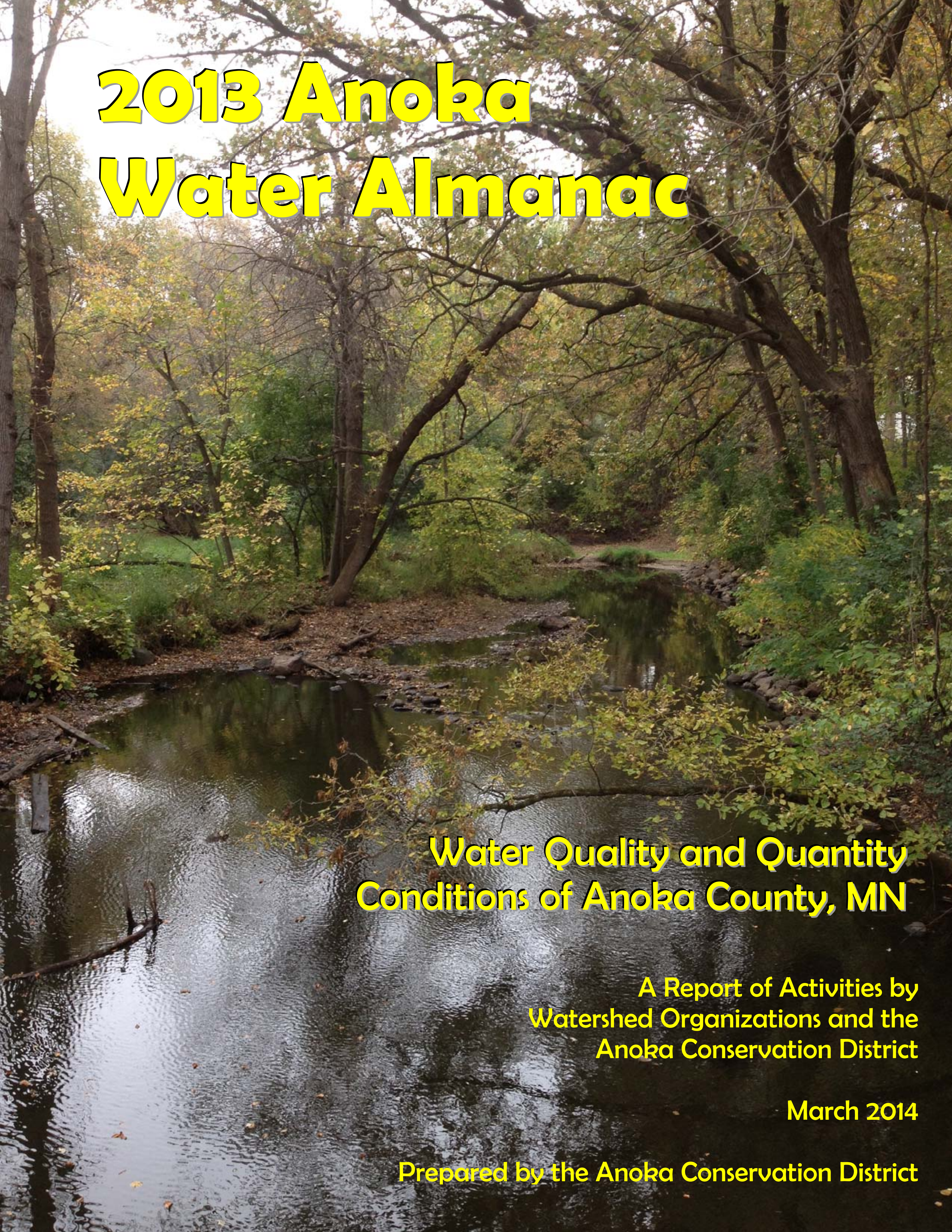


2013 Anoka Water Almanac

Water Quality and Quantity Conditions of Anoka County, MN

A Report of Activities by
Watershed Organizations and the
Anoka Conservation District

March 2014

Prepared by the Anoka Conservation District

2013 ANOKA WATER ALMANAC

Water Quality & Quantity Conditions of Anoka County, Minnesota

A Report of Activities by Watershed Organizations and the Anoka Conservation District

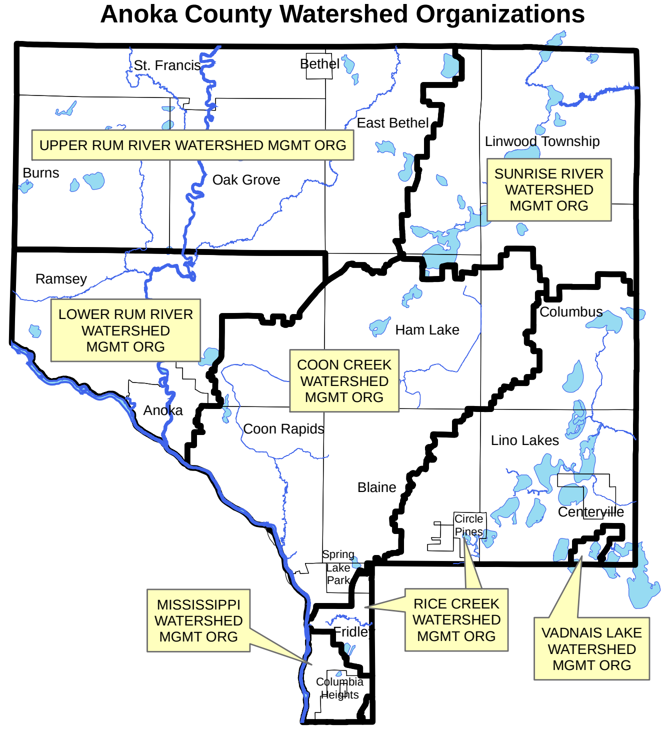
March 2013

Prepared by
Andrew Dotseth
Water Resource Technician
1318 McKay Drive NE, Suite 300
Ham Lake, MN 55304
(763) 434-2030
Andrew.Dotseth@AnokaSWCD.org

Digital copies of data in this report are available at www.AnokaSWCD.com

TABLE OF CONTENTS

Anoka County Watershed Organizations



EXECUTIVE SUMMARY AND ORGANIZATION OF THIS REPORT

This report summarizes water resources management and monitoring work done as a cooperative effort between the Anoka Conservation District (ACD) and a watershed district or watershed management organization. It includes information about lakes, streams, wetlands, precipitation, groundwater, and water quality improvement projects. The results of this work are presented on a watershed basis—this document serves as an annual report to each of the watershed organizations that have helped fund the work. Readers who are interested in a certain lake, stream or river should first determine which watershed it is located in, and then refer to the chapter corresponding to that watershed. The maps and county-wide summaries in Chapter 1 will help the reader determine if the information they are seeking is available and, if so, in which chapter to find it. In addition to county-wide summaries, Chapter 1 also provides methodologies used, explanations of terminology, and hints on interpreting data.

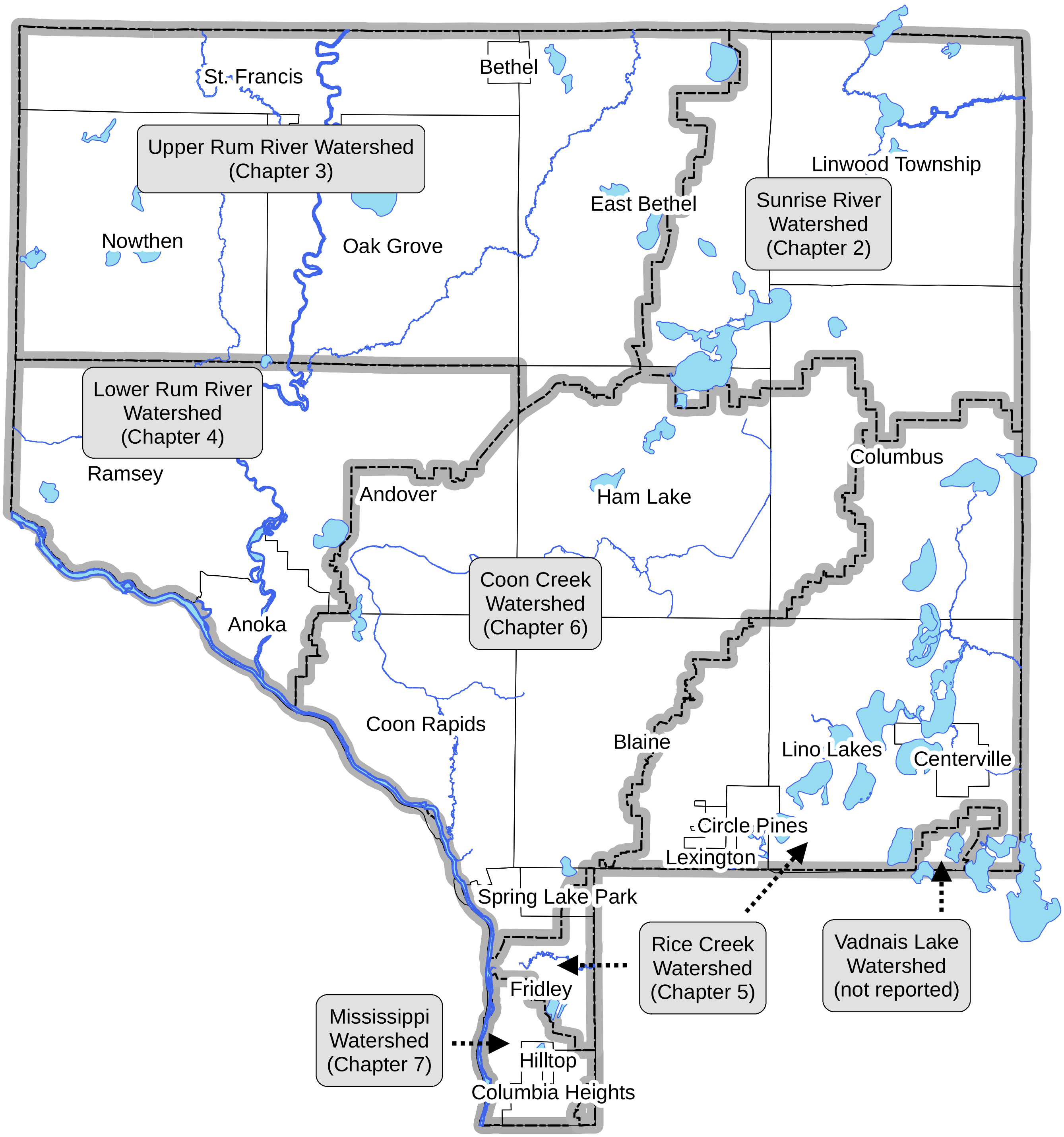
The water resource management and monitoring work reported here include:

