

2000
Water Quality
Monitoring Report

Wenck File #0002-33

Prepared for:

**CLEARWATER RIVER WATERSHED
DISTRICT**
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1.0 Introduction

The overall approach to the annual monitoring program has been to conduct baseline monitoring for precipitation, stream monitoring on Clearwater River, and lake monitoring on a rotating basis. In addition, citizen volunteers collect secchi depth readings on numerous lakes.

The year 2000 program included stream flow gauging and water quality monitoring for total phosphorus at three sites and fecal coliform bacteria monitoring at five sites. Two sites (WR0.2, Warner Creek above Clearwater Lake, East and CR 28.2, the Clearwater River below Kingston Wetland) were sampled for both parameters. Six lakes were monitored four times between July and September for water quality. See Figure 1 for monitoring locations and Appendix A for a summary of the 2000 monitoring plan.

2.0 Precipitation

For the watershed as a whole, precipitation for 2000 was very low, averaging 21.22 inches (Table 1). Overall, this was the driest year since 1989. Precipitation in the first five months, was only 1.12 inches below normal (Figure 2), but by October this deficit increased to 8.05 inches, and the year-end value was 6.13 inches below normal (slightly recovered due to a wet November and December). The water quality monitoring on streams and lakes was performed through October, which was a cumulative 8.05 inches below normal. Individual volunteer records are shown in Appendix B.

3.0 Streams

3.1 RUNOFF

Stream flow at the outlet of Clearwater Lake (station CR10.5) averaged 9.2 cubic feet per second (cfs) for the monitoring season and approximately 10.8 cfs for the whole year. The whole-year flow was equivalent to 1.0 inch of runoff from the 155-square-mile upstream watershed.

Throughout the summer, stream flows decreased from spring maximums to minor or zero flow by late August. Flows for each site are given in Table 2.

3.2 TOTAL PHOSPHORUS

Phosphorus levels in the Clearwater River remained much improved, compared with conditions monitored in the early 1980s prior to the lake restoration project's main implementation.

Upstream of the main-stem lake chain (station CR28.2), the mean total phosphorus concentration was 0.38 mg/L (milligrams per liter, or parts per million), versus 0.74 to 1.40 mg/L in the early 1980s. Sites WR0.2 and CR 10.5 had very low mean concentrations of 0.06 mg/L and 0.029 mg/L, respectively. Results for the three sites are given in Table 3.

3.3 FECAL COLIFORM

Five sites were monitored for fecal coliform bacteria for five events. Four of the sites are along the Clearwater River, and WR0.2 is a tributary to Clearwater Lake East Basin. Values ranged from 14 colony forming units per 100 milliliters (cfu/100 mL) to over 2,000 cfu/100 mL. All sites had one or more exceedances of the state standard of 200 cfu/100 mL. Site CR 30.0 had the most exceedances (three), WR0.2 and CR 28.2 had two exceedances, and CR 32.5 and CR 23.8 had one exceedance. Geometric means were calculated as is typical for bacteria data. The only

potential mean exceedance of the 200 cfu/100 mL state standard occurred at WR0.2. If laboratory values listed as >2,000, actually exceeded 6,200 cfu/100mL, the site's mean value would exceed the state standard for the year. The geometric mean values for the remaining sites did not exceed the state standard, even if the values listed as >2,000 cfu/100 mL were an order of magnitude larger (20,000 cfu/100 mL). However, since all sites exceeded the state standard for one or more events, bacteria are a concern. Results for all sites are given in Table 3.

4.0 Water Quality of Lakes Sampled in Year 2000

4.1 CLEAR LAKE

Clear Lake's mid-summer water quality was poor, with mean total phosphorus of 228 ug/L, chlorophyll-*a* of 134 ug/L, and secchi depth of 1.1 feet. The phosphorus and chlorophyll-*a* concentrations were the highest of the six lakes sampled this year (Figure 3). Clear Lake has been sampled in 1994, 1998, 1999, and 2000 (Figure 4). The 2000 data show the poorest water quality and significant degradation from the 1994. A citizen volunteer also monitors secchi depths, which show the water clarity peaked in June at two feet (Figure D-2).

4.2 CLEARWATER LAKE

Clearwater Lake is sampled in both the West and East basins every year as part of the long-term monitoring plan. Data for 2000 show very good water quality for both basins.

West - Mean values for the West basin are 41 ug/L for total phosphorus, 9 ug/L for chlorophyll-*a*, and 6.1 feet for secchi depth. The citizen secchi data (Figure D-3) show a maximum clarity of 14 feet and an average of 9.8 feet from May through September. A citizen site on the very north portion of the West basin had an average secchi depth of 11.3 feet, nearly double the average of the four measurements by District personnel. The extended period for citizen monitoring (early spring) and location on the lake account for the higher mean values.

East - Mean values for the East basin are 33 µg/L for total phosphorus, 10 µg/L for chlorophyll-*a*, and 7.5 feet for secchi depth. No citizen monitoring of secchi depths occurred in the East basin.

The historical data (Figures 5 and 6) show very good water quality in recent years, with downward trends in total phosphorus and chlorophyll-*a*, and a slight upward trend in secchi depth.

4.3 LAKE MARIE

Lakes Louisa and Marie are essentially one long lake with a narrows in the middle. The two lakes are generally monitored in alternate years, and in 2000 it was Lake Marie. The summer water quality was fair, with mean concentrations of total phosphorus and chlorophyll-*a* of 74 and 45 µg/L, respectively. The mean secchi depth was 2.6 feet, which is approximately the same as the citizen secchi mean value of 2.4 feet (Figure D-3) on the downstream lobe called Mill Pond. Historical data (Figure 7) show a dramatic reduction in total phosphorus since 1981. The chlorophyll-*a* data is less conclusive and has more variability over time. The mean secchi depth has remained constant between 2 and 4 feet for 11 of the 14 years monitored.

4.4 PLEASANT LAKE

Pleasant Lake lies in a small tributary watershed and forms Annandale's northerly boundary. Its 2000 water quality was very good, with mean concentrations of total phosphorus and chlorophyll-*a* of 30 and 13 µg/L, respectively. The secchi depth mean was 7.6 feet for the four water quality events, and 4.0 for the citizen events (four readings July through September Figure D-5). Historical data (Figure 8) show a slight increasing trend of total phosphorus and stable concentrations for chlorophyll-*a*. The secchi depth has ranged from 6 to 10 feet, which places year 2000 clarity near the average for the lake.

4.5 SCHOOL SECTION LAKE

School Section Lake average concentrations of total phosphorus and chlorophyll-*a* were 37 and 11 µg/L, respectively. These results are similar to both Pleasant Lake and Clearwater Lake and represent very good water quality. Secchi depth was 6.9 feet for the four water quality events, and the citizen mean value was also 6.9 feet (Figure D-5). Historical data (Figure 9) show a slightly increasing trend for total phosphorus and slightly decreasing trend for chlorophyll-*a*. The mean secchi depth has wide variability from a minimum of 3.3 (1999) to 7.2 feet. The 2000 result of 6.9 feet was a very good year for clarity.

5.0 Conclusions

1. Precipitation for the year was low, 21.22 inches (78% of normal) and was 8.05 inches below normal at the end of October and 6.13 inches at the end of the year.
2. The low precipitation resulted in extremely dry summer and fall conditions with very low runoff: 1.0 inch, the lowest since 1988.
3. The Clearwater River phosphorus load was very low, 530 pounds at CR 28.2, the second lowest in two decades of monitoring.
4. The water quality of Clearwater Lake, Pleasant Lake, and School Section Lake continued to be very good, while the water quality of Lake Marie was fair and Clear Lake was poor.
5. Fecal coliform bacteria were found at levels of concern in Clearwater River and Warner Creek. These findings confirm the 1999 fecal coliform monitoring results.

6.0 Recommendations

1. Continue the District's water quality and hydrologic monitoring program.
2. Investigate the sources of fecal coliform bacteria in the District and evaluate control methods.
3. Continue pursuing methods to improve the water quality of the District lakes.

Tables

TABLE 1
YEARLY PRECIPITATION AND RUNOFF TOTALS
Clearwater River Watershed District

Precipitation (inches of water)						
YEAR	Watkins	Kingston	Maine Prairie	Corinna	Area-Weighted Average	Runoff (inches)
1981	--	--	--	--	19.76	(1) 3.6
1982	--	--	--	--	24.58	(1) 6.8
1983	46.54	--	42.32	35.02	41.78	17.4
1984	32.23	30.13	32.37	36.07	32.95	13.3
1985	40.72	39.49	45.28	--	42.22	12.0
1986	40.02	35.63	39.68	33.40	37.26	16.0
1987	18.97	15.40	19.41	16.16	17.52	1.4
1988	16.57	18.98	15.96	15.01	16.48	0.7
1989	22.13	22.68	21.80	16.96	20.68	3.0
1990	40.35	39.18	41.36	32.18	37.94	11.7
1991	41.30	45.11	43.41	36.28	41.01	20.7
1992	23.06	18.41	20.47	24.35	22.01	12.9
1993	40.17	35.27 (2)	37.54 (2)	33.33	36.71	15.5
1994	34.77	--	30.13	30.26	31.98	9.0
1995	33.80	--	33.65	28.66	32.21	8.8
1996	31.31	--	24.32 (2)	26.13 (2)	27.59	4.8
1997	24.18	--	21.90	27.37	24.43	6.3
1998	30.03	--	29.39	27.43 (2)	29.05	5.5
1999	22.08	--	22.31 (2)	27.71	23.84	3.9
2000	23.83	--	20.56	19.91	21.22	1.0
Mean					29.06	8.7
Std. Dev.					8.4	5.9

NOTES:

Whole watershed runoff is based on time-weighted average flow at Clearwater Lake outlet (station CR 10.5), and total drainage area of 155 square miles.

- (1) Data for single gauge in east-central part of watershed (Camp Heritage on Lake Caroline).
- (2) Average values of other stations in District were used to fill in missing data.

TABLE 2
SUMMARY OF STREAM FLOWS

Clearwater River Watershed District

Flow Values (cubic feet per second)						
	WR 0.2	CR 32.5	CR 30.0	CR 28.2	CR 23.8	CR 10.5
27-Apr	0.94	0.38	0.19	1.67	1.15	13.5
18-May	1.30	0.38	0.21	2.00	1.5	18.3
25-May	0.94	0.27	0.21	1.28	1.77	18.3
11-Jun	0.43	0.27	0.21	0.85	1.0	18.3
26-Jun	0.43	0.14	0.39	0.41	0.57	18.1
7-Jul	0.43	0.10	0.32	0.50	0.7	18.2
25-Jul	0.10	0.06	0.07	0.70	0.94	10.4
4-Aug	0.05	0.04	0.020	0.35	0.08	6.0
21-Aug	0.01	0.03	0.004	0	0.08	0.6
9-Sep	0.01	0.03	0.020	0.20	0.08	<0.1
19-Sep	0.01	0.03	0	0	0.04	<0.1
6-Oct	0.05	0.03	0.015	0	0.04	<0.1
24-Oct	0.01	0.03	0.020	0	0.05	<0.1
Time Weighted Means:						
April to October	0.34	0.13	0.13	0.58	0.59	9.19
Year 2000	0.44	--	--	0.72	--	10.8

Note 1

Note 2

Notes: 1. First reading of water elevation below dam crest on August 21.

2. Based on interpolations using flows at end of 1999 monitoring season.

**TABLE 3.
STREAM WATER QUALITY**

Clearwater River Watershed District

	Total Phosphorus (mg/L)		
	WR 0.2	CR 28.2	CR 10.5
27-Apr	0.052	0.24	0.037
25-May	0.062	0.24	0.028
26-Jun	0.12	0.52	0.029
25-Jul	0.11	0.44	0.019
21-Aug	0.10	0.28	0.029
19-Sep	0.068	Dry	<0.01
24-Oct	0.13	Dry	0.092
2000 Flow Weighted Mean	0.07	0.30	0.029
2000 Adjusted Mean*	0.06	0.38	0.029
1999 Flow Weighted Mean	0.07	0.16	0.04

* Phosphorus concentrations per log-log regression on flow so as to correspond to annual mean flows.

	Fecal Coliform (cfu/100 mL)				
	WR 0.2	CR 32.5	CR 30.0	CR 28.2	CR 23.8
Notes	1, 2, and 3	1	1	1, 2, 4, and 5	1, 2 and 5
27-Apr	14	20	34	256	54
25-May	105	90	135	135	30
26-Jun	41	180	470	50	17
25-Jul	>2000	120	330	>2000	120
21-Aug	>2000	150	270	<10	100
19-Sep	180	360	Dry	Dry	>2000
24-Oct	31	19	110	Dry	78
Geometric Mean	51	88	166	112	91
2000 Average	624	134	225	489	343
1999 Average	Not Sampled	Not Sampled	Not Sampled	100	500

Notes:

1. **256** Exceeds State Standard of 200 cfu/100 mL.
2. Used 2,000 cfu/100 mL for lab value of >2,000 cfu/100mL.
3. Geometric mean is >200 cfu/100mL, if values listed as >2,000 are 6,200 or greater.
4. Used 5 cfu/100 mL for lab value of <10 cfu/100 mL.
5. 1999 value is average of two events.

TABLE 4 (cont.)

ISTORICAL SUMMARY OF STREAM FLOWS, PHOSPHORUS CONCENTRATIONS AND LOADIN

Clearwater River Watershed District

Station	Year	<u>Average Stream Flow</u>		Average Total	<u>Total Phosphorus Load</u>	
		(cu m/sec)	(cfs)	Phosphorus Concentration (mg/l)	(kg)	(lb)
Main Stem:						
CR 28.2	1981 (1)	--	--	1.40	--	--
	1982 (1)	0.93	32.8	0.74	19700	43,500
	1983	2.62	92.6	0.92	76000	168,000
	1984	1.49	52.6	0.76	35700	78,800
	1985	2.32	81.9	0.90	65500	144,000
	1986	3.20	113	0.78	55200	122,000
	1987	0.11	3.90	0.13	460	1,020
	1988	0.09	3.12	0.66	1850	4,080
	1989	0.02	0.72	0.19	120	260
	1990	0.51	18.0	0.44	7040	15,500
	1991	1.11	39.1	0.29	10200	22,500
	1992	0.26	9.30	0.20	1660	3,650
	1993	1.28	45.2	0.29	11600	25,600
	1994	1.17	41.2	0.28	10100	22,300
	1995	1.15	40.4	0.29	10400	22,900
	1996	0.33	11.7	0.27	2860	6,300
	1997	0.27	9.36	0.26	2170	4,790
	1998	0.41	14.4	0.25	3190	7,020
	1999	0.08	2.78	0.16	400	870
	2000	0.02	0.72	0.38	240	530
CR 10.5	1981 (1)	1.15	40.6	0.05	2060	4550
	1982 (1)	2.20	77.8	0.07	4990	11000
	1983	5.64	199	0.10	18500	40800
	1984	4.28	151	0.05	6620	14600
	1985	3.88	137	0.14	16700	36800
	1986	5.52	195	0.15	23700	52300
	1987	0.46	16.2	0.04	600	1320
	1988	0.23	7.95	0.04	260	580
	1989	0.97	34.2	0.08	2340	5150
	1990	3.77	133	0.03	3060	6750
	1991	6.68	236	0.05	10500	23200
	1992	4.16	147	0.06	8090	17800
	1993	5.01	177	0.04	6330	14000
	1994	2.92	103	0.03	2850	6290
	1995	2.83	100	0.03	3040	6710
	1996	1.53	54.2	0.04	1970	4350
	1997	2.06	72.8	0.04	2690	5940
	1998	1.78	63.0	0.04	2330	5120
	1999	1.25	44.1	0.04	1520	3350
	2000	0.31	10.8	0.03	280	610

TABLE 4 (cont.)

