2009 SUMMARY REPORT
of
Schreiber Lake

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

Schreiber Lake's water quality is better than most lakes in the county. Notably minimum concentrations of chlorides and low conductivity were recorded throughout the entire water column.

Water clarity, as measured by Secchi disk transparency, was better than the county median although it has declined since 2003. Total suspended solids, which include non-volatile suspended solids (sediments) and volatile solids (TVS) such as algae, plant, and animal matter can decrease water clarity remained relatively unchanged since 2003. The decrease was likely due to an algal bloom that occurred during 2003 that was not present in 2009. The average epilimnetic TVS concentration of 58 mg/L total volatile solids (TVS) was the lowest average concentration on record for Schreiber Lake. Chloride and conductivity concentrations were the lowest on record in Lake County during 2009.

The 2009 total phosphorus (TP) average concentration in the epilimnion (0.040mg/L) was more than 30% lower than the county median recorded for near surface samples (0.063 mg/L) from 2000 - 2009, but 23% higher than the 1999 average (0.035 mg/L). The 2009 average TP concentration in the hypolimnion (0.708 mg/L) was greater than twice the county median for anoxic samples (0.167 mg/L), but unchanged from 2003 (average of 0.423 mg/L). High nutrient concentrations in the hypolimnion are not uncommon in highly organic lakes like Schreiber Lake that strongly stratify in the summer months.

Thirteen aquatic plant species and several emergent shoreline plants were found in 2009. A qualitative survey was conducted on the submersed and floating leaf vegetation contained in the 5.35 acre lake area. Coontail and White Water Lily were the two co-dominant species. They were found at a frequency of 65.2% and 43.5% respectively. The only submersed exotic species found was Eurasian Watermilfoil (EWM). It was only found at one of the 23 sampling sites within the open water area of the lake. One state endangered aquatic plant species, Fernleaf Pondweed, and one rare aquatic species, Watershield, were found in the open water of Schreiber Lake in 2009 during the quantitative survey. Fernleaf Pondweed was found in three different locations within the open water area and Watershield one location. White-stem Pondweed was detected in 1999 but has not been found since. During two meander searches of the floating mats and shoreline areas, two other threatened and endangered species were detected.

An assessment of erosion on Schreiber Lake detected no evidence of erosion taking place on the on the shorelines at this time.

LAKE FACTS

Lake Name:	Schreiber Lake
Historical Name:	None
Nearest Municipality:	Wauconda
Location:	T44N, R10E, Section 29
Elevation:	838.7 feet mean sea level
Major Tributaries:	None
Watershed:	Fox River
Sub-watershed:	Squaw Creek
Receiving Waterbody:	Davis Lake
Surface Area:	5.4 acres
Shoreline Length:	0.3 miles
Maximum Depth:	25.3 feet
Average Depth:	11.9 feet
Lake Volume:	63.9 acre-feet
Lake Type:	Glacial
Watershed Area:	174.8 acres
Major Watershed Land Uses:	Single family, Wetlands, and Public and Private Open Space
Bottom Ownership:	Lake County Forest Preserve District
Management Entities:	Lake County Forest Preserve District
Current and Historical Uses:	Fishing, hiking, bicycling, cross country skiing, and aesthetics
Description of Access:	Access available through Lakewood Forest Preserve

SUMMARY OF WATER QUALITY

Schreiber Lake has remained relatively unchanged since the Lake County Health Department – Environmental Services (ES) first monitored it in 1999 (Figure 1). Other than the trail system that was constructed within the Lakewood Forest Preserve sometime between 2000 and 2002, little has changed within the 174.78 acre watershed (Figure 2).

Water samples were taken monthly from May through September at the deep-hole location (Figure 3, Appendix A). Samples were collected three feet below the surface and three feet off the bottom and analyzed for various water quality parameters (Appendix C). Schreiber Lake is within the Squaw Creek watershed which the ES sampled in 2009. Lakes within this watershed include Old Oak Lake, Schreiber Lake, Owens Lake, Davis Lake, Lake Helen, Summerhill Estates Lake, Nippersink Lake (LCFPD), Round Lake, Cranberry Lake, Highland Lake, Long Lake, Patski Pond, and Hook Lake (Figure 4).

Schreiber Lake's water quality was better than many lakes in Lake County. Most of the reported concentrations measured in the epilimnion were better than the medians (where 50% of the lakes are above and below this value) of other lakes monitored within the Squaw Creek watershed as well as throughout the county (Table 1, Appendix E).

Water clarity, as measured by Secchi disk transparency readings, averaged 7.25 feet for the season (Table 2), which was more than twice the depth of the county median 3.15 feet. Secchi depth was deepest in May (10.50 feet) and shallowest in July (4.00 feet). Although the water clarity was good, the Secchi depth average has decreased over time from the average of 9.70 feet in 1999 to 7.25 measured in 2009. Weather could have been a contributing factor and rainfall prior to sampling events can affect water quality parameters. Light rains fell prior to our July and September sampling events and could have contributed to the decrease in clarity and increase in total suspended solids (TSS) especially in July (Figure 5).

Schreiber Lake continued to have very low TSS concentrations. The 2009 epilimnetic average TSS concentration was 2.8 mg/L, the lowest average concentration during any of the monitoring years and it was well below the county median for near surface samples of 7.9 mg/L TSS.

In the hypolimnion, the 2009 TSS concentrations were much higher, with an average of 37.2 mg/L compared to the 1999 average of 12.9 mg/L. The TSS concentration has increased over the ten year period, although in 2009 a noticeably high measurement occurred in May which may have been due to the sediment being distributed into the water column from the anchor. Also nutrients and solids can become concentrated in the hypolimnion as the summer progresses due to the strengthening of the thermocline when additional nutrients are released from the sediment under anoxic conditions (< 1 mg/L of dissolved oxygen). In highly organic lakes, like Schreiber Lake, the concentrations of these nutrients and solids in the hypolimnion can be very high.

Epilimnetic total volatile solids (TVS) concentrations have remained relatively constant at 58 mg/L, 79 mg/L and 64 mg/L TVS as measured in 2009, 2003 and 1999 respectively. The average TVS concentrations were much less than the county median of 125.5 mg/L. A more detailed study looking at additional parameters including aquatic invertebrates and planktonic

Figure 1. 2000 Aerial Photography of the Schreiber Lake Watershed.

Figure 2. 2008 Aerial Photography of the Schreiber Lake Watershed.

Figure 3. Water quality sampling site on Schreiber Lake, 2009.

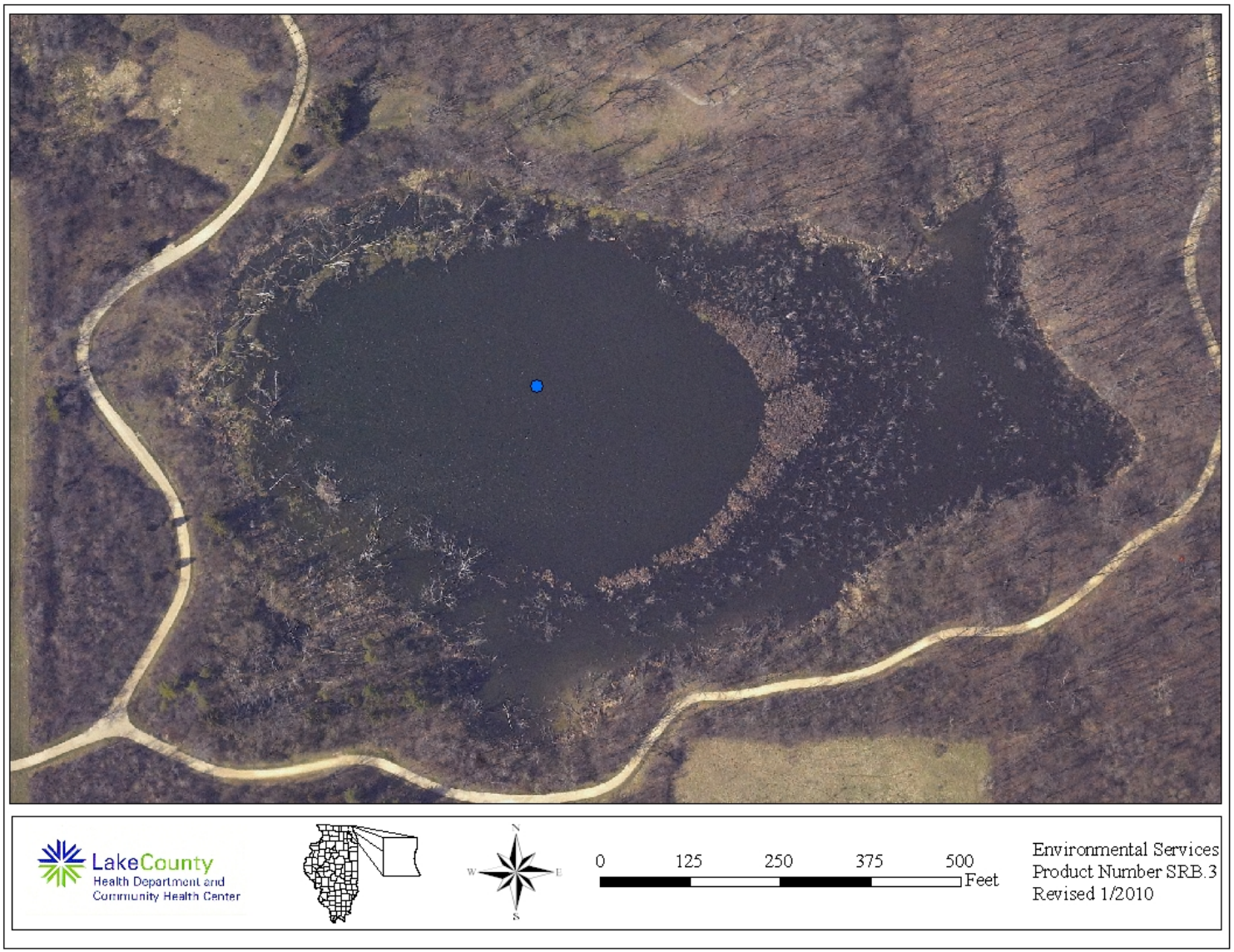


Figure 4. Lakes sampled in the Squaw Creek Watershed, 2009.

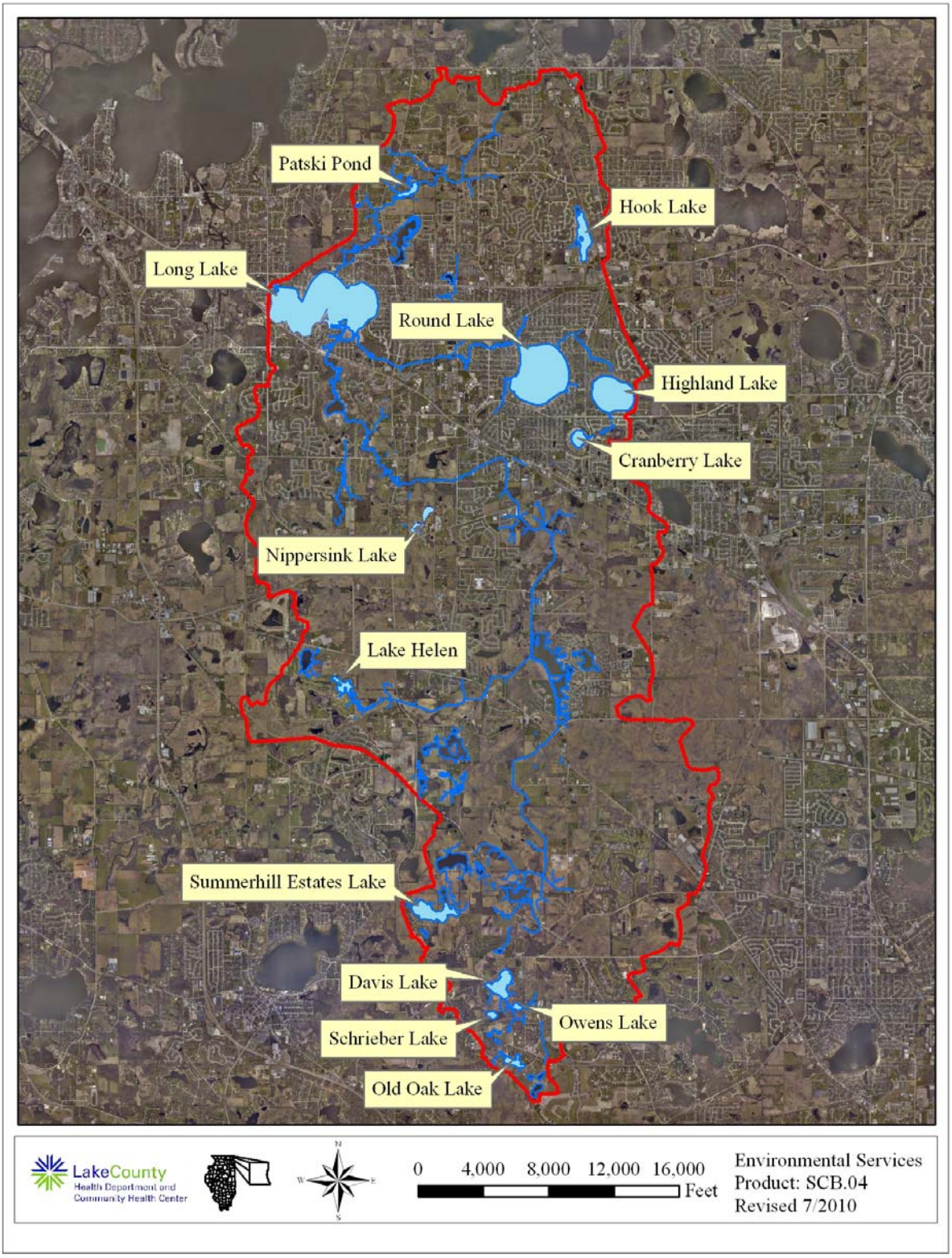


Table 1. Comparison of epilimnetic averages for Secchi disk transparency, total suspended solids, total phosphorus, and conductivity within the Squaw Creek watershed.

