

The Lakes of Maple Grove

Lake Water Quality Report for 2020

Maple Grove Lake Quality Commission

DRAFT

Prepared February 2021
by Steve McComas, Blue Water Science

The Lakes of Maple Grove Status Report - 2020

Prepared for the Maple Grove Lake Quality Commission.

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Introduction and Background

The City of Maple Grove has numerous lakes and smaller water bodies within the City limits. In 2020, a total of 12 lakes were monitored. Blue Water Science monitored 7 lakes over the summer months, including Cedar Island, Cook, Edward, Norwood, and the 3 Arbor Lakes. Three Rivers Park District sampled Fish, Rice, and Weaver Lakes. Shingle Creek Watershed Management Commission sampled Eagle and Pike lakes. This report summarizes the summer sampling data from May-September for all 12 lakes. A summary of general lake characteristics is shown in Table 1.

Table 1. General lake characteristics of Maple Grove Lakes. Watershed acreage is from the 1996 Stormwater Management Plan.

Lake	State ID Number	Watershed District	Size (acres)	Maximum Depth (feet)	Mean Depth (feet)	Total Watershed Size (ac)	Lake Classification (shallow or deep)	Lake Water Retention Time (years)
Cedar Island	27-119	Shingle Creek	86	7.0*	4.3	389	shallow	1.8
Cook	27-0120	Elm Creek	16.5	20	8	196	shallow	2.3
Eagle	27-111	Shingle Creek	285	37	10.5	1,838	deep	3.1
Edward	27-121	Elm Creek	33	9.5	5.5	102	shallow	
Fish	27-118	Elm Creek	239	48*	17.7	860	deep	9.1
Pike	27-111-02	Shingle Creek	75	25	4.9	746	shallow	1.0
Rice	27-116	Elm Creek	333	11	6.6	13,400	shallow	0.3
Weaver	27-117	Elm Creek	165	57*	21*	320	deep	20

* from Hennepin Conservation District

**from Met Council

Guide to Interpreting Water Quality Information

SD = Secchi disc - a black and white disc lowered into the water until it can't be seen from the surface. This is the Secchi disc transparency reading.

TP = Total phosphorus - the fertilizing nutrient most responsible for causing excess algae to grow.

Chl a = Chlorophyll a - the green pigment in algae that is analyzed in the laboratory. It is correlated to the amount of algae in a lake.

ppb = parts per billion - concentrations of phosphorus and chlorophyll are often reported in ppb.

Lake Goals (based on eutrophication criteria for North Central Hardwood Forest Ecoregion)

- Secchi disc: 5-7 feet of transparency as a summer average.
- Total phosphorus: try to keep phosphorus concentrations below 40 ppb as a summer average for deep lakes and less than 60 ppb for shallow lakes.
- Chlorophyll a: try to keep chlorophyll concentrations below 14 ppb as a summer average for deep lakes and less than 20 ppb for shallow lakes.

2020 Summer Sampling Results - Status Report

The objectives of the 2020 water quality sampling program were to check the health of the lakes in the City of Maple Grove and to see if they were improving, degrading, or staying the same. Water quality parameters monitored included Secchi disc (measure of water clarity), total phosphorus (measure of the primary nutrient that stimulates algal growth), and chlorophyll (measure of the amount of algae in the water).

Water quality was checked from May through September and results are shown in Table 2. North Arbor Lake had the best transparency and Cedar Island had the lowest transparency in 2020 (Tables 2 and 3).

Table 2. Water chemistry summer averages for Maple Grove Lakes in 2020 (source: Three Rivers Park District collected data for Fish, Rice, and Weaver Lakes [sampled on 11 dates]. Shingle Creek Watershed Commission collected data for Eagle and Pike Lakes. Other data collected by Blue Water Science [sampled on 5 dates]).

	May - Sept Averages, 2020		
	Secchi Disc (ft)	Total Phosphorus (ppb)	Chl a (ppb)
Cedar Island	2.5	129	20
Cook	5.4	96	7
Eagle**			
Edward	6.9	20	2
Fish*	9.1	22	9.6
Pike**			
Rice*	3.0	205	84
Weaver*	6.1	27	15
North Arbor	20	20	3
South Arbor	14	12	4
West Arbor	8.8	24	11
Norwood	16	12	2

*sampled by Three Rivers Park District

**sampled by Shingle Creek Watershed Management Commission

Table 3. Maple Grove water quality data 2020. Results for secchi disc (SD) are in feet, total phosphorus (TP) are in ppb, chlorophyll a (chl) are in ppb, chlorides (chlor) are in ppm, and conductivity (cond) are in μ S. Data for Fish, Rice, and Weaver are from Three Rivers Park District. Data for Eagle and Pike are from Shingle Creek Watershed Commission.

Lakes	Cedar Island					Cook					Eagle				Edward				Fish			Pike				Rice			Weaver					
	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	SD	TP	Chl
May																																		
week 1*																					5.9	24	18						4.6	35	7.9	8.2	34	19
week 2																																		
week 3	3.7	63	10.7	105	446	5.4	51	16	39.8	439						8.1	20	1	39.9	358	8.5	31	3.8						5.9	54	6.9	7.5	38	17
week 4																																		
June																																		
week 1																					18.4	16	2.3						4.3	49	34	4.3	30	25
week 2																																		
week 3	2.5	328	3.6		517	6.1	51	1.8		376						6.5	24	3.6		283	7.5	20	12						4.3	76	23	4.6	40	25
week 4																					10.2	22	7.2						3.6	93	51	5.6	29	10
July																																		
week 1																																		
week 2																					9.8	24	5.3											
week 3																																		
week 4	1.6	105	36.5		470	4.2	208*	11		370						8.5	17	3.6		254	10.8	21	6.7						1.6	324	221	4.6	20	14
August																																		
week 1																																		
week 2																					8.2	22	12						2.3	560	74	6.2	20	13
week 3																																		
week 4	2.2	99	25.8		466	5.9	130	1.8		337						6.1	21	1.8		349	6.2	25	15						2.0	377	131	6.2	30	13
September																																		
week 1																																		
week 2																																		
week 3	2.3	51	24.9		538	5.5	42	5.3		355						5.5	20	<1		343														
week 4																					8.9	21	6.3						1.6	204	57	7.9	23	10
May-September Average																																		
	2.5	129	20	105	487	5.4	96	7	40	375	0.0	0	0	0	0	6.9	20	2	40	317	9.1	22	10	0.0	0	0	0	0	3.0	205	84	6.1	27	15

* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4

Lakes	North Arbor					South Arbor					West Arbor					Norwood				
	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond
May																				
week 1*																				
week 2																				
week 3	14.4	13	8	290	1185	13.6	20	5.3	330	1335	13	17	8	39	488	17.1	17	2.7	82.7	485
week 4																				
June																				
week 1																				
week 2																				
week 3	22.1	11	<1		1190	11.6	15	2.7		1298	12.9	16	1.8		436	15	17	2.7		441
week 4																				
July																				
week 1																				
week 2																				
week 3																				
week 4	20.6	63	1.8		1158	18.2	10	<1		1131	9.4	24	8		350	16.8	11	3.6		435
August																				
week 1																				
week 2																				
week 3																				
week 4	23.2	10	1.8		1136	16.4	14	1.8		1295	5.2	30	17.8		385	14.8	15	1.8		502
September																				
week 1																				
week 2																				
week 3	20.6	<2	<1		1135	9.3	<2	8.9		1387	3.8	33	18.7		402	14.4	<2	<1		
week 4																				
May-September Average																				
	20	20	3	290	1161	14	12	4	330	1289	8.9	24	11	39	412	16	12	2	83	466

* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4

Eurasian Watermilfoil (EWM) Monitoring Summary

Eurasian watermilfoil (EWM) has been found in 8 lakes in Maple Grove - Fish, Eagle, Pike, Rice, Weaver, and all three Arbor Lakes. EWM in all 8 lakes is past the point of eradication, but typically nuisance growth is limited to several shoreline areas. Eagle Lake has a small infestation and little nuisance growth. Rice Lake had a new infestation in 1996 but milfoil was not found in 1997, 1998, or after 2007. Overall observations are summarized in Table 4.

