2005 Water Quality Monitoring Report

Wenck File #0002-69

Prepared for:

CLEARWATER RIVER WATERSHED DISTRICT
Box 481
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January 2006

Prepared by:

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1.0 Introduction

The Clearwater River Watershed District has conducted a stream, precipitation, and lake monitoring program since 1980. The monitoring program has focused on collecting baseline data to assess long-term water quality trends within the District. In the past few years, the monitoring plan was expanded to add more fecal coliform and phosphorus monitoring in the watershed. Beginning in 2003, the District returned to baseline monitoring. A Total Maximum Daily Load (TMDL) study is under way for the Clearwater River between Clear Lake and Lake Betsy for dissolved oxygen and bacteria, and for nutrients in Lake Louisa. Additional funding provided by the Minnesota Pollution Control Agency for monitoring to address the impaired waters allowed the District to focus on the Cedar Lake nutrient balance 2005.

In 2005, the Clearwater River was monitored at one long-term station (CR-10.5). Warner Creek was monitored near its inflow to Clearwater Lake at WR-0.2. The long-term station located in the upper reach of the Clearwater River (the listed reach between Clear Lake and Lake Betsy) was to be monitored under the TMDL Phase II contract. However, expected funding for this project was delayed and no monitoring was completed at this location.

Seven lakes were monitored by CRWD including Cedar Lake, Lake Albion, Swartout Lake, Henshaw Lake, Weigand Lake, Lake Betsy and Clear Lake. Cedar Lake and its tributaries, outflow, and tributary watersheds were monitored more frequently during 2005 in response to high total phosphorus concentrations observed in 2003 and 2004. The Minnesota DNR monitored Clearwater Lake, Lake Louisa, Lake Marie, Lake Caroline, Bass Lake, Lake Augusta, and Grass Lake. The MPCA monitored Union, Bass and Pleasant Lakes. Data is not yet available from the DNR and the MPCA. Upon receipt of the additional data, this report shall be appended.

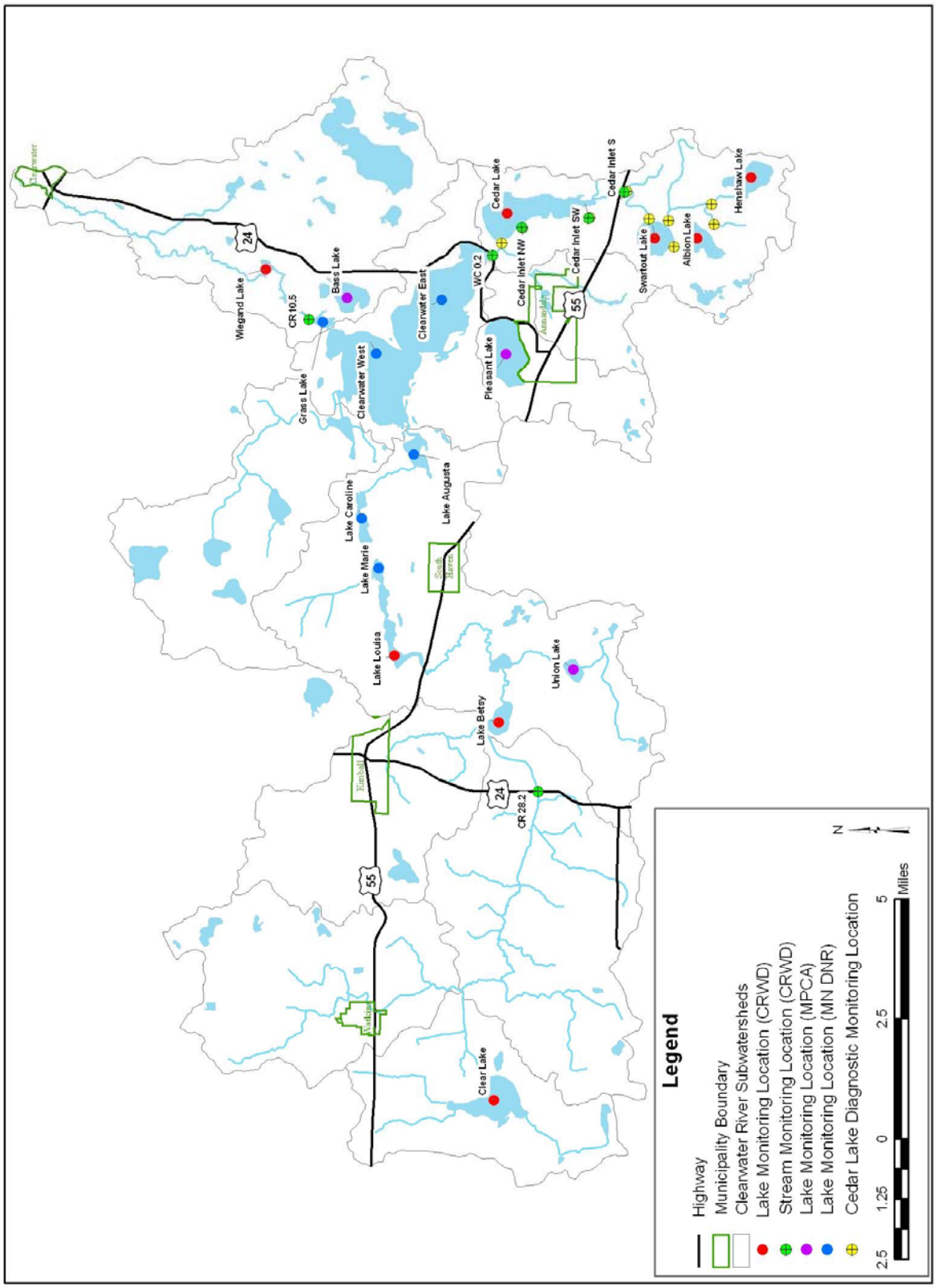
Citizen Precipitation Recorders (CPRs) collecting data in Watkins, and Annandale comprise the precipitation records, one less than in 2004. Citizen volunteers also collect Secchi depths for nine CRWD lakes.

The District continued intensive monitoring in the Cedar Lake subwatershed during 2005. High phosphorus readings in 2003 and 2004 combined with citizen concerns over nuisance algal blooms prompted the District to look more closely at the nutrient balance for Cedar Lake. As such, inflows and outflows to that lake were sampled during 2004.

Citizen concern prompted additional monitoring upstream and downstream of the constructed wetland in Watkins. The monitoring was geared towards determining if the wetland is still functioning, or if maintenance is needed.

Figure 1.1 shows the monitoring locations for 2004 and Appendix A gives the monitoring plan.

Figure 1.1 2005 Monitoring Locations



2.0 Precipitation

Precipitation during 2005 was generally below normal during spring and summer, but above normal during the fall. Two 10-year rainfall events were observed in Annandale during 2005: 4.08 inches on Oct 5 and 4.25 inches on Sept 13. These two events contributed to the higher than normal annual precipitation measured in Annandale of 41.47 inches for the year, which is 12.41 inches above normal. Table 2.1 and Figures 2.1-2.3 show the precipitation records for the CRWD (Appendix B).

Table 2.1 Clearwater River Watershed 2005 Volunteer Precipitation Records and Normals (inches)

	2005 St. Cloud (Stearns)	2005 Collegeville St. Johns	1971-2000 Normal (St. Cloud)	2005 Watkins (Meeker)*	1971-2000 Normal (Litchfield)	2005 Annandale/ Corinna (Wright)	1971-2000 Normal (Cokato)
January	1.8	1.9	0.76	0.79	0.79	1.78	0.93
February	0.97	--	0.59	0.67	0.67	1.08	0.70
March	0.65	--	1.50	1.27	1.55	0.63	1.69
April	2.11	2.71	2.13	2.65	2.35	2.80	2.33
May	3.3	3.67	2.97	2.98	3.37	4.09	3.30
June	4.37	7.1	4.51	4.53	4.89	8.99	4.62
July	2.11	1.65	3.34	1.84	4.02	3.08	4.04
August	3.64	2.93	3.93	2.72	3.67	2.44	4.00
September	5.54	6.32	2.93	6.62	2.92	8.24	2.78
October	--	--	2.24	2.97	2.15	4.84	2.23
November	--	--	1.54	3.39	1.50	2.55	1.73
December	--	--	0.69	1.87	0.68	0.95	0.71
Total	--		27.13	32.30	28.56	41.47	29.06

*** Normals were used to estimate the annual precipitation in Watkins**

T:\0002\69_2005 Monitoring\[Precip.xls]Summary

Figure 2.1 2005 St. Cloud and Collegeville Precipitation Records, and Normal Precipitation Record (inches)

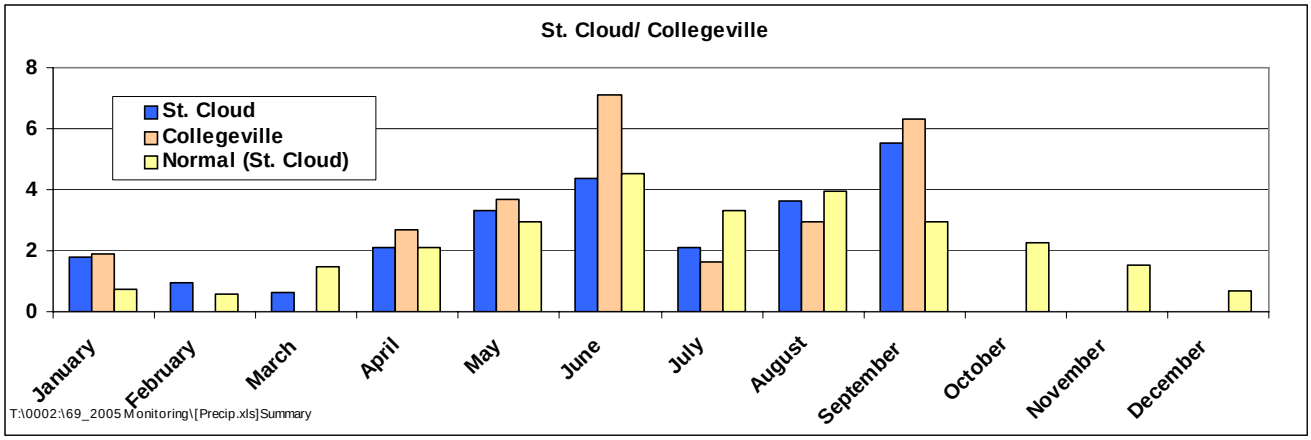


Figure 2.2 2005 Watkins Citizen Precipitation Record and Normal Precipitation Record (inches)

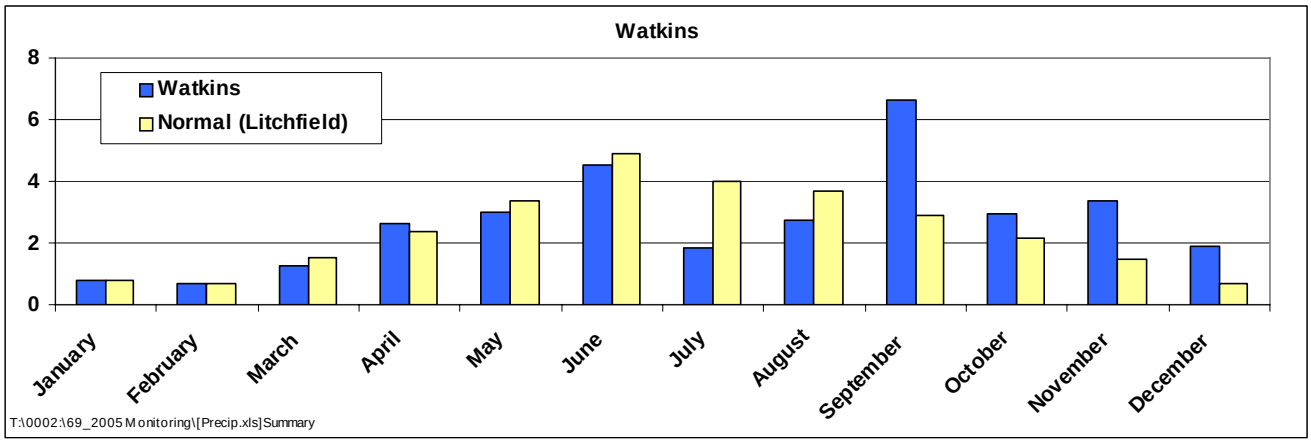
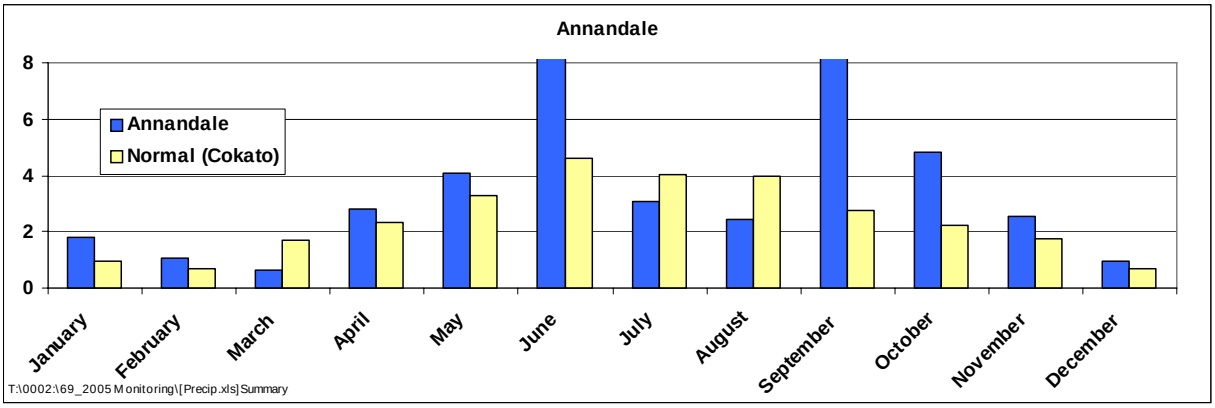


Figure 2.3 2005 Annandale Citizen Precipitation Record and Normal Precipitation Record (inches)

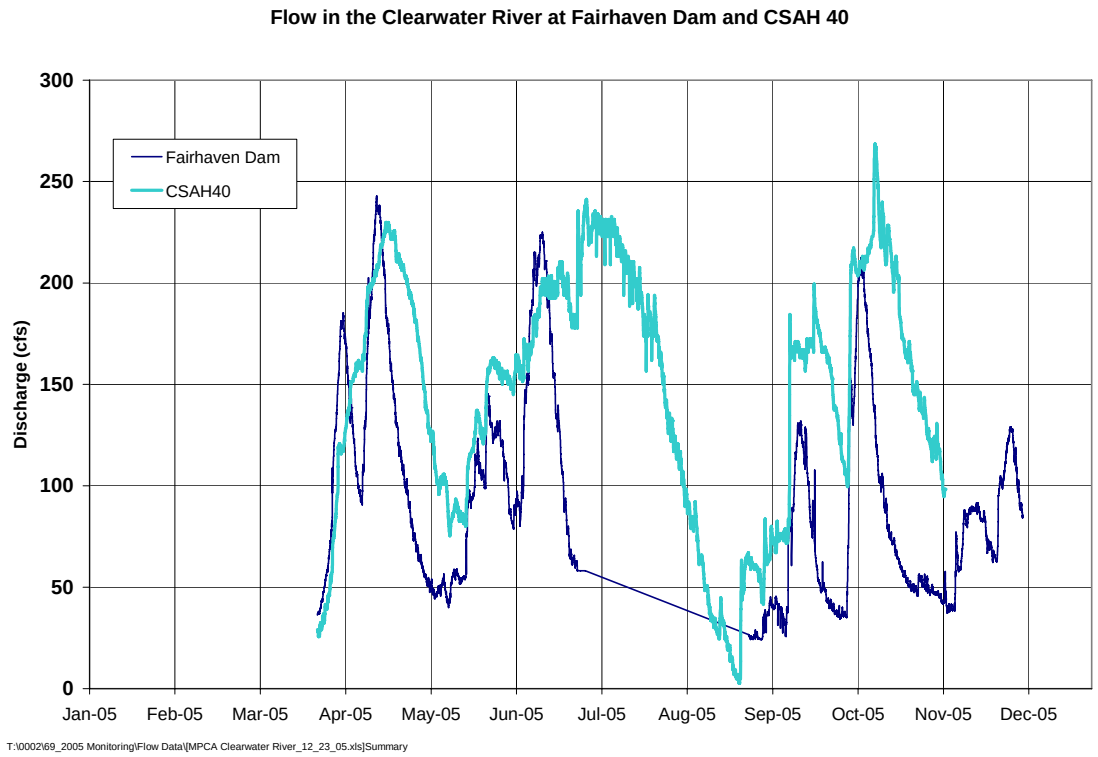


3.0 Streams

3.1 RUNOFF AND DISCHARGE

The MPCA maintained continuous discharge measurement stations on the Clearwater River at CSAH 40 at the downstream end of the watershed, and at the Fairhaven Dam near the center of the watershed (Figure 3.1). The flow records are complete except for a few weeks in July when the solar panel was stolen from the station.