- Monitoring
    - precipitation,
    - lake levels,
    - lake water quality,
    - stream hydrology,
    - stream water quality,
    - stream benthic macroinvertebrates,
    - shallow groundwater levels in wetlands, and
    - deep groundwater in observation wells.
- Water quality improvement projects
    - projects designed, installed, or planned are briefly discussed in this report,
    - cost share grants for erosion correction, lakeshore restorations, and rain gardens, and
    - promotion of available grants for water quality improvement projects.
- Studies and analyses
    - stormwater retrofitting assessments,
    - upstream to downstream water quality analyses,
    - water quality trend analyses,
    - precipitation storm analyses and long term antecedent moisture analyses, and
    - reference wetland vegetation inventories and multi-year summary analyses.
- Public education efforts
    - newsletters and mailings,
    - signage,
    - workshops,
    - web videos, and
    - websites.
- Other work done for watershed management organizations
    - reviews of local water plans,
    - grant searches and applications,
    - annual reports to the State, and
    - other administrative tasks

While this report is perhaps the most comprehensive source of monitoring data on lakes, stream, rivers, groundwater and wetlands in Anoka County, it is not the only source. Nor is this report a summary of all work completed throughout Anoka County in 2013. Rather, it is a summary of work carried out by the Anoka

Conservation District in conjunction with watershed organizations within the county. Furthermore, only work conducted during 2013 is presented in this almanac (although trend and similar analysis also include previous years' data). For results of work completed in years past, readers should refer to previous Water Almanacs. All data collected in 2013 and in years past is available in digital format from the Anoka Conservation District. All applicable data is also submitted to state databases for wider availability; these include the MPCA's EQuIS water quality database, the DNR's lakefinder tool for lake levels and groundwater level database, and the State Climatology's online precipitation database.

Chapter 1 - Primer



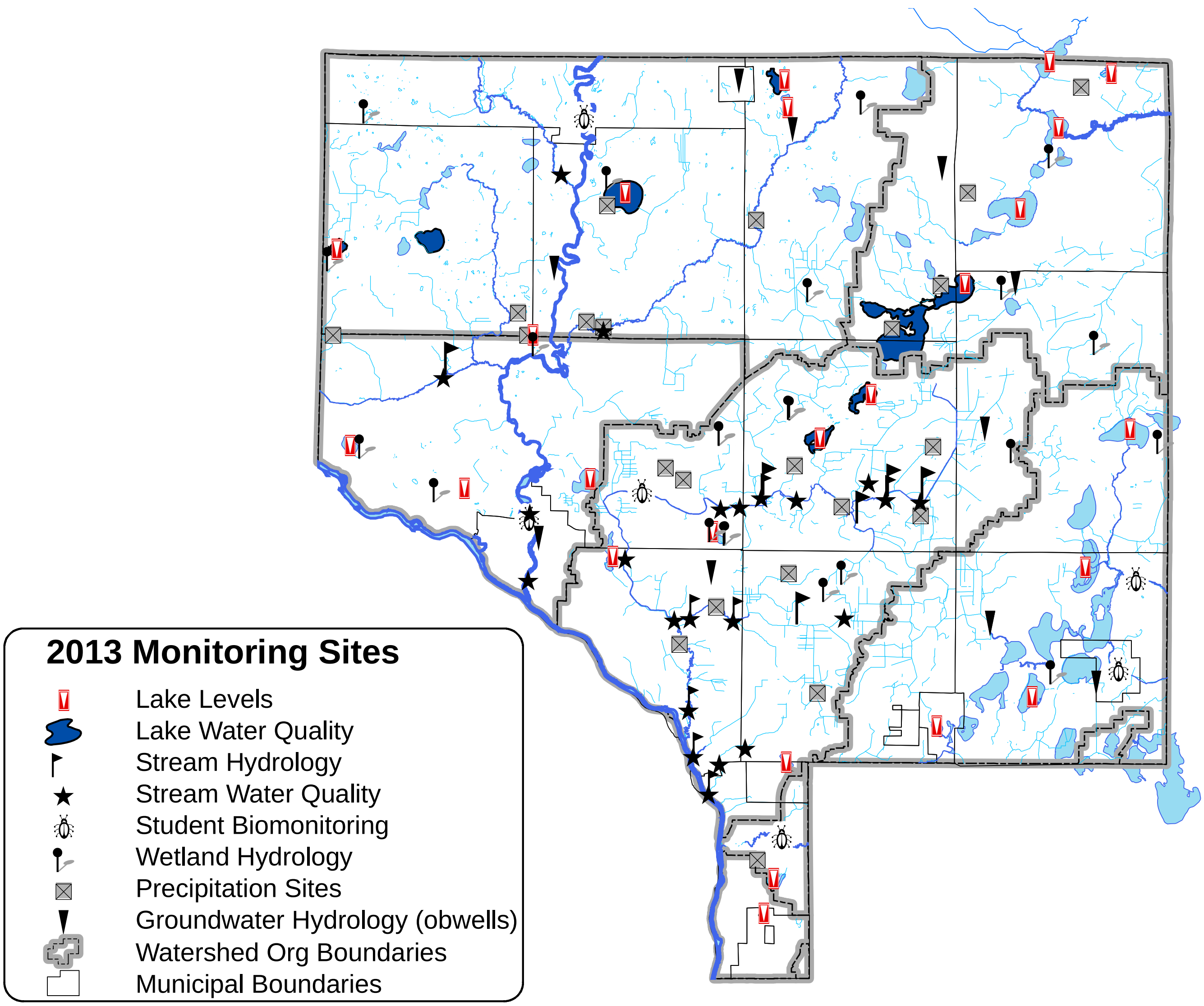
Contact Info: Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 1: WATER RESOURCE MONITORING PRIMER

This report is an annual report to watershed organizations that helped fund water monitoring and management in cooperative efforts with the Anoka Conservation District. It also includes other water-related work carried out by the ACD without partners. This chapter provides an overview of the monitoring activities reported in later chapters, the methodologies used, and information that will help the layperson interpret information found in later chapters. This report includes a variety of work aimed at managing water resources, including lakes, streams, rivers, wetlands, groundwater, and precipitation (see map below).

County-wide precipitation and groundwater hydrology data is presented in Chapter 1.

