2007 SUMMARY REPORT
of
Wooster Lake

Lake County, Illinois

Prepared by the

LAKE COUNTY HEALTH DEPARTMENT
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LAKE FACTS

Lake Name:	Wooster Lake
Historical Name:	None
Nearest Municipality:	Round Lake, Fox Lake
Location:	T45N, R9E, Section 23
Elevation:	742.0 feet
Major Tributaries:	None
Watershed:	Fox River
Sub-watershed:	Fish Lake Drainage
Receiving Water body:	Duck Lake
Surface Area:	98.5 acres
Shoreline Length:	2.0 miles
Maximum Depth:	28.0 feet
Average Depth:	16.3 feet
Lake Volume:	1,634.9 acre-feet
Lake Type:	Glacial
Watershed Area:	4,657.0 acres
Major Watershed Land uses:	Agriculture, forest and grassland
Bottom Ownership:	Village of Round Lake and Private
Management Entities:	Village and Private
Current and Historical uses:	Fishing, swimming and boating
Description of Access:	No public access

In 2005, Wooster Lake was chosen to be one of seven "sentinel" lakes in the county the Lakes Management Unit (LMU) will monitor annually for five years. This report summarizes the water quality sampling results and aquatic plant surveys conducted in 2007 on Wooster Lake. Similar reports have been written on data collected in 1999, 2003, 2005, and 2006 and are available from the LMU. The following report does not cover lake history and discussion of the watershed, as found in the 1999, 2003 and 2005 reports.

SUMMARY OF WATER QUALITY

Water samples were taken monthly from April through October at the deepest location in the lake (Figure 1). Two samples were taken; one from the upper water layer (epilimnion) and one from the lower water layer (hypolimnion). They were analyzed for nutrients, solids concentration and other physical parameters. The epilimnion sample was taken from three feet deep each month, while the hypolimnion sample varied from 24-26 feet deep, as these samples are always taken three feet above the bottom (Appendix A). Wooster Lake was stratified from May until October, with the strongest thermal stratification occurring in June and July (Appendix C).

Two swimming beaches were tested by the LMU in 2007. Both Holiday Park and Camp Henry Horner beaches received no closure recommendations (i.e. *E. coli* concentrations >235 colony forming units/100 mL). Camp Henry Horner is the only state licensed beach on Wooster Lake. It is required by law to have a beach licensed if it is used by the public. Currently Holiday Park is not licensed.

The average epilimnetic dissolved oxygen (DO) concentration was 7.70 mg/L (Table 1), with the highest reading in April (12.71 mg/L) and the lowest in August (4.28 mg/L). The average hypolimnetic DO concentration was 1.77 mg/L, with the highest reading in April (10.92 mg/L) and the lowest in August (0.06 mg/L). The hypoxic layer (where DO concentrations fall below 5.0 mg/L) went from non-existent in April to approximately 21 feet in May and then encompassed the entire water column by July (Appendix B). DO concentrations above 5.0 mg/L are recommended by the Illinois Department of Natural Resources (IDNR) in order to sustain a healthy bass/sunfish fishery. Anoxic conditions (DO < 1.0 mg/L) ranged from below 23 feet in May to below 10 feet in August. While an accurate bathymetric map for Wooster Lake does not exist, the apparent anoxic volume in August is a concern. Heavy rains prior to sampling in August likely caused a large "pulse" of nutrient-rich water from upstream sources (i.e., Fish and Fischer Lakes). The creation of a bathymetric map should be a high priority for the lake residents.

From 1995 to 2007, the average TSS concentration in the lake has increaseed (Table 2). The 2007 average epilimnetic total suspended solids (TSS) concentration for Wooster Lake was 4.9 mg/L. This was below the county median of 8.0 mg/L (Appendix D), and was a slight decrease from the 2006 value of 5.1 mg/L. The TSS was highest in August (11.0 mg/L) and lowest in May (1.6 mg/L). This high concentration in August is most likely due to the heavy rains received prior to sampling.

Due to the low TSS average, Secchi depth (water clarity) in Wooster Lake was good (Figure 2). The average Secchi depth in 2007 was 7.19 feet, which was a decrease of nearly two feet since the 2005 sampling season (9.54 feet), but was similar to the Secchi depth average in 2006 (7.87 feet) and 2003 (7.83 feet). The median county Secchi depth from 2000-2007 was 3.28 feet; more than two times shallower than that of Wooster Lake. Considerable differences in Secchi depth were found throughout the 2007 season with the deepest Secchi reading in April (19.55 feet) and the lowest reading in August (1.96 feet). This poor August reading correlated with the highest TSS concentration in August that was due to the heavy rains.

Based on LMU data, algal blooms have increased in Wooster Lake in the past few years. In 2005/06, this bloom consisted of the bluegreen algae *Aphanizomenon* sp. In 2006, the Fish Lake Drain (FLD) experienced decreases in Secchi depths from the previous Lake County Health Department (LCHD) sampling, with the exception of Duck Lake. Fischer Lake had a Secchi depth of 1.96 feet and Fish Lake had a Secchi depth of 3.47 feet, while Duck Lake had a Secchi depth of 3.49 feet. The Volunteer Lake Monitoring Program (VLMP) has been continuously active on Wooster Lake since 1995 with data also collected in 1992 (Figure 3). The VLMP average Secchi depth in 2007 was 4.65 feet, which was less than the LCHD average. Differences between VLMP and LCHD data can be attributed to discrepancies between samplers, as well as date and time samples were taken.

Average conductivity in 2007 was 0.7466 mS/cm. This was an increase from the 2006 average of 0.7388 mS/cm and the 2005 value of 0.6945 mS/cm. Since 1995, the conductivity concentration has increased by 43%. While this was an increase for Wooster Lake, the 2007 average was just below the county median (0.7948 mS/cm). The road salts used in winter road management runoff into surface waters (i.e. lakes and streams) and increase both conductivity and chloride ion (Cl^-) concentrations, which are correlated (Figure 4). The median Cl^- concentration in the county is 158 mg/L, however, Wooster Lake contains less than this concentration (111 mg/L). Almost all of the lakes in the county are experiencing similar increases in conductivity for the same reason. It is recommended that alternatives to road salt use in the watershed be explored.

In 2007, the average epilimnetic total phosphorus (TP) concentration in Wooster Lake was 0.066 mg/L, which was just above the county median (0.063 mg/L). Average TP concentrations have risen since sampling was performed in 2006 (0.043 mg/L) and 2005 (0.032 mg/L), and have more than doubled since 1995. The 2007 average concentration increased due to heavy rains that occurred during the sampling season as upstream water flowed into Wooster Lake. The trophic state of Wooster Lake in terms of its phosphorus concentration in 2007 was eutrophic, with a TSIp score of 64.6. This indicated a decrease in water quality from 2005 when the TSIp score was 54.3, and from 2006 when the TSIp score was 58.5. In 2007, Wooster Lake was 80th out of 163 lakes in Lake County based on TP concentrations, which was a drop from being ranked 51st in 2006 (Table 3).

TSI values along with other water quality parameters can be used to make other analyses based on use impairment indexes established by the Illinois Environmental Protection Agency (IEPA). Most water quality standard impairment assessments were listed as *None*. However, widespread aquatic vegetation was the source of impairments based on excessive plant growth and exotic species. For the first time in Wooster Lake, TP concentrations were of impairment as well. Furthermore, based on IEPA indices, Wooster Lake has *Full* support for aquatic life and *Partial* support for recreation use. Based on these indices, this lake was listed as providing *Partial* overall use support. This was a drop from 2005 when the lake was listed in *Full* overall use support.

Figure 1. Water quality sampling point on Wooster Lake, 2007.

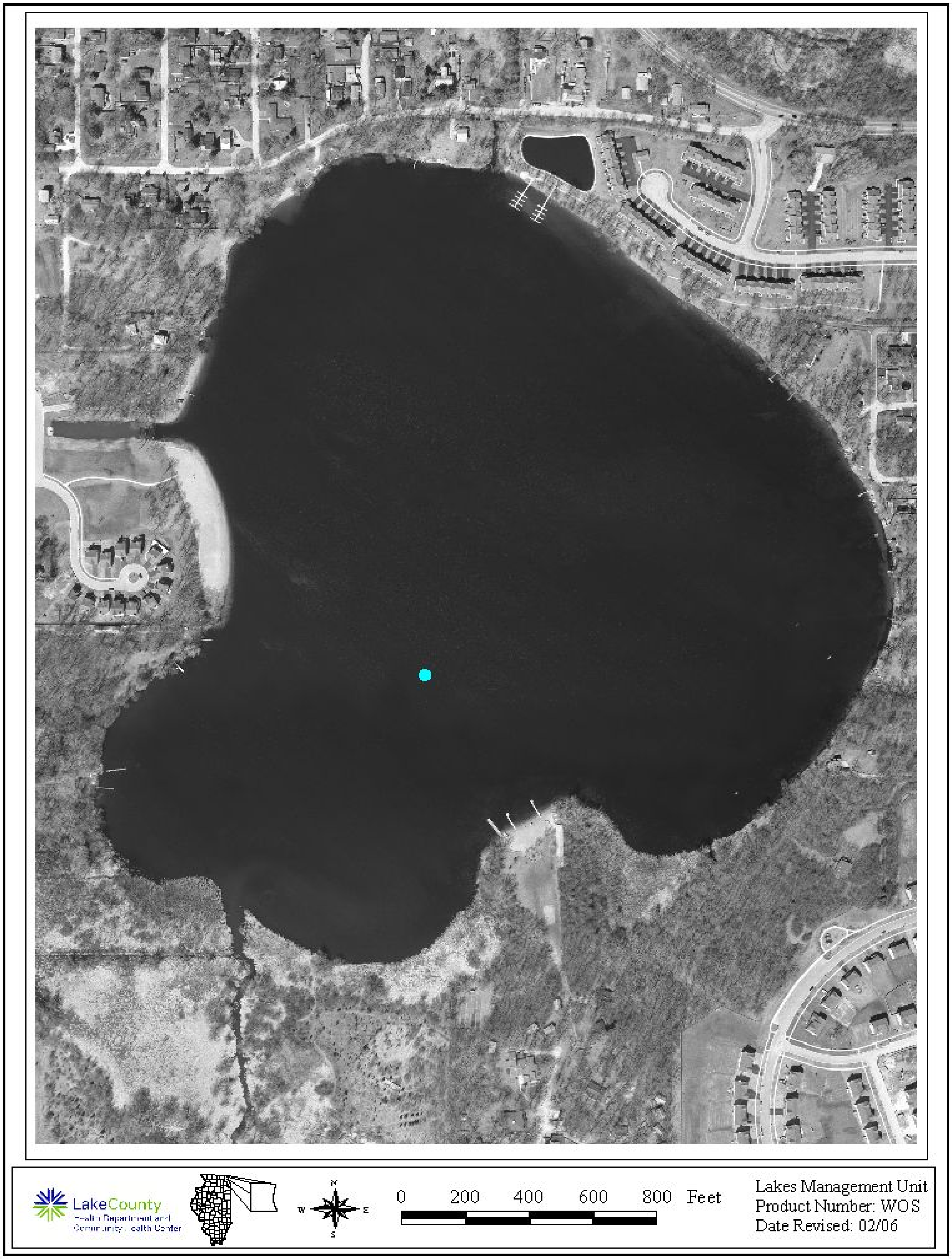

Table 1. Water quality data for Wooster Lake, 2005, 2006 and 2007.