Figure 3.1 Clearwater River Discharge at Fairhaven Dam and CSAH 40



Runoff over the subwatershed was 8.7 inches at Fairhaven Dam and 7.1 inches at CSAH 40 and average flows were 80 cfs and 142 cfs respectively. Table 3.1 summarizes the runoff volumes and average flows for these two stations. Table 3.2 compares historic annual precipitation and runoff in the District calculated using monthly flow gauging at CR 10.5.

Table 3.1 2005 Runoff Volume and Average Flow

	Tributary Sub-watershed Area (acres)	2005 Runoff Volume (ac-ft)	Runoff Over Watershed (inches)	Average Flow (cfs)
Fairhaven Dam	58,291	42,356	8.7	80
CSAH 40	113,282	66,985	7.1	142

T:\0002\69_2005 Monitoring\Flow Data\[MPCA Clearwater River_12_23_05.xls]Summary

Table 3.2 Historic Annual Precipitation and Runoff Volume at CR 10.5

Precipitation (inches of water)											
Year	**Watkins**		**Kingston**		**Maine Prairie**		**Annandale/ Corinna**		**Area-Weighted Precipitation 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
2001	31.00		--		33.56		29.57		31.28		2.8
2002	37.50		--		40.27		44.72		40.57		7.6
2003	22.63		--		21.34		26.77	(2)	23.02		6.5
2004	33.58		--		33.58		31.67		33.10		2.8
2005	32.30	(2)	--		--		41.47		41.47	(4)	7.1
							Mean		**30.03**		**8.0**
							Std. Dev.		**8.3**		**5.7**

T:\0002\69_2005 Monitoring\[Precip_Runoff.xls]Historical Runoff

Table 3.2 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.*
3. *Location of Watkins Station changed slightly*
4. *Calculated using continuous flow data from MPCA at CSAH 40*

Runoff at CR-10.5 was calculated using supplemental data from the CSAH 40 station maintained by the MPCA.

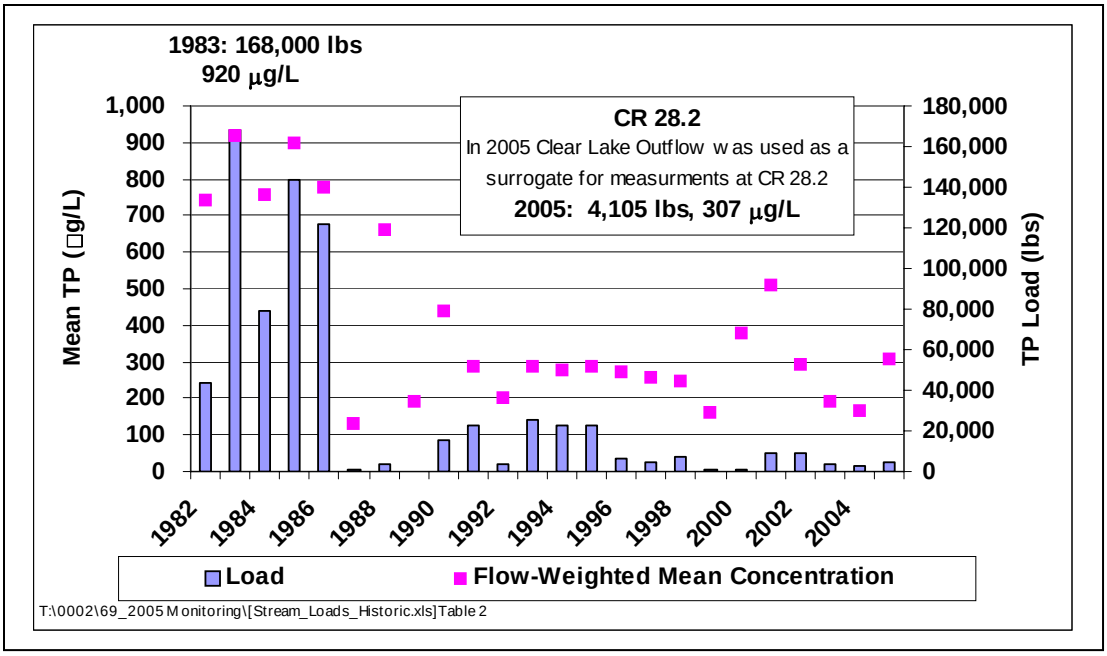
3.2 TOTAL PHOSPHORUS

Baseline Monitoring:

Baseline phosphorus levels in the Clearwater River remain low as compared with conditions monitored in the early 1980s. The average TP concentration at the upstream reach of the Clearwater River at Clear Lake was 307 µg/L (micrograms per liter, or parts per billion). Total phosphorus concentrations at CR 28.2, just upstream of Lake Betsy, have ranged from 740 to 1,400 µg/l in the early 1980s and was 166 µg/l in 2004.

Monitoring at the long-term station CR 28.2 was planned under the TMDL contract that was delayed, the result is that CR 28.2 was not monitored in 2005. The Clear Lake sampling results were used as a surrogate to estimate nutrient loading in the upper watershed. Flows were estimated based tributary watershed area and on the runoff volumes at CSAH 40. The TP load downstream of Clear Lake was approximately 4,105 lbs. Figure 3.2 compares the load at Clear Lake to the historical load at CR 28.2 which is located about 10 miles downstream. The concentration and load are higher than those observed at CR 28.2 in recent years.

Figure 3.2 Historical Total Phosphorus Loading and Mean Concentration at CR 28.2



The flow-weighted mean TP concentrations at CR-10.5 and WR-0.2 were 23 µg/l and 66 µg/l respectively. Total phosphorus loads were 130 lbs at CR-10.5 and 48 lbs at WR 0.2, well below historic levels (Figures 3.3 and 3.4). Nutrient loads at these stations were estimated using the runoff volumes at CSAH 40 and the tributary watershed areas to each station.

Figure 3.3 Historical Total Phosphorus Loading and Mean Concentration at CR 10.5

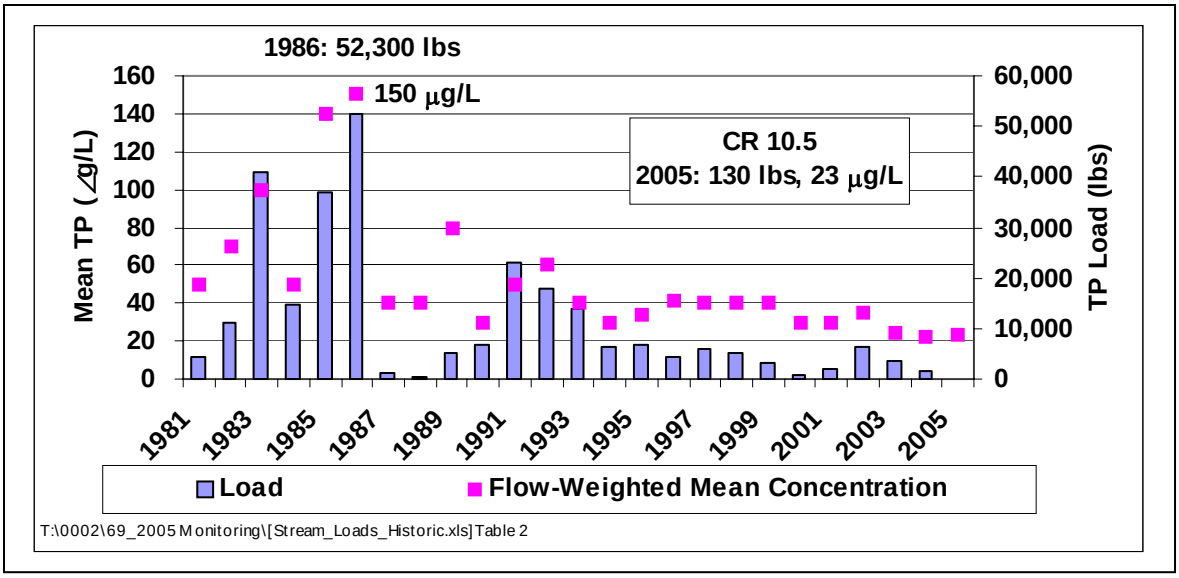
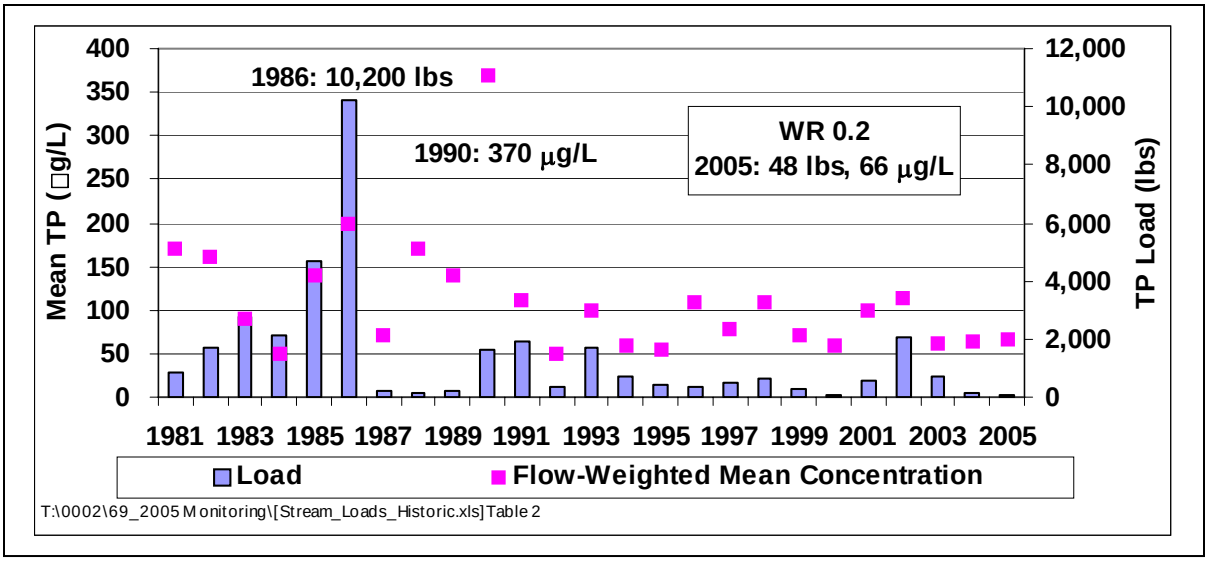


Figure 3.4 Historical Total Phosphorus Loading and Mean Concentration at WR-0.2



Soluble reactive phosphorus (SRP) (dissolved form of phosphorus easily utilized by algae) was also monitored. It represents 22 % of the total phosphorus value at the two stations, WR-0.2 and CR-10.5 (based on the mean of the ratios). This is similar to SRP/TP ratios observed in 2002 and 2003. Figure 3.2 shows historical phosphorus loadings at CR 10.5.

Appendix C shows historical phosphorus loads, stream flows, and flow-weighted mean concentrations.

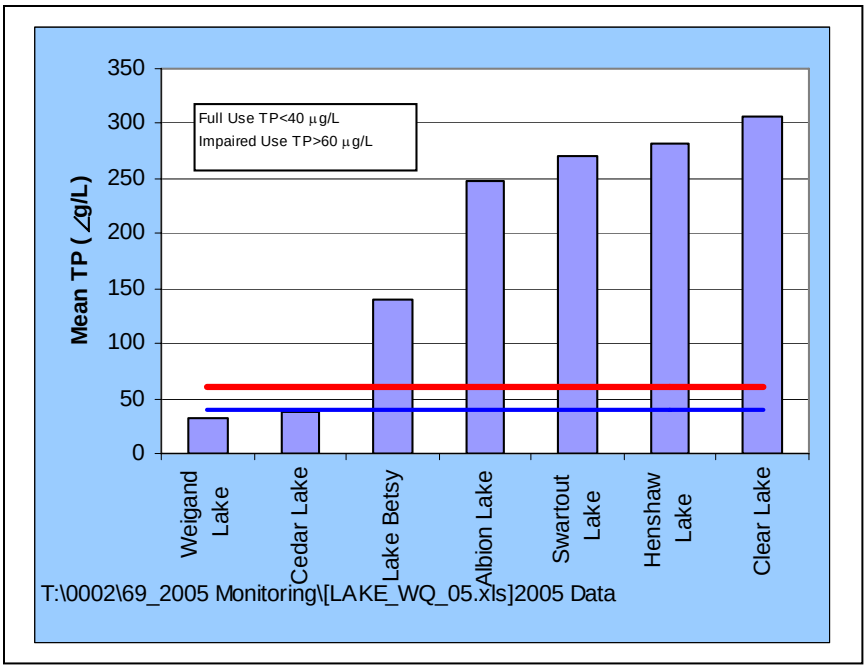
4.0 Water Quality of Lakes Sampled in Year 2005

Seven lake sites were sampled four times in 2005. The sites included Clear Lake, Lake Betsy, Cedar Lake, Swartout Lake, Henshaw Lake, Wiegand Lake and Albion Lake. Parameters analyzed include total phosphorus, soluble reactive phosphorus, chlorophyll-*a* , total nitrogen, and a field reading of secchi depth. Lake profiles of temperature and dissolved oxygen were collected when the meter was functioning. The DNR monitored Clearwater Lake, Lake Louisa, Lake Marie, Lake Caroline, Bass Lake, Lake Augusta, and Grass Lake, and the MPCA monitored Bass Lake, Union Lake and Lake Louisa. That data is not yet available. This report will be appended with the additional information as it arrives.

Water quality in the lakes monitored in 2005 was generally poor, but comparable to monitoring in recent years. Compared with the MCPA guidelines on lake impairment based on ecoregion•, only Cedar and Weigand Lakes are considered "full use" because the average TP concentrations are below 40 ug/L. Lake Betsy, Clear Lake, Swartout Lake, Henshaw Lake, and Albion Lake are considered impaired (Figure 4.1).