2013 Water Monitoring Sites



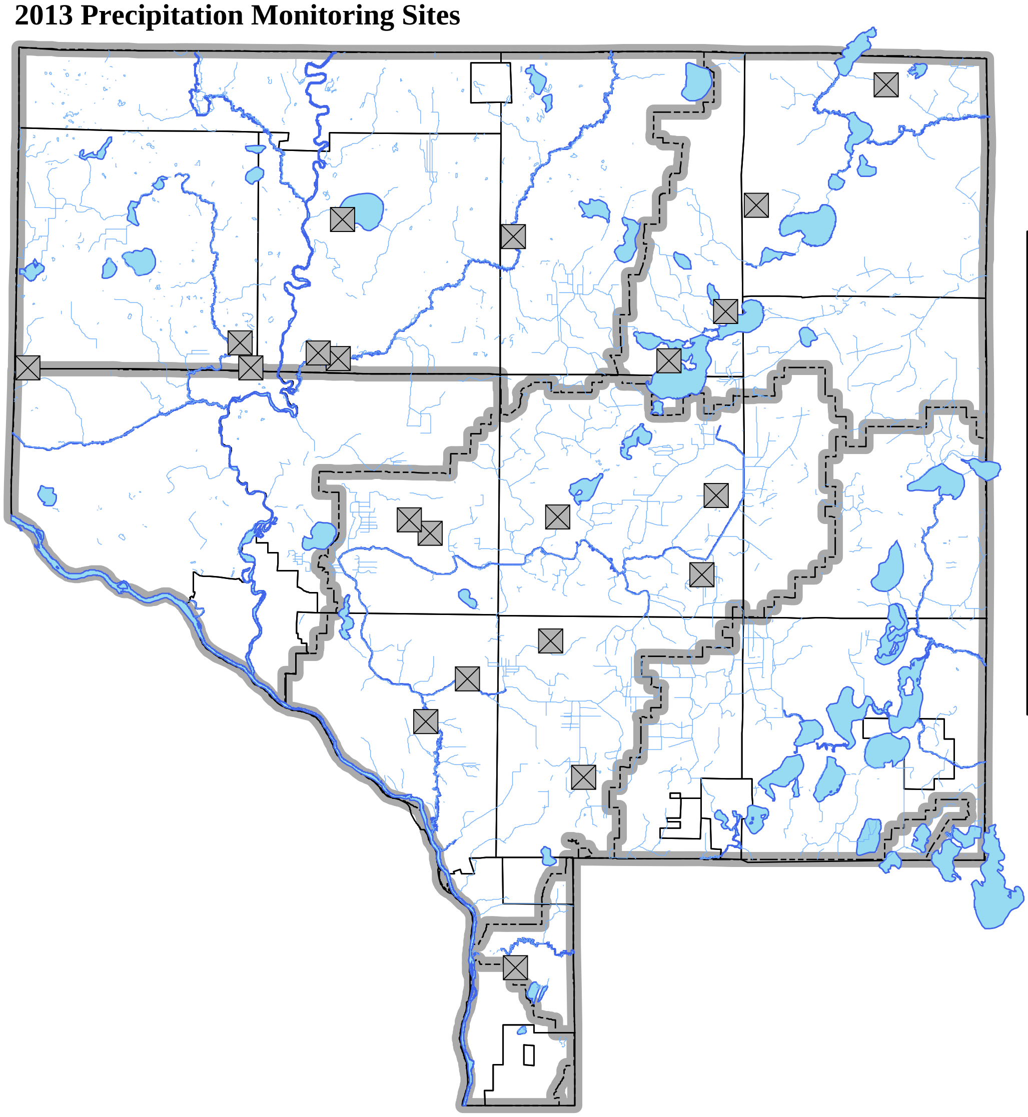
Precipitation

Precipitation data is useful for understanding the hydrology of water bodies, predicting flooding and groundwater limitations, and is needed to guide the use of special regulations that protect property and the environment in times of high or low water. Rainfall can vary substantially, even within one city.

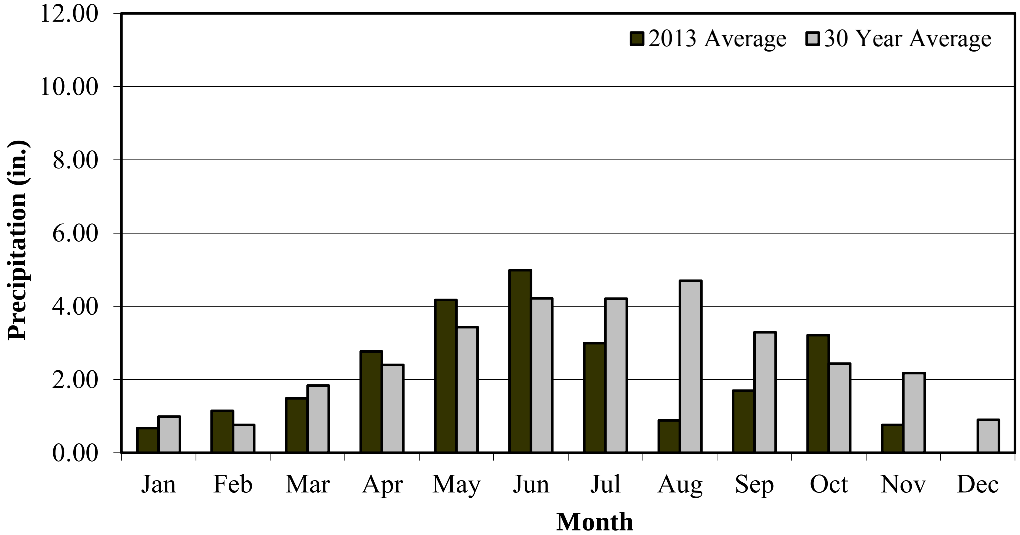
The ACD coordinates a network of 21 rain gauges countywide. Fifteen are monitored by volunteers and six are monitored using datalogging stations operated by the ACD for the Coon Creek Watershed District. The volunteer-operated stations are cylinder-style rain gauges located at the volunteer's home. Total rainfall is read daily. The datalogging rain gauges electronically record the time and date of each 0.01 inch of rain that falls. These gauges are downloaded approximately every four weeks. All data collected by volunteers is submitted to the Minnesota State Office of Climatology where it is available to the public through http://climate.umn.edu.

A summary of county-wide data is provided on the following page. Analyses of antecedent moisture for selected locations are provided in the Coon Creek Watershed chapter.

2013 Precipitation Monitoring Sites



2013 Anoka County Average Monthly Precipitation (average of all sites)



2013 Anoka County Monthly Precipitation at each Monitoring Site

Location or Volunteer	City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total	Growing Season (May-Sept)
							Month								
Tipping bucket, datalogging rain gauges (Time and date of each 0.01" is recorded)															
Andover City Hall	Andover				2.56	4.78	0.75		1.46	1.63				11.18	
Blaine Public Works	Blaine			0.60	2.18	4.49	5.05	3.07	0.92	1.16	3.32			20.79	14.69
Coon Rapids City Hall	Coon Rapids			0.66	2.69	4.81	5.54	3.71	1.14	1.53	1.77			21.85	16.73
Anoka Cons. District office	Ham Lake				0.83	0.76	2.56		0.73	1.49	3.63			10.00	5.54
Hoffman Sod Farm	Ham Lake			0.56	2.36	4.68	5.18	3.17	1.12	1.56	1.51			20.14	
Northern Nat. Gas substation	Ham Lake					4.02	5.23	0.82						10.07	
Cylinder rain gauges (read daily)															
N. Myhre	Andover	0.70	1.14		3.16	4.29	5.11	2.77	1.04	1.53	3.82	0.66		24.22	14.74
B. Guetzko	Nowthen														
J. Rufsvold	Burns				2.71	4.59	5.42	4.19	1.06	1.86	3.73	0.92		24.48	
J. Arzdorf	Blaine			1.11	3.04	4.92	4.98	2.89	1.03	1.48	4.40			23.85	15.30
S. Solie	Coon Rapids														
M. Gaynor	East Bethel				3.01	4.02	4.47	2.94	0.89					15.33	
P. Arzdorf	East Bethel				3.31	4.51	5.11	2.92	1.00	2.43	3.79			23.07	15.97
A. Mercil	East Bethel	0.69	0.72	1.93	2.39	4.10	4.57	3.49	0.57	1.74	3.12	0.70		24.02	14.47
K. Ackerman	Fridley	0.69	1.20	2.03	4.40	4.67	7.46	3.55	1.00	1.20	3.91			30.11	17.88
B. Myers	Linwood				2.46	4.93	4.66	1.96	0.97	1.79	2.51			19.28	14.31
D. Kramer	Linwood														0.00
A. Dalske	Oak Grove	0.62	1.29	2.55	4.32	3.40	6.18	3.65	0.61	1.65	3.48	0.75		28.50	15.49
P. Freeman	Oak Grove		1.37	2.42	2.24	3.13	6.12	0.21	0.35	1.12	1.70	0.61		15.49	10.93
D. Conger	Oak Grove					4.69	5.35	3.77	0.56	2.35	3.30			20.02	20.02
Y. Lyrenmann	Ramsey				2.58	4.30	5.95	4.89	0.65	2.62	4.25	0.94		26.18	18.41
2013 Average	County-wide	0.68	1.14	1.48	2.77	4.17	4.98	3.00	0.89	1.70	3.22	0.76		24.78	14.74
30 Year Average	Cedar	0.99	0.76	1.84	2.40	3.43	4.22	4.21	4.70	3.29	2.44	2.18	0.90	31.36	19.85

Precipitation as snow is given in melted equivalents.