ISTORICAL SUMMARY OF STREAM FLOWS, PHOSPHORUS CONCENTRATIONS AND LOADIN

Clearwater River Watershed District

Station	Year	<u>Average Stream Flow</u>		Average Total	<u>Total Phosphorus Load</u>	
		(cu m/sec)	(cfs)	Phosphorus Concentration (mg/l)	(kg)	(lb)
Tributaries:						
WR 0.2 (2)	1981 (1)	0.07	2.60	0.17	390	860
	1982 (1)	0.23	8.20	0.16	780	1720
	1983	0.47	16.50	0.09	1270	2800
	1984	0.60	21.20	0.05	950	2100
	1985	0.48	17.10	0.14	2130	4700
	1986	0.86	30.40	0.20	4630	10200
	1987	0.04	1.50	0.07	100	230
	1988	0.01	0.40	0.17	60	130
	1989	0.03	1.19	0.14	80	180
	1990	0.06	2.28	0.37	750	1660
	1991	0.26	9.22	0.11	860	1900
	1992	0.11	4.02	0.05	170	370
	1993	0.24	8.59	0.10	760	1670
	1994	0.18	6.34	0.06	320	700
	1995	0.12	4.27	0.05	210	460
	1996	0.05	1.78	0.11	180	380
	1997	0.09	3.15	0.08	220	480
1998	0.09	3.11	0.11	290	650	
1999	0.06	2.03	0.07	130	280	
2000 (3)	0.01	0.44	0.06	25	56	

NOTES:

Flow values are time-weighted averages unless otherwise noted.

Total phosphorus values are flow- and time-weighted averages unless otherwise noted.

(1) Values in 1981 and 1982 are arithmetic means

(2) Station WR 0.2 was designated Station WC 0.2 in 1981-1983

(3) Phosphorus values in 2000 are flow-weighted and adjusted per log-log regression on flow so as to correspond to annual mean flows.

**TABLE 5
LAKE SURFACE WATER QUALITY**

Clearwater River Watershed District

Total Phosphorus (micrograms/liter)

	July 5 and 6	July 27 and 30	Aug. 22 and 23	Sept. 14	Mean	Std. Dev.
Clear Lake	190	220	240	260	228	30
Clearwater Lake East	20	29	25	59	33	18
Clearwater Lake West	45	14	22	84	41	31
Lake Marie	60	93	86	56	74	18
Pleasant Lake	23	<10	31	59	30	22
School Section Lake	35	29	41	41	37	6

Note: Used 5 ug/L for calculating mean and standard deviation for value of <10.

Chlorophyll-a (micrograms/liter)

	July 5 and 6	July 27 and 30	Aug. 22 and 23	Sept. 14	Mean	Std. Dev.
Clear Lake	77	140	180	140	134	43
Clearwater Lake East	5.3	12	12	12	10	3
Clearwater Lake West	6.9	8	6.9	13	9	3
Lake Marie	27	52	59	42	45	14
Pleasant Lake	6.9	6.9	18	22	13	8
School Section Lake	9.6	12	14	9.6	11	2

Secchi Depth (feet)

	July 5 and 6	July 27 and 30	Aug. 22 and 23	Sept. 14	Mean	Std. Dev.
Clear Lake	1.5	1	1	1	1.1	0.3
Clearwater Lake East	12	6.5	7	4.5	7.5	3.2
Clearwater Lake West	7.5	5.5	7	4.5	6.1	1.4
Lake Marie	2.5	3	1.5	3.5	2.6	0.9
Pleasant Lake	12.5	7	6.5	4.5	7.6	3.4
School Section Lake	8.5	6.5	6.5	6.2	6.9	1.1

TABLE 6 (cont.)

HISTORICAL SUMMARY OF LAKE WATER QUALITY
 Summer (June - September) Epilimnetic Means

Clearwater River Watershed District

LAKE/ Year	Number of Samples	Total Phosphorous (ug/l)		Chlorophyll-a (ug/l)		Secchi Disk Transparency (m)	
		Mean (3)	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
<u>CLEARWATER EAST</u>							
1981	7	60	20	11	8	2.6	0.7
1982	7	60	30	12	9	2.7	1.6
1983	7	90	50	3	2	2.4	1.8
1984	7	90	40	4	2	1.4	0.2
1985	7	130	60	39	28	1.2	0.3
1986	6	80	40	85	132	2.1	0.8
1987	7	30	10	18	20	2.6	1.2
1988	5	40	10	10	5	2.9	1.8
1989	6	60	20	5	4	3.0	1.9
1990	5	90	100	18	9	2.0	0.6
1991	3	50	20	10	7	1.4	0.2
1992	8	30	10	20	10	2.0	0.6
1993	4 (1)	43	15	42	38	1.5	0.8
1994	4	23	5	14	9	1.4	0.2
1995	4 (2)	30	8	16	10	1.6	0.4
1996	4	33	8	10	3	2.1	0.3
1997	4	52	17	8	(5) 2	1.6	0.2
1998	4 (6)	36	18	11	3	1.9	0.4
1999	4	54	6	9.9	2.1	1.8	0.2
2000	4	33	18	10.3	3.4	2.3	1.0
Mean		56	25	17.8	15.3	2.0	0.8
<u>CLEARWATER WEST</u>							
1981	7	60	20	45	71	2.6	0.9
1982	7	100	60	29	25	1.7	0.7
1983	7	160	100	4	5	1.8	1.4
1984	7	70	30	4	2	1.4	0.2
1985	7	110	80	24	17	1.9	1.3
1986	6	50	20	77	137	2.6	1.0
1987	7	40	10	20	12	2.0	0.4
1988	5	40	10	17	10	2.6	1.2
1989	6	70	10	8	4	2.3	0.9
1990	5	50	20	31	15	1.9	0.8
1991	3	60	40	18	12	1.5	0.0
1992	8	60	70	29	24	1.9	0.6
1993	4 (1)	40	0	29	6	1.4	0.3
1994	4	33	15	17	8	1.5	0.2
1995	4 (2)	35	11	21	10	1.4	0.3
1996	4	43	11	9	2	2.0	0.3
1997	4	44	3	13	6	1.5	0.1
1998	4 (7)	34	11	14	3	1.5	0.1
1999	4(6)	31	4	10.2	2.0	1.6	0.3
2000	4	41	31	9	2.9	1.9	0.4
Mean		59	28	21.3	19.5	1.8	0.6

TABLE 6 (cont.)

HISTORICAL SUMMARY OF LAKE WATER QUALITY
Summer (June - September) Epilimnetic Means

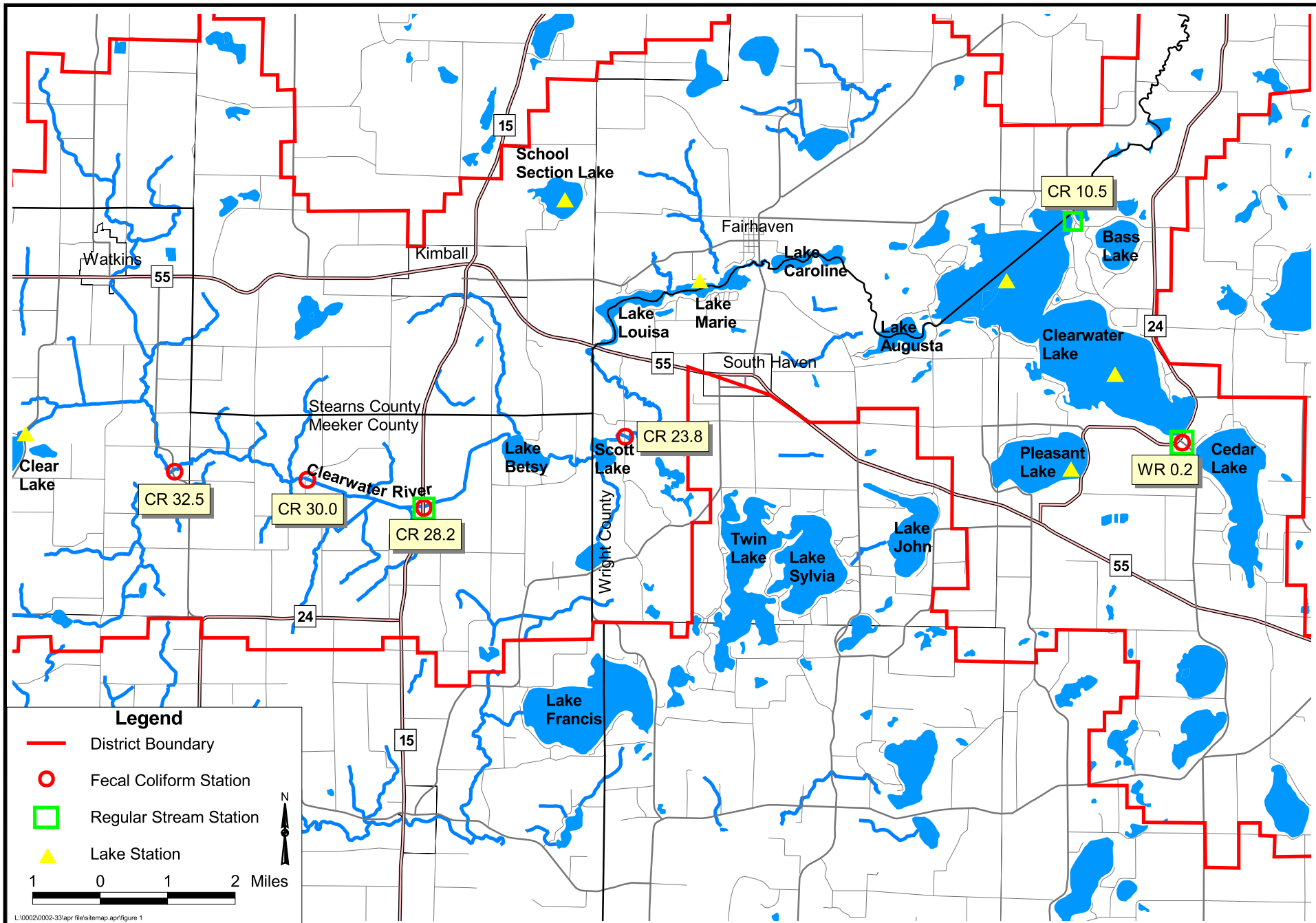
Clearwater River Watershed District

LAKE/ Year	Number of Samples	Total Phosphorous (ug/l)		Chlorophyll-a (ug/l)		Secchi Disk Transparency (m)	
		Mean (3)	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
<u>MARIE</u>							
1981	7	270	130	31	19	1.3	0.5
1982	7	360	120	63	57	1.3	0.6
1983	7	340	160	4	4	0.9	0.3
1984	7	190	60	7	5	0.9	0.3
1985	7	230	210	34	14	1.0	0.2
1986	6	160	30	92	91	1.1	0.1
1987	7	120	30	95	30	0.6	0.1
1988	5	220	80	153	91	0.4	0.1
1989	6	120	40	58	54	0.6	0.4
1990	5	150	60	101	33	0.8	0.2
1994	4	90	99	71	19	0.6	0.1
1996	4	100	39	37	5	0.8	0.1
1998	4	76	15	56	12	1.1	0.1
2000	4	74	18	45	13.9	0.8	0.3
Mean		179	78	60.4	32.0	0.9	0.2
<u>PLEASANT</u>							
1993	4	15	(4) 9	12	8	2.0	0.6
1997	4	51	31	9	(5) 2	2.4	0.6
1999	4(6)	25	5	9.1	5.8	3.0	0.9
2000	4	30	22	13.5	7.7	2.3	1.0
Mean		30.1	16.9	10.8	5.9	2.4	0.8
<u>SCHOOL SECTION</u>							
1993	4	35	(4) 38	14	9	2.2	0.8
1997	4	29	9	11	(5) 5	1.6	0.4
1999	4(5)	50	12	12.6	10	1.0	0.5
2000	4	37	6	11	2.1	2.1	0.3
Mean		38	16	12	6	2	0
<u>CLEAR</u>							
1994	4	80	24	17	8	1.2	0.3
1998	4	220	141	110	141	1.0	0.1
1999	4	188	43	84.5	47	0.5	0.0
2000	4	228	30	134.3	42.6	0.3	0.1
Mean		178.9	59.5	86.4	59.5	0.8	0.1

Notes:

- (1) The fourth sample was collected on October 6, 1993.
- (2) The fourth sample was collected on October 2 or 3, 1995
- (3) Starting in 1993, Total phosphorus means are rounded to two significant figures. Prior to 1993, the mean values were rounded to the nearest 10 ug/l.
- (4) Values reported as "Less than" the detection limit were estimated as half of the detection limit.
- (5) Three samples were analyzed for chlorophyll-a.
- (6) Three samples were analyzed for total phosphorus.
- (7) Three secchi disk readings were recorded.

