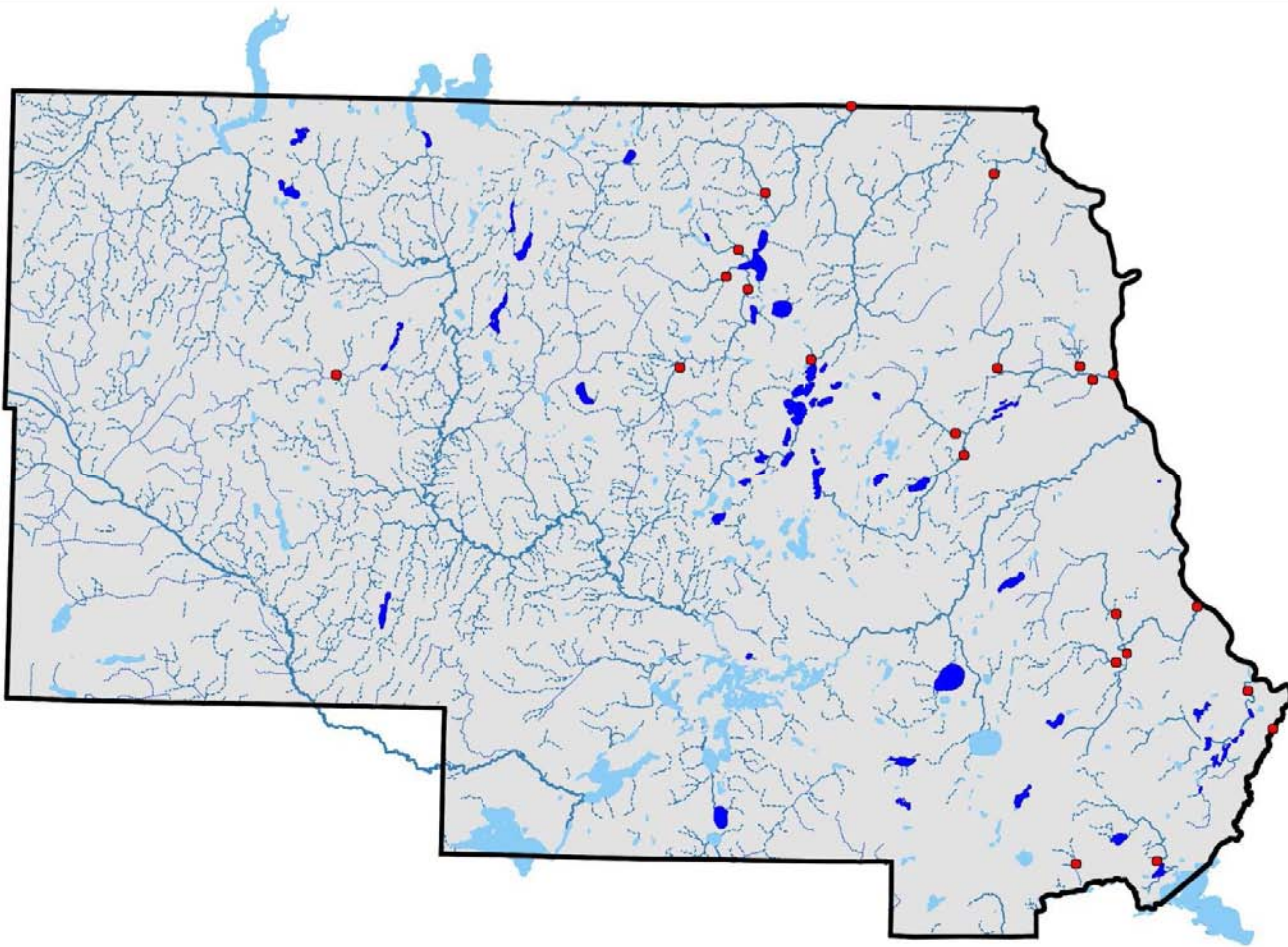


# **Stearns County 2009-2010 Surface Water Assessment Grant**



**2009-2010  
Stearns County Soil and Water Conservation District**

## Acknowledgements

### **Organization and oversight:**

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RMB Environmental Laboratories, Inc. – project management, sample collection, & lab analysis  
Sauk River Watershed District – sample collection  
Stearns County – background information  
Stearns County Soil & Water Conservation District – project & fiscal management

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\*Special thanks to all property owners providing access to lake and stream sites

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## List of Abbreviations

303(d):	List of assessed waters not meeting TMDL limits prepared for U.S. Congress under Section 303(d) of the Clean Water Act
305(b):	Streams assessments prepared for US Congress under Section 305(b) of the Clean Water Act
BWSR:	Board of Soil and Water Resources
Chl- <i>a</i> :	Chlorophyll- <i>a</i>
Cl:	Chloride
CLMP:	Citizen Lake Monitoring Program
CSMP:	Citizen Stream Monitoring Program
<i>E. coli</i> :	<i>Escherichia coli</i> (bacteria)
ESD:	Environmental Services Department
MPCA:	Minnesota Pollution Control Agency
N+N:	Nitrate + Nitrite
RMBEL:	RMB Environmental Laboratories, Inc.
SRWD:	Sauk River Watershed District
SWAG:	Surface Water Assessment Grant
SWCD:	Soil and Water Conservation District
TKN:	Total Kjeldahl Nitrogen
TMDL:	Total Maximum Daily Load – a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards
TP:	Total Phosphorous
TSI:	Trophic State Index
TSS:	Total Suspended Solids
T-tube:	Transparency Tube

## Introduction

Stearns County encompasses 4 major watersheds, and is home to 294 lakes and 189 rivers and streams (Figure 1). These surface waters are protected for aquatic life and designated uses. Many of these water bodies are in existing watershed districts, while others fall under the sole oversight of Stearns County Soil and Water Conservation District (SWCD). Stearns County SWCD does not employ a water-monitoring technician, and water bodies in its territory lacked chemical data consistent with other lakes and streams found in nearby watershed districts. Additionally, very few of the water bodies have active citizen organizations that can fulfill the data deficient monitoring. Due to this, a partnership was established by the Stearns County SWCD, with RMB Environmental Laboratories, Inc. (RMBEL) and Sauk River Watershed District (SRWD), to monitor data deficient lakes and streams. Most of these lakes and streams lacked chemical data due to sparse populations and a lack of funding for monitoring. Table 1 summarizes the data availability for lakes and streams in Stearns County.

