Clearwater River Watershed District Watershed Protection and Improvement Plan (TMDL Implementation Plan)

303d Impairments:

- Clearwater River: Clear Lake to Lake Betsy, Bacteria (Approved)
- Clearwater River Clear Lake to Lake Betsy, Dissolved Oxygen (Draft)
- Clear Lake, Nutrients (Approved)
- Lake Betsy, Nutrients (Approved)
- Scott Lake, Nutrients (Approved)
- Union Lake, Nutrients (Approved)
- Lake Louisa, Nutrients (Approved)
- Lake Marie, Nutrients (Approved)
- Lake Caroline, Nutrients (Draft)
- Lake Augusta, Nutrients (Draft)
- Swartout Lake, Nutrients (Draft)
- Albion Lake, Nutrients (Draft)
- Henshaw Lake, Nutrients (Draft)

Wenck File #0002-128

Prepared for:

CLEARWATER RIVER WATERSHED DISTRICT

MINNESOTA POLLUTION CONTROL AGENCY

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1.0 Introduction

The Clearwater River Watershed District (CRWD) Watershed Protection and Improvement Plan/ Total Maximum Daily Load (TMDL) Implementation Plan addresses dissolved oxygen (DO) and bacteria impairments in the Clearwater River and nutrient impairments in 11 lakes within the watershed district, which is located in Stearns and Meeker Counties, Minnesota in the Upper Mississippi St. Cloud Hydrologic Unit Code (HUC) 07010203.

The TMDL analysis has been completed for each of the impaired waters within CRWD in cooperation with the Minnesota Pollution Control Agency (MPCA). This plan outlines methods to achieve the required load reductions to meet state water quality standards and protect and improve water quality in the CRWD. The CRWD's TMDLs are at varying stages of completion. The following list shows the status for TMDLs in the CRWD.

Impairment	Water Body	Status
Bacteria	Clearwater River, Clear Lake to Lake Betsy (07010203-549),	TMDL is Final
Dissolved Oxygen	Clearwater River, Clear Lake to Lake Betsy (07010203-549),	Draft TMDL Awaiting Public Notice
Nutrients	Clear Lake (47-0095)	TMDL is Final
	Lake Betsy (47-0042)	TMDL is Final
	Scott Lake (86-0297)	TMDL is Final
	Union Lake (86-0298)	TMDL is Final
	Lake Louisa (86-0282)	TMDL is Final
	Lake Marie (73-0014)	TMDL is Final
	Lake Caroline (86-0281)	Draft TMDL Awaiting Public Notice
	Lake Augusta (86-0284)	Draft TMDL Awaiting Public Notice
	Swartout Lake (86-0208)	Draft TMDL Awaiting Public Notice
	Albion Lake (86-0212)	Draft TMDL Awaiting Public Notice
	Henshaw Lake (86-0213)	Draft TMDL Awaiting Public Notice

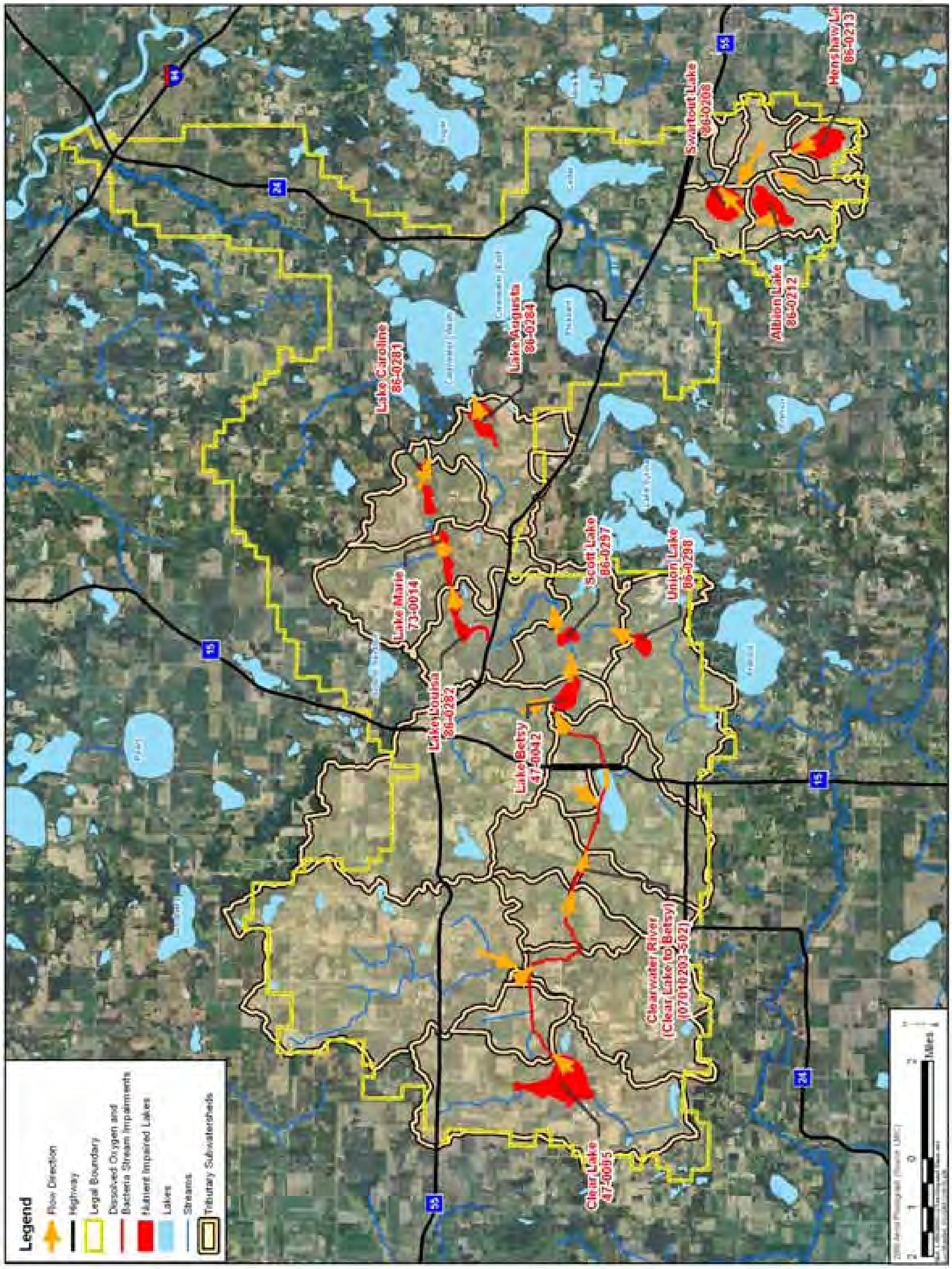
Figure 1.1 shows the watershed district and the location of the impaired waters and their tributary watersheds. The TMDLs were set in accordance with Section 303(d) of the Clean Water Act.

The final step in the TMDL process is the development of an Implementation Plan that sets forth the activities that will be undertaken to reduce phosphorus, bacteria and oxygen demand loadings to the impaired waters. This Implementation Plan provides a brief overview of the TMDL findings; describes the principles guiding this Implementation Plan; discusses sequencing, timing, lead agencies and organizations, and other implementation general strategies; and describes the proposed implementation activities.

The focus of the Implementation Plan is broad because the load reduction goals are significant in order to meet state standards. Load reductions will be required from urban, agricultural and lake shore land uses as well as reductions of internal nutrient loading for lakes, and wetland sediment oxygen demand (SOD).

Because the watersheds of the impaired waters overlap in many cases, the District has an opportunity to address many of the impairments at once. For example, BMPs used to address the nutrient impairment to Lake Betsy will likely improve not only water quality upstream in the Clearwater River, but downstream as well in Scott Lake, Lake Louisa, Lake Marie, Lake Caroline and Lake Augusta. Implementation projects will also serve to protect water quality in other District lakes that do currently meet state standards. To that end, implementation efforts will be sequenced to have the most immediate impact. Watershed and internal loads to Lake Betsy and Clear Lake will be targeted first to improve water quality in these lakes thereby reducing loads to all but three of the impaired lakes in the District. These three, Swartout, Albion, and Henshaw will be targeted separately. Implementation on a watershed level is appropriate due to the riverine nature of the system as shown in Figure 1.1 as well as the overlapping of watersheds.

Figure 1.1 Location of Impaired Waters and Tributary Watersheds


Legend
Flow Direction
Highway
Legal Boundary
Dissolved Oxygen and Bacteria Stream Impairments
Nutrient Impaired Lakes
Lakes
Streams
Tributary Subwatersheds
Lake Caroline 86-0281
Lake Augusta 86-0284
Swartout Lake 86-0208
Henshaw La 86-0213
Albion Lake 86-0212
Scott Lake 86-0297
Union Lake 86-0298
Lake Marie 73-0014
Lake Louisa 86-0282
Lake Betsy 47-0042
Clearwater River (Clear Lake to Betsy) (07010203-502)
Clear Lake 47-0095
Miles

2.0 Clearwater River TMDL Summary

A key aspect of a TMDL is the development of an analytical link between loading sources and receiving water quality. To establish the link between pollutant loading to the quality of water in the Clearwater River and the District's impaired lakes, additional water quality and hydrologic monitoring was conducted and historical monitoring data extending back to the 1980's was reviewed. This provided a better understanding of conditions and trends. Other data examined include fish and aquatic macrophyte survey data compiled by the Minnesota Department of Natural Resources (DNR).

2.1 CURRENT WATER QUALITY

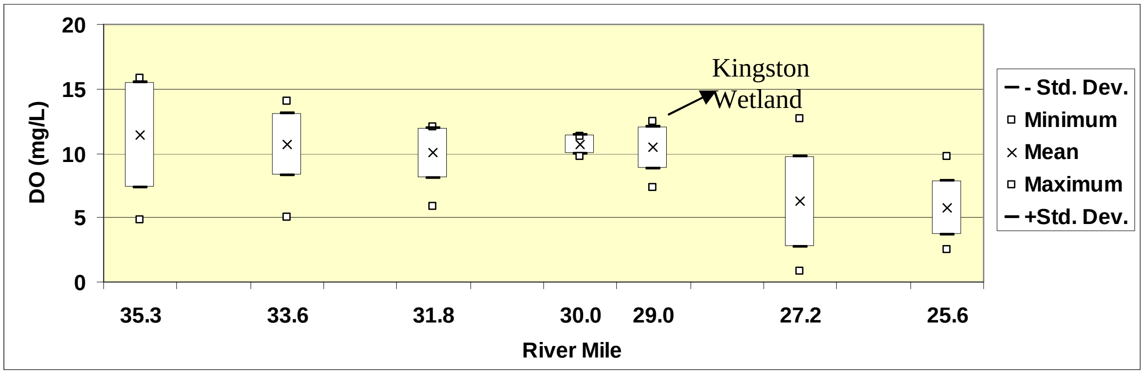
Though in-stream and lake water quality in the District has improved by an order of magnitude since the 1980's Chain of Lakes Restoration Project, water quality still does not meet state standards in several waterbodies identified on the 303(d) list of impaired waters. For example, summer average total phosphorus concentrations in Lake Louisa have decreased dramatically from 440 ug/l in 1981 to 79 ug/l in 2007, but still remain above the state standard for total phosphorus. (40 ug/l for deep lakes within the North Central Hardwood Forest ecoregion)

Current water quality for each impaired water is summarized below with respect to the impaired parameter.

2.1.1 Clearwater River – DO & Bacteria

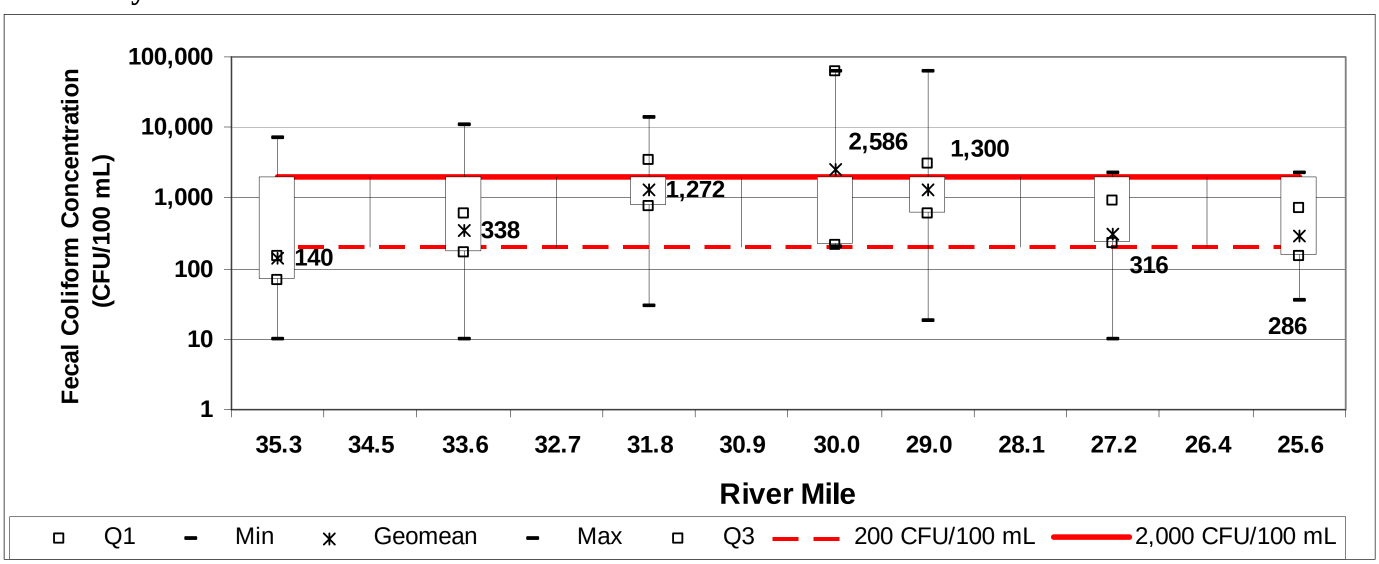
The Clearwater River is impaired for DO between Clear Lake and Lake Betsy (river mile 35.0 and 25.0). Monitoring conducted for this TMDL showed that DO concentrations in the Clearwater River sometimes fall below the state standard of 5 mg/L in the furthest downstream portion of the listed reach between river mile 29.0 and 25. 0, or Kingston Wetland and Lake Betsy. Figure 2.1 shows the longitudinal concentrations of DO in the impaired reach of the Clearwater River between Clear Lake and Lake Betsy. As you can see from Figure 2.1, the DO sag is limited to the area in and around the Kingston Wetland between river mile 29.0 and 25.0. The DO sag is caused by sediment oxygen demand in the Kingston Wetland and downstream wetland complex, coupled with flat topography, and some localized watershed impacts.

Figure 2.1 Longitudinal DO Concentrations in the Clearwater River, Clear Lake to Lake Betsy



The same reach of the Clearwater River is impaired for bacteria. Bacteria concentrations in the reach sometimes exceed the state's chronic and acute standards for bacteria. Figure 2.2 shows the longitudinal concentrations of bacteria in the impaired reach. Data shows that acute exceedances of the state standard of 2,000 CFU/ mL are generally driven by near shore sources and can be mitigated through riparian management and feedlot upgrades. Data collected was for fecal coliform. The current state standard is for *E. Coli*. Empirical relationships between fecal coliform and *E.Coli* in Minnesota suggest that reductions set for fecal coliform can be appropriately applied to meet *E. Coli* standards. Chronic exceedances will need to be dealt with in the watershed through agricultural BMPs, feedlot management, and buffering.

Figure 2.2 Longitudinal Bacteria Concentrations in the Clearwater River, Clear Lake to Lake Betsy



2.1.2 Nutrient Impaired Lakes

Current water quality data in the nutrient impaired lakes is presented as averages of the last ten years of data in Table 2.1. Historical water quality data for each lake is found in Appendix A. Addressing water quality impairments in the District's lakes will require a combination of watershed BMPs and control of in-lake nutrient cycling.

Table 2.1 Current Water Quality in 11 Nutrient Impaired Lakes (Ten Year Average)

Lake	Last Monitored	Mean TP (µg/L)	Mean Chla (µg/L)	Mean Secchi (m)
Albion	2008	210	133	0.9
Augusta	2007	48	16	1.7
Betsy	2007	265	68	0.9
Caroline	2008	60	32	1.5
Clear	2008	206	79	0.7
Henshaw	2008	265	139	0.6
Louisa	2007	66	48	1.0
Marie	2008	77	51	1.4
Scott	2008	161	75	0.8
Swartout	2008	322	324	0.6
Union	2008	50	18	1.8

T:\0002\127\Implementation Plan\[Lake Data.xls]Lake Data_10 yr avg

2.2 MEETING STATE STANDARDS

2.2.1 DO

This Clearwater River reach is classified as a Class 2B, 3C, 4A, 4B, 5 and 6 water and is protected for aquatic life (warm and cool water fisheries and associated biota) and recreation (all water recreation activities including bathing). The Minnesota standard for class 2B waters is as follows:

Minn. R. ch. 7050.0222 subp. 4: Dissolved oxygen concentrations of 5.0 mg/L as a daily minimum. This dissolved oxygen standard may be modified on a site-specific basis according to part 7050.0220, subpart 7, except that no site-specific standard shall be less than 5 mg/L as a daily average and 4 mg/L as a daily minimum. Compliance with this standard is required for 50 percent of the days at which the flow of the receiving water is equal to the $7Q_{10}$.

The 7Q10 for the downstream end of the listed reach, CR 25.0, is about 0.4 cfs. At this low flow rate, there is no flow in most of the channel, and backwater conditions are generally experienced in the downstream end of the channel (where the DO violations occur) due to the topography and elevation of the downstream lake, Lake Betsy. Further, at 7Q10 conditions, flows to the channel are limited to ground-water inflow. At 7Q10, non-point source loading is zero; therefore no achievable load reductions could be assigned under these conditions.

From monitoring data, the critical condition was determined to be during late summer with high temperatures and low flows; between 0 and 10 cfs at the downstream end of the channel. Further, the critical condition and therefore the DO TMDL is set only for the portion of the channel over which the impairment was observed; between the outlet of Kingston Wetland and Lake Betsy Inlet.

2.2.2 Bacteria

This Clearwater River reach is classified as a Class 2B, 3C, 4a, 4B, 5 and 6 water and is protected for aquatic life (warm and cool water fisheries and associated biota) and recreation (all water recreation activities including bathing). The Minnesota standard for class 2B waters is as follows:

Minn. R. ch. 7050.0222 subp. 4, *E. Coli* water quality standard for class 2B and 2C waters states that *E. coli* shall not exceed 126 organisms per 100 milliliters as a geometric mean of not less than five samples in any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 1,260 organisms per 100 milliliters. The standard applies between April 1 and October 31.

Endpoint *E. coli* concentrations were determined to be the State water quality standard of a monthly geometric mean of less than 126 cfu/ 100 ml and no value exceeding 1,260 cfu/ 100 ml for the period of April 1 through October 31. However, the focus of this TMDL is on the "chronic" standard of 126 cfu/ 100 ml. It is believed that achieving the necessary reductions to meet the chronic standard will also reduce the exceedances of the acute standard (MPCA 2002).

This standard, current as of 2008, represents a change from the historic use of fecal coliform as a regulated pathogen indicator. Because the change is recent, the in-stream water quality data available for this TMDL study was fecal coliform, not *E. Coli*. The fecal coliform data was used to link watershed sources of bacteria to in-stream bacteria concentrations and to determine effective load reduction strategies. The *E. Coli* standard was determined to be as protective as the fecal coliform standard, and load reductions that are applicable to fecal coliform will result in similar load reductions to E. Coli bacteria (MPCA 2007).

For reference, the historical fecal coliform standards were as follows: that Fecal Coliform shall not exceed 200 organisms per 100 milliliters as a geometric mean of not less than five samples in any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 2,000 organisms per 100 milliliters. The standard applies between April 1 and October 31.

2.2.3 Nutrients

Minnesota's standards for nutrients limit the quantity of nutrients which may enter waters. Minnesota's standards at the time of listing (Minnesota Rules 7050.0150(3)) stated that in all Class 2 waters of the State (i.e., "…waters…which do or may support fish, other aquatic life, bathing, boating, or other recreational purposes…") "…there shall be no material increase in undesirable slime growths or aquatic plants including algae…" In accordance with Minnesota

Rules 7050.0150(5), to evaluate whether a water body is in an impaired condition the MPCA developed “numeric translators” for the narrative standard for purposes of determining which lakes should be included in the section 303(d) list as being impaired for nutrients. The numeric translators established numeric thresholds for phosphorus, chlorophyll-a, and clarity as measured by Secchi depth. Table 2.2 lists the thresholds for listing lakes on the 303(d) list of impaired waters in Minnesota that were in place when these lakes were listed.