2007	Epilimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
16-Apr	3	189	1.35	0.216	0.273	0.078	0.012	120	2.3	507	124	19.55	0.8084	8.29	12.71
15-May	3	186	1.02	<0.1	<0.05	0.043	<0.005	124	1.6	497	110	11.65	0.8182	8.63	9.21
19-Jun	3	164	1.26	<0.1	<0.05	0.041	<0.005	126	4.6	501	134	3.61	0.7936	8.46	7.51
17-Jul	3	165	1.15	<0.1	<0.05	0.028	<0.005	128	3.9	493	136	4.43	0.7967	8.30	7.87
14-Aug	3	156	1.92	<0.1	<0.05	0.118	<0.005	99	11.0	436	131	1.96	0.6695	7.62	4.28
18-Sep	3	172	1.36	<0.1	<0.05	0.058	<0.005	88	7.1	432	127	3.03	0.6545	7.84	7.67
23-Oct	3	184	1.36	0.527	<0.05	0.098	0.042	90.2	3.7	405	104	6.07	0.685	7.64	4.66
	Average	174	1.35	0.372[k]	0.273[k]	0.066	0.027[k]	111	4.9	467	124	7.19	0.7466	8.11	7.70

2006	Epilimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
11-Apr	3	180	1.37	<0.1	0.148	0.090	<0.005	104	9.1	459	121	3.61	0.7292	8.46	11.57
10-May	3	164	2.09	<0.1	<0.05	0.049	<0.005	108	15.0	454	124	1.60	0.7207	8.71	10.90
14-Jun	3	148	1.38	<0.1	<0.05	0.027	<0.005	111	3.7	472	147	5.41	0.7222	8.84	9.34
12-Jul	3	150	1.32	<0.1	<0.05	0.023	<0.005	114	2.0	478	150	11.48	0.7404	8.57	6.00
09-Aug	3	150	1.27	<0.1	<0.05	0.020	<0.005	117	2.4	490	161	10.17	0.7591	8.55	6.86
13-Sep	3	153	1.21	<0.1	<0.05	0.021	<0.005	116	2.1	461	133	9.51	0.7431	8.20	5.80
31-Oct	3	172	1.83	0.728	<0.05	0.073	0.039	113	1.6	473	129	13.29	0.7571	7.40	8.69
	Average	160	1.50	0.728[k]	0.148[k]	0.043	0.039[k]	112	5.1	470	138	7.87	0.7388	8.39	8.45

2005	Epilimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
11-Apr	3	180	1.43	<0.1	0.200	0.050	<0.005	90.2	3.7	431	117	6.00	0.6662	8.67	11.95
17-May	3	173	1.40	<0.1	0.058	0.035	<0.005	92.1	3.2	412	114	9.02	0.6633	8.16	10.03
21-Jun	3	163	1.30	<0.1	<0.05	0.016	<0.005	97.2	<1.0	421	115	17.45	0.6761	8.18	8.23
19-Jul	3	163	1.24	<0.1	<0.05	0.021	<0.005	103.0	1.0	472	160	13.45	0.7094	8.05	6.53
16-Aug	3	167	1.34	<0.1	<0.05	0.038	<0.005	101.0	3.3	458	151	5.90	0.7055	8.86	7.79
20-Sep	3	174	1.32	<0.1	<0.05	0.027	<0.005	105.0	3.0	448	130	8.53	0.7232	8.28	6.12
18-Oct	3	180	1.46	0.209	<0.05	0.040	<0.005	101.0	2.9	432	117	6.40	0.7181	8.08	5.58
	Average	171	1.36	NA	0.130[k]	0.032	<0.005	98.5	2.9[k]	439	129	9.54	0.6945	8.33	8.03

Glossary

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

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

Table 1. Continued

2007	Hypolimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
16-Apr	25	190	1.22	0.27	0.281	0.058	0.019	119	1.3	505	124	NA	0.8090	8.11	10.92
15-May	24	201	1.68	0.80	0.140	0.182	0.144	119	1.1	488	107	NA	0.8295	7.49	0.68
19-Jun	26	209	2.44	1.37	<0.05	0.294	0.025	120	3.6	541	149	NA	0.8498	7.23	0.14
17-Jul	25	222	3.34	2.42	<0.05	0.411	0.340	122	3.6	522	135	NA	0.8721	6.99	0.23
14-Aug	25	231	3.61	2.67	<0.05	0.436	0.390	121	4.2	543	155	NA	0.8635	6.73	0.06
18-Sep	25	242	4.99	1.22	<0.05	0.671	0.616	121	4.1	528	144	NA	0.8982	6.70	0.07
23-Oct	24	214	3.50	2.58	<0.05	0.391	0.337	104	3.2	468	122	NA	0.8736	7.05	0.29
	Average	216	2.97	1.62	0.211[k]	0.349	0.267	118	3.0	514	134	NA	0.8565	7.19	1.77

2006	Hypolimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO2+NO3*	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
11-Apr	24	180	1.53	<0.1	0.188	0.066	<0.005	103	5.8	438	109	NA	0.7340	8.08	7.72
10-May	24	179	1.93	0.50	<0.05	0.104	0.039	105	5.6	446	113	NA	0.7560	7.33	0.13
14-Jun	25	218	4.15	3.02	<0.05	0.428	0.336	105	3.7	485	141	NA	0.7930	6.93	0.09
12-Jul	25	229	5.04	3.53	<0.05	0.467	0.394	106	5.8	483	137	NA	0.8004	6.84	0.10
09-Aug	24	230	5.06	3.65	<0.05	0.439	0.358	109	4.8	484	139	NA	0.8209	6.96	0.13
13-Sep	24	263	7.18	6.25	<0.05	0.724	0.652	108	4.6	497	137	NA	0.8293	6.97	0.08
31-Oct	25	172	1.89	0.74	<0.05	0.074	0.033	113	2.0	469	129	NA	0.7587	7.55	8.43
	Average	210	3.83	2.95[k]	0.188[k]	0.329	0.302[k]	107	4.6	472	129	NA	0.7846	7.24	2.38

2005	Hypolimnion														
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N	TP	SRP	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
11-Apr	26	186	2.09	0.95	0.133	0.065	0.022	87.2	2.7	421	111	NA	0.6717	7.56	2.51
17-May	24	186	2.00	0.77	0.063	0.137	0.099	89.8	<1.0	420	111	NA	0.6914	7.32	0.34
21-Jun	24	194	2.58	1.07	<0.05	0.210	0.129	90.0	4.8	442	122	NA	0.7062	6.85	0.05
19-Jul	24	198	2.97	<0.1	<0.05	0.245	0.140	91.4	8.4	456	132	NA	0.7297	6.87	0.06
16-Aug	23	225	4.60	3.10	<0.05	0.649	0.544	91.0	5.2	476	156	NA	0.7413	6.85	0.10
20-Sep	24	173	1.48	<0.1	<0.05	0.041	0.000	104.0	3.0	447	135	NA	0.7787	6.75	0.19
18-Oct	23	237	5.42	4.49	<0.05	0.713	0.617	92.0	4.0	437	101	NA	0.7592	7.24	0.11
	Average	200	3.02	1.47[k]	0.098[k]	0.294	0.222	93.7	4.68[k]	452	124	NA	0.7430	6.91	0.48

Glossary

ALK = Alkalinity, mg/L $CaCO_3$
TKN = Total Kjeldahl nitrogen, mg/L
NH_3-N = Ammonia nitrogen, mg/L
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TVS = Total volatile solids, mg/L
SECCHI = Secchi disk depth, ft.
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L

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

Table 2. Comparison of epilimnetic averages for selected water quality parameters in the Fish Lake Drain watershed.

	Fish Lake	Fish Lake	Fish Lake	Fischer Lake	Fischer Lake	Wooster Lake	Wooster Lake	Wooster Lake	Wooster Lake	Wooster Lake	Wooster Lake	Duck Lake	Duck Lake	Duck Lake
Year	**1997**	**2002**	**2006**	**2001**	**2006**	**1995**	**1999**	**2003**	**2005**	**2006**	**2007**	**1997**	**2001**	**2006**
Secchi (feet)	3.53	4.02	3.47	2.72	1.96	10.13	8.00	7.83	9.54	7.87	7.19	3.12	2.01	3.49
TSS (mg/L)	8.9	11.3	11.0	15.4	28.0	1.8	4.3	3.4	3.2	5.1	4.9	8.5	20.6	9.1
TP (mg/L)	0.134	0.102	0.096	0.198	0.228	0.024	0.027	0.032	0.03	0.043	0.066	0.047	0.100	0.100
Conductivity (milliSiemens/cm)	0.6984	0.663	0.8688	0.6687	0.8524	0.5160	0.5744	0.6437	0.7100	0.7388	0.7466	0.6544	0.6071	0.7807

Direction of Watershed Flow

∞

Figure 2. Total suspended solid (TSS) concentrations vs. Secchi depth for Wooster Lake, 2007.