Figures



Legend

- District Boundary
 - Fecal Coliform Station
 - Regular Stream Station
 - ▲ Lake Station
- 1 0 1 2 Miles

CLEARWATER RIVER WATERSHED DISTRICT

Stream and Lake Monitoring Locations

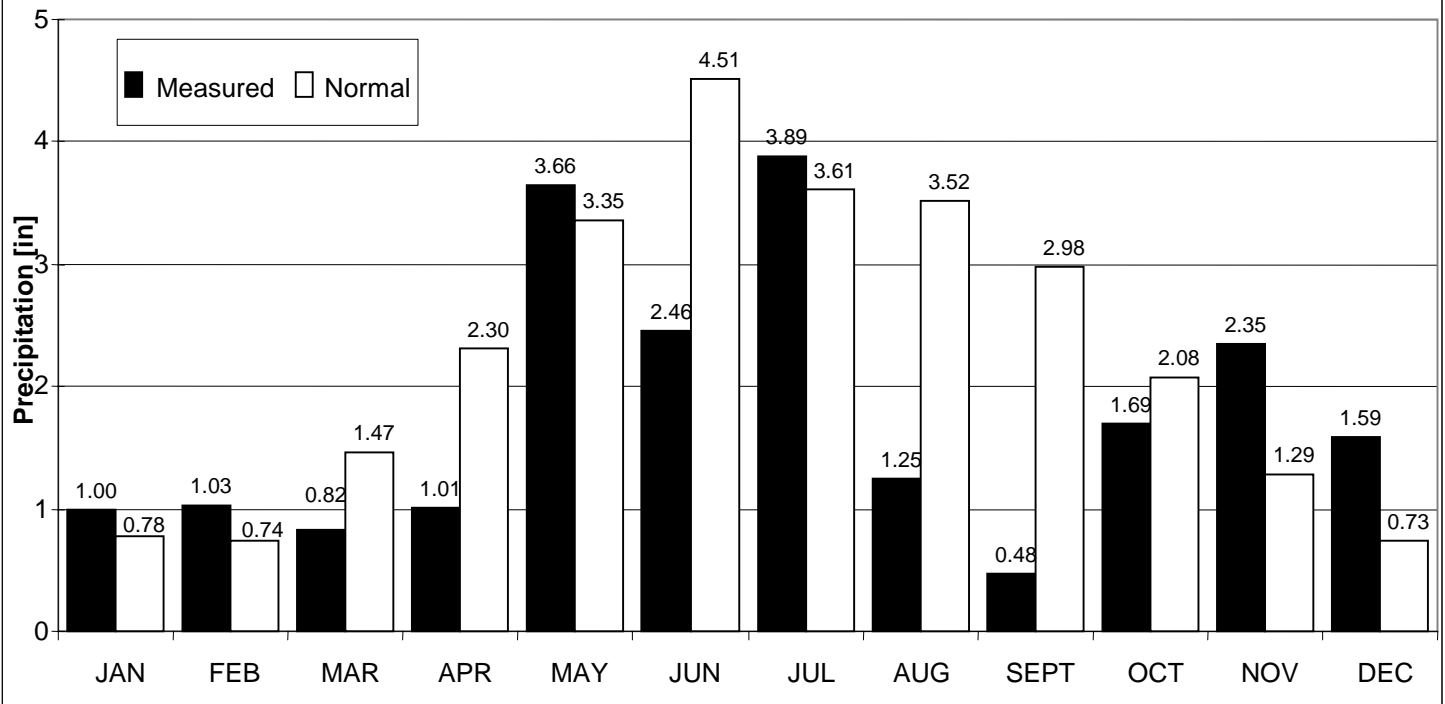

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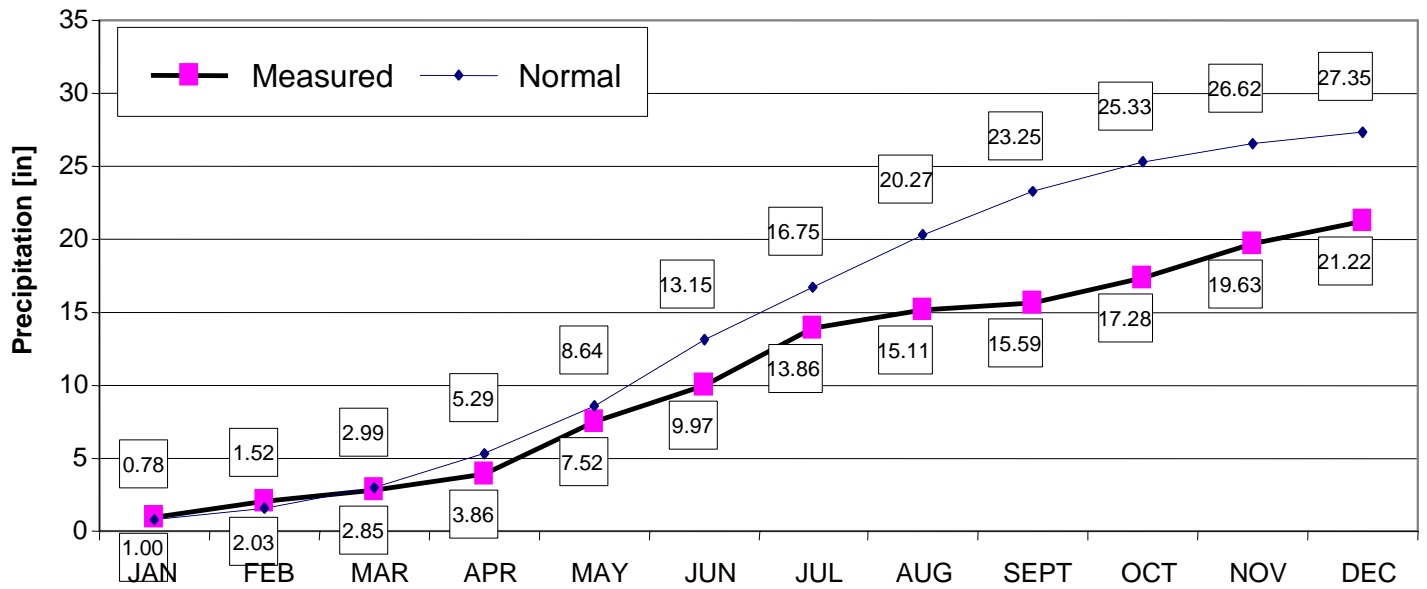
Figure 1

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Monthly Values



Cumulative Totals



T:\0002\33\precipitation.xls\Watershed Weighted Totals

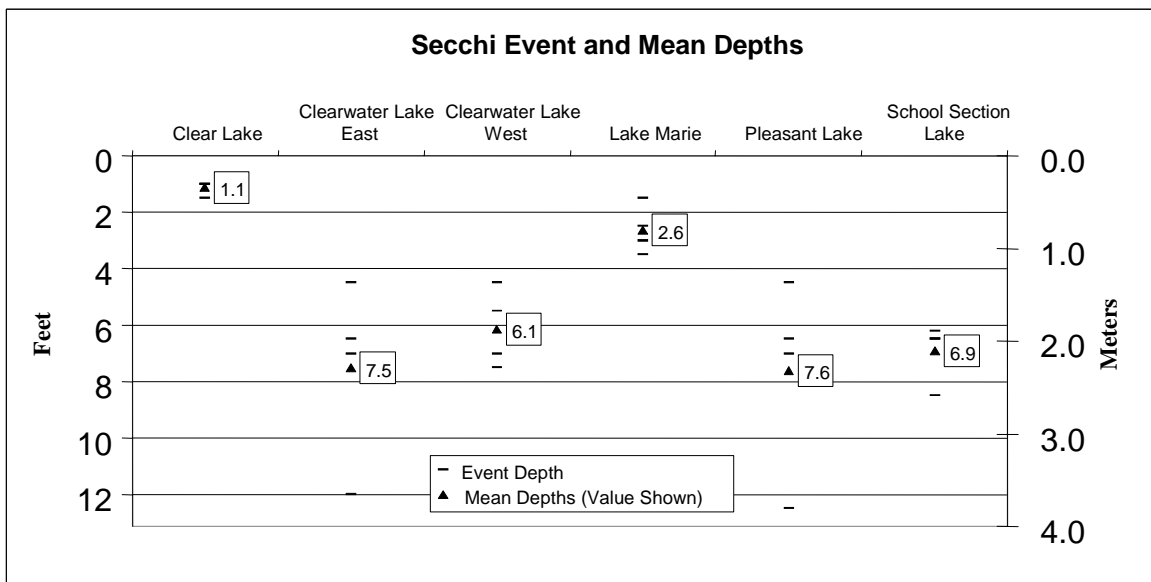
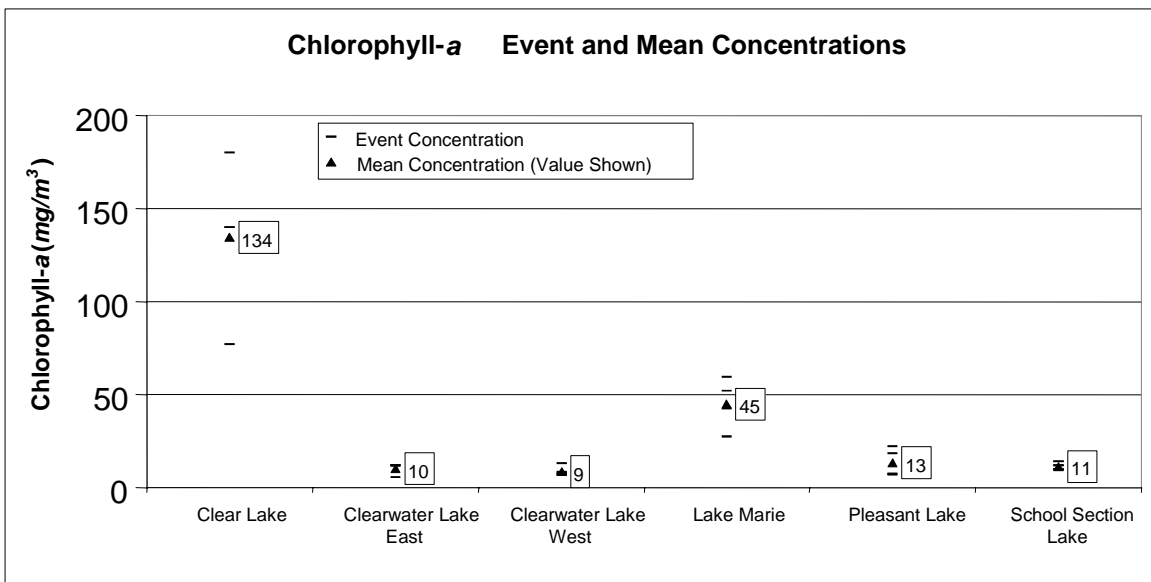
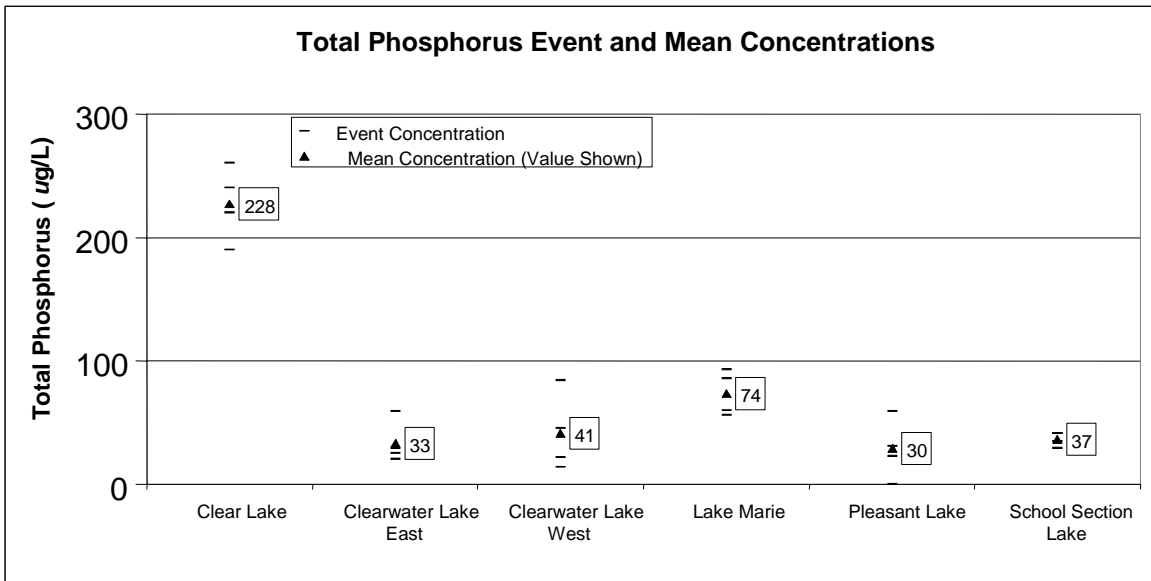
CLEARWATER RIVER WATERSHED DISTRICT