Table 2.2. Trophic status thresholds for determination of use support for lakes

305(b) Designation	Full Support			Partial support to Potential Non-Support			
303(d) Designation	Not Listed			Review	Listed		
Ecoregion	TP Range (ppb)	Chl-a (ppb)	Secchi (m)	TP Range (ppb)	TP (ppb)	Chl-a (ppb)	Secchi (m)
Northern Lakes and Forests	<30	<10	>1.6	30-35	>35	>12	<1.4
(Carlson’s TSI)	(<53)	(<53)	(<53)	(53-56)	(>56)	(>56)	(>56)
North Central Hardwood Forests	<40	<14	>1.4	40-45	>45	>18	<1.1
(Carlson’s TSI)	(<57)	(<57)	(<57)	(57-59)	(>59)	(>59)	(>59)
Western Cornbelt Plains and Northern Glaciated Plains	<70	<24	>1.0	70-90	>90	>32	<0.7
(Carlson’s TSI)	(<66)	(<61)	(<61)	(66-69)	(>69)	(>65)	(>65)

TSI= Carlson trophic state index; Chl-a= chlorophyll-a; ppb= parts per billion or µg/L; m=meters

The numeric target used to list these lakes was the numeric translator threshold phosphorus standard for Class 2B waters in the North Central Hardwood Forest ecoregion (40 µg/L) prior to adoption of new standards in 2008 (Table 2.2). Under the new standards, Clear Lake, Lake Marie, Swartout Lake, Albion Lake and Henshaw Lake are considered shallow lakes with a numeric target of 60 µg/L. Lake Betsy, Union Lake, Scott Lake, Lake Louisa, Lake Caroline and Lake Augusta would be considered deep lakes with a numeric target of 40 µg/L. Therefore, this TMDL presents load and wasteload allocations and estimated load reductions assuming an endpoint of 40 µg/L for Lake Betsy, Union Lake, Scott Lake, Lake Louisa, Lake Caroline and Lake Augusta and an endpoint of 60 µg/L for Clear Lake, Lake Marie, Swartout Lake, Albion Lake, and Henshaw Lake.

The numeric standards for chlorophyll-a and Secchi depth are 14 µg/L and 1.4 meters, respectively for deep lakes. The numeric standards for chlorophyll-a and Secchi depth are 20 µg/L and 1.0 meters, respectively for shallow lakes (Table 2.3).

Table 2.3 Numeric targets for Lakes in the North Central Hardwood Forest Ecoregion

Parameters	North Central Hardwood Forest	
	Shallow [1]	Deep
Phosphorus Concentration (µg/L)	60	40
Chlorophyll-a Concentration (µg/L)	20	14
Secchi disk transparency (m)	>1	>1.4

[1] Shallow lakes are defined as lakes with a maximum depth of 15 feet or a less, or with 80% or more of the lake area shallow enough to support emergent and submerged rooted aquatic plants (littoral zone).

2.3 ALLOCATIONS

2.3.1 DO

The DO impairment is primarily the result of SOD in the wetlands and natural channel morphometry in that section of the Clearwater River, and cannot be fully mitigated through watershed load reductions given how close the watershed loads of oxygen demand are to background concentrations. Topography in the area and some watershed impacts also contribute to the impairment.

The load allocations for dissolved oxygen are shown in Table 2.4,

Table 2.4 TMDL DO Allocation

	CBOD (lbs/day)	NBOD (lbs/day)	SOD (lbs/day)
Waste Load Allocation			
NPDES Construction	2.18	493.0	0
Other	0	0	0
Load Allocation			
Watershed Load	215.9	48,808.4	0.0
Groundwater	0.9	9,739.7	0.0
SOD	--	--	324.9
MOS- Implicit	--	--	--
RC	0.0	0.0	0.0
Total	218.9	59,041.2	324.9

T:\0002\117\DO Model\Background Data\[Eq. SOD calculation.xls]Existing Load Assim Cap

2.3.2 Bacteria

The sources of bacteria in the watershed are non-point source in nature; there are no permitted point sources within the watershed of the listed portion of the Clearwater River. Bacteria sources in the watershed tributary to the listed reach of the Clearwater River include livestock and associated land practices including feedlots and pasturing, crop farming and associated land uses including drain tiles, runoff from the City of Watkins, septic systems, pets, and natural wildlife sources.

There are no permitted sources in the watershed allowed to discharge to surface waters. Therefore, the load allocation is the portion of the loading capacity allocated to existing non-permitted sources. Proportional loads were derived by using the determined percentage contribution of each source. Wet condition proportions were applied to the High Flow and Wet flow regimes, dry condition proportions were applied to Dry and Low Flow flow regimes and the average of wet and dry condition proportions were applied to the Average flow condition. Bacteria load allocations are shown in Table 2.5.

Table 2.5 TMDL Bacteria Allocations

	Load Allocation (org/month 10^9)				
Source	**High Flow**	**Wet**	**Avg.**	**Dry**	**Low Flow**
Septic Systems (ISTS)	0	0	0	0	0
Urban Runoff	0.142	0.03	0.009	0	0
Riparian Livestock	87.74	23.33	12.01	1.45	0.014
Applied Manure	149.81	39.83	16.69	1.65	0.016
Incorporated Manure	0	0	0	0	0
Wildlife	0.02	0.006	0.004	0.001	0.000006
Total	237.9	63.2	28.7	3.11	0.03

2.3.3 Nutrients

Since there are no permitted sources in the watershed that are allowed to discharge to surface waters, non-permitted sources of nutrients to the listed watershed lakes include:

- In-lake nutrient cycling,
- Clearwater River, Upper Lakes & Wetlands which is comprised of drainage from:
    - Agricultural land uses
    - Urban land uses and
    - Residential land uses
- Local (Direct) watershed,
- Septic systems,

- Atmospheric loads and
- Ambient groundwater inflows

The Wasteload Allocation represents the WWTPs which operate using land application, cluster systems which discharge to drainfields, potential future systems that have been evaluated for the area, and the NPDES Construction Permit. All but the NPDES permits have a WLA of 0, as the MPCA and residents have rejected requests to discharge to area lakes in the past.

The Load Allocation must be divided among existing sources, save those that are not permitted under state law. Discharge from septic systems, for example, is not allowed by law and therefore the load allocation for septic systems is zero.

Simply stated, the loading capacity is the TMDL. Daily phosphorus load allocations by source for each upper watershed lake are provided in Table 2.6. Annual phosphorus load allocations are provided in Table 2.7. No reduction in atmospheric loading is targeted because this source is impossible to control on a local basis. The remaining load reductions were applied based on our understanding of the lakes, efficacy of proposed implementation strategies, as well as the model from the output.

Table 2.6 Partitioned Total Phosphorus Load Allocations Expressed as Daily Loads (lbs/day) (Upper Watershed Lakes)

Lake	Phosphours TMDL	Direct Watershed	Upstream Lakes	Septic Systems	Atmospheric + Groundwater	Internal
Clear Lake	3.4	2.3	0.0	0.0	1.0	0.1
Lake Betsy	7.9	4.2	2.0	0.0	0.6	1.0
Union Lake	1.6	0.9	0.0	0.0	0.5	0.2
Scott Lake	6.9	0.5	5.7	0.0	0.5	0.2
Lake Louisa	9.0	0.6	4.1	0.0	2.5	1.7
Lake Marie	12.5	1.3	7.9	0.0	2.4	0.6

T:\0002\117\Lake Response Modeling\Goal\[Goal LRModel (Clear-Betsy-Union-Scott-Louisa-Marie).xls]Goal Summary

Table 2.7 Partitioned Total Phosphorus Load Allocations Expressed as Annual Loads (lbs/year) (Upper Watershed Lakes)

Lake	Phosphours TMDL (lbs/yr)	Direct Watershed	Upstream Lakes	Septic Systems	Atmospheric + Groundwater	Internal
Clear Lake	1,250	857	0	0	359	21
Lake Betsy	2,868	1547	733	0	205	354
Union Lake	572	323	0	0	170	74
Scott Lake	2,535	185	2068	0	197	59
Lake Louisa	3,292	233	1499	0	895	631
Lake Marie	4,560	492	2902	0	883	236

T:\0002\117\Lake Response Modeling\Goal\[Goal LRModel (Clear-Betsy-Union-Scott-Louisa-Marie).xls]Goal Summary

Daily load allocations by source for lower watershed lakes are provided in Table 2.8. Annual load allocations are shown in Table 2.9. No reduction in atmospheric loading is targeted because this source is impossible to control on a local basis.

Table 2.8 Partitioned Total Phosphorus Load Allocations Expressed as Daily Loads (lbs/day) (Lower Watershed Lakes)

Lake	Load Allocation (lbs/day)	Direct Watershed	Upstream Lakes	Septic Systems	Atmospheric + Groundwater	Internal
Lake Caroline	10.04	0.59	6.41	0.00	2.23	0.82
Lake Augusta	11.25	0.76	6.65	0.00	1.93	1.91
Albion Lake	0.97	0.34	0.00	0.00	0.16	0.47
Henshaw Lake	0.72	0.08	0.00	0.00	0.18	0.46
Swartout Lake	2.20	0.82	0.33	0.00	0.19	0.86

T:\0002\127\models and data\Goal LRM (Marie-Caroline-Augusta).xls – TMDL Tables

Table 2.9 Partitioned Total Phosphorus Load Allocations Expressed as Annual Loads (lbs/year) (Lower Watershed Lakes)

Lake	Load Allocation (lbs/yr)	Direct Watershed	Upstream Lakes	Septic Systems	Atmospheric + Groundwater	Internal
Lake Caroline	3,668	214	2,342	0	814	298
Lake Augusta	4,109	279	2,429	0	704	697
Albion Lake	355	125	0	0	59	171
Henshaw Lake	262	30.1	0	0	64.8	167.5
Swartout Lake	804	300	120	0	70.5	314

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2.4 REQUIRED LOAD REDUCTIONS

2.4.1 DO

Percent load reductions by source are presented in Table 2.10. Modeling results indicate that load reductions of 60 percent in watershed oxygen demand and 60 percent wetland SOD would together result in DO concentrations at CR 25.6 of 9.12 mg/L. This concentration puts the stream back into equilibrium, in other words it brings downstream DO concentrations in line with concentrations observed upstream.

Table 2.10 Oxygen Demand Load Reductions by Source

Source	Oxygen Demand Load Reduction (%)
Watershed Loads	60% or greater *
Kingston Wetland Sediment Oxygen Demand	60% or greater *

* The percent load reductions are currently apportioned equally to each major source, however, if either load reduction is unachievable, the other will have to increase to mitigate.

2.4.2 Bacteria

Depending on the location along the Clearwater River, watershed bacteria load reductions required to meet the State water quality standards for bacteria range from 35 to 92 percent across the listed reach of the Clearwater River. These load reductions are based on fecal coliform bacteria data that was collected during the Clearwater River Bacteria TMDL study. The current state standard is for *E. Coli*. Empirical relationships between fecal coliform and *E.Coli* in Minnesota suggest that reductions set for fecal coliform can be appropriately applied to meet *E. Coli* standards.

2.4.3 Nutrients

In upper watershed lakes, total nutrient load reductions required to meet State water quality standards range from 26 percent to 90 percent. As shown in Table 2.11, nutrient load reductions are necessary in the direct watershed, upstream lakes, and septic systems. A significant reduction of internal nutrient loading is also necessary in Clear Lake, Lake Betsy, and Lake Marie.

Table 2.11 Nutrient Load Reduction by Lake, by Source, Upper Watershed Lakes

	Total	Direct Watershed	Upstream Lakes	Septic Systems	Atmospheric + Groundwater	Internal
Clear Lake	90%	80%	NA	100%	0%	100%
Lake Betsy	87%	84%	85%	100%	0%	95%
Union Lake	26%	36%	NA	100%	0%	0%
Scott Lake	85%	12%	87%	NA	0%	0%
Lake Louisa	57%	21%	74%	100%	0%	0%
Lake Marie	43%	54%	48%	100%	0%	30%

In lower watershed lakes, total nutrient load reductions required to meet State water quality standards range from 27 to 93 percent (Table 2.12). Swartout, Albion, and Henshaw Lakes each will require a 95 percent reduction in internal nutrient loads to meet water quality standards.

Table 2.12 Nutrient Load Reduction by Lake, by Source, Lower Watershed Lakes

Lake	Total	Direct Watershed	Upstream Lakes	Septic Systems	Atmospheric + Groundwater	Internal
Lake Caroline	35%	31%	43%	100%	0%	26%
Lake Augusta	27%	31%	33%	100%	0%	21%
Albion Lake	91%	63%	NA	100%	0%	95%
Henshaw Lake	93%	88%	NA	100%	0%	95%
Swartout Lake	90%	70%	77%	100%	0%	95%

2.4.4 Implementation Focus

The focus of the Implementation Plan is broad because the load reduction goals are significant in order to meet state standards. Load reductions will be required from urban, agricultural and lake shore land uses as well as internal nutrient loading for lakes, and wetland sediment oxygen demand (SOD).

Because the watersheds of the impaired waters overlap in many cases, the District has an opportunity to address many of the impairments at once. For example, BMPs used to address the nutrient impairment to Lake Betsy will likely improve not only water quality upstream, but downstream as well. To that end, implementation efforts will be sequenced to have the most immediate impact. In other words, watershed and internal loads to Lake Betsy and Clear Lake will be targeted first to improve water quality in these lakes thereby reducing load to all but three of the downstream lakes.

Specific focuses for each of the impairments are discussed below. Existing CRWD programs are typically aimed at phosphorus load reduction; however, since the delivery mechanisms for phosphorus, bacteria and oxygen demand to surface waters are often the same, the same programs work for all impairments. Current CRWD phosphorus reduction programs that also target oxygen demand and bacteria are described, along with the additional work that will be needed to meet state water quality standards.

Table 2.13 provides a conceptual implementation plan. Strategies are recommended based on their relative cost and effectiveness. Section 3.0 provides a more detailed discussion of implementation strategies.

Table 2.13 Conceptual Implementation Plan

Practice	TMDL	Unit Cost	Units	Note	Qty	Cost
Promote Ag BMPs (P Testing and fertilizer application)	Nutrient, DO	$75,000	ls		1	$75,000
Sedimentation Ponds/ Impoundments (weirs)	Nutrients	$100,000	ea	Use existing land options and evaluate oportuntites as they arise	5	$500,000
Replace Tile Intakes w/ Filters	Nutrient, DO, Bacteria	$500	per intake	*evaluate limestone/steel wool filter intakes to increase P removal	400	$200,000
Tile Intake Buffers	Nutrient, DO, Bacteria	$100	per intake		300	$30,000
Buffer Tributaries	Nutrient, DO, Bacteria	$350	ac		300	$105,000
Buffer Stream Banks	Nutrient, DO, Bacteria	$350	ac		200	$70,000
Address DO Impairment for Clearwater River	DO		lf	*design and construct, operation		$500,000
Tile Discharge Management	Nutrient, DO, Bacteria	$130,000	ls	* Inventory, FS, design construct	1	$130,000
Riparian Pasture/ Grazing Management Grants	Nutrient, DO, Bacteria	$10,000	ea		15	$150,000
Street Sweeping: Kimball, Southaven, Fairhaven & Watkins	Nutrient, DO, Bacteria	$40	per curb mile	* high efficiency, 55 curb miles for 15 years		$ 1,125,000
Lakeshore Septic Upgrade Grants	Nutrient	$7,500	ea	All Impaired Lakes	130	$975,000
Lake shore restoration grants (Shore land Erosion)	Nutrient	$300	ea	*grants	300	$90,000
Shallow Lakes Management Plans for Marie, Clear, Swartout, Albion & Henshaw Lakes	Nutrient	$15,000	ea		5	$75,000
Carp Control	Nutrient	$25,000	average per year per lake	*Fish trap already installed at Louisa, harvesting under way in several impaired lakes (5 lakes, 6 yrs)	30	$750,000
Curly Leaf Pondweed Control	Nutrient			*Lake association cost, some cost share		$300,000
Lake Aeration	Nutrient			2 Existing aerators re-installed		$600,000
Alum dosing of Cleawater River upstream of Kingston	Nutrient, DO					$600,000
Hypolimnetic withdrawl (Betsy)	Nutrient					$350,000
Kingston Wetland Enhancement/ Channel Re-meander Investigation	Nutrient, DO					$450,000
South Haven Stormwater Enhancement	Nutrient, DO, Bacteria					$75,000
City of Kimball Stormwater Enhancement Per 2004 Kimball Area Stormwater Management Study	Nutrient, DO, Bacteria					$500,000
City of Watkins Stormwater Enhancement per 2006 Watkins Area Stormwater Management Study	Nutrient, DO, Bacteria					$800,000
Public Outreach	Nutrient, DO, Bacteria	$10,000	per year		10	$100,000
Implementation Project Management and Administration	Nutrient, DO, Bacteria	$30,000	per year		10	$300,000
Implementation Performance Monitoring, Recommendations for Adaptive Management	Nutrient, DO, Bacteria	$25,000	per year		10	$250,000
Implementation Engineering	Nutrient, DO, Bacteria	$15,000	per year		10	$150,000
Q:\Old T Drive\0002\127\[TMDL Implementation_FINAL.xls]August 08					**TOTAL:**	**$9,250,000**

Clearwater River, Clear Lake to Lake Betsy, DO:
The implementation plan to address the DO impairment on the Clearwater River between Clear Lake and Lake Betsy relies initially on watershed BMPs. Watershed BMPs for reduction of oxygen demand will mirror those for reduction of phosphorus (P) and bacteria and are described in subsequent sections of this report.

The following options for reducing SOD to be evaluated include:

- ❖ Evaluate the habitat downstream of Kingston Wetland to assess the impact of low DO in this reach.
- ❖ Restoring Clearwater River to a meandered low flow channel that accesses floodplain storage during high flow events. Based on existing information, this is assumed to be the pre-development condition of the channel and riparian wetland. This scenario may be the best option to both reduce SOD and maintain the benefit of phosphorus reduction to downstream lakes currently afforded by the Kingston Wetland.
- ❖ Repairing and maintaining the original design of Kingston Wetland, or designing a new configuration to mimic the natural P trapping function of the wetland while avoiding the SOD, and release of soluble P.
- ❖ Dredging the existing wetland sediments to remove organic material. This strategy is not feasible due to the large size of the wetlands. Also, deeper wetlands soils may also exert oxygen demand which may leave the same problem or make it worse.
- ❖ Channel re-aeration. Opportunities are limited for this activity in this section of the river due to the naturally occurring flat topography.
- ❖ An alum dosing system upstream of Kingston may reduce nutrient load to downstream lakes and may have some additional benefit in terms of reducing SOD in the wetland over the long term by reducing productivity in the wetland by sequestering nutrients.

A feasibility study is necessary to determine which of these options would provide the best value in terms of addressing the impairments and protecting and improving habitat. Improving DO conditions should not be considered at the expense of the removal of particulate phosphorus the wetland currently provides. Further, scenarios to reduce export of soluble phosphorus from the wetland should be evaluated.

Clearwater River, Clear Lake to Lake Betsy, Bacteria:
The dominant bacteria sources to the Clearwater River are from riparian livestock and applied manure. While bacteria load reductions from all sources will be necessary, load reductions from these sources will be the most effective towards meeting water quality goals. To that end, the TMDL implementation plan for bacteria prioritizes three main strategies:

1. Riparian management, feedlot upgrades, and pasture management grants,
2. Manure application BMPs, and
3. Reduction of delivery potential from applied manure

Many of the watershed BMPs implemented for addressing the DO and nutrient impairments serve multiple purposes in addressing the bacteria impairment as well, since the delivery mechanisms for bacteria, nutrient and oxygen demand to surface waters are often the same.

Specific BMPs implemented to address the bacteria impairment include riparian management grants and the restoration of riparian areas used as pasture or feedlots. Animal feedlot upgrade incentives and pasture management plan grants may be given to landowners to prevent grazing animals from entering the Clearwater River. This program should be expanded to include a study to identify parcels for upgrade and approach land owners with incentives and education. Activities should be focused in the sub-watersheds tributary to the listed reach.

Clear Lake, Lake Betsy, Scott Lake, Union Lake, Nutrients:
Watershed load reductions are required to meet water quality goals in all of these lakes. Additionally, internal load reductions are necessary in Clear Lake and Lake Betsy, since internal loading contributes significantly to the total nutrient load in these lakes. The focus in implementation will be on a combination of watershed BMPs and in-lake reductions.

Because of the nature of this flow through lake chain system, managing water quality and loads to upper watershed lakes is critical to maintaining good water quality downstream. Initially focusing on the most upstream lakes, Betsy and Clear, provides significant benefit to the Clearwater River and downstream lakes.

Lake Louisa, Lake Marie, Lake Caroline, and Lake Augusta, Nutrients:
The focus in implementation will be on reduction of the annual phosphorus loads to the lakes from upstream waters and direct tributary watershed through structural and non-structural BMPs. Internal nutrient load reductions are also necessary to meet state standards in Lake Marie.

Swartout, Albion & Henshaw Lakes, Nutrients:
The Cedar Chain of Lakes Restoration project was started in 2007 in response to a petition by lake shore residents to address the declining water quality and severe algae blooms in Cedar Lake. The primary phosphorus source to Cedar Lake is phosphorus export from the upper watersheds routed through shallow upper watershed lakes namely Swartout, Albion and Henshaw Lakes. The primary phosphorus source to the upper watershed lakes is internal cycling of phosphorus.