Lake Name	Year	Secchi (feet)	TSS (mg/L)	TP (mg/L)	Conductivity (milliSiemens/cm)
Cranberry Lake	2000	10.96	1.2	0.024	0.3809
Cranberry Lake	2005	10.52	1.5	0.024	0.5625
Cranberry Lake	2006	9.33	1.6	0.024	0.6019
Cranberry Lake	2007	9.06	1.8	0.023	0.5138
Cranberry Lake	2008	9.63	2.2	0.027	0.5070
Cranberry Lake	2009	8.56	3.7	0.036	0.4262
Highland Lake	1991	7.08	3.4	0.039	NA
Highland Lake	1996	7.98	2.4	0.023	0.4076
Highland Lake	2001	6.58	3.3	0.030	0.5560
Highland Lake	2009	6.97	4.8	0.020	0.5834
Round Lake	1989	7.07	4.4	0.100	NA
Round Lake	1991	5.20	5.4	0.031	NA
Round Lake	1995	7.44	3.4	0.024	0.6290
Round Lake	1999	10.32	2.7	0.015	0.8364
Round Lake	2003	6.25	3.5	0.025	1.0730
Round Lake	2009	7.01	3.0	0.023	1.2292
Long Lake	1996	2.44	13.9	0.086	0.5222
Long Lake	2001	4.11	9.7	0.092	0.9430
Long Lake	2005	4.18	10.9	0.076	1.0821
Long Lake	2006	4.52	7.2	0.068	1.1120
Long Lake	2007	3.24	11.1	0.103	0.9066
Long Lake	2008	2.69	11.6	0.117	0.8722
Long Lake	2009	4.16	10.2	0.092	0.7587
Old Oak Lake	2003	5.08	3.6	0.043	0.7240
Old Oak Lake	2009	4.85	4.9	0.049	0.7700
Schreiber Lake	1999	9.70	3.4	0.035	0.2750
Schrieber Lake	2003	9.59	3.1	0.043	0.2882
Schrieber Lake	2009	7.25	2.8	0.040	0.2582
Owens Lake	2000	4.38	11.0	0.124	0.5395
Owens Lake	2009	5.30	3.5	0.058	0.5274
Davis Lake	2000	8.14	2.1	0.048	0.5143
Davis Lake	2009	9.65	2.6	0.065	0.6306
Summmerhill Estates Lake	2004	3.65	6.1	0.138	0.5858
Summmerhill Estates Lake	2009	3.27	9.4	0.199	0.5552
Lake Helen	2009	6.43	4.1	0.072	0.4742
Lake Nippersink (LCFPD)	2009	1.73	18.9	0.100	0.4588
Patski Pond	2004	NA	52.7	0.251	0.8194
Patski Pond	2009	NA	33.7	0.197	0.8994
Hook Lake	2004	5.03	5.1	0.030	1.1067
Hook Lake	2009	3.95	6.5	0.041	1.4690

Table 2. Water quality data for Schreiber Lake, 2003 and 2009.

2009	Epilimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl-	TDS**	TSS	TS	TVS	SECCHI	COND	pH	DO
20-May	3	133	0.76	<0.1	<0.05	0.034	<0.005	3	187	1.4	173	55	10.50	0.2780	8.52	8.02
17-Jun	3	127	0.81	<0.1	<0.05	0.025	<0.005	4	179	1.6	164	61	8.53	0.2610	8.17	8.47
22-Jul	3	129	1.04	<0.1	<0.05	0.064	<0.005	3	178	6.8	169	62	4.00	0.2590	7.71	7.27
19-Aug	3	133	0.95	<0.1	<0.05	0.041	<0.005	3	161	2.6	173	64	5.80	0.2260	7.31	7.13
23-Sep	3	135	0.97	<0.1	<0.05	0.034	<0.005	3	182	1.4	160	48	7.40	0.2670	8.16	3.89
	Average	131	0.90	<0.1	<0.05	0.040	<0.005	3	177	2.8	168	58	7.25	0.2582	7.97	6.96

2003	Epilimnion															
DATE	DEPTH	ALK	TKN	NH3-N	NO3-N	TP	SRP	Cl-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
14-May	3	145	1.23	0.244	0.065	0.038	0.012	NR	180	1.5	185	62	10.3	0.2910	7.69	7.67
11-Jun	3	143	1.39	<0.1	<0.05	0.052	<0.005	NR	180	4.4	198	97	4.79	0.2910	8.03	8.82
16-Jul	3	140	1.14	<0.1	<0.05	0.049	<0.005	NR	160	1.9	183	65	11.91	0.2780	8.09	8.77
13-Aug	3	146	1.26	<0.1	<0.05	0.046	0.009	NR	170	4.5	198	84	9.02	0.2834	7.45	2.96
17-Sep	3	156	1.24	<0.1	<0.05	0.032	0.006	NR	170	<1.0	192	87	11.94	0.2978	7.55	4.74
	Average	146	1.25	0.244[k]	0.065[k]	0.043	0.009[k]	NR	172	3.1	191	79	9.59	0.2882	7.76	6.59

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_2+NO_3-N = Nitrate + Nitrite nitrogen, mg/L
NO_3-N = Nitrate + Nitrite nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
Cl^- = Chloride, mg/L

TDS = Total dissolved solids, 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

k = Denotes that the actual value is known to be less than the value presented.
NA= Not applicable
* = Prior to 2006 only Nitrate - nitrogen was analyzed
**=Estimated TDS based on Conductivity

Table 2 Continued.

2009	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	Cl-	TDS**	TSS	TS	TVS	SECCHI	COND	pH	DO
20-May	23	167	6.30	5.590	<0.05	1.59	0.756	4.00	235	67	173	55	NA	0.3735	7.5	0.42
17-Jun	21	149	2.68	1.530	<0.05	0.126	0.006	4.47	209	19	193	56	NA	0.3210	7.02	0.48
22-Jul	22	178	7.02	5.490	<0.05	0.927	0.361	3.53	236	46	256	80	NA	0.3750	6.83	0.47
19-Aug	22	165	5.01	3.530	<0.05	0.511	0.24	4.52	261	36	226	70	NA	0.4250	6.68	5.27
23-Sep	22	142	4.05	3.270	<0.05	0.388	0.207	4.05	268	18	222	51	NA	0.4390	7.13	0.44
	Average	160	5.01	3.882	<0.05	0.708	0.314	4.114	242	37.2	214	62	NA	0.3867	7.03	1.42

2003	Hypolimnion															
DATE	DEPTH	ALK	TKN	NH3-N	NO3-N	TP	SRP	Cl-	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
14-May	22	178	2.90	1.750	<0.05	0.178	0.077	NR	200	20	228	80	NA	0.3980	6.99	0.09
11-Jun	22	176	4.34	2.180	<0.05	0.354	0.132	NR	222	26	238	109	NA	0.4130	6.91	0.10
16-Jul	22	200	5.26	3.800	<0.05	0.449	0.126	NR	216	35	250	73	NA	0.4140	6.92	0.05
13-Aug	22	200	5.89	4.620	<0.05	0.807	0.324	NR	230	40	285	118	NA	0.5062	7.09	0.08
17-Sep	22	172	3.06	1.710	<0.05	0.325	0.090	NR	200	14	227	76	NA	0.5183	6.96	0.08
	Average	185	4.29	2.812	<0.05	0.423	0.150	NR	214	27.0	246	91	NA	0.4499	6.97	0.08

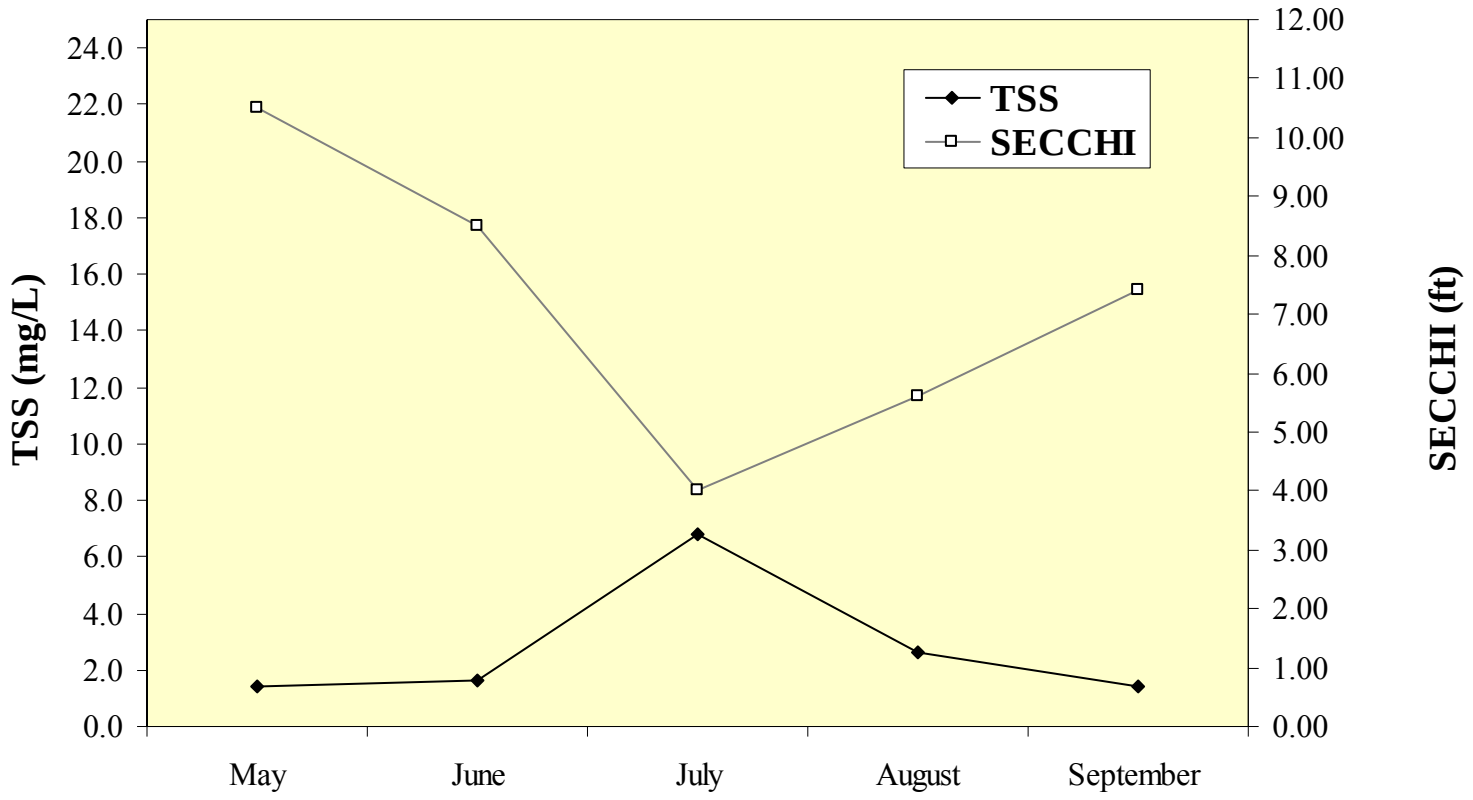
Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
NO_2+NO_3-N = Nitrate + Nitrite nitrogen, mg/L
NO_3-N = Nitrate + Nitrite nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
Cl^- = Chloride, mg/L

TDS = Total dissolved solids, 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

k = Denotes that the actual value is known to be less than the value presented.
NA= Not applicable
* = Prior to 2006 only Nitrate - nitrogen was analyzed
**=Estimated TDS based on Conductivity

Figure 5. Total suspended solid (TSS) concentrations vs. Secchi depth for Schreiber Lake, 2009.



communities is recommended as it would give a baseline for better understanding this very unique resource in the county.

Conductivity measurements in Schreiber Lake were the lowest in the county. The average reading for 2009 was 0.2582 milliSiemens/cm (mS/cm), this was the lowest conductivity reading since 1999, when the measurement was 0.2748. Transportation, which contributed 19.2% of the total watershed runoff did not appear to impact the lake. This can be attributed to Schreiber Lake having 54.1% of its combined watershed land use in open space, wetlands and forest and grasslands (Table3; Figure 6). It is estimated that the retention time of Schreiber Lake was 285 days.

In past monitoring years (1999, 2003), total dissolved solids (TDS) concentrations were collected. However, since 2003, it has been discovered, especially in urbanized areas, that chloride, a major constituent in road salt, has been the largest contributor to TDS concentrations, so the ES began monitoring chloride concentrations in 2004. In July and September 2009, Schreiber Lake had a chloride concentration of 2.7 mg/L, this was the lowest recorded chloride concentration among Lake County lakes. Although transportation represents 6.5% of the land use within the Schreiber Lake watershed it was estimated to contribute 19.2% of the estimated runoff to the lake. The ES continues to monitor chloride levels throughout the county due to the upward trend that lakes in the county have been experiencing in conductivity and TDS concentrations. Schreiber Lake has a rather large watershed for its size however, it has 94.9% of combined land use in wetlands, open space, forest and grassland or water, which contributes very little (20%) estimated run off while helping to buffer the lake.

