mentioned above, lakes with low water clarity are, generally, considered to have poor water quality. This is because the causes and effects of low clarity negatively impact the plant and fish communities, as well as the levels of phosphorus in a lake. The detrimental impacts of low Secchi depth to plants has already been discussed. Fish populations will suffer as water clarity decreases due to a lack of food and decreased ability to successfully hunt for prey. Bluegills are planktivorous fish and feed on invertebrates that inhabit aquatic plants. If low clarity results in the disappearance of plants, this food source will disappear too. Largemouth Bass and Northern Pike are piscivorous fish that feed on other fish and hunt by sight. As the water clarity decreases, these fish species find it more difficult to see and ambush prey and may decline in size as a result. This could eventually lead to an imbalance in the fish community. Phosphorus release from resuspended sediment could increase as water clarity and plant density decrease. This would then result in increased algae blooms, further reducing Secchi depth and aggravating all problems just discussed. The average Secchi depth for Lake County lakes is 3.12 feet. From 2000-2008, Fairfield Marsh and Patski Pond had the lowest Secchi depths (0.33 feet) and Bangs Lake had the highest (29.23 feet). As an example of the difference in Secchi depth based on plant coverage, South Churchill Lake, which had no plant coverage and large numbers of Common Carp in 2003 had an average Secchi depth of 0.73 feet (over four times lower than the county average), while Deep Lake, which had a diverse plant community and few carp had an average 2003 Secchi depth of 12.48 feet (almost four times higher than the county average).

Another measure of clarity is the use of a light meter. The light meter measures the amount of light at the surface of the lake and the amount of light at each depth in the water column. The amount of attenuation and absorption (decreases) of light by the water column are major factors controlling temperature and potential photosynthesis. Light intensity at the lake surface varies seasonally and with cloud cover, and decreases with depth. The deeper into the water column light penetrates, the deeper potential plant growth. The maximum depth at which algae and plants can grow underwater is usually at the depth where the amount of light available is reduced to 0.5%-1% of the amount of light available at the lake surface. This is called the euphotic (sunlit) zone. A general rule of thumb in Lake County is that the 1% light level is about 1 to 3 times the Secchi disk depth.

Alkalinity, Conductivity, Chloride, pH:

Alkalinity:

Alkalinity is the measurement of the amount of acid necessary to neutralize carbonate ($CO_3^{=}$) and bicarbonate (HCO_3^-) ions in the water, and represents the buffering capacity of a body of water. The alkalinity of lake water depends on the types of minerals in the surrounding soils and in the bedrock. It also depends on how often the lake water comes in contact with these minerals. If a lake gets groundwater from aquifers containing limestone minerals such as calcium carbonate ($CaCO_3$) or dolomite ($CaMgCO_3$), alkalinity will be high. The median alkalinity in Lake County lakes (162 mg/L) is considered moderately hard according to the hardness classification scale of Brown, Skougstad and Fishman (1970). Because hard water (alkaline) lakes often have watersheds with fertile soils that add nutrients to the water, they usually produce more fish and aquatic plants than soft water lakes. Since the majority of Lake County lakes have a high alkalinity they are able to buffer the adverse effects of acid rain.

Conductivity and Chloride:

Conductivity is the inverse measure of the resistance of lake water to an electric flow. This means that the higher the conductivity, the more easily an electric current is able to flow through water. Since electric currents travel along ions in water, the more chemical ions or dissolved salts a body of water contains, the higher the conductivity will be. Accordingly, conductivity has been correlated to total dissolved solids and chloride ions. The amount of dissolved solids or conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, and evaporation and bacterial activity. Many Lake County lakes have elevated conductivity levels in May, but not during any other month. This was because chloride, in the form of road salt, was washing into the lakes with spring rains, increasing conductivity. Most road salt is sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocyanide salts. Beginning in 2004, chloride concentrations are one of the parameters measured during the lake studies. Increased chloride concentrations may have a negative impact on aquatic organisms. Conductivity changes occur seasonally and with depth. For example, in stratified lakes the conductivity normally increases in the hypolimnion as bacterial decomposition converts organic materials to bicarbonate and carbonate ions depending on the pH of the water. These newly created ions increase the conductivity and total dissolved solids. Over the long term, conductivity is a good indicator of potential watershed or lake problems if an increasing trend is noted over a period of years. It is also important to know the conductivity of the water when fishery assessments are conducted, as electroshocking requires a high enough conductivity to properly stun the fish, but not too high as to cause injury or death.