To reduce the phosphorus concentrations in Cedar Lake it is necessary to reduce the nutrient load from the upper watershed, and to reduce the in-lake concentrations in the upper watershed lakes: Swartout, Albion, and Henshaw Lakes.

Several alternatives were considered, and in 2007 and 2008 several projects were implemented to reduce in lake phosphorus concentrations in Swartout, Albion, and Henshaw Lakes, thereby reducing the phosphorus load to Cedar Lake and improving lake water quality in Cedar, Swartout, Albion, and Henshaw Lakes. The original recommendation went further in terms of its load reductions to meet goals in Cedar Lake. However, the project as recommended met with significant resistance from land owners. The plan that was implemented was a portion of the original plan. Far more aggressive strategies are required to meet the load reduction goals for these lakes. In the following sections, the existing BMPs are discussed as well as additional implementation requirements to meet standards, and barriers to those proposed BMPs.

Part of the restoration project includes on-going monitoring of progress. The restoration efforts, monitoring, and results are discussed below.

BMPs implemented in 2007 included installation of rough fish migration barriers, buffers, and tile inlet replacements. In 2008, the construction of Segner Pond, a wetland treatment basin with a permeable limestone weir to remove soluble phosphorus, was completed, additional fish barriers were installed, and rough fish harvesting was conducted.

Rough fish management activities were undertaken in 2008 to help control rough fish populations in the upstream lakes. Fish barriers were installed in 2008 at two inlets to Swartout Lake and in the diversion channel upstream of Segner Pond. These fish barriers were constructed in addition to the three fish barriers that were installed during early spring 2007 on the Cedar Lake inlet upstream of Highway 55, and at the Swartout Lake and Henshaw Lake outlets. The fish barriers are intended to impede upstream migration of carp, which prevents adult carp from reaching their preferred spawning grounds in the wetlands adjacent to the lakes. This can help keep carp populations in check and also reduces carp damage to shallow upstream lakes. Carp can cause problems in shallow lakes by stirring up bottom sediments through their feeding activities. This makes the waters turbid which typically does not allow submerged aquatic vegetation to grow in the lake. The disturbance of the nutrient rich bottom sediments can also lead to an increase in internal cycling of nutrients from the bottom sediments, exacerbating the impairment of upstream lakes and therefore adding higher phosphorus loads to Cedar Lake.

In addition to the installation of fish barriers, rough fish harvesting was conducted on the upstream lakes in 2008. Approximately 57,000 lbs of carp were removed from Swartout Lake by two nettings performed by a commercial fishing operation in February 2008. An additional 4,760 lbs of rough fish were removed from the lake in December 2008. Netting was also performed on Henshaw Lake in 2008, removing 220 lbs of bullheads from the lake.

While it is difficult to completely eradicate carp from lakes, effective rough fish population management would likely result in a significant reduction in the internal loading in upstream watershed lakes, and a decrease in nutrient loading to waters downstream. A reduction in the carp population in the lakes and improved water clarity may allow aquatic vegetation to grow, which would provide more suitable habitat for waterfowl and other wildlife. In short, with these improvements, Swartout and Henshaw Lakes could start to look more like Albion Lake, another shallow lake with better water quality than Swartout and Henshaw Lakes.

When addressing impairments in shallow lakes it is also necessary to address the health of biological communities. To improve the quality of shallow lakes, it is beneficial to restore the health of biological communities in the lake, including fish, plants, and zooplankton. Ideally, shallow lake management plans incorporating water level management to promote vegetation growth, and fish community management strategies, such as lake drawdowns or the application of Rotenone to promote rough fish kills, would be implemented. However, efforts to implement these strategies have been met with resistance from landowners so the implementation strategies will be limited to rough fish barriers and harvesting, and watershed BMPs.

3.0 Implementation Plan

3.1 TMDL AND IMPLEMENTATION PLAN PROCESS

The activities and BMPs identified in this Implementation Plan are the result of:

- The development of a list of potential implementation options very early in the TMDL process. The list was developed through technical evaluation of the impairments and the watersheds by the District and input gathered through early stakeholder meetings. The list was presented to District Board, Staff, Technical Advisory Committee (TAC) and Stakeholders and refined through the course of setting the TMDLs.
- A TAC meeting and continuous, ongoing communications with the TAC representative from the MPCA, Margaret Leach.
- Several formal and informal stakeholder meetings and visits led by the Clearwater River Watershed District.
- Meetings and work sessions held by the CRWD Board of Managers, District staff and District Engineers with representatives from the TAC and Stakeholder groups in attendance.

The TAC includes representatives from the MPCA, DNR and Department of Agriculture. There was continuous communication with and input from the TAC coordinated through the MPCA and District Project Managers and District Administrator, as well as a formal meeting of the TAC in the MPCA office in Baxter. Additionally, the MPCA Project Manager representing the TAC attended most stakeholder meetings, CRWD Board meetings and workshops where the TMDL was discussed. Other members of the TAC from the DNR attended Board meetings and workshops from time to time.

Stakeholder meetings were held for lake associations, cities, townships, counties, and citizens. Representatives from all impaired waters were invited and did attend. The MPCA project manager for this TMDL was present at most stakeholder meetings. Stakeholders such as residents, representatives from lake associations, and Ducks Unlimited also attended CRWD Board meetings periodically to discuss the TMDL, receive updates, and provide input. All formal meetings were open to interested individuals and organizations and publicized. Stakeholder activities conducted to date are summarized in the Five-Lakes TMDL Report (Wenck 2009).

The stakeholder process is on-going and also involves specific calls and visits from the District Administrator to key residents, lake associations such as the Chain of Lakes Association (COLA) elected officials as well as township, city and county employees in the watersheds tributary to impaired waters.

Specific load reduction scenarios and implementation principles presented in this report were developed through CRWD Board and Staff workshops taking into account all the input gathered through the stakeholder and TAC processes as well as technical input from the District Engineers. The District Staff and Board of Managers played a significant role in selecting the final BMPs for implementation. This is critical given the Districts role as the leader in implementing the TMDL on a watershed basis.

3.2 IMPLEMENTATION PLAN PRINCIPLES

Through the discussion of policies and practices, current activities, and ongoing research, the stakeholders have come to understand the required steps towards implementation of the load reduction plan. Additionally, as our understanding of watershed load reductions improve and as land changes hands, new opportunities for load reductions will arise. These opportunities must be evaluated and implemented if they provide a reasonable benefit in terms of cost per pound of load reduction. The CRWD is maintaining a spreadsheet to track cost / benefit of projects for implementation. New projects will be compared to other proposed projects and existing projects for funding prioritization. The general principles that will guide implementation are listed below:

1. Implement Agricultural BMPs in the Watershed As Opportunities Arise

Nutrient, bacteria and oxygen demand loading to the Clearwater River and impaired lakes must be reduced significantly to meet goals. Given the dominant land use in the watershed is agricultural, some of the biggest opportunities for watershed load reductions come from agricultural areas.

2. Implement Residential, Urban and Lakeshore BMPs in the Watershed As Opportunities Arise

Nutrient, bacteria and oxygen demand loading to the Clearwater River and impaired lakes must be reduced to meet goals. The CRWD will look for opportunities to partner with each stakeholder to evaluate and include nutrient-reduction BMPs in new development, street and highway projects, and to consider opportunities such as redevelopment to add or upsize BMPs. The CRWD has a successful track record of such partnership as demonstrated by Stormwater Management Plans it developed for Kimball, Annandale and Watkins. The CRWD funded these plans, through which several opportunities for Stormwater BMPs were identified. The CRWD is continually looking for funding opportunities to implement the plans.

3. Control Internal Load in Lakes

A significant portion of the phosphorus load to most of CRWDs impaired lakes is the result of internal loading. The internal load must be addressed to successfully improve water quality. Consequently, the CRWD will work with stakeholders to cooperatively reduce internal phosphorus loading in the lake.

4. Restore Biological Integrity

The CRWD recognizes the importance of healthy biological communities in shallow lakes, shallow near shore areas of deep lakes, lake shore, streams, and riparian areas. To that end, the CRWD will work cooperatively with stakeholders to restore these biological communities of impaired lakes and these areas in full use lakes where such restorations will have a positive benefit for downstream impairments. Biological integrity, as defined by stakeholder input, includes healthy fish, plant, and zooplankton communities as well as healthy lake and riverine sediments in shallow areas of District lakes and streams.

5. Foster Stewardship

City, county and township staff and officials will be provided opportunities for education and training to better understand how their areas of responsibility relate to the protection and improvement of water quality in the CRWD.

6. Communicate with the Public

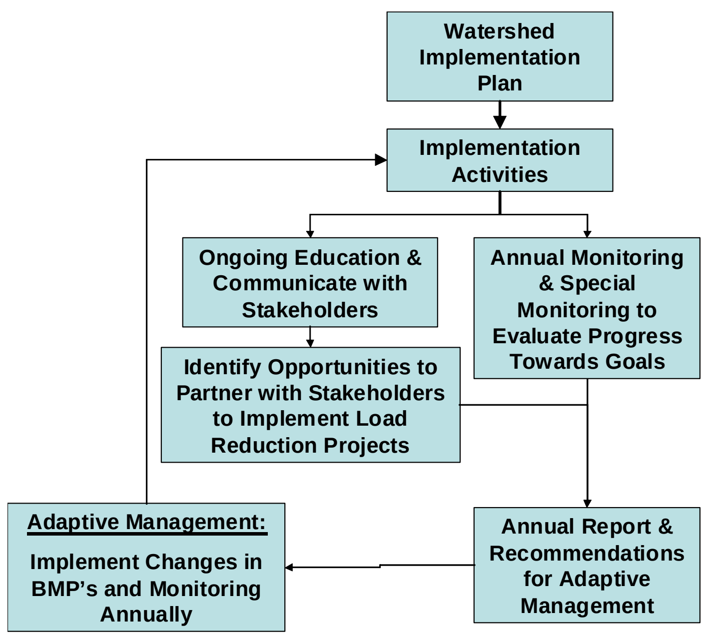
Public education should take a variety of forms, and should include both general and specialized information, targeted but not limited to:

- Urban, residential, and rural residents
- Elected and appointed officials from Cities, Counties and Townships
- Lakeshore residents and Lake Associations
- Lake users
- Property owners and managers
- Staff from Cities, Counties and Townships

3.3 IMPLEMENTATION PLAN

The CRWD will work with stakeholders to identify opportunities for partnership in implementation plan activities. The CRWD will take responsibility for ongoing coordination of projects, education and outreach, monitoring activities, and evaluation for adaptive management. This framework is illustrated in Figure 3.1 below.

Figure 3.1 Implementation Framework



3.3.1 Implementation Approach

The approach to implementation is summarized by four key elements:

TMDL Implementation on a Watershed Wide Basis: The One-Water Approach
The watersheds of the impaired waters overlap to such an extent that a watershed approach to implementation is essential, as well as cost effective. The District has selected a lynch-pin approach targeting first upper watershed lakes and tributary watersheds. This is not to say the rest of the watershed will be neglected, but early efforts to reduce loads to Clear Lake and Lake Betsy in the upper watershed will reduce loads in the Clearwater River and in downstream lakes significantly. This philosophy will guide the scheduling of BMPs for short term (0-10 years) and long-term (10-50 years) implementation.

A Sustained Implementation Effort
The significant load reduction goals needed to meet state standards require participation and buy-in from all stakeholders. As the impairments were not created overnight, the solution will not be implemented overnight, but over a longer period of time. A sustained effort requires a sustained stakeholder process.

Innovation in Watershed Management
The CRWD has long been committed to innovative management as evidenced by the many successful projects within the District including the Clearwater Chain of Lakes Restoration, and this TMDL. It is through innovations that CRWD has made the largest gains towards water quality improvement. Implementation of this TMDL calls for significant load reduction that will not be easily achieved with conventional tools available. To that end, the District is committed to continued innovation in terms of capitol projects, BMPs, and stakeholder involvement. This approach recognizes that the largest potential for progress towards water quality goals might be evolving technologies and as such, not identified specifically in this plan. This plan addresses a framework and timeline for evaluating new technologies and ranking them for implementation.

Leverage Existing Programs & Partnerships to the Maximum Practical Extent
The CRWD already implements several District programs to improve water quality, for example lake shore restorations, agricultural buffers, rain gardens, etc. The CRWD also partners with state and local governments, lake associations, and groups like Ducks Unlimited and the DNR to implement programs and projects for water resource improvements. This ongoing CRWD approach leverages existing state and local available funding and expertise to maximize water quality benefits. To achieve the significant load reductions required to meet state standards at a reasonable cost, the CRWD will continue with this approach.

3.3.2 Implementation Strategies

The overlap of the watersheds tributary to the impaired waters provides an opportunity to focus implementation efforts in key areas of the watershed to achieve the bulk of the improvements. However, load reductions in these watersheds coupled with internal load management will not achieve the load reduction goals by themselves. Because the load reductions goals for impaired lakes are large, for example 90 and 87 percent reductions in phosphorus load to Clear Lake and Lake Betsy, all feasible load reductions strategies throughout the tributary watersheds must be evaluated for implementation.

The early (0 to 5 year) emphasis of implementation for the upper watershed will be on controlling the loads to Clear Lake and Lake Betsy. Because of the nature of this flow through lake chain system, managing water quality and loads to upper watershed lakes are critical to maintaining good water quality downstream. Focusing on these upstream lakes early provides significant benefit to the Clearwater River and to all downstream lakes except Swartout, Albion and Henshaw Lakes. These lakes will be addressed separately.

An important part of the internal load strategy in shallow lakes such as Swartout, Albion and Henshaw is restoring and maintaining biological integrity and associated impacts to water quality through management of the aquatic plant community, fishery, and macroinvertebrate and zooplankton assemblages. However, biological manipulation may not provide all the internal load reduction that would be required. Preliminary feasibility work to evaluate whether chemical treatment with alum, hypolimnetic withdrawal, or other means of reducing internal loading is necessary.

The following sections discuss the general BMP strategies that were identified in the TMDL process to reduce phosphorus, bacteria and oxygen demand load, restore ecological integrity, and meet state water quality goals for these lakes; the general sequence of implementation activities; and the stakeholders who would take the lead in implementing each activity. BMP strategies are listed below and described in more detail in Sections 4 and 5 of this Plan.

<u>Watershed Load Best Management Practice (BMP) Strategies for Impaired Lakes and the Clearwater River</u>

- Implement soybean stubble buffers and other agricultural BMPs
- Implement soil testing and fertilizer spreading program in cooperation with area fertilizer supplier
- Implement septic system upgrades
- Implement feedlot upgrades and riparian management for bacteria impairment on the Clearwater River
- Add BMPs as opportunities arise to decrease runoff from the watershed and increase stormwater treatment in urban, residential and lake shore areas. This includes implementation of the Kimball and Watkins Stormwater Management Plans (Wenck 2004 and 2006)
- Implement street sweeping in Kimball and Watkins
- Encourage shoreline restoration to improve runoff filtration
- Implement capital projects as funding and land opportunities arise. Projects identified include:
    - Kingston Wetland Restoration Feasibility Study
    - Stormwater Reclamation and re-use projects (Kimball, Watkins, Annandale, Clearwater)
    - Clear Lake V-notch Weir project to provide nutrient reduction through increased storage and settling in the watershed tributary to Clear Lake ($70,000)
    - Watkins Stormwater Pond (land purchased in 2005), estimated cost of construction $300,000 to $500,000

<u>Internal Load Best Management Practice (BMP) Strategies for Impaired Lakes and the Clearwater River</u>

- Manage rough fish and Curly Leaf Pondweed populations in all watershed lakes
- Conduct pilot studies and or feasibility studies on the following internal load management capital projects with a goal to implement one or more selected projects within 5 years. Projects include:
    - Hypolimnetic withdrawal for upper watershed lakes, specifically Lake Betsy
    - Alum dosing for inflows to Lake Betsy to address loads in Lake Betsy, and downstream lakes
    - Lake aeration for District Lakes
    - Aeration of flows in and around Kingston Wetland to mitigate for dissolved oxygen impairment in Clearwater River and potentially reduce nutrient load to Lake Betsy and downstream lakes

<u>Ecological Integrity</u>

- Conduct aquatic plant, fish, zooplankton, and phytoplankton surveys for Clear Lake, Swartout Lake, Lake Albion, and Henshaw Lake.
- Prepare and implement an aquatic vegetation management plan for Clear Lake, Swartout Lake, Lake Albion, and Henshaw Lake.
- Restore a balanced fishery in Clear Lake, Swartout Lake, Lake Albion, and Henshaw Lake.
- Conduct sediment surveys and sampling in shallow areas to determine if these areas are contributing to internal nutrient loading, if increased sedimentation rates exist, and if they are damaging ecological integrity.
- Evaluate ecological integrity in Clearwater River including channel morphometry and impacts of DO impairment.

3.3.3 Sequencing

Some of the above activities may be undertaken immediately, while others would be implemented as opportunities arise. In general, implementation will proceed according to the following sequence of activities:

<u>First Five Years</u>

- Continue the CRWD's annual monitoring program
- Implement special monitoring and additional work as specified in the Five-Lakes TMDL Report (Wenck 2009). Special monitoring will include the following added studies:
    - Sediment core studies and profile sampling to further quantify and document phosphorus release and internal load. The sampling includes sampling bottom phosphorus and iron, as well as increased frequency of temperature and dissolved oxygen profiles. (CRWD has already implemented this activity.)
    - *E. Coli* will be added to stream monitoring.
    - The frequency of stream sampling upstream of Lake Betsy will be increased as this helps to better quantify total annual loads.
    - Currently District Lakes are monitored on a rotating schedule, with one event every 10 years to monitor all lakes in the District. The updated monitoring plan will monitor all lakes during the same year every three years to track progress and update lake response models to refine goals and load reductions.

- Evaluate monitoring and implementation results annually for adaptive management opportunities and evaluate opportunities for BMPs annually. Specifically, report progress towards goals in terms of number of BMPs implemented and load reductions as well as current water quality compared to standards and a recalculation of load reduction required to meet goals.
- Amend the Implementation Plan as necessary based on progress. Track cost per pound of load reduction for proposed and implemented projects to prioritize funding. Develop spreadsheet for tracking benefits and costs of projects.
- Implement an internal load reduction project in both Clear Lake and Lake Betsy.
- Implement soil tests and fertilizer spreading program in upper watershed tributary to Lake Betsy and to Swartout Lake, which will benefit all impaired lakes and the Clearwater River.
- Conduct aquatic vegetation, fish, phytoplankton, and zooplankton surveys in shallow lakes and Kingston Wetland.
- Develop and implement an aquatic vegetation management plan, including a management plan for curly leaf pondweed and rough fish which builds on the existing programs.
- Continue to fund lake shore and riparian restorations and agricultural buffers.
- Implement urban stormwater BMPs as funding and development opportunities arise.
- Implement BMP and restoration demonstration projects as opportunities arise.
- Implement capital projects as funding and land opportunities arise.
- Sediment surveys in shallow areas of lakes.

<u>Second Five Years and Subsequent Permit Cycles</u>

- Continue the CRWD's annual monitoring program.
- Implement special monitoring and additional work as specified in the Five-Lakes TMDL Report (Wenck 2009).
- Evaluate monitoring and implementation results annually for adaptive management opportunities and evaluate opportunities for BMPs annually. Specifically report progress towards goals in terms of number of BMPs implemented and load reductions as well as current water quality compared to standards and a recalculation of load reduction required to meet goals.
- Amend the Implementation Plan by reference to Annual Water Quality Monitoring Report as necessary based on progress.
- Implement urban, rural, agricultural and lake shore BMPs as opportunities arise to continue to reduce external loading.
- Work with the DNR to restore a balanced fishery and aquatic macrophytes. Continue to manage curly leaf pond weed and rough fish.

3.3.4 Stakeholder Responsibilities

The primary stakeholder in this Plan are the CRWD, the Cities of Kimball and Watkins, Stearns, Wright and Meeker counties, the DNR and the MPCA, Lake Associations and other citizens. In addition, property owners in the watershed have a critical role to play in implementing BMPs on their private properties. The CRWD stakeholder program will provide both residential and nonresidential property owners and managers with information on BMPs that would have the most impact on improving water quality.

Table 3.1 shows which stakeholders will take the lead in implementing the various activities identified in this Plan.

Table 3.1 Implementgation activity by stakeholder.