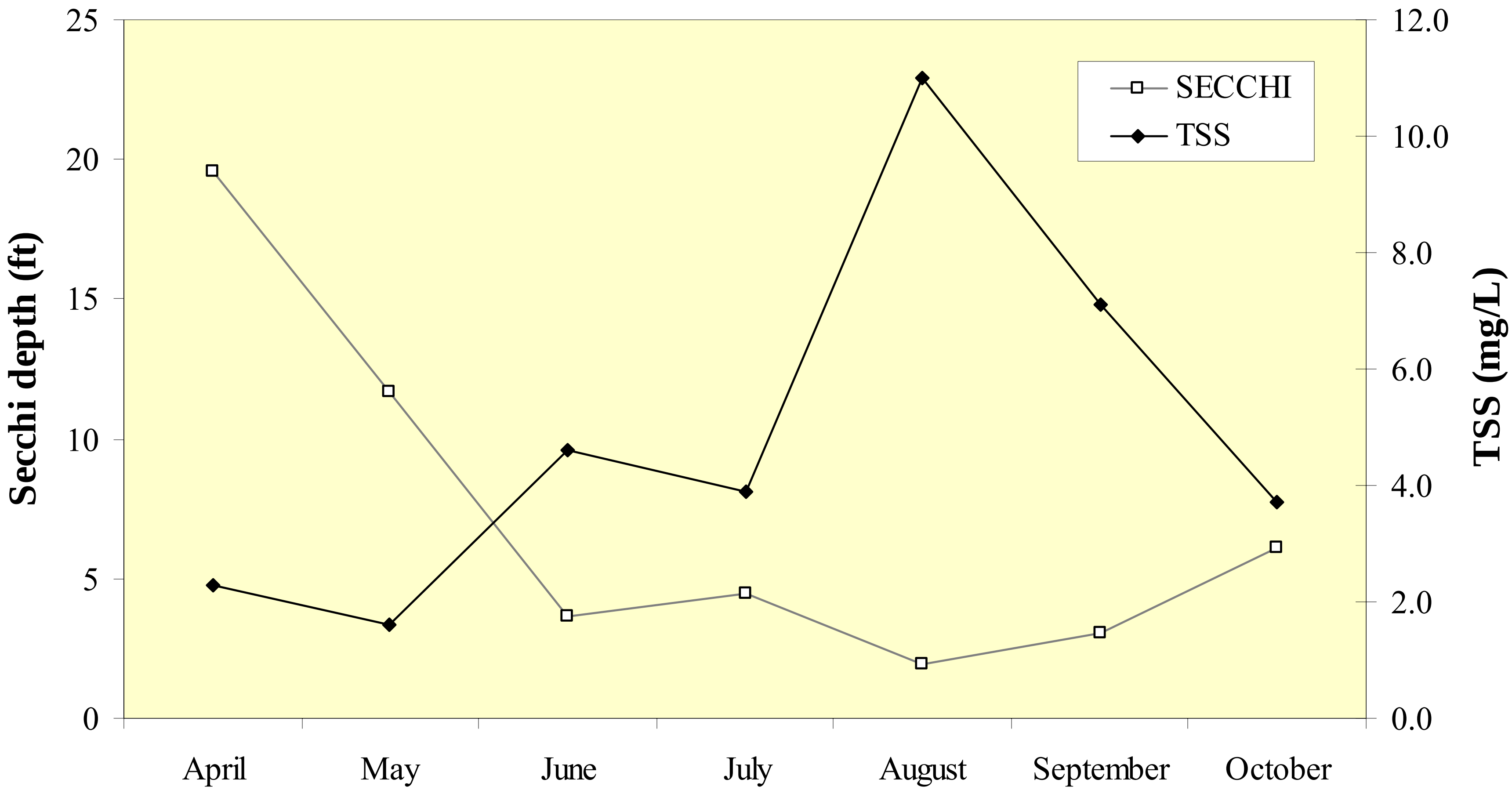

Figure 3. Comparison of average Secchi disk depths between VLMP records and LCHD records from 1992-2007 for Wooster Lake.

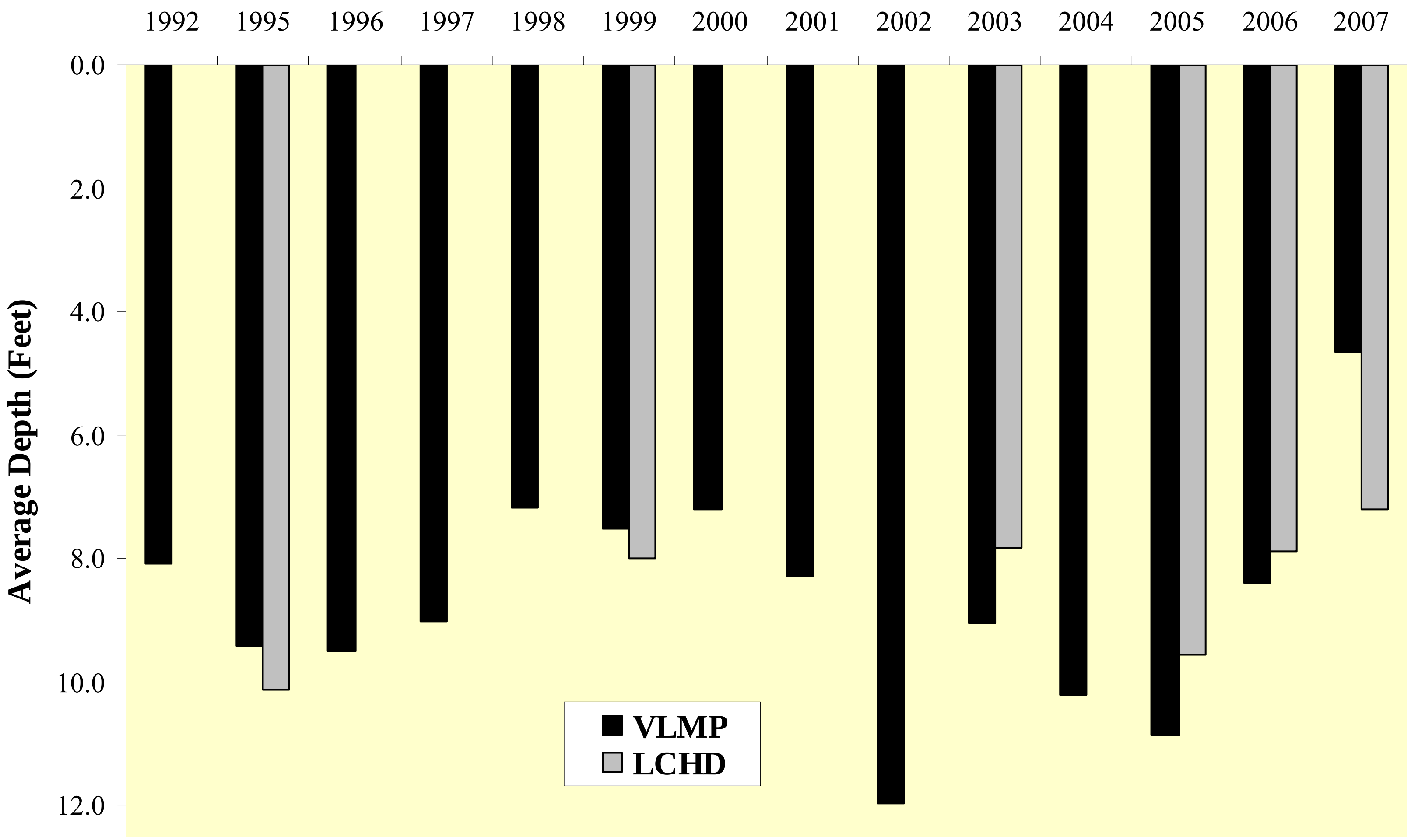

Figure 4. Chloride vs. conductivity concentrations in Wooster Lake, 2007.

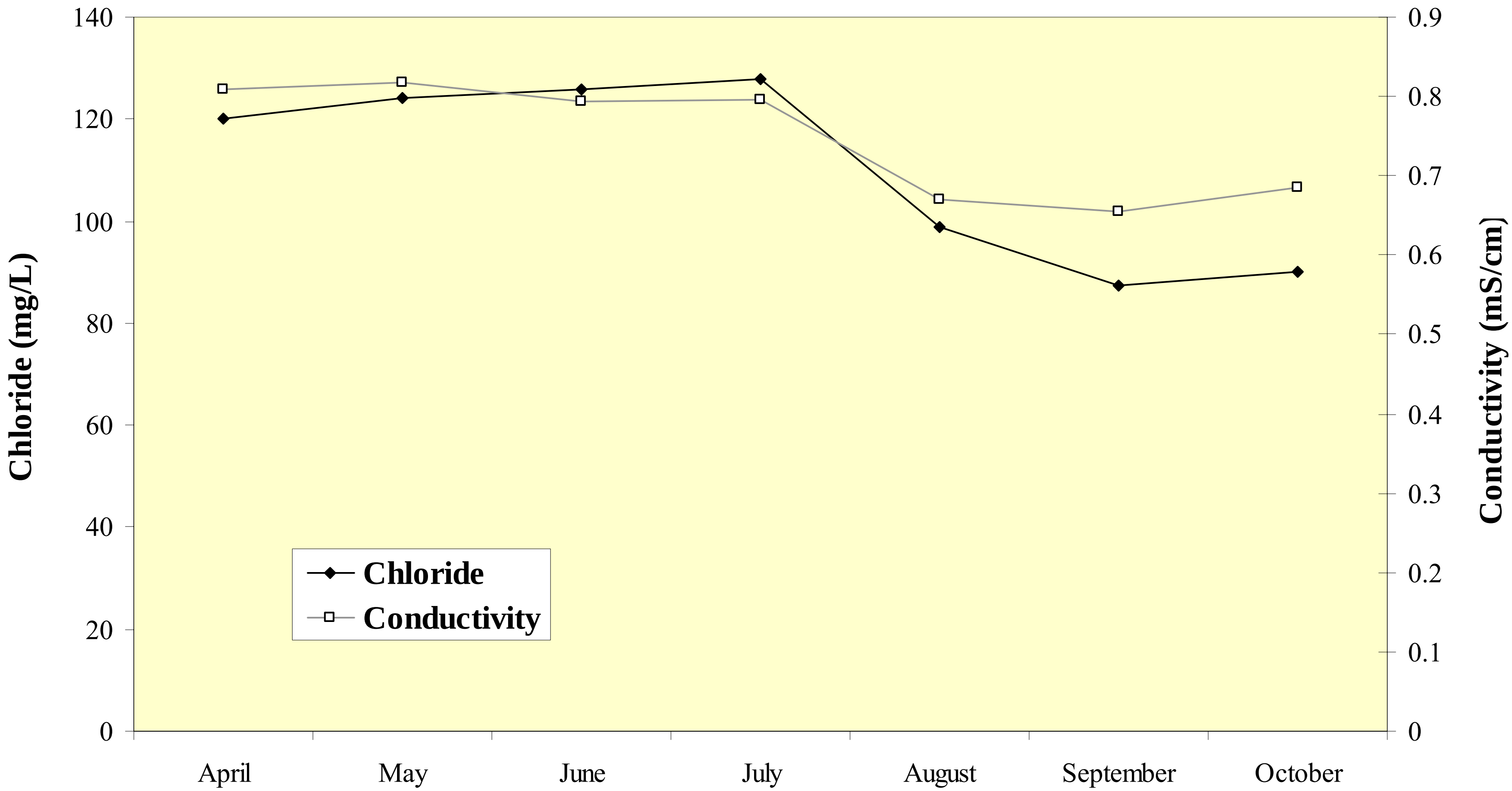

Table 3. Lake County average TSI phosphorus (TSIp) ranking, 2000-2007.