pH:

pH is the measurement of hydrogen ion (H^+) activity in water. The pH of pure water is neutral at 7 and is considered acidic at levels below 7 and basic at levels above 7. Low pH levels of 4-5 are toxic to most aquatic life, while high pH levels (9-10) are not only toxic to aquatic life but may also result in the release of phosphorus from lake sediment. The presence of high plant densities can increase pH levels through photosynthesis, and lakes dominated by a large amount of plants or algae can experience large fluctuations in pH levels from day to night, depending on the rates of photosynthesis and respiration. Few, if any pH problems exist in Lake County lakes. Typically, the flooded gravel mines in the county are more acidic than the glacial lakes as they have less biological activity, but do not usually drop below pH levels of 7. The median near surface pH value of Lake County lakes is 8.32, with a minimum of 7.06 in Deer Lake and a maximum of 10.28 in Round Lake Marsh North.

Eutrophication and Trophic State Index:

The word *eutrophication* comes from a Greek word meaning "well nourished." This also describes the process in which a lake becomes enriched with nutrients. Over time, this is a lake's natural aging process, as it slowly fills in with eroded materials from the surrounding watershed and with decaying plants. If no human impacts disturb the watershed or the lake, natural eutrophication can take thousands of years. However, human activities on a lake or in the watershed accelerate this process by resulting in rapid soil erosion and heavy phosphorus inputs. This accelerated aging process on a lake is referred to as cultural eutrophication. The term trophic state refers to the amount of nutrient enrichment within a lake system. *Oligotrophic* lakes are usually deep and clear with low nutrient levels, little plant growth and a limited fishery. *Mesotrophic* lakes are more biologically productive than oligotrophic lakes and have moderate nutrient levels and more plant growth. A lake labeled as *eutrophic* is high in nutrients and can support high plant densities and large fish populations. Water clarity is typically poorer than oligotrophic or mesotrophic lakes and dissolved oxygen problems may be present. A *hypereutrophic* lake has excessive nutrients, resulting in nuisance plant or algae growth. These lakes are often pea-soup green, with poor water clarity. Low dissolved oxygen may also be a problem, with fish kills occurring in shallow, hypereutrophic lakes more often than less enriched lakes. As a result, rough fish (tolerant of low dissolved oxygen levels) dominate the fish community of many hypereutrophic lakes. The categorization of a lake into a certain trophic state should not be viewed as a "good to bad" categorization, as most lake residents rate their lake based on desired usage. For example, a fisherman would consider a plant-dominated, clear lake to be desirable, while a water-skier might prefer a turbid lake devoid of plants. Most lakes in Lake County are eutrophic or hypereutrophic. This is primarily as a result of cultural eutrophication. However, due to the fertile soil in this area, many lakes (especially man-made) may have started out under eutrophic conditions and will never attain even mesotrophic conditions, regardless of any amount of money put into the management options. This is not an excuse to allow a lake to continue to deteriorate, but may serve as a reality check for lake owners attempting to create unrealistic conditions in their lakes.

The Trophic State Index (TSI) is an index which attaches a score to a lake based on its average total phosphorus concentration, its average Secchi depth (water transparency) and/or its average chlorophyll *a* concentration (which represent algae biomass). It is based on the principle that as phosphorus levels increase, chlorophyll *a* concentrations increase and Secchi depth decreases. The higher the TSI score, the more nutrient-rich a lake is, and once a score is obtained, the lake can then be designated as oligotrophic, mesotrophic or eutrophic. Table 1 (below) illustrates the Trophic State Index using phosphorus concentration and Secchi depth.

Table 1. Trophic State Index (TSI).

Trophic State	TSI score	Total Phosphorus (mg/L)	Secchi Depth (feet)
Oligotrophic	<40	≤ 0.012	>13.12
Mesotrophic	≥40<50	>0.012 ≤ 0.024	≥6.56<13.12
Eutrophic	≥50<70	>0.024 ≤ 0.096	≥1.64<6.56
Hypereutrophic	≥70	>0.096	< 1.64

APPENDIX D. WATER QUALITY STATISTICS FOR ALL LAKE COUNTY LAKES.