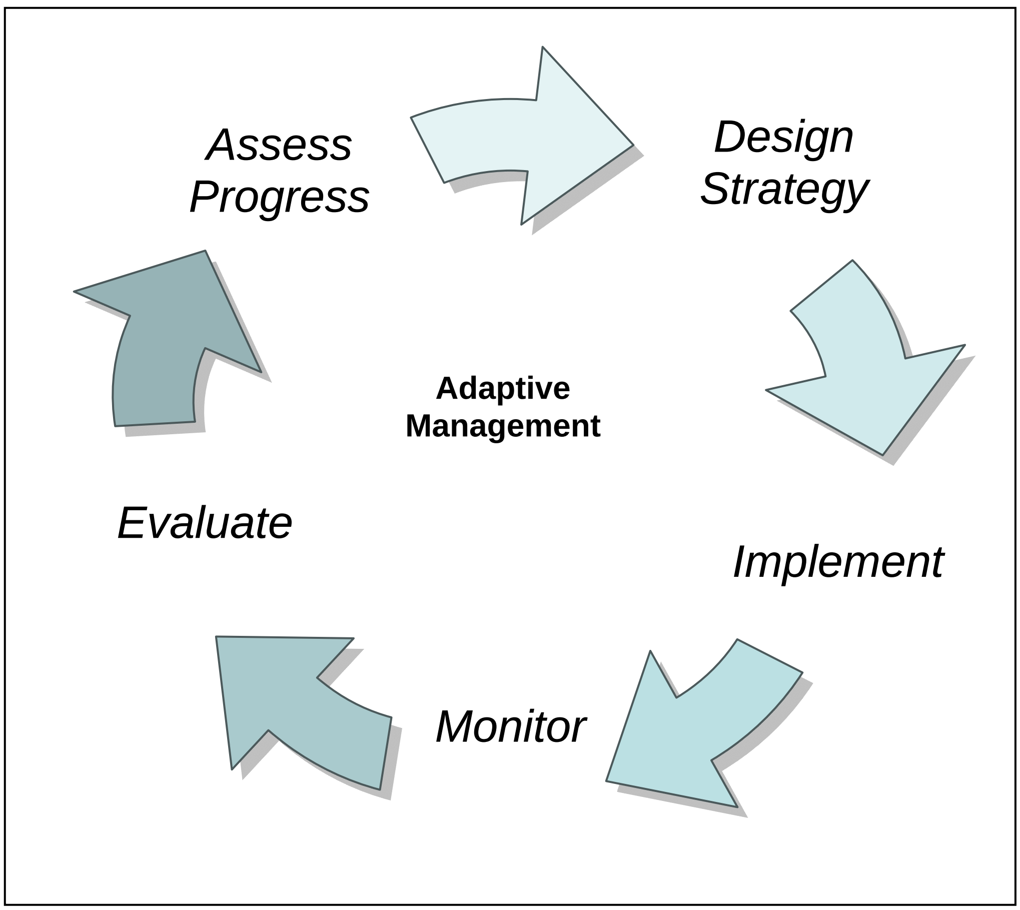
Stakeholder	Watershed Load	Internal Load	Ecological Integrity	Monitoring/ Reporting
CRWD	• Provide focused education and outreach • Solicit and fund Demonstration Projects • Prepare grant applications • Coordinate a program with the Coop to test soils and apply fertilizer • Consider partial funding, or low interest financing for septic system upgrades	• Measure internal loads • Prepare feasibility reports and make recommendations on internal load strategies • Implement internal load reduction projects and programs	• Evaluate and make recommendations for curly-leaf pondweed management and rough fish control • Identify potential shoreline and riparian restoration projects • Monitor aquatic vegetation, zooplankton, and phytoplankton every five years • Shallow lake area sediment surveys (2 studies)	• Continue annual and special water quality monitoring as recommended herein • Prepare annual report on monitoring and BMP activities and recommendations for adaptive management
Cities and Townships & Counties	• Counties to continue development permitting, soliciting review and input from the CRWD • Partner with the CRWD to implement watershed BMPs • Provide input in stakeholder process			
MPCA/ DNR/ BWSR	• Provide funding to implement TMDL BMPs as available (BWSR)	• Provide funding to implement TMDL BMPs as available (BWSR) • Review feasibility studies		
Property Owners/ Lake Associations/ Etc.	• Implement BMPs to reduce loads as opportunities arise including riparian management, feedlot upgrades, septic upgrades • Lake associations to provide education opportunities to members with support from CRWD • Provide input in stakeholder process		• Implement curly-leaf pond weed management • Implement shoreline and riparian restoration projects	

3.4 ADAPTIVE MANAGEMENT

The load allocations in the TMDL represent aggressive goals for nutrients, bacteria and oxygen demand load reduction. Consequently, implementation will be conducted using adaptive management principles. Adaptive management is an iterative approach of implementation, evaluation, and course correction (see Figure 3.2). It is appropriate here because it is difficult to predict the lake and stream responses to load reductions. Future conditions and technological advances may alter the specific course of actions detailed in this Plan. Continued lake and stream water quality monitoring and course corrections responding to monitoring results offer the best opportunity for meeting the water quality goals established in this TMDL and Implementation Plan.

Adaptive management will be tracked by leveraging the CRWD's existing monitoring program. The program has been enhanced to track progress towards goals and to quantify progress of specific BMPs. A section will be added to the end of the monitoring report that will specifically track the BMPs implemented, load reductions and progress towards goals. Potential implementation strategies will be evaluated and ranked based on the criteria developed in this report. A spreadsheet will be maintained to rank choices for funding.

Figure 3.2 Adaptive Management



4.0 Clearwater River Watershed District Activities

The CRWD has agreed to take the lead on general coordination, implementation, stakeholder involvement, and ongoing monitoring. The CRWD will also report on implementation progress, new opportunities for implementation and update the implementation plan as necessary to implement adaptive management. This information will be incorporated into the CRWD's Annual Water Quality Report. The following activities will be conducted by the CRWD.

4.1 GENERAL COORDINATION

4.1.1 Coordination

One of the primary CRWD roles in managing the watershed is serving as a coordinator of water resource policies and activities. The CRWD will continue in that role in the implementation of this TMDL. General activities now undertaken by the CRWD will be continued or expanded as the CRWD moves from management planning to implementation coordination:

- Provide advice and assistance to cities, townships, and counties on storm water management, development requirements,
- Research and disseminate information on changing BMP technology and practices;
- Collect annual implementation activity data;
- Through partnership with DNR, recommend activities such as vegetation or fishery management;
- Conduct public hearings on proposed projects; and
- Share the cost of qualifying improvement projects.

4.1.2 Annual Report on Monitoring and Activities

An annual report on phosphorus, oxygen demand and bacteria load reduction activities is necessary under the adaptive management approach established in the TMDL. Each year the CRWD will compile a listing of the activities undertaken in the previous year, quantify load reductions, review existing BMP strategies and make recommendations for new projects or practices. The annual monitoring report will summarize the BMP activities as well as annual monitoring, and track progress towards meeting water quality goals.

4.1.3 Rules and Standards

The TMDLs call for a no-net increase in nutrient, bacteria and oxygen demand in the watershed. This will be accomplished through development review. Currently the counties regulate development, relying on review and input from the CRWD. CRWD will continue to provide review and input to Counties on new development, and re-development projects and recommend stormwater management BMPs to reduce water quality impacts.

4.2 EDUCATION

4.2.1 Public Education and Outreach

As part of the TMDL process, the District Administrator has been meeting with stakeholders and the public to discuss the TMDLs and water quality improvement within the District. Given the District's significant load reduction requirements, cooperation and buy in is necessary over a long period of time to ensure implementation.

4.2.2 Encourage Public Official and Staff Education

There is a need for township, city, county and state officials and staff to understand the TMDL process and the proposed implementation activities so that they can effectively make regulatory, budget and programming decisions, and conduct daily business. Resources such as self-study lake management background information from Water on the Web ("Understanding Lake Ecology"), Project NEMO (Nonpoint Education for Municipal Officials), UW Extension ("Understanding Lake Data") and other sources provide basic information about lake ecology to help staff and officials make informed decisions about lake management. The CRWD will facilitate this.

4.2.3 Presentations at Meetings

Awareness of lake, stream, and watershed management can be raised through periodic presentations at meetings of lake associations, homeownership associations, block clubs, garden clubs, service organizations or other groups. Displays at events such as remodeling fairs and yard and garden events can also raise public awareness. "Discussion kits" including more detailed information about topics and questions and points for topic discussion could be made available to interested parties. The CRWD will budget for 6 of these events annually.

4.2.4 Demonstration Projects

Property owners may be reluctant to adopt good lake, stream and watershed management practices without examples they can evaluate and emulate. A few demonstration projects have been completed in the watershed through CRWD funding. The CRWD will encourage demonstration projects so property owners can see how a project or practice is implemented and how it looks. Examples might include native plantings, rain garden installations, restoring shorelines and agricultural BMP installations. The estimated cost of this activity is highly variable. The CRWD will evaluate appropriate activities and develop guidelines for funding demonstration projects from this budget.

4.3 ONGOING MONITORING

4.3.1 Water Quality Monitoring

The CRWD will conduct annual and specialized monitoring and track the effectiveness of activities implemented to reduce nutrient, bacteria, and oxygen demand loading in the watershed. The CRWD 2009 Annual Monitoring Plan is found in Appendix B.

In addition to the CRWD's annual monitoring plan, supplemental annual monitoring and special monitoring projects will be added to better track progress towards goals and to provide additional information and tools for adaptive management. The CRWD will also provide additional evaluation to facilitate adaptive management. These additional activities include:

- Assess special monitoring needs annually based on implementation projects, report findings in the Annual Monitoring Reports.
- Evaluate the aquatic habitat and the impacts of the DO impairment on aquatic wildlife and periodically evaluate the options for mitigating wetland SOD.
- Add E. Coli to the parameter list for stream water quality samples to assess progress towards meeting the bacteria TMDL. Consider adding two sampling stations along the impaired reach of the Clearwater River. This will require close coordination of District sampling technicians to ensure sample holding times are met.
- Install a continuous pressure transducer at the watershed outlet at the Clearwater Dam and either Fairhaven Dam or County Road 15 to measure flows and annual runoff.
- Increase sampling frequency for the station downstream of the Kingston Wetland. The site is currently sampled monthly. Increase frequency in early high flow spring conditions to weekly monitoring. Lower flow regimes can be sampled monthly with 2-4 rainfall sampling events throughout the season. Increased sampling provides better tracking of DO and bacteria concentrations and loads in the listed reach of the river and better quantification of nutrient loads to downstream impaired lakes. Both of which will allow better evaluation of progress made towards watershed goals.
- Quantify internal loads to lakes through sediment core analysis (phosphorus fractionation and oxic/anoxic release rates) and additional profile sampling. Thermocline and bottom sampling will be included. Bottom samples will be analyzed for total and soluble phosphorus as well as iron. Thermocline samples will be analyzed for total and soluble phosphorus. The frequency of temperature and DO profiles will also be increased to better characterize internal loading.
- The CRWD will also periodically (every 3-5 years) conduct a more detailed analysis of water quality, collecting bi-weekly data on lake surface, water column, and bottom conditions for all lakes in the District (currently lakes are sampled on a rotating basis with a District-wide sampling event of all lakes every 10 years.). This data will provide a more detailed picture of lake response to BMP activities and will help determine necessary "course corrections" as part of the Adaptive Management philosophy guiding this Implementation Plan.

As described above, the CRWD annually publishes a Water Quality Report that compiles and interprets monitoring data from the lakes and streams in the watershed. The monitoring data collected will be analyzed annually to determine the linkage between BMP implementation and water quality and biotic integrity in impaired waters, and to assess progress toward meeting the Total Maximum Daily Load goals. This detailed monitoring is not part of the CRWD existing Monitoring budget.

4.3.2 Other Monitoring

A baseline aquatic vegetation survey should be completed and then updated every 4-5 years as part of the more detailed water quality assessment described above. Zooplankton sampling has not been conducted recently and should be periodically completed to assess overall biologic conditions.

The CRWD will work together with the DNR to determine the optimum strategy for monitoring the fish community.

The CRWD will explore funding opportunities to research or pilot monitoring of BMP effectiveness.

The CRWD will conduct a sediment survey for shallow lakes and shallow areas of deep lakes along the shore to assess rates of sedimentation and the impact of areas of increased sedimentation on ecological integrity and internal loading.

4.4 REDUCE EXTERNAL LOAD

4.4.1 Implement Urban Stormwater Management

The CRWD funded stormwater management studies for Kimball, Watkins and Annandale within the watershed. Kimball and Watkins lie within the watersheds of the impaired waters, and therefore projects identified to control stormwater runoff from these two cities will reduce watershed loads to the impaired waters.

Street sweeping was also identified as a potential BMP for evaluation.

4.4.2 Septic Upgrades

By law, no loads from septic systems are allowed to impaired waters. To that end, septic system upgrades may be required for some homes ringing impaired lakes. The District will evaluate funding options for providing low cost loans or potentially even some matching funds to upgrade septic systems.

4.4.3 Implement Management of Agricultural Runoff

The CRWD will partner with an area supplier to fund soil testing and fertilizer management for area farmers. The soil testing will be conducted on a 2-acre grid for $10/acre and then follow up with appropriate application of fertilizer using GPS system to reduce the overall amount of fertilizer applied. Fertilizer application costs are $4/acre.

Soil sampling intervals around tile intakes would be conducted on a finer grid, and application rates within a 100-foot radius of intakes and riparian buffers would be limited. The area supplier reports that reductions in fertilizer application can be significant relative to existing practices. On average, the supplier in the area reports a 4 lb/ acre reduction in fertilizer application. This is because the current practice is to apply fertilizer at the rate needed for the least productive portion of the land, rather than to vary application rates by need.

The soil sampling and fertilizer applications would be conducted in conjunction with soy bean stubble buffers, riparian management, feedlot upgrades and other best management practices. Focusing efforts on a small area in the upper watershed can have a big impact on downstream lakes in terms of load reductions to Clear Lake and Lake Betsy and the subsequent improvements expected in remaining downstream lakes.

The District and area supplier staff estimate that based on existing information, these practices translate into a 10-50% reduction in watershed phosphorus, bacteria and oxygen demand load from these areas, which translates into a 1,812 lb reduction to Lake Betsy for example.

4.4.4 Shoreline Management and Restoration, Agricultural Buffers and Rain Gardens

Restore shoreline and riparian areas with native vegetation, lakescaping and bioengineering where opportunities present themselves. Continue to provide funds for farmers to implement riparian and tile intake buffers. Opportunities for riparian restorations are limited given that most riparian areas are currently buffered and the channels are primarily stable.

4.5 REDUCE INTERNAL LOAD

4.5.1 Internal Load Management

Several options will be considered to manage internal sources of nutrients in the District's impaired lakes. Feasibility Studies and or Pilot Studies of the following options will be completed:

Hypolimnetic withdrawal. This option would require pumping nutrient-rich water from the hypolimnion of Lake Betsy to an external location. The water will be land applied to grassed areas north of Lake Betsy. If this is implemented on other lakes, the hypolimnetic water will require ponding and chemical treatment prior to discharge.

Hypolimnetic aeration. This option uses a specialized pump to circulate water from the hypolimnion to keep it aerated and reduce the potential for anoxic conditions that lead to sediment phosphorus release. The District currently owns three of these pumps that require maintenance, but could potentially be used.

Chemical treatment. Following implementation of BMPs to reduce external nutrient load sources, it may be feasible to chemically dose inflows to Lake Betsy with alum to remove phosphorus from the water column as well as bind it in sediments.

Aeration of Kingston Wetland. The aeration of Kingston Wetland may mitigate for the oxygen demand within the wetland itself. A 60% or greater reduction in the wetland sediment oxygen demand is necessary to achieve TMDL load reduction goals for oxygen demand (greater than 60% if watershed load reductions of 60% cannot be met).

4.6 BIOLOGIC INTEGRITY MANAGEMENT

4.6.1 Aquatic Plant Management

The CRWD recognizes the importance of a healthy biological community in meeting water clarity goals, especially in shallow lakes. Aquatic plant management is a key aspect in maintaining a healthy shallow lake. To establish and maintain a healthy lake system, an aquatic plant management plan should be developed, including an action plan for treatment and management of invasive aquatic vegetation, most notably curly-leaf pondweed.

4.6.2 Fish Population Management

Partner with the DNR to monitor and manage the fish population to maintain a beneficial community.

4.6.3 Sediment Accumulation

Pending the outcome of sediment surveys and studies, CRWD will draft a plan to address areas of high sediment accumulation as they impact ecological integrity and internal nutrient loads.

5.0 Stakeholder Activities

The CRWD will lead and coordinate implementation of the CRWD watershed wide TMDLs. The primary expectation of stakeholders will be to act as project cooperators. Specifically, the District expects stakeholders to communicate actively. The District will disseminate information about current events, citizen concerns, potential problems, and opportunities to partner for improved water quality. This active communication provides the District with important information about opportunities to improve water quality within the District. A list of expected activities by stakeholder is provided below.

Board of Water and Soil Resources (BWSR): Review grant applications, provide comments, feedback and funding for TMDL implementation. A 50% funding match will be required to implement the full range of TMDLs.

Minnesota DNR: Review grant applications, provide comments, feedback and necessary permits for TMDL implementation projects. Work may include attending CRWD meetings, and providing technical support and possibly funding support for implementation projects. Specific assistance in surveying and managing aquatic habitat is expected.

Minnesota Pollution Control Agency: The MPCA's role in TMDL implementation may entail reviewing grant applications and providing some funding for eligible implementation projects. Some implementation projects, specifically capital projects, may require permit reviews. It is hoped that the project manager will remain in contact with and continue to support the CRWD in its TMDL efforts.

Counties, Cities and Townships:

- Counties: Meeker, Stearns and Wright Counties will be expected to continue to allow the CRWD to review and comment on development projects. The recommendation of the TMDLs is no net increase in watershed export, and reductions will be necessary. The District expects to partner with the Counties early on in the process of development review to provide insight into reducing the impact of land development and redevelopment on water quality.
- Cities: Kimball and Watkins will be expected to partner with the CRWD to implement the projects in each city's stormwater management plan.
- Townships: Elected township officials and staff can play an important role in water quality improvement through ongoing communication with the District. This communication provides the District with information about current events in the township, as well as citizen concerns, potential problems, and opportunities to partner for improved water quality.

Lake Associations: Lake Associations such as Chain of Lakes Association (COLA) or the Clear Lake Association are expected to disseminate information to their members about septic system upgrades, shore land restorations, and turf management for lake water quality. Representatives of each lake association will be contacted 2-4 times annually by District staff, to ascertain their needs and level of interest. Periodically the District will coordinate their annual meeting around the activities of one specific lake. During these events, District staff and engineers present material on the lake of interest and provide information to residents about the role they can play in improving water quality. The District counts on these lake associations to notify their members to attend. The District encourages this continued cooperation.

Ducks Unlimited: While Ducks Unlimited is not specifically affiliated with the Clearwater River Watershed District, we have attempted to partner with them to improve water quality and wildlife habitat in the past. Past attempts at shallow lakes management have been unsuccessful due to the objection of residents. The CRWD will continue to look for opportunities to partner with Ducks Unlimited to improve water quality. These projects will likely be geared towards management of wetlands to improve downstream water quality or shallow lakes.