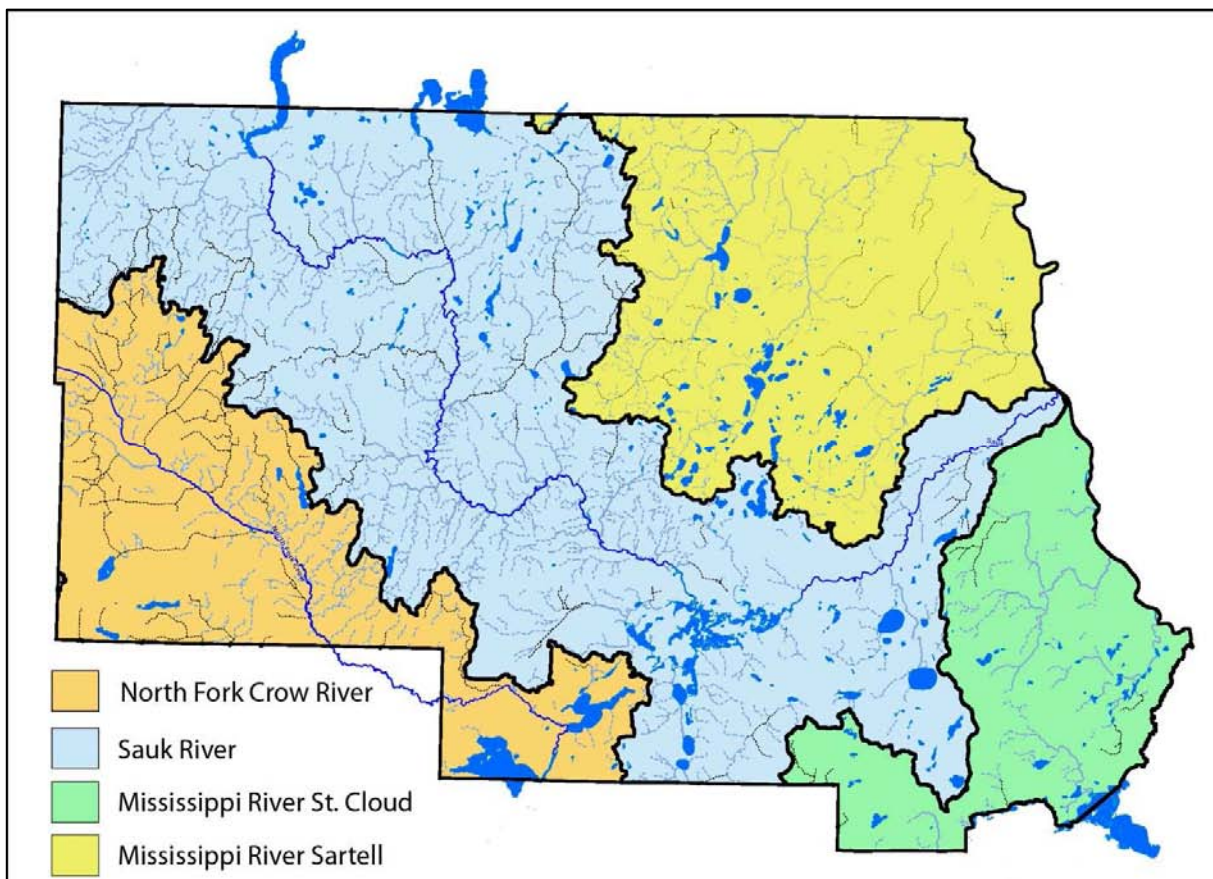





Figure 1. Major watersheds, lakes, rivers, and streams in Stearns County.

In order to obtain sufficient data to assess Stearns County's lakes and streams, Stearns County SWCD applied for, and was awarded, a Surface Water Assessment Grant (SWAG). The SWAG was set-up over a two year time period from 2009-2010, with funding administered by the Minnesota Pollution Control Agency (MPCA) under Minnesota Session Laws 2009, Chapter 172, Article 2, Section 4.

Table 1. Data availability for Stearns County lakes and streams.

Data Type	Data Availability
Transparency Data	 Secchi disk data is limited mostly to public access lakes.
Chemical Data	 Chemical data is more available as a result of SWAG monitoring.
Inlet/Outlet Data	 Inlet/outlet data is rarely available.

As part of the Stearns SWAG, lake and stream monitoring was conducted during the 2009-2010 sampling season by RMBEL and SRWD. Lakes were assessed for total phosphorus (TP), chlorophyll-*a* (Chl-*a*), and Secchi transparency six time per year, from June through September. Lakes with at least one year of existing data within the past ten years were sampled for one year to supplement existing data, while lakes with no existing data were sampled over a two-year period.

Streams were assessed for chloride (Cl), nitrate + nitrite (N+N), total Kjeldahl nitrogen (TKN), total suspended solids (TSS), Chl-*a*, and pheophytin eight times per year, for two years, from June through September. In addition, *Escherichia coli* (*E. coli*) was sampled in streams during the months of June through August. At its sites, RMBEL sampled *E. coli* five times per month from June through August in 2009, and 2 times per month from June through August in 2010. At its site (County Ditch 9), SRWD sampled *E. coli* two times per month from June through August in 2009, and three times per month from June through August in 2010. Field parameters including temperature, dissolved oxygen, conductivity, turbidity, pH, and flow, were also analyzed at each site during water sample collection.

The completion of this project provides a comprehensive data set that enables 303(d) and 305(b) state assessments. These assessments will provide valuable information for the county’s water plan, while supporting public awareness of water quality in the stream and lake networks.

The purpose of this report is to compile and summarize data gathered through the SWAG project. This report contains a summary of the current state of SWAG monitored lakes and streams in Stearns County. Table 2 and Table 3 list the lakes and streams monitored as part of the Stearns SWCD SWAG.

Table 2. Lakes monitored as part of the 2009-2010 SWAG.