• The MPCA uses total phosphorus as the criteria for swimability. This is called the "Swimable Use Support Classification". The TP values are different for different Ecoregions. For the North Central Hardwood Forest Ecoregion (where CRWD is located), TP concentrations below 40 ug/L are considered "full use"

Figure 4.1 2005 Average Total In-Lake Phosphorus



Weigand and Cedar Lakes are considered Mesotrophic based on the Carlson Tropic Status Index (TSI). Lake Betsy is eutrophic; Lake Albion, Swartout Lake, Henshaw Lake and Clear Lake are all hypereutrophic. The TSI for lakes monitored in 2005 is shown in Table 4.1.

Table 4.1 2005 Trophic Status Index

	Avg TSI	TP TSI	Chla-a TSI	Secchi TSI	TSI Based Classification
Weigand Lake	46	54	41	42	Mesotrophic
Cedar Lake	51	56	52	45	
Lake Betsy	65	75	60	59	Eutrophic
Albion Lake	72	84	71	63	Hypereutrophic
Swartout Lake	78	85	79	69	
Henshaw Lake	78	85	79	69	
Clear Lake	72	87	71	59	

T:\0002\69_2005 Monitoring\[LAKE_WQ_05.xls]2005 Data

Water quality observed in most lakes monitored during 2005 is within ranges seen in recent years. However, TP levels in Lake Albion and Clear Lake are higher than those observed in recent years, possibly indicating a decline in water quality for these lakes (Table 4.2).

Table 4.2 2004 Mean In-Lake Total Phosphorus, Chlorophyll-a, and Secchi Depth, and Historical Ranges

	Total Phosphorus µg/l		**Chlorophyll-*a* µg/l**		**Secchi Depth (meters)**	
Lake	2005 Mean	Historical Range Mean	2005 Mean	Historical Range Mean	2005 Mean (Citizen Reading)	Historical Range Mean
Weigand	31	35-61	3	5-12	3.4	1.7-3.0
Cedar	37	26-52	9	6-13.	2.2	1.1-3.0
Lake Betsy	140	120-700	20	5-170	1.1	0.8-2.4
Albion Lake	248	130-220	60	72-224	0.8	0.5-1.0
Swartout Lake	270	200-421	134	151-444	0.5	0.7-1.0
Henshaw Lake	281	150-295	144	53-238	0.5	0.4-0.9
Clear Lake	307	80-228	60	17-134	1.1	0.3-1.2

Figures showing historical lake data and trends are shown in Appendix D. Citizen Secchi depths are shown in Appendix E. Water quality lab reports are in Appendix F, and field notes are in Appendix G.

4.1 CEDAR LAKE SPECIAL MONITORING

Additional monitoring was conducted in the Cedar Lake subwatershed to quantify the nutrient budget. Results of the special monitoring are discussed in this section.

First, total phosphorus concentrations in the lake were within normal ranges (about 30 µg/L), except one reading of 56 µg/L in April. Table 4.2 shows that singular high TP readings 2003-2005 skewed the average values. The rest of the measured TP values were closer to the

historical average of around 30 µg/L. This indicates that the water quality is declining, and that the problem in Cedar Lake is episodic in nature.

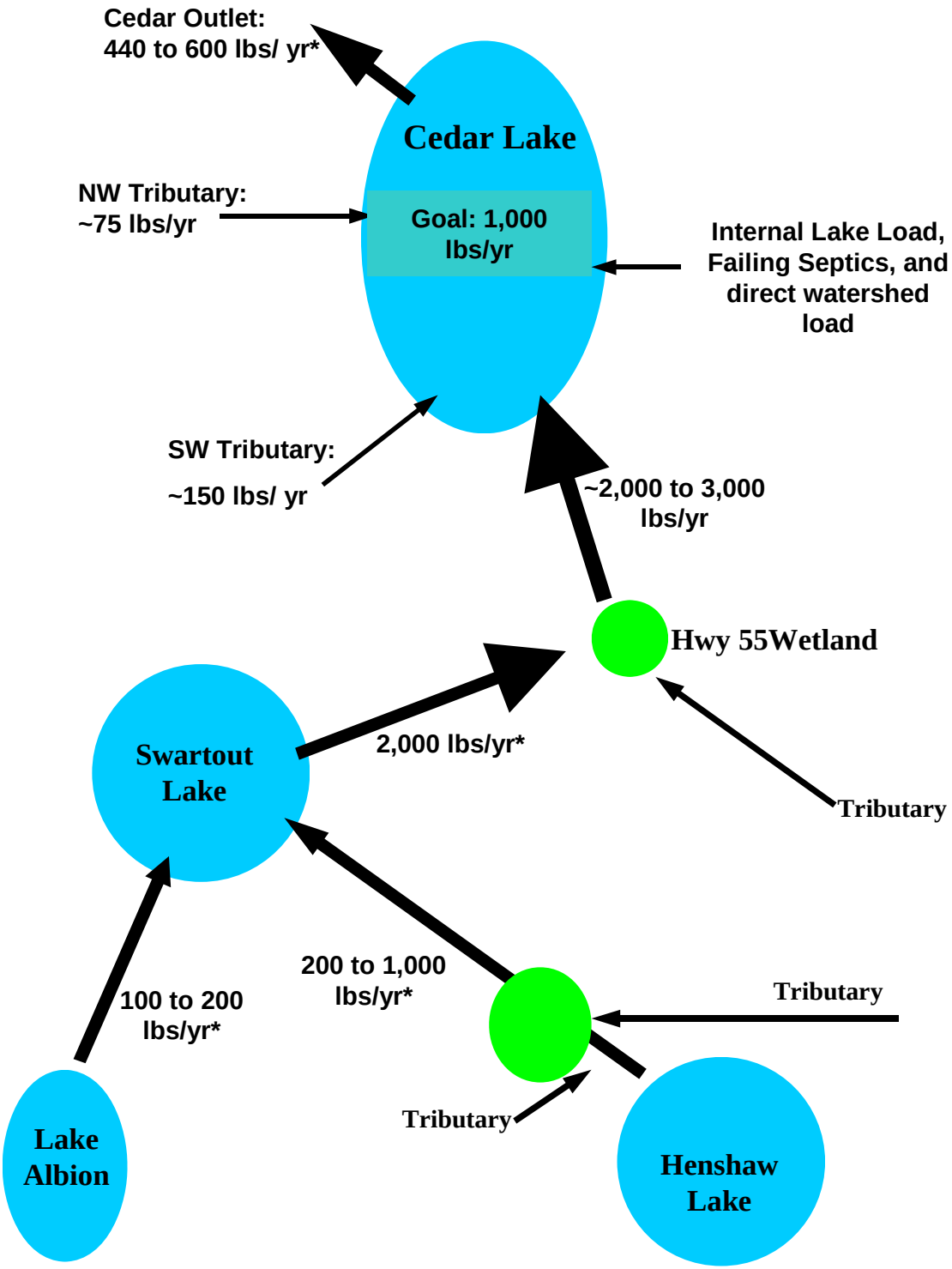
With the exception of one early spring reading in 2005, SRP values in Cedar Lake are below detection limits. The high early spring value is likely indicative of a small annual internal loading.

Table 4.3 2003 to 2005 Total Phosphorus in Cedar Lake

Date	Total Phosphorus (µg/L)	Soluble Reactive Phosphorus (µg/L)	Chlorophyll-*a* (µg/L)	Secchi Depth (ft)
6/17/2003	33	<5	7	10.5
7/9/2003	28	<5	12	4.5
8/20/2003	33	<5	6	--
9/17/2003	**112**	<5	18	--
2003 Average	52	<5	11	7.5
6/22/2004	**055**	<5	5.87	--
7/20/2004	31	<5	1.07	--
8/11/2004	25	<5	<0.200	8.5
9/16/2004	21	<5	2.14	--
2004 Average:	33	<5	3	NA
4/16/2005	**56**	20	10	--
5/25/2005	37	<5	5	14
7/5/2005	29	<5	8	7
8/4/2005	30	<5	14	8
9/8/2005	33	<5	6	--
2005 Average	37	8	9	--

Additional water quality monitoring better defined the nutrient balance for the Cedar Lake sub-watershed, and allowed the District to determine a nutrient loading goal for Cedar Lake of 1,000 lbs of TP annually to maintain an in-lake TP concentration of 20 µg/L. Presently, nutrient loading to Cedar Lake exceeds the goal by 1,200 to 2,200 lbs of TP annually. Figure 4.2 summarizes the results of the 2005 monitoring.

Figure 4.2 Nutrient Loading and Budget for the Cedar Lake Subwatershed



4.2 WATKINS WETLAND SPECIAL MONITORING

Citizen concerns prompted additional monitoring of the constructed wetland south of the City of Watkins. Two monitoring events were geared towards determining if the wetland was still functioning or if it required maintenance. One monitoring event was conducted under the TMDL Program.

The early spring monitoring event generally showed a 70% or greater decrease in total suspended solid (TSS) concentrations from upstream to downstream. The first fall event showed a 42% reduction in TSS concentrations upstream to downstream. The fall sampling event conducted under the TMDL project showed upstream TSS concentrations were below detection limits, and that downstream concentrations were slightly higher. Results may reflect the timing of the sampling with respect to rainfall events, rather than the sediment removal efficiency of the Watkins wetland. Tables 4.4 and 4.5 summarize the results.

Table 4.4 Monitoring Results Upstream of Watkins Wetland

	Watkins Upstream				
	Q (cfs)	TP (μg/L)	TP (lbs/day)	SRP (μg/L)	TSS (mg/L)
4/15/2005	15	263	21.31	176	14
9/15/2005	5	413	11.18	--	7
9/26/2005	2.24	257	3.11	249	<2

T:\0002\69_2005 Monitoring\Data_Analysis\[Load and RUnoff_2.xls]Tables_Snapshot (2)

T able 4.5 Monitoring Results Downstream of Watkins Wetland

	Watkins Downstream				
	Q (cfs)	TP (μg/L)	TP (lbs/day)	SRP (μg/L)	TSS (mg/L)
4/15/2005	21	220	24.75	173	<4.0
9/15/2005	13	635	45.93	--	4
9/26/2005	0.828	345	1.54	322	7

T:\0002\69_2005 MONITORING\DATA_ANALYSIS\[LOAD AND RUNOFF_2.XLS]TABLES_SNAPSHOT (2)

Initial results indicate an increase in SRP from upstream to downstream. However, the expanded monitoring done in the September 26, 2005 event also shows significant increase in bacteria

concentrations from upstream to downstream, and an increase in ultimate biological oxygen demand (BOD-ultimate). Further, all events show increased flow from upstream to downstream (Table 4.6). These factors, combined with the fact that all events were conducted following major precipitation events, seem to indicate that additional intervening tributary sub-watersheds may be contributing to the results. If that is the case, the results do not conclusively quantify the efficiency of the wetland. Additional data is needed to determine of the wetland requires maintenance.

Table 4.6 Expanded Watkins Monitoring Results from 9/26-27/2005 Event

Parameter	Upstream	Downstream
Flow (cfs)	2.24	0.828
Fecal Coliform (#/100mL)	1,300	>60,000
TP (μg/L)	257	345
SRP (μg/L)	249	322
TSS (mg/L)	<2	7
BOD-Ultimate (mg/L)	4	15

T:\0002\69_2005 Monitoring\Data_Analysis\[Load and RUnoff_2.xls]Tables_Snapshot (2)

5.0 Conclusions

1. Annual precipitation for the Annandale station was 41.47 inches, 12.1 inches above normal for the year.

2. Continuous flow measurements recorded at CSAH 40 near Clearwater show that runoff over the watershed was 7.1 inches. This is comparable to runoff measured at CR 10.5 just upstream of CSAH 40 near Grass Lake in years with similar precipitation.

3. The Clearwater River phosphorus load was about 130 pounds at CR-10.5. This is low compared with historical averages. The upper watershed load was similar to those measured in previous years for similar runoff conditions.

4. The water quality of Cedar and Wiegand Lakes was good; water quality in Lake Betsy, Clear Lake, Lake Albion, Henshaw Lake, and Swartout Lake were poor. Total phosphorus concentrations in Lake Albion and Clear Lake exceed values previously measured, possibly indicating deterioration of water quality.

5. Water quality in Cedar Lake continues to decline. The nutrient balance for the watershed shows the cause to be high nutrient loads from shallow lakes in the upper watershed.

6. The Watkins wetland reduces suspended sediment load. The soluble phosphorus data is inconclusive.

7. After the 2005 MPCA and MDNR results are available, that data will be integrated with the results in this document.

Appendix A

2005 Monitoring Plan

MEMORANDUM

TO: **Clearwater River Watershed District Board of Managers**

FROM: **Norman C. Wenck**
Engineer for the District

DATE: **March 9, 2005**

RE: **Proposed 2005 Water Quality Monitoring Program**

Introduction

The Clearwater River Watershed District conducts annual water quality monitoring at selected lakes and selected locations on streams. The District's proposed 2005 program is intended to provide data throughout the District. Three TMDL studies, currently underway, will focus on the impaired waters. Phase II of the TMDL studies (data collection) will begin in 2005. Additionally, the MPCA is scheduled to perform Lake Assessment Program (LAP) sampling on three District lakes in 2005, and the DNR will conduct sampling and assessments on seven District lakes in 2005.

The 2005 proposed lake monitoring follows the long-term plan shown in Table 1, which has been extended to the year 2010. The proposed stream monitoring sites together with laboratory and field parameters are shown in Table 2.

Lake Monitoring

The District 2005 regular lake monitoring includes Clear Lake and Lake Betsy (at the upstream and downstream listed reaches of the Clearwater River. The District Lake monitoring will also include Cedar Lake, Swartout Lake, Henshaw Lake Wiegand Lake, and Albion Lake. Clearwater Lake, Lake Louisa, Lake Marie, Lake Caroline, Bass Lake, Lake Augusta, and Grass Lake will be monitored by the DNR. Lake Louisa will also be monitored under the TMDL Grant. The MPCA will be monitoring Union, Bass, and Pleasant Lakes. Stations and the parameters to be monitored are shown on Table 2. Citizens also monitor approximately 14 lakes for secchi depth.

Stream Monitoring

The Clearwater River will be monitored at station CR10.5, Warner Creek will be monitored at WR 0.2 and three Cedar Lake tributaries will be monitored. CR 28.2 will be monitored under the TMDL program, as it is located in the listed reach of the Clearwater River. These stations will be monitored six times for water quality and flow. Parameters are total phosphorus and soluble reactive phosphorus.

Cedar Lake Diagnostic

Cedar Lake tributaries were monitored in 2004 to determine the cause of algal blooms, and episodic high total phosphorus in 2003 and 2004. Several potential causes were evaluated. Monitoring in 2005 will be geared towards confirming or eliminating each of these causes.

Given the episodic nature of the issues in Cedar Lake, a highly responsive and flexible sampling schedule is necessary. Lake temperature, pH, DO, and conductivity profiles will be necessary, as well as the collection of deep water samples in Cedar Lake, and flow of the tributaries with a high resolution digital velocity meter to catch low flows. This requires the use of additional equipment, and professional staff.

Estimated Cost

This proposed basic program is estimated to cost $16,200.

Summary

The proposed monitoring program continues the program in place since 1981, coordinates with other programs, and reflects input from the Board and citizens. Please feel free to call me at 763-479-4201 or Rebecca Kluckhohn at 763-479-4224 with any questions or comments that you may have.