Table 4. Summary of Eurasian watermilfoil observations for Maple Grove Lakes in 2020.

	2020 Summer
Arbor - North	Eurasian watermilfoil found in 2003
Arbor - South	Eurasian watermilfoil found in 2004
Arbor - West	Eurasian watermilfoil found in 2002
Cedar Island Lake	No Eurasian watermilfoil found
Cook Lake	No Eurasian watermilfoil found
Eagle Lake	Scattered Eurasian watermilfoil, found in 1992
Lake Edward	No Eurasian watermilfoil found
Fish Lake	Scattered Eurasian watermilfoil, found in 1993
Norwood Lake	No Eurasian watermilfoil found
Pike Lake	Scattered Eurasian watermilfoil, found in 1992
Rice Lake	Scattered Eurasian watermilfoil, found in 1996
Weaver Lake	Eurasian watermilfoil found in 2012

Water Quality Summaries

Secchi Disc, Phosphorus, and Chlorophyll a

A 26 year summary of water quality results for Maple Grove Lakes (except for the 3 Arbor lakes and Norwood Lake) is shown in Table 5. City lakes have been stable in regard to water quality except for Lake Edward and Rice Lake. Fluctuating clarity in Lake Edward may be influenced by previous fish kills. Rice and Cedar Island Lakes have the highest phosphorus concentrations in town and Fish and Edward have the lowest.

Table 5. Growing season (May - September) averages for the Maple Grove Lakes [SD = secchi disc (ft), TP = total phosphorus (ppb), Chl a = chlorophyll a (ppb)].

	Cedar Island			Cook			Eagle			Edward			Fish			Pike			Rice			Weaver		
	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
1995	2.0	106	73	--	--	--	5.8	51	7	5.0	61	16	6.4	51	16	3.9	78	20	2.2	233	44	7.8	40	18
1996	1.8	--	--	--	--	--	5.9	33	9	8.1	104	2	7.0	55	9	3.4	66	23	2.9	453	37	6.5	35	6
1997	1.5	117	40	--	--	--	5.4	31	11	5.8	47	4	5.4	50	17	3.6	76	24	2.3	316	39	6.6	32	10
1998	1.4	102	44	--	--	--	5.9	29	11	4.1	46	11	5.9	46	13	3.3	70	31	3.3	469	20	6.6	40	14
1999	1.1	203	66	--	--	--	5.9	53	23	4.5	43	13	4.8	45	19	3.9	74	35	3.5	248	35	6.4	42	21
2000	--	--	--	--	--	--	9.5	36	5	5.5	45	6	4.6	53	19	4.3	65	30	5.2	175	23	6.6	43	15
2001	2.1	78	47	--	--	--	11	34	18	7.1	26	4	5.4	38	17	4.9	83	30	4.5	339	22	5.5	42	38
2002	1.8	90	55	--	--	--	3.3	42	67	6.7	48	13	3.6	51	26	--	--	--	4.2	152	18	8.3	43	20
2003	1.1	163	116	--	--	--	7.0	44	31	3.2	118	102	4.5	55	37	3.5	80	60	3.2	185	35	6.6	46	31
2004	1.0	147	133	6.2	26	4	6.8	45	28	2.2	77	47	7.9	47	29	3.5	97	65	3.9	207	36	8.9	51	40
2005	1.1	123	134	6.6	51	2	8.8	18	20	2.4	104	61	5.4	40	25	3.5	95	54	4.6	214	44	16.5	23	4
2006	0.7	161	173	7.5	22	33	5.8	47	36	1.9	95	55	3.9	49	29	4.3	89	47	3.0	187	50	14.4	25	7
2007	0.8	240	194	7.8	19	6	--	--	--	1.6	115	62	4.1	51	31	--	--	--	2.2	206	48	9.0	35	7
2008	0.7	455	226	8.0	20	2	--	--	--	3.2	105	67	2.7	47	17	--	--	--	2.6	436	51	8.0	30	8
2009	0.6	330	147	10.6	23	3	5.7	44	30	2.2	149	82	4.6	57.9	17	3.5	80.6	20	3.5	395	151	9.2	30.8	5
2010	0.7	143	67	7.4	18	3	5.9	50	21	3.6	88	58	4.9	48	14	3.9	89	29	3.4	227	57	13.1	31	5
2011	1.8	94	61	5.7	32	3	5.4	38	25	2.5	94	40	6.2	50	19	3.6	52	14	3.7	153	36	7.9	30	8
2012	0.9	130	58	5.0	34	3	5.7	42	25	3.4	72	41	5.5	42	26	3.5	34.8	15	2.5	256	53	7.6	31	11
2013	1.0	138	49	5.6	31	2	5.7	30	6	3.2	97	50	4.9	53	33	3.9	66	14	2.5	326	114	7.2	37	17
2014	1.7	88	27	6.1	36	2	6.2	34	7	4.7	43	7	7.1	40	22	4.5	48	8	4.2	232	60	6.9	37	21
2015	1.0	133	65	5.6	33	3.1	4.7	41	10	4.8	56	7.7	6.1	44	25	4.3	67	14	2.2	236	88	6.7	37	15
2016	1.3	153	68	5.0	45	2.2	6.7	47	11	6.1	67	13.1	6.6	42	21	4.8	63	9	2.4	168	50	10.9	30	8
2017	1.4	111	35	4.7	33	4	8.6	37	17	6.3	41	7	7.0	50	18	5.3	82	40	3	162	56	7.7	33	14
2018	1.5	123	73	6.2	29	4	7.8	33	7	6.7	29	1	7.5	30	15	5.2	67	8	3.0	151	45	7.6	31	12
2019	1.9	110	62	5.7	35	4	5.3	39	11	5.2	30	3	6.8	25	19	51	70	9	3.1	116	49	12.9	20	12
2020	2.5	129	20	5.4	96	7				6.9	20	2	9.1	22	10				3.0	205	84	6.1	27	15

Cedar Island Lake data: Met Council - 1995; MPCA - 1996; and Blue Water Science - 1997 through 2020.

Fish and Weaver Lake data collected by Three Rivers Park District.

Rice Lake data: Met Council and by Three Rivers Park District

Eagle and Pike Lake data collected by Shingle Creek Watershed Management Commission

Report Card

Water quality data have been converted to grades based on a Met Council grading scale. Grades are shown in Table 6.

Table 6. Lake grades for Maple Grove Lakes.