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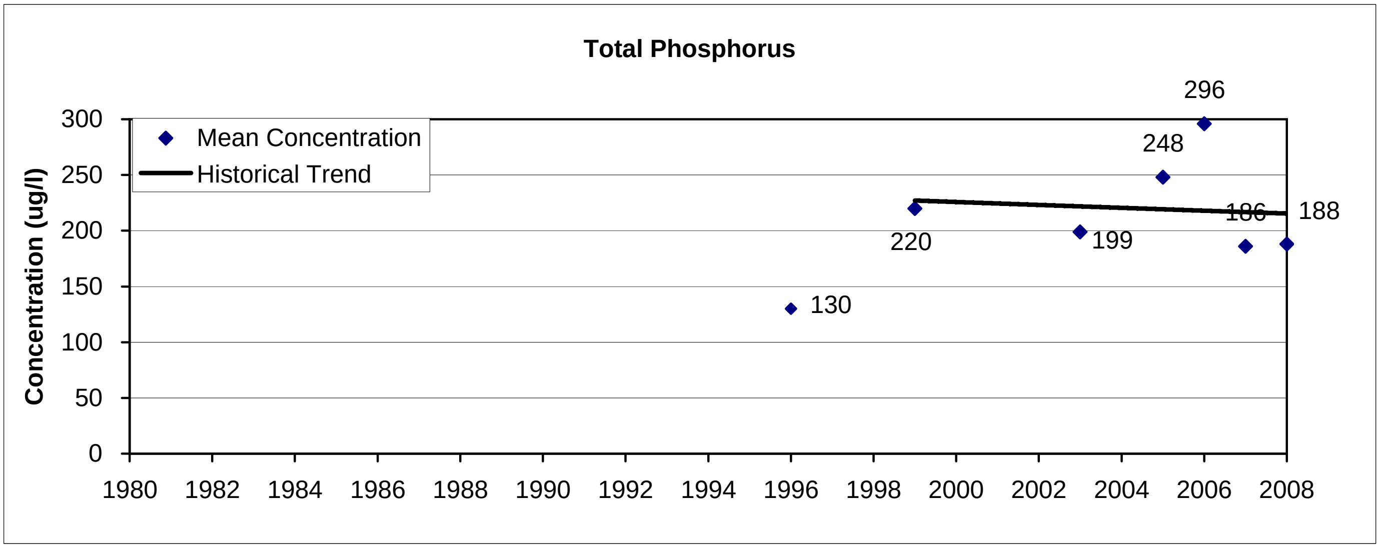
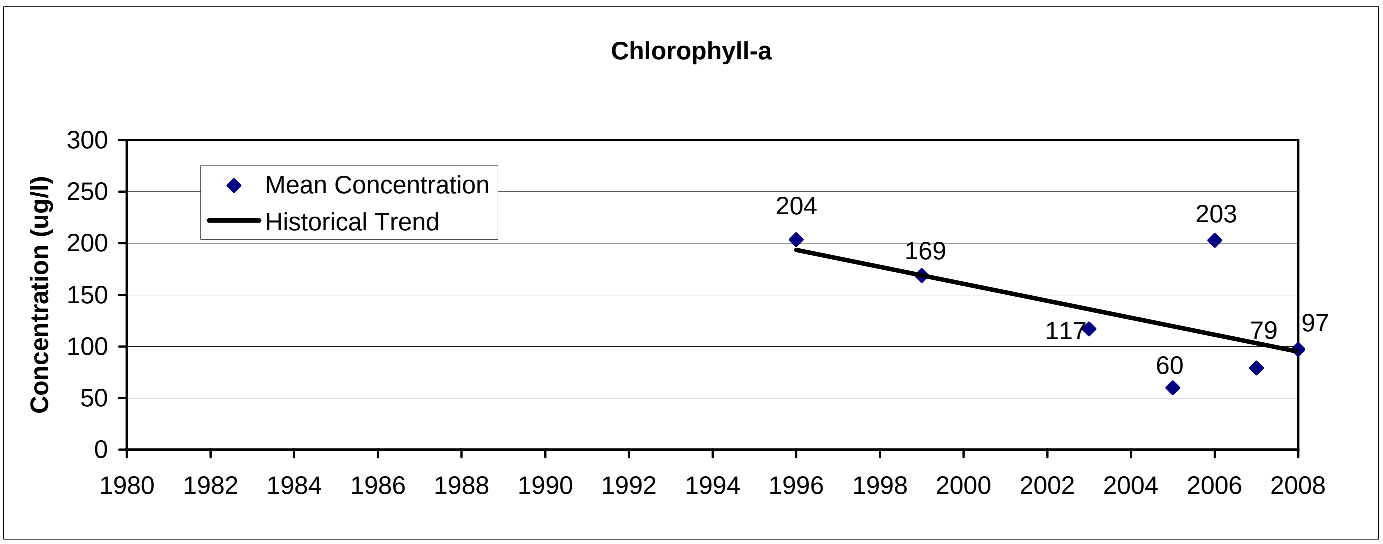
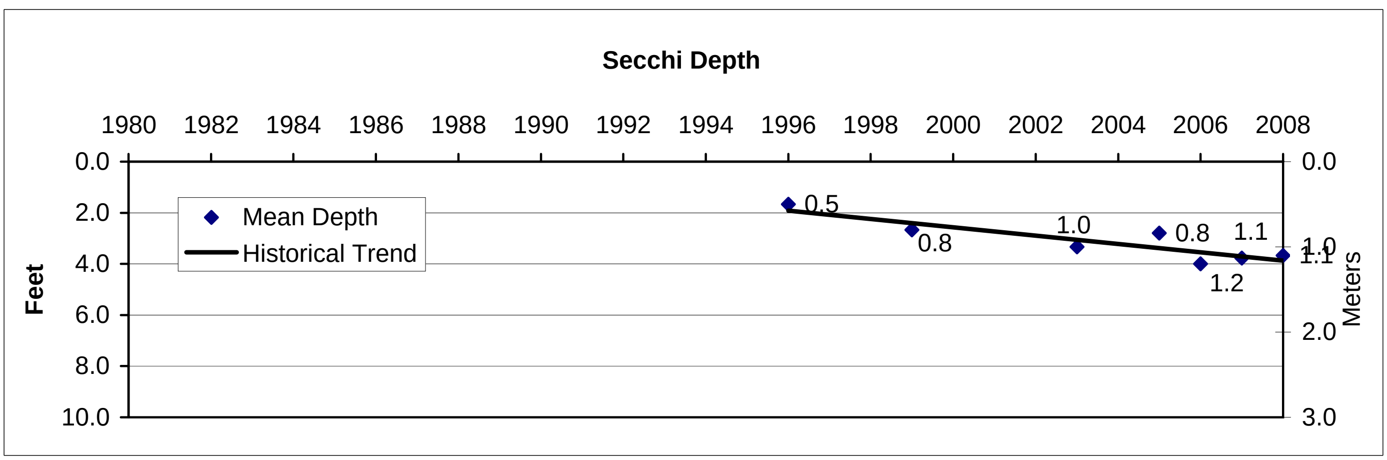
Wenck Associates, Inc. (2009) "Clearwater River Clear Lake to Lake Betsy Bacteria TMDL" Prepared by Wenck on Behalf of the Clearwater River Watershed District for the MPCA

Wenck Associates, Inc. (2009) "Clearwater River Five-Lakes Nutrient TMDL" Prepared by Wenck on Behalf of the Clearwater River Watershed District for the MPCA

Appendix A-Historic Lake Water Quality Data Summaries







Clearwater River Watershed District

Lake Albion Historical Data

Wenck

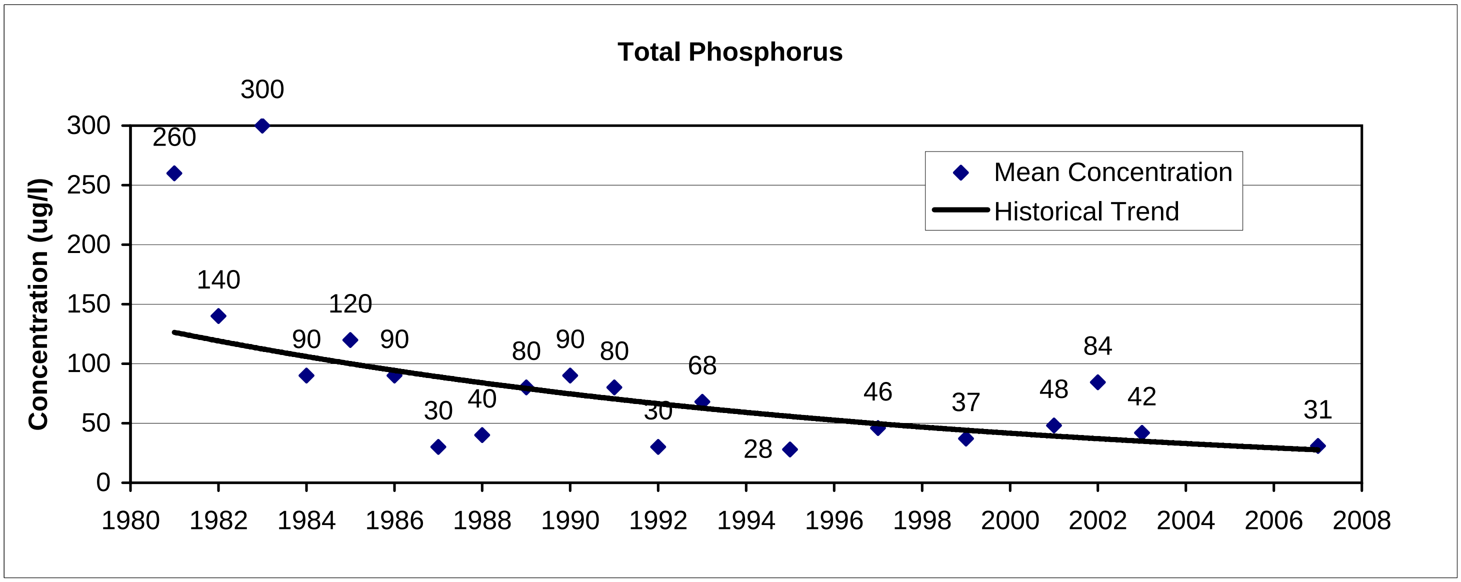
Wenck Associates, Inc.
Environmental Engineers

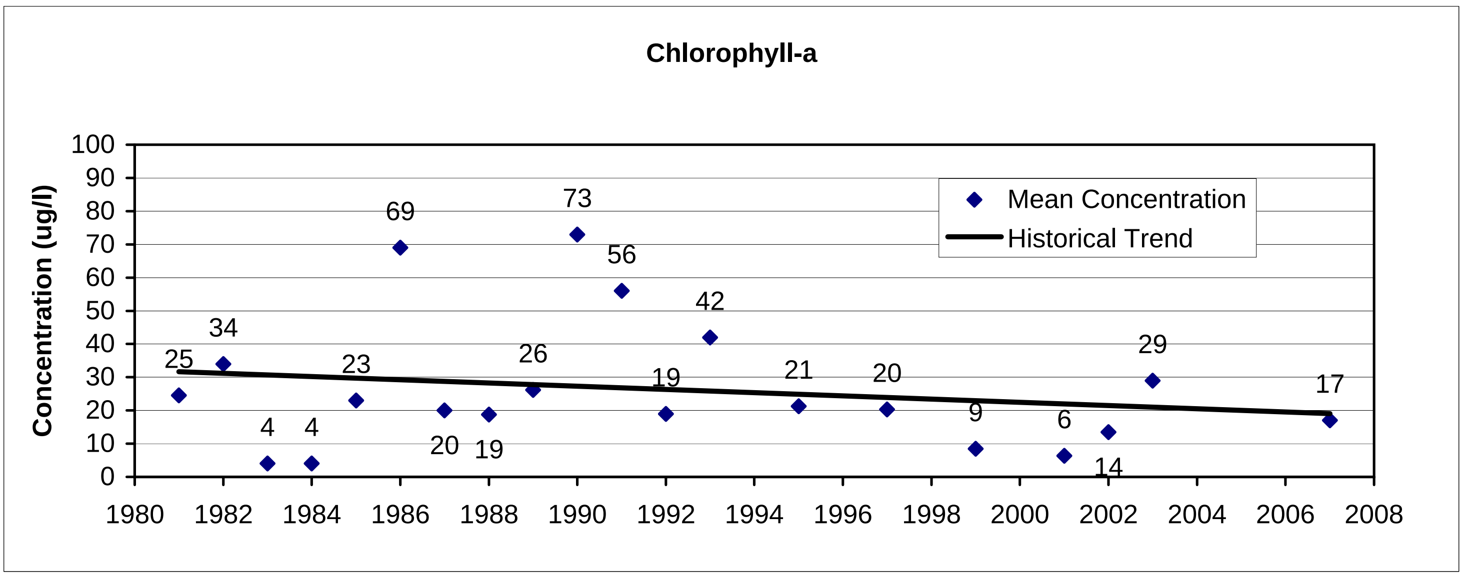
1800 Pioneer Creek Center
Maple Plain, MN 55359

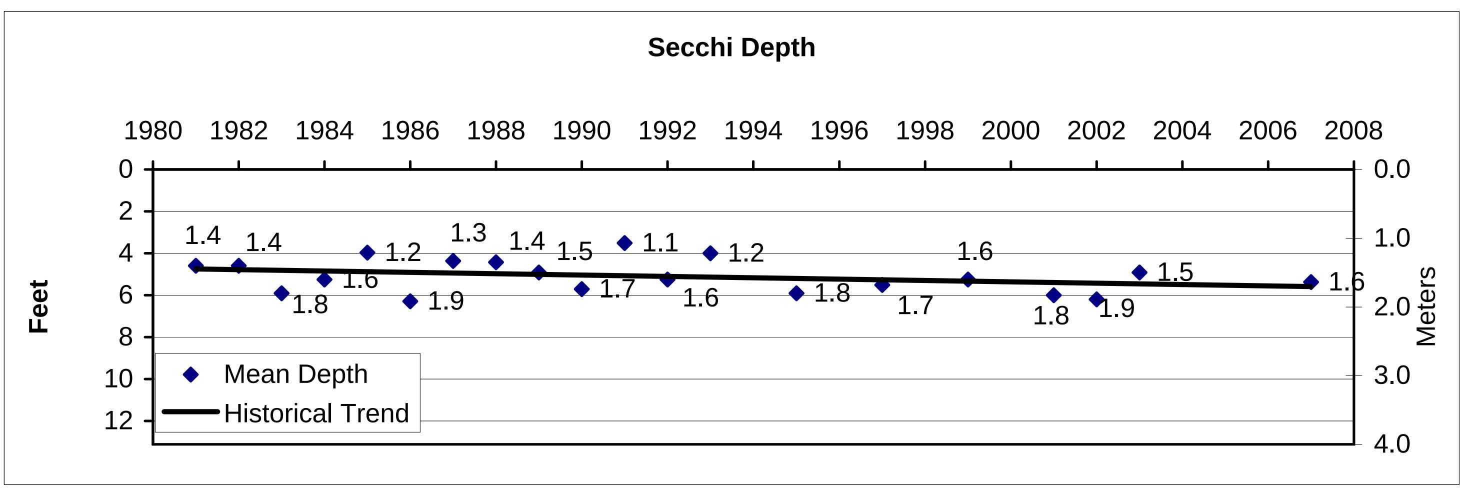
Apr 2009

Appendix A

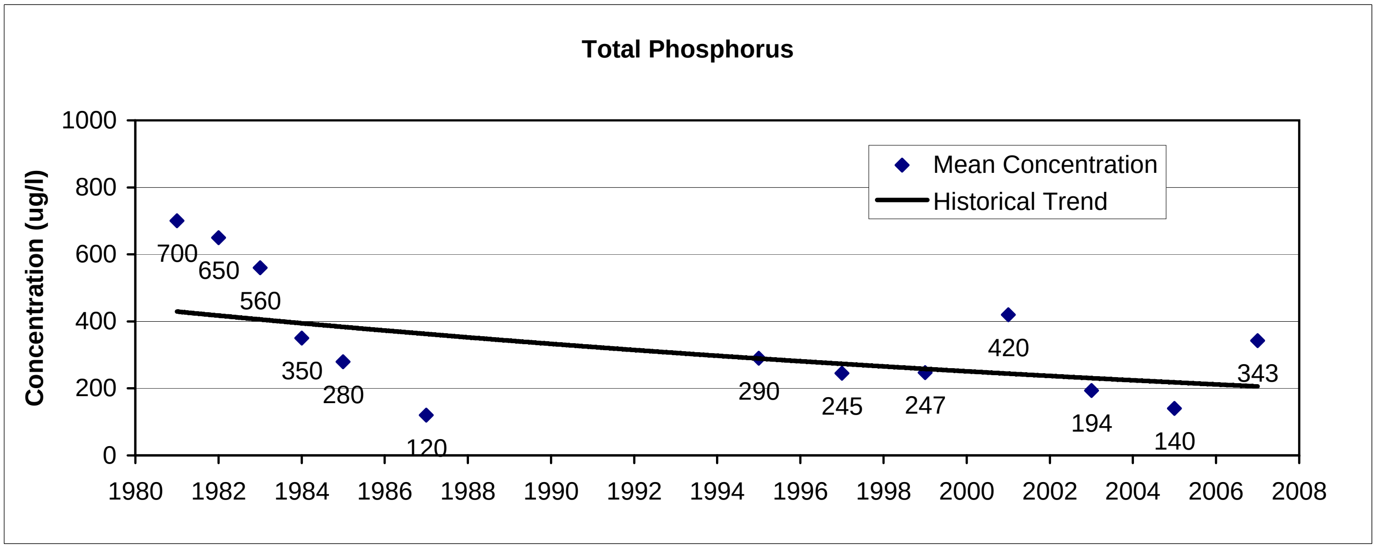
T:\0002\115\LAKE_WQ_08Lake Albion

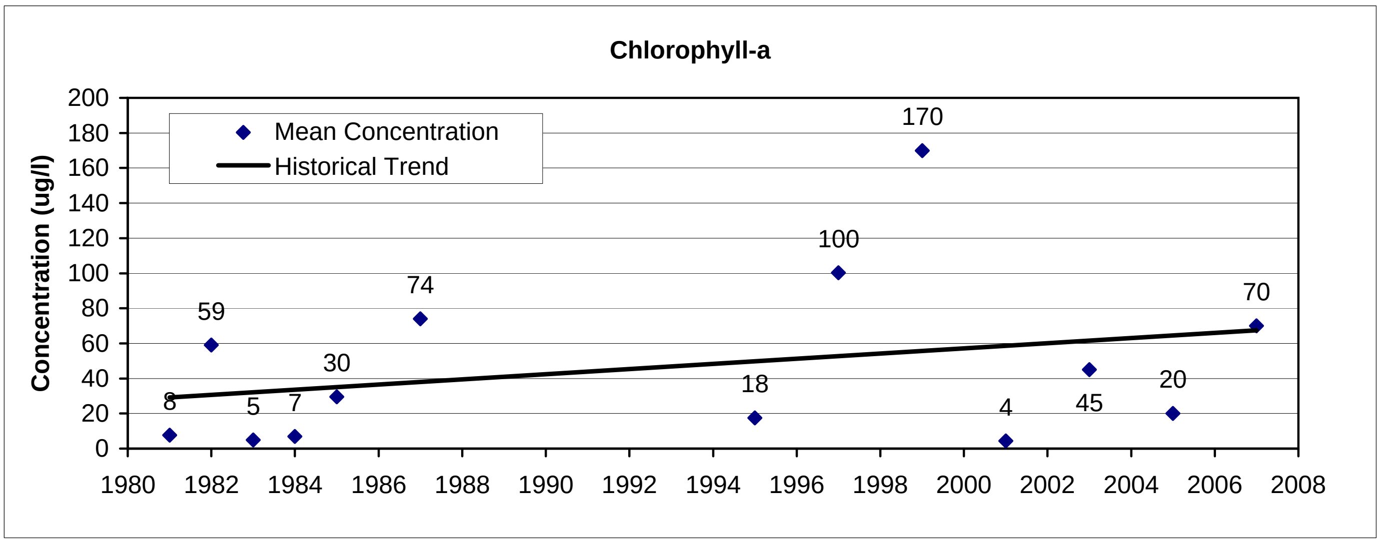


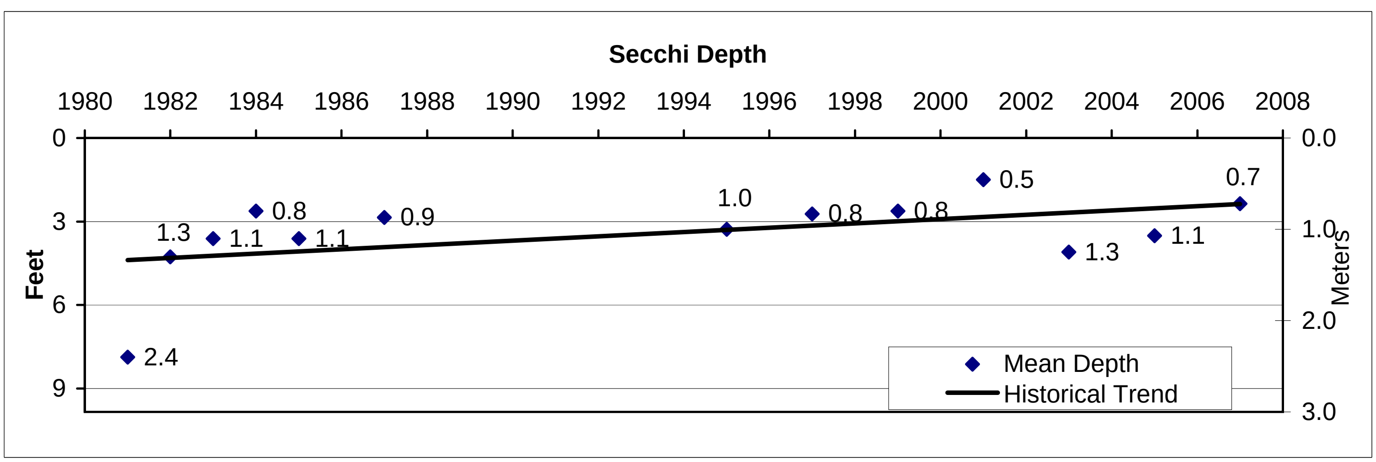




Clearwater River Watershed District	Wenck Wenck Associates, Inc. Environmental Engineers 1800 Pioneer Creek Center Maple Plain, MN 55359	Apr 2009
Lake Augusta Historical Data		Appendix A