TABLE 1

PROPOSED LONG-TERM WATER QUALITY MONITORING PLAN FOR CRWD LAKES

LAKE STATIONS[1]	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Clearwater Lake:														
Clearwater East	X	X	X	X	X	X	X	X	DNR	X	X	X	X	X
Clearwater West	X	X	X	X	X	X	X	X	DNR	X	X	X	X	X
Main Stem Lakes:														
Augusta	X		X		X		X		DNR		X		X	
Louisa	X		X		X		X		TMDL/ DNR		X		X	
Caroline		X				X		X	DNR	X		X		X
Scott		X	X			X		X		X		X		X
Marie		X		X		X		X	DNR	X		X		X
Betsy	X		X		X		X		X		X		X	
Other Lakes:														
Cedar			X		X		X	X	X	X		X		X
Pleasant	X		X	X				X	MPCA		X			X
School Section	X		X	X				X			X			X
Nixon	X		X		X			X			X			X
Otter	X		X		X			X			X			X
Bass		X	X		X				MPCA/ DNR				X	
Clear		X	X	X			X		X			X		
Union		X	X			X			MPCA			X		
Henshaw		X	X			X			X		X			
Little Mud			X			X				X			X	
Wiegand			X			X			X				X	
Swartout			X				X		X	X			X	
Albion			X				X		X	X			X	
Grass			X				X		DNR			X		
Number of Lakes Monitored W/ CRWD Funding	9	9	20	6	9	9	10	10	7	9	10	9	10	10

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

TABLE 2
Proposed 2005 CRWD Monitoring Plan Summary

Category	Schedule	Station	Parameters
Lakes:	May 16 -17	The CRWD will monitor Clear, Betsy, Cedar, Henshaw, Wiegand, Swartout, and Albion)	Field: Secchi depth, DO and temperature profiles Lab: surface samples only for total phosphorus, soluble reactive phosphorus, chlorophyll-a
	June 20 - 21	Lake Louisa will be monitored through the TMDL Study	
	Jul 25 - 26 Aug 29 - 30	(Clearwater, Augusta, Louisa, Caroline, Marie, Bass, and Grass Lakes will be monitored by the DNR) (Bass, Pleasant, and Union Lakes will be monitored by the MPCA)	Citizen Secchi: fourteen sites not listed here
Streams:	4/11/2005	WRO.2	Field: flows, DO and temperature Lab: total phosphorus, soluble reactive phosphorus
	5/2/2005 6/6/2005 7/11/2005 8/1/2005 9/5/2005	CR10.5 3 Cedar Lake Tributaries	
	Weekly	River Stage at CR10.5	
Precipitation:	Daily	Watkins, Marie Prairie and Corrinna	
Special:	4 events	Cedar Lake Synoptic Surveys	Tributaries Field: DO, temperature, conductivity, pH profiles; Lab: total phosphorus, soluble reactive phosphorus Lakes Field: DO, temperature, conductivity, pH profiles; Lab: 3 profile samples for total phosphorus, soluble reactive phosphorus, iron, chlorophyll-a

Appendix B

Citizen Precipitation Records

Department of Natural Resources
Division of Waters

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time	County	Township	Range	Section	
05	03	[ ] am [ ] pm (No Ob)	47	121	32	03	1

Name	County Name	Township Name
Clarence and Luella Klein	Meeker	Forest Prairie

Address	Telephone No.
417 Luella Street, Unit 8, Watkins, MN 55389	(320) 764-7395

At the end of each month, forward forms to:
Office of State Climatology
Department of Natural Resources
University of Minnesota, 279 North Hall
St. Paul, Minnesota 55108

REMARKS:
Give times and comments about events.
(Temperature and Phenology Items are very useful).

Type of Gauge: (Check One)

Cyl.	X	Test Tube	
Wedge		Other	

24-HOUR AMOUNTS				
RAIN MELTED SNOW ETC INS & HDTHS)	SNOW INS & TENTHS	SNOW ON GROUND (INCHES)		
			01	
			02	
			03	
			04	
			05	
			06	
			07	
			08	
			09	
			10	
			11	
			12	
			13	
			14	
			15	
			16	
			17	
			18	
			19	
			20	
			21	
			22	
			23	
			24	
			25	
			26	
			27	
			28	
			29	
1.27			30	
			31	
1.27			TOTALS	

Minnesota Department of Natural Resources
Division of Forestry

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time	County	Township	Range	Section
05	04	7:00 am / pm	47	121	32	03

Name: Gary Klein
County Name: Meeker
Township Name: Forest Prairie
Address: 310 Meeker Aves Watkins Mn 55389
Telephone No.: (320) 764-2645

24-HOUR AMOUNTS			REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).	Gauge type (Check One):				catch opening diameter/size (inches) ___
Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		cylinder	X	tipping bucket		maximum catch depth (inches) ___
				test tube		weighing		board/ruler/post used for snow ___yes ___
				wedge		Other		

			01	
			02	
			03	
↓			04	
.28			05	
			06	
			07	
			08	
			09	
↓			10	
.87			11	
.73			12	
			13	
			14	
.02			15	
.17			16	
.06			17	
			18	
.32			19	
			20	
			21	
			22	
			23	
			24	
.06			25	
.12			26	
			27	
.02			28	
			29	
			30	
			31	
2.65			TOTALS	

NA-02732-07

Minnesota Department of Natural Resources
Division of Forestry

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time		County	Township	Range	Section
05	05	7 00	am	47	121	32	03
			pm				

Name: Gary Klein
County Name: Meeker
Township Name: Forest Prairie
Address: 310 Meeker Ave S Watkins Mn. 55389
Telephone No.: (320) 764-2645

24-HOUR AMOUNTS				REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
	Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)	
01	.02			
02				
03				
04				
05				
06				
07				
08	.06			
09				
10				
11	.			
12	.17			
13	.02			
14	.22			
15				
16	.02			
17	.43			
18	.84			
19				
20				
21	.18			
22				
23				
24				
25	.85			
26	.11			
27	.04			
28	.02			
29				
30				
31				
TOTALS	2.98			

Gauge type (Check One): cylinder [X] tipping bucket [ ] test tube [ ] weighing [ ] wedge [ ] Other [ ]

catch opening diameter/size (inches) ___
maximum catch depth (inches) _____
board/ruler/post used for snow ___yes __

State Climatology Office, 439 Borlaug Hall, University of Minnesota, 1991 Upper Buford Circle, St. Paul, MN 55108-6026

2.98

Minnesota Department of Natural Resources
Division of Forestry

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time		County	Township	Range	Section
05	06	7:00	am	47	121	32	03
			pm				

Name: Gary Klein
County Name: Meeker
Township Name: Forest Prairie
Address: 310 Meeker Ave S Watkins Mn 55389
Telephone No.: (320) 764-2640

Gauge type (Check One): cylinder X; tipping bucket; test tube; weighing; wedge; Other
catch opening diameter/size (inches) __
maximum catch depth (inches) ____
board/ruler/post used for snow ___yes __

24-HOUR AMOUNTS: Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
.11			01	
			02	
.03			03	
1.12			04	
			05	
			06	
.84			07	
			08	
.42			09	
.29			10	
.62			11	
			12	
.25			13	
.09			14	
			15	
			16	
			17	
			18	
			19	
.48			20	
			21	
			22	
			23	
.02			24	
			25	
			26	
.05			27	
			28	
.21			29	
			30	
			31	
4.53			TOTALS	

NA-02732-07

MINNESOTA CLIMATOLOGICAL NETWORK

Minnesota Department of Natural Resources
Division of Forestry

Year	Month	Ob Time		County	Township	Range	Section
05	07	7 00	am	47	121	32	31
			pm				

Name: Gary Klein | County Name: Meeker | Township Name: Forest Prairie

Address: 310 Meeker Aves Watkins Mn. 55389 | Telephone No.: (320) 764-264

24-HOUR AMOUNTS: Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
			01	
			02	
.34			03	
			04	
			05	
			06	
			07	
			08	
			09	
			10	
			11	
			12	
			13	
			14	
			15	
			16	
			17	
			18	
			19	
.46			20	
			21	
			22	
.82			23	
			24	
.22			25	
			26	
			27	
			28	
			29	
			30	
			31	
1.84			TOTALS	

Gauge type (Check One): cylinder X | tipping bucket | test tube | weighing | wedge | Other

catch opening diameter/size (inches) ___
maximum catch depth (inches) _____
board/ruler/post used for snow ___yes __

State Climatology Office, 439 Borlaug Hall, University of Minnesota, 1991 Upper Buford Circle, St. Paul, MN 55108-6030

NA-02732-07

Minnesota Department of Natural Resources
Division of Forestry

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time		County	Township	Range	Section
05	08	7 00	am	47	121	32	03
			pm				

Name: Gary Klein | County Name: Meeker | Township Name: Forest Prairie

Address: 310 Meeker Ave S Watkins Mn 55389 | Telephone No.: (320) 764-26[illegible]

Gauge type *(Check One)*: cylinder [ ] | tipping bucket [X] | test tube [ ] | weighing [ ] | wedge [ ] | Other [ ]

catch opening diameter/size (inches) ___
maximum catch depth (inches) ___
board/ruler/post used for snow ___yes ___

24-HOUR AMOUNTS: Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
			01	
			02	
.12			03	
			04	
			05	
			06	
			07	
			08	
.08			09	
			10	
			11	
			12	
			13	
			14	
			15	
			16	
			17	
.28			18	
.12			19	
			20	
			21	
			22	
			23	
			24	
			25	
2.12			26	
			27	
			28	
			29	
			30	
			31	
2.72			TOTALS	

NA-02732-07

Minnesota Department of Natural Resources
Division of Forestry

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time		County	Township	Range	Section
05	09	7 00	am / pm	47	121	32	031

Name	County Name	Township Name
Gary Klein	Meeker	Forest Prairie

Address	Telephone No.
310 Meeker Aves Watkins Mn 55389	(320) 764-2645

Gauge type *(Check One)*: cylinder [X] tipping bucket [ ] test tube [ ] weighing [ ] wedge [ ] Other [ ]

catch opening diameter/size (inches) ___
maximum catch depth (inches) ___
board/ruler/post used for snow ___yes ___

24-HOUR AMOUNTS				REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		
			01	
			02	
1.94			03	
			04	
			05	
.22			06	
			07	
.12			08	
			09	
			10	
			11	
3.14			12	
			13	
			14	
			15	
			16	
.02			17	
			18	
			19	
			20	
.78			21	
			22	
			23	
.22			24	
			25	
			26	
.18			27	
			28	
			29	
			30	
			31	
6.62			TOTALS	

State Climatology Office, 439 Borlaug Hall, University of Minnesota, 1991 Upper Buford Circle, St. Paul, MN 55108-6030

NA-02732-07

MINNESOTA CLIMATOLOGICAL NETWORK

Minnesota Department of Natural Resources
Division of Forestry

Year	Month	Ob Time	County	Township	Range	Section
05	10	2 00 am / pm	47	121	32	03

Name: Gary Klein
County Name: Meeker
Township Name: Forest Prairie
Address: 310 Meeker Ave S Watkins Mn 55389
Telephone No.: (320) 764-2645

24-HOUR AMOUNTS				REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
	Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)	
01				
02				
03				
04	2.37			
05				
06				
07				
08				
09				
10				
11				
12	.27			
13				
14				
15				
16				
17	.04			
18				
19				
20				
21	.02			
22				
23				
24				
25				
26				
27				
28				
29				
30	.27			
31				
TOTALS	2.97			

Gauge type (Check One):

cylinder	X	tipping bucket	
test tube		weighing	
wedge		Other	

catch opening diameter/size (inches) ___
maximum catch depth (inches) ___
board/ruler/post used for snow ___yes ___

NA-02732-07

Minnesota Department of Natural Resources
Division of Forestry

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time		County	Township	Range	Section
05	11	700	am	47	121	32	03
			pm				

Name: Gary Klein | County Name: Meeker | Township Name: Forest Prairie

Address: 310 Meeker Ave S Watkins Mn 55389 | Telephone No.: (320) 764-264

24-HOUR AMOUNTS			REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).	Gauge type (Check One):				catch opening diameter/size (inches) _
Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		cylinder	X	tipping bucket		maximum catch depth (inches) _____
				test tube		weighing		board/ruler/post used for snow ___yes
				wedge		Other		

			01	
			02	
			03	
			04	
			05	
			06	
			07	
			08	
			09	
			10	
			11	
1.23			12	
			13	
			14	
.32	.75	.75	15	
			16	
			17	
.12		0	18	
			19	
			20	
			21	
			22	
			23	
			24	
.22	2.75	2.75	25	
			26	
.69		0	27	
.66	2.25	2.25	28	
			29	
.15	1.25	3.50	30	
			31	
3.39	7.00	3.50	TOTALS	

NA-02732-07

MINNESOTA CLIMATOLOGICAL NETWORK

Minnesota Department of Natural Resources
Division of Forestry

Year	Month	Ob Time		County	Township	Range	Sectic
05	12	700	am	47	121	32	03
			pm				

Name: Gary Klein

County Name:

Township Name: Forest Prairie

Address: 310 Meeker Ave S Watkins MN 55389

Telephone No.: (320) 764-264

Gauge type (Check One): cylinder X; tipping bucket; test tube; weighing; wedge; Other

catch opening diameter/size (inches) _____
maximum catch depth (inches) _____
board/ruler/post used for snow ___yes

24-HOUR AMOUNTS: Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
			01	
			02	
.04	1.50	3.75	03	
			04	
			05	
			06	
			07	
			08	
			09	
			10	
			11	
			12	
			13	
.71	4.5	6.75	14	
			15	
			16	
			17	
			18	
			19	
			20	
			21	
			22	
			23	
			24	
			25	
			26	
			27	
			28	
1.12	6.5	8.5	29	
			30	
			31	
1.87	12.5	8.5	TOTALS	

2 days

2 days

Department of Natural Resources
Division of Waters

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time	County	Township	Range	Section	
05	01	am ✓ pm	86	121	27	17	1

Name	County Name	Township Name
Viola Novotne	Wright	Corinna

Address	Telephone No.
9214 Kilbury Avenue NW, Annandale, MN 55302	(320) 274-5179

At the end of each month, forward forms to:
Office of State Climatology
Department of Natural Resources
University of Minnesota, 279 North Hall
St. Paul, Minnesota 55108

REMARKS:
Give times and comments about events.
(Temperature and Phenology items are very useful).

Type of Gauge (Check One): Cyl. X | Test Tube | Wedge | Other

24-HOUR AMOUNTS				
RAIN MELTED SNOW ETC (INS & HDTHS)	SNOW (INS & TENTHS)	SNOW ON GROUND (INCHES)		
.60	1.	1.	01	very snow and rain.
			02	
			03	
			04	
			05	
			06	
			07	
			08	
			09	
			10	
			11	
.42	5.	5	12	
			13	
			14	
			15	
			16	
			17	
			18	
			19	
			20	
			21	
.61	8.	8	22	
			23	
			24	
			25	
			26	
			27	
			28	
			29	
			30	
.15	1.5	3	31	
1.78			TOTALS	

Department of Natural Resources
Division of Waters

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MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time	County	Township	Range	Section
05	02	✓ am / pm	86	121	27	17

Name	County Name	Township Name
Viola Novotne WENCK ASSOCIATES,	Wright	Corinna

Address	Telephone No.
9214 Kilbury Avenue NW, Annandale, MN 55302	(320) 274-5179

At the end of each month, forward forms to:
Office of State Climatology
Department of Natural Resources
University of Minnesota, 279 North Hall
St. Paul, Minnesota 55108

REMARKS:
Give times and comments about events.
(Temperature and Phenology items are very useful).