	Cedar Island			Cook			Eagle			Edward			Fish			Pike			Rice			Weaver		
	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
1995	F	D	D	--	--	--	C	C	A	C	C	B	C	C	B	C	D	B	F	F	C	B	C	B
1996	F	--	--	--	--	--	C	B	A	B	D	A	C	C	A	D	D	C	D	F	C	C	C	A
1997	F	D	C	--	--	--	C	B	B	C	C	A	C	C	B	D	D	C	D	F	C	C	B	B
1998	F	D	D	--	--	--	C	B	B	C	C	B	C	C	B	D	D	C	D	F	D	C	C	B
1999	F	F	D	--	--	--	C	C	C	C	C	B	C	C	B	C	D	C	D	F	C	C	C	C
2000	--	--	--	--	--	--	B	C	A	C	C	A	C	C	B	C	C	C	C	F	C	C	C	B
2001	F	D	C	--	--	--	A	C	B	C	B	A	C	C	B	C	D	C	C	F	C	C	C	C
2002	F	D	D	--	--	--	D	C	D	C	C	B	D	C	C	--	--	--	C	D	B	B	C	B
2003	F	F	F	--	--	--	C	C	C	D	D	F	C	C	C	D	D	D	D	F	C	C	C	C
2004	F	D	F	C	B	A	B	C	C	F	D	C	B	C	C	D	D	D	D	F	C	B	C	C
2005	F	D	F	C	C	A	B	A	B	D	D	D	C	C	C	D	D	D	C	F	C	A	B	A
2006	F	F	F	B	A	C	C	C	C	F	D	D	C	C	C	C	D	C	D	F	D	A	B	A
2007	F	F	F	B	A	A	--	--	--	F	D	D	C	C	C	--	--	--	F	F	C	B	C	A
2008	F	F	F	B	A	A	--	--	--	D	D	D	D	C	B	--	--	--	D	F	D	B	B	A
2009	F	F	F	A	A	A	C	C	C	F	D	F	C	C	B	D	D	C	D	F	F	B	B	A
2010	F	D	D	B	A	A	C	C	C	D	D	C	C	C	B	C	D	C	D	F	D	A	B	A
2011	F	D	D	C	B	A	A	C	C	D	D	C	C	C	B	D	C	B	D	F	C	B	B	A
2012	F	D	D	C	C	A	C	C	C	D	D	C	C	C	C	D	C	B	D	F	D	B	B	B
2013	F	F	D	C	B	A	C	B	A	D	D	D	C	C	C	D	C	B	D	F	F	B	C	B
2014	F	D	C	C	C	A	C	C	A	C	C	A	C	C	C	C	C	A	C	F	D	C	C	C
2015	F	D	D	C	C	A	C	C	B	C	C	A	C	C	C	C	C	B	F	F	F	C	C	B
2016	F	F	D	C	C	A	C	C	B	C	C	B	C	C	C	C	C	A	D	F	D	A	B	A
2017	F	D	C	C	C	A	B	C	B	C	C	A	C	C	B	C	D	C	D	F	D	B	C	B
2018	F	D	C	C	B	A	B	C	A	B	B	A	B	B	B	C	C	A	D	F	C	B	B	B
2019	F	D	D	C	C	A	C	C	B	C	B	A	C	B	B	C	D	A	D	D	D	A	A	B
2020	D	D	D	C	D	A				C	A	A	B	A	B				D	F	F	C	B	B

Arbor and Norwood Lakes: Results from sampling three Arbor Lakes and Norwood Lake are summarized in Tables 7 and 8 and Figure 1. All four have good water quality and relatively low phosphorus concentrations.

Table 7. Growing season averages for the Arbor Lakes and Norwood Lake.

	West Arbor			North Arbor			South Arbor			Norwood		
	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
May-September Average												
1999 (1 date - Aug)	3.1	18	11	6.7	20	<1	5.4	13	<1	--	--	--
2001 (1 date - Sept)	5.3	--	--	16.0	--	--	8.2	--	--	--	--	--
2002 (3 dates)	9.0	16	1	8.9	11	2	13.0	12	1	--	--	--
2003 (5 dates)	7.0	19	4	12.3	9	3	11.7	10	3	--	--	--
2004 (5 dates)	9.6	18	5	11.5	12	2	12.4	12	2	--	--	--
2005 (5 dates)	10.7	28	2.4	13.2	17	3	10.7	17	2	--	--	--
2006 (5 dates)	9.7	23	2	13.8	13	2	7.9	29	17	--	--	--
2007 (5 dates)	9.4	19	2.6	12.1	9	2.2	11.3	15	5	--	--	--
2008 (5 dates)	8.4	24	7.0	14.3	12	3.7	10.2	16	4.4	--	--	--
2009 (5 dates)	9.6	28	5.3	13.9	14	1.1	13.9	17	2.0	--	--	--
2010 (5 dates)	7.9	36	11	13.8	9	1.7	13.4	14	1.7	--	--	--
2011 (5 dates)	7.1	27	12	12.7	12	4.4	12.4	14	2.6	--	--	--
2012 (5 dates)	6.6	28	12	14.5	11	6.1	13.0	15	5.3	--	--	--
2013 (5 dates)	7.6	24	5.7	15.3	11	1.5	12.2	18	2.7	--	--	--
2014 (5 dates)	9.1	24	6.7	18.1	8	1.1	12.9	11	2.4	14.9	13	2.2
2015 (5 dates)	5.0	57	14	15.0	12	1.7	12.0	18	3.2	16.4	14	2.1
2016 (5 dates)	7.7	40	10	14.8	15	2.8	10.7	20	3.3	11.1	28	6.3
2017 (5 dates)	7.0	33	13	16.2	15	3.0	12.0	19	3.0	19.0	14	2.0
2018 (5 dates)	9.5	23	9	15.2	13	2.2	13.6	12	2.3	17	20	6.5
2019 (5 dates)	8.8	22	8	24	10	2	16	17	3	16	19	4
2020 (5 dates)	8.9	24	11	20	20	3	14	12	4	16	12	2

Table 8. Lake grades for the Arbor Lakes and Norwood Lake.

	West Arbor			North Arbor			South Arbor			Norwood		
	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
1999	D	A	B	C	A	A	C	A	A	--	--	--
2001	C	--	--	A	--	--	B	--	--	--	--	--
2002	B	A	A	B	A	A	A	A	A	--	--	--
2003	C	A	A	A	A	A	A	A	A	--	--	--
2004	A	A	A	A	A	A	A	A	A	--	--	--
2005	A	B	A	A	A	A	A	A	A	--	--	--
2006	B	B	A	A	A	A	B	B	B	--	--	--
2007	B	A	A	A	A	A	A	A	A	--	--	--
2008	B	B	A	A	A	A	A	A	A	--	--	--
2009	B	B	A	A	A	A	A	A	A	--	--	--
2010	B	C	B	A	A	A	A	A	A	--	--	--
2011	B	B	B	A	A	A	A	A	A	--	--	--
2012	C	B	B	A	A	A	A	A	A	--	--	--
2013	B	B	A	A	A	A	A	A	A	--	--	--
2014	B	B	A	A	A	A	A	A	A	A	A	A
2015	C	C	B	A	A	A	A	A	A	A	A	A
2016	B	C	B	A	A	A	A	A	A	A	B	A
2017	B	C	B	A	A	A	A	A	A	A	A	A
2018	B	B	A	A	A	A	A	A	A	A	A	A
2019	B	A	A	A	A	A	A	A	A	A	A	A
2020	B	B	B	A	A	A	A	A	A	A	A	A



Location map of lakes.