Lake Name	Lake ID	Lake Name	Lake ID	Lake Name	Lake ID
Achman	73-0125	Island	73-0042	Ochotto	73-0122
Anna	73-0126	Island	73-0104	Otter	73-0015
Bear	73-0190	Kalla	73-0100	Pelican	73-0118
Beaver	73-0023	Kings	73-0233	Pine	73-0136
Big Spunk	73-0117	Koop	73-0166	Pitts	73-0098
Big Watab	73-0102	Kraemer	73-0064	Pleasant	73-0051
Black Oak	73-0241	Kreighle	73-0096	Quinn	73-0007
Bunt	73-0010	Ellering	73-0244	Rossier	73-0072

Carnelian	73-0038		Laura	73-0020		Saint Anna	73-0183
Cedar	73-0255		Linneman	73-0127		Sand	73-0199
Clear	73-0172		Long	73-0231		Schmid	73-0101
Crooked	73-0006		Long	73-0004		Schuman	73-0096
Dallas	73-0001		Lower Spunk	73-0123		Sylvia	73-0249
Eden	73-0150		Lower Watab	73-0071		Thien	73-0132
Feldges	73-0002		Maria	73-0003		Two River	73-0138
George	73-0611		McCormic	73-0273		Uhlenkolts	73-0208
Goodners	73-0076		Middle Spunk	73-0128		Warner	73-0011
Grand	73-0055		Minnie	73-0099		Watab	73-0070
Henry	73-0237		Minnie	73-0129			

Table 3. Streams assessed as part of the 2009-2010 SWAG.

Stream Name	Site ID		Stream Name	Site ID
Two Rivers @ 450th St	S000-424		3 Mile Crk @ Otter Lk Inlet	S002-671
Stoney Crk @ 95th Ave	S005-719		Fairhaven Crk @ Co Rd 144	S002-674
Co Ditch 12 @ Co Rd 4	S005-713		Watab S. Fork @ Hwy 75	S005-715
Co Ditch 13 @ 2 1/2 St N	S003-363		Watab N. Fork @ Hwy 3	S005-714
Co Ditch 16 @ Sartell Ln	S005-712		Spunk Crk @ Co Rd 9	S002-450
Watab River @ Co Rd 1	S002-947		Two Rivers @ Co Rd 156	S004-271
Robinson Crk @ Co Rd 136	S003-365		Two Rivers @ St. Anna Rd	S004-273
Luxemburg Crk @ 43rd Ave	S003-366		Unnamed @ 380th St	S005-716
Johnson Crk @ 228th St	S005-711		Unnamed @ Co Rd 10	S005-717
Johnson Crk @ Franklin Rd	S003-765		Krain Crk @ 190th St	S005-718
Plum Crk @ Franklin Rd	S005-721		County Ditch 9 @ St Hwy 4	S003-517
Clearwater River @ Co Rd 145	S004-508			


## Trophic State Index

The Trophic State Index (TSI) is a standard measure for calculating the productivity and trophic status of a lake. The trophic state is defined as the total weight of biomass (living biological material) in a water body at the time of measurement. Because they are normally correlated, three variables are used to calculate the Carlson TSI: TP (nutrients), chl-*a* (a measure of algal concentration), and Secchi depth (transparency). As the concentration of TP increases, there is more available food for algae, resulting in an increase of algal concentration. As algal concentrations increase, the water becomes less transparent, which results in a decrease of Secchi depths.

Trophic states are defined divisions of a continuum in water quality. The continuum is based on the three variables mentioned above. Scientists define certain ranges of the lake variables as different trophic states (Table 4); these different states make for easy reference.

Most of the lakes sampled in the Stearns County SWAG fall into the mesotrophic or eutrophic categories (Figure 2; Table 5). Technically, if the TSI for any of the three parameters are more than five points apart, they should not be averaged.

Table 4. Trophic state index values and corresponding trophic states.



TSI	Attributes	Fisheries & Recreation
<30	<b>Oligotrophy:</b> Clear water, oxygen throughout the year at the bottom of the lake, very deep cold water.	Trout fisheries dominate
30-40	Bottom of shallower lakes may become anoxic (no oxygen).	Trout fisheries in deep lakes only. Walleye, Tullibee present.
40-50	<b>Mesotrophy:</b> Water moderately clear most of the summer. May be "greener" in late summer.	No oxygen at the bottom of the lake results in loss of trout. Walleye may predominate.
50-60	<b>Eutrophy:</b> Algae and aquatic plant problems possible. "Green" water most of the year.	Warm-water fisheries only. Bass may dominate.
60-70	Blue-green algae dominate, algal scums and aquatic plant problems.	Dense algae and aquatic plants. Low water clarity may discourage swimming and boating.
70-80	<b>Hypereutrophy:</b> Dense algae and aquatic plants.	Water is not suitable for recreation.
>80	Algal scums, few aquatic plants	Rough fish (carp) dominate; summer fish kills possible

Source: Carlson, R.E. 1997. A trophic state index for lakes. *Limnology and Oceanography*. 22:361-369.