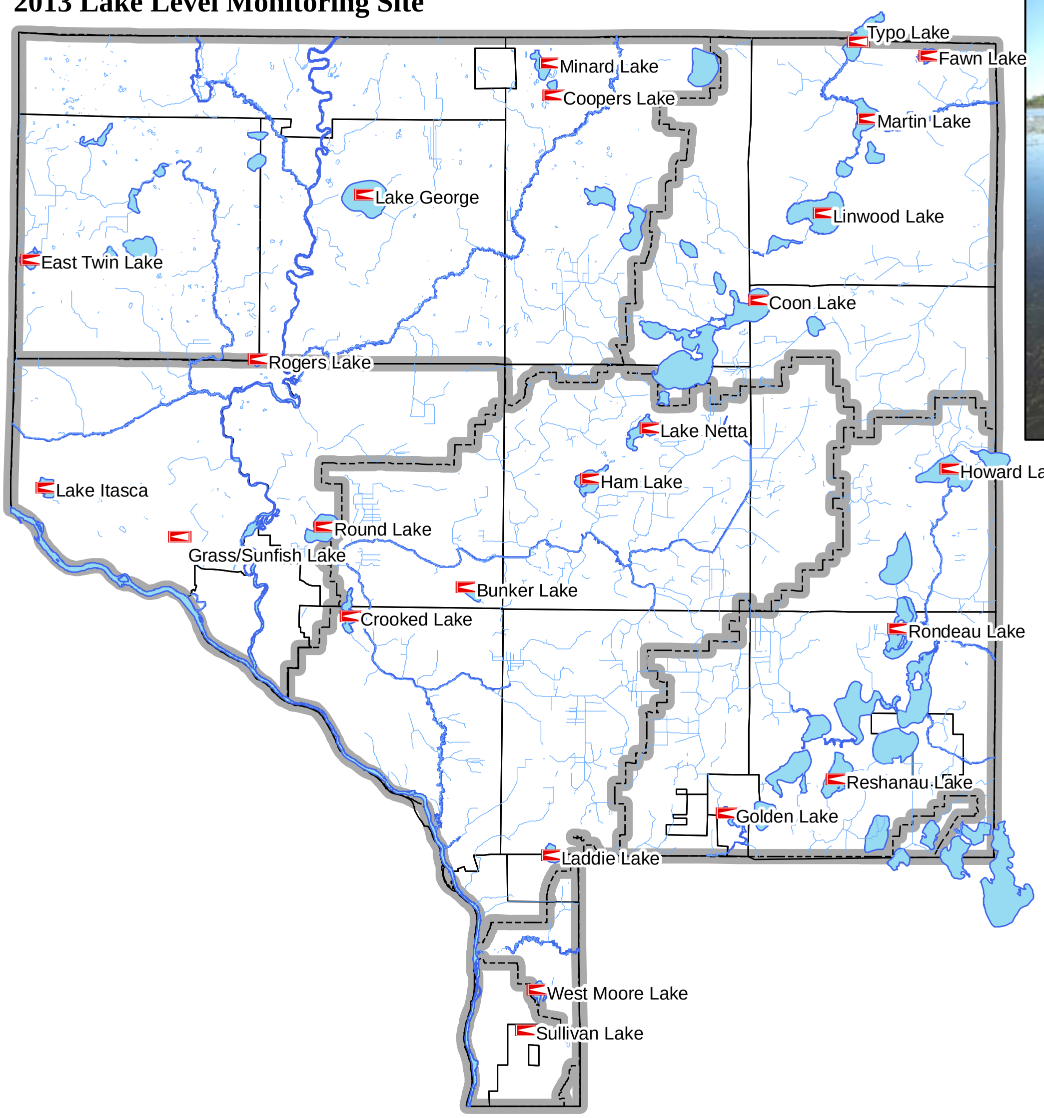
Lake Levels

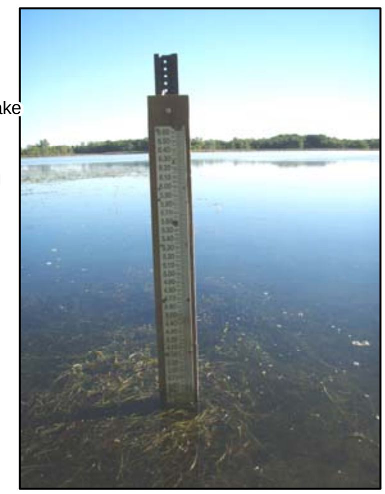
Long-term lake level records are useful for regulatory decision-making, building/development decisions, lake hydrology manipulation decisions, and investigation of possible non-natural impacts on lake levels. ACD coordinates volunteers who monitor water levels on 24 lakes.

An enamel gauge is installed in each lake and surveyed so that readings coincide with sea level elevations. Each gauge is read weekly. The ACD reports all lake level data to the MN DNR, where it is posted on their website (www.dnr.mn.us.state\lakefind\index.html), along with other information about each lake.

Results of lake level monitoring are separated by watershed in the following chapters.

2013 Lake Level Monitoring Site





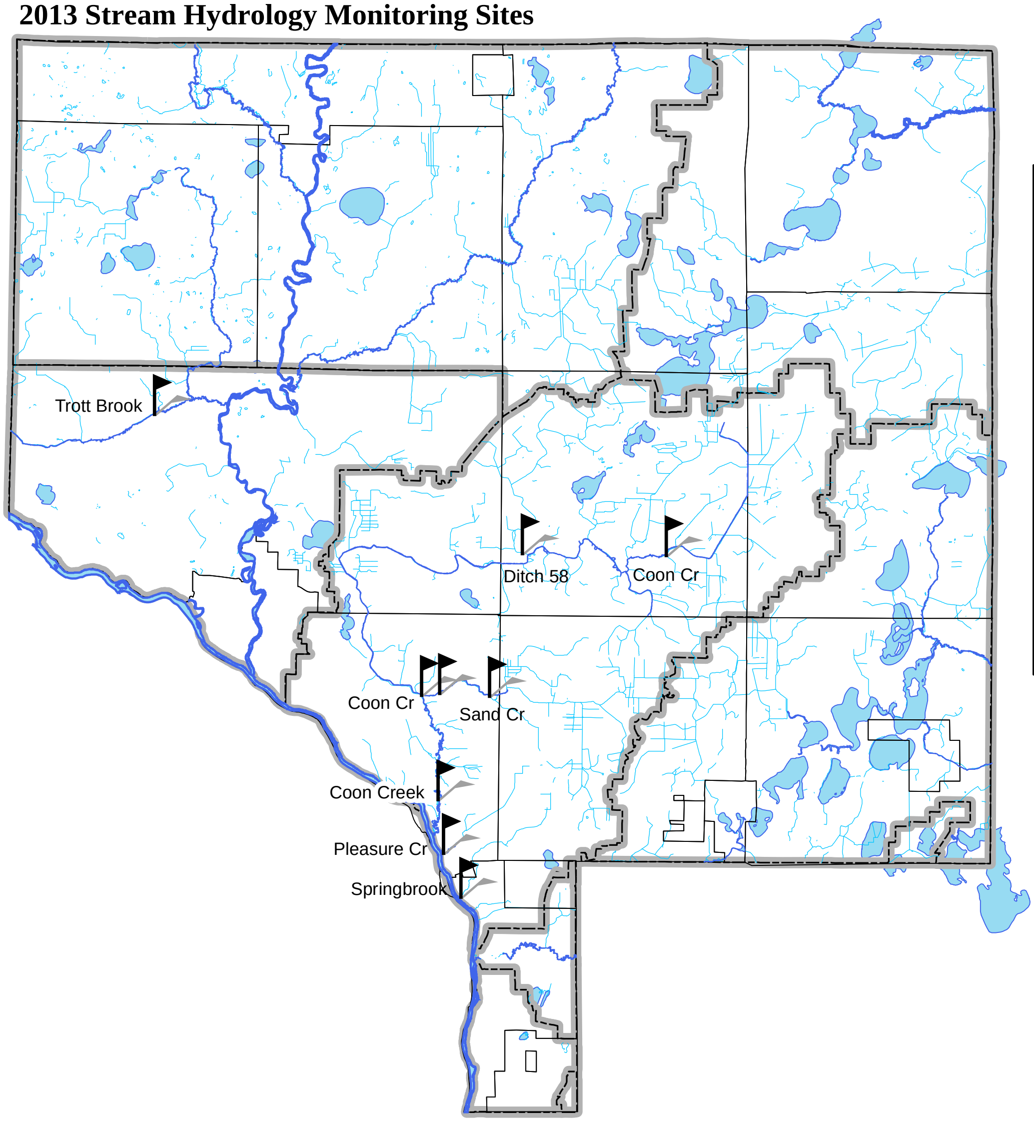
Stream Hydrology

Hydrology is the study of water quantity and movements. Records of the quantity of water flowing in a stream helps engineers and natural resource managers better understand the effects of rain events, land development and storm water management. This information is also often paired with water quality monitoring and used to calculate pollutant loadings, which is then used in computer models and water pollution regulatory determinations.

The ACD monitored hydrology at 9 stream sites in 2013. At each site is an electronic gauge that records water levels every two hours. These gauges are surveyed and calibrated so that stream water level is measured in feet above sea level. Rating curves—a known mathematical relationship between water level and flow such that one can be calculated from the other—have been developed for some sites. The information gained from the stream hydrology monitoring sites is used by the ACD, watershed management organizations, watershed districts, townships, cities, and others.

Results of stream hydrology monitoring are separated by watershed in the following chapters.