Arbor Lakes and Norwood Lake Secchi Disc and Total Phosphorus Data

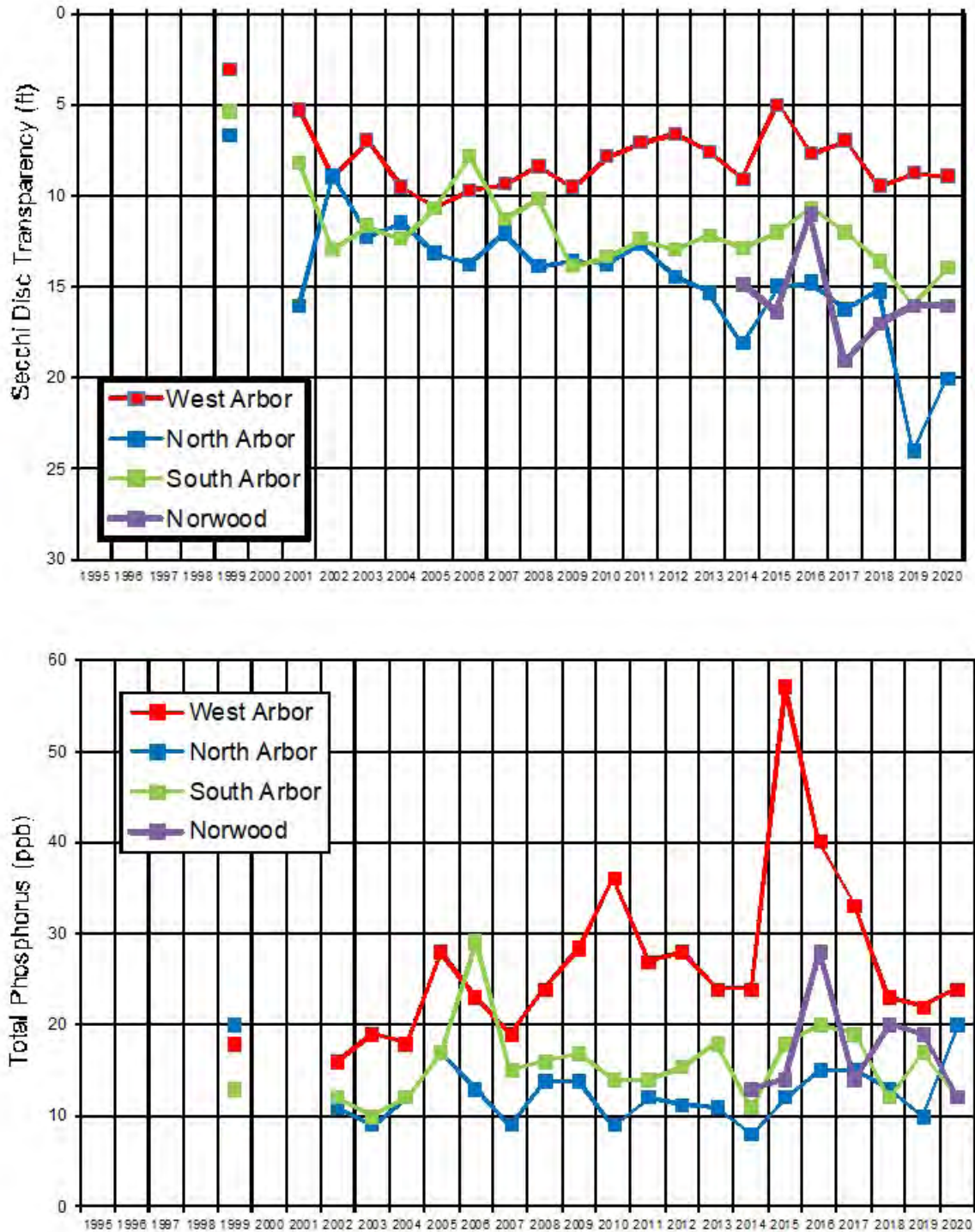


Figure 1. Secchi disc transparency (top) and total phosphorus concentrations (bottom) for the Arbor Lakes and Norwood Lake from 1999 - 2020.

Chloride Concentrations for Maple Grove Lakes

Lake chloride concentrations have been taken occasionally for the past few years. Cedar Island appears to have an increase in chlorides and several other lakes have fluctuating concentrations. Cook has the lowest chloride concentrations and North and South Arbor have the highest.

Table 9. Chloride concentrations for Maple Grove lakes in 2017-2020.

	2017	2018	2019	2020
Cedar Island Lake	73	91	133	105
Cook Lake	30	28	34	40
Eagle Lake	--	--	150	--
Lake Edward	36	41	43	40
Fish Lake	--	--	--	--
Pike Lake	--	--	--	--
Rice Lake	--	--	--	--
Weaver Lake	--	--	--	--
North Arbor Lake	229	192	263	290
South Arbor Lake	235	187	267	330
West Arbor Lake	38	33	40	39
Norwood Lake	61	52	88	83

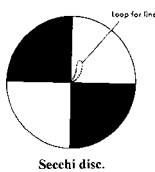
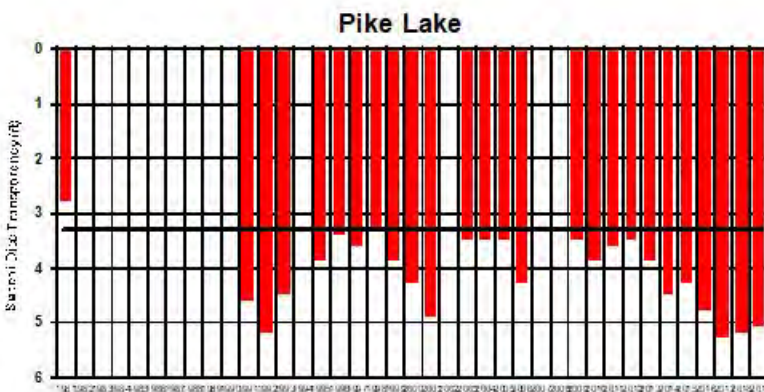
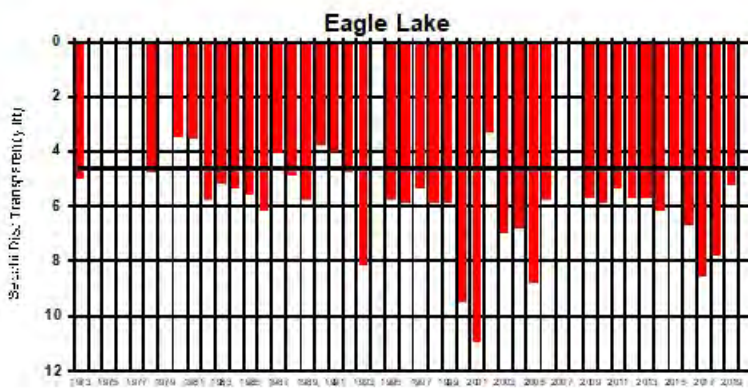
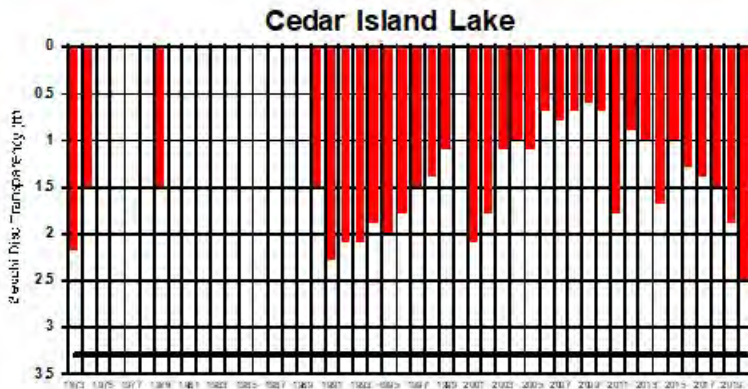
Secchi Disc Transparency Graphs for Maple Grove Lakes