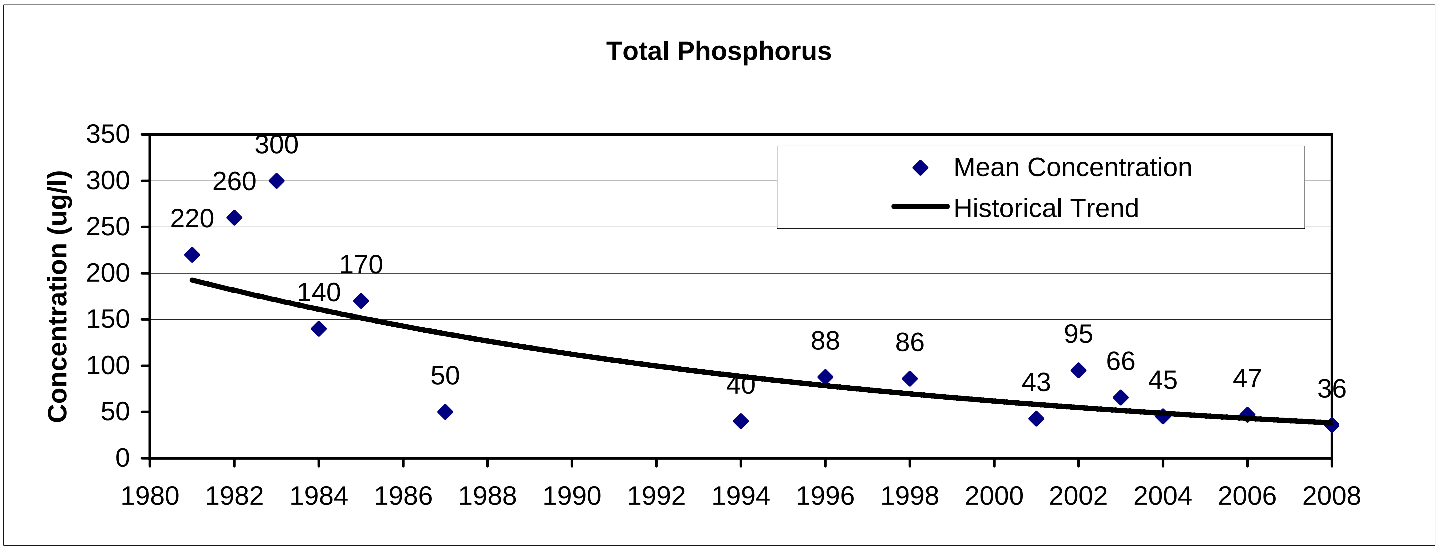


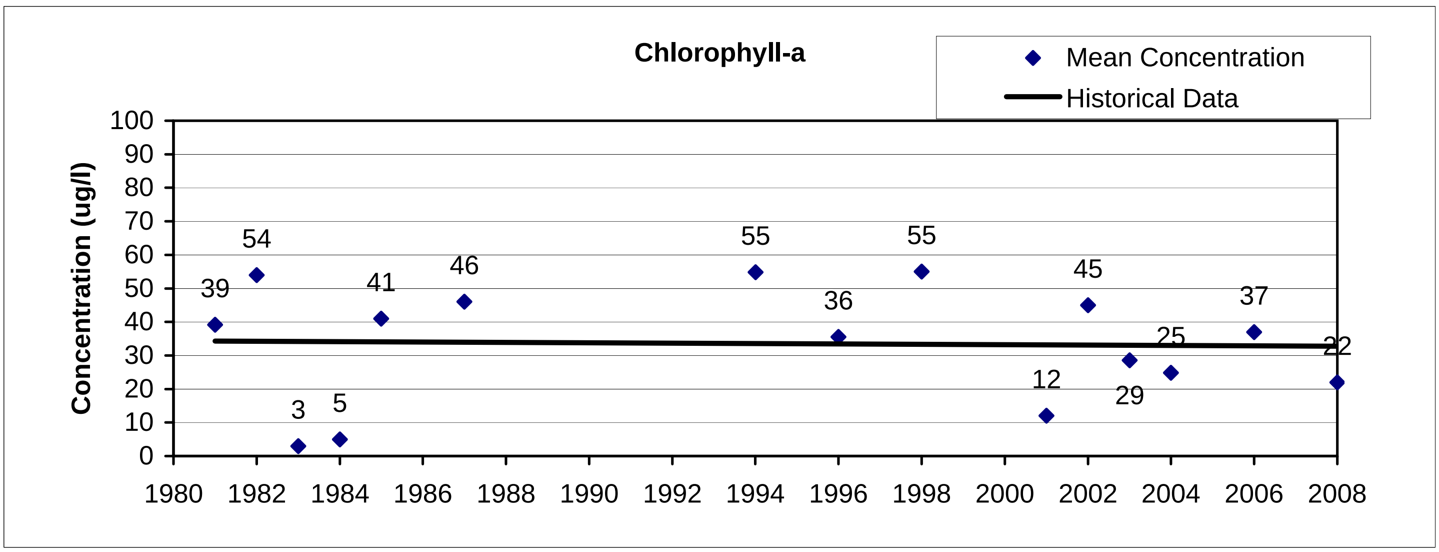


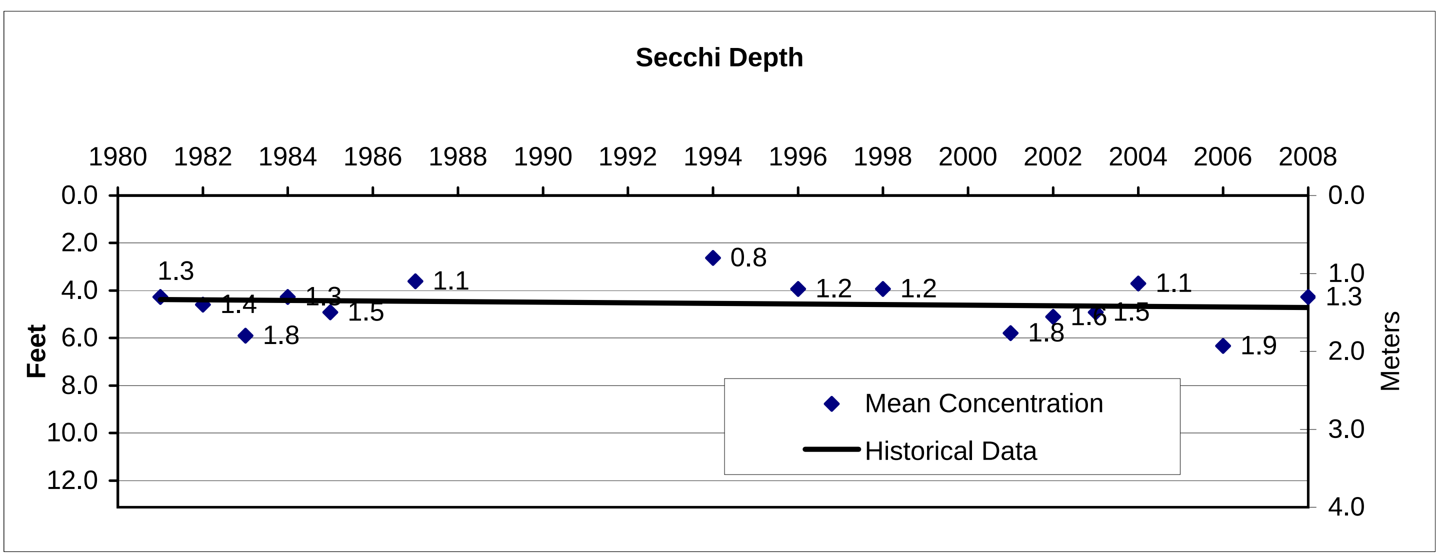


Clearwater River Watershed District	Wenck Associates, Inc. Environmental Engineers 1800 Pioneer Creek Center Maple Plain, MN 55359	Apr 2009
Lake Betsy Historical Data		Appendix A

T:\0002\115\LAKE_WQ_08Lake Betsy

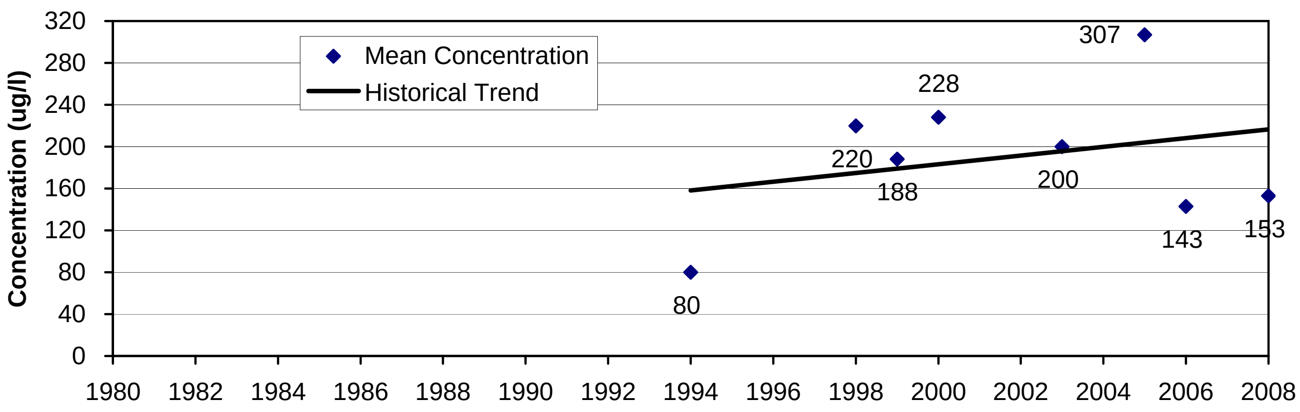




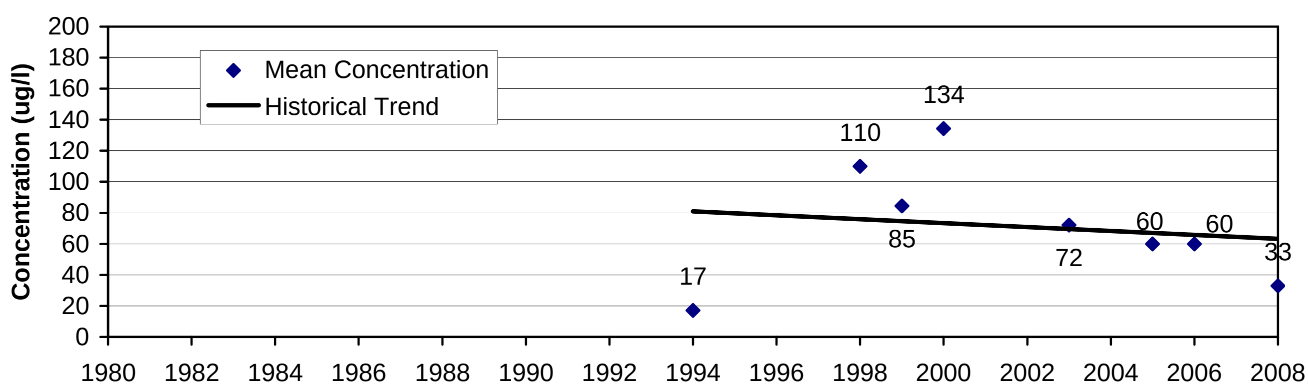


Clearwater River Watershed District	Wenck Wenck Associates, Inc. Environmental Engineers 1800 Pioneer Creek Center Maple Plain, MN 55359	Apr 2009
Lake Caroline Historical Data		Appendix A

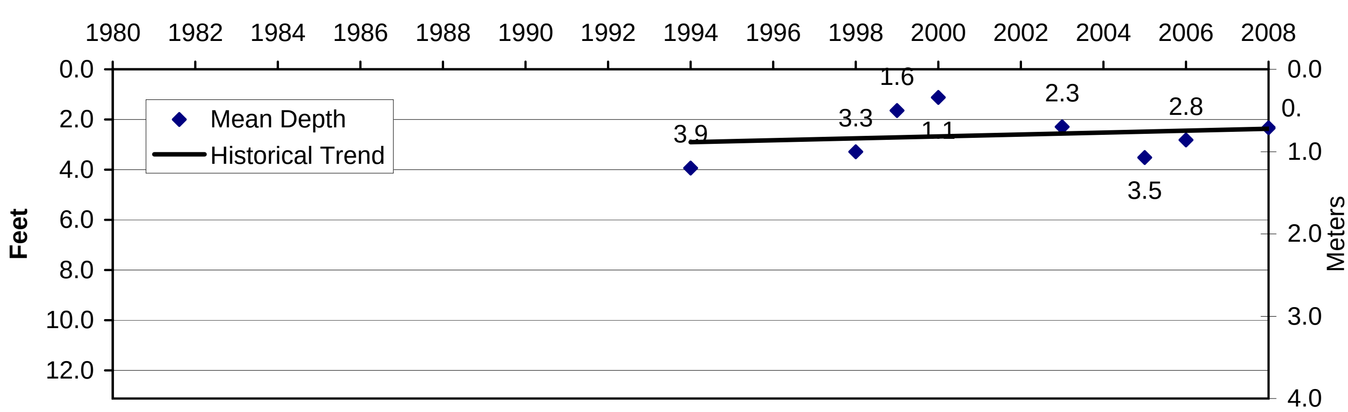
Total Phosphorus



Chlorophyll-a

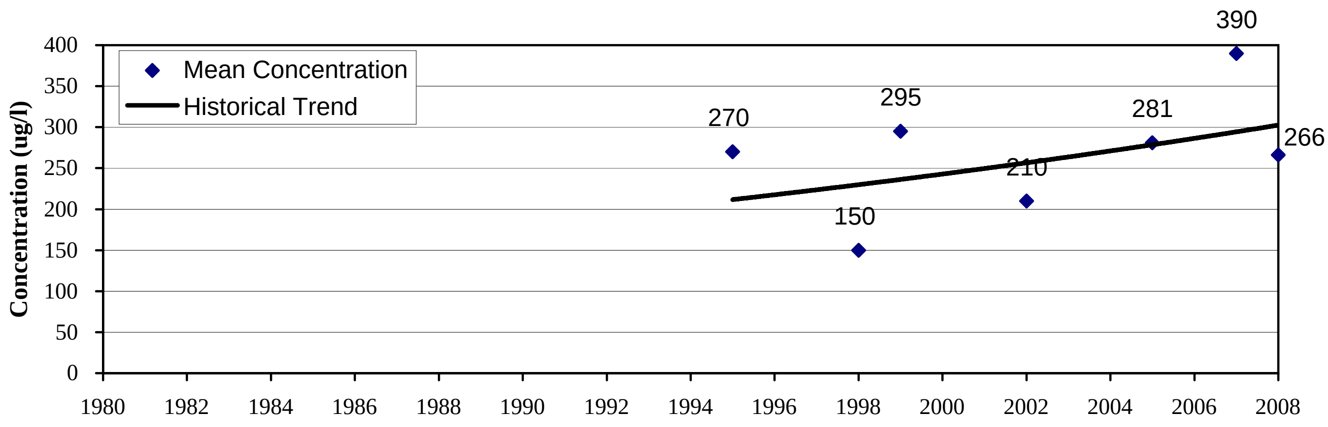


Secchi Depth

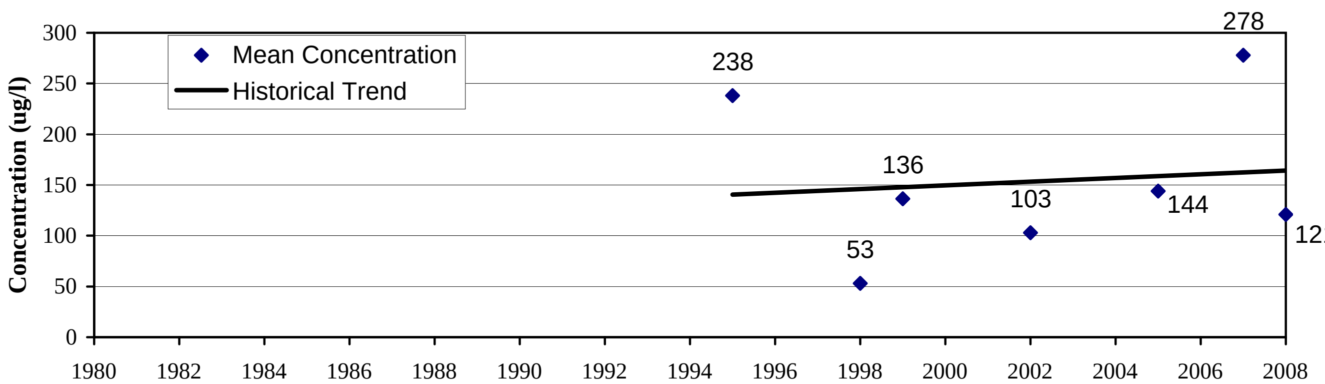


Clearwater River Watershed District	Wenck Wenck Associates, Inc. Environmental Engineers 1800 Pioneer Creek Center Maple Plain, MN 55359	Apr 2009
Clear Lake Historical Data		Appendix A

Total Phosphorus



Chlorophyll-*a*



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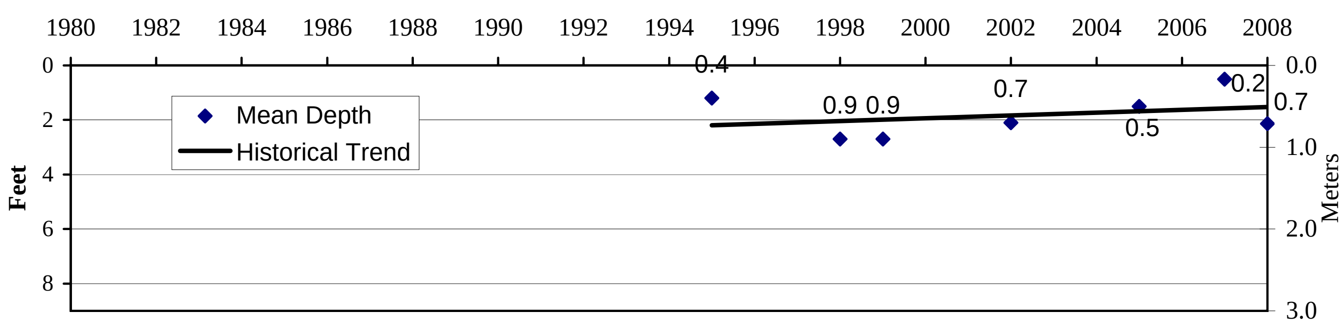
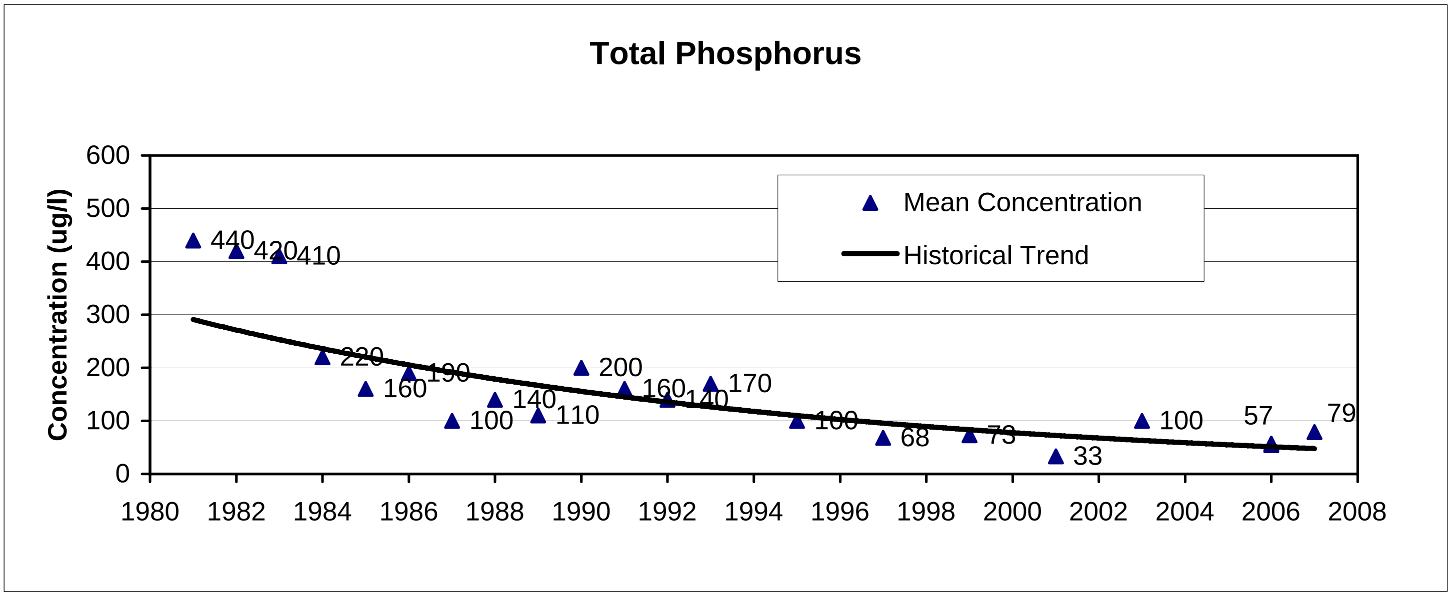
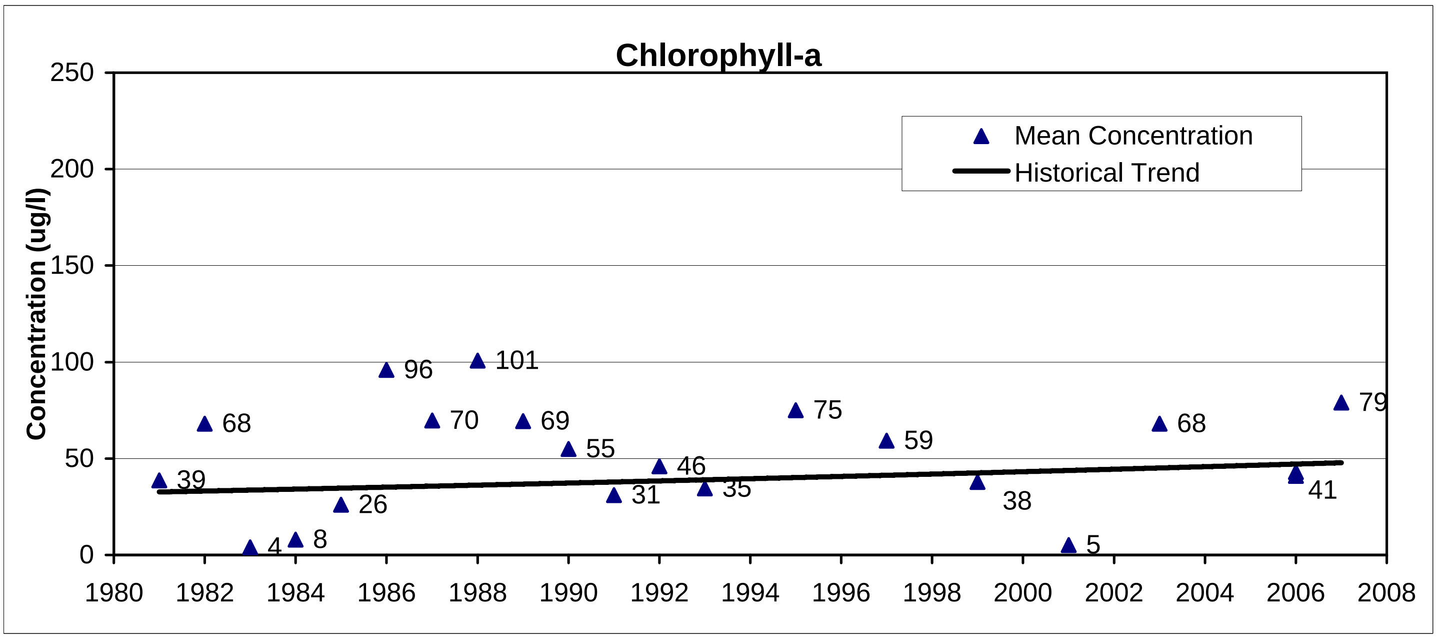
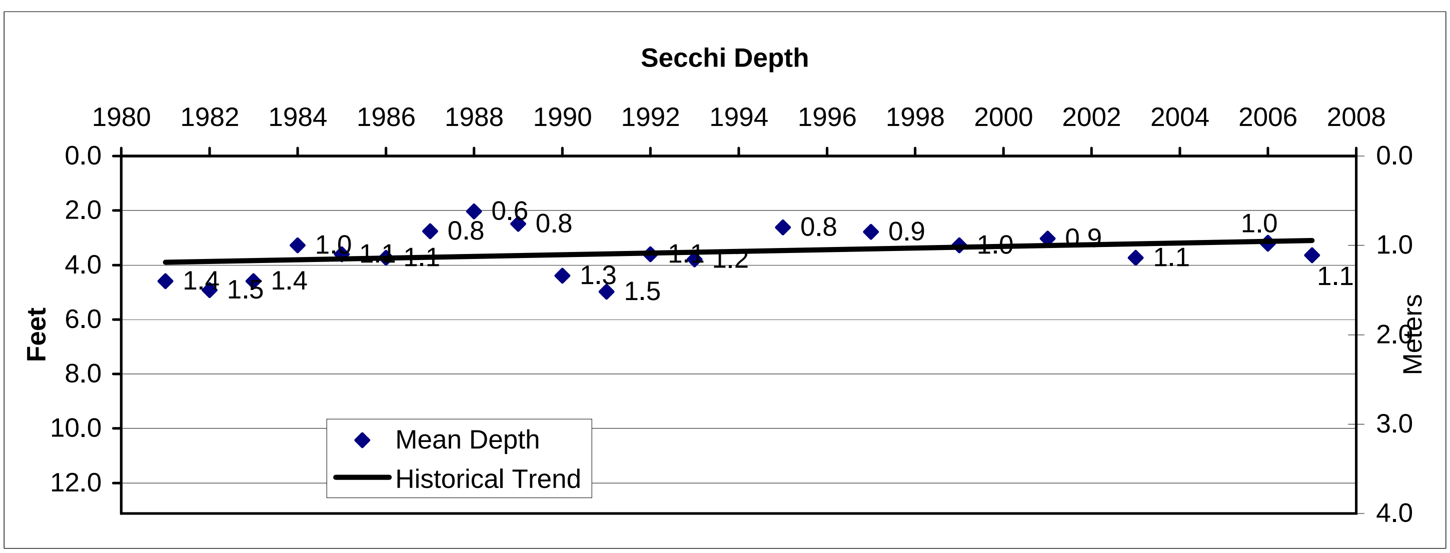