Precipitation Data

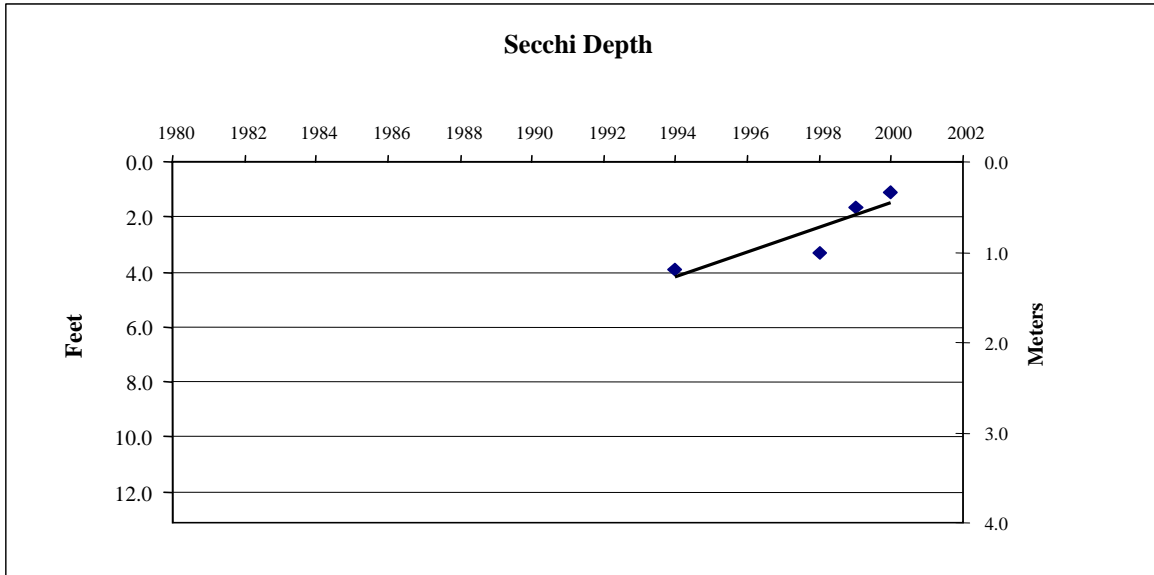
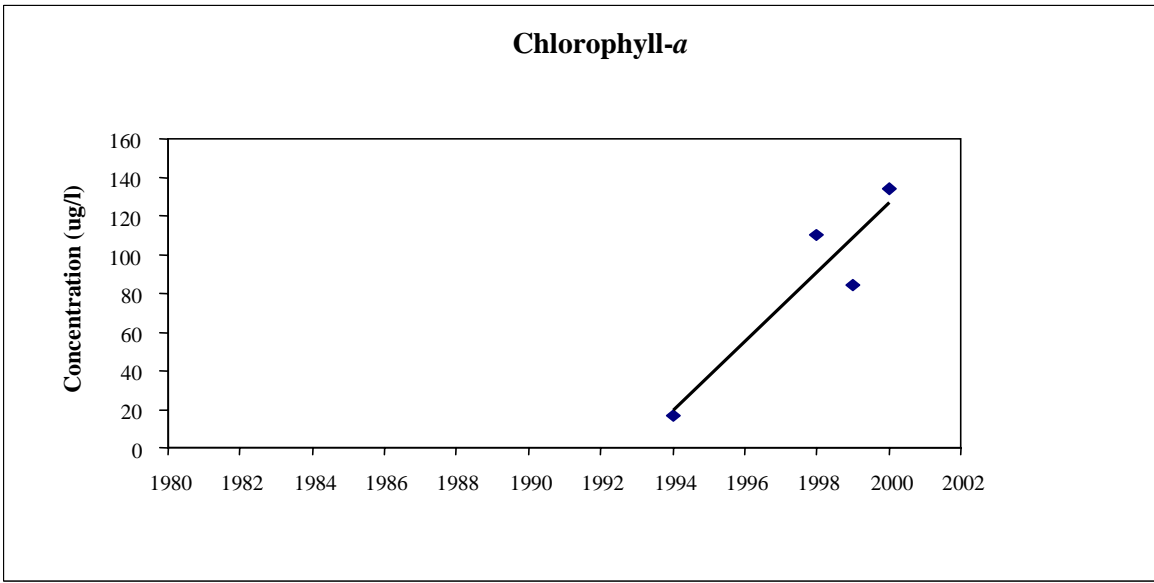
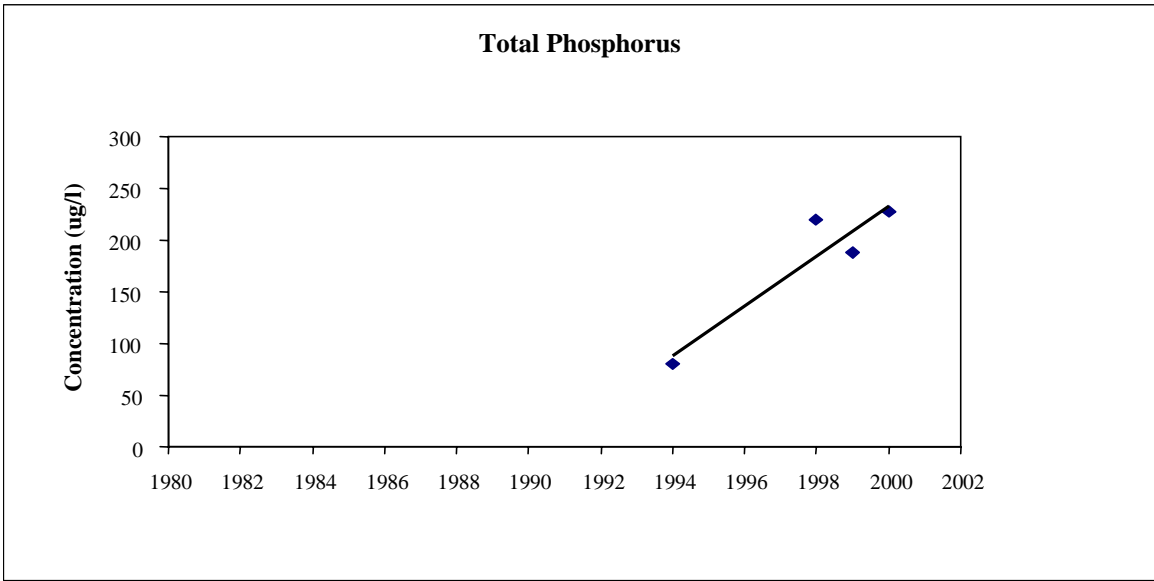
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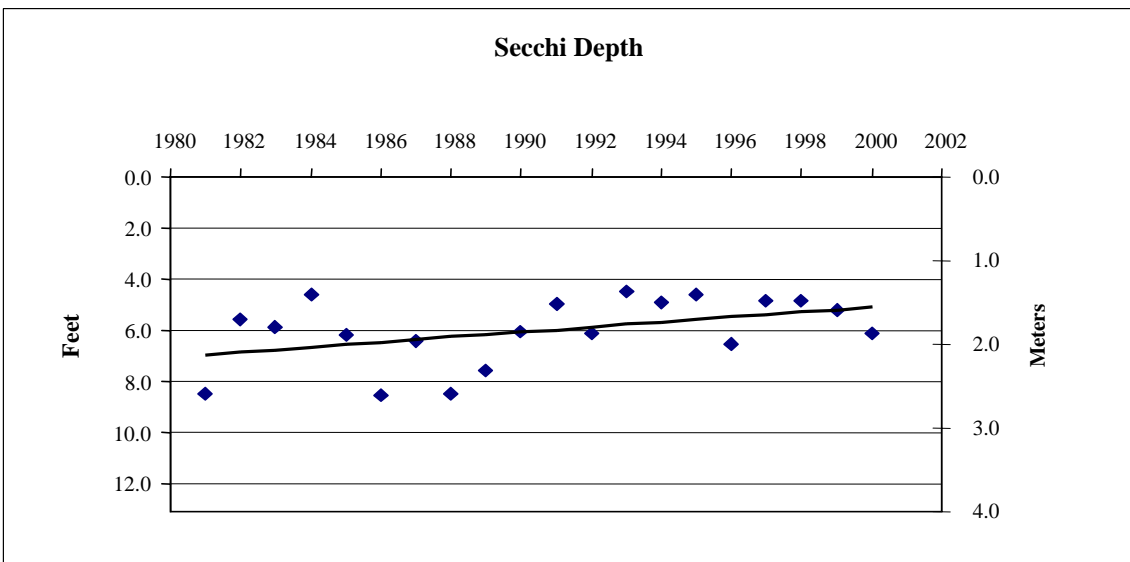
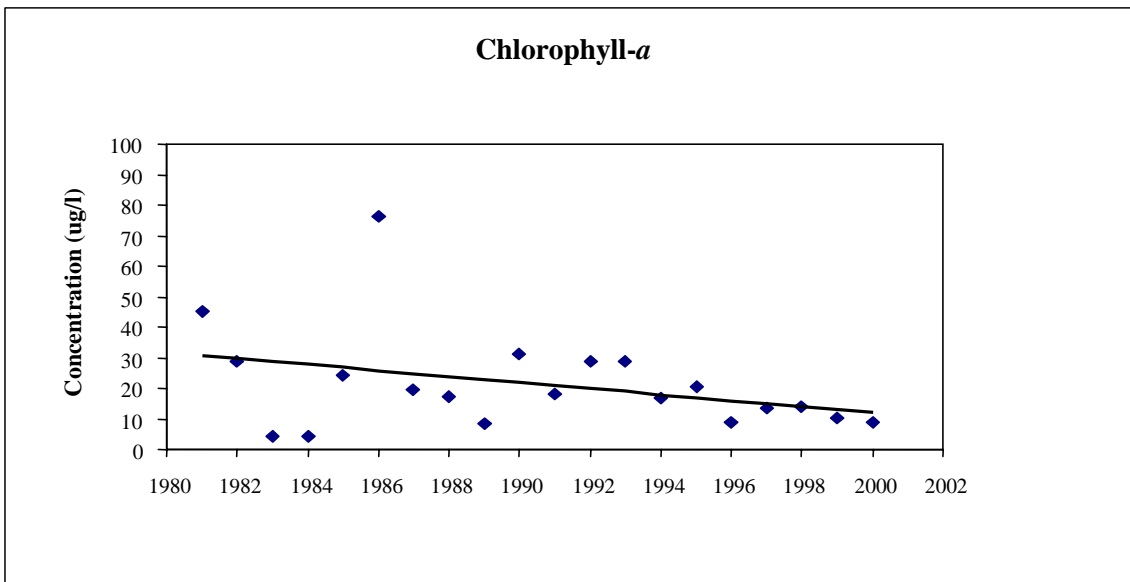
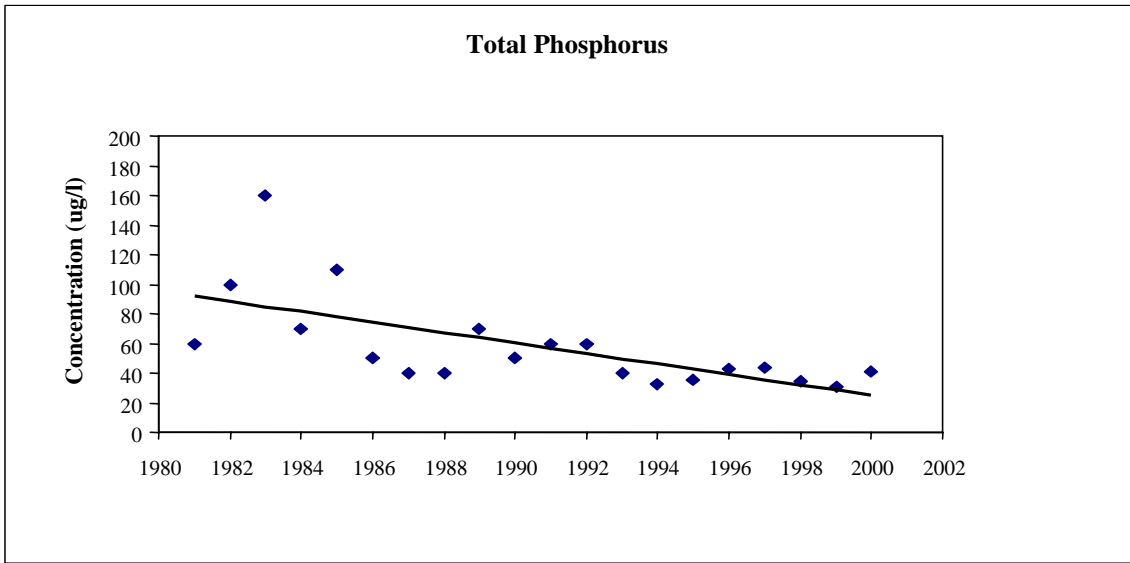
Figure 2