Graphs of average summer water transparency over the years for each of the major Maple Grove lakes are displayed on the next two pages. Cook, Eagle, Edward, Fish, Pike, and Weaver Lakes have summer water clarity averages generally over five feet. Cedar Island Lake generally has a summer average less than two feet. Rice Lake average is right around 3 feet. Transparency goals for all lakes should average 5 to 7 feet over the summer.

Total Phosphorus Graphs for Maple Grove Lakes

Graphs of average summer water total phosphorus for the major Maple Grove Lakes (not including the Arbor Lakes) are shown after the Secchi disc graphs. Weaver Lake had the lowest summer phosphorus concentration of the lakes (although the Arbor Lakes also have low phosphorus concentrations). Rice Lake had the highest total phosphorus in 2020.

Shingle Creek Watershed District - Secchi Disc Data



Secchi Disc Results

Cedar Island Lake has the lowest Secchi disc transparency in Maple Grove. Transparency fluctuates in the remaining Maple Grove lakes. Aquatic plants could grow to twice

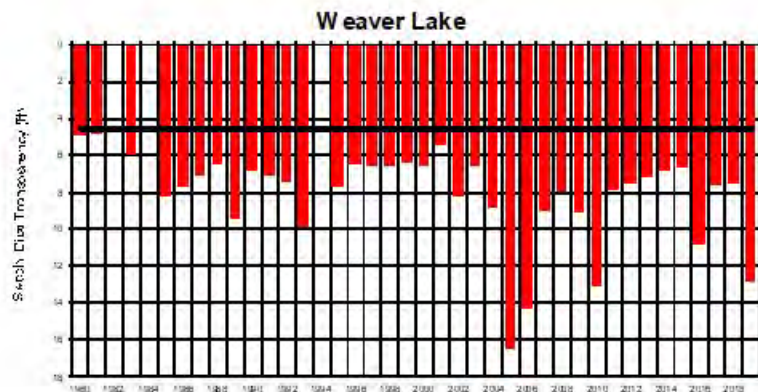
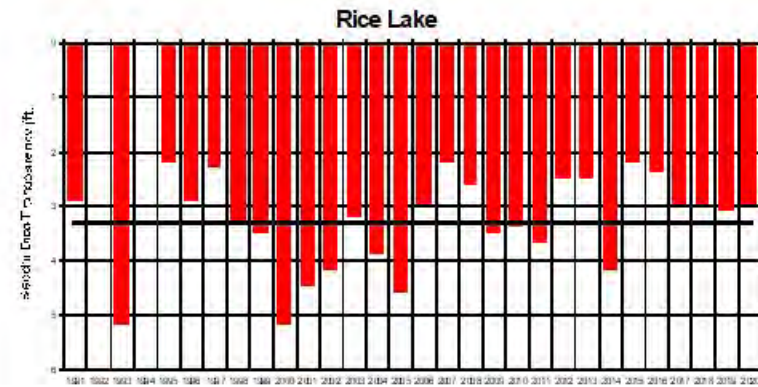
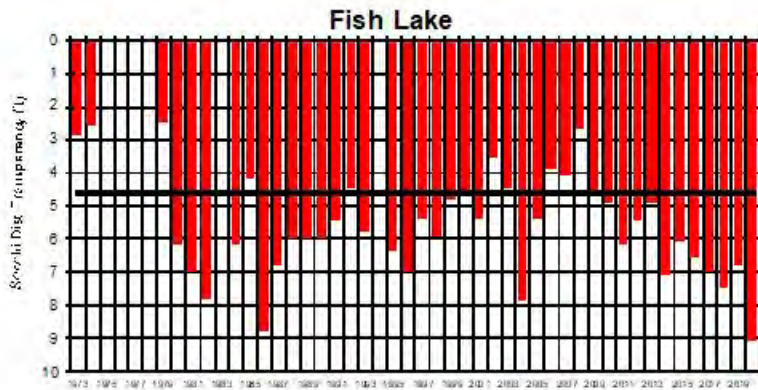
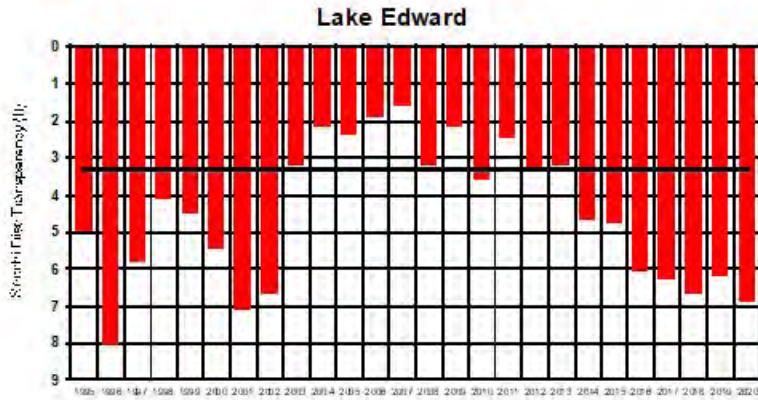
the average seasonal Secchi disc transparency. Aquatic plants are beneficial for lakes and help to maintain or improve water clarity.

Legend: Secchi Disc Clarity Criteria
(shown with line in above graphs)

Shallow Lakes: Secchi disc transparency greater than 3.3 feet is considered to be unimpaired.

Deep Lakes: Secchi disc transparency greater than 4.6 feet is considered to be unimpaired.