RANK	LAKE NAME	TP AVE	TSIp
1	Lake Carina	0.0100	37.35
2	Sterling Lake	0.0100	37.35
3	Independence Grove	0.0114	39.24
4	Sand Pond (IDNR)	0.0132	41.36
5	Cedar Lake	0.0157	41.60
6	Windward Lake	0.0158	43.95
7	Pulaski Pond	0.0180	45.83
8	Timber Lake (North)	0.0180	45.83
9	Fourth Lake	0.0182	45.99
10	West Loon Lake	0.0182	45.99
11	Lake Kathyrn	0.0200	47.35
12	Lake of the Hollow	0.0200	47.35
13	Banana Pond	0.0202	47.49
14	Lake Minear	0.0204	47.63
15	Bangs Lake	0.0212	48.17
16	Cross Lake	0.0220	48.72
17	Dog Pond	0.0222	48.85
18	Stone Quarry Lake	0.0230	49.36
19	Cranberry Lake	0.0234	49.61
20	Deep Lake	0.0240	49.98
21	Druce Lake	0.0244	50.22
22	Little Silver Lake	0.0246	50.33
23	Round Lake	0.0254	50.80
24	Lake Leo	0.0256	50.91
25	Dugdale Lake	0.0274	51.89
26	Peterson Pond	0.0274	51.89
27	Lake Miltmore	0.0276	51.99
28	East Loon Lake	0.0280	52.20
29	Lake Zurich	0.0282	52.30
30	Lake Fairfield	0.0296	53.00
31	Gray's Lake	0.0302	53.29
32	Highland Lake	0.0302	53.29
33	Hook Lake	0.0302	53.29
34	Lake Catherine (Site 1)	0.0308	53.57
35	Lambs Farm Lake	0.0312	53.76
36	Old School Lake	0.0312	53.76
37	Sand Lake	0.0316	53.94
38	Sullivan Lake	0.0320	54.13
39	Lake Linden	0.0326	54.39
40	Countryside Lake	0.0332	54.66
41	Gages Lake	0.0338	54.92
42	Hendrick Lake	0.0344	55.17
43	Third Lake	0.0346	55.24
44	Diamond Lake	0.0372	56.30
45	Channel Lake (Site 1)	0.0380	56.60
46	Ames Pit	0.0390	56.98

Table 3. Continued.

RANK	LAKE NAME	TP AVE	TSIp
47	White Lake	0.0408	57.63
48	Sun Lake	0.0410	57.70
49	Potomac Lake	0.0424	58.18
50	Duck Lake	0.0426	58.25
51	Old Oak Lake	0.0428	58.32
52	Deer Lake	0.0434	58.52
53	Schreiber Lake	0.0434	58.52
54	Nielsen Pond	0.0448	58.98
55	Turner Lake	0.0458	59.30
56	Seven Acre Lake	0.0460	59.36
57	Willow Lake	0.0464	59.48
58	Lucky Lake	0.0476	59.85
59	Davis Lake	0.0476	59.85
60	East Meadow Lake	0.0478	59.91
61	College Trail Lake	0.0496	60.45
62	Lake Lakeland Estates	0.0524	61.24
63	Butler Lake	0.0528	61.35
64	West Meadow Lake	0.0530	61.40
65	Heron Pond	0.0545	61.80
66	Little Bear Lake	0.0550	61.94
67	Lucy Lake	0.0552	61.99
68	Lake Christa	0.0576	62.60
69	Lake Charles	0.0580	62.70
70	Crooked Lake	0.0608	63.38
71	Waterford Lake	0.0610	63.43
72	Lake Naomi	0.0616	63.57
73	Lake Tranquility S1	0.0618	63.62
74	Werhane Lake	0.0630	63.89
75	Liberty Lake	0.0632	63.94
76	Countryside Glen Lake	0.0642	64.17
77	Lake Fairview	0.0648	64.30
78	Leisure Lake	0.0648	64.30
79	Tower Lake	0.0662	64.61
80	**Wooster Lake**	**0.0663**	**64.63**
81	St. Mary's Lake	0.0666	64.70
82	Mary Lee Lake	0.0682	65.04
83	Hastings Lake	0.0684	65.08
84	Honey Lake	0.0690	65.21
85	Spring Lake	0.0726	65.94
86	ADID 203	0.0730	66.02
87	Bluff Lake	0.0734	66.10
88	Harvey Lake	0.0766	66.71
89	Broberg Marsh	0.0782	67.01
90	Echo Lake	0.0792	67.19
91	Sylvan Lake	0.0794	67.23
92	Big Bear Lake	0.0806	67.45

Table 3. Continued.

RANK	LAKE NAME	TP AVE	TSIp
93	Petite Lake	0.0834	67.94
94	Timber Lake (South)	0.0848	68.18
95	Lake Marie (Site 1)	0.0850	68.21
96	North Churchill Lake	0.0872	68.58
97	Grand Avenue Marsh	0.0874	68.61
98	Grandwood Park, Site II, Outflow	0.0876	68.65
99	North Tower Lake	0.0878	68.68
100	South Churchill Lake	0.0896	68.97
101	Rivershire Pond 2	0.0900	69.04
102	McGreal Lake	0.0914	69.26
103	International Mine and Chemical Lake	0.0948	69.79
104	Eagle Lake (Site I)	0.0950	69.82
105	Valley Lake	0.0950	69.82
106	Dunns Lake	0.0952	69.85
107	Fish Lake	0.0956	69.91
108	Lochanora Lake	0.0960	69.97
109	Owens Lake	0.0978	70.23
110	Woodland Lake	0.0986	70.35
111	Island Lake	0.0990	70.41
112	McDonald Lake 1	0.0996	70.50
113	Longview Meadow Lake	0.1024	70.90
114	Long Lake	0.1029	70.96
115	Lake Barrington	0.1053	71.31
116	Redwing Slough, Site II, Outflow	0.1072	71.56
117	Lake Forest Pond	0.1074	71.59
118	Bittersweet Golf Course #13	0.1096	71.88
119	Fox Lake (Site 1)	0.1098	71.90
120	Osprey Lake	0.1108	72.04
121	Bresen Lake	0.1126	72.27
122	Round Lake Marsh North	0.1126	72.27
123	Deer Lake Meadow Lake	0.1158	72.67
124	Taylor Lake	0.1184	72.99
125	Columbus Park Lake	0.1226	73.49
126	Nippersink Lake (Site 1)	0.1240	73.66
127	Grass Lake (Site 1)	0.1288	74.21
128	Lake Holloway	0.1322	74.58
129	Lakewood Marsh	0.1330	74.67
130	Summerhill Estates Lake	0.1384	75.24
131	Redhead Lake	0.1412	75.53
132	Forest Lake	0.1422	75.63
133	Antioch Lake	0.1448	75.89
134	Slocum Lake	0.1496	76.36
135	Drummond Lake	0.1510	76.50
136	Pond-a-Rudy	0.1514	76.54
137	Lake Matthews	0.1516	76.56
138	Buffalo Creek Reservoir	0.1550	76.88

Table 3. Continued.

RANK	LAKE NAME	TP AVE	TSIp
139	Pistakee Lake (Site 1)	0.1592	77.26
140	Salem Lake	0.1650	77.78
141	Half Day Pit	0.1690	78.12
142	Lake Eleanor Site II, Outflow	0.1812	79.13
143	Lake Farmington	0.1848	79.41
144	ADID 127	0.1886	79.71
145	Lake Louise Inlet	0.1938	80.10
146	Grassy Lake	0.1952	80.20
147	Dog Bone Lake	0.1990	80.48
148	Redwing Marsh	0.2072	81.06
149	Stockholm Lake	0.2082	81.13
150	Bishop Lake	0.2156	81.63
151	Hidden Lake	0.2236	82.16
152	Fischer Lake	0.2278	82.43
153	Lake Napa Suwe (Outlet)	0.2304	82.59
154	Patski Pond (outlet)	0.2512	83.84
155	Oak Hills Lake	0.2792	85.36
156	Loch Lomond	0.2954	86.18
157	McDonald Lake 2	0.3254	87.57
158	Fairfield Marsh	0.3264	87.61
159	ADID 182	0.3280	87.69
160	Slough Lake	0.4134	91.02
161	Flint Lake Outlet	0.4996	93.75
162	Rasmussen Lake	0.5025	93.84
163	Albert Lake, Site II, outflow	1.1894	106.3

SUMMARY OF AQUATIC MACROPHYTES

An aquatic plant (macrophyte) survey was conducted in May and August of 2007. These sample times allowed the determination of plant growth at the beginning and end of the season. On Wooster Lake, there were 79 sampling sites in May and 68 in August covering all but the deepest parts of the lake (Figure 5; Figure 6). Overall, there were 14 species (Table 4) found in May, with Eurasian Watermilfoil having the highest density (found at 46% of the sites). *Chara* spp. (a macroalgae), Coontail and White Water Lily were also abundant and were found at 42%, 39% and 35% of the sites respectively (Table 5a). The total number of species present in August increased to 15 species. Coontail was the most abundant (found at 66% of the sites), followed by White Water Lily (53% of the sites), and Eurasian Watermilfoil (44% of the sites; Table 6a). The species present during the May and August sampling differed quite a bit. Flatstem Pondweed, Floating Leaf Pondweed, Grass-leaved Arrowhead and Spatterdock were found in May but not in August. Illinois Pondweed, Southern Naiad, Spiny Naiad, White-stem Pondweed and Water Stargrass were found in August but not in May. White Stem Pondweed was found at a single location along the northeast shoreline. It was found in 2005 in low numbers and not found in 2006. Care should be taken to ensure that this Illinois endangered species is not eradicated from Wooster Lake. Plants need at least 1% of surface light levels in order to survive. In May, plants were found down to a depth of 18.0 feet, which relates to the 1% light level depth of 18.0 feet. In August, the 1% light level depth was around 6.0 feet, while plants were found at depths of 11.0 feet. Out of the 79 May sample sites, plants were found at 56 of them (71%; Table 5b). In August, plants were found at 51 of the 68 sites (75%; Table 6b).

Plant coverage stayed about the since 2006. In June and August of 2006 plant coverage was 46%. In 2007 plant coverage in May and August was 49% and 45%, respectively. Topped out vegetation (plants reaching and crowding the surface of the lake) was mapped in August of 2007 (Figure 7) and covered approximately 30 acres (31% of the lake). Since, the land uses and existing waterbodies in the watershed inevitably contribute high nutrient inputs to Wooster Lake, the high-density plant community helps utilize these nutrients and keep the water clarity high. If plants were reduced, algal populations may increase and decrease water clarity. Also, the threatened and endangered fish (Starhead Topminnow (*Fundulus dispar*) and Blackchin Shiner (*Notropsis heterodon*), both threatened in Illinois, and the state endangered Blacknose Shiner (*Notropsis heterolepsis*) in the lake require high densities of plants for proper habitat.