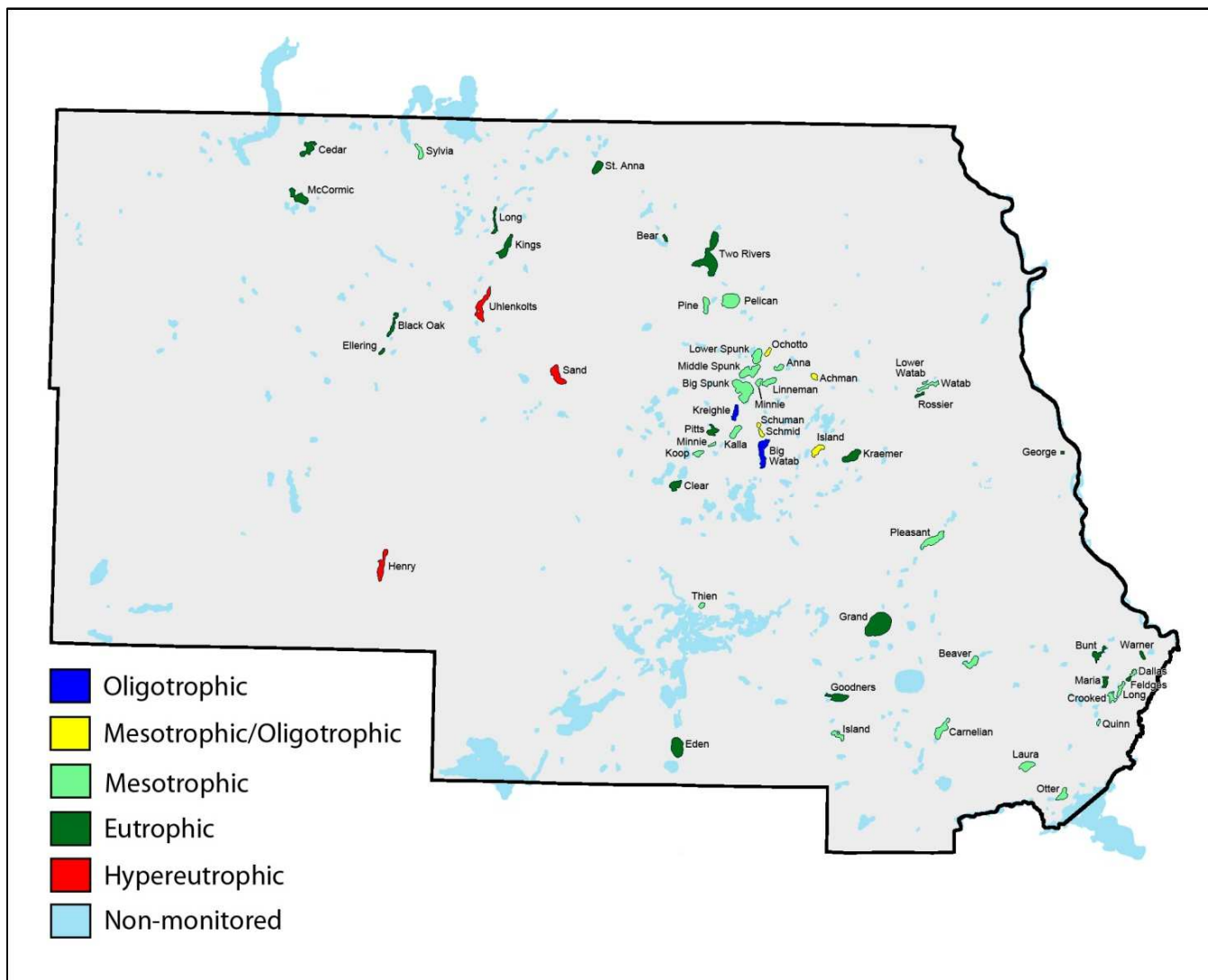


Figure 2. Trophic states of monitored lakes.

Table 5. Trophic states and trophic state indexes for monitored lakes.

Lake	Mean TSI	Trophic State	Mean TSI Phosphorous	Mean TSI Chlorophyll- <i>a</i>	Mean TSI Secchi
Big Watab	36	Oligotrophic	36	37	36
Kreighle	38	Oligotrophic	39	39	38
Achman	40*	Mesotrophic/Oligotrophic	45	38	37
Island (0104)	40	Mesotrophic/Oligotrophic	42	40	38
Ochotto	40	Mesotrophic/Oligotrophic	39	42	38
Schmid	41	Mesotrophic/Oligotrophic	43	42	39
Schuman	41	Mesotrophic/Oligotrophic	40	43	40
Anna	43**	Mesotrophic	45	42	41
Beaver	43	Mesotrophic	44	45	40
Big Spunk	48	Mesotrophic	48	50	45
Carnelian	42	Mesotrophic	42	44	39
Crooked	42	Mesotrophic	43	43	40
Dallas	47*	Mesotrophic	50	48	43
Island (0042)	45**	Mesotrophic	51	39	45
Kalla	47*	Mesotrophic	50	48	43
Koop	45*	Mesotrophic	50	45	40
Laura	48**	Mesotrophic	46	43	54
Linneman	46**	Mesotrophic	47	46	44
Long (0004)	42	Mesotrophic	43	43	39
Lower Spunk	45	Mesotrophic	44	45	44
Lower Watab	44**	Mesotrophic	46	43	43
Middle Spunk	42	Mesotrophic	41	44	40
Minnie (0099)	42	Mesotrophic	43	43	40
Minnie (0129)	44**	Mesotrophic	46	44	43
Otter	49	Mesotrophic	48	52	48
Pelican	44	Mesotrophic	43	44	44
Pine	49	Mesotrophic	51	49	47
Pleasant	43*	Mesotrophic	40	46	42
Quinn	44*	Mesotrophic	48	45	40
Sylvia	46	Mesotrophic	45	47	46
Thien	44*	Mesotrophic	45	47	41
Watab	45	Mesotrophic	48	48	43
Bear	54*	Eutrophic	60	54	49
Black Oak	64*	Eutrophic	69	63	60
Bunt	55**	Eutrophic	58	52	57
Cedar	53**	Eutrophic	52	51	55
Clear	50*	Eutrophic	54	49	45
Eden	61*	Eutrophic	68	61	55
Feldges	50*	Eutrophic	52	51	46
George	57*	Eutrophic	58	59	53

Goodners	53	Eutrophic	55	55	50
Grand	50*	Eutrophic	50	54	47
Kings	53*	Eutrophic	53	56	50
Kraemer	56	Eutrophic	56	58	54
Lake Ellering	61*	Eutrophic	67	60	55
Long (0231)	55*	Eutrophic	58	57	49
Maria	52*	Eutrophic	53	54	48
McCormic	62*	Eutrophic	66	63	57
Pitts	54*	Eutrophic	58	54	51
Rossier	61*	Eutrophic	62	67	53
Saint Anna	56*	Eutrophic	62	57	49
Two River	60*	Eutrophic	61	64	55
Warner	52*	Eutrophic	47	57	52
Henry	73**	Hypereutrophic	97	61	61
Sand	78**	Hypereutrophic	80	76	78
Uhlenkolts	83**	Hypereutrophic	91	78	81

\*Mean TSIs for Secchi, phosphorous, and chlorophyll a are more than 5 points apart, so should not be averaged.

\*\* Due to the shallow nature of the lake (max depth of less than 15 ft), TSI may not applicable.

## Ecoregion Comparisons

Minnesota is divided into 7 ecoregions based on land use, vegetation, precipitation and geology (Figure 3). The MPCA has developed a way to determine the "average range" of water quality expected for lakes in each ecoregion.

From 1985-1988, the MPCA evaluated the lake water quality for chosen reference lakes. These reference lakes are not considered pristine, but are considered to have little human impact and therefore are representative of the typical lakes within the ecoregion. The "average range" refers to the 25<sup>th</sup> - 75<sup>th</sup> percentile range for data within each ecoregion.

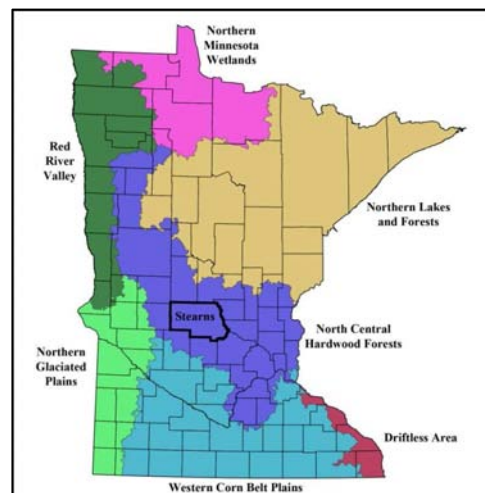


Figure 3. Minnesota ecoregions.