Type of Gauge: (Check One)
Cyl. X Test Tube
Wedge Other

24-HOUR AMOUNTS				
RAIN MELTED SNOW ETC INS & HDTHS)	SNOW INS & TENTHS	SNOW ON GROUND (INCHES)		
			01	
			02	
			03	
			04	
			05	
			06	
			07	
			08	
			09	
			10	
			11	
			12	
			13	
.48	1.5	1.5	14	RAIN = SNOW 3:1
			15	
			16	
			17	
			18	
			19	
.50	3.0	3	20	
			21	
			22	
			23	
.10	2.0	4	24	
			25	
			26	
			27	
			28	
			29	
			30	
			31	
1.08			TOTALS	

Department of Natural Resources
Division of Waters

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time	County	Township	Range	Section	
05	03	V (am/pm)	86	121	27	17	1

Name	County Name	Township Name
Viola Novotne	Wright	Corinna

Address	Telephone No.
9214 Kilbury Avenue NW, Annandale, MN 55302	(320) 274-5179

At the end of each month, forward forms to:
Office of State Climatology
Department of Natural Resources
University of Minnesota, 279 North Hall
St. Paul, Minnesota 55108

REMARKS:
Give times and comments about events.
(Temperature and Phenology Items are very useful).

Type of Gauge (Check One): Cyl. X | Test Tube | Wedge | Other

24-HOUR AMOUNTS: RAIN MELTED SNOW ETC INS & HDTHS)	SNOW INS & TENTHS	SNOW ON GROUND (INCHES)		
			01	
			02	
			03	
			04	
			05	
			06	
			07	
			08	
			09	
			10	
			11	
			12	
06	-	.5	13	RAIN SNOW MIX QUICKLY MELTED
			14	
			15	
.02	.5	.4	16	
			17	
			18	
			19	
			20	
			21	
			22	
			23	
			24	
			25	
			26	
			27	
			28	
			29	
			30	
.55	-	-	31	
0.63			TOTALS	

WR-00906-02
Rev. 3/01

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time	County	Township	Range	Section
05	04	☐ am ☑ pm	86	121	27	177

Name	County Name	Township Name
Viola Novotne	Wright	Corinna

Address	Telephone No.
9214 Kilbury Avenue NW, Annandale, Minnesota 55302	(320) 274-5179

Gauge type *(Check One)*: ☐ cylinder ☐ tipping bucket ☐ test tube ☐ weighing ☐ wedge ☐ Other

catch opening diameter/size (inches) _____
maximum catch depth (inches) _____
board/ruler/post used for snow ___yes ___no

24-HOUR AMOUNTS: Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
			01	
			02	
			03	
			04	
			05	
.22			06	
			07	
			08	
			09	
.43			10	
.56			11	
.84			12	
			13	
			14	
			15	
.34			16	
			17	
			18	
.25			19	
			20	
			21	
			22	
			23	
			24	
			25	
.16			26	
			27	
			28	
			29	
			30	
			31	
2.8			TOTALS	

State Climatology Office, 439 Borlaug Hall, University of Minnesota, 1991 Upper Buford Circle, St. Paul, MN 55108-6028

WR-00906-02
Rev. 3/01

MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time	County	Township	Range	Section
05	05	am / pm ✓	86	121	27	17 7

Name	County Name	Township Name
Viola Novotne	Wright	Corinna

Address	Telephone No.
9214 Kilbury Avenue NW, Annandale, Minnesota 55302	(320) 274-5179

Gauge type *(Check One)*: cylinder ✓ | tipping bucket | test tube | weighing | wedge | Other

catch opening diameter/size (inches) 5
maximum catch depth (inches) 10
board/ruler/post used for snow ✓ yes ___ no

24-HOUR AMOUNTS: Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
.05			01	SNOW SQUALLS OFF AND ON
			02	
			03	
			04	
.09			05	
.10			06	
			07	
			08	
.30			09	
.16			10	
			11	
.36			12	
.07			13	
.18			14	
.03			15	
.27			16	
			17	
			18	
1.13			19	
			20	
			21	
.20			22	
.15			23	
.85			24	
			25	
			26	
.35			27	
			28	
			29	
			30	
			31	
4.09			TOTALS	

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MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time	County	Township	Range	Section
05	06	✓ pm	86	121	27	177

Name	County Name	Township Name
Viola Novotne	Wright	Corinna

Address	Telephone No.
9214 Kilbury Avenue NW, Annandale, Minnesota 55302	(320) 274-5179

Gauge type *(Check One)*: cylinder ✓ | tipping bucket | test tube | weighing | wedge | Other

catch opening diameter/size (inches) 5
maximum catch depth (inches) 10
board/ruler/post used for snow ✓ yes ___ no

24-HOUR AMOUNTS				REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
	Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)	
01				
02	.10			
03				
04	.40			
05	.33			
06	.44			
07				
08	.96			
09				
10	.57			
11	.65			
12				
13	.27			
14	.97			
15	.13			
16				
17				
18				
19				
20	.55			
21				
22				
23				
24	.07			
25				
26				
27	.02			
28	3.04			
29	.46			
30	.03			
31				
TOTALS	8.99			

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Rev. 3/01

MINNESOTA CLIMATOLOGICAL NETWORK

05	07	am / pm	86	121	27	17	7
Year	Month	Ob Time	County	Township	Range	Section	

Name	County Name	Township Name
Viola Novotne	Wright	Corinna

Address	Telephone No.
9214 Kilbury Avenue NW, Annandale, Minnesota 55302	(320) 274-5179

Gauge type *(Check One)*: cylinder ✓ | tipping bucket | test tube | weighing | wedge | Other

catch opening diameter/size (inches) 5
maximum catch depth (inches) 10
board/ruler/post used for snow ✓ yes ___ no

24-HOUR AMOUNTS: Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
			01	
			02	
.60			03	
			04	
			05	
			06	
			07	
			08	
			09	
			10	
			11	
			12	
			13	
			14	
			15	
			16	
			17	
			18	
			19	
1.20			20	
			21	
			22	
.92			23	
			24	
.12			25	
.24			26	
			27	
			28	
			29	
			30	
			31	
3.08			TOTALS	

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MINNESOTA CLIMATOLOGICAL NETWORK

05	08	am ✓ / pm	86	121	27	17	7
Year	Month	Ob Time	County	Township	Range	Section	

Name	County Name	Township Name
Viola Novotne	Wright	Corinna

Address	Telephone No.
9214 Kilbury Avenue NW, Annandale, Minnesota 55302	(320) 274-5179

24-HOUR AMOUNTS				REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).	Gauge type *(Check One)*:				catch opening diameter/size (inches) ____ maximum catch depth (inches) ____ board/ruler/post used for snow ___yes ___no
Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)			cylinder		tipping bucket		
					test tube		weighing		
					wedge		Other		
			01						
			02						
.04			03						
.09			04						
			05						
			06						
			07						
			08						
.10			09						
			10						
			11						
			12						
			13						
			14						
			15						
			16						
02			17						
06			18						
			19						
			20						
			21						
			22						
			23						
			24						
			25						
2.13			26						
			27						
			28						
			29						
			30						
			31						
2.44			TOTALS						

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MINNESOTA CLIMATOLOGICAL NETWORK

0 5	0 9	am / pm	8 6	1 2 1	2 7	1 7	7
Year	Month	Ob Time	County	Township	Range	Section	

Name	County Name	Township Name
Viola Novotne	Wright	Corinna
Address		**Telephone No.**
9214 Kilbury Avenue NW, Annandale, Minnesota 55302		(320) 274-5179

Gauge type *(Check One)*: cylinder ☐ tipping bucket ☐ test tube ☐ weighing ☐ wedge ☐ Other ☐

catch opening diameter/size (inches) _____
maximum catch depth (inches) _____
board/ruler/post used for snow ___yes ___no

24-HOUR AMOUNTS: Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
			01	
			02	
.90			03	
.15			04	
			05	
.35			06	
			07	
.28			08	
			09	
			10	
			11	
.50			12	
4.25			13	
			14	
			15	
			16	
			17	
			18	
.40			19	
			20	
			21	
.72			22	
			23	
			24	
.30			25	
			26	
			27	
.29			28	
			29	
			30	
			31	
8.24			TOTALS	

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MINNESOTA CLIMATOLOGICAL NETWORK

0 5	1 0	am ✓ pm	8 6	1 2 1	2 7	1 7	7
Year	Month	Ob Time	County	Township	Range	Section	

Name	County Name	Township Name
Viola Novotne	Wright	Corinna
Address: 9214 Kilbury Avenue NW, Annandale, Minnesota 55302		Telephone No.: (320) 274-5179

24-HOUR AMOUNTS			REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).	Gauge type *(Check One)*:				catch opening diameter/size (inches) _____ maximum catch depth (inches) _____ board/ruler/post used for snow ___yes ___no
Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)		cylinder		tipping bucket		
				test tube		weighing		
				wedge		Other		

			01	
			02	
			03	
			04	
4.08			05	
			06	
			07	
			08	
			09	
			10	
			11	
			12	
.11			13	
			14	
			15	
			16	
.15			17	
			18	
			19	
			20	
			21	
			22	
.28			23	
			24	
			25	
			26	
			27	
			28	
			29	
			30	
.42			31	
4.84			TOTALS	

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MINNESOTA CLIMATOLOGICAL NETWORK

05	11	am / pm	86	121	27	17	7
Year	Month	Ob Time	County	Township	Range	Section	

Name	County Name	Township Name
Viola Novotne	Wright	Corinna
Address		**Telephone No.**
9214 Kilbury Avenue NW, Annandale, Minnesota 55302		(320) 274-5179

Gauge type *(Check One)*: cylinder ☐ tipping bucket ☐ test tube ☐ weighing ☐ wedge ☐ Other ☐

catch opening diameter/size (inches) _____
maximum catch depth (inches) _____
board/ruler/post used for snow ___yes ___no

24-HOUR AMOUNTS				REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
	Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)	
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13	.70			
14				
15	.49			
16	.02	.7	.7	
17				
18				
19				
20				
21				
22				
23				
24				
25	.39	4.	4.	
26				
27				
28	.75		-	RAIN
29	.20	.3	.3	RAIN + SNOW MIX
30				
31				
TOTALS	2.55			

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MINNESOTA CLIMATOLOGICAL NETWORK

Year	Month	Ob Time	County	Township	Range	Section
05	12	am / pm ✓	86	121	27	17 7

Name	County Name	Township Name
Viola Novotne	Wright	Corinna

Address	Telephone No.
9214 Kilbury Avenue NW, Annandale, Minnesota 55302	(320) 274-5179

Gauge type *(Check One)*: cylinder ☐ tipping bucket ☐ test tube ☐ weighing ☐ wedge ☐ Other ☐

catch opening diameter/size (inches) _____
maximum catch depth (inches) _____
board/ruler/post used for snow ___yes ___no

	24-HOUR AMOUNTS			REMARKS: Give times and comments about events. (Temperature and Phenology items are very useful).
	Rain, Melted Snow, Etc. (Ins. & Hdths)	Snow (Ins. & Tenths)	Snow On Ground (Inches)	
01	.07	.5	1.5	
02				
03				
04	.04	2.	3.	LIGHT FLUFFY SNOW
05				
06				
07				
08				
09				
10				
11				
12				
13				
14	.30	7.5	9.	
15	.14	2.	10.	
16	.10	1.5	11.	
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30	.30	5.0	6.	
31				
TOTALS	0.95			

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Appendix C

Historical Mean Flow, Mean Phosphorus, and Phosphorus Loading

TABLE 1
HISTORICAL SUMMARY OF STREAM FLOWS, PHOSPHORUS CONCENTRATIONS, AND LOADINGS

Clearwater River Watershed District

Station	Year	Average Stream Flow (cu m/sec)	Average Stream Flow (cfs)	Average Total Phosphorus Concentration (mg/l)	Total Phosphorus Load (kg)	Total Phosphorus Load (lb)
Main Stem:						
CR 28.2	1981 (1)	--	--	1.40	--	--
	1982 (1)	0.93	32.8	0.74	19,700	43,500
	1983	2.62	92.6	0.92	76,000	168,000
	1984	1.49	52.6	0.76	35,700	78,800
	1985	2.32	81.9	0.90	65,500	144,000
	1986	3.20	113	0.78	55,200	122,000
	1987	0.11	3.90	0.13	460	1,020
	1988	0.09	3.12	0.66	1,850	4,080
	1989	0.02	0.72	0.19	120	260
	1990	0.51	18.0	0.44	7,040	15,500
	1991	1.11	39.1	0.29	10,200	22,500
	1992	0.26	9.30	0.20	1,660	3,650
	1993	1.28	45.2	0.29	11,600	25,600
	1994	1.17	41.2	0.28	10,100	22,300
	1995	1.15	40.4	0.29	10,400	22,900
	1996	0.33	11.7	0.27	2,860	6,300
	1997	0.27	9.36	0.26	2,170	4,790
	1998	0.41	14.4	0.25	3,190	7,020
	1999	0.08	2.78	0.16	400	870
	2000	0.02	0.72	0.38	240	530
	2001 (4),(5)	0.27	9.46	0.51	4,309	9,500
	2002	0.47	16.50	0.29	4,290	9,460
	2003	0.28	9.92	0.19	1,710	3,770
	2004	0.48	17.04	0.17	1,248	2,751
	2005 (6)	1.11	39.28	0.31	1,862	4,105
CR 10.5	1981 (1)	1.15	40.6	0.05	2,060	4,550
	1982 (1)	2.20	77.8	0.07	4,990	11,000
	1983	5.64	199	0.10	18,500	40,800
	1984	4.28	151	0.05	6,620	14,600
	1985	3.88	137	0.14	16,700	36,800
	1986	5.52	195	0.15	23,700	52,300
	1987	0.46	16.2	0.04	600	1,320
	1988	0.23	7.95	0.04	260	580
	1989	0.97	34.2	0.08	2,340	5,150
	1990	3.77	133	0.03	3,060	6,750
	1991	6.68	236	0.05	10,500	23,200
	1992	4.16	147	0.06	8,090	17,800
	1993	5.01	177	0.04	6,330	14,000
	1994	2.92	103	0.03	2,850	6,290
	1995	2.83	100	0.03	3,040	6,710
	1996	1.53	54.2	0.04	1,970	4,350
	1997	2.06	72.8	0.04	2,690	5,940
	1998	1.78	63.0	0.04	2,330	5,120
	1999	1.25	44.1	0.04	1,520	3,350
	2000	0.31	10.8	0.03	280	610
	2001 (4),(5)	0.90	31.7	0.03	850	1,873
	2002	2.46	87.0	0.04	2,950	6,500
	2003	2.11	74.6	0.024	1,590	3,500
	2004	1.66	58.8	0.022	639	1,409
	2005 (6)	3.05	107.6	0.023	59	130

TABLE 1
HISTORICAL SUMMARY OF STREAM FLOWS, PHOSPHORUS CONCENTRATIONS, AND LOADINGS

Clearwater River Watershed District

Station Tributaries:	Year	Average Stream Flow (cu m/sec)	(cfs)	Average Total Phosphorus Concentration (mg/l)	Total Phosphorus Load (kg)	(lb)
WR 0.2 (2)	1981 (1)	0.07	2.60	0.17	390	860
	1982 (1)	0.23	8.20	0.16	780	1,720
	1983	0.47	16.50	0.09	1,270	2,800
	1984	0.60	21.20	0.05	950	2,100
	1985	0.48	17.10	0.14	2,130	4,700
	1986	0.86	30.40	0.20	4,630	10,200
	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	1,660
	1991	0.26	9.22	0.11	860	1,900
	1992	0.11	4.02	0.05	170	370
	1993	0.24	8.59	0.10	760	1,670
	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
	2001 (4),(5)	0.08	2.88	0.10	257	567
	2002	0.26	9.17	0.11	930	2,060
	2003	0.16	5.79	0.06	320	710
	2004	0.07	2.6	0.06	78	172
	2005	0.58	20.6	0.07	22	48