The average total phosphorus (TP) concentration in the epilimnion (0.040 mg/L) was 7% lower than 2003 when the average TP concentration in the epilimnion was 0.043 mg/L and lower than the county median of 0.063 mg/L. It was however 14.3% higher than the average TP concentration from 1999. Although the average TP concentration decreased slightly in the epilimnion the concentrations continued to be at a level (0.03 mg/L) sufficient enough to cause algae blooms. The 2009 average TP concentration in the hypolimnion (0.708 mg/L) and was twice the county median for anoxic samples (0.167 mg/L). At this time there is little concern in this increase and it was attributed to a concentration measured in May of 1.59 mg/L, since phosphorus binds to sediments it is likely related to anchor movement, although high TP concentrations in the hypolimnion are not uncommon in highly organic lakes like Schreiber Lake that strongly stratify in the summer months. The lake was stratified during the entire sampling season (May – September) with the thermocline fluctuating between five and six feet.

High nutrient concentrations are usually indicative of water quality problems. Plants and algae require light and nutrients, most importantly carbon, nitrogen (N) and phosphorus (P), to grow. Light and carbon are not normally in short supply (limiting). This means that nutrients (N&P) are usually the limiting factors in plant and algal growth. Nitrogen, as well as carbon, naturally occur in high concentrations and come from a variety of sources (soil, air, etc.) that are more difficult to control than sources of phosphorus. To compare the availability of these nutrients, a ratio of total nitrogen to total phosphorus is used (TN: TP). Ratios <10:1 indicate nitrogen is limiting. Ratios of >15:1 indicate phosphorus is limiting. Ratios >10:1, <15:1 indicate that there is enough of both nutrients for excessive algal growth. The average ratio between total nitrogen

Table 3. Approximate land uses and retention time for Schreiber Lake, 2009.

Land Use	Acreage	% of Total
Agricultural	12.27	7.0%
Disturbed Land	0.00	0.0%
Forest and Grassland	17.07	9.8%
Government and Institutional	0.00	0.0%
Industrial	0.00	0.0%
Multi Family	0.00	0.0%
Office	0.00	0.0%
Public and Private Open Space	27.65	15.8%
Retail/Commercial	0.00	0.0%
Single Family	56.58	32.4%
Transportation	11.42	6.5%
Utility and Waste Facilities	0.00	0.0%
Water	19.59	11.2%
Wetlands	30.20	17.3%
Total Acres	**174.78**	**100.0%**

Land Use	Acreage	Runoff Coeff.	Estimated Runoff, acft.	% Total of Estimated Runoff
Agricultural	12.27	0.05	1.7	2.1%
Disturbed Land	0.00	0.05	0.0	0.0%
Forest and Grassland	17.07	0.05	2.3	2.9%
Government and Institutional	0.00	0.50	0.0	0.0%
Industrial	0.00	0.50	0.0	0.0%
Multi Family	0.00	0.50	0.0	0.0%
Office	0.00	0.85	0.0	0.0%
Public and Private Open Space	27.65	0.15	11.4	13.9%
Retail/Commercial	0.00	0.85	0.0	0.0%
Single Family	56.58	0.30	46.7	56.9%
Transportation	11.42	0.50	15.7	19.2%
Utility and Waste Facilities	0.00	0.30	0.0	0.0%
Water	19.59	0.00	0.0	0.0%
Wetlands	30.20	0.05	4.2	5.1%
TOTAL	**174.78**		**82.0**	100.0%

Lake volume	**63.92**	**acre-feet**
Retention Time (years)= lake volume/runoff	**0.78**	**years**
	284.62	**days**

Figure 6. Approximate land use within the Schreiber Lake watershed, 2009.

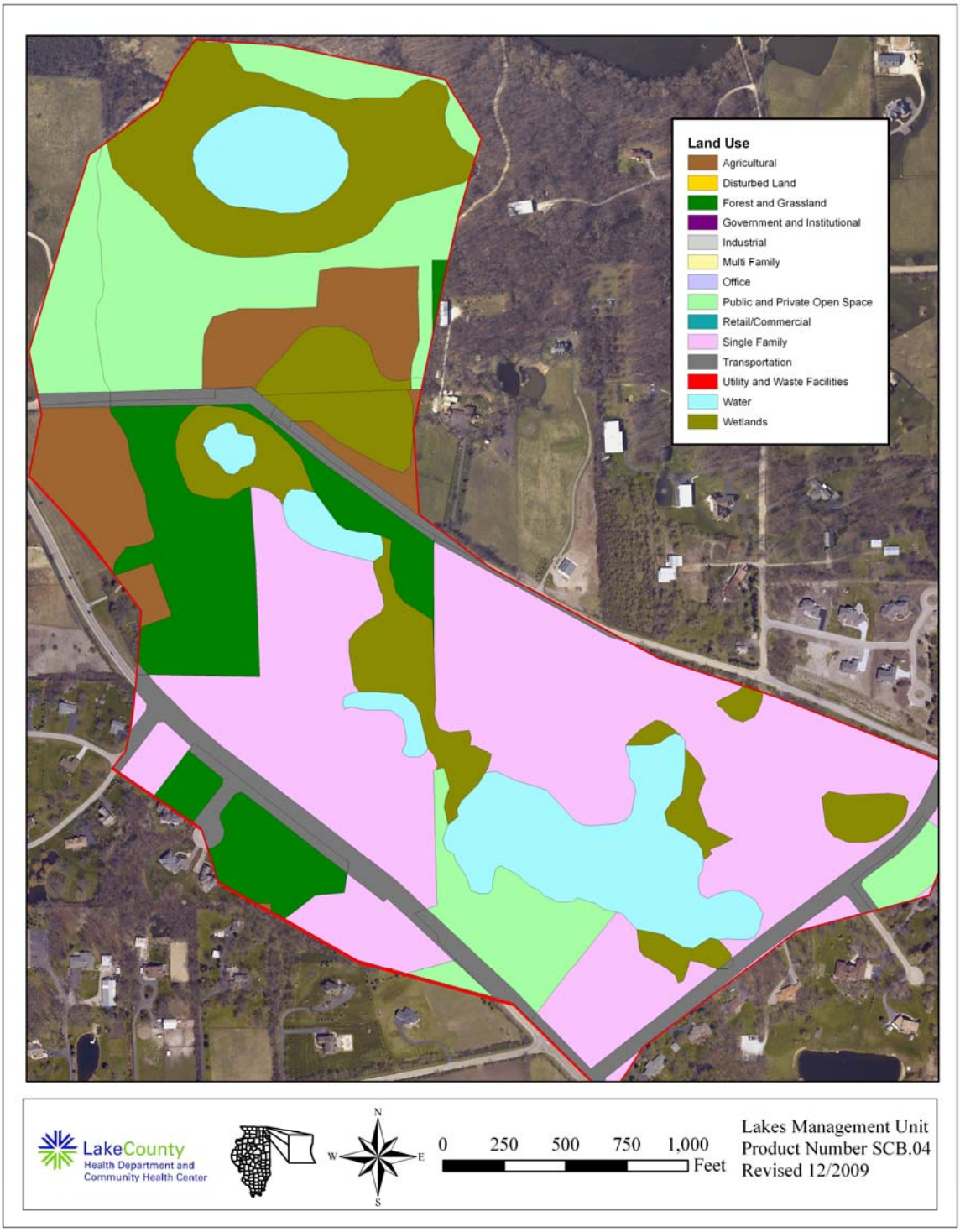


Figure 7. Bathymetric map of Schreiber Lake, 2008.

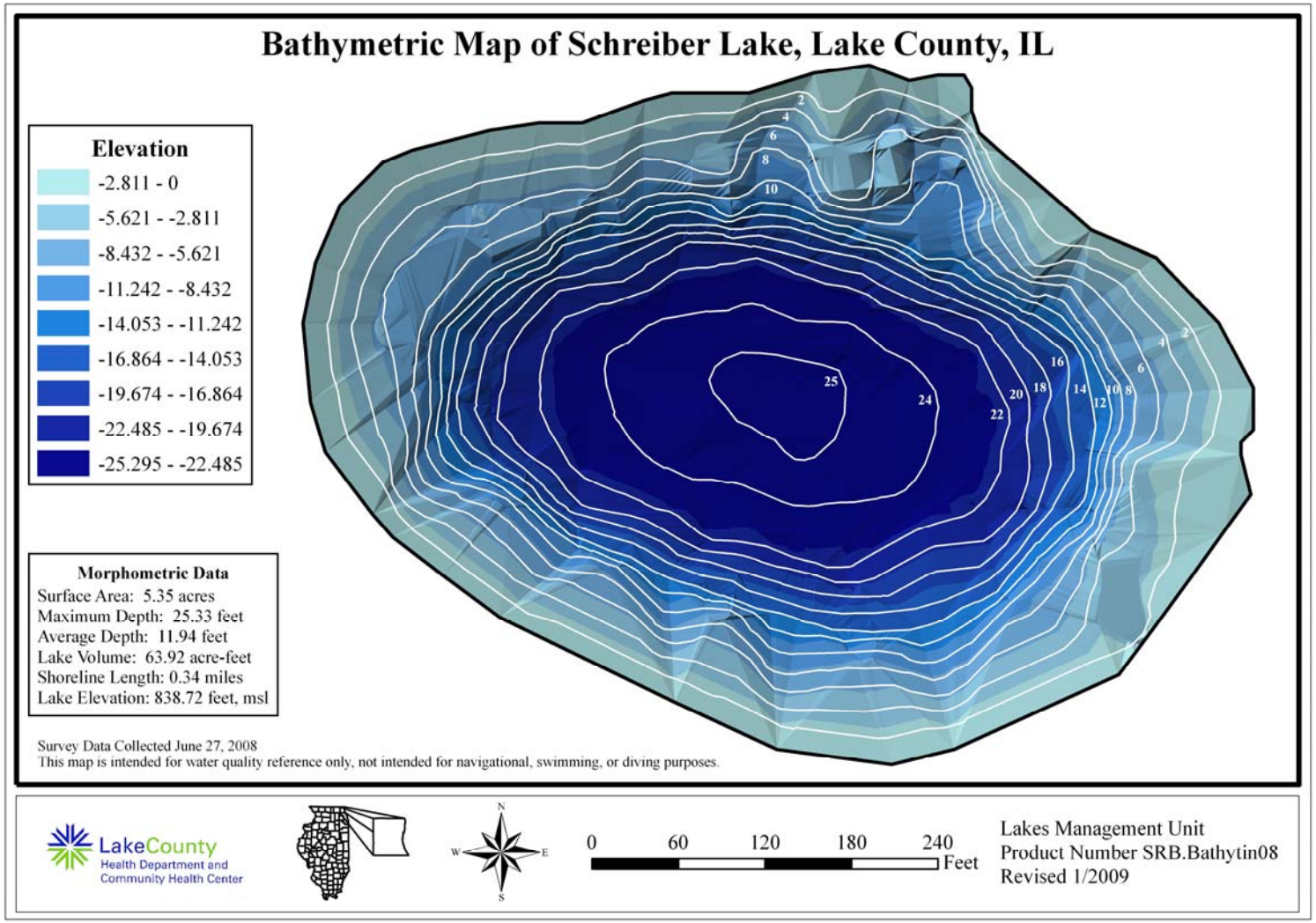


Table 4. Morphometric features of Schreiber Lake, 2009.

Morphometric Features of Schreiber Lake ~

Data From the June 2008 Bathymetric Survey, LCHD Lakes Management Unit

Contour (Feet)	Area Enclosed (Acres)	Percent of Total Acres	Volume (Acre-feet)	Depth Zone (Feet)	Area (Acres)	Percent (Depth Zone to Total Acres)	Percent (Acre-feet to Total Volume)
0	5.35	100%	5.18	0 - 1	0.34	6.4%	8.1%
1	5.01	94%	4.85	1 - 2	0.33	6.1%	7.6%
2	4.68	88%	4.53	2 - 3	0.32	5.9%	7.1%
3	4.37	82%	4.20	3 - 4	0.34	6.4%	6.6%
4	4.02	75%	3.89	4 - 5	0.27	5.1%	6.1%
5	3.75	70%	3.61	5 - 6	0.28	5.2%	5.7%
6	3.48	65%	3.34	6 - 7	0.26	4.9%	5.2%
7	3.21	60%	3.12	7 - 8	0.20	3.7%	4.9%
8	3.02	56%	2.93	8 - 9	0.17	3.2%	4.6%
9	2.85	53%	2.76	9 - 10	0.18	3.3%	4.3%
10	2.67	50%	2.60	10 - 11	0.13	2.4%	4.1%
11	2.54	47%	2.48	11 - 12	0.11	2.1%	3.9%
12	2.43	45%	2.37	12 - 13	0.10	1.9%	3.7%
13	2.32	43%	2.27	13 - 14	0.11	2.0%	3.5%
14	2.22	41%	2.15	14 - 15	0.12	2.3%	3.4%
15	2.09	39%	2.03	15 - 16	0.12	2.3%	3.2%
16	1.97	37%	1.91	16 - 17	0.12	2.3%	3.0%
17	1.85	35%	1.78	17 - 18	0.13	2.4%	2.8%
18	1.72	32%	1.65	18 - 19	0.13	2.4%	2.6%
19	1.59	30%	1.52	19 - 20	0.13	2.5%	2.4%
20	1.46	27%	1.39	20 - 21	0.14	2.6%	2.2%
21	1.32	25%	1.23	21 - 22	0.18	3.4%	1.9%
22	1.14	21%	1.01	22 - 23	0.26	4.9%	1.6%
23	0.88	16%	0.70	23 - 24	0.34	6.3%	1.1%
24	0.54	10%	0.28	24 - 25	0.45	8.4%	0.4%
25	0.09	2%	0.13	25 +	0.09	1.7%	0.2%
			63.92		5.35	100%	100%

Maximum Depth of Lake: 25.33 Feet
Average Depth of Lake: 11.94 Feet
Volume of Lake: 63.92 Acre-Feet

Area of Lake: 5.35 Acres
Shoreline Length: 0.34 Miles
Water elevation at 838.72 feet above mean sea level

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and total phosphorus for Schreiber Lake in 2009 was 23:1, indicating a phosphorus limited system. Most lakes in Lake County are phosphorus limited. Lakes that are phosphorus limited may be easier to manage, since controlling phosphorus is more feasible than controlling nitrogen or carbon. It is recommended that the Lake County Forest Preserve District (LCFPD) be supportive of any ordinances banning the use of fertilizers as the largest land use comes from single family (56.8%), which was estimated to contribute 32.4% of total runoff in the watershed.