Stearns County is in the North Central Hardwood Forest Ecoregion. This ecoregion is an area of transition between the forested areas to the north and east and the agricultural areas to the south and west. The terrain varies from rolling hills to smaller plains. Upland areas are forested by hardwoods and conifers. Plains include livestock pastures, hay fields and row crops such as potatoes, beans, peas and corn.

The ecoregion contains many lakes, and water clarity and nutrient levels are moderate. Land surrounding many of these lakes has been developed for housing and recreation, and the densely populated metropolitan area dominates the eastern portion of this region. Water quality problems that face many of the water bodies in this area are associated with contaminated runoff from paved surfaces and lawns.

## State Water Quality Standards

Inferences for potentially impaired waters were made by RMBEL for the purpose of this report only. Although some of the lake and stream sites may be in violation of some or all of the standards for impairment, final decisions for impairment are under the discretion of the MPCA.

Minnesota has adopted water-quality standards to protect its waters from pollution under the federal Clean Water Act. These standards define how much of a pollutant can be in the water and still allow it to meet designated uses, such as recreation and drinking. These standards are established on a wide range of pollutants, including bacteria, nutrients, turbidity and mercury. A waterbody is defined as “impaired” if it fails to meet one or more water quality standards. Figure 4 shows the lakes and streams that were monitored as part of the Stearns SWAG that appear to not meet state standards.

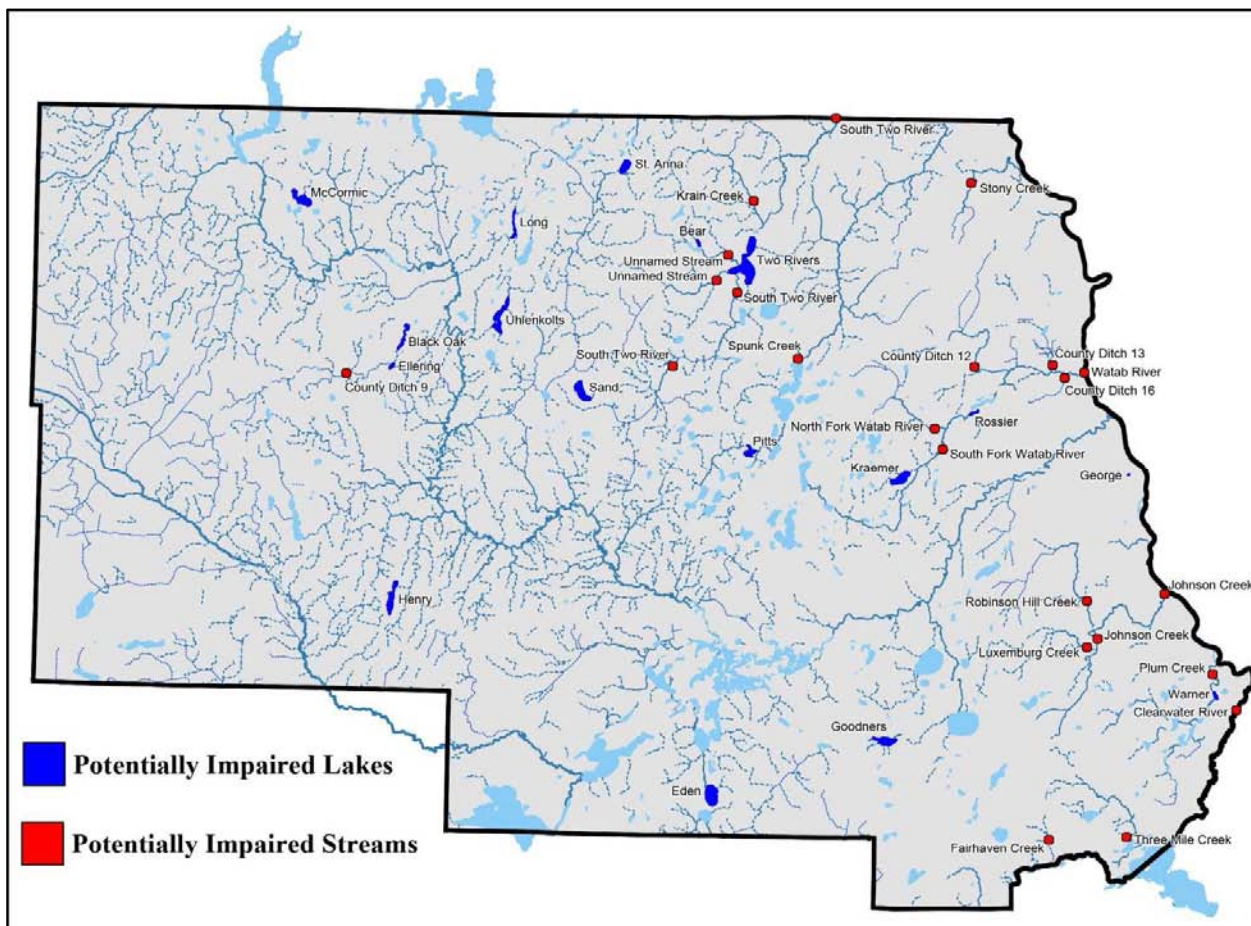


Figure 4. Monitored lakes and streams not meeting state standards.

To identify and restore impaired waters, Section 303(d) of the Clean Water Act requires states to assess all state waters to determine if they meet water quality standards. Any waters that do not meet standards are listed and updated every other year. Waters listed as impaired must have Total

Maximum Daily Load (TMDL) studies completed on them to set pollutant reduction goals needed to restore the waters. A TMDL study measures the maximum amount of a pollutant that a water body can receive while still safely meeting water quality standards outlined for their designated use.

## Streams

Pollutants and water quality characteristics tested for during the SWAG stream monitoring included turbidity, pH, dissolved oxygen, transparency, *E. coli*, Cl, N+N, TKN, TP, Chl-*a*, pheophytin, and TSS. Table 6 lists the standards for these pollutants and water quality characteristics. There are currently no standards for nutrients (TP, TKN, and N+N), Chl-*a*, or pheophytin in streams; however, the MPCA is currently in the process of creating those standards. While the MPCA assesses and determines what waters are actually impaired, it is possible to review the criterion used for determining impaired waters and speculate which waters are potentially impaired.

Table 6. Conventional pollutants and water quality characteristic standards for Class 2 waters.