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.
(4) 2001 Flow and total phosphorus values are arithmetic averages.
(5) 2001 total phosphorus loads estimated from arithmetic averages of flow and total phosphorus values.
(6) Values in 2005 were calculated using suplimental flow data from CSAH 40 near Clearwater

Appendix D

Lake Historical Data

TABLE 1
HISTORICAL SUMMARY OF LAKE WATER QUALITY DATA
Summer (June-September) Epilimnetic Means

Clearwater River Watershed District

	Number of Samples	Total Phosphorous (ug/l) Mean (3)	Std. Dev.	Chlorophyll-a (ug/l) Mean	Std. Dev.	Secchi Disk Transparency (m) Mean	Std. Dev.
ALBION							
1996	4	130	24	204	224	0.5	0.3
1999	4(5)	220	65	168.7	72	0.8	0.0
2003	4	199	78	117	73	1.0	
2005	4	248	182	60	44		
Mean		199	87	137	103	0.8	0.1
AUGUSTA							
1981	7	260	400	25	14	1.4	0.3
1982	7	140	120	34	21	1.4	0.6
1983	7	300	90	4	3	1.8	1.0
1984	7	90	30	4	2	1.6	0.8
1985	7	120	120	23	12	1.2	0.2
1986	6	90	40	69	91	1.9	0.5
1987	7	30	10	20	12	1.3	0.3
1988	5	40	10	19	6	1.4	0.3
1989	6	80	30	26	40	1.5	0.4
1990	5	90	20	73	105	1.7	0.7
1991	3	80	40	56	73	1.1	0.4
1992	8	30	20	19	6	1.6	0.7
1993	4 (1)	68	20	42	19	1.2	0.4
1995	4 (2)	28 (4)	15	21	12	1.8	0.7
1997	4	46 (4)	13	20 (5)	1	1.7	0.2
1999	4(6)	37	4	8.5	2.7	1.6	0.2
2001	2	48	6	6.4	0.0	1.8	0.0
2002	SWCD	84.3		13.5		1.9	
2003	3	42	15	29	23	1.5	
Mean		90	56	27	25	1.5	0.4
BASS							
1994	4	13 (4)	14	4.8	0.8	3.2	0.4
1998	4	28	11	2.0	1.0	3.1	0.6
1999	3	22	5	2.9	1.4	3.1	0.7
2001	2	25	4	2.7	1.0	4.2	1.8
Mean		22	9	3.1	1.1	3.4	0.9
BETSY							
1981	7	700	190	7.7	5.6	2.4	1.1
1982	7	650	90	59	50	1.3	0.7
1983	7	560	270	5	4	1.1	1.3
1984	7	350	160	7	5	0.8	0.2
1985	7	280	230	30	26	1.1	0.6
1987	2	120	0	74	35	0.87	0.41
1995	4 (2)	290	183	18	13	1.0	0.34
1997	4	245	108	100 (5)	98	0.83	0.05
1999	3(8)	247	110	170	85	0.8	0.2
2001	2	420	368	4.3	1	0.46	0.0
2003	4	194	78	45.0	52.0	1.3	
2005	4	140	58	20.0	11.4		
Mean		350	154	45	32	1.1	0.5

TABLE 1
HISTORICAL SUMMARY OF LAKE WATER QUALITY DATA
Summer (June-September) Epilimnetic Means

Clearwater River Watershed District

		Number of Samples	Total Phosphorous (ug/l) Mean (3)	Std. Dev.	Chlorophyll-a (ug/l) Mean	Std. Dev.	Secchi Disk Transparency (m) Mean	Std. Dev.
CAROLINE								
1981		7	220	100	39	33	1.3	0.3
1982		7	260	140	54	35	1.4	0.8
1983		7	300	140	3	3	1.8	1.1
1984		7	140	50	5	2	1.3	0.3
1985		7	170	150	41	46	1.5	0.6
1987		2	50	10	46	30	1.1	0.4
1994		4	40	18	55	16	0.8	0.2
1996		4	88	33	36	12	1.2	0.2
1998		4	86	24	55	43	1.2	0.1
2001	(SCWD)	5	43	18	12	10	1.8	0.8
2002			95		45		1.6	
2003	(SCWD)	5	66		28.6		1.5	
2004		4	45	8	25	18	1.1	0.0
Mean			123	63	34	23	1	0
CEDAR								
1993		4	30	10	13.3	5.9	3.0	0.4
1996		4	33	8	12.9	6.5	2.4	0.3
1999		4	31	8	9.5	4.4	1.1	0.2
2001		2	26	5	5.9	1.0	1.8	1.4
2003		4	52	41	11.0	6	1.9	
2004		4	33	15	3.0	3	2.6	1 reading
2005		5	37	11	9.0	4		
Mean			35	14	9	4	2	0.6
CLEAR								
1994		4	80	24	17	8	1.2	0.3
1998		4	220	141	110	141	1.0	0.1
1999		4	188	43	85	47	0.5	0.0
2000		4	228	30	134	42.6	0.3	0.1
2003		4	200	52	72	23	0.7	
2005		4	307	107	60	82		
Mean			204	66	80	57	0.7	0.1
CLEARWATER EAST								
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	10	2.1	1.8	0.2
2000		4	33	18	10	3.4	2.3	1.0
2001		2	40	25	7	0.0	2.4	0.7
2002			36		14		1.8	
2003		3	22	5	7	6	2.4	
2004		4	29	13	6	3	2.6	0
Mean			51.7	23.8	16.2	13.7	2.1	0.7

TABLE 1
HISTORICAL SUMMARY OF LAKE WATER QUALITY DATA
Summer (June-September) Epilimnetic Means

Clearwater River Watershed District

	Number of Samples	Total Phosphorous (ug/l) Mean (3)	Total Phosphorous (ug/l) Std. Dev.	Chlorophyll-a (ug/l) Mean	Chlorophyll-a (ug/l) Std. Dev.	Secchi Disk Transparency (m) Mean	Secchi Disk Transparency (m) Std. Dev.
CLEARWATER WEST							
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
2001	2	42	11	8	1.0	1.4	0.0
2002		42		18		1.9	
2003	3	27	9	14	9	2.2	
2004	4	26	8	7	4	1.7	0.0
Mean		55	25	20	17	2	1
GRASS							
1996	4	38	26	12	5	1.9	0.5
1998	1	30	0				
1999	4	25	2	14	9.3	1.9	0.4
2003	2	24	2	1	1	2.9	
Mean		29	8	13	7	1.9	0.4
HENSHAW							
1995	4	270	58	238	67	0.4	0.1
1998	4 (5)	150	48	53	22	0.9	0.2
1999	4	295	156	136.3	166	0.9	0.1
2002		210		103.0		0.7	
2005	5	281	177	144.0	137.9		
Mean		241	110	135	98	0.7	0.1
LITTLE MUD							
1995	4	55	50	36	38	1.6	0.5
1999	3	62	42	4.5	4	2.1	0.1
2002		49		21.0		1.4	
Mean		55	46	20	21	1.7	0.3

TABLE 1
HISTORICAL SUMMARY OF LAKE WATER QUALITY DATA
Summer (June-September) Epilimnetic Means

Clearwater River Watershed District

	Number of Samples	Total Phosphorous (ug/l) Mean (3)	Std. Dev.	Chlorophyll-a (ug/l) Mean	Std. Dev.	Secchi Disk Transparency (m) Mean	Std. Dev.
LOUISA							
1981	7	440	110	39	29	1.4	0.4
1982	7	420	140	68	26	1.5	0.5
1983	7	410	170	4	4	1.4	1.4
1984	7	220	80	8	6	1.0	0.1
1985	7	160	100	26	17	1.1	0.3
1986	6	190	50	96	86	1.1	0.1
1987	7	100	10	70	44	0.8	0.2
1988	5	140	60	101	39	0.6	0.3
1989	6	110	40	69	78	0.8	0.5
1990	5	200	80	55	35	1.3	0.5
1991	3	160	70	31	18	1.5	0.3
1992	8	140	140	46	22	1.1	0.3
1993	4 (1)	170	40	35	13	1.2	0.2
1995	4 (2)	100	36	75	27	0.8	0.2
1997	4	68	7	59 (5)	8	0.9	0.2
1999	4	73	29	37.8	20	1	0.1
2001	2	33	30	5.1	4	0.9	
2003	3	100	13	68	28.0	1.1	
Mean		180	67	50	28	1.1	0.3
MARIE							
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	13.5	7.7	2.3	1.0
2002		70		37.0		1.2	
2003	3	87	50	81	67	1.3	
2004	4	84	45	34	16	1.1	0.0
Mean		166	76	58	34	1.0	0.3
NIXON							
1994	4	25 (4)	25	5.0 (4)	3.4	1.8	0.7
1997	4	30	8	4.7 (5)	1.5	2.8	0.2
1999	4	39	17	7.0	8.7	3.3	0.5
2001	2	21	1	5.6	3.0	3.2 (8)	
2004	4	15	4	2	1	3.0	0.1
Mean		26	11	5	3	3	0

TABLE 1
HISTORICAL SUMMARY OF LAKE WATER QUALITY DATA
Summer (June-September) Epilimnetic Means

Clearwater River Watershed District

	Number of Samples	Total Phosphorous (ug/l) Mean (3)		Std. Dev.	Chlorophyll-a (ug/l) Mean		Std. Dev.	Secchi Disk Transparency (m) Mean	Std. Dev.
OTTER									
1994	4	13	(4)	4	7.8		1.8	1.9	0.3
1997	4	23		10	3.7	(5)	1.5	2.1	0.3
1999	4	34		5	6.6		4.8	3.0	0.4
2001	2	30		22	4.0		1.0	2.8	0.4
2004	4	16		10	3		2	2.2	0.0
Mean		23		10	5		2	2	0
PLEASANT									
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
2004	4	20		9	4		1	2.3	0.0
Mean		27.8		13.5	8.4		4.3	2.4	0.5
SCHOOL SECTION									
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
2004	4	21		9	3		2	2.0	0.0
Mean		38		20	12.4		7.8	1.6	0.6
SCOTT									
1981	7	660		340	26		27	1.9	0.9
1982	6	540		220	57		39	1.4	0.7
1983	7	450		170	3		3	1.2	1.4
1984	7	270		100	6		5	0.7	0.1
1985	7	260		280	35		29	1.1	0.5
1994	4	160		117	94		71	0.7	0.1
1996	4	280		174	223		68	0.5	0.1
1998	4 (5)	230		176	141		77	0.8	0.1
1999	3	223		163	76		30	0.6	0.1
2002		210			103			0.7	
2003	4	158		52	66		33	0.8	
2004	4	103		20	51		4	0.8	0.0
Mean		295		165	73		35	0.9	0.4
SWARTOUT									
1996	4	370		181	173		164	1.0	0.7
1999	4(6)	200		75	151		91	0.7	0.2
2003	4	421		293	444		524	0.9	
2005	4	278		41.8	144		53		
Mean		317		148	228		208	0.9	0.5

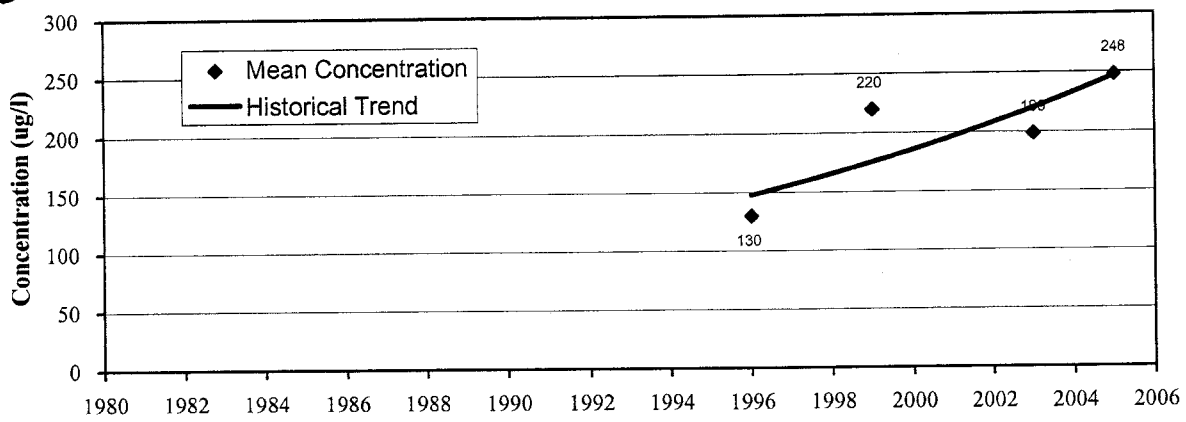
TABLE 1
HISTORICAL SUMMARY OF LAKE WATER QUALITY DATA
Summer (June-September) Epilimnetic Means

Clearwater River Watershed District

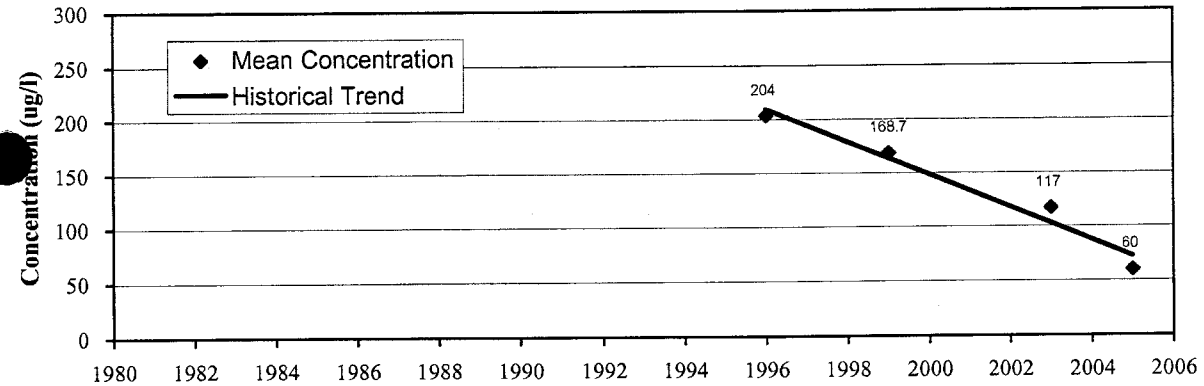
	Number of Samples	Total Phosphorous (ug/l) Mean (3)	Total Phosphorous (ug/l) Std. Dev.	Chlorophyll-a (ug/l) Mean	Chlorophyll-a (ug/l) Std. Dev.	Secchi Disk Transparency (m) Mean	Secchi Disk Transparency (m) Std. Dev.
UNION							
1995	4	43	15	15	1	1.4	0.3
1998	4 (5)	50	27	16	9	1.7	0.4
1999	3	31	15	12.4	10	1.8	0.9
2002		88		39.0		1.0	
Mean		41	19	14	7	1	1
WIEGAND							
1995	4	35	5	12	2	1.7	0.2
1999	4(5)	61	44	6.4	1.1	2.4	0.6
2002		37		5.3		3.0	
2005	4	31	4	3.0	1.9		
Mean		41	18	7	2	2.4	0.4

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.
(8) One secchi disk reading was recorded.