Schreiber Lake was strongly stratified during the sampling season. A thermocline was present between 5 and 6 feet May through September, being particularly strong from June through August. Dissolved oxygen (DO) concentrations in Schreiber Lake fluctuated during the season. Generally concern arises when DO concentrations fall below 5 mg/L in the epilimnion. In 2009, the DO concentrations at the surface were >5mg/L until September when it was measured at 4.20 mg/L. Anoxic conditions (where DO concentrations drop below 1 mg/L) did exist below approximately 7 feet July and September (Appendix B). This translates to approximately forty percent of the lake volume being anoxic during these periods based on the bathymetric map. The map does not include the vast littoral zone and morphometric table created by ES in 2008 (Figure 7, Table 4). Conditions in the lake (i.e., high organic content, strong stratification, and algae and macrophyte prevalence) may cause DO concentrations to fluctuate widely, which may result in low DO concentrations at various times.

Rain events can contribute additional sediment or nutrients (like phosphorus) to a lake, which may influence water sample results. Rain events occurred within 48 hours prior to sampling in June (0.56 inches) and July (0.06 inches) as recorded at the Lake County Stormwater Management Commission (LCSMC) rain gage in Wauconda. Based on this gage there was 17.72 inches of rain that fell in the area within our monitoring period. In Illinois, 2009 was the fourth wettest on record with 50.27 inches of precipitation falling. This followed the second wettest year of 2008 in which 50.46 inches fell. In theory our area potentially had up to 100.73 inches of precipitation, which amounts to a surplus 22.4 inches of precipitation in that two year period (http://www.isws.illinois.edu/atmos/statecli/). Monthly precipitation as measured at LCSMC Wauconda station yielded 5.35, 4.12, 3.32, 5.00 and 3.23 inches of rain, for May, June, July, August and September, respectively. The July rain event did raise the water level in the lake slightly, and was reflected in increased TSS and a reduction is Secchi depth month.

Based on data collected in 2009, standard classification indices compiled by the Illinois Environmental Protection Agency (IEPA) were used to determine the current condition of Schreiber Lake. A general overall index that is commonly used is called a trophic state index or TSI. The TSI index classifies the lake into one of four categories: oligotrophic (nutrient-poor, biologically unproductive), mesotrophic (intermediate nutrient availability and biological productivity), eutrophic (nutrient-rich, highly productive), or hypereutrophic (extremely nutrient-rich productive). This index can be calculated using total phosphorus values obtained at or near the surface. The TSIp for Schreiber Lake in 2009 classified it as a eutrophic lake (TSIp = 57.2). The TSIp has remained relatively stable since 1999. Eutrophic lakes are the most common type of lake throughout the lower Midwest, and they are particularly common among manmade lakes. Schreiber Lake 46th out of the 165 lakes assessed for TSIp (Table 5). This ranking was only a relative assessment of the lakes in the county. The current rank of a lake is dependent upon many factors including lake origin, water source, nutrient loads, and morphometric features (volume,

Table 5. Lake County average TSI phosphorous (TSIp) ranking 2000-2009.

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	Cedar 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	Highland Lake	0.0200	47.35
14	Banana Pond	0.0202	47.49
15	Lake Minear	0.0204	47.63
16	Cross Lake	0.0220	48.72
17	Sun Lake	0.0220	48.72
18	Dog Pond	0.0222	48.85
19	Lake of the Hollow	0.0230	49.36
20	Stone Quarry Lake	0.0230	49.36
21	Round Lake	0.0230	49.36
22	Deep Lake	0.0234	49.61
23	Bangs Lake	0.0240	49.98
24	Druce Lake	0.0244	50.22
25	Little Silver	0.0250	50.57
26	Lake Leo	0.0256	50.91
27	Dugdale Lake	0.0274	51.89
28	Peterson Pond	0.0274	51.89
29	Lake Miltmore	0.0276	51.99
30	Lake Fairfield	0.0296	53.00
31	Third Lake	0.0300	53.20
32	Gray's Lake	0.0302	53.29
33	Lake Catherine (Site 1)	0.0308	53.57
34	Lambs Farm Lake	0.0312	53.76
35	Old School Lake	0.0312	53.76
36	Sand Lake	0.0316	53.94
37	Lake Linden	0.0326	54.39
38	Gages Lake	0.0338	54.92
39	Honey Lake	0.0340	55.00
40	Hendrick Lake	0.0344	55.17
41	Cranberry Lake	0.0360	55.82
42	Sullivan Lake	0.0370	56.22
43	Diamond Lake	0.0372	56.30
44	Channel Lake (Site 1)	0.0380	56.60
45	Ames Pit	0.0390	56.98
46	Schreiber Lake	0.0400	57.34

Table 5. Continued.

RANK	LAKE NAME	TP AVE	TSIp
47	White Lake	0.0408	57.63
48	Hook Lake	0.0410	57.70
49	Potomac Lake	0.0424	58.18
50	Duck Lake	0.0426	58.25
51	Deer Lake	0.0434	58.52
52	Nielsen Pond	0.0448	58.98
53	Turner Lake	0.0458	59.30
54	Seven Acre Lake	0.0460	59.36
55	Willow Lake	0.0464	59.48
56	Lucky Lake	0.0476	59.85
57	East Meadow Lake	0.0478	59.91
58	Old Oak Lake	0.0490	60.27
59	East Loon Lake	0.0490	60.27
60	Countryside 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 Napa Suwe (Outlet)	0.0570	62.45
69	Lake Christa	0.0576	62.60
70	Lake Charles	0.0580	62.70
71	Owens Lake	0.0580	62.70
72	Crooked Lake	0.0608	63.38
73	Waterford Lake	0.0610	63.43
74	Wooster Lake	0.0610	63.43
75	Lake Naomi	0.0616	63.57
76	Lake Tranquility S1	0.0618	63.62
77	Werhane Lake	0.0630	63.89
78	Liberty Lake	0.0632	63.94
79	Countryside Glen Lake	0.0642	64.17
80	Lake Fairview	0.0648	64.30
81	Leisure Lake	0.0648	64.30
82	Davis Lake	0.0650	64.34
83	Tower Lake	0.0662	64.61
84	St. Mary's Lake	0.0666	64.70
85	Mary Lee Lake	0.0682	65.04
86	Hastings Lake	0.0684	65.08
87	Lake Helen	0.0720	65.82
88	Spring Lake	0.0726	65.94
89	ADID 203	0.0730	66.02
90	Bluff Lake	0.0734	66.10
91	Harvey Lake	0.0766	66.71
92	Broberg Marsh	0.0782	67.01

Table 5. Continued.

RANK	LAKE NAME	TP AVE	TSIp
93	Sylvan Lake	0.0794	67.23
94	Big Bear Lake	0.0806	67.45
95	Petite Lake	0.0834	67.94
96	Timber Lake (South)	0.0848	68.18
97	Lake Marie (Site 1)	0.0850	68.21
98	North Churchill Lake	0.0872	68.58
99	Grand Avenue Marsh	0.0874	68.61
100	Grandwood Park, Site II, Outflow	0.0876	68.65
101	North Tower Lake	0.0878	68.68
102	South Churchill Lake	0.0896	68.97
103	Rivershire Pond 2	0.0900	69.04
104	McGreal Lake	0.0914	69.26
105	Long Lake	0.0920	69.35
106	International Mine and Chemical Lake	0.0948	69.79
107	Eagle Lake (Site I)	0.0950	69.82
108	Valley Lake	0.0950	69.82
109	Dunns Lake	0.0952	69.85
110	Fish Lake	0.0956	69.91
111	Lochanora Lake	0.0960	69.97
112	Woodland Lake	0.0986	70.35
113	Island Lake	0.0990	70.41
114	McDonald Lake 1	0.0996	70.50
115	Nippersink Lake	0.1000	70.56
116	Longview Meadow Lake	0.1024	70.90
117	Lake Barrington	0.1053	71.30
118	Redwing Slough, Site II, Outflow	0.1072	71.56
119	Lake Forest Pond	0.1074	71.59
120	Bittersweet Golf Course #13	0.1096	71.88
121	Fox Lake (Site 1)	0.1098	71.90
122	Osprey Lake	0.1108	72.04
123	Bresen Lake	0.1126	72.27
124	Round Lake Marsh North	0.1126	72.27
125	Deer Lake Meadow Lake	0.1158	72.67
126	Taylor Lake	0.1184	72.99
127	Columbus Park Lake	0.1226	73.49
128	Nippersink Lake (Site 1)	0.1240	73.66
129	Echo Lake	0.1250	73.77
130	Grass Lake (Site 1)	0.1288	74.21
131	Lake Holloway	0.1322	74.58
132	Lakewood Marsh	0.1330	74.67
133	Redhead Lake	0.1412	75.53
134	Forest Lake	0.1422	75.63
135	Antioch Lake	0.1448	75.89
136	Slocum Lake	0.1496	76.36
137	Pond-a-Rudy	0.1514	76.54
138	Lake Matthews	0.1516	76.56

Table 5. Continued.

RANK	LAKE NAME	TP AVE	TSIp
139	Buffalo Creek Reservoir	0.1550	76.88
140	Pistakee Lake (Site 1)	0.1592	77.26
141	Grassy Lake	0.1610	77.42
142	Salem Lake	0.1650	77.78
143	Half Day Pit	0.1690	78.12
144	Lake Eleanor Site II, Outflow	0.1812	79.13
145	Lake Farmington	0.1848	79.41
146	Lake Louise	0.1850	79.43
147	ADID 127	0.1886	79.71
148	Patski Pond (outlet)	0.1970	80.33
149	Summerhill Estates Lake	0.1990	80.48
150	Dog Bone Lake	0.1990	80.48
151	Redwing Marsh	0.2072	81.06
152	Stockholm Lake	0.2082	81.13
153	Bishop Lake	0.2156	81.63
154	Ozaukee Lake	0.2200	81.93
155	Hidden Lake	0.2236	82.16
156	Fischer Lake	0.2278	82.43
157	Oak Hills Lake	0.2792	85.36
158	Loch Lomond	0.2954	86.18
159	McDonald Lake 2	0.3254	87.57
160	Fairfield Marsh	0.3264	87.61
161	ADID 182	0.3280	87.69
162	Slough Lake	0.4134	91.02
163	Flint Lake Outlet	0.4996	93.75
164	Rasmussen Lake	0.5025	93.84
165	Albert Lake, Site II, outflow	1.1894	106.26

depth, substrate, etc.). Thus, unlike Schreiber Lake, a small, shallow, manmade lake with high nutrient loads may not expect to achieve a high ranking even with intensive management.

In Schreiber Lake, the IEPA aquatic life impairment index was low, indicating a full degree of support for all aquatic organisms in the lake. However, due to the eutrophic state of the lake and the abundance of aquatic plants, recreation indices indicated only a partial degree of support for these activities. The degree of overall use of the lake was classified as a partial impairment. Schreiber Lake is a unique resource, and since it usage is more for aesthetic quality, the fact that it is partially impaired is of no concern. If at a time there is a change in the lakes ability to support aquatic organisms, a change in management strategy may be required.

SUMMARY OF AQUATIC MACROPHYTES

In July, 2009, the 5.4 acre open water area of Schreiber Lake was monitored for submersed and floating leaved aquatic plant populations; plant species presence and cover were assessed. The sampling sites were based on a grid system created by mapping software (ArcMap), with each site located 30 meters apart for a total of 23 sites (Figure 8). Twelve aquatic plant species were detected at 70% of the sites (Table 6a, b). There were two co-dominant species within the open water area; Coontail and White Water Lily and were encountered with a frequency of 65.2% and 43.5% respectively. The only exotic species found in the open water area was Eurasian Watermilfoil (EWM). It was found at only one of the sites and has historically been a minor component of the vegetation. Populations of EWM should be monitored and when detected removed. One state endangered Fernleaf Pondweed and one rare species Watershield were detected in the survey of the open water. Fernleaf Pondweed had an estimated cover of 10%. Watershield which has not been detected in previous surveys was detected during our quantitative sampling at one sampling point and at two other locations during a meander survey of the shoreline and floating mats (Figure 9).

The 1% light levels (the point where plant photosynthesis ceases) during the season were found between 10-18 feet (no light data was collected in August or September). Coontail was found at a maximum depth of 18.0 feet. The average depth where plants were found at was 13.1 feet. It is estimated that 70% of the lake was populated by plants.

It was determined that the vegetation within the estimated 9-acre littoral zone and immediate shoreline areas of the lake be monitored, allowing a more complete species list to be compiled for the lake (Table 7). Two meander surveys were conducted; one in June and the other in August. Notably, along the shorelines, there were large beds of Pickerelweed.