2013 Stream Hydrology Monitoring Sites



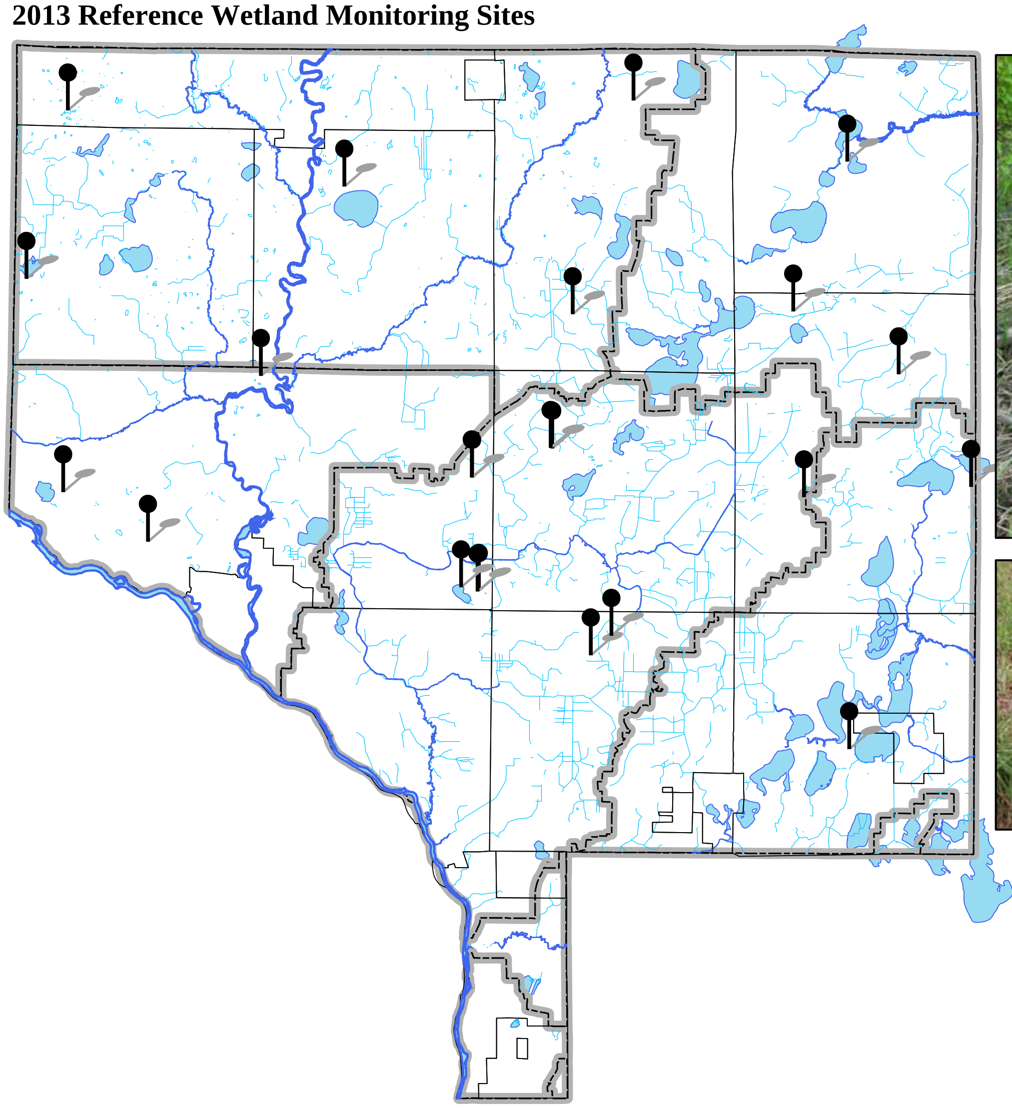
Wetland Hydrology

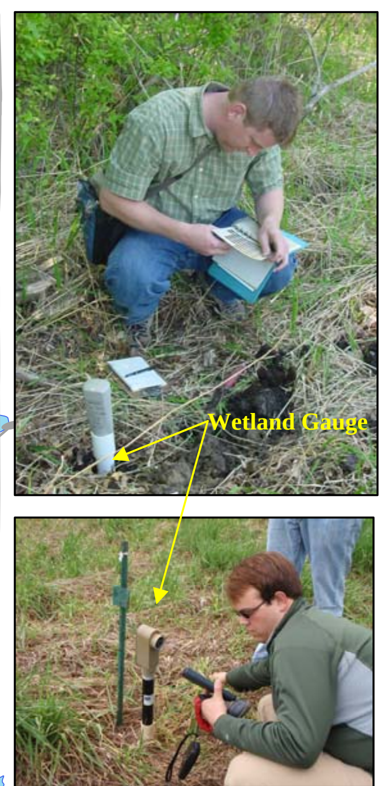
Wetland regulations are often focused upon determining whether an area is, or is not, a wetland. This is difficult at times because most wetlands are not continually wet. In order to facilitate fair, accurate wetland determinations the ACD monitors 18 wetlands throughout the county that serve as a reference of conditions county-wide. These are called reference wetlands. Electronic monitoring wells are used to measure subsurface water levels at the wetland edge every four hours down to a depth of 40 inches below grade. This hydrologic information, along with examination of the vegetation and soils, aids in accurate wetland determinations and delineations. These reference wetlands represent several wetland types and some most been monitored for 10+ years.

Reference wetland data provides insights into shallow groundwater hydrology trends. This can be useful for a variety of purposes from flood predictions to indices of drought severity. There are concerns locally that shallow aquifers are being drawn down.

Results of wetland hydrology monitoring are separated by watershed in the following chapters. The Coon Creek Watershed chapter includes a multi-year and most recent year analysis of all the wetlands.

2013 Reference Wetland Monitoring Sites



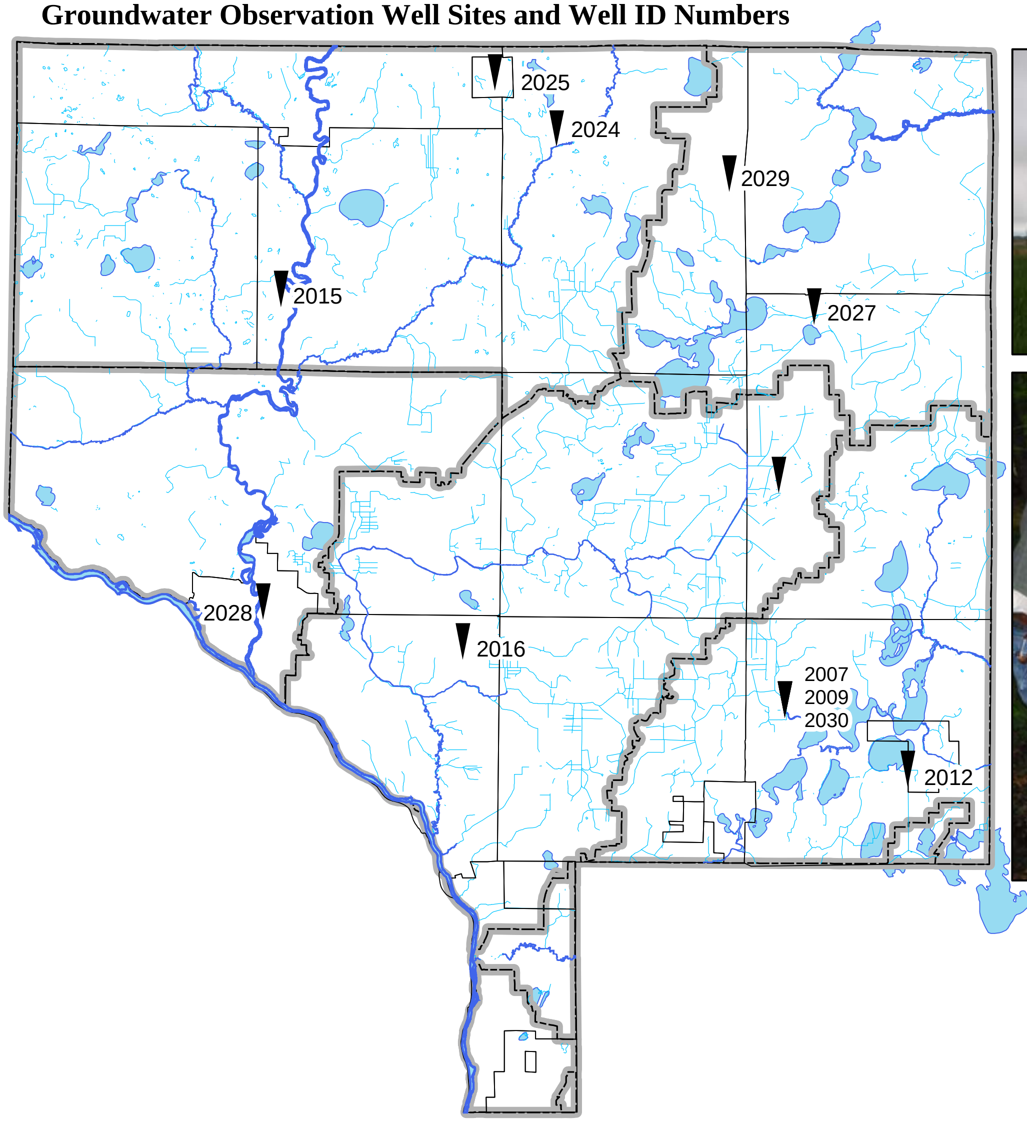


Groundwater Hydrology

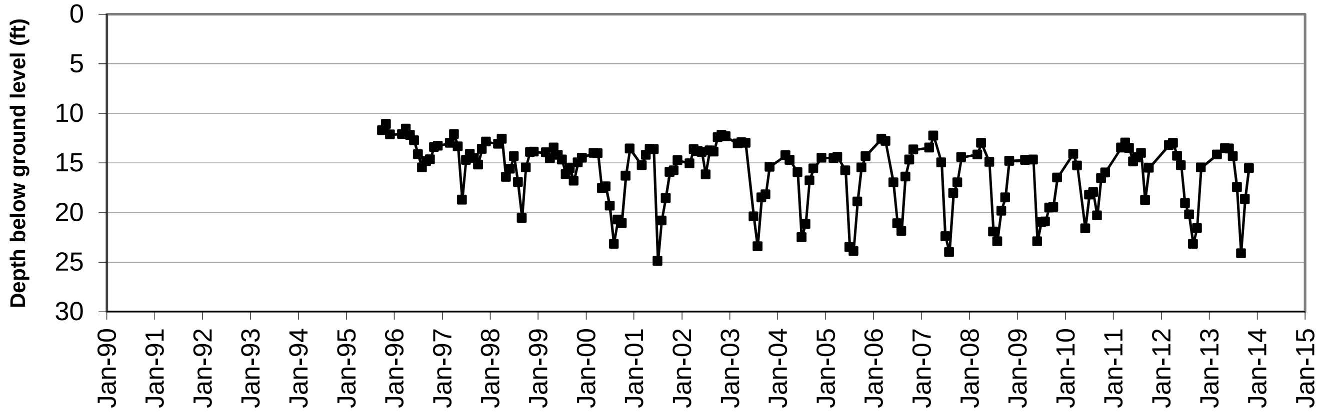
The Minnesota Department of Natural Resources (MN DNR) and ACD are interested in understanding Minnesota's groundwater quantity and flow. The MN DNR maintains a network of groundwater observation wells across the state. The ACD is contracted to take monthly water level readings in wells at 11 sites in Anoka County from March to December. At some sites, the MN DNR also has automated devices taking water level readings at more frequent intervals. The MN DNR incorporates these data into a statewide database that aids in groundwater mapping. The data are reported by the MN DNR and available to the public on their web site http://www.dnr.state.mn.us/waters/groundwater_section/obwell. These deep groundwater wells are not as sensitive to precipitation as other hydrologic systems such as wetlands and streams, but rather respond to longer term trends.

The charts on the following pages show groundwater levels for 1990-2013. These results are not presented elsewhere in this report. Raw data can be downloaded from the MN DNR website.