Clearwater River Watershed District	Wenck Associates, Inc. Environmental Engineers 1800 Pioneer Creek Center Maple Plain, MN 55359	Apr 2009
Henshaw Lake Historical Data		Appendix A







Clearwater River Watershed District	Wenck Associates, Inc. Environmental Engineers — 1800 Pioneer Creek Center, Maple Plain, MN 55359	Apr 2009
Lake Louisa Historical Data		Appendix A

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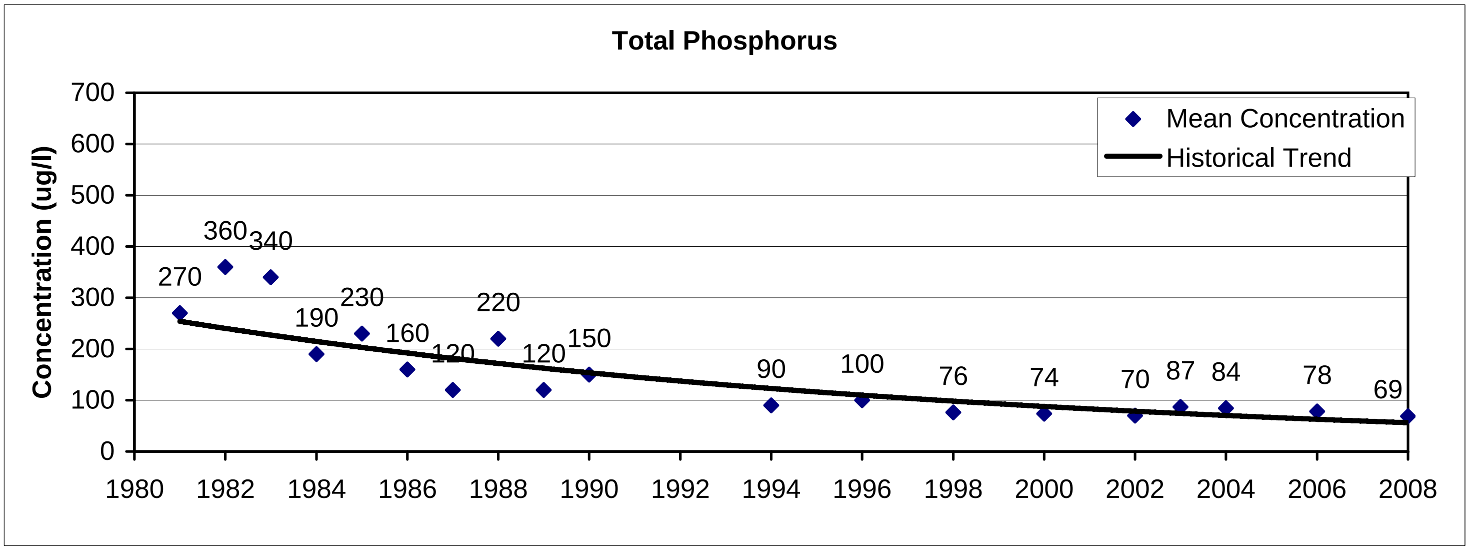

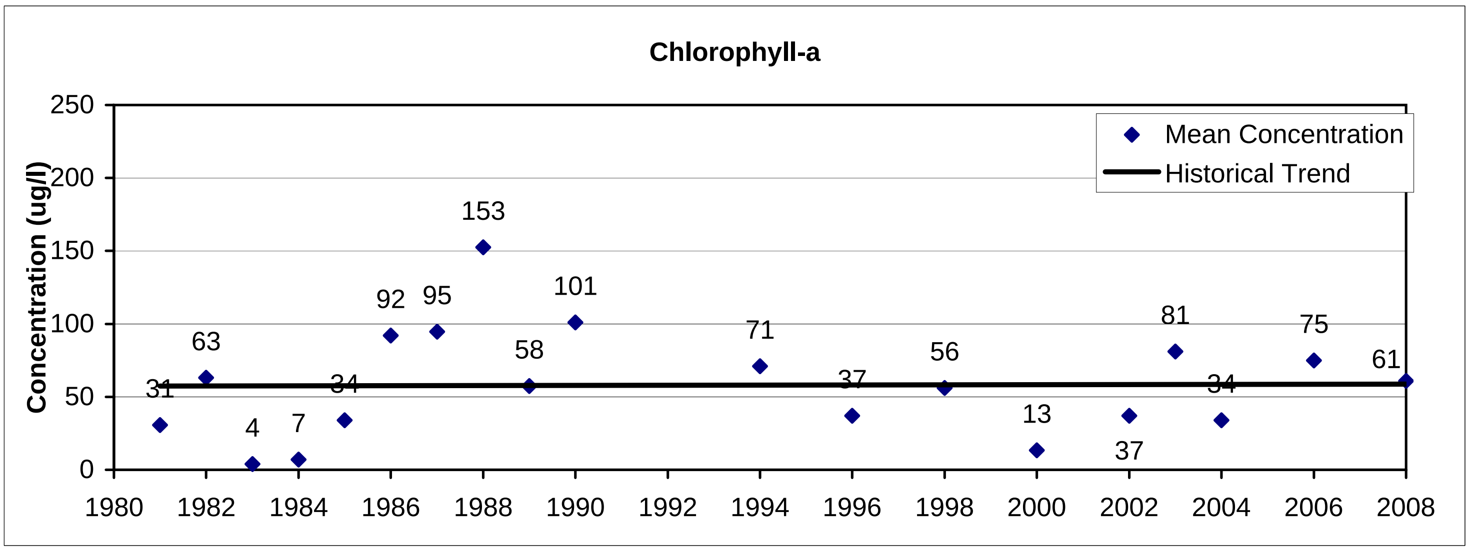

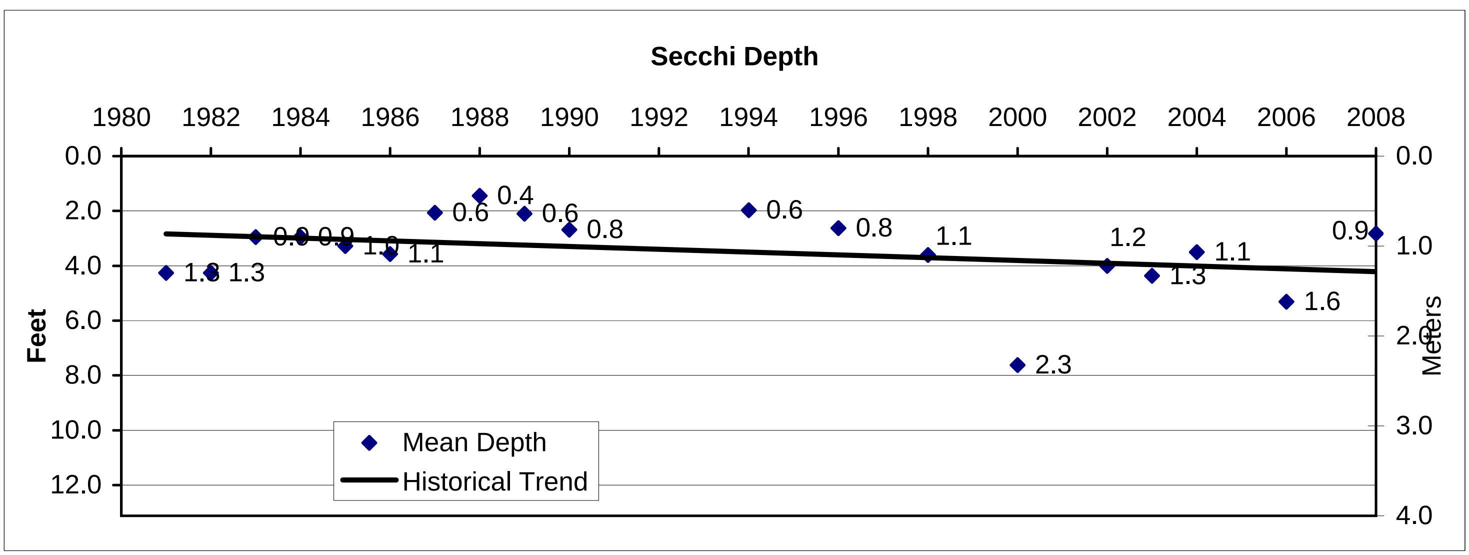

Clearwater River Watershed District	Wenck Associates, Inc. Environmental Engineers 1800 Pioneer Creek Center Maple Plain, MN 55359	Apr 2009
Lake Marie Historical Data		Appendix A

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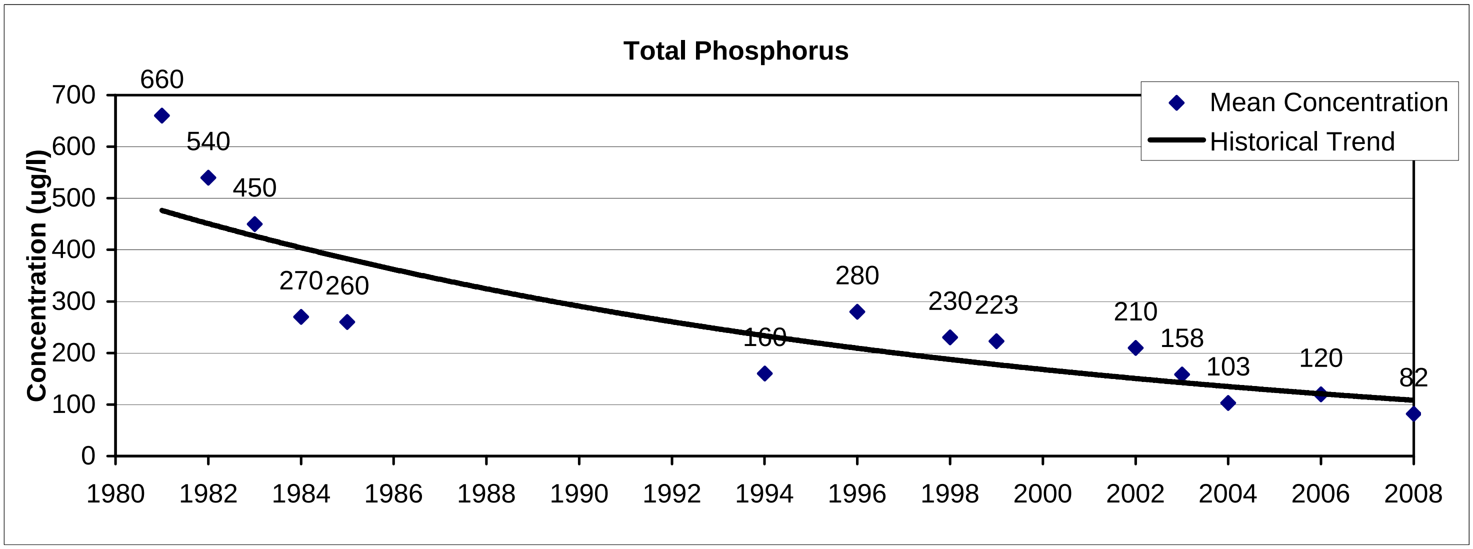

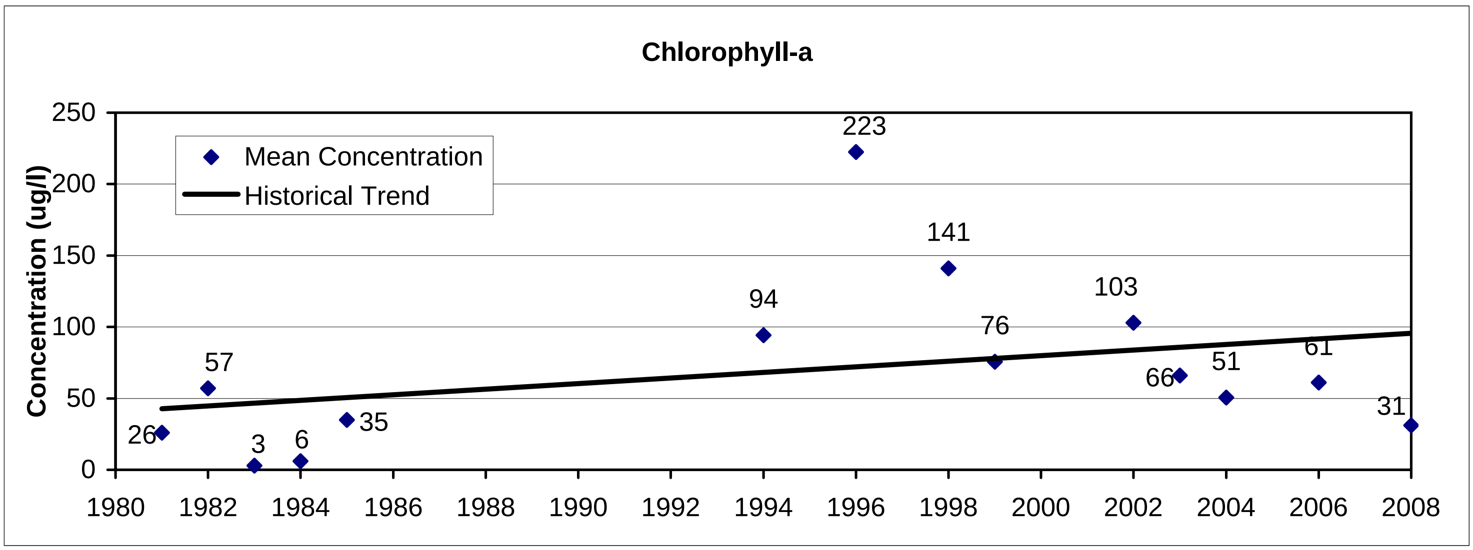

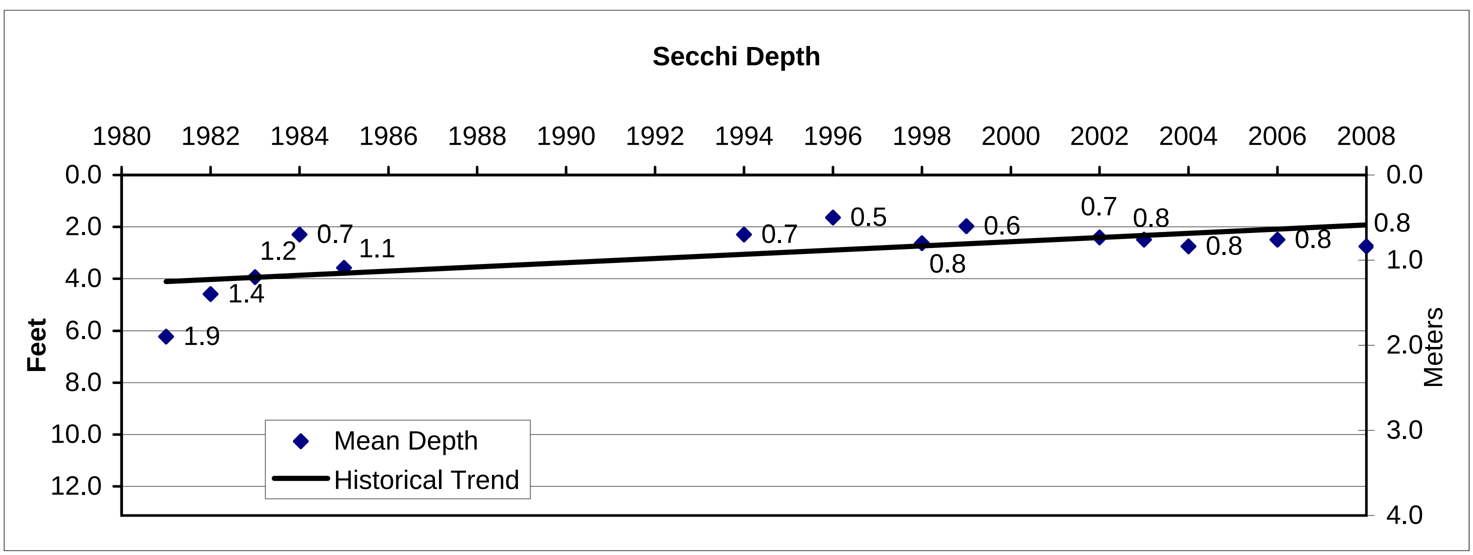

Clearwater River Watershed District	Wenck Wenck Associates, Inc. Environmental Engineers 1800 Pioneer Creek Center Maple Plain, MN 55359	Apr 2009
Scott Lake Historical Data		Appendix A