Floristic Quality Index (FQI) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. A high FQI number indicates there is a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The median FQI for 2000-2007 Lake County lakes is 12.5. Wooster Lake had a FQI of 20.8 in 2007, which is an increase from 2006 (19.8) but a decrease from the 2005 FQI of 25.2. It ranked 14th in 2005, 29th in 2006 and 26th in 2007 (Table 7). For comparison, Fish Lake, Fischer Lake, and Duck Lake have 2006 FQIs of 19.3, 9.0 and 21.1, respectively.

Figure 5. Aquatic plant sampling grid illustrating plant density on Wooster Lake, May 2007.

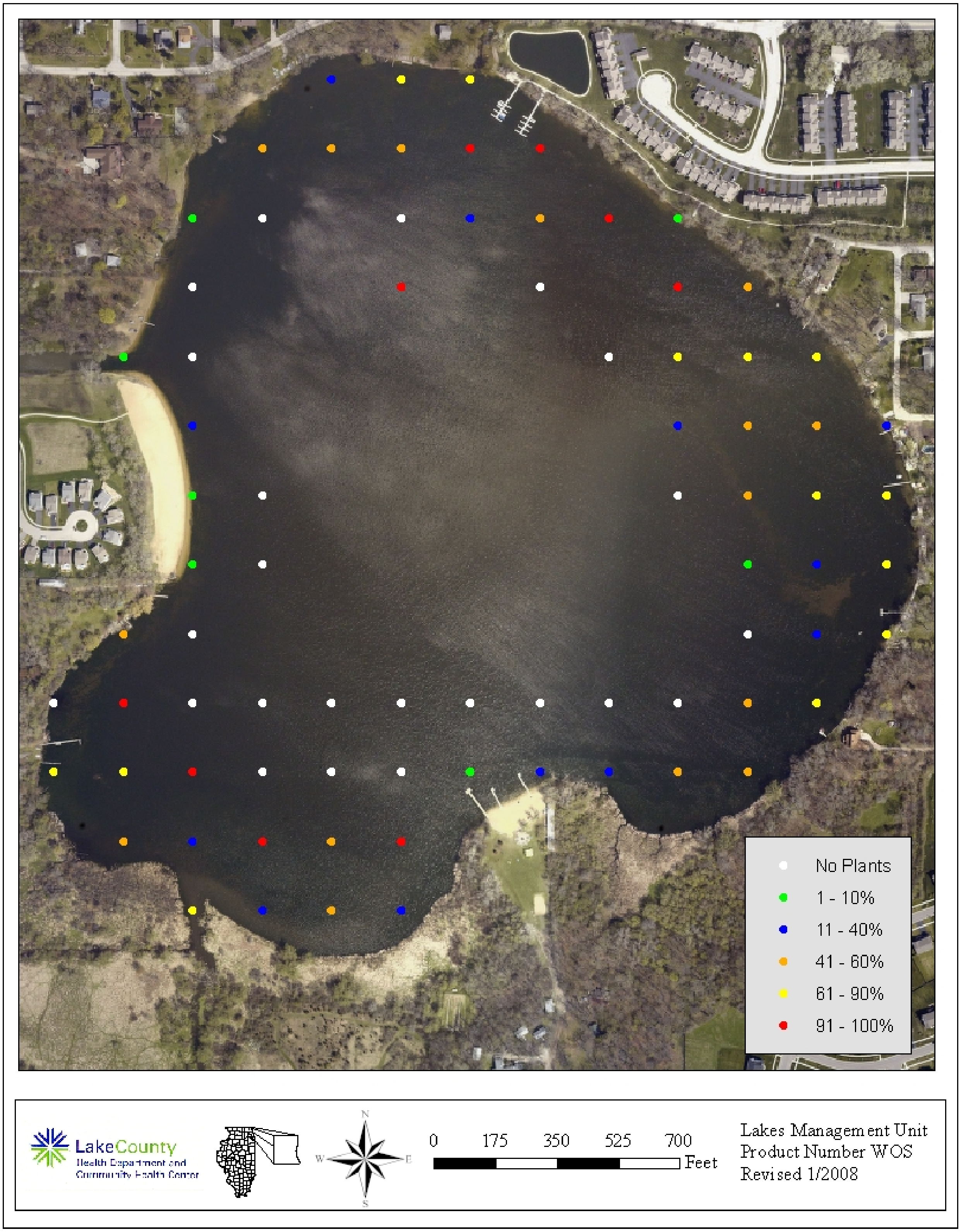

Figure 6. Aquatic plant sampling grid illustrating plant density on Wooster Lake, August 2007.

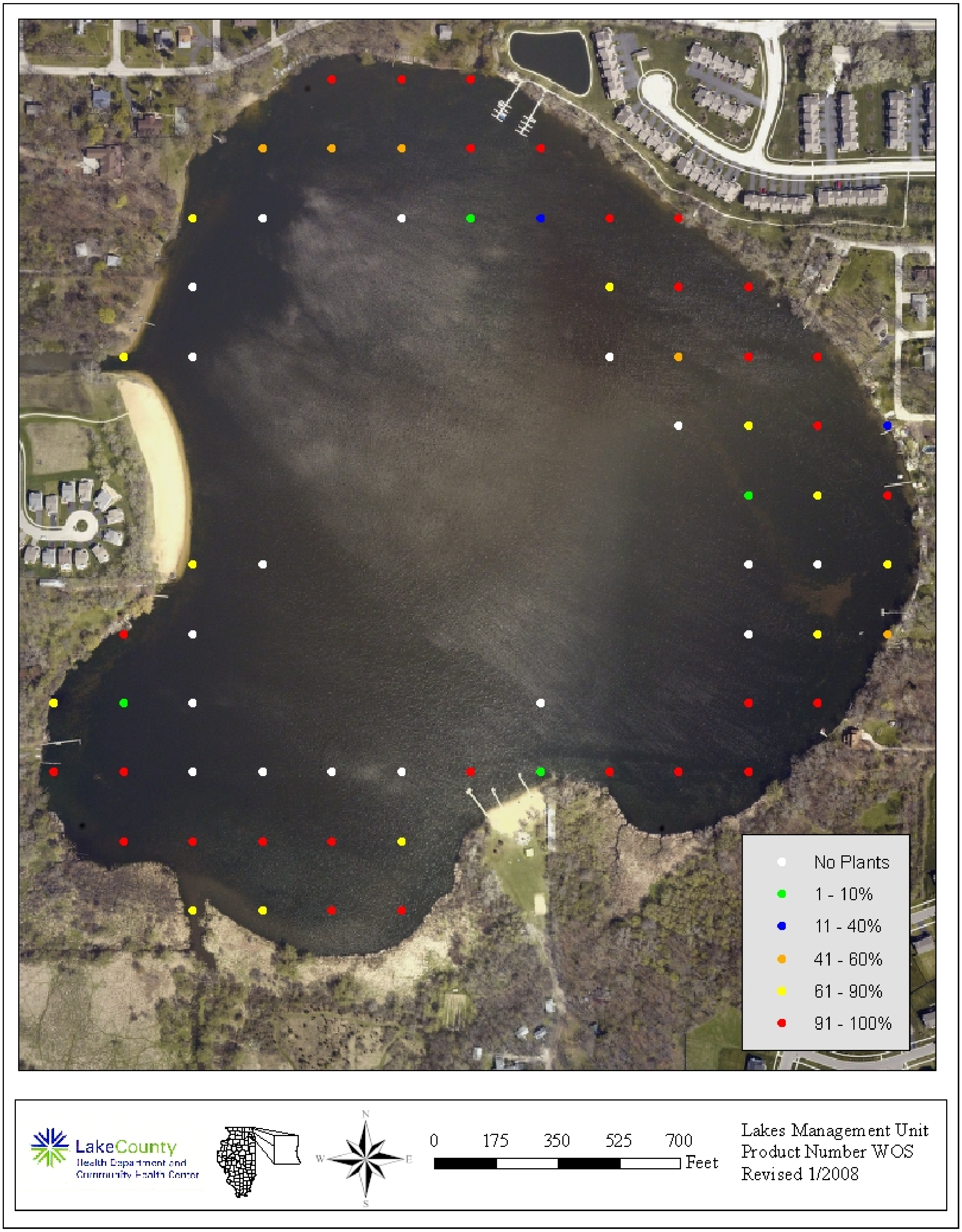

Table 4: Aquatic plant species found in Wooster Lake, 2007.

Coontail	*Ceratophyllum demersum*
Chara (Macro algae)	*Chara* spp.
Water Stargrass	*Heteranthera dubia*
Duckweed	*Lemna* spp.
Star Duckweed	*Lemna trisulca*
Eurasian Watermilfoil^	*Myriophyllum spicatum*
Southern Naiad	*Najas guadalupensis*
Spiny Naiad	*Najas marina*
Spatterdock	*Nuphar variegata*
White Water Lily	*Nymphaea tuberosa*
Curlyleaf Pondweed^	*Potamogeton crispus*
Illinois Pondweed	*Potamogeton illinoensis*
Floating-leaf Pondweed	*Potamogeton natans*
Sago Pondweed	*Potamogeton pectinatus*
Whitestem Pondweed*	*Potamogeton praelongus*
Flatstem Pondweed	*Potamogeton zosteriformis*
Grass-leaved Arrowhead	*Sagittaria graminea*
Eel Grass	*Vallisneria americana*
Watermeal	*Wolffia* spp.

*** Endangered in Illinois**
^ Exotic plant

Table 5a. Aquatic plant species found at the sampling sites in May on Wooster Lake, 2007. Maximum depth that plants were found was 18.0 feet.

Plant Density	Chara	Coontail	Curlyleaf Pondweed	Duckweed	Eurasian Watermilfoil	Flatstem Pondweed	Floating Leaf Pondweed	Grass-leaved Arrowhead
Absent	46	48	61	76	43	78	78	78
Present	12	17	12	3	24	0	0	1
Common	8	3	3	0	7	1	0	0
Abundant	5	9	2	0	4	0	1	0
Dominant	8	2	1	0	1	0	0	0
% Plant Occurrence	42	39	23	4	46	1	1	1

Plant Density	Sago Ponweed	Spatterdock	Star Duckweed	Vallisneria	Watermeal	White Water Lily
Absent	59	78	70	76	77	51
Present	13	1	8	3	1	20
Common	5	0	1	0	1	8
Abundant	2	0	0	0	0	0
Dominant	0	0	0	0	0	0
% Plant Occurrence	25	1	11	4	3	35

Table 5b. Distribution of rake density across all sampling sites in May.

Rake Density (coverage)	# of Sites	% of Sites
No Plants	23	29%
>0-10%	7	9%
10-40%	12	15%
40-60%	15	19%
60-90%	13	16%
>90%	9	11%
Total Sites with Plants	56	71%
Total # of Sites	79	100%

Table 6a. Aquatic plant species found at the sampling sites in August on Wooster Lake, 2007. Maximum depth that plants were found was 11.0 feet.