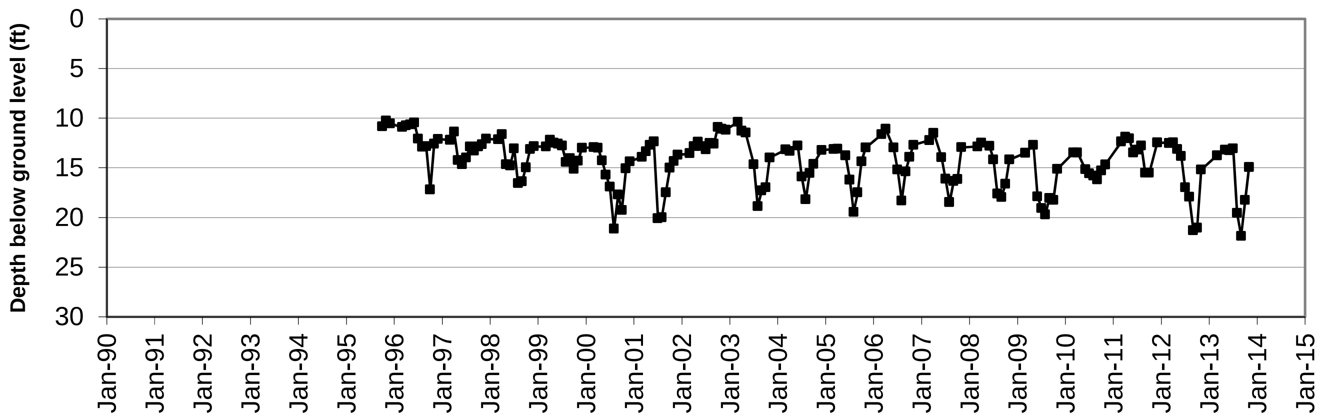
Groundwater Observation Well Sites and Well ID Numbers



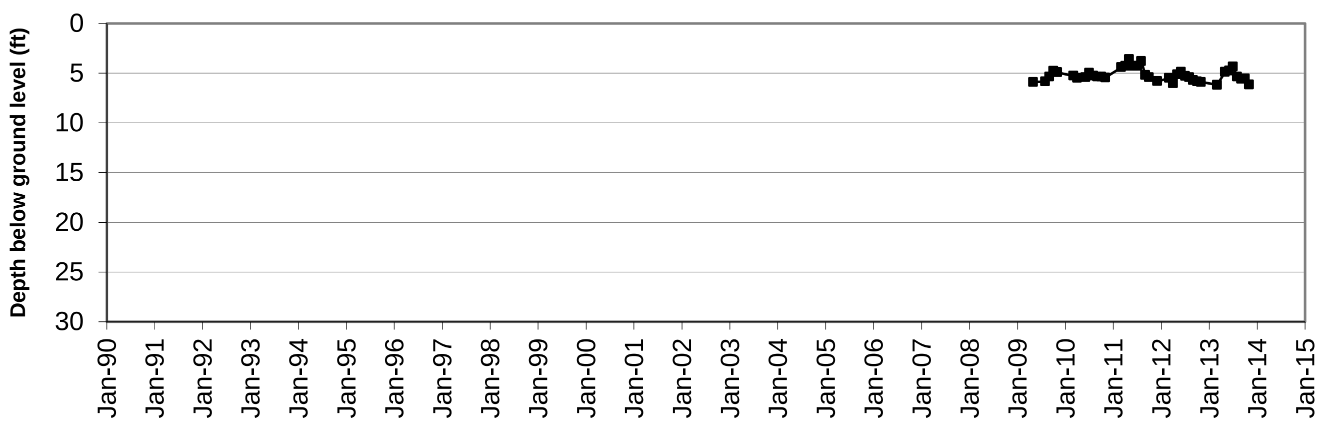
Observation Well #2007 (270 ft deep)—Lino Lakes



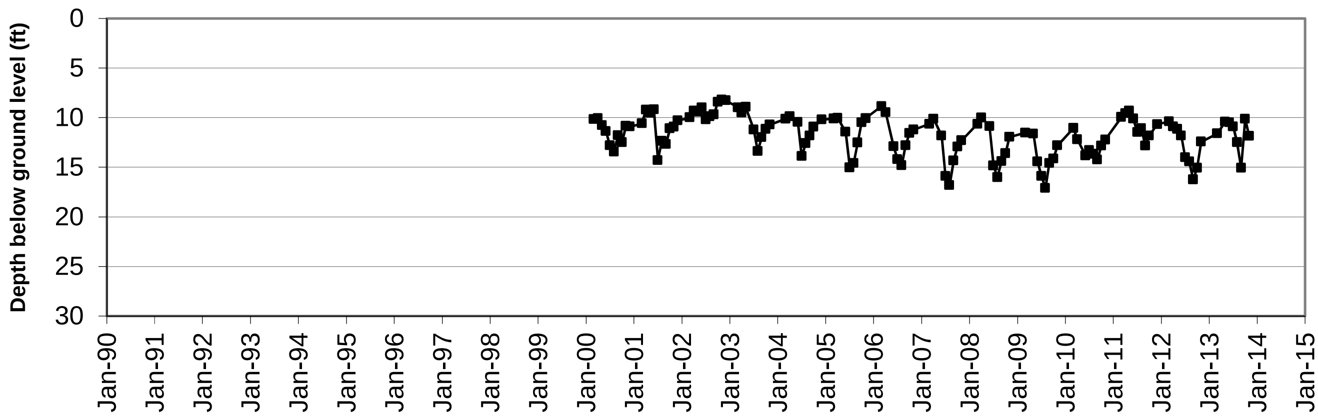
Observation Well #2009 (125 ft deep)—Lino lakes



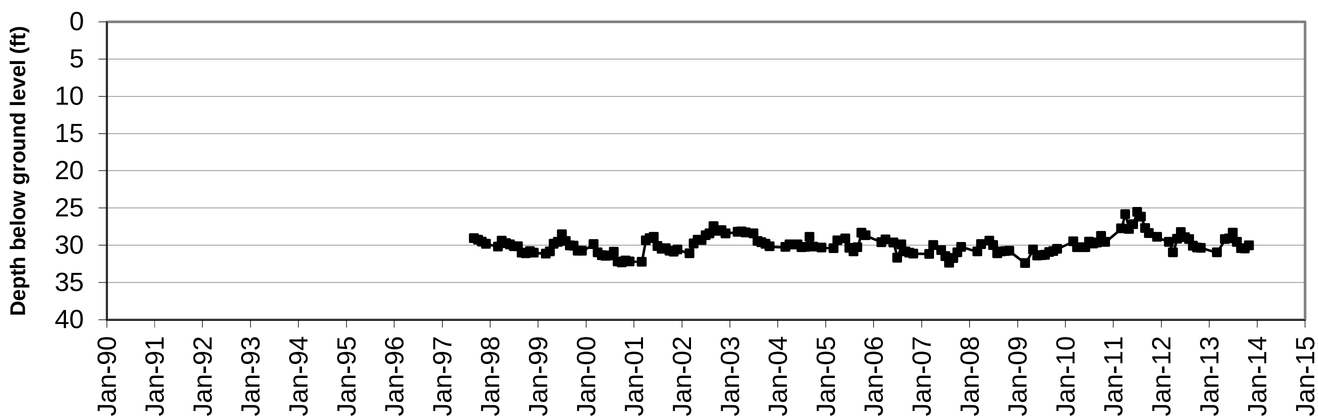
Observation Well #2030 (15 ft deep)—Lino Lakes



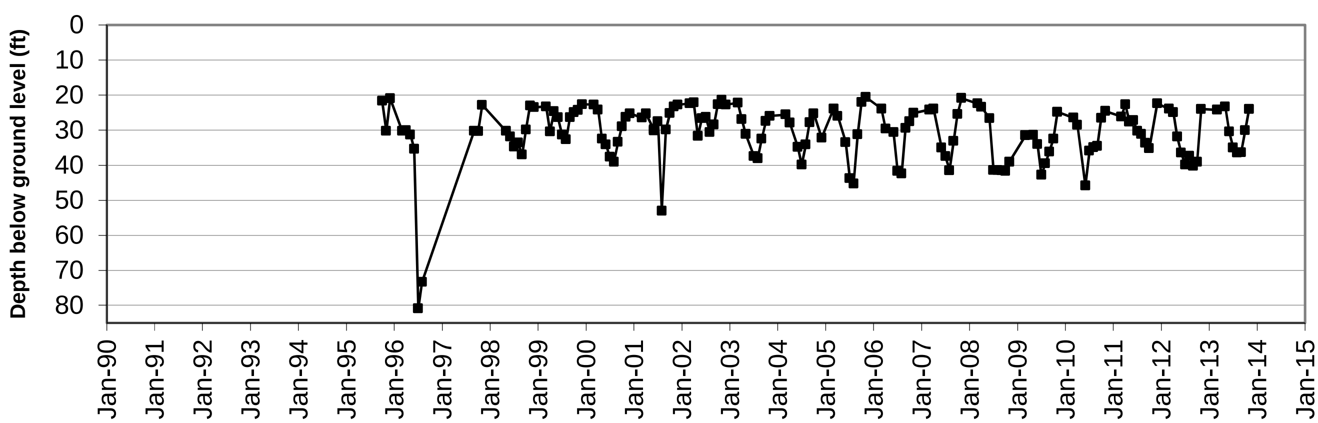
Observation Well #2012 (277 ft deep) – Centerville