The floating mats were dominated by Cattail, Glossy Buckthorn and Willow and Spagnum spp. and the meander survey picked up two of the known Illinois threatened and endangered (T & E) plant species Round-leaved Sundew and Small Cranberry known to inhabit these mats. One of these species was actively reproducing. Other non detected T & E species that have historically been found harboring in the mats were Creeping Sedge (*Carex chordorrhiza),* Star Sedge (*Carex echinata),* White Beaksedge (*Rhynchospora alba),* and Smith's Bulrush (*Schoenoplectus smithii*), per LCFPD, 2003.

Figure 8. Aquatic plant sampling grid that illustrates plant density on Schreiber Lake, July 2009.

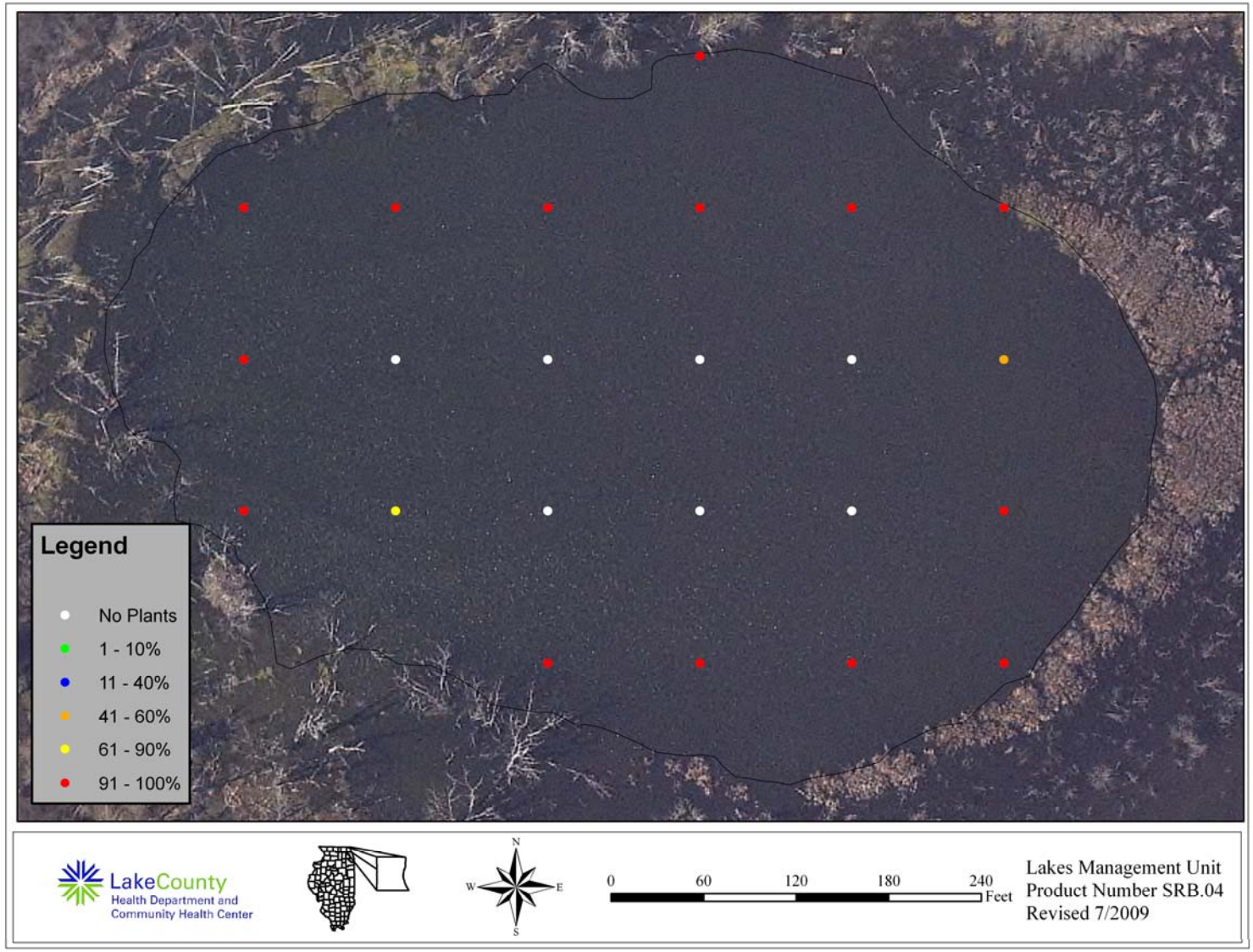

Table 6a. Aquatic plant species found at the 23 sampling sites on Schreiber Lake, July 2009. (Maximum depth that plants were found was 18.0 feet).

July									
Plant Density	Common Bladderwort	Common Duckweed	Coontail	Elodea	Eurasian Watermilfoil	Fernleaf Pondweed	Flatstem Pondweed	Giant Duckweed	Sago Pondweed
Absent	15	15	8	22	22	20	16	18	22
Present	5	5	0	1	1	2	1	4	1
Common	2	3	0	0	0	1	4	1	0
Abundant	1	0	1	0	0	0	1	0	0
Dominant	0	0	14	0	0	0	1	0	0
% Plant Occurrence	34.8%	34.8%	65.2%	4.3%	4.3%	13.0%	30.4%	21.7%	4.3%

July				
Plant Density	Spatterdock	Star Duckweed	Watershield	White Water Lily
Absent	20	14	22	13
Present	0	3	1	0
Common	2	6	0	4
Abundant	0	0	0	2
Dominant	1	0	0	4
% Plant Occurrence	13.0%	39.1%	4.3%	43.5%

Table 6b. Distribution of rake density across all sampled sites.

July		
Rake Density (Coverage)	# of Sites	%
No plants	7	30.4%
>0 to 10%	0	0.0%
>10 to 40%	0	0.0%
>40 to 60%	1	4.3%
>60 to 90%	1	4.3%
>90%	14	60.9%
Total Sites with Plants	16	69.6%
Total # of Sites	23	100.0%

Figure 9. Watershield locations on Schreiber Lake, 2009.

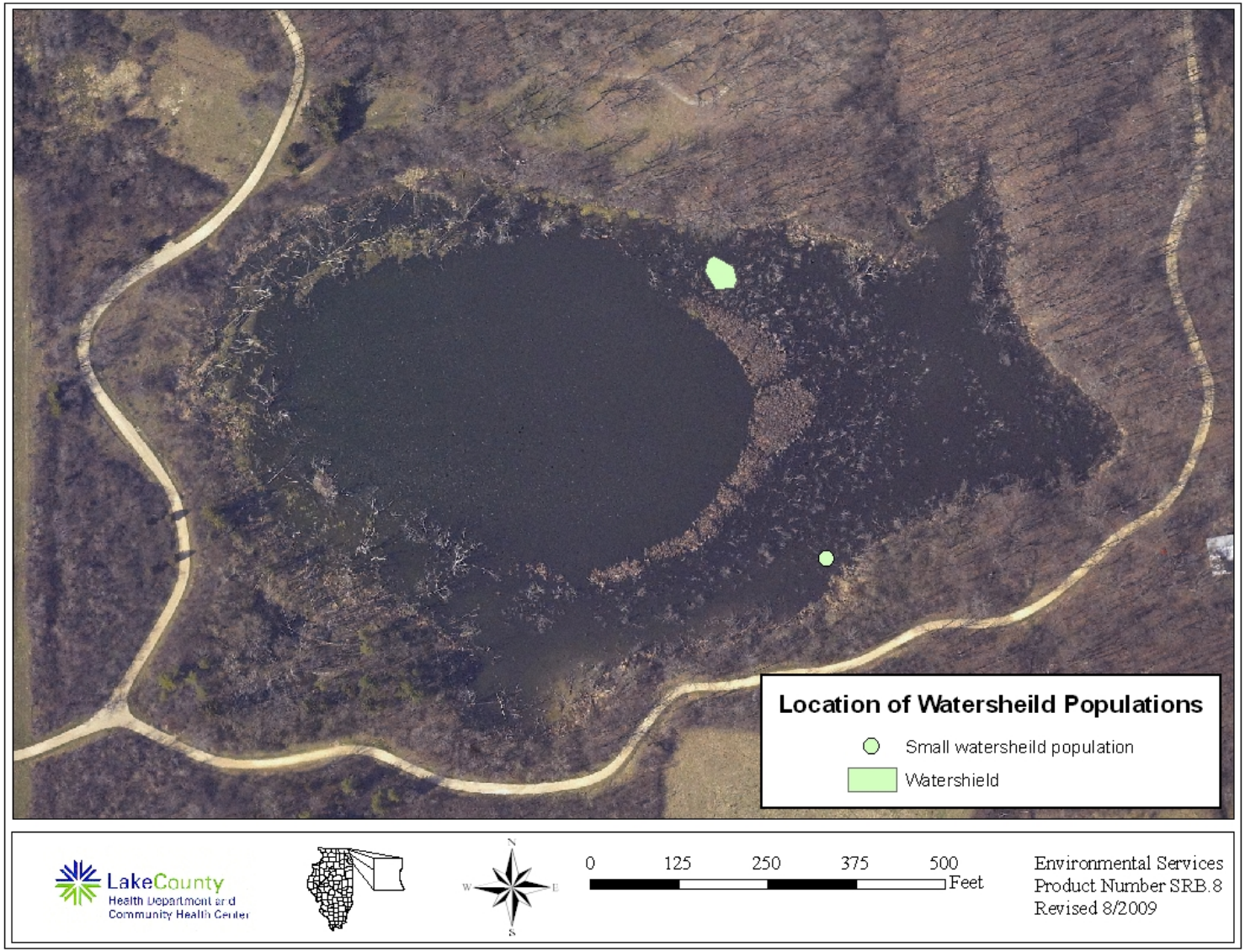

Table 7. Aquatic and shoreline plants found on Schreiber Lake, 2009.

Acer negundo	BOX ELDER
Agalinas spp.	FALSE FOXGLOVE
Arisaema triphyllum	JACK-IN-THE-PULPIT
Aster spp.	ASTER
Bidens frondosa	COMMON BEGGAR'S TICKS
*Brasenia schreberi***	WATER SHIELD
Calamagrostis canadensis	BLUE JOINT GRASS
Carex blanda	COMMON WOOD SEDGE
Carex comosa	BRISTLY SEDGE
Carex stipata	COMMON FOX SEDGE
Carex stricta	COMMON TUSSOCK SEDGE
Ceratophyllum demersum	HORNWORT
Cicuta bulbifera	BULBLET-BEARING WATER HEMLOCK
Cyperus spp.	NUT SEDGE
*Drosera rotundifolia**	ROUND-LEAVED SUNDEW
Dryopteris thelypteris pubescens	MARSH SHIELD FERN
Eleocharis acicularis	NEEDLE SPIKE RUSH
Elodea canadensis	COMMON WATERWEED
Epilobium coloratum	CINNAMON WILLOW HERB
Equisetum arvense	HORSETAIL
Eupatorium maculatum	SPOTTED JOE PYE WEED
Eupatorium serotinum	LATE BONESET
Fragaria virginiana	WILD STRAWBERRY
Fraxinus pennsylvanica subintegerrima	GREEN ASH
Geranium maculatum	WILD GERANIUM
Geum spp.	AVENS
Glyceria striata	FOWL MANNA GRASS
Impatiens capensis	ORANGE JEWELWEED
Iris virginica shrevei	BLUE FLAG
Juncus spp.	RUSH
Leersia oryzoides	RICE CUT GRASS
Lemna minor	SMALL DUCKWEED
Lemna trisulca	FORKED DUCKWEED
Lonicera spp.	HONEYSUCKLE
Ludwigia spp.	MARSH PURSELANE
Lythrum salicaria##	PURPLE LOOSESTRIFE
Melilotus spp.	SWEET CLOVER
Myriophyllum spicatum ##	EUROPEAN WATER MILFOIL
Nuphar variegatum	BULLHEAD LILY
Nymphaea tuberosa	WHITE WATER LILY
Onoclea sensibilis	SENSITIVE FERN
Osmundoa regalis spectabilis	ROYAL FERN
Parthenocissus quinquefolia	VIRGINIA CREEPER
Phalaris arundinacea##	REED CANARY GRASS
Phragmites communis##	COMMON REED

Table 7. Continued

Pontederia cordata	PICKEREL WEED
Populus deltoids	EASTERN COTTONWOOD
Potamogeton pectinatus	SAGO PONDWEED
*Potamogeton robbinsii**	FERN LEAF PONDWEED
Potamogeton zosteriformis	FLAT-STEMMED PONDWEED
Potentilla spp.	CINQUEFOIL
Ranunculus spp.	BUTTERCUP
Rhamnus cathartica ##	COMMON BUCKTHORN
Rhamnus frangula#	GLOSSY BUCKTHORN
Rosa multiflora ##	MULTIFLORA ROSE
Rumex crispus#	CURLY DOCK
Sagittaria latifolia	COMMON ARROWHEAD
Scirpus atrovirens	GREEN BULRUSH
Scirpus cyperinus	WOOL GRASS
Scirpus fluviatilis	RIVER BULRUSH
Scutellaria lateriflora	MAD-DOG SKULLCAP
Solanum dulcamara #	BITTERSWEET NIGHTSHADE
Sparganium eurycarpum	COMMON BUR REED
Spirodela polyrhiza	GREAT DUCKWEED
Taraxacum officinale##	COMMON DANDELION
Typha spp.	CATTAIL
Utricularia vulgaris	GREAT BLADDERWORT
*Vaccinium oxycoccos**	SMALL CRANBERRY
Verbena hastate	BLUE VERVAIN
Verbascum thapsus#	COMMON MULLEIN
Viburnum opulus#	EUROPEAN HIGHBUSH CRANBERRY
Viola sororia	COMMON BLUE VIOLET
Vitis riparia	RIVERBANK GRAPE

***Endangered in Illinois**
****Rare in Illinois**
 # Exotic species
##Invasive Species

Several exotics were found growing along the shoreline and on vegetative floating mats, including Buckthorn, Honeysuckle and Purple Loosestrife. Similar to aquatic exotics, these terrestrial exotics are detrimental to the native plant ecosystems around the lake. Removal or control of exotic species is recommended. Also recommended is a quantitative vegetation study due to the concern of the district over beaver activity in the lake. This would provide a baseline in which to gauge whether or not impacts to plant communities are occurring due to the activity.