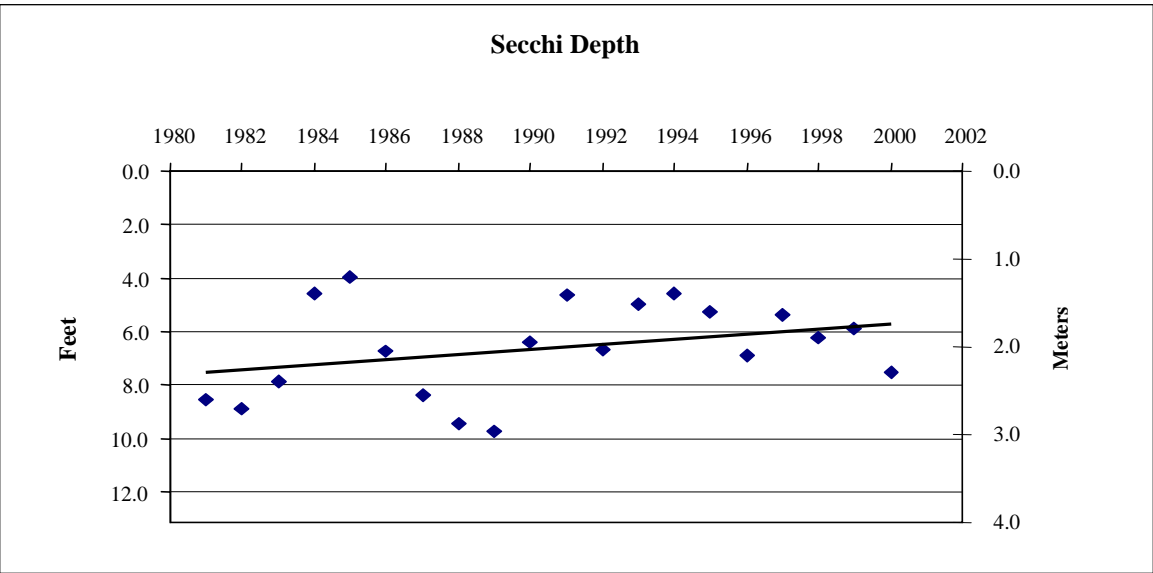
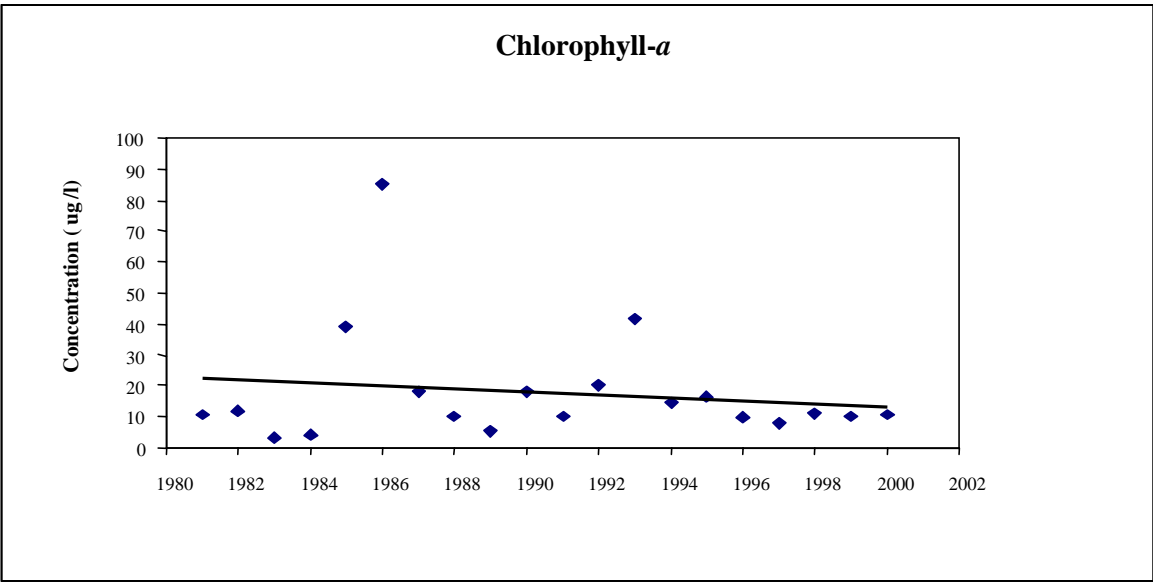
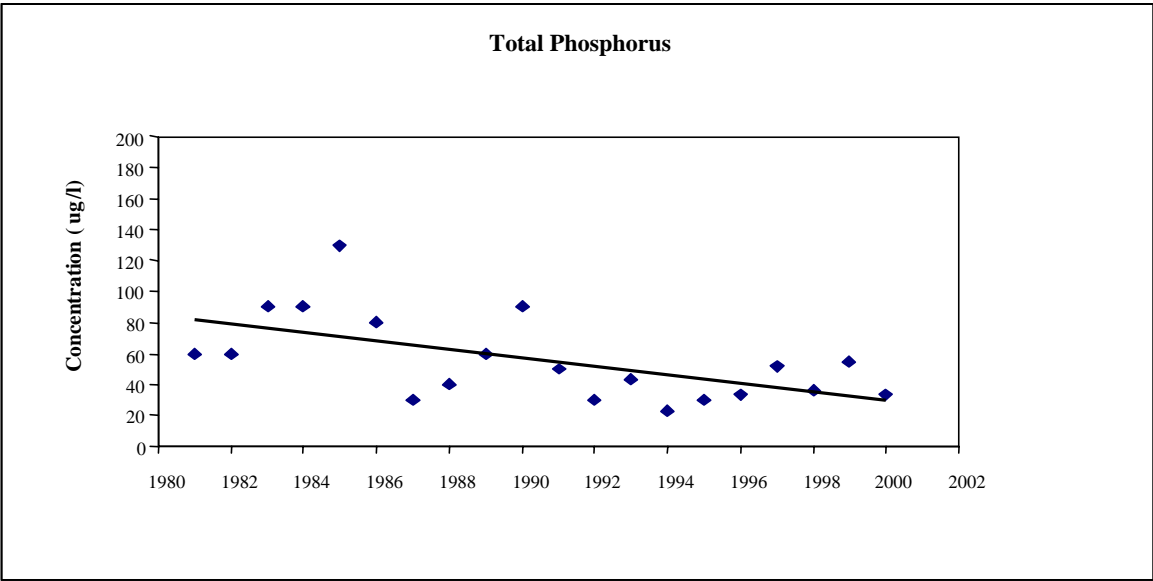
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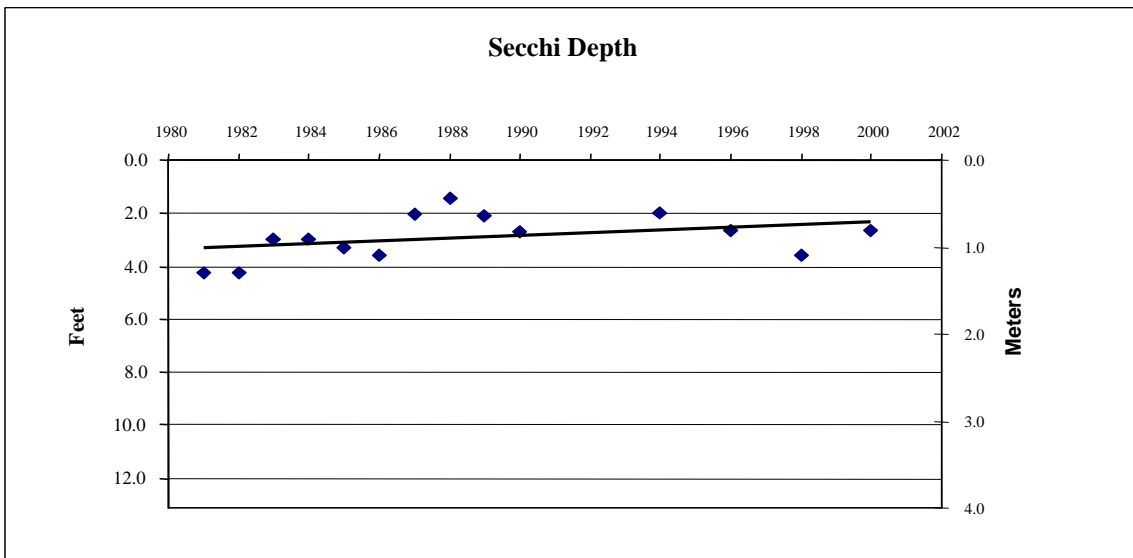
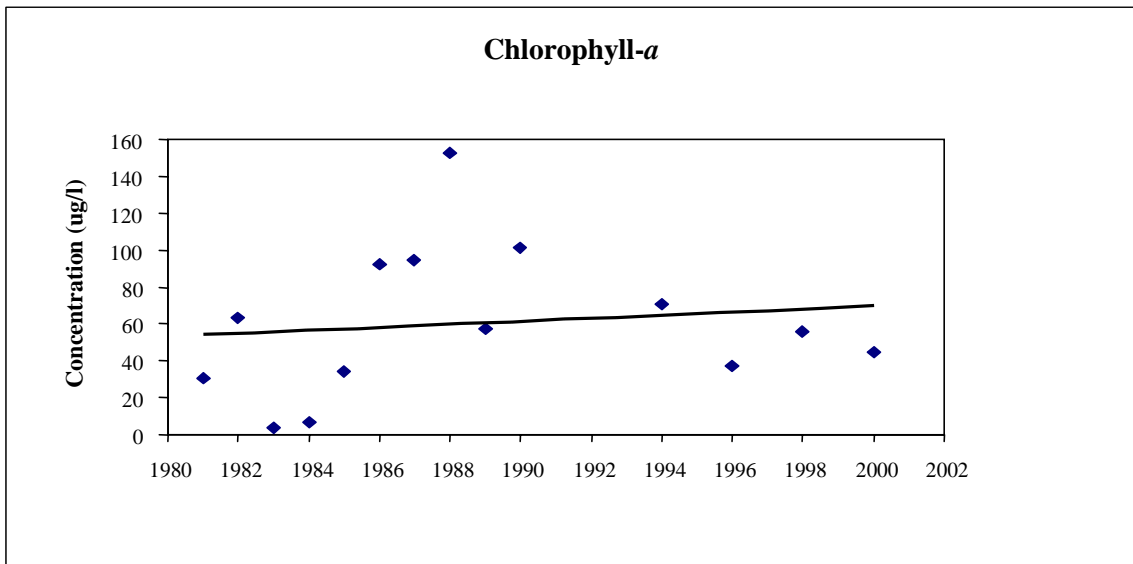
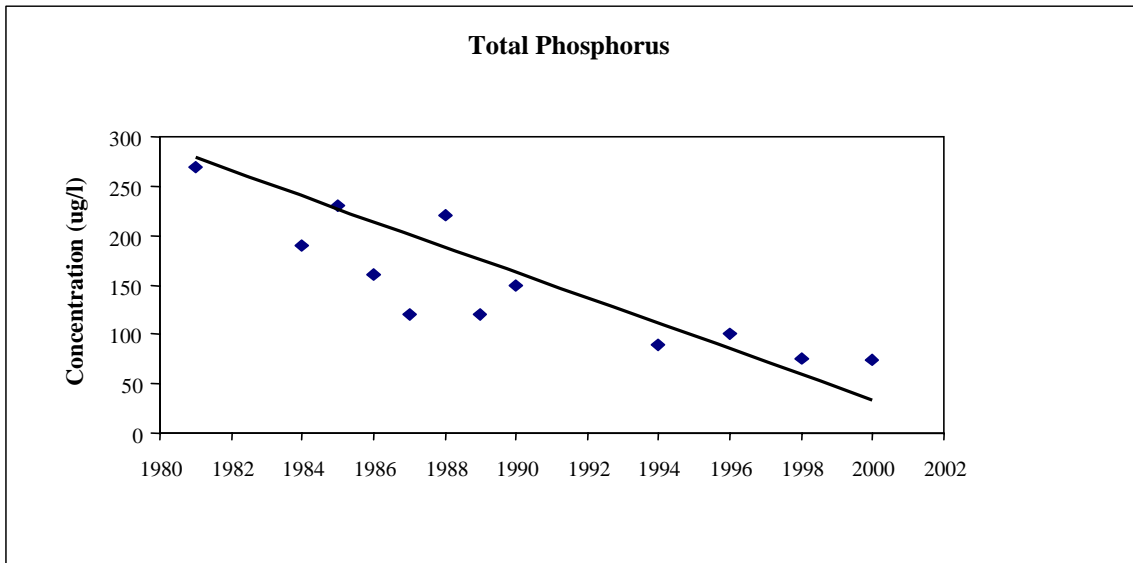
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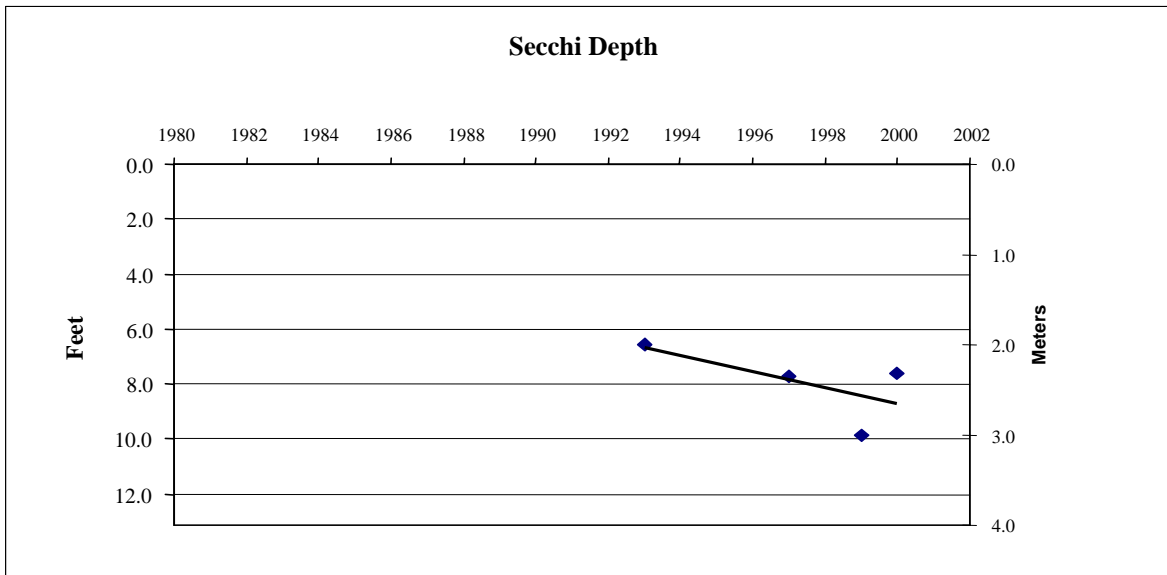
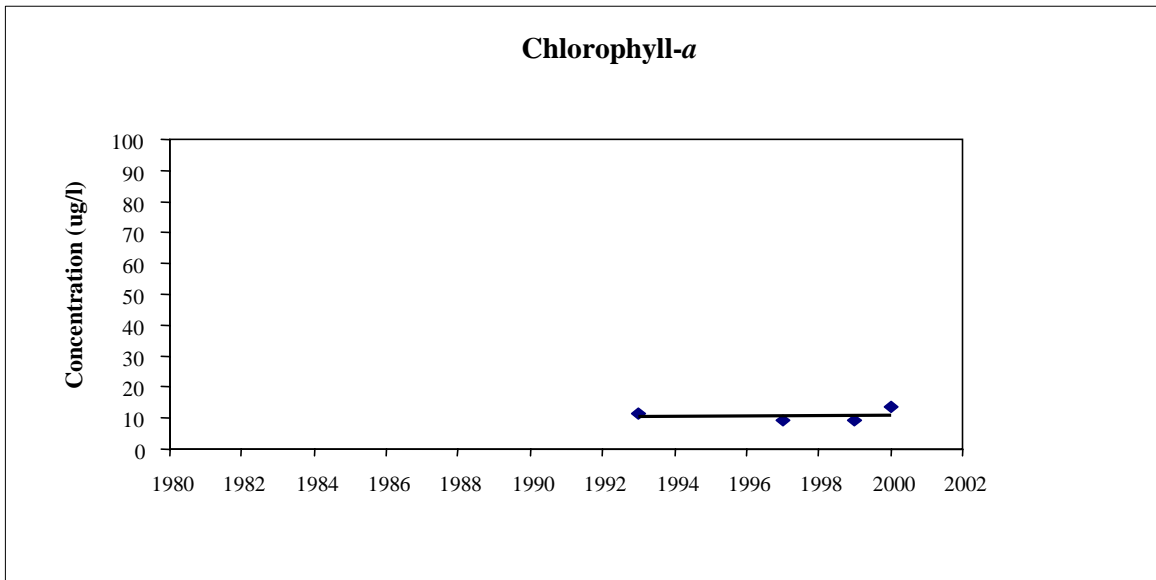
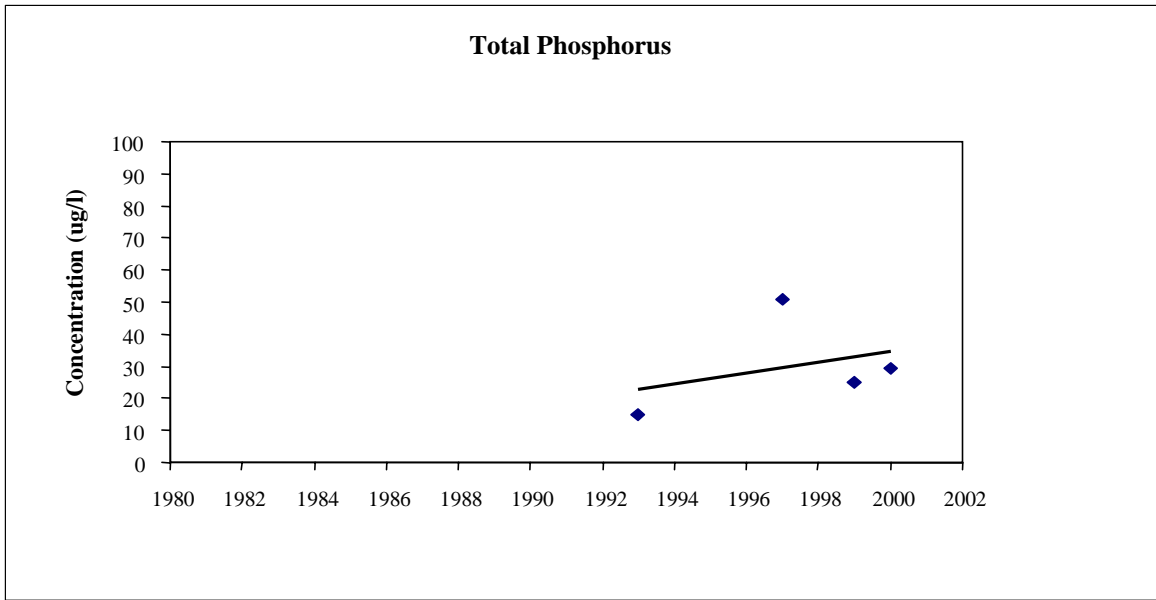
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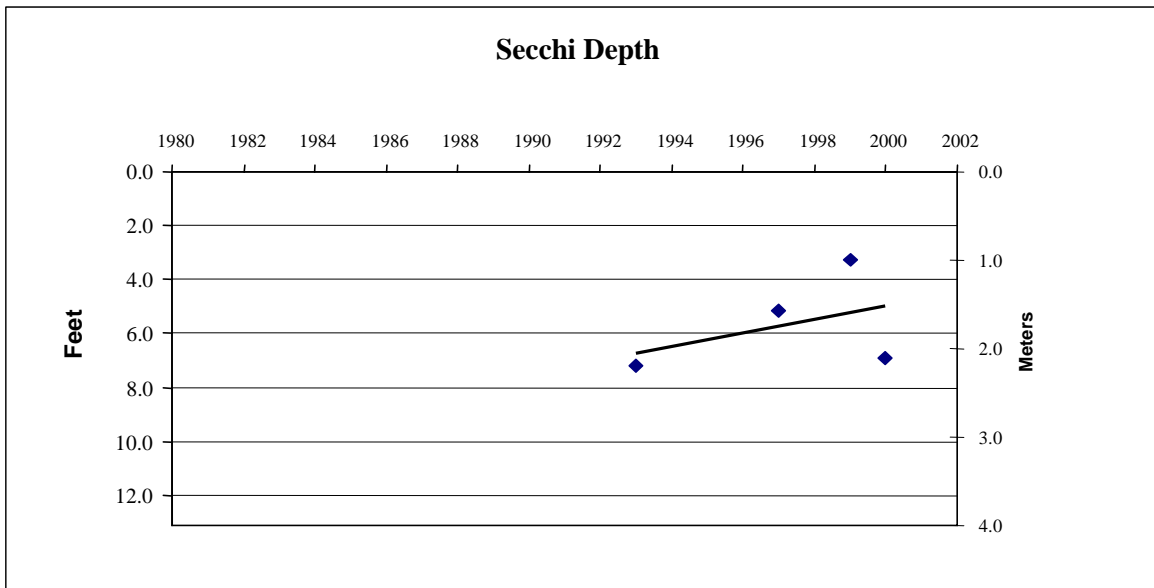
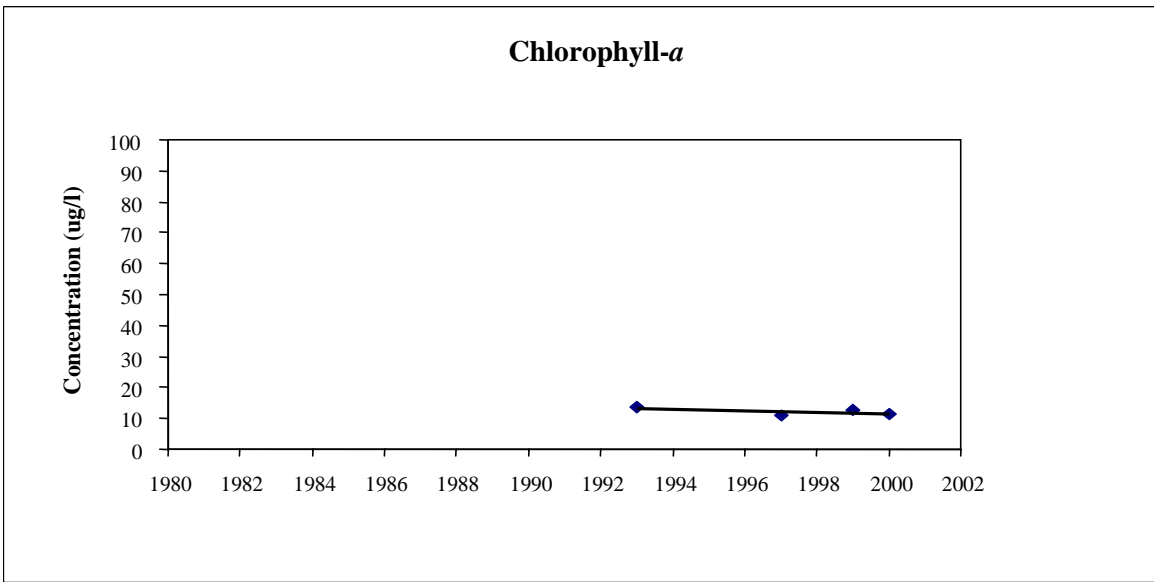
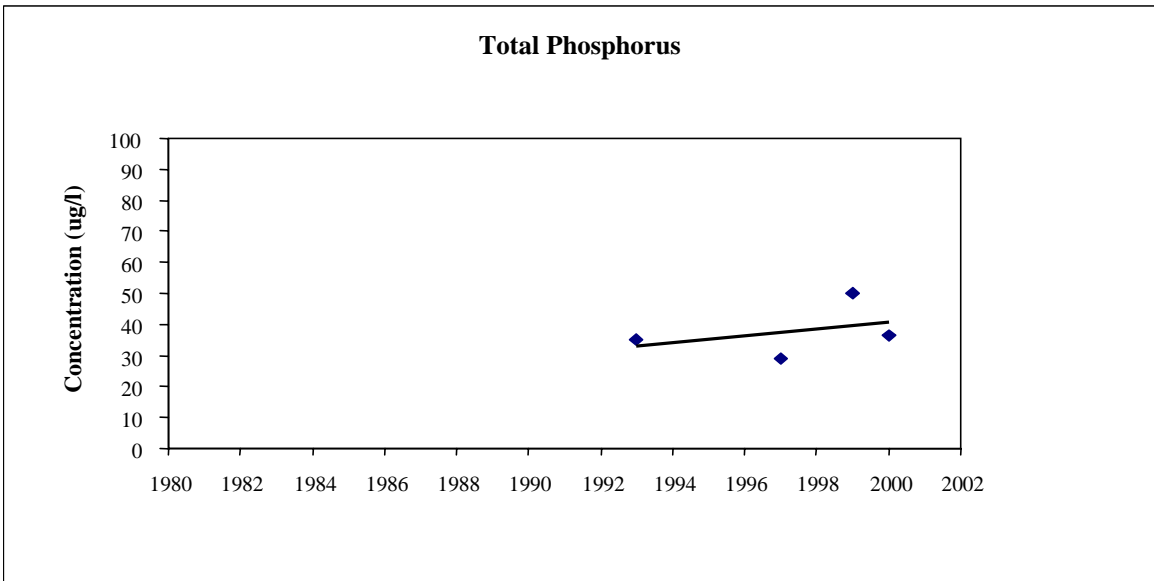
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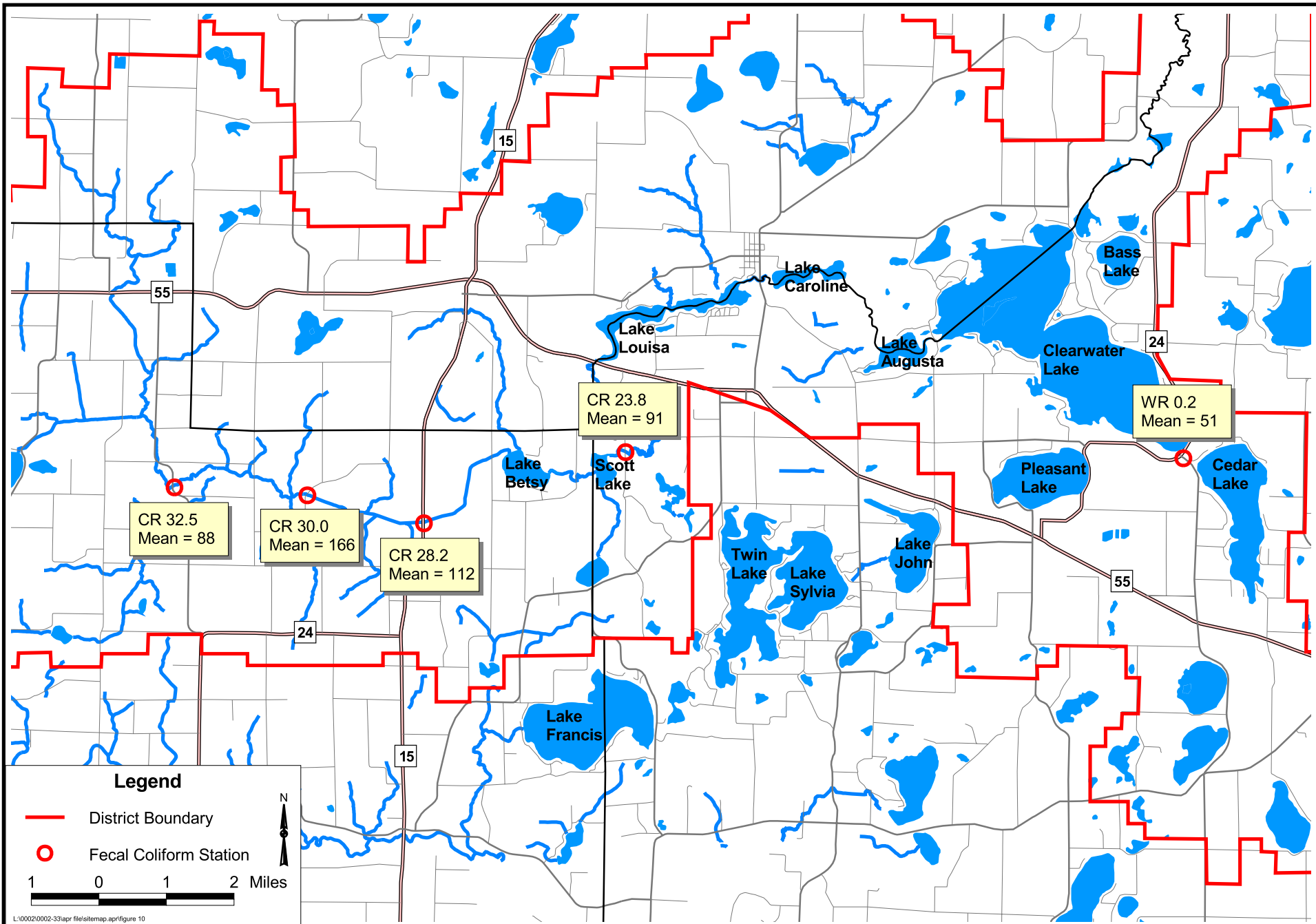
CLEARWATER RIVER WATERSHED DISTRICT