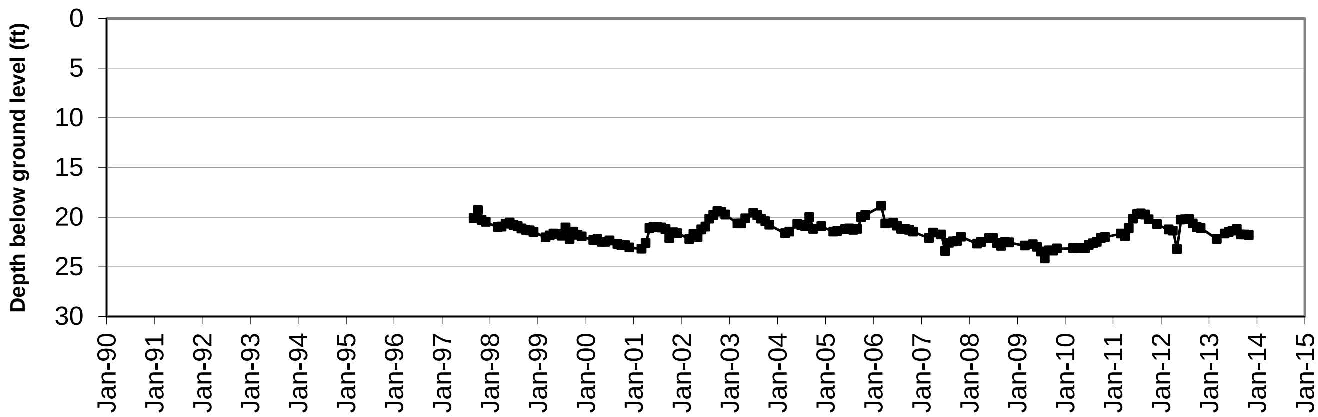
Observation Well #2015 (280 ft deep)—Ramsey



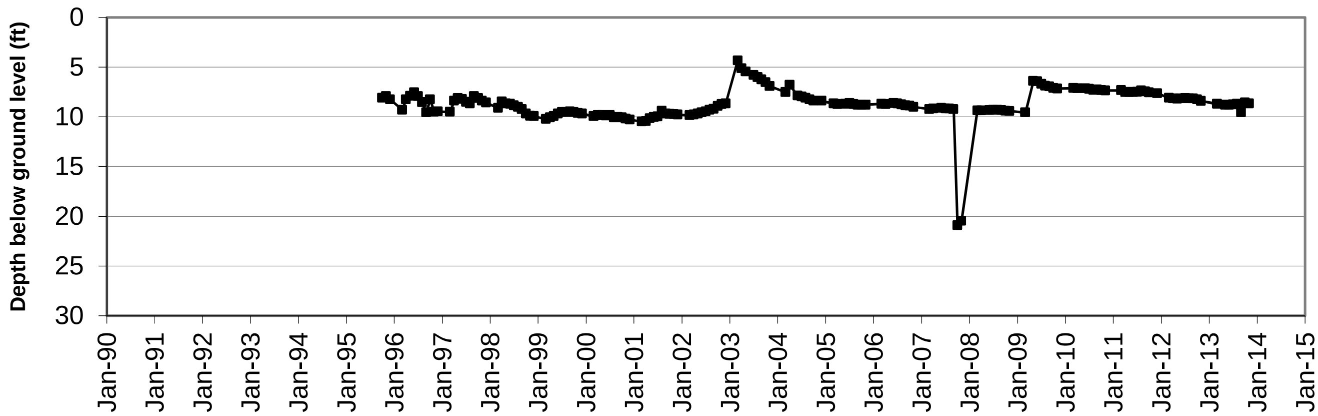
Observation Well #2016 (193 ft deep)—Coon Rapids



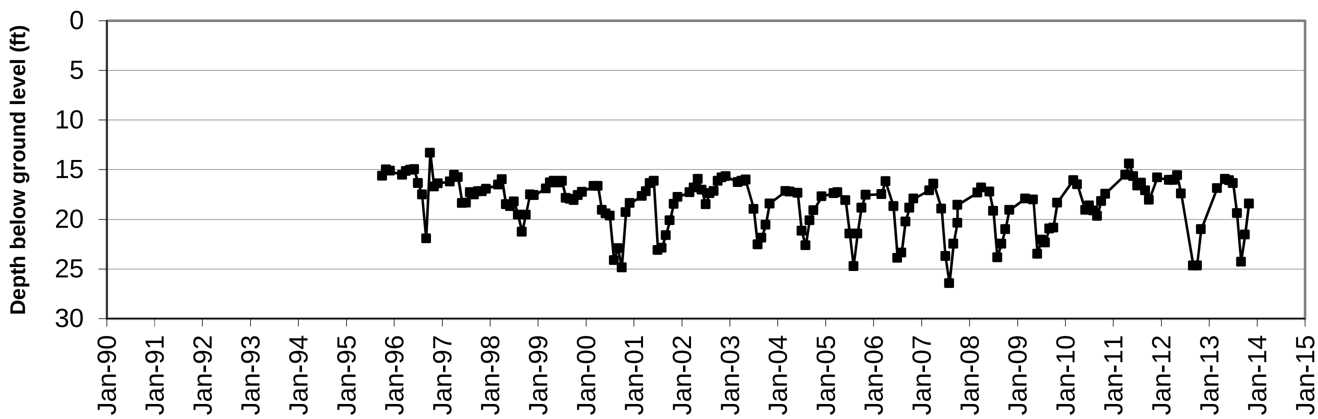
Observation Well #2024 (141 ft deep)—East Bethel



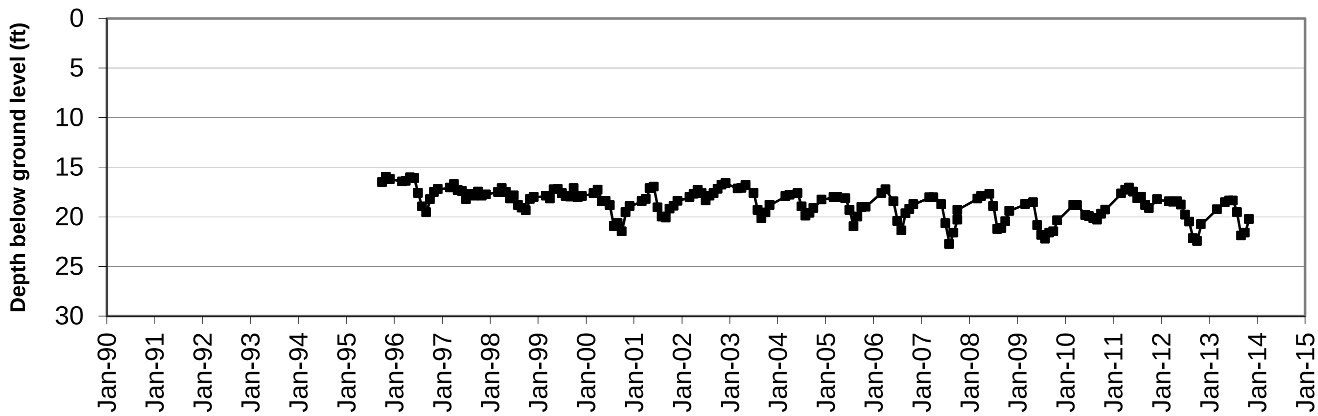
Observation Well #2025 (21 ft deep)—Bethel



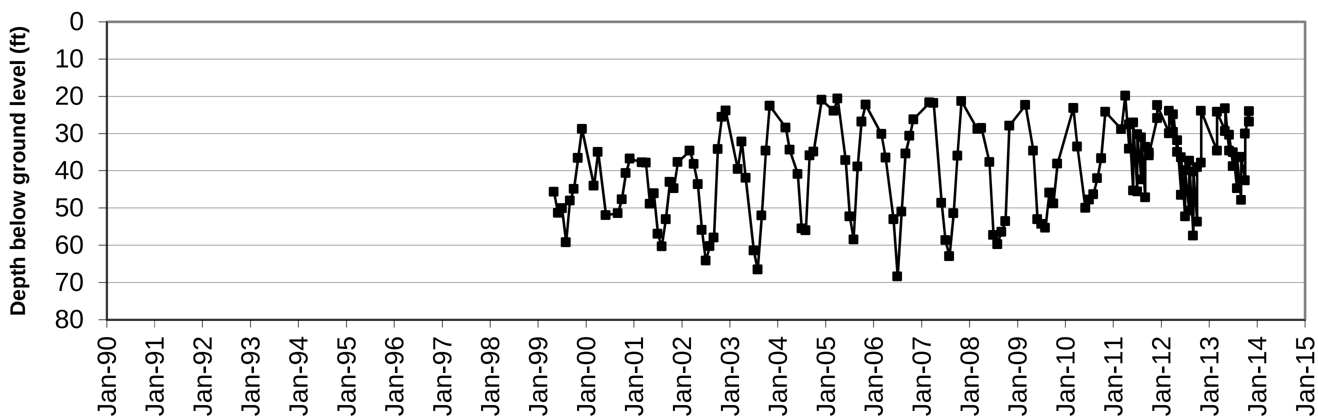
Observation Well #2026 (150 ft deep)— Carlos Avery #4



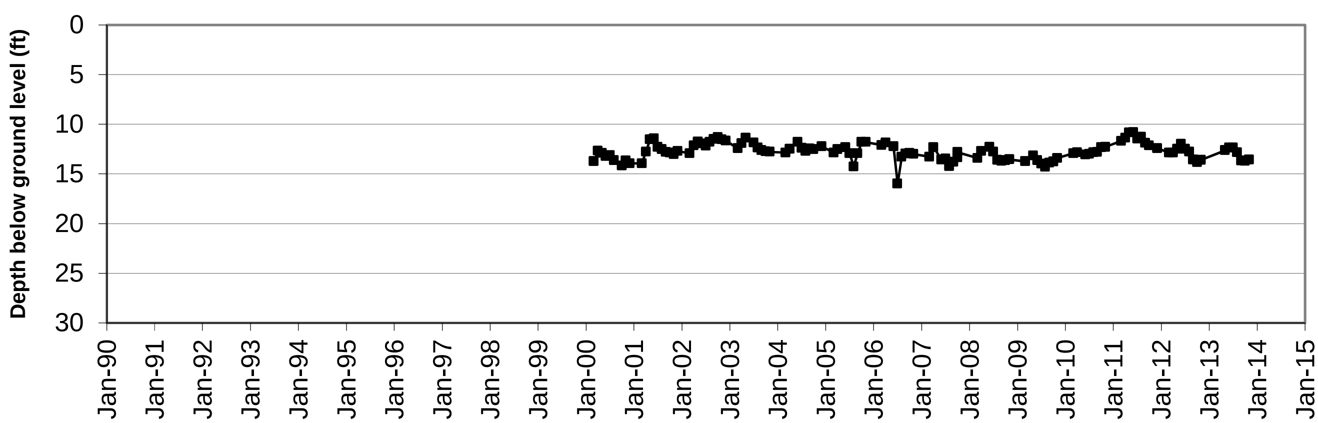
Observation Well #2027 (333 ft deep)— Columbus Twp.