Elm Creek Watershed District - Secchi Disc Data

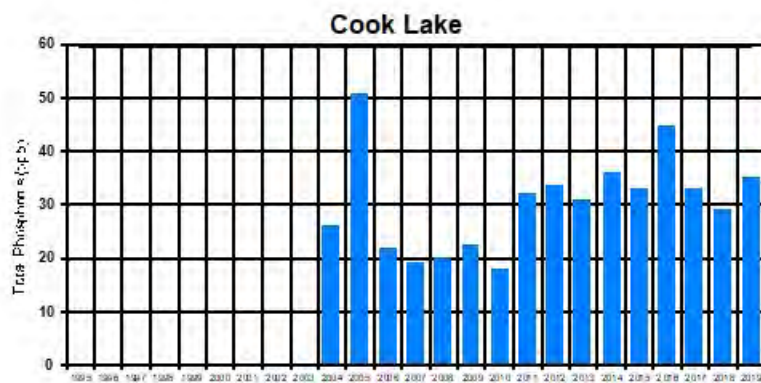
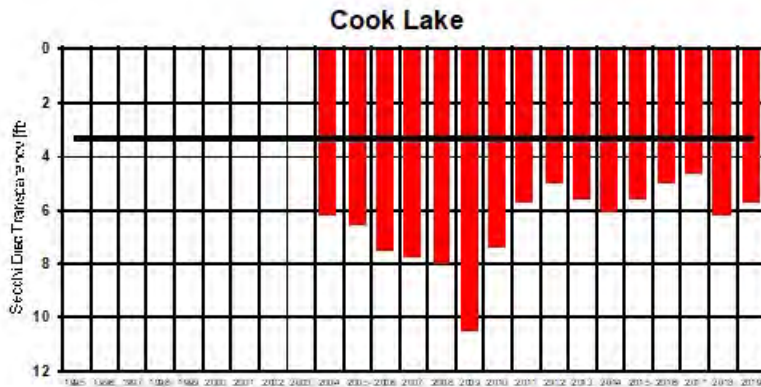


Legend: Secchi Disc Clarity Criteria
 (shown with line in above graphs)

Shallow Lakes: Secchi disc transparency greater than 3.3 feet is considered to be unimpaired.

Deep Lakes: Secchi disc transparency greater than 4.6 feet is considered to be unimpaired.

Cook Lake Data



Legend: Secchi Disc Clarity Criteria
(shown with line in above graphs)

Shallow Lakes: Secchi disc transparency greater than 3.3 feet is considered to be unimpaired.

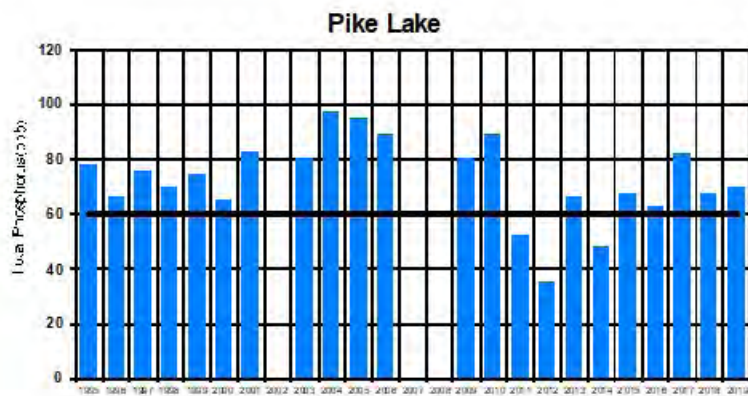
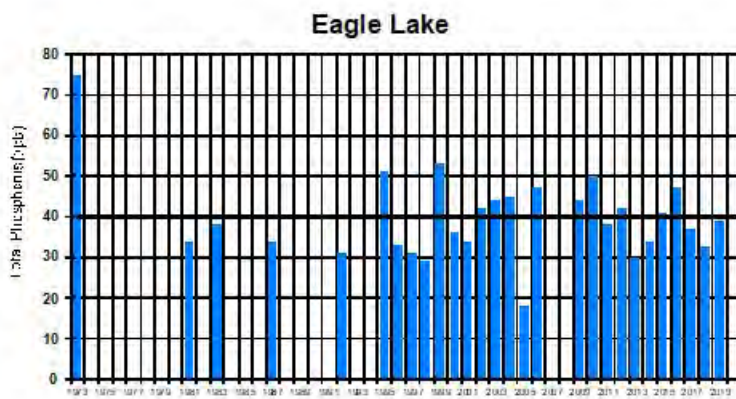
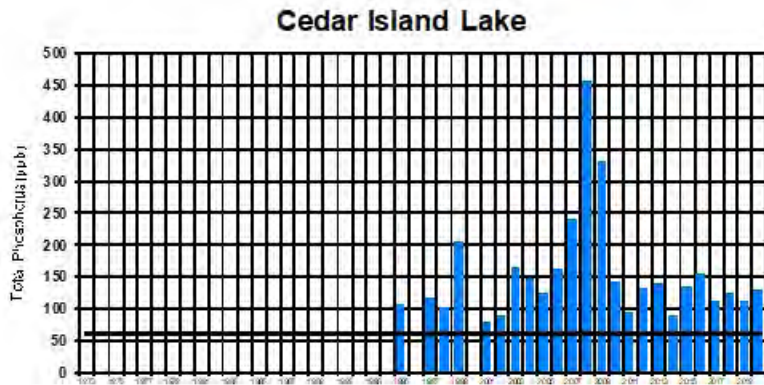
Deep Lakes: Secchi disc transparency greater than 4.6 feet is considered to be unimpaired.

Legend: Total Phosphorus Criteria
(shown with line in above graphs)

Shallow Lakes: Total phosphorus concentrations less than 60 ppb are considered to be unimpaired.

Deep Lakes: Total phosphorus concentrations less than 40 ppb is considered to be unimpaired.

Shingle Creek Watershed District - Total Phosphorus Data

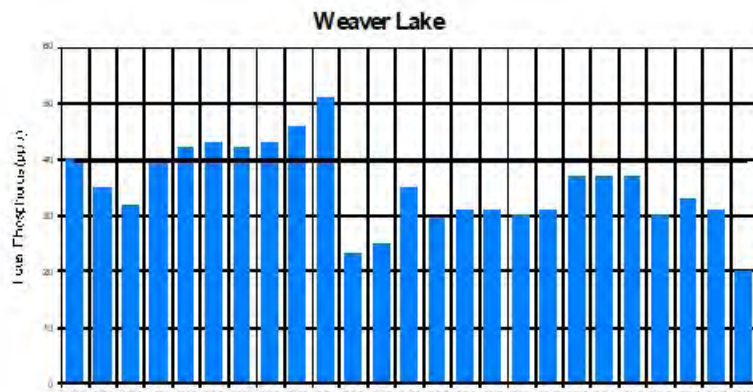
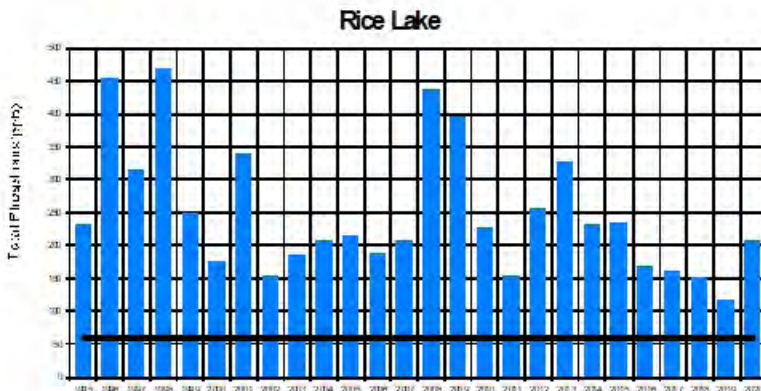
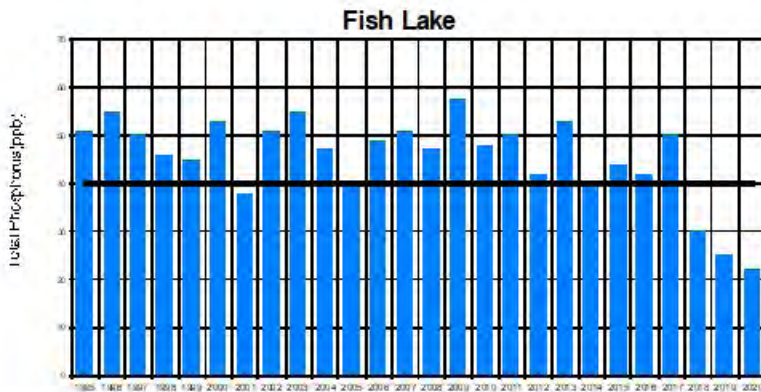
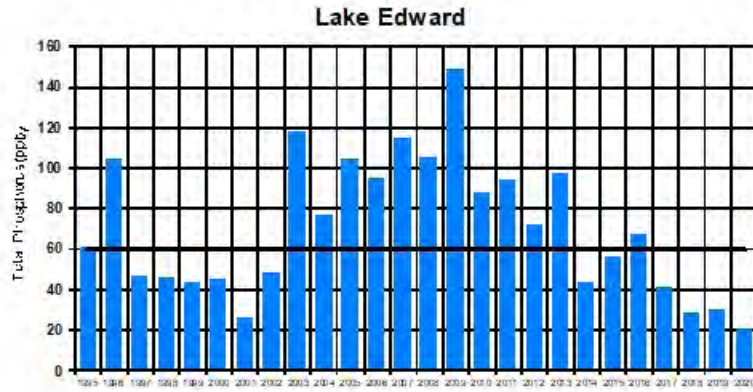