School Section Historical Data


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Figure 9



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CLEARWATER RIVER WATERSHED DISTRICT

Fecal Coliform Stream Monitoring Results

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Figure 10

Appendix A

2000 Monitoring Plan Summary

MEMORANDUM

TO: Clearwater River Watershed District Board of Managers

FROM: Norman C. Wenck
Engineer for the District

DATE: April 12, 2000

RE: Proposed 2000 Water Quality Monitoring Program

Introduction

The Clearwater River Watershed District conducts annual water quality monitoring at selected lakes and selected locations on streams. Typically the monitoring plan consists of following a plan shown in Table 1. Some years special monitoring is also conducted. This memo addresses the regular monitoring proposed for 2000.

Lake Monitoring

The schedule on Table 1 was modified somewhat in 1999. Last year 20 lakes were monitored in an expanded program. The regular schedule for the 2000 program has Clearwater East and West being monitored, as they are every year. In addition, it is proposed to monitor Marie, Pleasant, School Section, and Clear Lake during 2000.

Stream Monitoring

Clearwater River will be monitored at station CR 28.2, CR10.5 and WR 0.2 monthly in addition to 8 other flow measurements.

Parameters

The parameters monitored will be the same as 1999 (Table 2). Field parameters consist of Dissolved Oxygen, Temperature, and Specific Conductivity. For lakes secchi is also measured. Laboratory parameters consist of total phosphorus and total suspended sediment for stream samples and additionally, chlorophyll-*a* for lake samples. This proposed program is estimated to cost \$9,800.

Option 1 – Additional Fecal Coliform Monitoring

In view of the MPCA's determination that a portion of the Clearwater River is impaired due to fecal coliform, a five station fecal coliform monitoring option is presented in Table 2 at an estimated cost of \$2,400.

TABLE 2

Proposed 2001 CRWD Monitoring Plan Summary

Category	Schedule	Station	Parameters
Lakes:	June 15 - July 5	Clearwater-East	Field: Secchi, DO and temperature profiles
	Jul 27 - Aug 4	Clearwater-West	
	Aug 26 - Sep 15	Augusta	Lab: Total phosphorus and Chlorophyll-a
		Louisa	
		Betsy	
		Cedar	
		Nixon	
		Otter	
Bass	Citizen Secchi: Fourteen Sites		
Streams:	April	CR28.2	Field: Flows, DO and temperature
	May	WRO.2	Lab: Total phosphorus, soluble reactive phosphorus
	June	CR10.5	
	July		
	August		
	September		
Precipitation:	Daily at three sites (Watkins, Maire Prairie and Corrinna)		
Option 1: Fecal Coliform Monitoring			
	April	5 River Stations	Lab: Fecal Coliform
	May	CR32.5	
	June	CR30.0	
	July	CR28.2	
	August	CR23.8	
	September	WR0.2	

TABLE 1
PROPOSED LONG-TERM WATER QUALITY MONITORING PLAN FOR CRWD LAKES

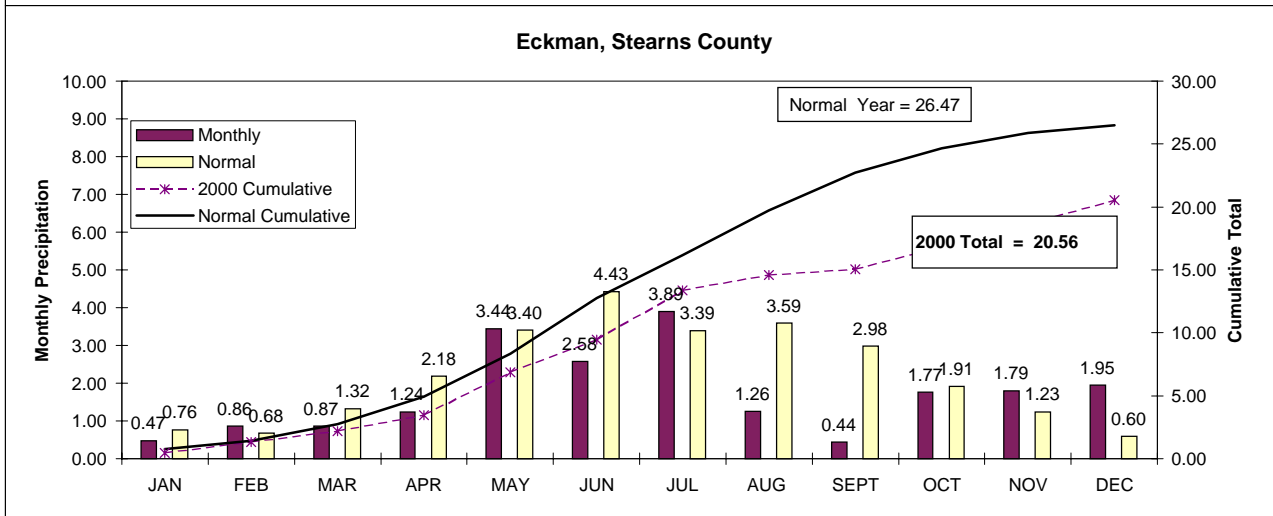
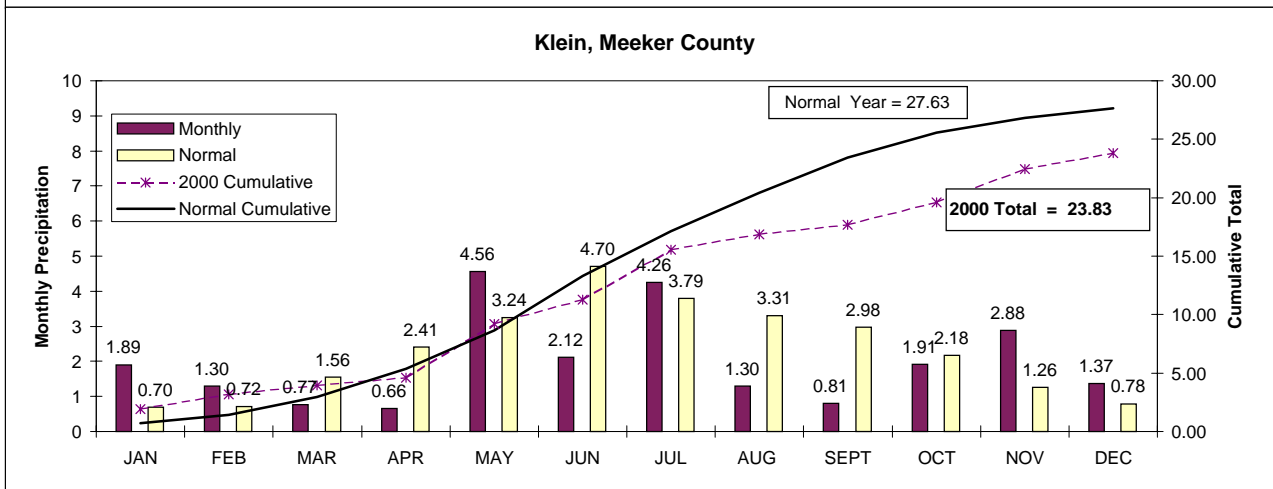
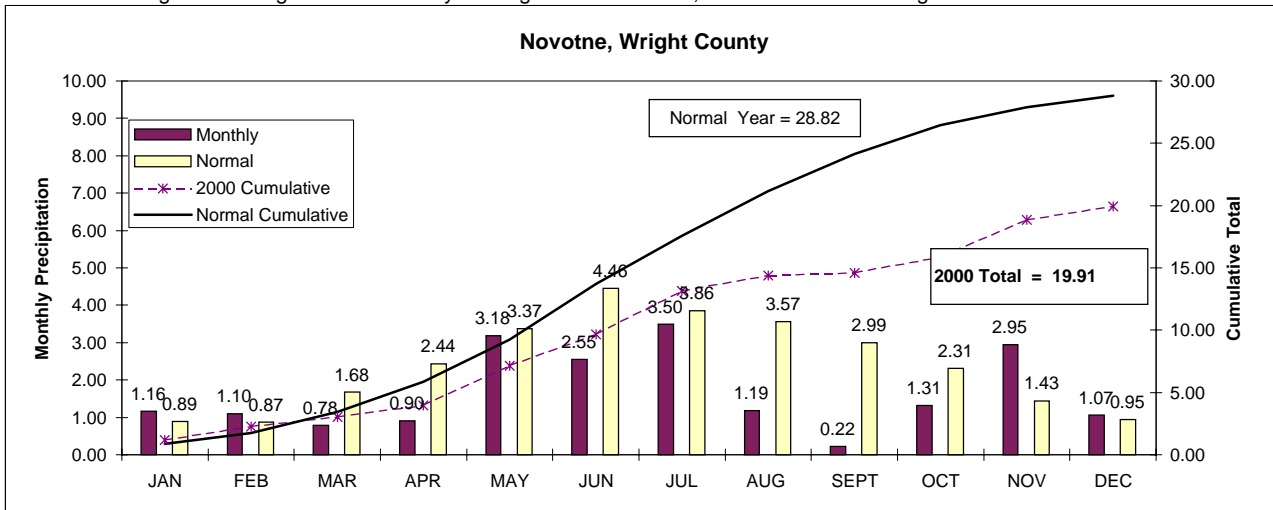
<u>LAKE STATIONS</u> ⁽¹⁾	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>
<u>Clearwater Lake:</u>								
Clearwater East	X	X	X	X	X	X	X	X
Clearwater West	X	X	X	X	X	X	X	X
<u>Main Stem Lakes:</u>								
Augusta	X		X		X		X	
Louisa	X		X		X		X	
Caroline		X				X		X
Scott		X	X			X		X
Marie		X		X		X		X
Betsy	X		X		X		X	
<u>Other Lakes:</u>								
Cedar			X		X		X	
Pleasant	X		X	X				X
School Section	X		X	X				X
Nixon	X		X		X			X
Otter	X		X		X			X
Bass		X	X		X			
Clear		X	X	X			X	
Union		X	X			X		
Henshaw		X	X			X		
Little Mud			X			X		
Wiegand			X			X		
Swart Watts			X				X	
Albion			X				X	
Grass			X				X	