Pollutant/Water Quality Characteristic	Standards for Class 2 Waters
Dissolved Oxygen (DO)	5 mg/L
pH	6.5 - 8.5
Turbidity	25 NTU
Transparency	20 cm
Total Suspended Solids (TSS)	100 mg/L
Bacteria ( <i>E. coli</i> )	126 MPN/100 ml*
Chloride	230 mg/L

\*Standard is monthly geometric mean; 10% of samples cannot exceed a maximum of 1260 MPN/100 mL.

For determining impairments for conventional pollutants and water quality characteristics, at least 10% of the waterbody's measurement levels must be in violation of the standard acceptable level. There is also a minimum amount of required observations that must be met before a site can be listed as impaired. The actual amount of required observations depends on the variability of the pollutant measurement. Table 7 lists the data requirements and exceedance thresholds for assessment of conventional pollutants.

Table 7. Data requirements and exceedance thresholds for assessment of conventional pollutants and water quality characteristics.

Period of Record	Minimum Number of Data Points	Chronic Standard Exceedance Thresholds	
		< 10% (Not Listed)	≥ 10 % (Listed)
Most recent 10 years	20		

Table adapted from MPCA's *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List*. 2010.

Determining impairments for pollutants with toxicity-based standards differs from the data requirements and exceedance thresholds of conventional pollutants. Chloride is a pollutant with toxicity-based standards that was tested for during the SWAG stream sampling. For pollutants with

toxicity-based standards, no more than one violation may occur within a 3-year period given a minimum number of 5 data points. Table 8 lists the data requirements and exceedance thresholds for assessment of pollutants with toxicity-based standards.

Table 8. Data requirements and exceedance thresholds for assessment of pollutants with toxicity-based standards.

Period of Record	Minimum Number of Data Points	Chronic Standard Exceedance Thresholds	
		1 or less in 3 yrs (Not Listed)	2 or more in 3 yrs (Listed)
Most recent 10 years	5, within a 3-yr. period		

Table adapted from MPCA's *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List*. 2010.

Determining impairments for *E. coli* differ from the requirements of conventional pollutants/water quality characteristics and toxicity-based pollutants. The monthly geometric mean and maximum standards apply to samples collected from April through October. Table 9 and Table 10 list the assessment criteria for *E. coli*.

Table 9. Data requirements and geometric mean exceedance thresholds for assessment of *E. coli*.

Period of Record	Minimum Number of Data Points	Monthly Geometric Mean Standard Exceedance Threshold	
		No months (Not Listed)	≥ 1 month (Listed)
Most recent 10 years	5 per month (averaged over 2-year period)		

Table adapted from MPCA's *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List*. 2010.

Table 10. Data requirements and maximum exceedance thresholds for assessment of *E. coli*.

Period of Record	Minimum Number of Data Points	Maximum Standard Exceedance Threshold	
		< 10 % (Not Listed)	≥ 10% (Listed)
Most recent 10 years	10		

Table adapted from MPCA's *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List*. 2010.

All of the twenty-three stream sites monitored as part of the Stearns SWCD SWAG were in violation of one or more of the standards for dissolved oxygen, pH, *E. coli*, and transparency (Table 11). Even though these sites appear to exceed state standards, streams are not considered as impaired until assessed and determined to be by the MPCA. These are probable impairments, based upon a preliminary comparison to MPCA standards.

Table 11. Stream sites not meeting state standards.

Stream Name	DO	pH*	<i>E. coli</i>	Transparency
Two Rivers @ 450 <sup>th</sup> St		X	X	
Stony Creek @ 95 <sup>th</sup> Ave	X		X	
County Ditch 12 @ Co Rd 4		X	X	
County Ditch 13 @ 2 ½ St N	X		X	
County Ditch 16 @ Sartell Ln	X		X	
Watab River @ Co Rd 1		X	X	
Robinson Hill Creek @ Co Rd 136			X	
Luxemberg Creek @ 43 <sup>rd</sup> Ave			X	
Johnson Creek @ 228 <sup>th</sup> St			X	
Johnson Creek @ Franklin Rd			X	
Plum Creek @ Franklin Rd			X	
Clearwater River @ Co Rd 145		X		
3 Mile Creek @ Otter Lk Inlet		X	X	
Fairhaven Creek @ Co Rd 44			X	
Watab River, S Fork @ Hwy 75		X	X	
Watab River, N Fork @ Co Rd 3			X	
Spunk Creek @ Co Rd 9	X		X	
S Two Rivers @ Co Rd 156			X	
S Two Rivers @ St Anna Rd	X			
Unnamed stream @ 380 <sup>th</sup> St			X	X
Unnamed stream @ Co Rd 10	X		X	
Krain Creek @ 190 <sup>th</sup> St			X	
County Ditch 9 @ St Hwy 4	X	X	X	

\* The applicable pH standard for most Class 2 waters is a minimum of 6.5 and a maximum of 8.5, based on the more stringent of the standards for the applicable multiple beneficial uses. pH values that are either too high or too low can be harmful to aquatic organisms; however, natural waters can exhibit a very broad range of pH value.

## Lakes

The lake monitoring component of the SWAG was conducted to assess eutrophication standards. Eutrophication standards for lakes monitored during the Stearns County SWAG are divided into two categories: Class 2b Lakes and Class 2b Shallow Lakes. Class 2b Lakes are lakes in which the maximum depth is greater than 15 feet, and Class 2b Shallow Lakes are lakes with a maximum depth of 15 feet or less, or with 80 percent or more of the lake area being shallow enough to support emergent and submerged rooted aquatic plants. Each of the two categories has different standards that must be met to qualify as impaired water (Table 12).

Table 12. Eutrophication standards for lakes in the North Central Hardwood Forest Ecoregion.

Ecoregion	TP (ug/L)	Chl- <i>a</i> (ug/L)	Secchi (ft)
NCHF – Class 2b Lakes	< 40	< 14	> 4.6
NCHF – Class 2b Shallow Lakes	< 60	< 20	> 3.3

For standards used to determine lake impairments, the waterbody must fail to meet two of the water quality standards. The lake must fail to meet the TP standard in addition to failing either the Chl-*a* or Secchi depth standard to be considered for impairment. In addition, there are a minimum number of data points needed over a specified amount of time for the data to be used for assessment purposes. For 303(d) assessment purposes, lakes are usually required to fall within the “Excellent” category listed in Table 13.

Table 13. Lake data quality characterizations.

Period of Record	Data Quality Categories			
	Excellent	Good	Fair	Poor
Most recent 10 years	≥ 8 TP, Chl- <i>a</i> , & Secchi over 2 yrs	8 < TP < 12 w/some Chl- <i>a</i> & Secchi	4 ≤ TP < 8 w/some Chl- <i>a</i> & Secchi	< 4 TP

Table adapted from MPCA’s *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List*. 2010.