Legend: Total Phosphorus Criteria
(shown with line in above graphs)

Shallow Lakes: Total phosphorus concentrations less than 60 ppb are considered to be unimpaired.

Deep Lakes: Total phosphorus concentrations less than 40 ppb is considered to be unimpaired.

Elm Creek Watershed District - Total Phosphorus Data



Legend: Total Phosphorus Criteria
 (shown with line in above graphs)

Shallow Lakes: Total phosphorus concentrations less than 60 ppb are considered to be unimpaired.

Deep Lakes: Total phosphorus concentrations less than 40 ppb is considered to be unimpaired.

2014 Data

Table with columns for Lakes (North Arbor, South Arbor, West Arbor, Cedar Island, Cook, Eagle, Edward, Fish, Norwood, Pike, Rice, Weaver) and rows for monthly data from May to September, including weekly averages and a May-September average.

* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4

Arbor Lakes and Norwood Lake profile data for temp, diss oxygen, pH, conductivity, oxidation/reduction potential (ORP) for 2014.

West Arbor Lake

Profile data for West Arbor Lake with columns for Depth (m), Temp (C), DO (mg/l), pH, Cond (mS/cm), and ORP (mV) for dates May 29, June 26, July 17, August 21, and September 29.

North Arbor Lake

Profile data for North Arbor Lake with columns for Depth (m), Temp (C), DO (mg/l), pH, Cond (mS/cm), and ORP (mV) for dates May 29, June 26, July 17, August 29, and September 29.

South Arbor Lake

Profile data for South Arbor Lake with columns for Depth (m), Temp (C), DO (mg/l), pH, Cond (mS/cm), and ORP (mV) for dates May 29, June 26, July 17, August 21, and September 29.

Norwood Lake

Profile data for Norwood Lake with columns for Depth (m), Temp (C), DO (mg/l), pH, Cond (mS/cm), and ORP (mV) for dates May 29, June 26, July 17, August 21, and September 29.

Lakes	Cedar Island				Cook				Eagle			Edward				Fish			Pike			Rice			Weaver					
	SD	TP	Chl	Chlor	SD	TP	Chl	Chlor	SD	TP	Chl	SD	TP	Chl	Chlor	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
May																														
week 1*									12.7	35	4.2					8.1	64	18.1	5.1	54	14.9	3.2	115	22.1	10.0	48	5.1			
week 2																														
week 3									14.1	18	3.5					2.8	72	36.0	8.2	34	10.4	4.7	39	11.6	12.1	32	7.5			
week 4	1.2	144	43.4	74	5.1	33	3.6	31	11.6	15	5.0	6.5	51	3.6	36.7	11.2	55	9.8	8.9	53	14.6	3.6	108	35.7	11.8	28				
June																														
week 1																														
week 2									12.8	27	7.3					9.2	46	11.6	8.4	70.9	27.1	4.4	90	34.7	7.2	26	12.0			
week 3																														
week 4	1.3	157	52.9	75	5.2	37	4.3	30.1	8.2	30	9.0	4.3	61	27.1	35.7	7.8	45	16.5	4.9	143	52.5	4.3	131	48.2	9.4	32	10.7			
July																														
week 1																														
week 2									10.3	33	7.0					6.9	50	10.7	2.6	113	111.6	2.7	210	118.4	4.8	32	17.1			
week 3																														
week 4	1.4	124	45.3	79	4.1	42	6.4	31.0	7.8	32	12	6.8	35	2.1	37.7	6.9	42	11.3	4.3	76	41.9	1.5	243	123.4	4.4	55	22.8			
August																														
week 1									5.2	36	28.0					4.1	32	18.6	4.7	76	39.0	1.3	286	92.4	6.6	29	9.9			
week 2																														
week 3									4.4	47	32.7					4.3	37	22.5	5.0	74	23.0	2.1	230	49.1	5.1	28	21.7			
week 4	1.4	77	12.8	65	5.1	26	2.1	29.1				5.7	34	1.1	31.9															
September																														
week 1									4.3	59	33.8					11.5	52	9.7	3.3	91	37.0	2.8	189	38.1	6.8	30	16.1			
week 2																														
week 3									3.7	75	46.8					4.2	58	37.3	3.2	116	72.1	2.6	136	40.5	6.9	26	14.5			
week 4	1.6	54	19.2	69	4.3	26	2.1	30.7				6.1	22	<1	35.8															
May-September Average																														
	1.4	111	35	73	4.8	33	4	30.4	8.6	37	17	5.9	41	7	35.6	7.0	50	18	5.3	82	40	3.0	162	56	7.7	33	14			

Lakes	North Arbor					South Arbor					West Arbor					Norwood				
	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond
May																				
week 1*																				
week 2																				
week 3																				
week 4	9.6	19	6.4	238		9.2	26	6.4	238		11.7	18	3.6	37.6		16.1	16	2.1	61.4	
June																				
week 1																				
week 2																				
week 3																				
week 4	11.1	17 (30)	4.3	234		13.5	15 (52)	2.8	236		7.9	20 (23)	5.0	37.7		12.1	21 (25)	2.8	57.5	
July																				
week 1																				
week 2																				
week 3																				
week 4	20.2	13	1.4	235		13.4	16	2.1	236		10.8	20	5.0	38.3		12.8	13	3.4	64.5	
August																				
week 1																				
week 2																				
week 3																				
week 4	14.8	16	2.1	213		12.2	16	2.8	224		3.8	54	24.6	37.2		23.8	9	2.1	59.4	
September																				
week 1																				
week 2																				
week 3																				
week 4	20.1	9	<1	224	800	14.2	20	2.8	243	900	2.2	53	27.1	39.8	350	21.8	9	<1	61.7	325
May-September Average																				
	15.2	15	3	229	800	13	19	3	235	900	7	33	13	38	350	17	14	2	61	325