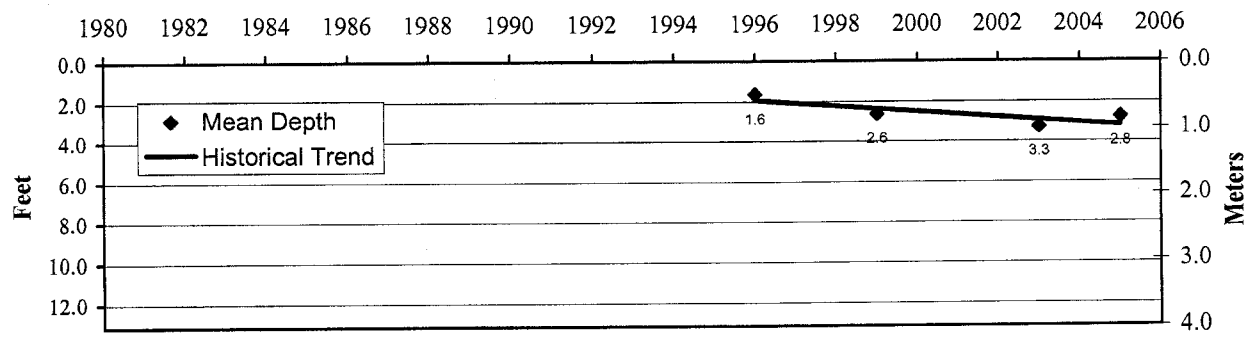
Total Phosphorus



Chlorophyll-*a*



Secchi Depth



Clearwater River Watershed District	Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359	Jan 2006
Lake Albion Historical Data		Figure 1

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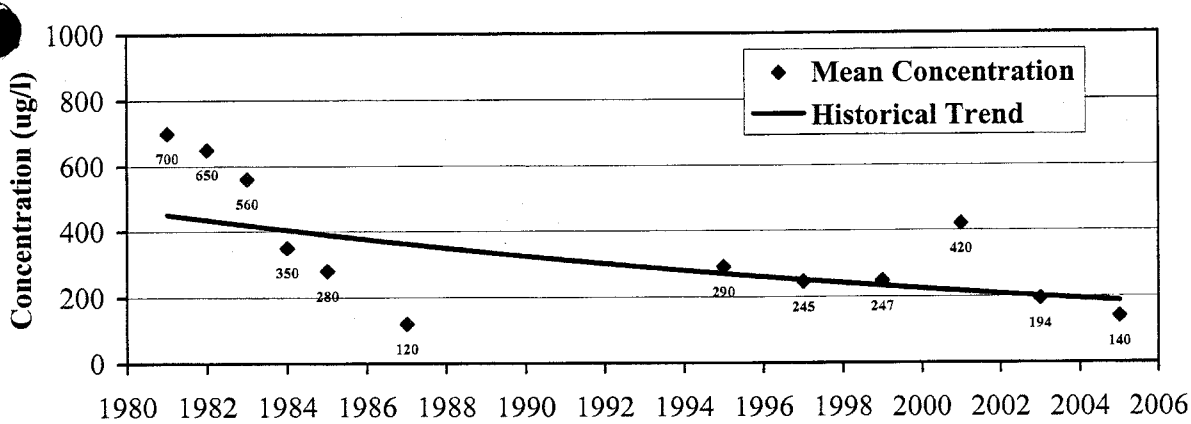
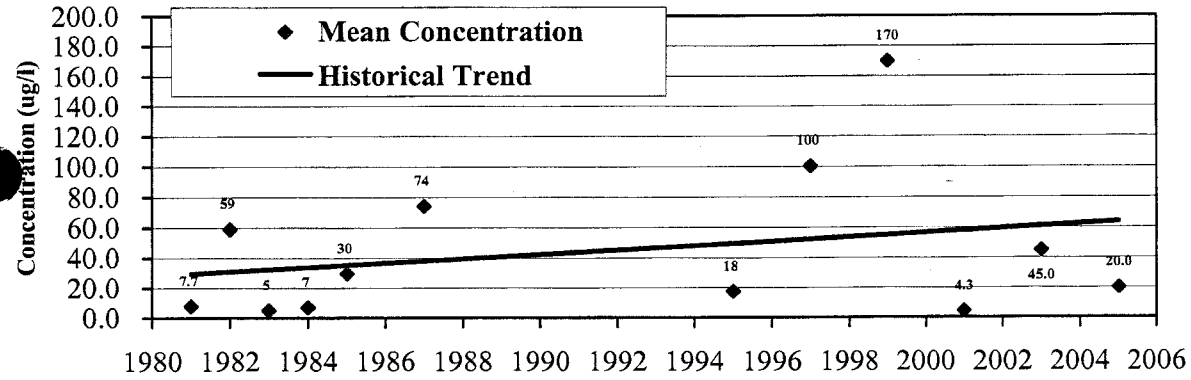
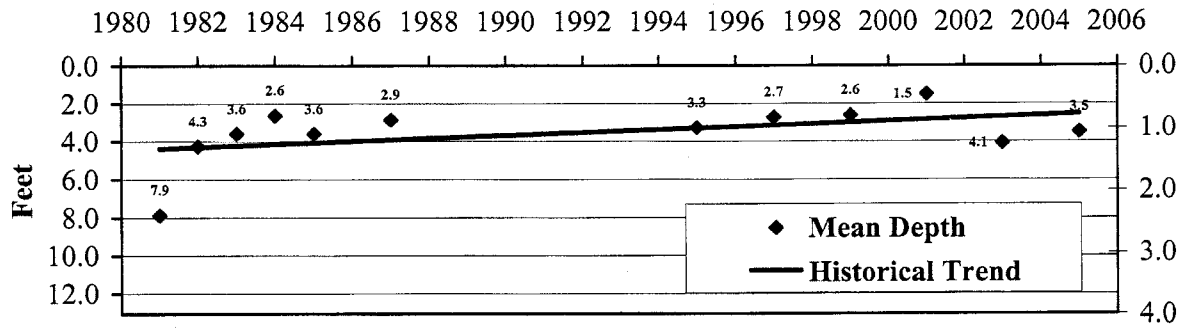
Total Phosphorus



Chlorophyll-*a*



Secchi Depth



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Lake Betsy Historical Data		Figure 2

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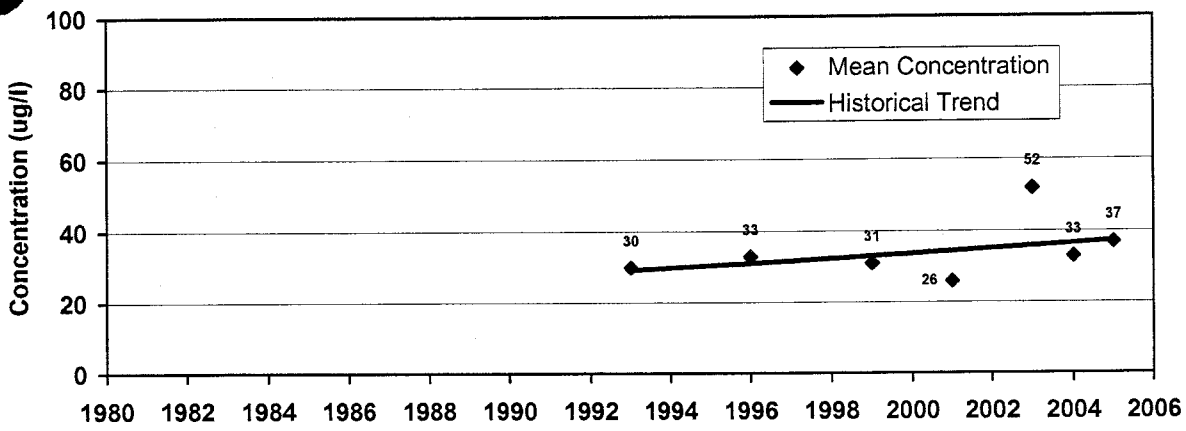
Total Phosphorus



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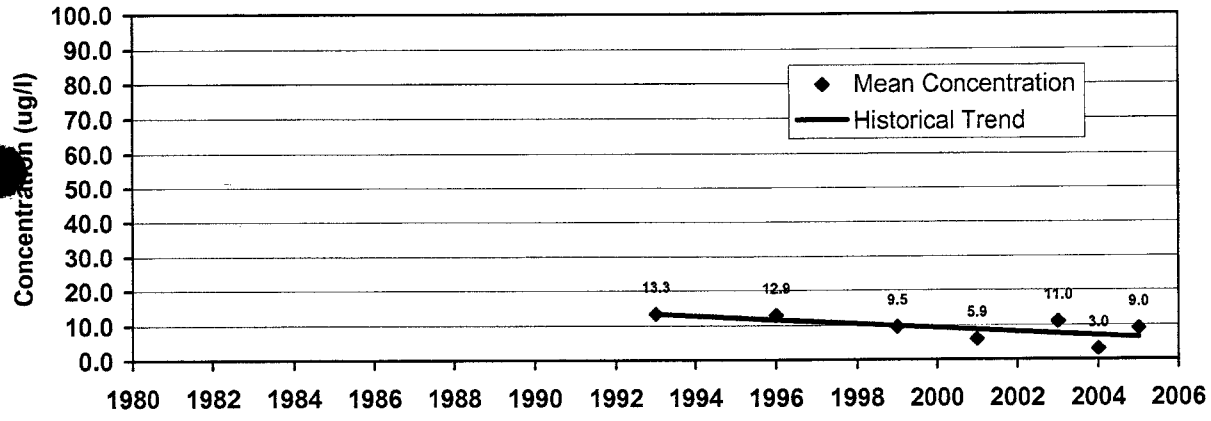
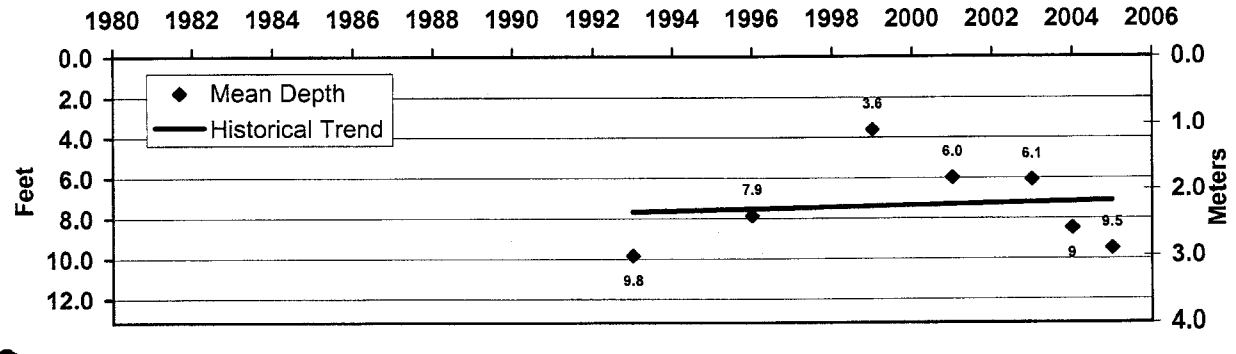


Secchi Depth



Clearwater River Watershed District	Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359	Jan 2006
Cedar Lake Historical Data		Figure 3

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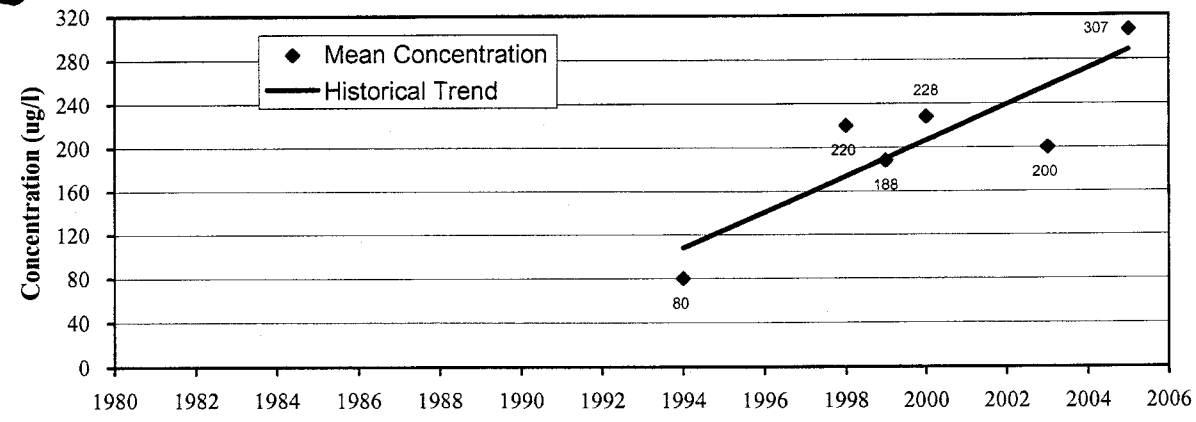
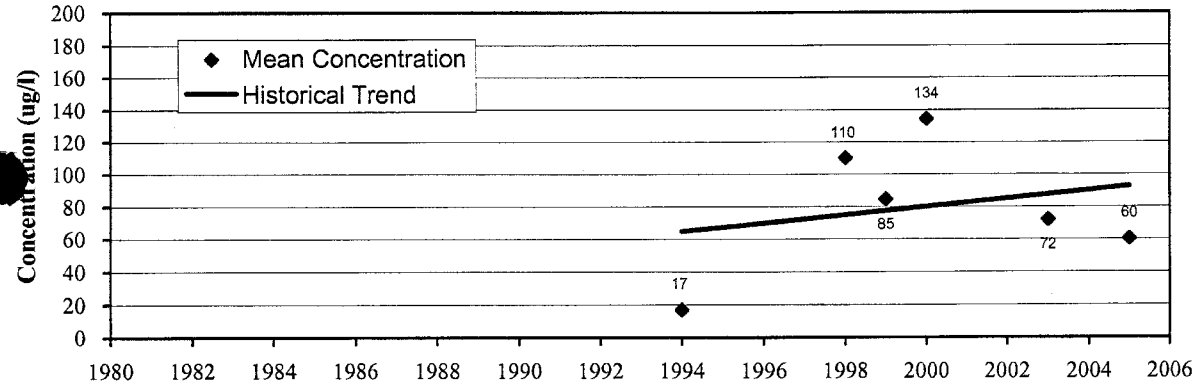
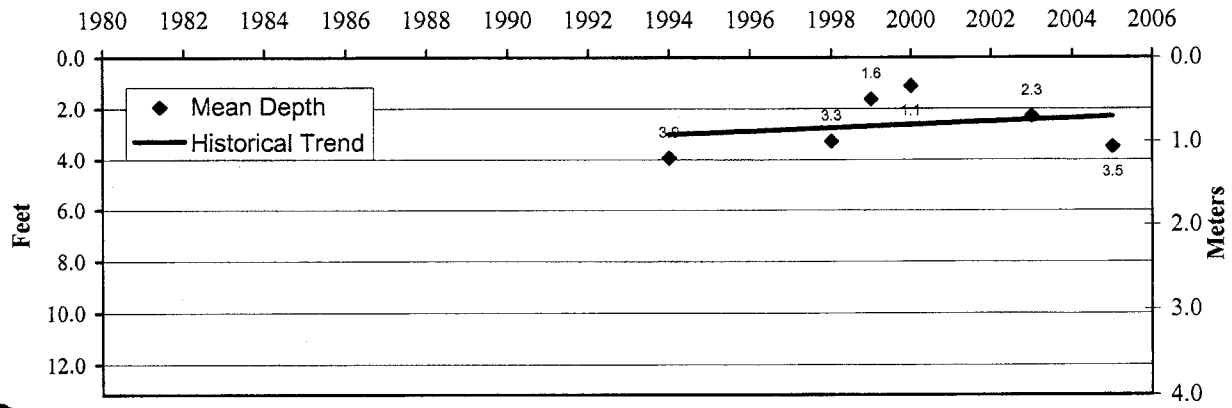
Total Phosphorus