Plant Density	Chara	Coontail	Curlyleaf Pondweed	Duckweed	Eurasian Watermilfoil	Illinois Pondweed	Sago Ponweed	Southern Naiad
Absent	47	23	66	62	38	67	52	66
Present	7	22	2	3	22	1	8	2
Common	4	6	0	1	4	0	1	0
Abundant	3	11	0	1	2	0	5	0
Dominant	7	6	0	1	2	0	2	0
% Plant Occurrence	31	66	3	9	44	1	24	3

Plant Density	Spiny Naiad	Star Duckweed	Vallisneria	White-stem Pondweed	Watermeal	Water Stargrass	White Water Lily
Absent	67	60	52	67	62	64	32
Present	0	7	13	1	4	3	8
Common	0	1	0	0	2	0	4
Abundant	1	0	3	0	0	0	12
Dominant	0	0	0	0	0	1	12
% Plant Occurrence	1	12	24	1	9	6	53

Table 6b. Distribution of rake density across all sampling sites in August.

Rake Density (coverage)	# of Sites	% of Sites
No Plants	17	25%
>0-10%	4	6%
10-40%	2	3%
40-60%	5	7%
60-90%	12	18%
>90%	28	41%
Total Sites with Plants	51	75%
Total # of Sites	68	100%

Figure 7. Approximate vegetation topped out on Wooster Lake in August, 2007.

Table 6. 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	35.1	37.3
2	Deep Lake	33.9	35.4
3	Cranberry Lake	30.1	31.0
4	Round Lake Marsh North	29.1	29.9
5	East Loon Lake	28.4	29.9
6	Deer Lake	28.2	29.7
7	Sullivan Lake	28.2	29.7
8	Little Silver Lake	27.9	30.0
9	Schreiber Lake	26.8	27.6
10	West Loon Lake	26.0	27.6
11	Cross Lake	25.2	27.8
12	Independence Grove	24.6	27.5
13	Sterling Lake	24.5	26.9
14	Bangs Lake	24.5	26.2
15	Lake Zurich	24.0	26.0
16	Lake of the Hollow	23.8	26.2
17	Lakewood Marsh	23.8	24.7
18	Round Lake	23.5	25.9
19	Fourth Lake	23.0	24.8
20	Druce Lake	22.8	25.2
21	Sun Lake	22.7	24.5
22	Countryside Glen Lake	21.9	22.8
23	Butler Lake	21.4	23.1
24	Duck Lake	21.1	22.9
25	Timber Lake (North)	20.8	22.8
26	**Wooster Lake**	**20.8**	**22.6**
27	Broberg Marsh	20.5	21.4
28	Davis Lake	20.5	21.4
29	ADID 203	20.5	20.5
30	McGreal Lake	20.2	22.1
31	Lake Kathryn	19.6	20.7
32	Fish Lake	19.3	21.2
33	Redhead Lake	19.3	21.2
34	Owens Lake	19.3	20.2
35	Turner Lake	18.6	21.2
36	Salem Lake	18.5	20.2
37	Lake Miltmore	18.4	20.3
38	Hendrick Lake	17.7	17.7
39	Summerhill Estates Lake	17.1	18.0
40	Seven Acre Lake	17.0	15.5
41	Gray's Lake	16.9	19.8
42	Lake Barrington	16.7	17.7
43	Bresen Lake	16.6	17.8
44	Windward Lake	16.3	17.6

Table 6. Continued.

Rank	Lake Name	FQI (w/A)	FQI (native)
45	Diamond Lake	16.3	17.4
46	Lake Napa Suwe	16.3	17.4
47	Long Lake	16.1	18.0
48	Dog Bone Lake	15.7	15.7
49	Redwing Slough	15.6	16.6
50	Osprey Lake	15.5	17.3
51	Lake Fairview	15.2	16.3
52	Heron Pond	15.1	15.1
53	Lake Tranquility (S1)	15.0	17.0
54	North Churchill Lake	15.0	15.0
55	Island Lake	14.7	16.6
56	Dog Training Pond	14.7	15.9
57	Highland Lake	14.5	16.7
58	Grand Avenue Marsh	14.3	16.3
59	Taylor Lake	14.3	16.3
60	Dugdale Lake	14.0	15.1
61	Eagle Lake (S1)	14.0	15.1
62	Longview Meadow Lake	13.9	13.9
63	Ames Pit	13.4	15.5
64	Hook Lake	13.4	15.5
65	Third Lake	13.4	15.5
66	Bishop Lake	13.4	15.0
67	Mary Lee Lake	13.1	15.1
68	Old School Lake	13.1	15.1
69	Buffalo Creek Reservoir	13.1	14.3
70	McDonald Lake 2	13.1	14.3
71	Old Oak Lake	12.7	14.7
72	Timber Lake (South)	12.7	14.7
73	White Lake	12.7	14.7
74	Dunn's Lake	12.7	13.9
75	Echo Lake	12.5	14.8
76	Hastings Lake	12.5	14.8
77	Sand Lake	12.5	14.8
78	Stone Quarry Lake	12.5	12.5
79	Honey Lake	12.1	14.3
80	Lake Carina	12.1	14.3
81	Lake Leo	12.1	14.3
82	Lambs Farm Lake	12.1	14.3
83	Stockholm Lake	12.1	13.5
84	Pond-A-Rudy	12.1	12.1
85	Lake Matthews	12.0	12.0
86	Flint Lake	11.8	13.0
87	Harvey Lake	11.8	13.0
88	Rivershire Pond 2	11.5	13.3
89	Antioch Lake	11.3	13.4
90	Lake Charles	11.3	13.4

Table 6. Continued.

Rank	Lake Name	FQI (w/A)	FQI (native)
91	Lake Linden	11.3	11.3
92	Lake Naomi	11.2	12.5
93	Pulaski Pond	11.2	12.5
94	Lake Minear	11.0	13.9
95	Redwing Marsh	11.0	11.0
96	Tower Lake	11.0	11.0
97	West Meadow Lake	11.0	11.0
98	Nielsen Pond	10.7	12.0
99	Lake Holloway	10.6	10.6
100	Countryside Lake	10.5	12.1
101	Crooked Lake	10.2	12.5
102	College Trail Lake	10.0	10.0
103	Lake Lakeland Estates	10.0	11.5
104	Valley Lake	9.9	9.9
105	Werhane Lake	9.8	12.0
106	Big Bear Lake	9.5	11.0
107	Little Bear Lake	9.5	11.0
108	Loch Lomond	9.4	12.1
109	Columbus Park Lake	9.2	9.2
110	Sylvan Lake	9.2	9.2
111	Fischer Lake	9.0	11.0
112	Grandwood Park Lake	9.0	11.0
113	Lake Fairfield	9.0	10.4
114	McDonald Lake 1	8.9	10.0
115	East Meadow Lake	8.5	8.5
116	Lake Christa	8.5	9.8
117	Lake Farmington	8.5	9.8
118	Lucy Lake	8.5	9.8
119	South Churchill Lake	8.5	8.5
120	Bittersweet Golf Course #13	8.1	8.1
121	Woodland Lake	8.1	9.9
122	Albert Lake	7.5	8.7
123	Banana Pond	7.5	9.2
124	Fairfield Marsh	7.5	8.7
125	Lake Eleanor	7.5	8.7
126	Lake Louise	7.5	8.7
127	Patski Pond	7.1	7.1
128	Rasmussen Lake	7.1	7.1
129	Slough Lake	7.1	7.1
130	Lucky Lake	7.0	7.0
131	Lake Forest Pond	6.9	8.5
132	Leisure Lake	6.4	9.0
133	Peterson Pond	6.0	8.5
134	Gages Lake	5.8	10.0
135	Grassy Lake	5.8	7.1
136	Slocum Lake	5.8	7.1

Table 6. Continued.

Rank	Lake Name	FQI (w/A)	FQI (native)
137	Deer Lake Meadow Lake	5.2	6.4
138	Drummond Lake	5.0	7.1
139	IMC Lake	5.0	7.1
140	ADID 127	5.0	5.0
141	Liberty Lake	5.0	5.0
142	Oak Hills Lake	5.0	5.0
143	Forest Lake	3.5	5.0
144	Sand Pond (IDNR)	3.5	5.0
145	Half Day Pit	2.9	5.0
146	Lochanora Lake	2.5	5.0
147	Hidden Lake	0.0	0.0
148	North Tower Lake	0.0	0.0
149	Potomac Lake	0.0	0.0
150	St. Mary's Lake	0.0	0.0
151	Waterford Lake	0.0	0.0
152	Willow Lake	0.0	0.0
	Mean	**13.6**	**14.9**
	Median	**12.5**	**14.3**

APPENDIX A. METHODS FOR FIELD DATA COLLECTION AND LABORATORY ANALYSES

Water Sampling and Laboratory Analyses

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

Plant Sampling

In order to randomly sample each lake, mapping software (ArcMap 9.1) overlaid a grid pattern onto a 2006 aerial photo of Lake County and placed points 60 or 30 meters apart, depending on lake size. Plants were sampled using a garden rake fitted with hardware cloth. The hardware cloth surrounded the rake tines and is tapered two feet up the handle. A rope was tied to the end of the handle for retrieval. At designated sampling sites, the rake was tossed into the water, and using the attached rope, was dragged across the bottom, toward the boat. After pulling the rake into the boat, plant coverage was assessed for overall abundance. Then plants were individually identified and placed in categories based on coverage. Plants that were not found on the rake but were seen in the immediate vicinity of the boat at the time of sampling were also recorded. Plants difficult to identify in the field were placed in plastic bags and identified with plant keys after returning to the office. The depth of each sampling location was measured either by a hand-held depth meter, or by pushing the rake straight down and measuring the depth along the rope or rake handle. One-foot increments were marked along the rope and rake handle to aid in depth estimation.

Wildlife Assessment

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

Table A1. Analytical methods used for water quality parameters.

Parameter	***Method***
Temperature	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Dissolved oxygen	Hydrolab DataSonde ®4a or YSI 6600 Sonde®
Nitrate and Nitrite nitrogen	USEPA 353.2 rev. 2.0 EPA-600/R-93/100 Detection Limit = 0.05 mg/L
Ammonia nitrogen	SM 18^{th} ed. Electrode method, #4500 NH_3-F Detection Limit = 0.1 mg/L
Total Kjeldahl nitrogen	SM 18^{th} 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 18^{th} ed, Method #2540B
Total suspended solids	SM 18^{th} ed, Method #2540D Detection Limit = 0.5 mg/L
Chloride	SM 18^{th} ed, Method #4500C1-D
Total volatile solids	SM 18^{th} ed, Method #2540E, from total solids
Alkalinity	SM 18^{th} ed, Method #2320B, patentiometric titration curve method
Conductivity	Hydrolab DataSonde® 4a or YSI 6600 Sonde®
Total phosphorus	SM 18^{th} ed, Methods #4500-P B 5 and #4500-P E Detection Limit = 0.01 mg/L
Soluble reactive phosphorus	SM 18^{th} 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 WOOSTER LAKE, 2007.