Unfortunately due to different sampling methodology that was used in the past, it is difficult to compare vegetation data. However, a list of plants that have been found in the lake historically is included in Table 8. Native plant populations often fluctuate, even on an annual basis depending on many factors (i.e., water levels, predation by animals, climatic conditions, seed production, etc.). Qualitative vegetation monitoring studies should be an intricate part of the lake's overall management plan including the floating mats and littoral zones of the lake.

A species of freshwater sponge was found in 1999. A survey was not performed that would have allowed for invertebrates to be detected in 2009. Additional surveys looking at aquatic invertebrates should be conducted in future monitoring years.

Floristic quality index (FQI; Swink and Wilhelm 1994) is an assessment tool designed to evaluate the closeness that the flora of an area is to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts. Each aquatic plant in a lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). This is done for every floating and submersed plant species found in the lake. These numbers are averaged and multiplied by the square root of the number of species present to calculate an FQI. A high FQI number indicates that there is a large number of sensitive, high quality plant species present in the lake. Non-native species are considered in the FQI rankings for Lake County lakes (Table 9). In 2009, Schreiber Lake had a FQI of 23.9 (17th of 154 lakes). The median FQI of lakes that we have studied from 2000-2009 is 12.5. Due to different monitoring practices which have occurred in the past it is difficult to make a comparison of FQI values from the past. It is recommended that at this lake be monitored at least twice during the growing season, once in June and then again in September, in order to pick up ephemeral species.

SUMARY OF SHORELINE CONDITION

Lakes with stable water levels potentially have less shoreline erosion problems. Water levels on Schreiber Lake fluctuated slightly throughout the season. The maximum one-month change in water level occurred from June to July (5.75 inch decrease), with a maximum seasonal change of 4.75 inches (decrease) during the study which occurred during the same time frame. According to the Lake County Stormwater Management Commission's Wauconda rain gauge, there was 17.72 inches of rain that fell during from April 1 through September 30. 2009. Fluctuations in water levels may be the result of natural rain events or lack thereof. Significant changes in water levels may have a negative impact on water quality. Unlike Schreiber, lakes with highly fluctuating water levels usually have shoreline erosion problems. Due to the lack of change

Table 8. Historical Record of Aquatic Species found in Schreiber Lake during ES Monitoring Years.				
Common Name	**Scientific Name**	**2009**	**2003**	**1999**
Coontail	*Ceratophyllum demersum*	X	X	X
Muskgrass	*Chara sp.*		X	
American Elodea	*Elodea canadensis*	X		X
Water Stargrass	*Heteranthera dubia*		X	
Common Duckweed	*Lemna minor*	X	X	X
Star Duckweed	*Lemna trisulca*	X	X	X
Northern Water Milfoil	*Myriophyllum sibiricum*			X
Eurasian Water Milfoil	*Myriophyllum spicatum*	X	X	X
Slender Naiad	*Najas flexilis*		X	X
Spatterdock	*Nuphar variegata*	X	X	X
White Water Lily	*Nymphaea tuberosa*	X	X	X
Largeleaf Pondweed	*Potamogeton amplifolius*			X
Leafy Pondweed	*Potamogeton foliosus*			X
Illinois Pondweed	*Potamogeton illinoensis*			X
Floatingleaf Pondweed	*Potamogeton natans*			X
American Pondweed	*Potamogeton nodosus*			X
Whitestem Pondweed*	*Potamogeton praelongus*			X
Small Pondweed	*Potamogeton pusillus*		X	X
Fernleaf Pondweed*	*Potamogeton robbinsii*	X	X	X
Flatstem Pondweed	*Potamogeton zosterifomis*	X	X	X
White Water Crowfoot	*Ranunculus longirostris*		X	X
Giant Duckweed	*Spirodella polyrhiza*	X	X	
Sago Pondweed	*Stuckenia pectinatus*	X	X	X
Common Bladderwort	*Utricularia vulgaris*	X	X	X
Watermeal	*Wolffia columbiana*		X	X
Watershield*	*Brasenia schreberi*	X		

*Endangered in Illinois
Data compiled by LCHD
Note: Sampling methodologies were not the same in all years.

Table 9. 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	38.2	40.2
2	Cranberry Lake	32.5	33.3
3	East Loon Lake	30.6	32.7
4	Deep Lake	29.7	31.2
5	Little Silver	29.6	31.6
6	Bangs Lake	29.5	31.0
7	Round Lake Marsh North	29.1	29.9
8	Deer Lake	28.2	29.7
9	Sullivan Lake	26.9	28.5
10	West Loon Lake	25.7	27.3
11	Cross Lake	25.2	27.8
12	Wooster Lake	25.0	26.6
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	Lakewood Marsh	23.8	24.7
18	Round Lake	23.5	25.9
19	**Schreiber Lake**	**23.4**	**24.4**
20	Honey Lake	23.3	25.1
21	Fourth Lake	23.0	24.8
22	Lake of the Hollow	23.0	24.8
23	Druce Lake	22.8	25.2
24	Countryside Glen Lake	21.9	22.8
25	Butler Lake	21.4	23.1
26	Davis Lake	21.4	21.4
27	Duck Lake	21.1	22.9
28	Timber Lake (North)	20.8	22.8
29	ADID 203	20.5	20.5
30	Broberg Marsh	20.5	21.4
31	McGreal Lake	20.2	22.1
32	Lake Kathryn	19.6	20.7
33	Fish Lake	19.3	21.2
34	Redhead Lake	19.3	21.2
35	Turner Lake	18.6	21.2
36	Salem Lake	18.5	20.2
37	Lake Miltmore	18.4	20.3
38	Lake Helen	18.0	18.0
39	Old Oak Lake	18.0	19.1
40	Hendrick Lake	17.7	17.7
41	Long Lake	17.2	19.0
42	Seven Acre Lake	17.0	15.5
43	Gray's Lake	16.9	19.8
44	Owens Lake	16.3	17.3

Table 9. Continued

Rank	LAKE NAME	FQI (w/A)	FQI (native)
91	Antioch Lake	11.3	13.4
92	Hook Lake	11.3	13.4
93	Lake Charles	11.3	13.4
94	Lake Linden	11.3	11.3
95	Lake Naomi	11.2	12.5
96	Pulaski Pond	11.2	12.5
97	Lake Minear	11.0	13.9
98	Redwing Marsh	11.0	11.0
99	Tower Lake	11.0	11.0
100	West Meadow Lake	11.0	11.0
101	Nielsen Pond	10.7	12.0
102	Lake Holloway	10.6	10.6
103	Crooked Lake	10.2	12.5
104	College Trail Lake	10.0	10.0
105	Lake Lakeland Estates	10.0	11.5
106	Valley Lake	9.9	9.9
107	Werhane Lake	9.8	12.0
108	Big Bear Lake	9.5	11.0
109	Little Bear Lake	9.5	11.0
110	Loch Lomond	9.4	12.1
111	Columbus Park Lake	9.2	9.2
112	Sylvan Lake	9.2	9.2
113	Fischer Lake	9.0	11.0
114	Grandwood Park Lake	9.0	11.0
115	Lake Fairfield	9.0	10.4
116	Lake Louise	9	10.4
117	McDonald Lake 1	8.9	10.0
118	East Meadow Lake	8.5	8.5
119	Lake Christa	8.5	9.8
120	Lake Farmington	8.5	9.8
121	Lucy Lake	8.5	9.8
122	South Churchill Lake	8.5	8.5
123	Bittersweet Golf Course #13	8.1	8.1
124	Woodland Lake	8.1	9.9
125	Albert Lake	7.5	8.7
126	Banana Pond	7.5	9.2
127	Fairfield Marsh	7.5	8.7
128	Lake Eleanor	7.5	8.7
129	Patski Pond	7.1	7.1
130	Rasmussen Lake	7.1	7.1
131	Slough Lake	7.1	7.1
132	Lucky Lake	7.0	7.0
133	Lake Forest Pond	6.9	8.5
134	Leisure Lake	6.4	9.0
135	Peterson Pond	6.0	8.5
136	Gages Lake	5.8	10.0

Table 9. Continued

Rank	LAKE NAME	FQI (w/A)	FQI (native)
45	Countryside Lake	16.7	17.7
46	Highland Lake	16.7	18.9
47	Lake Barrington	16.7	17.7
48	Bresen Lake	16.6	17.8
49	Diamond Lake	16.3	17.4
50	Windward Lake	16.3	17.6
51	Dog Bone Lake	15.7	15.7
52	Redwing Slough	15.6	16.6
53	Osprey Lake	15.5	17.3
54	Lake Fairview	15.2	16.3
55	Heron Pond	15.1	15.1
56	Lake Tranquility (S1)	15.0	17.0
57	North Churchill Lake	15.0	15.0
58	Dog Training Pond	14.7	15.9
59	Island Lake	14.7	16.6
60	Grand Avenue Marsh	14.3	16.3
61	Lake Nippersink	14.3	16.3
62	Taylor Lake	14.3	16.3
63	Dugdale Lake	14.0	15.1
64	Eagle Lake (S1)	14.0	15.1
65	Longview Meadow Lake	13.9	13.9
66	Third Lake	13.9	16.6
67	Ames Pit	13.4	15.5
68	Bishop Lake	13.4	15.0
69	Buffalo Creek Reservoir	13.1	14.3
70	Mary Lee Lake	13.1	15.1
71	McDonald Lake 2	13.1	14.3
72	Old School Lake	13.1	15.1
73	Dunn's Lake	12.7	13.9
74	Summerhill Estates Lake	12.7	13.9
75	Timber Lake (South)	12.7	14.7
76	White Lake	12.7	14.7
77	Hastings Lake	12.5	14.8
78	Sand Lake	12.5	14.8
79	Stone Quarry Lake	12.5	12.5
80	Lake Carina	12.1	14.3
81	Lake Leo	12.1	14.3
82	Lambs Farm Lake	12.1	14.3
83	Pond-A-Rudy	12.1	12.1
84	Stockholm Lake	12.1	13.5
85	Grassy Lake	12.0	12.0
86	Lake Matthews	12.0	12.0
87	Flint Lake	11.8	13.0
88	Harvey Lake	11.8	13.0
89	Lake Napa Suwe	11.7	13.9
90	Rivershire Pond 2	11.5	13.3

Table 9. Continued

Rank	LAKE NAME	FQI (w/A)	FQI (native)
137	Slocum Lake	5.8	7.1
138	Deer Lake Meadow Lake	5.2	6.4
139	Ozaukee Lake	6.7	8.7
140	ADID 127	5.0	5.0
141	IMC Lake	5.0	7.1
142	Liberty Lake	5.0	5.0
143	Oak Hills Lake	5.0	5.0
144	Forest Lake	3.5	5.0
145	Sand Pond (IDNR)	3.5	5.0
146	Half Day Pit	2.9	5.0
147	Lochanora Lake	2.5	5.0
148	Echo Lake	0.0	0.0
149	Hidden Lake	0.0	0.0
150	North Tower Lake	0.0	0.0
151	Potomac Lake	0.0	0.0
152	St. Mary's Lake	0.0	0.0
153	Waterford Lake	0.0	0.0
154	Willow Lake	0.0	0.0
	Mean	**13.7**	**15.0**
	Median	**12.5**	**14.3**

occurring in the watershed of Schreiber Lake, large fluctuations in water levels are not anticipated, however, if something were to occur to change the "static" water level conditions on Schreiber Lake, undercutting of shoreline could occur due to the encroachment of species such as Buckthorn, Boxelder etc., which prevent light penetration to the herbaceous zone, making soils less stable. At this time, water levels appear to be controlled by a beaver dam that exists at the lake's outlet on the northeastern portion of the lake (Figure 10). In the event that there was significant flooding of the lake and surrounding terrestrial habitats it could impact both aquatic and terrestrial plant species, some of which are endangered species. It is recommended that a permanent staff gage be placed and monitored regularly to track long term changes in water elevations. The shorelines were assessed for erosion as well as vegetation. There were no signs of erosion during this assessment (Figure 11).

OBSERVATIONS OF WILDLIFE AND HABITAT

In 2009, green frogs were calling. There was also a great egret observed fishing (Figure 12). A fish survey conducted in 2007 by the Illinois Department of Natural Resources, found fish species fairly representative of a lake that was not impacted too much due to human activity, and no carp! The woodlands, wetlands and littoral zone adjacent to Schreiber Lake provide valuable wildlife habitat in and around the lake. There was evidence of beaver activity at the outlet and inlet of the lake.

Figure 10. Photograph of the Beaver Dam on Schreiber Lake, 2009.

Figure 11. Shoreline erosion on Schreiber Lake, 2009.