2000 - 2008 Water Quality Parameters, Statistics Summary

	ALKoxic <=3ft00-2008			ALKanoxic 2000-2008	
Average	**167**		Average	**202**	
Median	**162**		Median	**194**	
Minimum	**65**	**IMC**	Minimum	**103**	**Heron Pond**
Maximum	**330**	**Flint Lake**	Maximum	**470**	**Lake Marie**
STD	**42**		STD	**50**	
n =	**802**		n =	**243**	

	Condoxic <=3ft00-2008			Condanoxic 2000-2008	
Average	**0.8934**		Average	**1.0312**	
Median	**0.8195**		Median	**0.8695**	
Minimum	**0.2542**	**Broberg Marsh**	Minimum	**0.3210**	**Lake Kathyrn**
Maximum	**6.8920**	**IMC**	Maximum	**7.4080**	**IMC**
STD	**0.5250**		STD	**0.7985**	
n =	**806**		n =	**243**	

	NO3-N, Nitrate+Nitrite,oxic <=3ft00-2008			NH3-Nanoxic 2000-2008	
Average	**0.508**		Average	**2.192**	
Median	**0.156**		Median	**1.630**	
Minimum	**<0.05**	***ND**	Minimum	**<0.1**	***ND**
Maximum	**9.670**	**South Churchill Lake**	Maximum	**18.400**	**Taylor Lake**
STD	**1.073**		STD	**2.343**	
n =	**807**		n =	**243**	

*ND = Many lakes had non-detects (74.1%)
Only compare lakes with detectable concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

*ND = 19.8% Non-detects from 28 different lakes

	pHoxic <=3ft00-2008			pHanoxic 2000-2008	
Average	**8.32**		Average	**7.28**	
Median	**8.32**		Median	**7.28**	
Minimum	**7.07**	**Bittersweet #13**	Minimum	**6.24**	**Banana Pond**
Maximum	**10.28**	**Round Lake Marsh North**	Maximum	**8.48**	**Heron Pond**
STD	**0.44**		STD	**0.42**	
n =	**801**		n =	**243**	

	All Secchi 2000-2008	
Average	**4.51**	
Median	**3.12**	
Minimum	**0.33**	**Fairfield Marsh, Patski Pon**
Maximum	**24.77**	**West Loon Lake**
STD	**3.78**	
n =	**749**	

LakeCounty
Health Department and
Community Health Center

2000 - 2008 Water Quality Parameters, Statistics Summary (continued)

	TKNoxic <=3ft00-2008	
Average	**1.450**	
Median	**1.200**	
Minimum	**<0.1**	***ND**
Maximum	**10.300**	**Fairfield Marsh**
STD	**0.845**	
n =	**802**	

*ND = 3.9% Non-detects from 15 different lakes

	TKNanoxic 2000-2008	
Average	**2.973**	
Median	**2.330**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.324**	
n =	**243**	

*ND = 2.9% Non-detects from 4 different lakes

	TPoxic <=3ft00-2008	
Average	**0.105**	
Median	**0.065**	
Minimum	**<0.01**	***ND**
Maximum	**3.880**	**Albert Lake**
STD	**0.218**	
n =	**808**	

*ND = 2.6% Non-detects from 9 different lakes

	TPanoxic 2000-2008	
Average	**0.316**	
Median	**0.181**	
Minimum	**0.012**	**Independ. Grove**
Maximum	**3.800**	**Taylor Lake**
STD	**0.419**	
n =	**243**	

	TSSall <=3ft00-2008	
Average	**15.5**	
Median	**8.2**	
Minimum	**<0.1**	***ND**
Maximum	**165.0**	**Fairfield Marsh**
STD	**20.3**	
n =	**813**	

*ND = 1.5% Non-detects from 9 different lakes

	TVSoxic <=3ft00-2008	
Average	**132.8**	
Median	**129.0**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**298.0**	**Fairfield Marsh**
STD	**39.8**	
n =	**757**	

No 2002 IEPA Chain Lakes

	TDSoxic <=3ft00-2004	
Average	**470**	
Median	**454**	
Minimum	**150**	**Lake Kathryn, White**
Maximum	**1340**	**IMC**
STD	**169**	
n =	**745**	

No 2002 IEPA Chain Lakes.

	CLanoxic <=3ft00-2008	
Average	**234**	
Median	**139**	
Minimum	**41**	**Timber Lake (N)**
Maximum	**2390**	**IMC**
STD	**364**	
n =	**125**	

	CLoxic <=3ft00-2008	
Average	**210**	
Median	**166**	
Minimum	**30**	**White Lake**
Maximum	**2760**	**IMC**
STD	**233**	
n =	**470**	

LakeCounty
Health Department and
Community Health Center

Anoxic conditions are defined <=1 mg/l D.O.
pH Units are equal to the -Log of [H] ion activity
Conductivity units are in MilliSiemens/cm
Secchi Disk depth units are in feet
All others are in mg/L

Minimums and maximums are based on data from all lakes from 2000-2008 (n=1351).