Wooster Lake 2007 Multiparameter data

Date MMDDYY	Text Depth feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý	Depth of Light Meter feet	% Light Transmission Average	Extinction Coefficient
											0.26
41607	0	0.38	7.07	12.69	107.7	0.8075	8.30	3770	Surface		
41607	1	1.06	7.05	12.71	107.8	0.8071	8.30	3962	Surface	100%	
41607	2	2.03	7.06	12.68	107.6	0.8074	8.30	1720	0.28	46%	2.98
41607	3	2.99	7.00	12.71	107.6	0.8084	8.29	1144	1.24	30%	0.33
41607	4	4.02	6.94	12.68	107.2	0.8069	8.29	732	2.27	19%	0.20
41607	6	6.02	6.87	12.54	105.9	0.8070	8.28	588	4.27	16%	0.05
41607	8	8.07	6.75	12.46	104.9	0.8077	8.28	449	6.32	12%	0.04
41607	10	10.05	6.67	12.50	105.0	0.8073	8.27	166	8.30	4%	0.12
41607	12	12.02	6.61	12.57	105.4	0.8074	8.27	114	10.27	3%	0.04
41607	14	14.03	6.43	12.43	103.8	0.8091	8.26	131	12.28	3%	-0.01
41607	16	16.01	6.41	12.28	102.4	0.8097	8.24	79	14.26	2%	0.04
41607	18	18.01	6.38	12.09	100.8	0.8125	8.24	48	16.26	1.3%	0.03
41607	20	20.06	6.15	11.56	95.8	0.8137	8.19	37	18.31	1.0%	0.01
41607	22	22.01	5.99	11.41	94.2	0.8093	8.16	24	20.26	0.6%	0.02
41607	24	24.09	5.69	11.11	91.0	0.8088	8.13	16	22.34	0%	0.02
41607	26	26.08	5.41	10.72	87.2	0.8082	8.09	11	24.33	0%	0.02
41607	28	28.05	5.32	10.29	83.6	0.8089	8.05	6	26.30	0%	0.02

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
											0.45
51507	0	0.27	19.01	9.21	102.6	0.0124	8.49	3110	Surface		
51507	1	1.05	19.06	9.08	101.5	0.8180	8.57	2443	Surface	100%	
51507	2	2.06	19.01	9.23	103.1	0.8179	8.61	392	0.31	16%	5.90
51507	3	3.06	19.03	9.21	102.9	0.8182	8.63	407	1.31	17%	-0.03
51507	4	4.06	18.92	9.02	100.6	0.8182	8.65	494	2.31	20%	-0.08
51507	6	6.03	18.90	9.02	100.5	0.8185	8.66	363	4.28	15%	0.07
51507	8	7.97	18.84	8.96	99.7	0.8188	8.66	128	6.22	5%	0.17
51507	10	10.02	18.75	8.98	99.8	0.8198	8.66	81	8.27	3%	0.06
51507	12	12.05	17.08	8.10	87.0	0.8236	8.53	74	10.30	3%	0.01
51507	14	14.00	14.63	7.04	71.7	0.8273	8.37	53	12.25	2%	0.03
51507	16	16.01	11.58	5.90	56.2	0.8237	8.03	30	14.26	1%	0.04
51507	18	18.02	9.16	5.42	48.8	0.8245	7.84	18	16.27	1%	0.03
51507	20	20.01	8.19	5.21	45.8	0.8213	7.74	15	18.26	0.6%	0.01
51507	22	22.02	7.17	4.47	38.4	0.8243	7.63	8	20.27	0.3%	0.03
51507	24	24.04	6.53	0.68	5.7	0.8295	7.49	5	22.29	0%	0.02
51507	26	26.04	6.21	0.26	2.2	0.8361	7.38	2	24.29	0%	0.04

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
											0.47
61907	0	0.43	25.91	7.48	95.3	0.7928	8.49	3524	Surface		
61907	1	1.04	25.94	7.56	96.3	0.7935	8.47	3527	Surface	100%	
61907	2	2.02	25.92	7.53	96.0	0.7929	8.47	1374	0.27	39%	3.49
61907	3	3.11	25.93	7.51	95.7	0.7936	8.46	923	1.36	26%	0.29
61907	4	4.06	25.93	7.49	95.5	0.7946	8.46	603	2.31	17%	0.18
61907	6	6.02	25.90	7.51	95.7	0.7944	8.45	252	4.27	7%	0.20
61907	8	8.13	23.35	5.52	67.0	0.8066	8.21	106	6.38	3%	0.14
61907	10	10.02	22.09	3.85	45.7	0.8055	8.10	37	8.27	1.0%	0.13
61907	12	12.05	21.13	1.46	16.9	0.8102	7.94	9	10.30	0.3%	0.14
61907	14	14.07	19.14	0.20	2.2	0.8200	7.81	4	12.32	0%	0.07
61907	16	16.08	16.07	0.18	1.9	0.8338	7.71	2	14.33	0%	0.05
61907	18	18.05	11.76	0.15	1.5	0.8342	7.52	1	16.30	0%	0.04
61907	20	20.04	9.75	0.14	1.3	0.8381	7.45	1	18.29		
61907	22	22.04	8.43	0.14	1.2	0.8356	7.39	1	20.29		
61907	24	24.05	7.61	0.14	1.2	0.8406	7.33	1	22.30		
61907	26	26.01	6.99	0.14	1.2	0.8498	7.23	1	24.26		
61907	28	28.04	6.74	0.12	1.0	0.8641	7.13	1	26.29		

	Text								Depth of	% Light	
									Light		
Date	Depth	Dep25	Temp	DO	DO%	SpCond	pH	PAR	Meter	Transmission	Extinction
MMDDYY	feet	feet	øC	mg/l	Sat	mS/cm	Units	æE/s/mý	feet	Average	Coefficient
											0.75
71707	0	0.29	24.70	7.88	93.5	0.7954	8.25	199	Surface		
71707	1	1.05	24.71	7.88	93.6	0.7953	8.28	123	Surface	100%	
71707	2	2.01	24.71	7.83	93.0	0.7954	8.29	29	0.26	24%	5.56
71707	3	3.06	24.72	7.87	93.5	0.7967	8.30	28	1.31	23%	0.03
71707	4	4.05	24.71	7.84	93.1	0.7967	8.32	25	2.30	20%	0.05
71707	6	6.03	24.71	7.95	94.4	0.7973	8.32	15	4.28	12%	0.12
71707	8	8.10	24.60	7.54	89.4	0.7992	8.27	9	6.35	7%	0.08
71707	10	10.05	24.08	5.39	63.3	0.8032	8.05	6	8.30	5%	0.05
71707	12	12.01	22.83	3.52	40.3	0.8078	7.87	4	10.26	3%	0.04
71707	14	14.06	19.95	2.39	25.9	0.8197	7.78	2	12.31	2%	0.06
71707	16	16.06	15.99	0.50	5.0	0.8328	7.50	0	14.31		
71707	18	18.01	13.02	0.38	3.6	0.8428	7.39	0	16.26		
71707	20	20.02	10.40	0.32	2.9	0.8451	7.27	0	18.27		
71707	22	22.00	9.27	0.25	2.2	0.8494	7.16	0	20.25		
71707	24	24.02	7.90	0.24	2.0	0.8666	7.03	0	22.27		
71707	26	25.98	7.29	0.22	1.8	0.8775	6.95	0	24.23		
71707	28	28.02	7.17	0.17	1.4	0.8798	6.90	0	26.27		

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
											1.34
81407	0	0.37	25.90	4.74	57.6	0.6709	7.45	1315	Surface		
81407	1	1.08	25.91	4.60	55.9	0.6704	7.53	1189	Surface	100%	
81407	2	2.08	25.91	4.46	54.2	0.6698	7.60	215	0.33	18%	5.18
81407	3	3.08	25.90	4.28	52.0	0.6695	7.62	110	1.33	9%	0.50
81407	4	4.14	25.90	4.29	52.1	0.6699	7.64	44	2.39	4%	0.38
81407	6	6.07	25.89	4.20	51.0	0.6703	7.66	9	4.32	0.8%	0.37
81407	8	8.06	25.85	4.05	49.2	0.6725	7.69	2	6.31	0.2%	0.24
81407	10	10.07	24.13	0.60	7.1	0.7630	7.41	0	8.32		
81407	12	11.99	22.90	0.12	1.4	0.7892	7.38	0	10.24		
81407	14	14.01	20.68	0.10	1.1	0.8095	7.33	0	12.26		
81407	16	16.05	18.23	0.08	0.9	0.8235	7.27	0	14.30		
81407	18	18.00	14.80	0.07	0.7	0.8326	7.09	0	16.25		
81407	20	20.03	11.91	0.06	0.5	0.8446	6.95	0	18.28		
81407	22	22.04	10.69	0.05	0.5	0.8456	6.89	0	20.29		
81407	24	24.07	8.79	0.06	0.5	0.8575	6.76	0	22.32		
81407	26	26.00	8.10	0.05	0.4	0.8692	6.69	0	24.25		
81407	28	27.99	7.78	0.05	0.4	0.8820	6.64	0	26.24		

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
											0.73
91807	0	0.37	18.49	7.92	82.9	0.6541	7.81	3005	Surface		
91807	1	1.08	18.48	7.85	82.1	0.6541	7.84	2931	Surface	100%	
91807	2	2.10	18.48	7.78	81.3	0.6545	7.84	616	0.35	97%	4.46
91807	3	3.04	18.48	7.67	80.2	0.6545	7.84	374	1.29	86%	0.39
91807	4	4.05	18.47	7.71	80.6	0.6543	7.84	207	2.30	52%	0.26
91807	6	6.04	18.47	7.70	80.5	0.6544	7.77	58	4.29	31%	0.30
91807	8	8.05	18.46	7.60	79.4	0.6546	7.85	18	6.30	21%	0.19
91807	10	10.11	18.43	7.55	78.9	0.6548	7.84	6	8.36	14%	0.13
91807	12	12.06	18.43	7.54	78.8	0.6549	7.84	2	10.31	7%	0.11
91807	14	14.02	18.35	7.18	74.8	0.6561	7.82	1	12.27	0%	0.06
91807	16	16.01	17.58	0.30	3.1	0.7151	7.35	1	14.26		
91807	18	18.06	14.85	0.12	1.1	0.8519	7.14	1	16.31		
91807	20	20.05	12.37	0.09	0.9	0.8611	6.99	1	18.30		
91807	22	22.03	9.78	0.08	0.7	0.8770	6.84	0	20.28		
91807	24	24.01	9.28	0.07	0.6	0.8882	6.72	1	22.26		
91807	26	26.02	8.81	0.07	0.6	0.9001	6.68	0	24.27		
91807	28	28.06	8.32	0.07	0.6	0.9149	6.60	1	26.31		