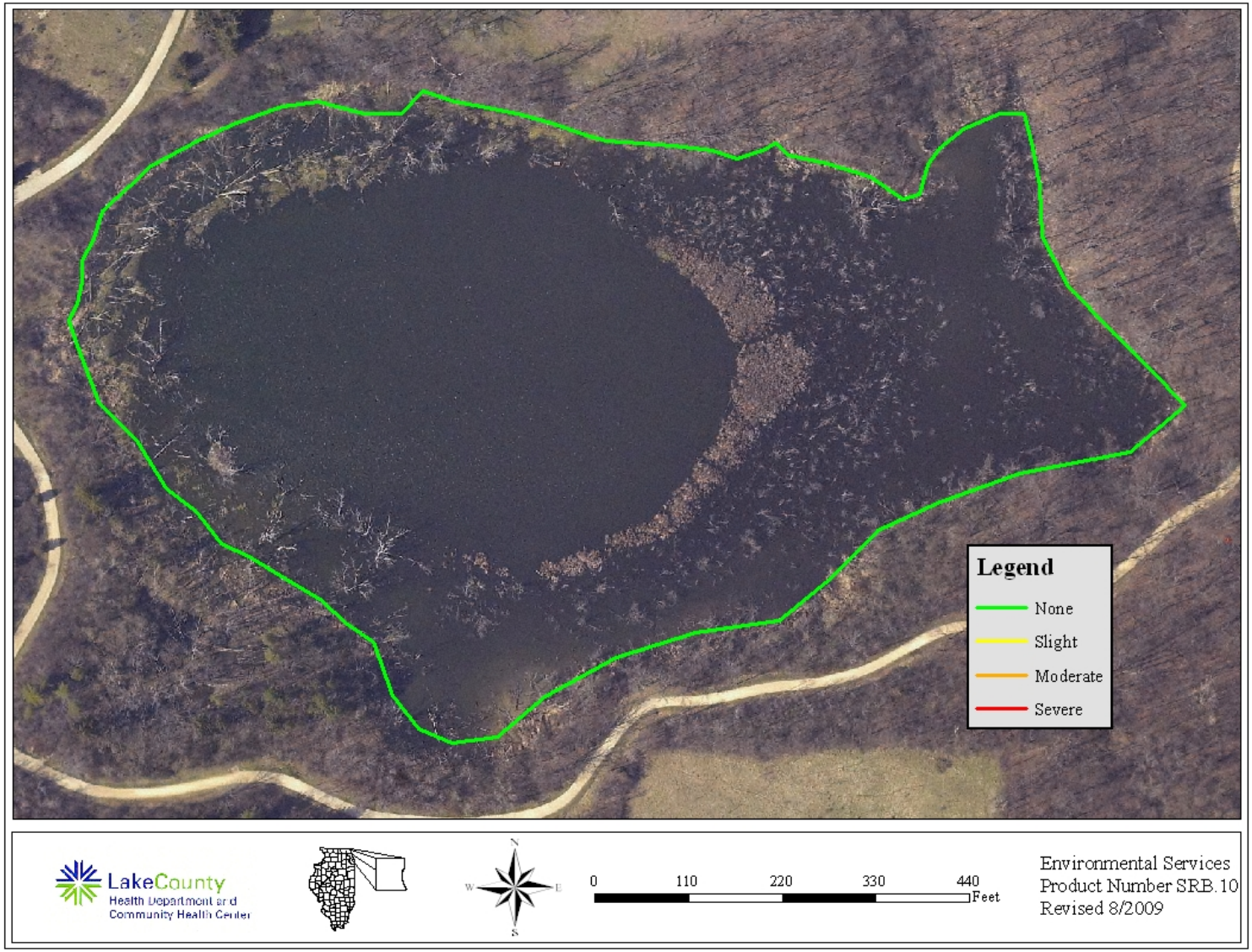

Figure 12. Photograph of Great Egret on Schreiber Lake, 2009.

LAKE MANAGEMENT RECOMMENDATIONS

Schreiber Lake has better water quality compared to many of the other lakes in the county. Many of the water quality parameters measured were either at or below county medians. The lake provides excellent habitat for plants, fish, and wildlife, including species listed as threatened or endangered in Illinois. These are some of the reasons that the lake is designated as an Illinois Natural Area. Schreiber Lake is a unique resource in Lake County and its preservation should be a high priority. To maintain the quality of Schreiber Lake, the ES has the following recommendations:

- **Eliminate or Control Exotic Species**

  In the water, Eurasian Watermilfoil (EWM) was found in Schreiber Lake, but in low numbers. Its presence should be monitored. When detected it should be removed. The abundance of native plant populations and the overall natural state of Schreiber Lake likely make the lake more resistant to invasion by EWM.

  Several other exotic species were found along the shoreline and floating mats including Buckthorn and Purple Loosestrife. Buckthorn was most common along the woodland and shrub habitat and has established (on the vegetative mats. These exotics have the potential to become a significant problem and should be removed or kept in control to prevent their spread (Appendix D1).

- **Watershed Nutrient Reduction**

  Most of the nutrient and solid concentrations in the lake have remained stable since 1999. There was a decrease in water clarity observed since 2009, the largest decrease being recorded between 2003 and 2009. Total volatile solids decreased in both the epilimnion and hypolimnion which could be a sign of loss of the lake's plankton community. These parameters as well as some additional parameters should be considered for monitoring in the future to ascertain any pattern in declining water quality in Schreiber Lake (Appendix D2).

- **Beaver Management**

  Beaver activity was noted around the outlet. This activity should be monitored….(Appendix D4).

- **Participate in the Volunteer Lake Monitoring Program (VLMP)**

  To fill in gaps of some data at times that LCHD-ES is not actively monitoring and even while monitoring, it is recommended the LCFPD become enrolled in the Volunteer Lake Monitoring Program (VLMP). THE VLMP trains volunteers to measure the Secchi disk readings on a bimonthly basis from April to October (Appendix D5). In addition to enrolling in the VLMP program, a permanent staff gauge should be installed to monitor the lake levels due to the presence of E&T species.

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.

Shoreline Assessment

In previous years a complete assessment of the shoreline was done. However, this year we did a visual estimate to determine changes in the shoreline. The degree of shoreline erosion was categorically defined as none, slight, moderate, or severe. Below are brief descriptions of each category.

None – Includes man-made erosion control such as beach, rip-rap and sea wall.

Slight – Minimal or no observable erosion; generally considered stable; no erosion control practices will be recommended with the possible exception of small problem areas noted within an area otherwise designated as "slight".

Moderate – Recession is characterized by past or recently eroded banks; area may exhibit some exposed roots, fallen vegetation or minor slumping of soil material; erosion control practices may be recommended although the section is not deemed to warrant immediate remedial action.

Severe – Recession is characterized by eroding of exposed soil on nearly vertical banks, exposed roots, fallen vegetation or extensive slumping of bank material, undercutting, washouts or fence posts exhibiting realignment; erosion control practices are recommended and immediate remedial action may be warranted.

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 *SCHREIBER LAKE* IN *2009*

Schrieber Lake 2009 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 0.80
05/20/2009	0	0.50	18.52	8.68	92.8	0.2780	9.18	2704	Surface		
05/20/2009	1	1.09	18.50	8.19	87.5	0.2780	8.78	2950	Surface	100%	
05/20/2009	2	2.06	18.50	8.08	86.3	0.2780	8.65	625	0.31	23%	4.972
05/20/2009	3	3.12	18.48	8.02	85.6	0.2780	8.52	106	1.37	4%	1.291
05/20/2009	4	4.09	18.43	8.09	86.2	0.2770	8.50	70	2.34	3%	0.180
05/20/2009	6	6.01	17.34	8.21	85.6	0.2770	8.46	69	4.26	2.6%	0.002
05/20/2009	8	8.00	16.67	7.51	77.2	0.2770	8.33	60	6.25	2.2%	0.023
05/20/2009	10	9.90	13.84	7.01	67.9	0.2760	8.26	153	8.15	5.7%	-0.115
05/20/2009	12	11.89	10.93	3.97	35.9	0.2750	8.14	100	10.14	3.7%	0.042
05/20/2009	14	13.99	8.86	1.22	10.6	0.2750	7.99	65	12.24	2.4%	0.035
05/20/2009	16	16.10	7.91	0.66	5.6	0.2730	7.89	39	14.35	1.4%	0.035
05/20/2009	18	17.92	7.23	0.56	4.6	0.2730	7.84	26	16.17	1.0%	0.025
05/20/2009	20	19.89	6.50	0.44	3.6	0.2770	7.77	10	18.14	0.4%	0.053
05/20/2009	22	21.95	5.76	0.43	3.4	0.3230	7.58	3	20.20	0.1%	0.063
05/20/2009	24	23.97	5.46	0.41	3.2	0.4240	7.42	0	22.22		
05/20/2009	26	25.89	5.32	0.37	3.0	0.5040	7.23	0	24.14		

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 0.53
06/17/2009	0	0.30	20.68	8.89	99.2	0.2610	8.08	643	Surface		
06/17/2009	1	1.05	20.71	8.20	91.5	0.2610	8.09	514	Surface	100%	
06/17/2009	2	2.01	20.70	8.26	92.2	0.2610	8.12	208	0.26	8%	3.446
06/17/2009	3	3.00	20.70	8.47	94.5	0.2610	8.17	105	1.25	4%	0.548
06/17/2009	4	3.99	20.69	8.45	94.2	0.2610	8.16	101	2.24	4%	0.017
06/17/2009	6	6.00	20.62	8.14	90.6	0.2610	8.07	74	4.25	2.7%	0.074
06/17/2009	8	8.00	19.49	3.77	41.0	0.2760	7.36	49	6.25	1.8%	0.065
06/17/2009	10	10.05	16.95	3.71	38.4	0.2790	7.34	30	8.30	1.1%	0.060
06/17/2009	12	12.00	13.55	2.81	27.0	0.2770	7.27	24	10.25	0.9%	0.023
06/17/2009	14	14.00	11.26	1.98	18.0	0.2740	7.24	16	12.25	0.6%	0.032
06/17/2009	16	16.03	9.25	1.10	9.6	0.2760	7.21	10	14.28	0.4%	0.035
06/17/2009	18	18.01	8.07	0.52	4.4	0.2760	7.18	6	16.26	0.2%	0.035
06/17/2009	20	20.00	6.83	0.29	2.4	0.2890	6.99	1	18.25	0.04%	0.083
06/17/2009	22	21.99	6.11	0.19	1.6	0.3530	7.05	0	20.24		
06/17/2009	24	23.99	5.77	0.23	1.8	0.4660	6.98	0	22.24		

Schrieber Lake 2009 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 0.61
07/22/2009	0	0.52	21.65	7.85	89.2	0.2600	7.89	1255	Surface		
07/22/2009	1	1.00	21.59	7.47	84.8	0.2480	7.73	876	Surface	100%	
07/22/2009	2	2.00	21.52	7.40	83.9	0.2590	7.72	338	0.25	12%	3.813
07/22/2009	3	3.00	21.48	7.27	82.3	0.2590	7.71	212	1.25	8%	0.371
07/22/2009	4	4.01	21.43	5.48	62.1	0.2460	7.60	139	2.26	5%	0.186
07/22/2009	6	6.00	20.87	2.04	22.8	0.2630	7.36	88	4.25	3.3%	0.108
07/22/2009	8	8.01	20.38	0.70	7.8	0.2640	7.21	50	6.26	1.8%	0.092
07/22/2009	10	10.01	18.30	0.87	9.2	0.2800	7.13	26	8.26	1.0%	0.078
07/22/2009	12	12.01	16.53	0.82	8.4	0.2770	7.12	10	10.26	0.4%	0.096
07/22/2009	14	14.00	12.97	0.53	5.1	0.2760	7.13	3	12.25	0.1%	0.108
07/22/2009	16	16.01	10.13	0.48	4.2	0.2770	7.12	1	14.26	0.04%	0.060
07/22/2009	18	18.00	8.47	0.44	3.8	0.2830	7.02	0	16.25		
07/22/2009	20	20.00	7.47	0.44	3.6	0.3100	6.91	0	18.25		
07/22/2009	22	22.00	6.68	0.47	3.9	0.3750	6.83	0	20.25		
07/22/2009	24	24.00	6.03	0.50	4.1	0.5510	6.80	0	22.25		

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 NA
08/19/2009	0	0.30	24.29	12.20	145.7	0.2660	8.02	NA	Surface		
08/19/2009	1	1.05	24.26	5.13	61.2	0.2660	7.38	NA	Surface	NA	
08/19/2009	2	2.01	24.25	6.03	72.0	0.2660	7.34	NA	0.26	NA	NA
08/19/2009	3	3.01	24.23	7.13	85.1	0.2660	7.31	NA	1.26	NA	NA
08/19/2009	4	4.00	23.95	7.38	87.6	0.2660	7.27	NA	2.25	NA	NA
08/19/2009	6	6.04	23.32	7.13	83.7	0.2660	7.14	NA	4.29	NA	NA
08/19/2009	8	8.04	21.53	6.27	71.1	0.2710	7.09	NA	6.29	NA	NA
08/19/2009	10	10.00	18.89	8.94	96.2	0.2810	6.97	NA	8.25	NA	NA
08/19/2009	12	12.04	15.81	6.91	69.8	0.2840	6.93	NA	10.29	NA	NA
08/19/2009	14	14.00	12.76	7.17	67.7	0.2810	6.91	NA	12.25	NA	NA
08/19/2009	16	16.03	10.64	6.22	55.9	0.2750	6.89	NA	14.28	NA	NA
08/19/2009	18	18.01	8.97	5.03	43.5	0.2950	6.86	NA	16.26	NA	NA
08/19/2009	20	20.04	7.77	6.05	50.9	0.3210	6.79	NA	18.29	NA	NA
08/19/2009	22	22.00	6.80	5.27	43.3	0.4250	6.68	NA	20.25	NA	NA
08/19/2009	24	24.00	6.27	4.70	38.1	0.5700	6.79	NA	22.25	NA	NA