Based on the data collected during the 2009-2010 sampling season, five lakes failed to meet at least one of the eutrophication standards (Table 14), while twelve lakes failed to meet at least two of the eutrophication standards (Table 15). Even though these lakes appear to exceed state standards, lakes are not considered as impaired until assessed and determined to be by the MPCA. These are probable impairments, based upon a preliminary comparison to MPCA standards.

Table 14. Lakes failing to meet at least one of the eutrophication standards.

Lake Name	Lake ID	TP	CHL- <i>a</i>	Transparency
Bear	73-0190	X		
Goodners	73-0076		X	
Kraemer	73-0064		X	
Pitts	73-0098		X	
Warner	73-0011		X	

Table 15. Lakes failing to meet two or more of the eutrophication standards.

Lake Name	Lake ID	TP	CHL- <i>a</i>	Transparency
Black Oak	73-0241	X	X	X
Eden	73-0150	X	X	
George	73-0611	X	X	
Henry*	73-0237	X	X	X
Lake Ellering	73-0244	X	X	
Long	73-0231	X	X	
McCormic	73-0273	X	X	
Rossier	73-0072	X	X	

Saint Anna	73-0183	X	X	
Sand*	73-0199	X	X	X
Two River	73-0138	X	X	
Uhlenkolts*	73-0208	X	X	X

\* Indicates shallow lake

## Trend Analysis

For detecting trends, a minimum of 8-10 years of data with 4 or more readings per season are recommended. Minimum confidence accepted by the MPCA is 90%. This means that there is a 90% chance that the data are showing a true trend and a 10% chance that the trend is a random result of the data. Only short-term trends can be determined with just a few years of data, because there can be different wet years and dry years, water levels, weather, etc., that affect the water quality naturally.

There is not enough historical data to perform trend analyses for total phosphorus or chlorophyll-*a* on any of the monitored lakes; however, Bear (Site 201), Kraemer (Site 201), Kreighle (Site 201), and Ochotto (Site 201) Lakes had enough transparency data to perform long-term trend analyses (Figures 5-8). The data were analyzed using the Mann-Kendall trend analysis.

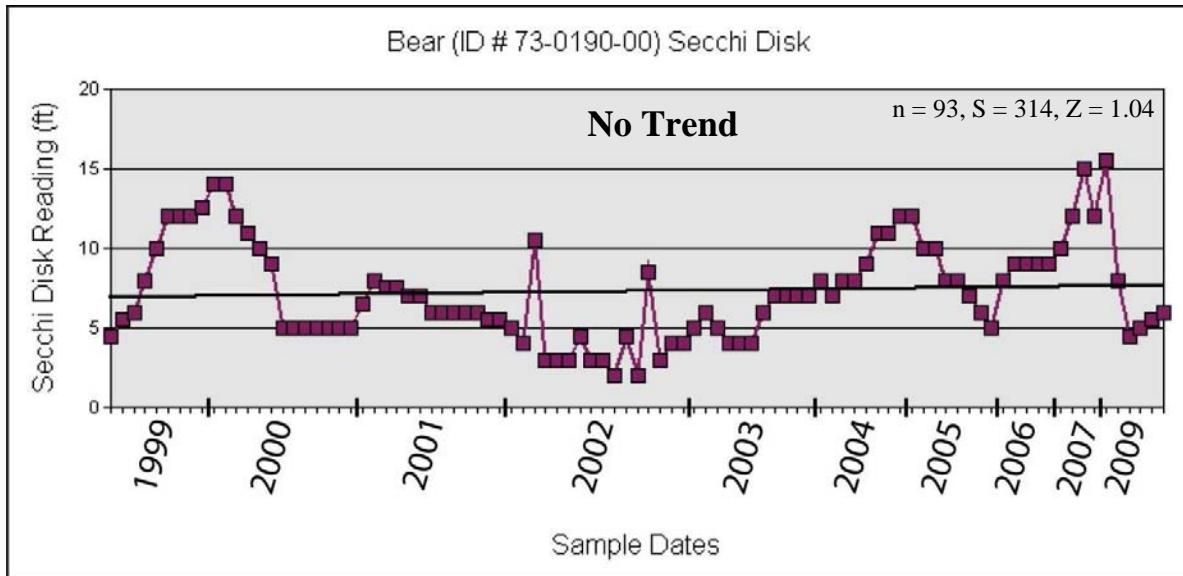


Figure 5. Bear Lake long-term trend analysis.

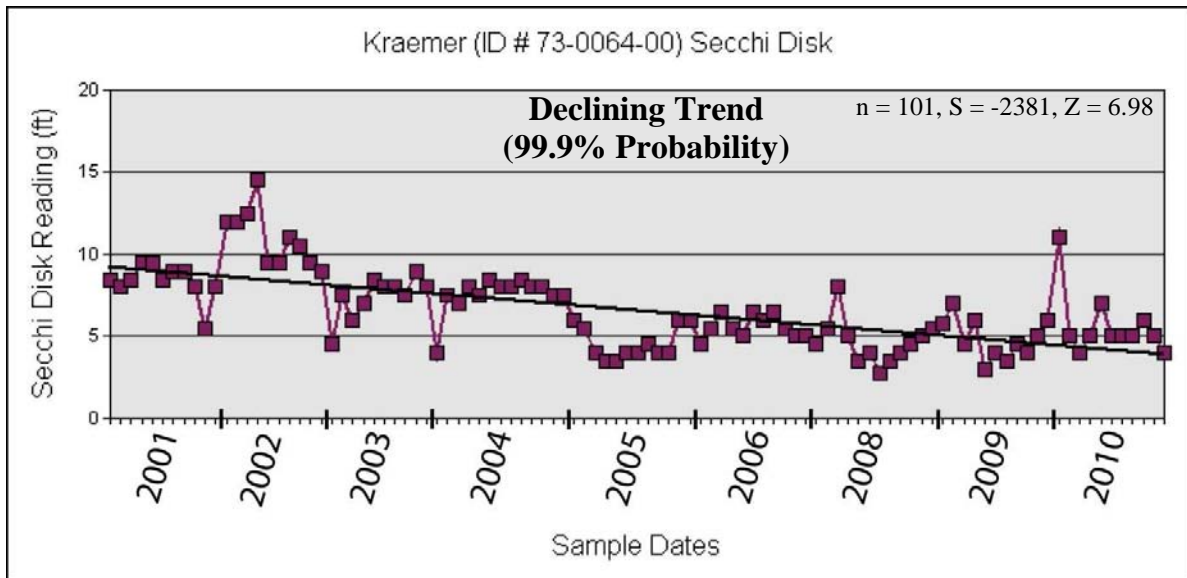


Figure 6. Kraemer Lake long-term trend analysis.