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
											0.55
102307	0	0.24	13.21	5.23	51.4	0.7061	7.67	3156	Surface		
102307	1	1.56	14.45	4.71	47.6	0.6857	7.65	2962	Surface	100%	
102307	2	2.03	14.46	4.68	47.3	0.6853	7.64	900	0.28	30%	4.25
102307	3	2.97	14.46	4.66	47.1	0.6850	7.64	609	1.22	21%	0.32
102307	4	3.98	14.45	4.67	47.2	0.6850	7.63	379	2.23	13%	0.21
102307	6	6.01	14.45	4.55	46.0	0.6847	7.63	135	4.26	5%	0.24
102307	8	7.99	14.44	4.49	45.3	0.6850	7.62	57	6.24	2%	0.14
102307	10	10.00	14.42	4.39	44.3	0.6854	7.61	23	8.25	0.8%	0.11
102307	12	12.01	14.39	4.39	44.3	0.6856	7.60	10	10.26	0.3%	0.08
102307	14	13.98	14.36	4.32	43.6	0.6859	7.59	5	12.23	0%	0.06
102307	16	16.06	14.35	4.25	42.9	0.6858	7.59	3	14.31	0%	0.04
102307	18	18.07	14.32	4.23	42.6	0.6860	7.58	1	16.32	0%	0.07
102307	20	20.00	14.28	4.17	42.0	0.6864	7.57	1	18.25		
102307	22	22.04	14.25	4.27	43.0	0.6853	7.57	1	20.29		
102307	24	23.99	10.95	0.29	2.7	0.8736	7.05	0	22.24		
102307	26	25.97	9.43	0.09	0.8	0.9053	6.92	0	24.22		

APPENDIX C. INTERPRETING YOUR LAKE’S WATER QUALITY DATA.

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

The following pages will discuss the different water quality parameters measured by Lake County Health Department staff, how these parameters relate to each other, and why the measurement of each parameter is important. The median values (the middle number of the data set, where half of the numbers have greater values, and half have lesser values) of data collected from Lake County lakes from 2000-2005 will be used in the following discussion.

Temperature and Dissolved Oxygen:

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

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

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

Nutrients:

Phosphorus:

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

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

Lakes with an average phosphorus concentration greater than 0.05 mg/L are considered nutrient rich. The median near surface total phosphorus (TP) concentration in Lake County lakes from 2000-2005 is 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 2000-2005 was 0.174 mg/L and ranged from a minimum of 0.012 mg/L in West Loon Lake to a maximum of 3.880 mg/L in Taylor Lake.

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

Nitrogen:

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

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

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

Solids:

Although several forms of solids (total solids, total suspended solids, total volatile solids, total dissolved solids) were measured each month by the Lakes Management Staff, total suspended solids (TSS) and total volatile solids (TVS) have the most impact on other variables and on the lake as a whole. TSS are particles of algae or sediment suspended in the water column. High TSS concentrations can result from algae blooms, sediment resuspension, and/or the inflow of turbid water, and are typically associated with low water clarity and high phosphorus concentrations in many lakes in Lake County. Low water clarity and high phosphorus concentrations, in turn, exacerbate the high TSS problem by leading to reduced plant density (which stabilize lake sediment) and increased occurrence of algae blooms. The median TSS value in epilimnetic waters in Lake County is 7.9 mg/L, ranging from below the 1 mg/L detection limit (10 lakes) 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 mg/L, ranging from 34 mg/L in Pulaski Pond to 298 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 3.17 feet. From 2000-2005, Fairfield Marsh and Patski Pond had the lowest Secchi depths (0.33 feet) and Bangs Lake had the highest (29.23 feet). As an example of the difference in Secchi depth based on plant coverage, South Churchill Lake, which had no plant coverage and large numbers of Common Carp in 2003 had an average Secchi depth of 0.73 feet (over four times lower than the county average), while Deep Lake, which had a diverse plant community and few carp had an average 2003 Secchi depth of 12.48 feet (almost four times higher than the county average).

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

Alkalinity, Conductivity, Chloride, pH:

Alkalinity:

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

Conductivity and Chloride:

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

pH:

pH is the measurement of hydrogen ion (H^+) activity in water. The pH of pure water is neutral at 7 and is considered acidic at levels below 7 and basic at levels above 7. Low pH levels of 4-5 are toxic to most aquatic life, while high pH levels (9-10) are not only toxic to aquatic life but may also result in the release of phosphorus from lake sediment. The presence of high plant densities can increase pH levels through photosynthesis, and lakes dominated by a large amount of plants or algae can experience large fluctuations in pH levels from day to night, depending on the rates of photosynthesis and respiration. Few, if any pH problems exist in Lake County lakes. Typically, the flooded gravel mines in the county are more acidic than the glacial lakes as they have less biological activity, but do not usually drop below pH levels of 7. The median near surface pH value of Lake County lakes is 8.30, with a minimum of 7.06 in Deer Lake and a maximum of 10.28 in Round Lake Marsh North.

Eutrophication and Trophic State Index:

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

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

Table 1. Trophic State Index (TSI).

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

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

2000 - 2007 Water Quality Parameters, Statistics Summary

ALKoxic
<=3ft00-2007

Average	**167.3**	
Median	**162.0**	
Minimum	**64.9**	**IMC**
Maximum	**330.0**	**Flint Lake**
STD	**42.0**	
n =	**803**	

ALKanoxic
2000-2007

Average	**200**	
Median	**193**	
Minimum	**103**	**Heron Pond**
Maximum	**470**	**Lake Marie**
STD	**48**	
n =	**253**	

Condoxic
<=3ft00-2007

Average	**0.8856**	
Median	**0.8038**	
Minimum	**0.2542**	**Broberg Marsh**
Maximum	**6.8920**	**IMC**
STD	**0.5243**	
n =	**802**	

Condanoxic
2000-2007

Average	**1.0035**	
Median	**0.8340**	
Minimum	**0.3210**	**Lake Kathyrn**
Maximum	**7.4080**	**IMC**
STD	**0.7787**	
n =	**252**	

NO3-N,
Nitrate+Nitrite,oxic
<=3ft00-2007

Average	**0.515**	
Median	**0.150**	
Minimum	**<0.05**	***ND**
Maximum	**9.670**	**South Churchill Lake**
STD	**1.082**	
n =	**808**	

*ND = Many lakes had non-detects (74.5%)
Only compare lakes with detectable
concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

NH3-Nanoxic
2000-2007

Average	**2.070**	
Median	**1.340**	
Minimum	**<0.1**	***ND**
Maximum	**18.400**	**Taylor Lake**
STD	**2.296**	
n =	**252**	

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

pHoxic
<=3ft00-2007

Average	**8.31**	
Median	**8.31**	
Minimum	**7.07**	**Bittersweet #13**
Maximum	**10.28**	**Round Lake Marsh North**
STD	**0.44**	
n =	**797**	

pHanoxic
2000-2007

Average	**7.22**	
Median	**7.21**	
Minimum	**6.24**	**Banana Pond**
Maximum	**8.48**	**Heron Pond**
STD	**0.41**	
n =	**252**	

All Secchi
2000-2007

Average	**4.57**	
Median	**3.28**	
Minimum	**0.33**	**Fairfield Marsh, Patski Pond**
Maximum	**21.33**	**Bangs Lake**
STD	**3.81**	
n =	**750**	

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2000 - 2007 Water Quality Parameters, Statistics Summary (continued)

	TKNoxic <=3ft00-2007	
Average	**1.457**	
Median	**1.220**	
Minimum	**<0.1**	***ND**
Maximum	**10.300**	**Fairfield Marsh**
STD	**0.830**	
n =	**808**	

*ND = 4.5% Non-detects from 16 different lakes

	TKNanoxic 2000-2007	
Average	**2.910**	
Median	**2.320**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.272**	
n =	**252**	

*ND = 2.8% Non-detects from 4 different lakes

	TPoxic <=3ft00-2007	
Average	**0.100**	
Median	**0.063**	
Minimum	**<0.01**	***ND**
Maximum	**3.880**	**Albert Lake**
STD	**0.171**	
n =	**808**	

*ND = 2.4% Non-detects from 7 different lakes (Carina, Minear,& Stone Quarry)

	TPanoxic 2000-2007	
Average	**0.294**	
Median	**0.177**	
Minimum	**0.012**	**Indep. Grove and W. Loon Lake**
Maximum	**3.800**	**Taylor Lake**
STD	**0.380**	
n =	**252**	

	TSSall <=3ft00-2007	
Average	**15.5**	
Median	**8.0**	
Minimum	**<0.1**	***ND**
Maximum	**165.0**	**Fairfield Marsh**
STD	**20.3**	
n =	**814**	

*ND = 1.8% Non-detects from 11 different lakes

	TVSoxic <=3ft00-2007	
Average	**135.3**	
Median	**132.0**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**298.0**	**Fairfield Marsh**
STD	**39.9**	
n =	**758**	

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 <=3ft00-2007	
Average	**232**	
Median	**119**	
Minimum	**41**	**Timber Lake (N)**
Maximum	**2390**	**IMC**
STD	**400**	
n =	**102**	

	CLoxic <=3ft00-2007	
Average	**211**	
Median	**158**	
Minimum	**30**	**White Lake**
Maximum	**2760**	**IMC**
STD	**247**	
n =	**411**	

77 of 163 lakes had anoxic conditions
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 2000-2007 (n=1363).

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

LCHD Lakes Management Unit ~ 12/17/2007

LakeCounty
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APPENDIX E. GRANT PROGRAM OPPORTUNITES.

Table E1. 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 E1. Continued

Grant Program Name	Funding Source	Contact Information	Funding Focus: Water Quality/ Wetland	Habitat	Erosion	Flooding	Cost Share
Northeast Illinois Wetland Conservation Account	USFWF	847-381-2253	X				
Partners for Fish and Wildlife	USFWS	http://ecos.fws.gov/partners/		X			> 50%
River Network's Watershed Assistance Grants Program	River Network	http://www.rivernetwork.org	X	X	X		na
Section 206: Aquatic Ecosystems Restoration	USACE	312-353-6400, 309-794-5590 or 314-331-8404		X			35%
Section 319: Non-Point Source Management Program	IEPA	http://www.epa.state.il.us/water/financial-assistance/non point.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

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