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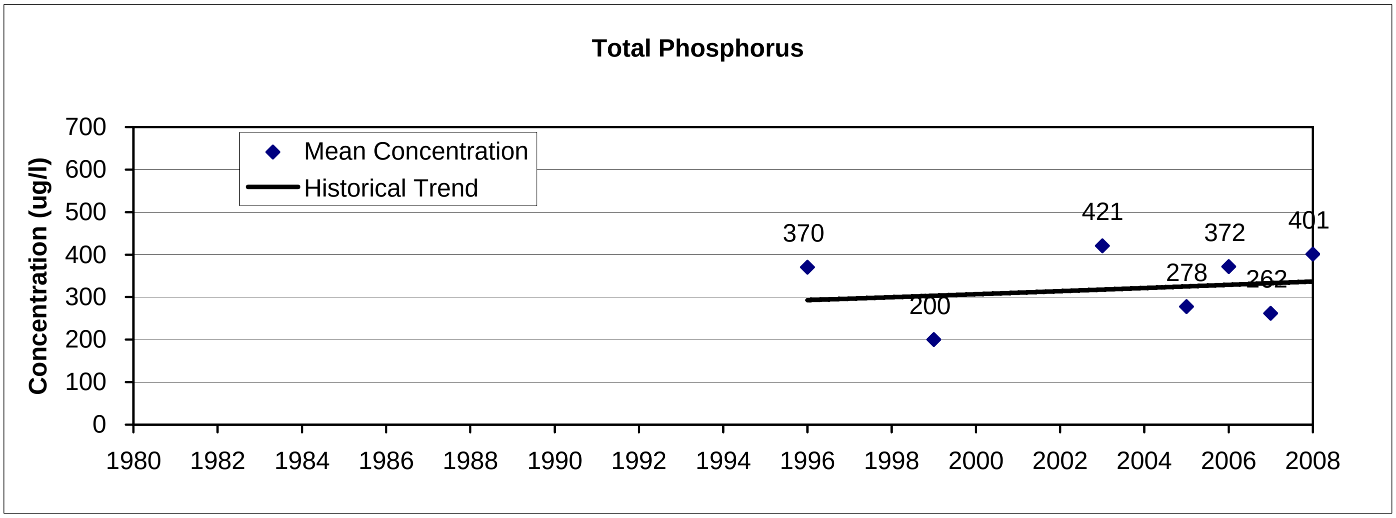
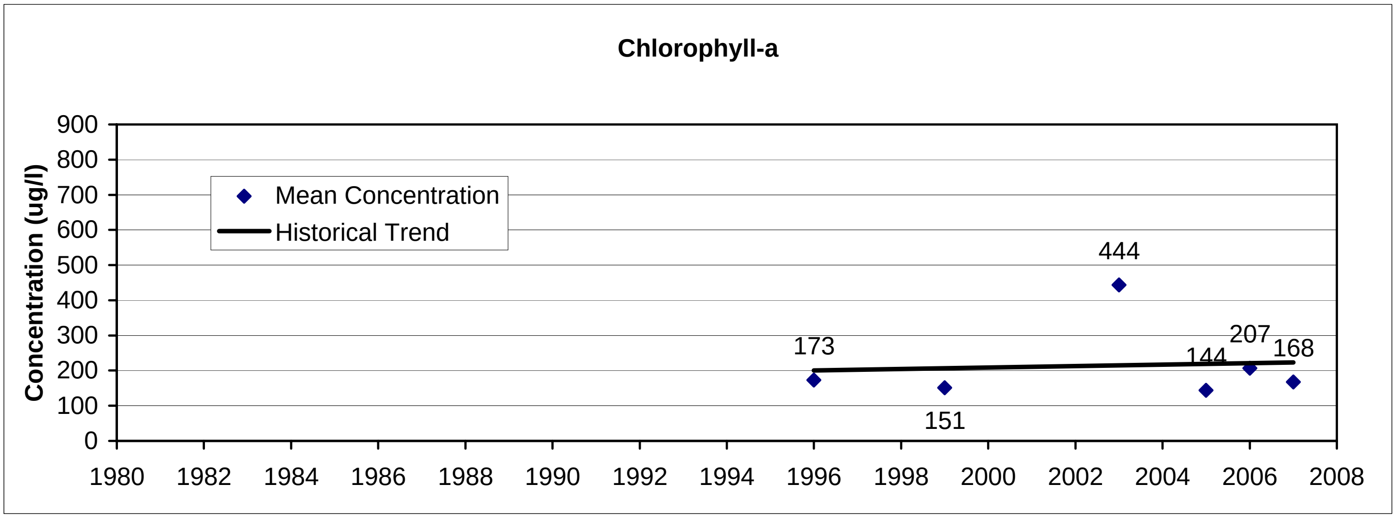
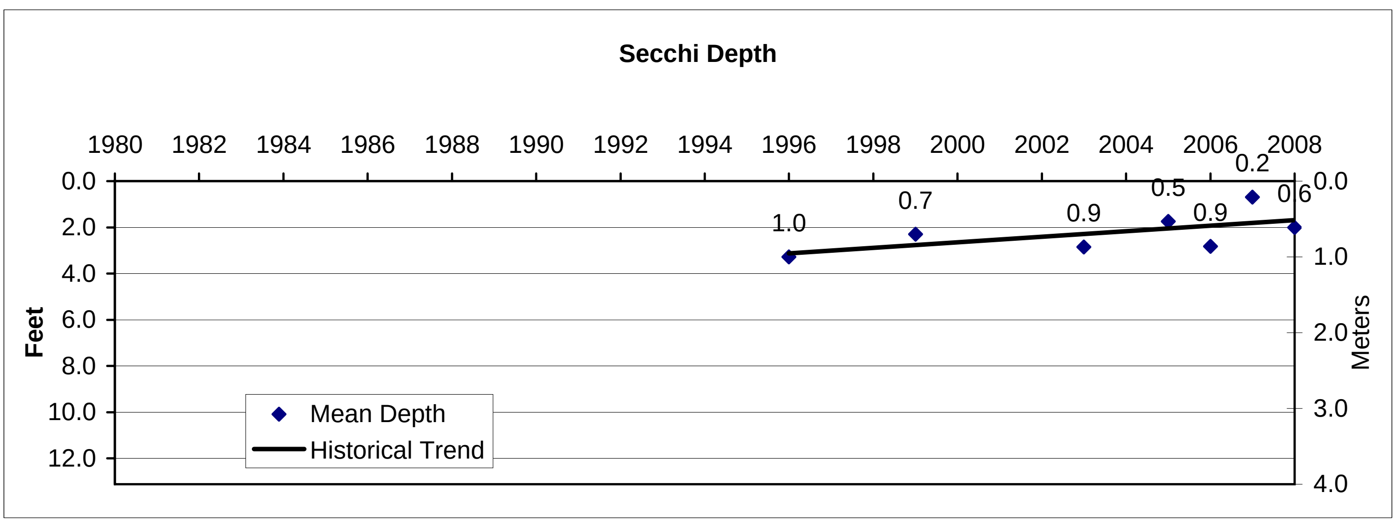
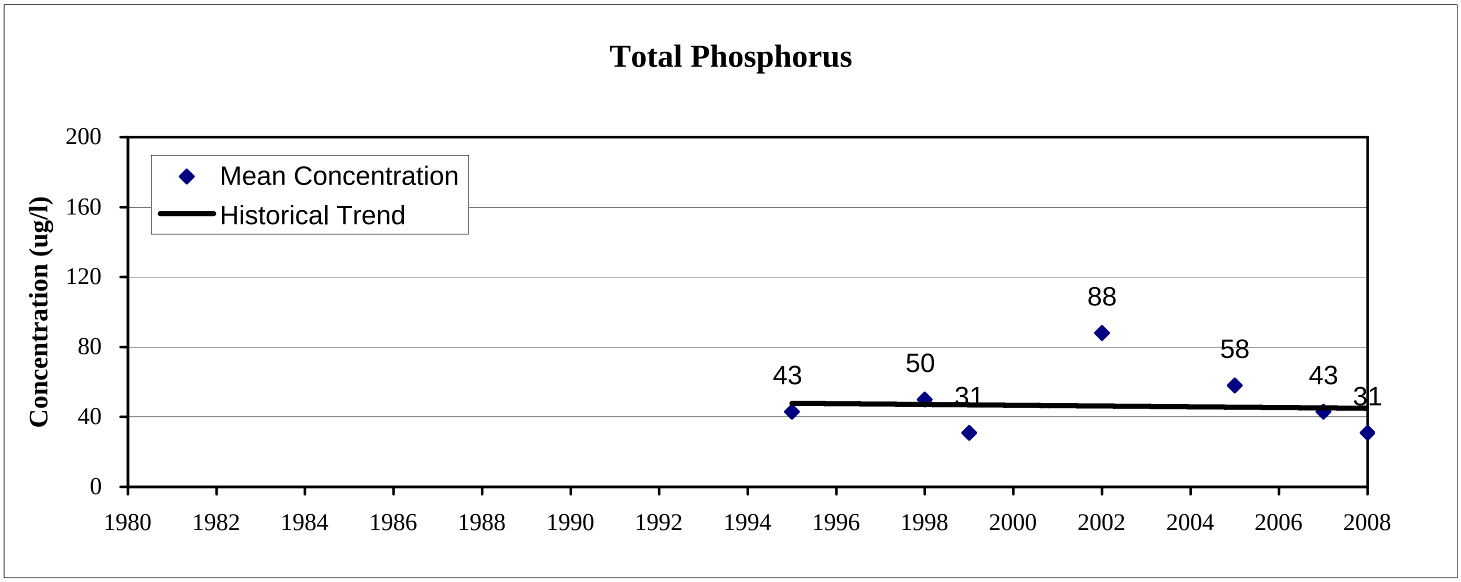
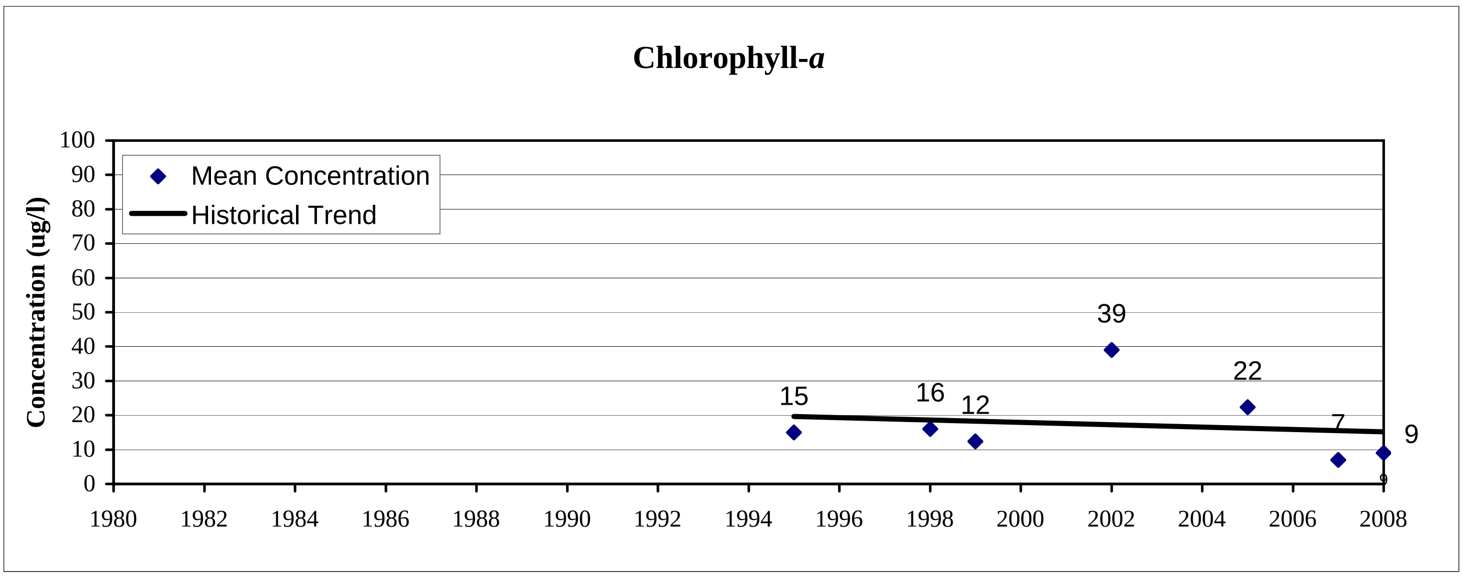


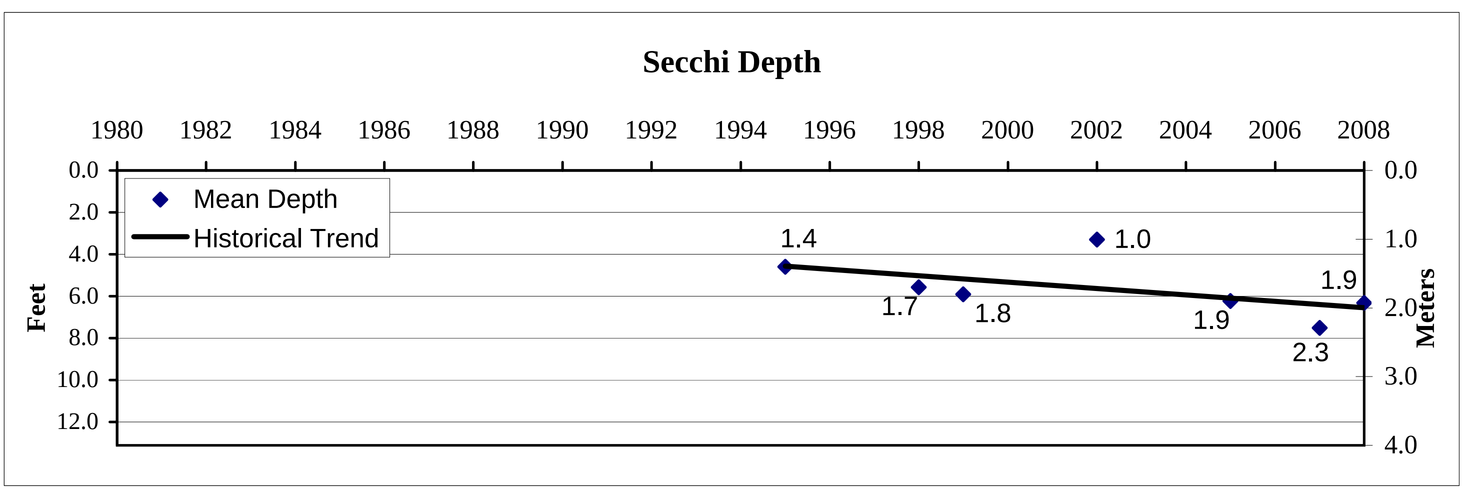




Clearwater River Watershed District	Wenck Wenck Associates, Inc. Environmental Engineers 1800 Pioneer Creek Center Maple Plain, MN 55359	Apr 2009
Swartout Lake Historical Data		Appendix A







Clearwater River Watershed District	Wenck Associates, Inc. Environmental Engineers — 1800 Pioneer Creek Center, Maple Plain, MN 55359	Apr 2009
Union Lake Historical Data		Appendix A

T:\0002\115\LAKE_WQ_08Union Lake

Appendix B-CRWD 2009 Annual Water Quality Monitoring Plan

MEMORANDUM

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

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

DATE: **February 11, 2009**

RE: **Proposed 2009 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 2009 program is intended to provide data throughout the District.

The 2009 proposed lake monitoring follows the long-term plan as shown in Table 1 and Figure 1. The proposed stream monitoring sites together with laboratory and field parameters are shown in Table 2.

Lake Monitoring

It is recommended that the District's 2009 lake monitoring include all of the lakes in the District as shown on Table 1. The sampling of all of the lakes provides a District-wide look at lake water quality. It is also recommended that bottom water samples be collected at all of the sampled lakes. The proposed stations and the parameters to be monitored are shown on Table 2. Citizens also monitor approximately 10 lakes for secchi depth. The Cedar Lake watershed and its upper watershed lakes will be monitored for the third year under a special three year program as part of the Cedar, Albion, Swartout, Henshaw Improvement Project No 06-1.

Stream Monitoring

The Clearwater River will be monitored twice a month from April-June and once a month from July-September at station CR28.2. A tributary to the Clearwater River will be monitored once a month from April-September at station T B 33.2 near Watkins. Warner Creek will be monitored once a month from April-September at WR 0.2. These stations will be monitored for water quality and flow. Parameters are total phosphorus, total suspended solids, total nitrogen and soluble reactive phosphorus. CR 28.2 and T B33.2 will also be monitored for *E. coli* bacteria.

Estimated Cost

This proposed basic program is estimated to cost $26,700.

Recommended Supplemental Monitoring

In addition to the basic program, it is recommended that supplemental monitoring efforts be considered in 2009. The proposed supplemental monitoring efforts would allow the District to track the success of individual projects or to investigate specific water quality concerns.

Supplemental Monitoring Task 1: Collect additional temperature/dissolved oxygen profiles from selected lakes in the District to better characterize the anoxic factor in lakes.
It is recommended that the District collect profile data twice monthly from May to October in Clear, Betsy, Scott, Union, Louisa, and Marie Lakes. Since the lakes are already being sampled monthly from June to September, this additional task would add eight visits to each lake. The cost of this additional task is approximately $1,200.

Supplemental Monitoring Task 2: Collect lake bottom sediment samples to quantify phosphorus release rates in selected District Lakes.
It is recommended that the District collect lake sediment samples from Clear, Betsy, Scott, Union, Louisa, and Marie Lakes on an one lake per year basis. The cost of this task is approximately $3,500 per lake.

Supplemental Monitoring Task 3: Maintain two continuous flow measurement stations in the District.
It is recommended that the District install pressure transducers at the watershed outlet and midpoint to measure continuous flows and better characterize annual runoff. The approximate cost of this task, including equipment purchase is $4,500.

Equipment Purchase
The current equipment used to collect lake profile data and gauge stream flow is in need of replacement. New equipment would improve the efficiency of data collection and improve the quality of the data. The cost of a new digital temperature/dissolved oxygen meter is approximately $950. The cost of a new digital velocity meter to be used in stream flow gauging is approximately $750.

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	
Clearwater West	X	X	X	X	X	X	X	X	DNR	X		X	X	X
Main Stem Lakes:														
Augusta	X		X		X		X		DNR		X		X	
Louisa	X		X		X		X		TMDL/ DNR	TMDL	X		X	
Caroline		X				X		X	DNR	X		X	X	X
Scott		X	X			X		X		X		X	X	X
Marie		X		X		X		X	DNR	X		X	X	X
Betsy	X		X		X		X		X		X		X	
Other Lakes:														
Cedar			X		X		X	X	X	X		X(2)	X(2)	X
Pleasant	X		X	X				X	MPCA		X	X(3)	X	X
School Section	X		X	X				X			X		X	X
Nixon	X		X		X			X			X	X	X	X
Otter	X		X		X			X			X		X	X
Bass		X	X		X				MPCA/ DNR	X		X(3)	X	
Clear		X	X	X			X		X			X	X	X
Union		X	X			X			MPCA			X	X	
Henshaw		X	X			X			X		X	X(2)	X(2)	
Little Mud			X			X				X			X	
Wiegand			X			X			X				X	
Swartout			X				X		X	X		X(2)	X(2)	
Albion			X				X		X	X		X(2)	X(2)	
Grass			X				X		DNR			X	X	
Number of Lakes Monitored W/ CRWD Funding	9	9	20	6	9	9	10	10	7	10	9	14	22	10

Note:
(1) Lake selection based on total lake size ranking scores (Lake Priority Ranking, 1990)
(2) Part of Project #06-1
(3) Added to assess trends

TABLE 2
Proposed 2009 CRWD Monitoring Plan Summary

Category	2009Schedule	Station	Parameters
Lakes:	June 1-5, July 6-10, August 3-7, September 7-11	The CRWD will monitor Clearwater (West), Clearwater (East), Augusta, Louisa, Caroline, Scott, Marie, Betsy, Pleasant, School Section, Nixon, Otter, Bass, Clear, Union, Little Mud, Wiegand, Grass	Field: Secchi depth, DO and temperature profiles
		Cedar, Albion, Swartout, and Hensaw Lakes will be monitored under Project No. 06-1	Lab: surface samples for total phosphorus, soluble reactive phosphorus, total nitrogen, chlorophyll-a Bottom samples for total phosphorus, soluble reactive phosphorus, and total iron.
			Citizen Secchi: 10 sites not listed here
Streams:	Twice monthly April-June, monthly July-September	CR 28.2	Field: flows, DO and temperature Lab: total phosphorus, soluble reactive phosphorus, total suspended solids, Total Nitrogen, E. coli
	Monthly April-September	TB 33.2	Field: flows, DO and temperature Lab: total phosphorus, soluble reactive phosphorus, total suspended solids, Total Nitrogen, E. coli
	Monthly April-September	WR0.2	Field: flows, DO and temperature Lab: total phosphorus, soluble reactive phosphorus, total suspended solids, Total Nitrogen
	Bi-weekly	River Stage at CR10.5	
Precipitation:	Daily	Corinna, Kimball, Watkins	
		Cedar, Albion, Swartout, Henshaw, Project #06-1	Tributaries Field: DO, temperature, conductivity, pH profiles; Lab: total phosphorus, soluble reactive phosphorus, TSS, TN Lakes Field: Secchi, DO, temperature profiles Lab: surface: total phosphorus, soluble reactive phosphorus, total nitrogen, chlorophyll-a bottom: total phosphorus, soluble reactive phosphorus, total iron