Note: ⁽¹⁾Lake selection based on total lake size ranking scores (Lake Priority Ranking, 1990)

Appendix B

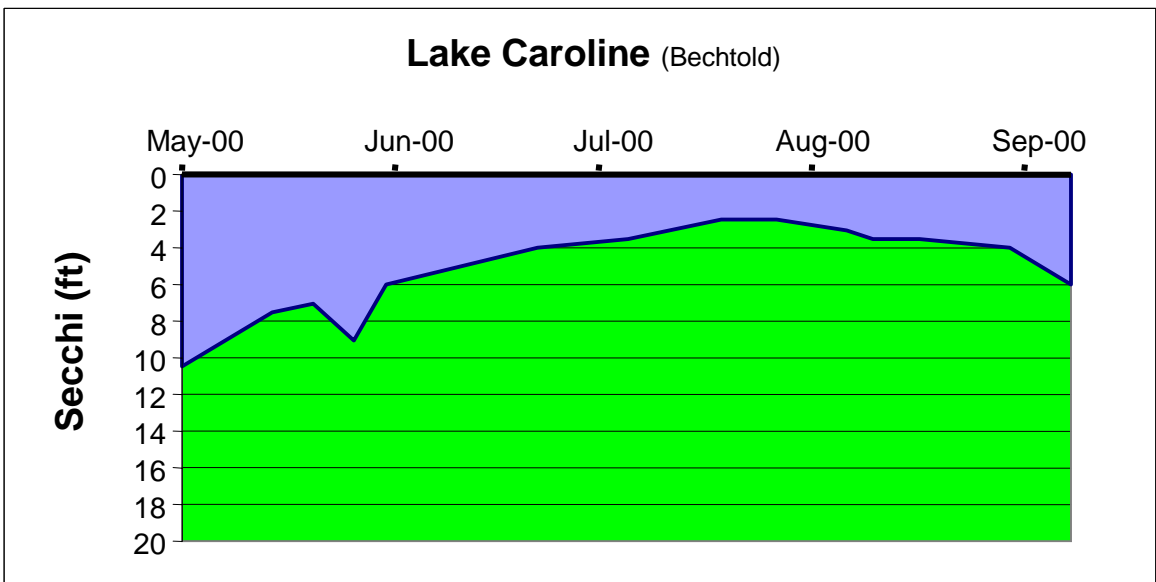
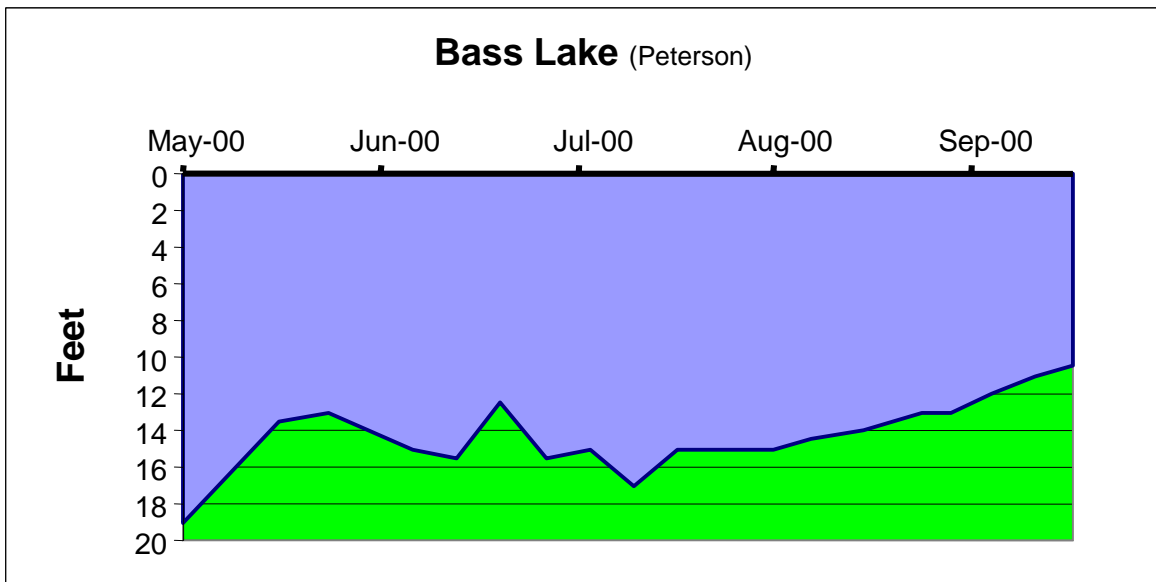
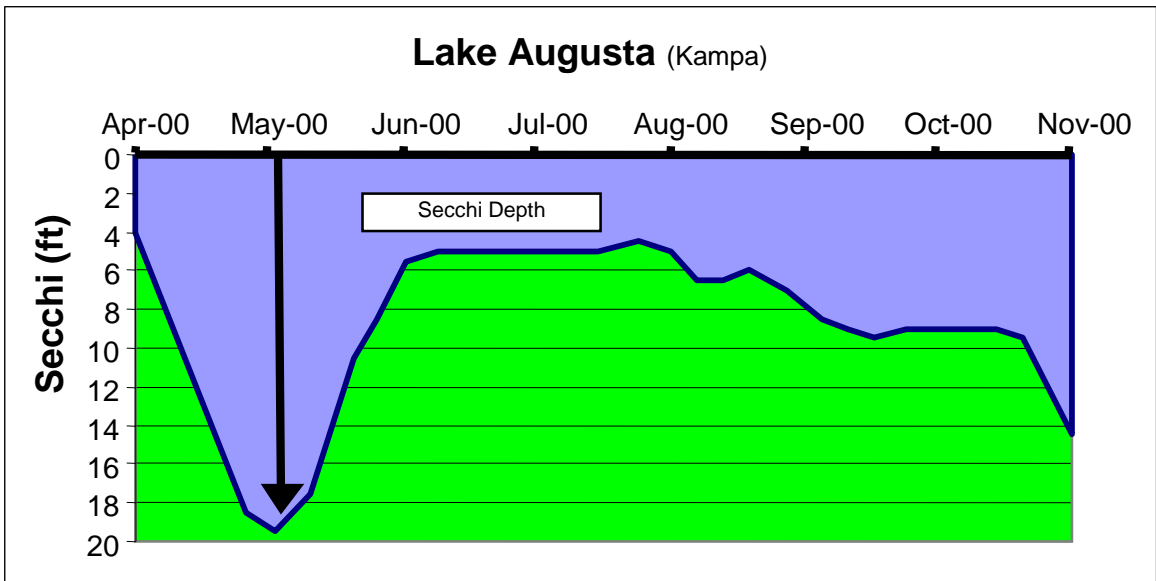
Volunteer Precipitation Data

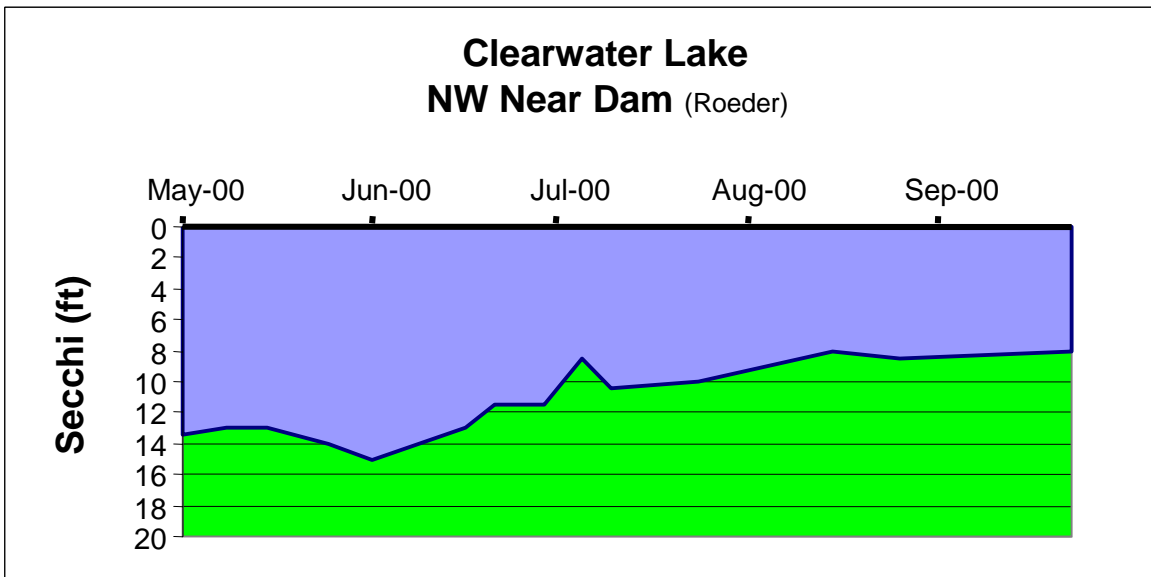
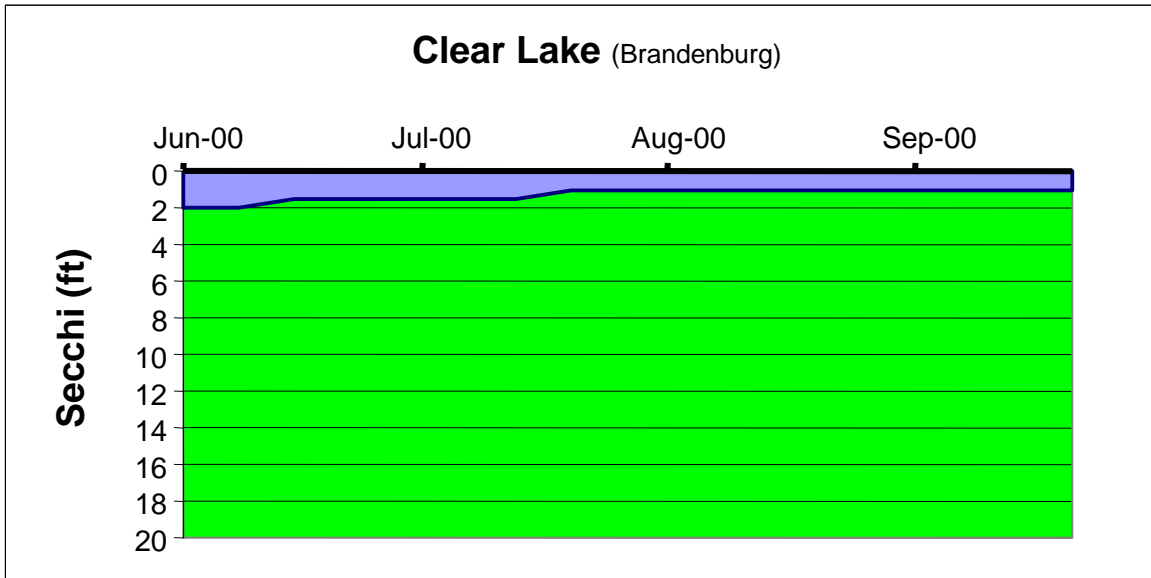
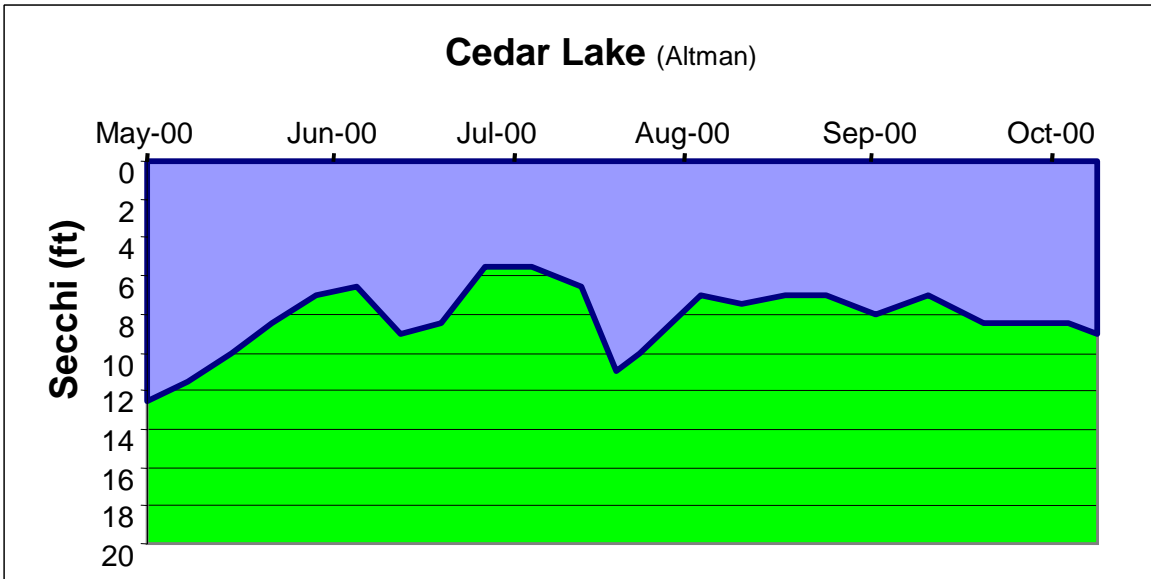
Watershed Weighted Average is calculated by scoring Eckman double, Novotne and Klein single.