Average, median and STD are based on data from the most recent water quality sampling year for each lake.

LCHD Lakes Management Unit ~ 12/1/2008

APPENDIX E. GRANT PROGRAM OPPORTUNITES.

Table E1. Potential Grant Opportunities

Grant Program Name	Funding Source	Contact Information	Funding Focus: Water Quality/ Wetland	Habitat	Erosion	Flooding	Cost Share
Challenge Grant Program	USFWS	847-381-2253 or 309-793-5800		X	X		
Chicago Wilderness Small Grants	CW	312-346-8166 ext. 30					None
Partners in Conservation (formerly C2000)	IDNR	http://dnr.state.il.us/orep/c2000/		X			None
Conservation Reserve Program	NRCS	http://www.nrcs.usda.gov/programs/crp/		X			Land
Ecosystems Program	IDNR	http://dnr.state.il.us/orep/c2000/ecosystem/		X			None
Emergency Watershed Protection	NRCS	http://www.nrcs.usda.gov/programs/ewp/			X	X	None
Five Star Challenge	NFWF	http://www.nfwf.org/AM/Template.cfm		X			None
Illinois Flood Mitigation Assistance Program	IEMA	http://www.state.il.us/iema/construction.htm				X	None
Great Lakes Basin Program	GLBP	http://www.glc.org/basin/stateproj.html?st=il	X		X		None
Illinois Clean Energy Community Foundation	ICECF	http://www.illinoiscleanenergy.org/		X			
Illinois Clean Lakes Program	IEPA	http://www.epa.state.il.us/water/financial-assistance/index.html					None
Lake Education Assistance Program (LEAP)	IEPA	http://www.epa.state.il.us/water/conservation-2000/leap/index.html	X				$500

CW = Chicago Wilderness
ICECF = Illinois Clean Energy Community Foundation
IEMA = Illinois Emergency Management Agency
IEPA = Illinois Environmental Protection Agency
IDNR = Illinois Department of Natural Resources
IDOA = Illinois Department of Agriculture
LCSMC = Lake County Stormwater Management Commission
LCSWCD = Lake County Soil and Water Conservation District
NFWF = National Fish and Wildlife Foundation
NRCS = Natural Resources Conservation Service
USACE = United States Army Corps of Engineers
USFWS = United States Fish and Wildlife Service

Table E1. Continued

Grant Program Name	Funding Source	Contact Information	Funding Focus: Water Quality/ Wetland	Habitat	Erosion	Flooding	Cost Share
Northeast Illinois Wetland Conservation Account	USFWF	847-381-2253	X				
Partners for Fish and Wildlife	USFWS	http://ecos.fws.gov/partners/		X			> 50%
River Network's Watershed Assistance Grants Program	River Network	http://www.rivernetwork.org	X	X	X		na
Section 206: Aquatic Ecosystems Restoration	USACE	312-353-6400, 309-794-5590 or 314-331-8404		X			35%
Section 319: Non-Point Source Management Program	IEPA	http://www.epa.state.il.us/water/financial-assistance/nonpoint.html	X	X			>40%
Section 1135: Project Modifications for the Improvement of the Environment	USACE	312-353-6400, 309-794-5590 or 314-331-8404		X			25%
Stream Cleanup And Lakeshore Enhancement (SCALE)	IEPA	http://www.epa.state.il.us/water/watershed/scale.html	X	X			None
Streambank Stabilization & Restoration (SSRP)	IDOA/ LCSWCD	http://www.agr.state.il.us/Environment/conserv/ or call LCSWCD at (847) 223-1056		X	X		25%
Watershed Management Boards	LCSMC	http://www.co.lake.il.us/smc/projects/wmb/default.asp	X		X	X	50%
Wetlands Reserve Program	NRCS	http://www.nrcs.usda.gov/programs/wrp/	X	X			Land
Wildlife Habitat Incentive Program	NRCS	http://www.nrcs.usda.gov/programs/whip/		X			Land

CW = Chicago Wilderness
ICECF = Illinois Clean Energy Community Foundation
IEMA = Illinois Emergency Management Agency
IEPA = Illinois Environmental Protection Agency
IDNR = Illinois Department of Natural Resources
IDOA = Illinois Department of Agriculture
LCSMC = Lake County Stormwater Management Commission
LCSWCD = Lake County Soil and Water Conservation District
NFWF = National Fish and Wildlife Foundation
NRCS = Natural Resources Conservation Service
USACE = United States Army Corps of Engineers
USFWS = United States Fish and Wildlife Service