Lakes	Cedar Island				Cook				Eagle			Edward				Fish			Pike			Rice			Weaver					
	SD	TP	Chl	Chlor	SD	TP	Chl	Chlor	SD	TP	Chl	SD	TP	Chl	Chlor	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl	SD	TP	Chl
May																														
week 1*																4.6	39	19.5							3.7	79	34.4	4.3	44.1	8.1
week 2																														
week 3																14.4	37	2.2							3.1	93	20.8	13.3	55	2.4
week 4	2.3	105	7.7	91	5.9	37	7.9	28	10.3	22	3.8	6.4	28	1.6	40.9				7.4	55	2.3									
June																														
week 1																12.3	21	9.0							4.6	106	11.2	13.3	26	8.9
week 2																														
week 3																9.7	25	5.4							2.8	99	61.4	8.0	37	6.6
week 4	1.1	130	63.5		5.8	30	4.6		9.8	24	4.6	7	17	4.7				4.6	50	12.8										
July																														
week 1																7.7	29	12.6							2.9	143	56.4	3.9	32	21.4
week 2																														
week 3																9.3	29	9.3							3.6	130	38.2	5.9	27	12.2
week 4	1.2	141	51.1		6.5	33	3.5		9.8	24	5	7.1	32	3.4	5.1	24	17.2	4.6	69	8.1	3.3	181	29.2	4.8	29	16.0				
August																														
week 1																3.9	26	24.6							2.5	263	70.5	3.1	25	21.6
week 2																														
week 3																														
week 4	1.2	143	53.4		6.2	26	2.3		5.9	28	8.2	6.5	46	1.6	4.5	29	29.0	5.8	52	4.6	2.3	211	54.6	6.3	23	14.0				
September																														
week 1																														
week 2																4.6	26	18.9							2.2	175	42.4	9.7	21	7.0
week 3																														
week 4	1.7	94	189		6.7	19	2.3		4.7	61	14.4	6.3	23	2.2	6.3	40	15.3	3.4	109	11.2	2.3	179	76.0	10.7	26	10.8				
May-September Average																														
	1.5	123	73	91	6.2	29	4	28.0	8.1	32	7	6.7	29	3	40.9	7.5	30	15	5.2	67	8	3.0	151	45	7.6	31	12			

* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4

Lakes	North Arbor					South Arbor					West Arbor					Norwood				
	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond
May																				
week 1*																				
week 2																				
week 3																				
week 4	17.1	20	1.5	192	800	12.2	14	<1	187	800	13.9	185	3.1	32.8	330	22.9	11	<1	51.6	370
June																				
week 1																				
week 2																				
week 3																				
week 4	13.7	11	3.5		900	14.1	12	2.3		900	12.7	13	2.3		315	12.9	13	3.5		470
July																				
week 1																				
week 2																				
week 3																				
week 4	14.7	9	2.3		900	14.1	13	1.2		900	6.9	24	12.6		310	16.4	14	1.1		460
August																				
week 1																				
week 2																				
week 3																				
week 4	17.2	9	2.8		980	14.9	14	3.4		1050	6.7	37	19.2		397	16.4	12	2.2		471
September																				
week 1																				
week 2																				
week 3																				
week 4	13.4	16	1.1		990	12.9	9	2.3		1088	7.4	25	7.4		390	16.4	51	19.2		501
May-September Average																				
	15.2	13	2	192	914	14	12	2	187	948	10	57	9	32.8	348	17	20	5	51.6	454

* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4

Lakes	Cedar Island					Cook					Eagle					Edward					Fish			Pike					Rice			Weaver		
	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	SD	TP	Chl
May																																		
week 1*																					11.0	23	<10						3.9	65	13	13.0	29	<10
week 2																																		
week 3	2.4	63	5.3	147	570	6.5	20	2.7	37.0	356	8.7	28	8.0	160	730	6.7	23	3.6	47.0	350	13.4	37	10	6.8	65	21.4	285	1080	2.7	80	24	27.5	25	<10
week 4																																		
June																																		
week 1																					6.6	29	18						5.4	71	16	21.8	19	<10
week 2																																		
week 3																					7.5	17	<10						3.8	93	26	12.6	16	<10
week 4	1.7	127	16		546	6.4	32	1.8		308	5.3	28	1.8		691	6.4	41	<1		293				4.8	61	<1		985						
July																																		
week 1																					7.9	32	13						3.4	92	77	10.8	17	<10
week 2																																		
week 3																					4.5	23	22						3.1	100	48	11.6	18	<10
week 4	1.8	106	33.8	130	510	5.7	57	6.2	32.9	330	3.9	39	21	147	720	5.7	31	2.7	41.9	280	3.1	27	39	4.4	62	8.9	192.0	800	2.5	188	44	7.9	16	<10
August																																		
week 1																					3.9	24	25						1.5	158	101	7.1	15	<10
week 2																																		
week 3	1.8	172	232	121	494	5.4	28	7.1	31.8	276	3.5	39	18.7	144	680	5.9	28	5.3	40.6	297				4.9	56	9.8	177.0	819						
week 4																					4.2	25	31						1.8	141	70	9.7	19	25.9
September																																		
week 1																																		
week 2																					6.7	19	<13						1.7	148	52	8.9	27	<13
week 3																																		
week 4	1.7	83	25.6		450	4.7	38	1.8		343	5.1	62	6.7		673	6.1	25	2.7		303	6.5	19	20	4.4	104	1.8		742	3.9	139	66	10.8	22	<10
May-September Average																																		
	1.9	110	63	133	514	5.7	35	4	34	323	5.3	39	11	150	699	6.2	30	3	43	305	6.8	25	19	5.1	70	9	218	885	3.1	116	49	12.9	20	12

* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4

Lakes	North Arbor					South Arbor					West Arbor					Norwood				
	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond	SD	TP	Chl	Chlor	Cond
May																				
week 1*																				
week 2																				
week 3	29.2	10	1.8	267	1040	12.6	25	7.1	272	1056	8.7	13	4.4	41.7	367	13.1	15	2.7	98.1	535
week 4																				
June																				
week 1																				
week 2																				
week 3																				
week 4	16.4	10	1.8		1062	15.8	14	1.8		1048	9.3	14	5.3		384	18.5	19	1.8		517
July																				
week 1																				
week 2																				
week 3																				
week 4	23.9	8	1.8	258	1030	17.7	13	1.8	262	1020	12.4	20	4.4	39.1	350	12.8	23	5.3	83.8	470
August																				
week 1																				
week 2																				
week 3	26.1	10	2.7	265	1064	23.2	13	2.7	267	1014	8.1	25	15.1	39.0	329	19.7	19	5.3	81.0	473
week 4																				
September																				
week 1																				
week 2																				
week 3																				
week 4	24.1	11	1.8		1090	9.6	21	4.0		1197	5.7	37	9.8		342	14.4	18	2.7		433
May-September Average																				
	24	10	2	263	1057	16	17	3	267	1067	8.8	22	8	40	354	16	19	4	88	486

* Weeks: days 1-7 = week 1; days 8-14 = week 2; days 15-21 = week 3; days 22+ = week 4