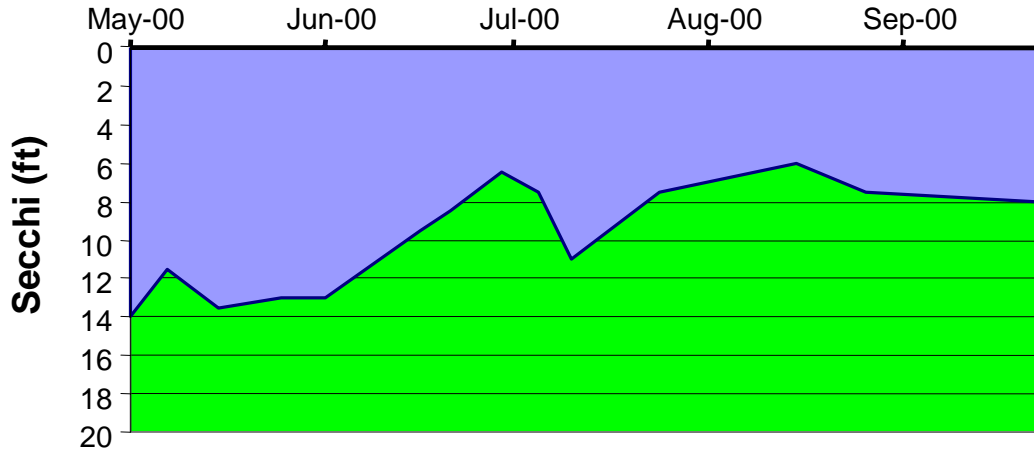
Appendix D

Citizen's Lake Monitoring Program – Secchi Data

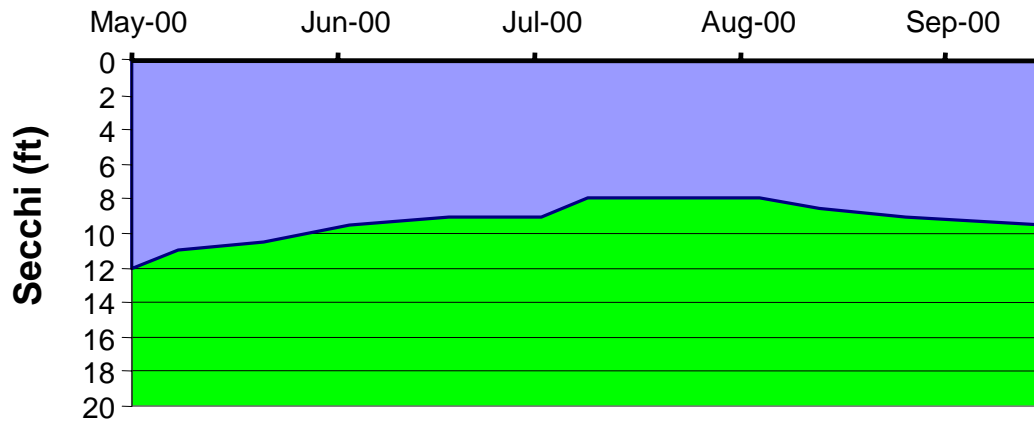




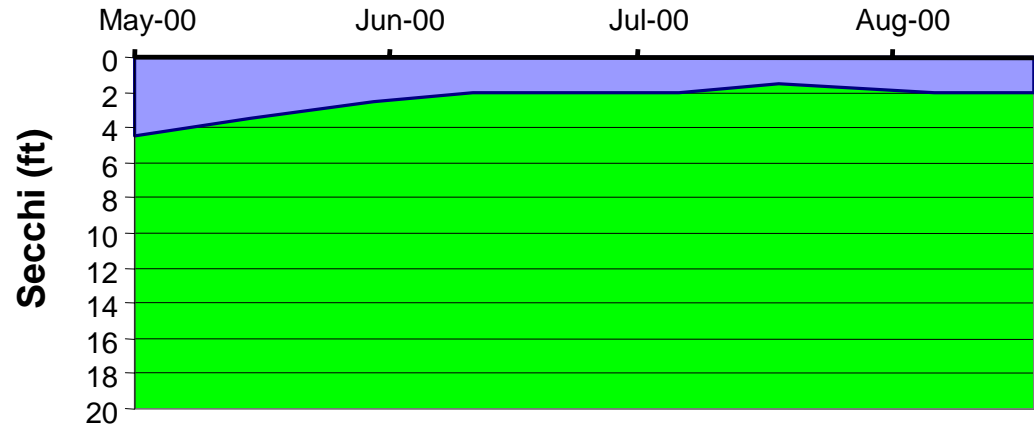
Clearwater Lake, West (Roeder)

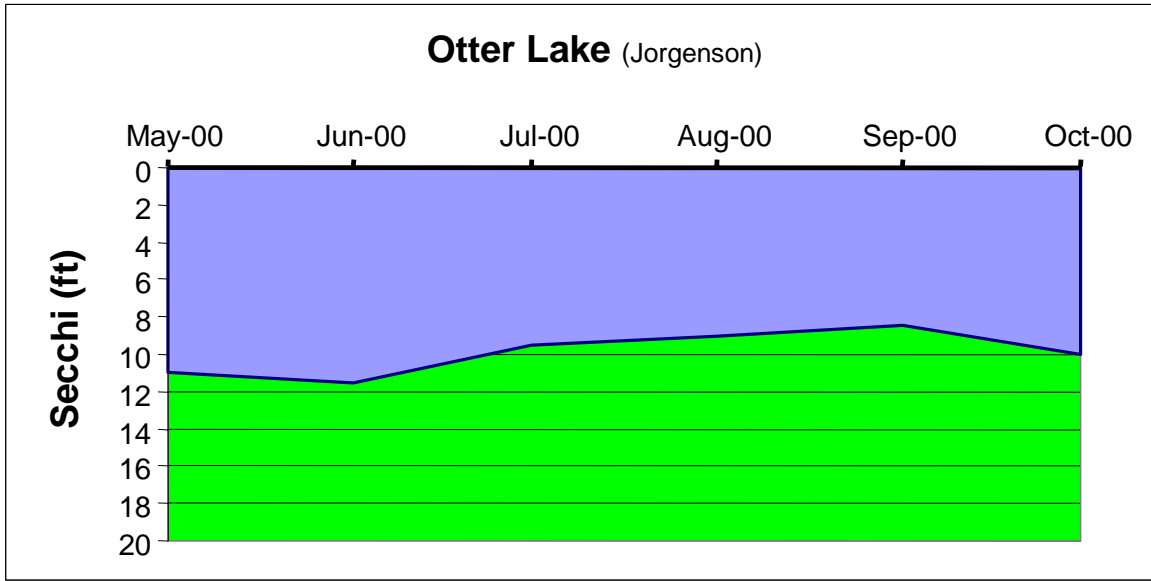
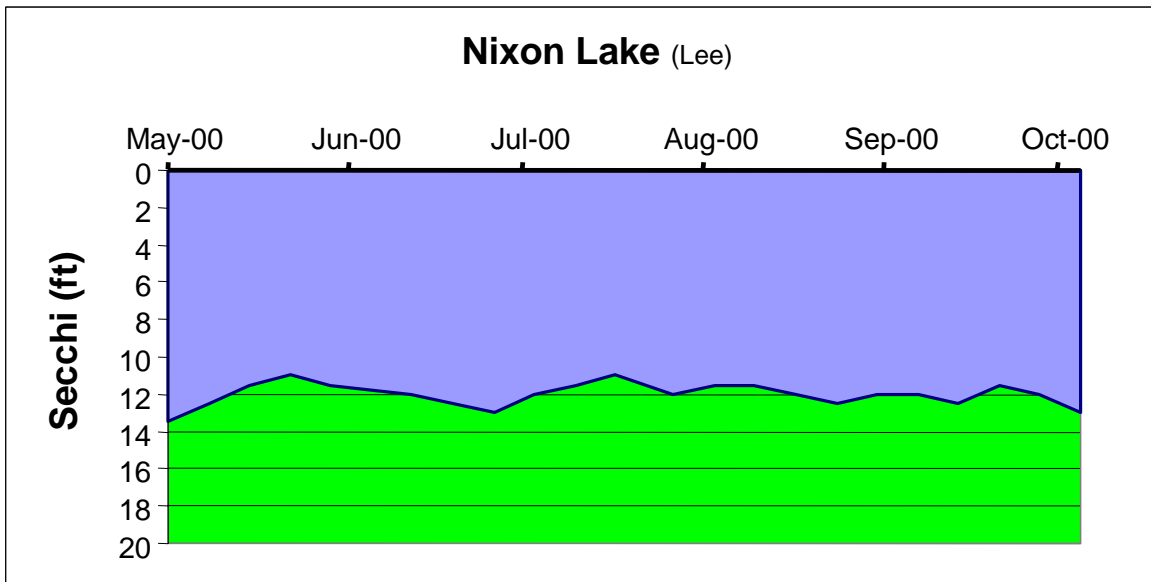
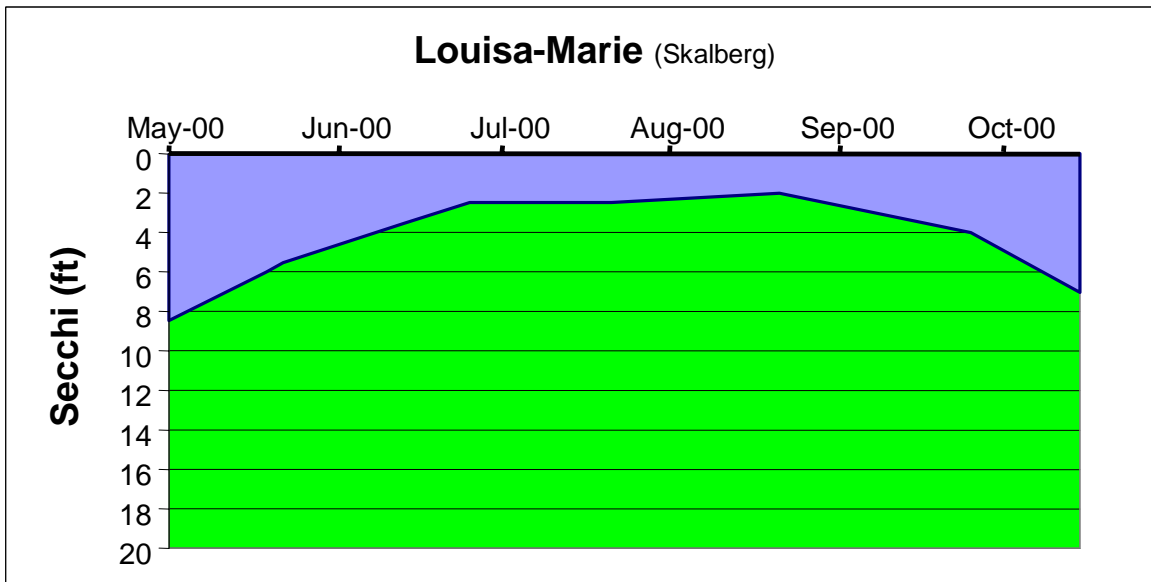


Lake Grass (Liebrenz)

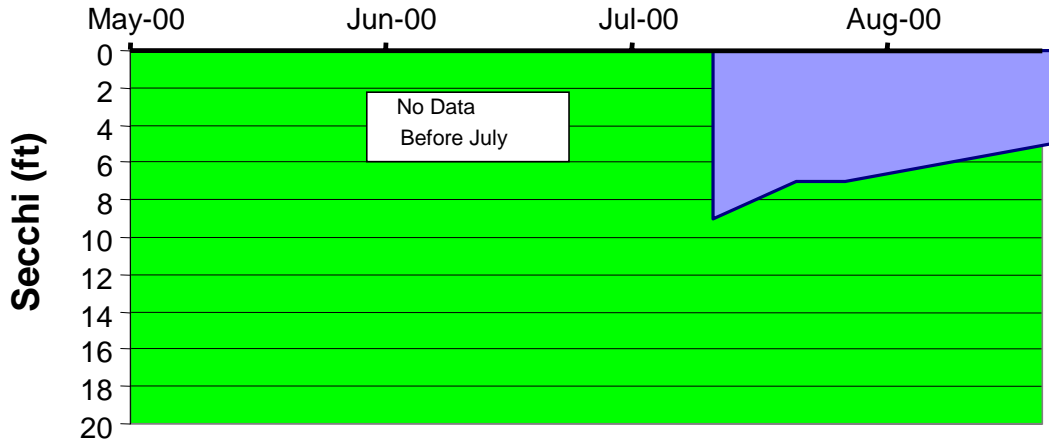


Millpond Lake Marie (Tracy)

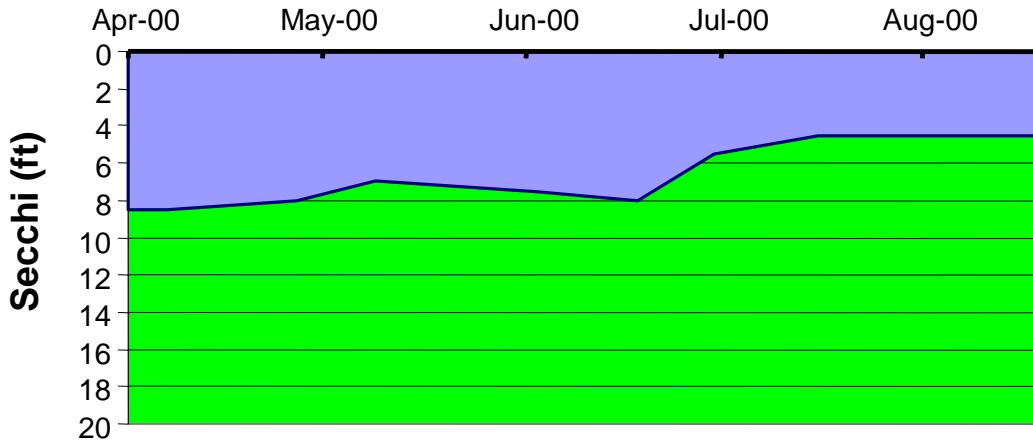




Pleasant Lake (Lundberg)



School Section Lake (Eckman)



Union Lake (Hauck)