Schrieber Lake 2009 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 NA
09/23/2009	0	0.32	19.86	7.08	77.7	0.2700	9.38	NA	Surface		
09/23/2009	1	1.00	19.84	4.20	46.1	0.2670	8.45	NA	Surface	NA	
09/23/2009	2	2.00	19.81	4.09	44.8	0.2660	8.32	NA	0.25	NA	NA
09/23/2009	3	3.00	19.82	3.89	42.6	0.2670	8.16	NA	1.25	NA	NA
09/23/2009	4	4.00	19.80	3.84	42.1	0.2660	8.08	NA	2.25	NA	NA
09/23/2009	6	6.02	19.60	2.39	26.1	0.2670	7.97	NA	4.27	NA	NA
09/23/2009	8	8.00	19.31	0.95	10.3	0.2690	7.86	NA	6.25	NA	NA
09/23/2009	10	9.99	18.34	0.57	6.0	0.2690	7.75	NA	8.24	NA	NA
09/23/2009	12	12.00	16.42	0.95	9.7	0.2840	7.65	NA	10.25	NA	NA
09/23/2009	14	14.01	14.04	0.59	5.8	0.2970	7.52	NA	12.26	NA	NA
09/23/2009	16	15.99	11.52	0.48	4.4	0.3020	7.45	NA	14.24	NA	NA
09/23/2009	18	18.01	9.66	0.46	4.1	0.3150	7.38	NA	16.26	NA	NA
09/23/2009	20	20.00	8.27	0.48	4.1	0.3530	7.28	NA	18.25	NA	NA
09/23/2009	22	22.01	7.26	0.44	3.7	0.4390	7.13	NA	20.26	NA	NA
09/23/2009	24	24.00	6.66	0.42	3.4	0.5730	7.00	NA	22.25	NA	NA

APPENDIX C. INTERPRETING YOUR LAKE'S WATER QUALITY DATA

Introduction:

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 2000-2009 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 $\leq$ 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 2000-2009 was 0.063 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 2000-2009 was 0.167 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 was 7.9 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 2000-2009, Ozaukee Lake had the lowest Secchi depths (0.25 feet) and West Loon Lake had the highest (24.77 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 was 8.34, with a minimum of 7.07 in Bittersweet #13 Lake and a maximum of 10.40 in Summerhill Estates Lake.

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. LAKE MANAGEMENT OPTIONS

D1. Options to Eliminate or Control Exotic Species

Option 1: Biological Control

Biological control (bio-control) is a means of using natural relationships already in place to limit, stop, or reverse an exotic species' expansion. In most cases, insects that prey upon the exotic plants in its native ecosystem are imported. Since there is a danger of bringing another exotic species into the ecosystem, state and federal agencies require testing before any bio-control species are released or made available for purchase.

Control of exotics by a natural mechanism is preferable to chemical treatments, however there are few exotics that can be controlled by biological means. Insects, being part of the same ecological system as the exotic plant (i.e., the beetles with Purple Loosestrife and weevils with Eurasian Watermilfoil) are more likely to provide long-term control. Chemical treatments are usually non-selective while bio-control measures target specific plant species. Bio-control can also be expensive and labor intensive.

Option 2: Control by Hand

Controlling exotic plants by hand removal is most effective on small areas (< 1 acre) and if done prior to heavy infestation. Some exotics, such as Purple Loosestrife and Reed Canary Grass, can be controlled to some degree by digging, cutting, or mowing if done early and often during the year. Digging may be required to ensure the entire root mass is removed. Spring or summer is the best time to cut or mow, since late summer and fall is when many of the plant seeds disperse. Proper disposal of excavated plants is important since seeds may persist and germinate even after several years. Once exotic plants are removed, the disturbed ground should be planted with native vegetation and closely monitored since regrowth of the removed species is common. Many exotic species, such as Purple Loosestrife, Buckthorn, and Garlic Mustard are proficient at colonizing disturbed sites. This method can be labor intensive but costs are low.

Option 3: Herbicide Treatment

Chemical treatments can be effective at controlling exotic plant species, and works best on individual plants or small areas already infested with the plant. In some areas where individual spot treatments are prohibitive or impractical (i.e., large expanses of a wetland or woodland), chemical treatments may not be an option because in order to chemically treat the area, a broadcast application would be needed. Because many of the herbicides are not selective, meaning they kill all plants they contact, this may be unacceptable if native plants are found in the proposed treatment area.

Herbicides are commonly used to control nuisance shoreline vegetation by applying it to green foliage or cut stems. They provide a fast and effective way to control or eliminate nuisance vegetation by killing the root of the plant, preventing regrowth. Products are applied by either spraying or wicking (wiping) solution on plant surfaces. Spraying is used when large patches of undesirable vegetation are targeted. Herbicides are sprayed on growing foliage using a hand-held or backpack sprayer. Wicking is used when selected plants are to be removed from a group

of plants. It is best to apply herbicides when plants are actively growing, such as in the late spring/early summer, but before formation of seed heads. Herbicides are often used in conjunction with other methods, such as cutting or mowing, to achieve the best results. Proper use of these products is critical to their success. Always read and follow label directions.

D3. Options for Beaver Management

Option 1: Exclusion

One of the most successful options in beaver management is using exclusion techniques to prevent damage to valued resources, like shrubs and trees. Excluding the beavers from damaging trees and shrubs is accomplished by erecting a fence either around an area or individual plant. A height of four feet is necessary to prevent beaver from breaching the fence in winters with significant snow depths.

Excluding beaver from certain areas or individual plants will prevent the damage of the plants selected for protection. Exclusion of beavers may also force them to move to another more suitable location since their main source of food has been made inaccessible. Preventing beaver from damaging certain areas or plants may force them to select other areas or plants that are not protected. This may lead to having to exclude more areas or plants from damage than previously planned.

Option 2: Removal

Removing beavers from an area is usually done by live or kill trapping or shooting. Live traps may look like a box or an open clamshell. These traps usually need to be set on dry land so the captured beaver does not drown. Kill traps are usually set underwater, along a run, or at the surface of the water. Licenses are required to trap or shoot beaver in Illinois. Many municipalities prohibit discharging a firearm within its boundaries.

Trapping beavers will remove the nuisance animals from the immediate area. If a commercial trapper is used, nothing else needs to be done by the landowner. Physically removing beavers is a time consuming, often is short-lived, and is sometimes an expensive technique. Hiring someone to trap beaver can be costly and seldom are all beavers trapped out of an area. Even if all members of a population are trapped, it is likely that other beavers will immigrate into the habitat vacated by the trapped individuals.

Option 3: Habitat Alteration

Altering the habitat around the dam or lodge can also avert beaver damage. Removing the preferred foods (i.e., maple, aspen, and willow) and replacing or replanting with less preferred foods (i.e., pine or spruce) may reduce the amount of damage. Physically removing the dam or lodge may encourage the beaver to move elsewhere, but significant time and effort would be needed to alter the habitats around a lake. However, permits from the Illinois Department of

Natural Resources are needed for this. Beaver may still gnaw on non-preferred food items. Damaged or removed dams may be rebuilt.

D4. Participate in the Volunteer Lake Monitoring Program

In 1981, the Illinois Volunteer Lake Monitoring Program (VLMP) was established by the Illinois Environmental Protection Agency (Illinois EPA) to gather fundamental information on Illinois' inland lakes, and to provide an educational program for citizens. Approximately 165 lakes (of 3,041 lakes in Illinois) are sampled annually by approximately 300 volunteers. The volunteers are lakeshore residents, lake owners/managers, members of environmental groups, public water supply personnel, and/or citizens with interest in a particular lake.

The VLMP relies on volunteers to gather a variety of information on their chosen lake. The primary measurement is Secchi disk depth. Analysis of the Secchi disk measurement provides an indication of the general water quality condition of the lake, as well as the amount of usable habitat available for fish and other aquatic life.

Microscopic plants and animals, water color, and suspended sediments are factors that interfere with light penetration through the water column and lessen the Secchi disk depth. As a rule, one to three times the Secchi depth is considered the lighted zone of the lake. In this region of the lake there is enough light to allow plants to grow and produce oxygen. Water below the lighted zone can be expected to have little or no dissolved oxygen. Other observations such as water color, suspended algae and sediment, aquatic plants, and odor are also recorded. The sampling season is May through October with volunteer measurements taken twice a month. After volunteers have completed one year of the basic monitoring program, they are qualified to participate in the Expanded Monitoring Program. In the expanded program, volunteers are trained to collect water samples that are shipped to the Illinois EPA laboratory for analysis of total and volatile suspended solids, total phosphorus, nitrate-nitrite nitrogen and ammonia nitrogen. Other parameters that are part of the expanded program include dissolved oxygen, temperature, and zebra mussel monitoring. Additionally, chlorophyll *a* monitoring has been added to the regiment for selected lakes.

For information, please contact:

VLMP Regional Coordinator: Mike Adam
Lake County Health Department – Environmental Services
500 W. Winchester Unit 102
Libertyville, IL 60048
(847) 377-8030

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

2000 - 2009 Water Quality Parameters, Statistics Summary

	ALKoxic <=3ft00-2009	
Average	**166**	
Median	**161**	
Minimum	**65**	**IMC**
Maximum	**330**	**Flint Lake**
STD	**42**	
n =	**819**	

	ALKanoxic 2000-2009	
Average	**198**	
Median	**189**	
Minimum	**103**	**Heron Pond**
Maximum	**470**	**Lake Marie**
STD	**49**	
n =	**251**	

	Condoxic <=3ft00-2009	
Average	**0.8846**	
Median	**0.7910**	
Minimum	**0.2260**	**Schreiber Lake**
Maximum	**6.8920**	**IMC**
STD	**0.5217**	
n =	**823**	

	Condanoxic 2000-2009	
Average	**1.0121**	
Median	**0.8431**	
Minimum	**0.3210**	**Lake Kathyrn, Schreiber Lake**
Maximum	**7.4080**	**IMC**
STD	**0.7784**	
n =	**251**	

	NO3-N, Nitrate+Nitrite,oxic <=3ft00-2009	
Average	**0.514**	
Median	**0.160**	
Minimum	**<0.05**	***ND**
Maximum	**9.670**	**South Churchill Lake**
STD	**1.087**	
n =	**824**	

*ND = Many lakes had non-detects (76.5%)
Only compare lakes with detectable concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

	NH3-Nanoxic 2000-2009	
Average	**2.134**	
Median	**1.430**	
Minimum	**<0.1**	***ND**
Maximum	**18.400**	**Taylor Lake**
STD	**2.325**	
n =	**251**	

*ND = 20.3% Non-detects from 32 different lakes

	pHoxic <=3ft00-2009	
Average	**8.35**	
Median	**8.34**	
Minimum	**7.07**	**Bittersweet #13**
Maximum	**10.40**	**Summerhill Estates**
STD	**0.46**	
n =	**818**	

	pHanoxic 2000-2009	
Average	**7.31**	
Median	**7.33**	
Minimum	**6.24**	**Banana Pond**
Maximum	**8.48**	**Heron Pond**
STD	**0.41**	
n =	**251**	

	All Secchi 2000-2009	
Average	**4.56**	
Median	**3.15**	
Minimum	**0.25**	**Ozaukee Lake**
Maximum	**24.77**	**West Loon Lake**
STD	**3.80**	
n =	**763**	

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2000 - 2009 Water Quality Parameters, Statistics Summary (continued)

	TKNoxic <=3ft00-2009	
Average	**1.418**	
Median	**1.180**	
Minimum	**<0.1**	***ND**
Maximum	**10.300**	**Fairfield Marsh**
STD	**0.826**	
n =	**824**	

*ND = 3.8% Non-detects from 15 different lakes

	TKNanoxic 2000-2009	
Average	**2.883**	
Median	**2.235**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.300**	
n =	**251**	

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

	TPoxic <=3ft00-2009	
Average	**0.099**	
Median	**0.063**	
Minimum	**<0.01**	***ND**
Maximum	**3.880**	**Albert Lake**
STD	**0.171**	
n =	**824**	

*ND = 2.4% Non-detects from 8 different lakes

	TPanoxic 2000-2009	
Average	**0.311**	
Median	**0.167**	
Minimum	**0.012**	**Independ. Grove**
Maximum	**3.800**	**Taylor Lake**
STD	**0.417**	
n =	**251**	

	TSSall <=3ft00-2009	
Average	**15.3**	
Median	**7.9**	
Minimum	**<0.1**	***ND**
Maximum	**165.0**	**Fairfield Marsh**
STD	**20.3**	
n =	**830**	

*ND = 1.3% Non-detects from 8 different lakes

	TVSoxic <=3ft00-2009	
Average	**129.7**	
Median	**125.5**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**298.0**	**Fairfield Marsh**
STD	**39.8**	
n =	**774**	

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 <=3ft00-2009	
Average	**198**	
Median	**117**	
Minimum	**3.5**	**Schreiber Lake**
Maximum	**2390**	**IMC**
STD	**327**	
n =	**159**	

	CLoxic <=3ft00-2009	
Average	**191**	
Median	**145**	
Minimum	**2.7**	**Schreiber Lake**
Maximum	**2760**	**IMC**
STD	**220**	
n =	**561**	

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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 2000-2009 (n=1378).

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

LCHD Lakes Management Unit ~ 12/9/2009

APPENDIX F. GRANT PROGRAM OPPORTUNITES

Table F1. Potential Grant Opportunities

Grant Program Name	Funding Source	Contact Information	Funding Focus				Cost Share
			Water Quality/ Wetland	Habitat	Erosion	Flooding	
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 F1. Continued

Grant Program Name	Funding Source	Contact Information	Funding Focus: Water Quality/ Wetland	Funding Focus: Habitat	Funding Focus: Erosion	Funding Focus: 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
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LCSMC = Lake County Stormwater Management Commission
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