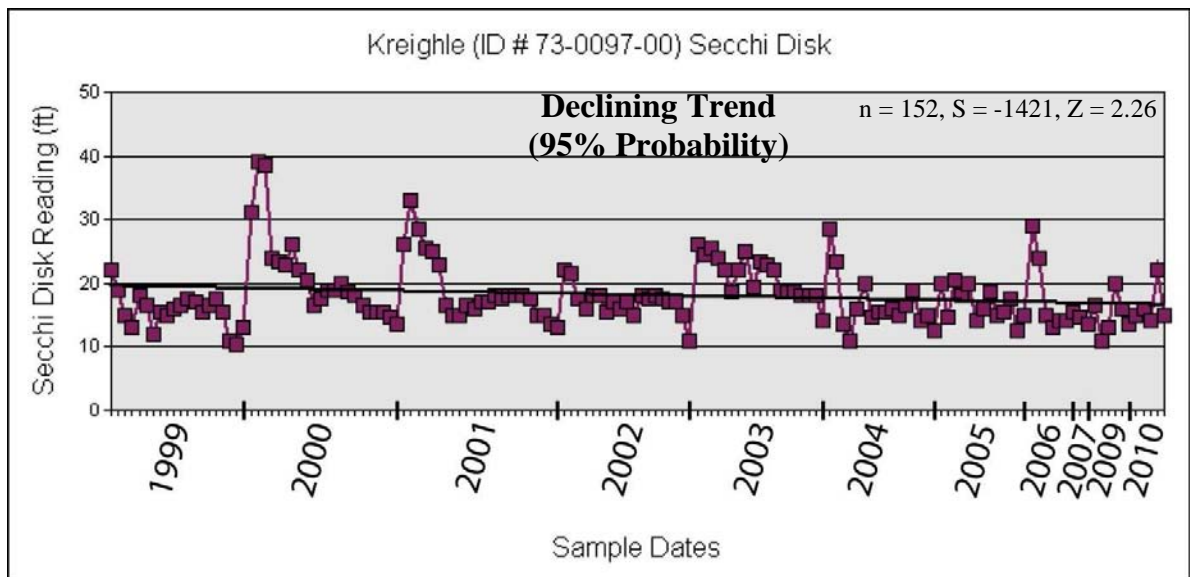


Figure 7. Kreighle Lake long-term trend analysis.

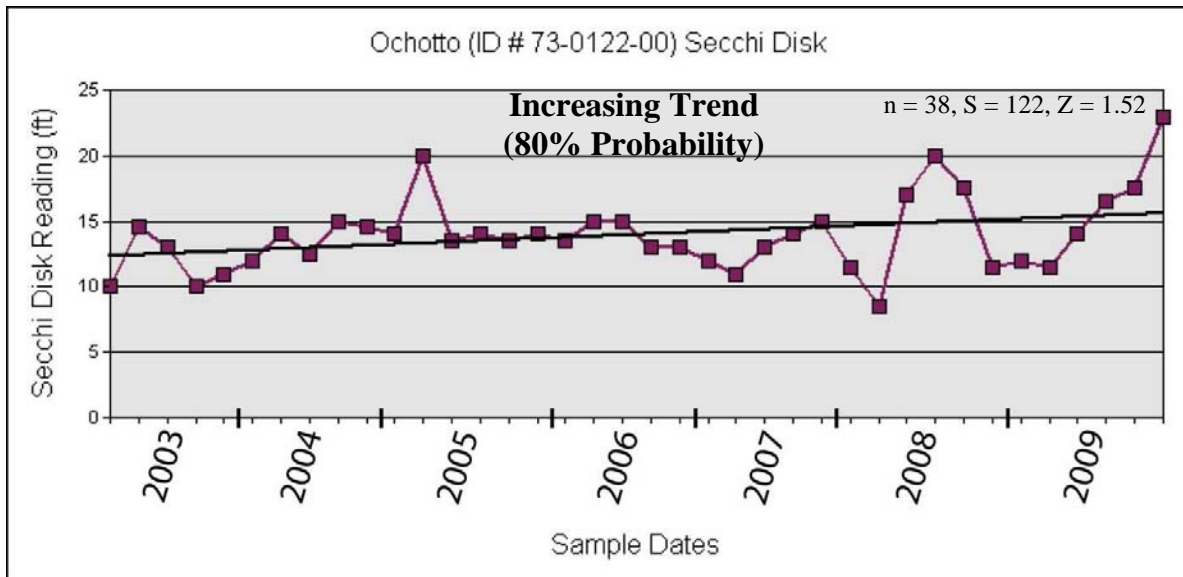


Figure 8. Ochotto Lake long-term trend analysis.

## Recommendations

With the completion of the Stearns SWAG, all monitored waterbodies have sufficient data to meet the MPCA's requirements for assessment. However, with the exception of Secchi depth data for Bear, Kraemer, Kreighle, and Ochotto Lakes, none of the waterbodies have sufficient data to track long-term trends. Tracking long-term trends can help to identify waterbodies that are perhaps meeting state standards, but that may be experiencing a decline in water quality. This is an important concept, as it is generally more cost-effective to prevent the degradation of lakes and streams than it is to clean them up and restore them to a state that is supporting of designated uses. Citizen involvement in the MPCA's Citizen Lake Monitoring Program (CLMP) and Citizen Stream Monitoring Program (CSMP), where citizen volunteers take Secchi depth readings in lakes and t-tube readings in streams, respectively, is an excellent way to obtain data that can be used to track long-term trends. Not only are the CLMP and CSMP cost-effective ways to obtain continuous baseline monitoring data, they also empower citizens and get them involved in water quality issues.

Because assumptions regarding impairment cannot be made based on data alone, it would be beneficial to conduct lakeshed and stream reach assessments on the waters that are potentially impaired. Analyzing each lakeshed and stream reach will help to show where efforts should be focused. Areas of focus could include additional monitoring, land use practices, best management practices (BMPs), shoreline inventory, septic surveys, easements, civic engagement, etc. Determining where efforts need to be focused can be done by county staff or consultants. RMBEL is available to meet with the county to address any needs. The Board of Water Soil Resources (BWSR) currently has a cost-share program in place to assist counties with lakeshed assessments.