Chlorophyll-*a*



Secchi Depth



Clearwater River Watershed District	Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359	Jan 2006
Clear Lake Historical Data		Figure 4

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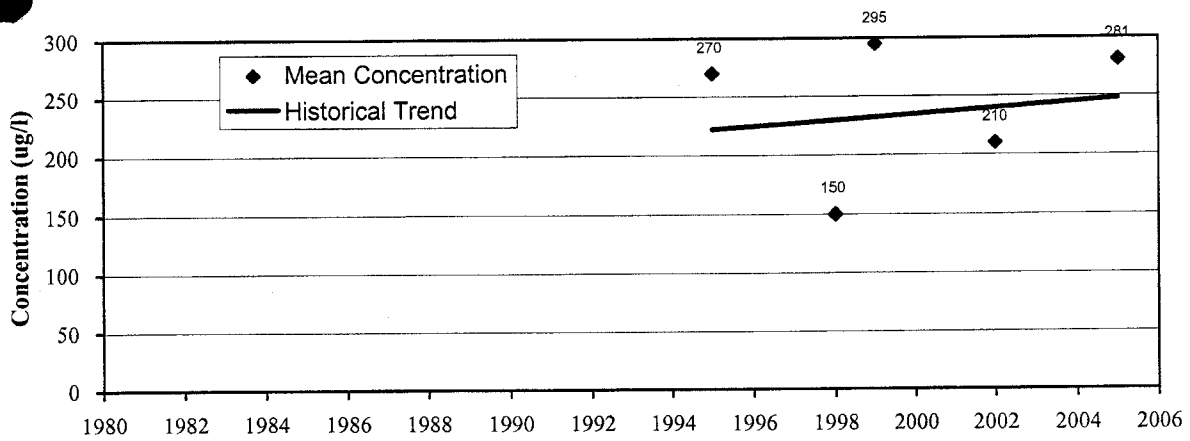
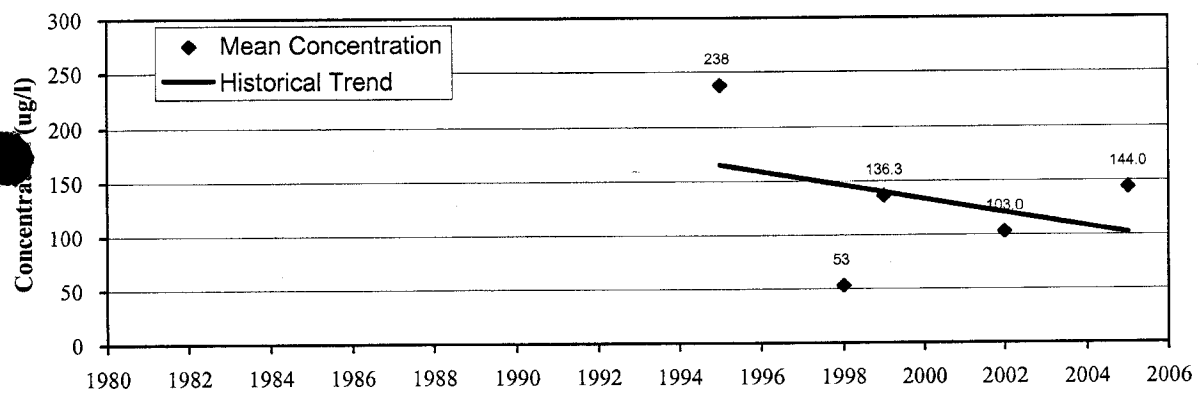
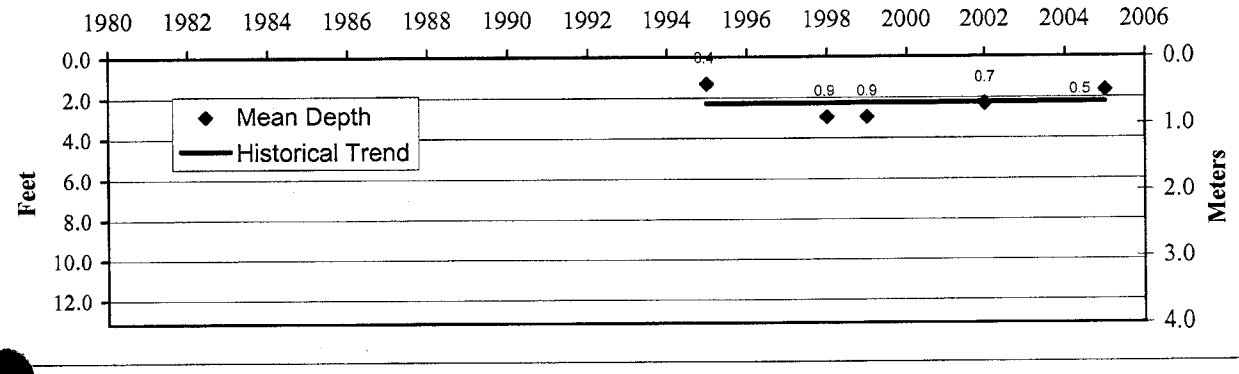
Total Phosphorus



Chlorophyll-*a*



Secchi Depth



Clearwater River Watershed District	Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359	Jan 2006
Henshaw Lake Historical Data		Figure 5

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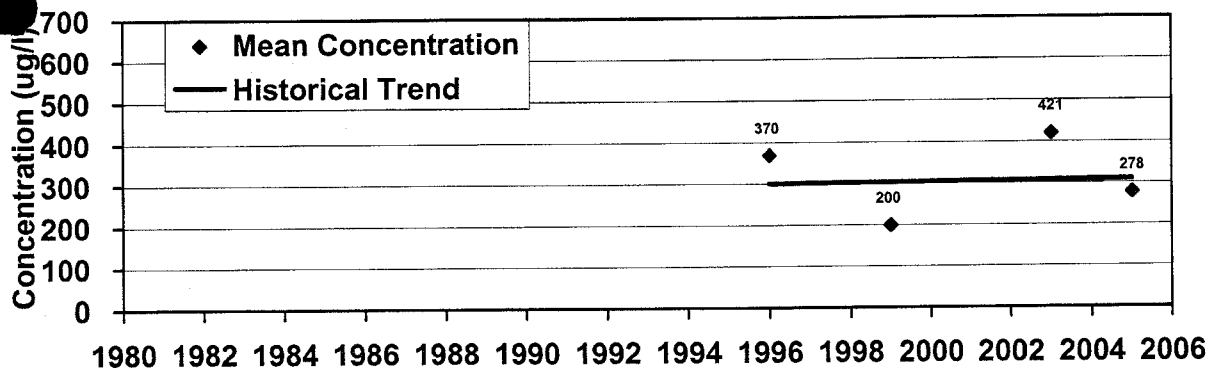
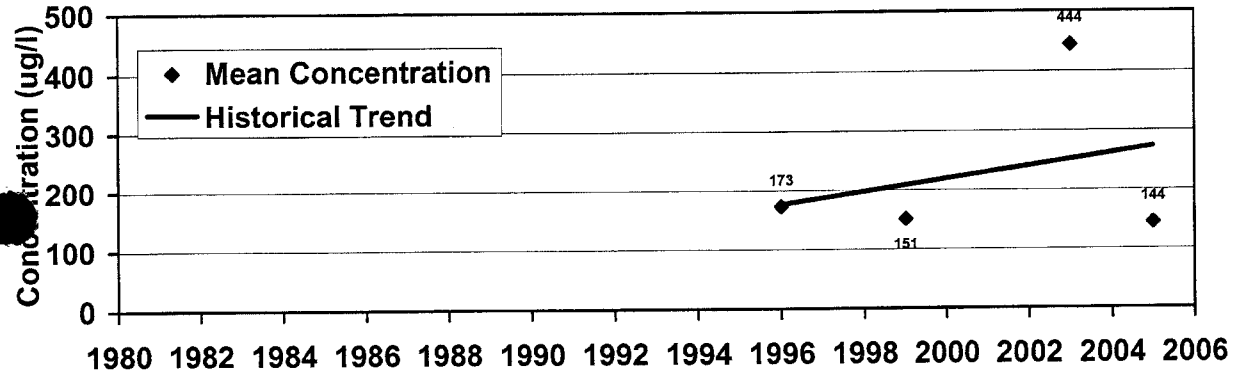
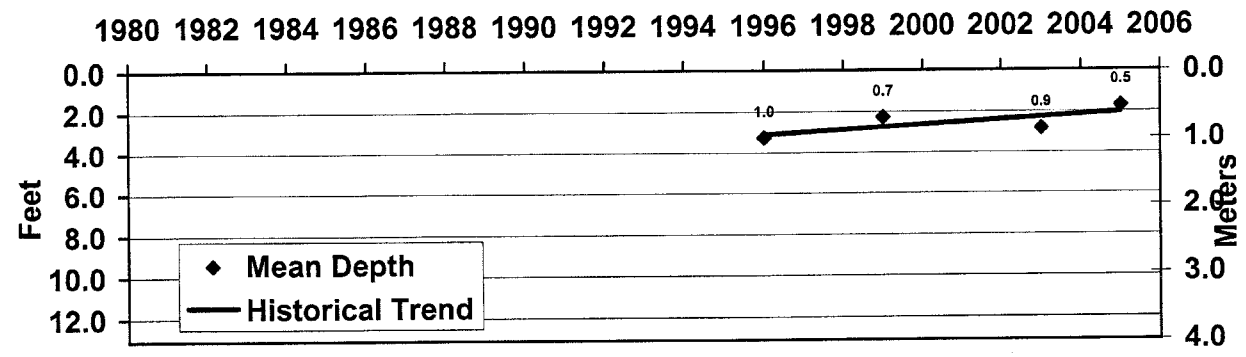
Total Phosphorus



Chlorophyll-*a*



Secchi Depth



Clearwater River Watershed District	Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359	Jan 2006
Swart Watts Lake Historical Data		Figure 6

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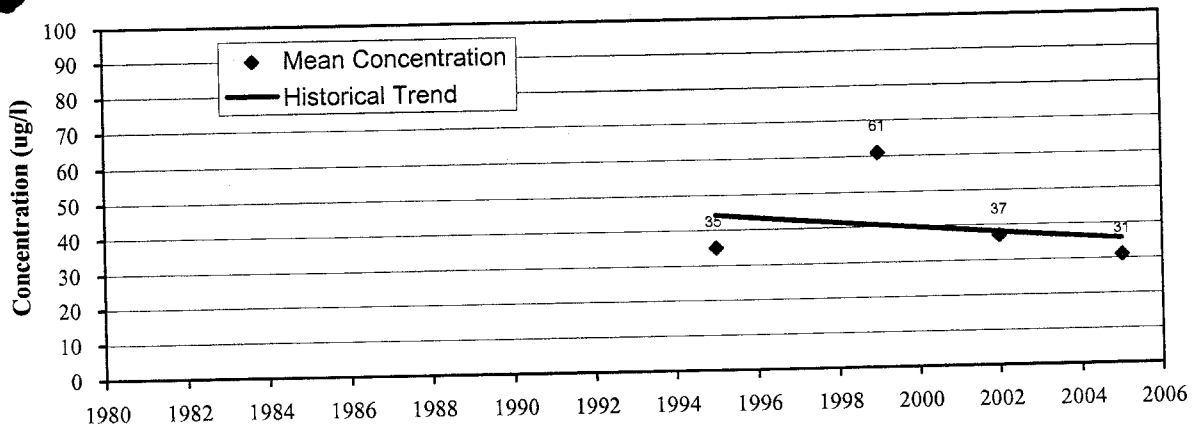
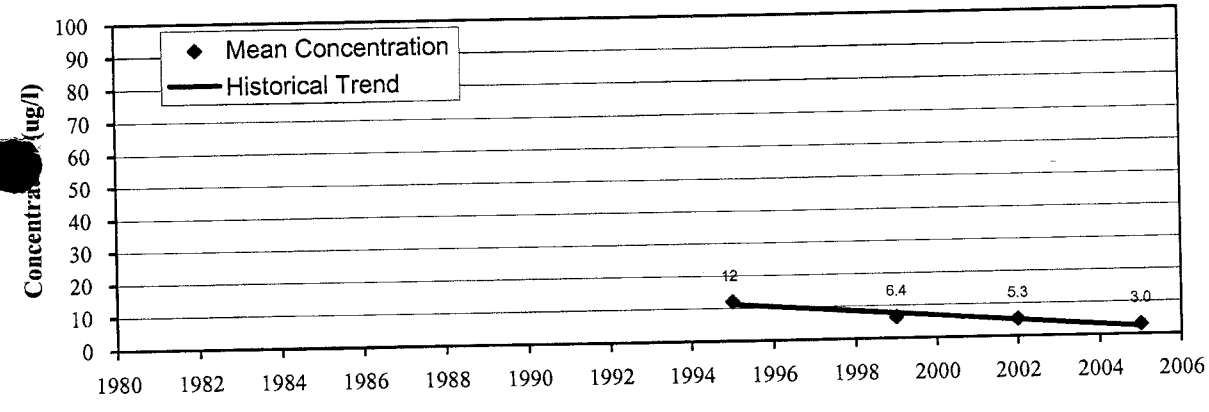
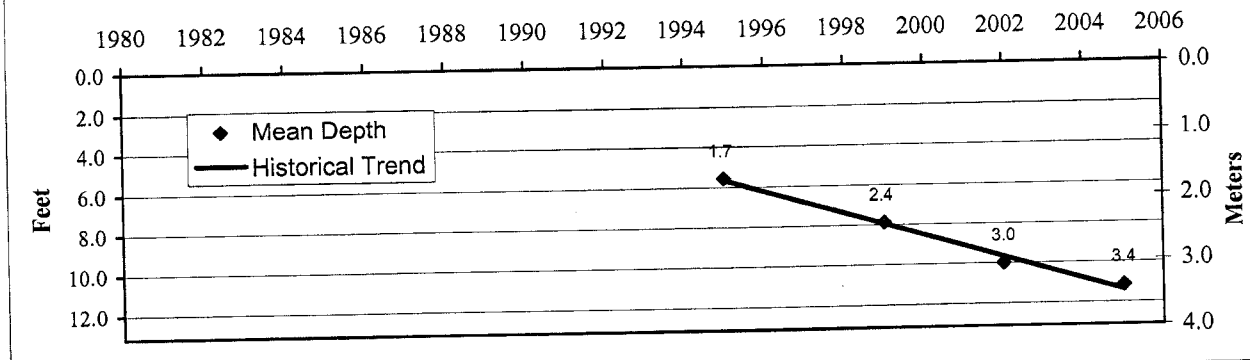
Total Phosphorus



Chlorophyll-*a*



Secchi Depth



Clearwater River Watershed District	Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359	Jan 2006
Wiegand Lake Historical Data		Figure 7

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