Observation Well #2028 (510 ft deep)—Anoka



Observation Well #2029 (221 ft deep)—Linwood Twp.

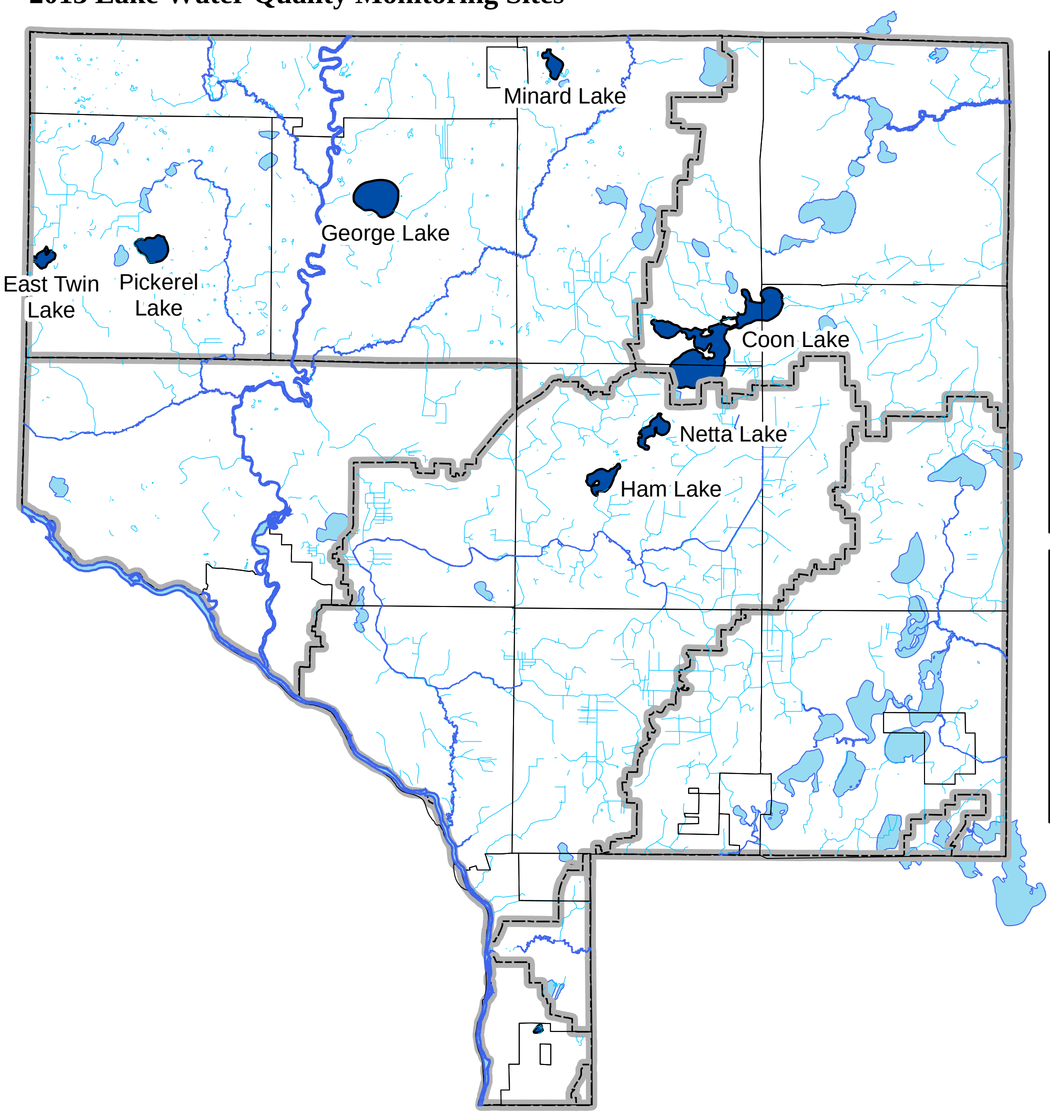


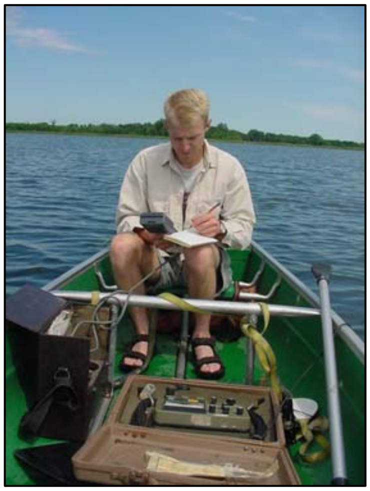
Lake Water Quality

The purpose of lake water quality monitoring is to detect and diagnose water quality problems that may affect suitability for recreation or that may adversely affect people or wildlife. The monitoring regime is designed to ensure major recreational lakes are monitored every 2-3 years. Some lakes are monitored more frequently if problems are suspected or projects are occurring that could affect lake water quality. Lakes with stable conditions, no suspected new problems, and robust datasets are monitored less often. Monitoring efforts of the Minnesota Pollution Control Agency or Metropolitan Council are not duplicated, and are not presented in this report.

In addition to this report, there are several sources of lake water quality data. For lakes monitored by the ACD prior to the current year, see the summary table on page 16. Detailed analyses for the lakes shown in that table are in that year's Water Almanac Report. All data collected by the ACD and most other agencies can be retrieved through the MPCA's website Electronic Data Access tool, which draws data from their EQuIS database.

2013 Lake Water Quality Monitoring Sites





LAKE WATER QUALITY MONITORING METHODS

The following parameters are tested at each lake:

- Dissolved Oxygen (DO);
- Turbidity;
- Conductivity;
- Temperature;
- Salinity;
- Total Phosphorus (TP);
- Transparency (Secchi Disk);
- Chlorophyll-a (Cl-a);
- pH.

Lakes are sampled every two weeks from May to September. Monitoring is conducted by boat at the deepest area of the lake. These sites are located using a portable depth finder or GPS. Conductivity, pH, turbidity, salinity, dissolved oxygen (DO), and temperature are measured using the Hydolab Quanta multi-probe at a depth of one meter. Water samples are collected with a Kemmerer sampler from a depth of one meter, to be analyzed by an independent laboratory (MVTL Labs) for chlorophyll-a, chlorides, and total phosphorus. Sample bottles are provided by the laboratory. Total phosphorus sample bottles contain preservative sulfuric acid (H_2SO_4), while bottles for Chlorides and Chlorophyll-a analyses do not require preservative. Chlorophyll-a bottles are wrapped in aluminum foil to exclude light. Water samples are kept on ice and delivered to the laboratory within 24 hours of collection.

Transparency is measured using a Secchi disk. The disk is lowered over the shaded side of the boat until it disappears and is then pulled up to the point where it reappears again. The midpoint between these two depths is the Secchi disk measurement.

To evaluate the lake, results are compared to other lakes in the region and past readings at the lake. Comparisons to other lakes are based on the Metropolitan Council's lake quality grading system and the Carlson's Trophic State Index for the North Central Hardwood Forest ecoregion. Historical data for each lake can be obtained from the U.S. EPA's national water quality database, EQuIS, via the Minnesota Pollution Control Agency.

Lake Water Quality Questions and Answers

This section is intended to answer basic questions about the Anoka Conservation District's methodology for monitoring lake water quality and interpreting the data.

Q- Which parameters did you test and what do they mean?

A- The table on the following page outlines technical information about the parameters measured, which include:

pH- This test measures if the lake water is basic or acidic. A pH reading of greater than 7 signifies that the lake is basic and a reading of less than 7 means the lake is acidic. Many fish and other aquatic organisms need a pH in the range of 6.5 to 9.0 in order to remain viable. Eutrophic lakes are often basic (pH = >7). The pH of a lake will fluctuate daily and seasonally due to algal photosynthesis, runoff, and other factors.

Conductivity- This is a measure of the amount of dissolved minerals in the lake. Although every lake has a certain amount of dissolved matter, high conductivity readings may indicate additional inputs from sources such as storm water, agricultural runoff, or from failing septic systems.

Turbidity- This is a measure of the amount of solid material suspended in the water column, due to "muddiness" or algae.

Dissolved Oxygen (DO) - Sources of dissolved oxygen include the atmosphere, aeration from stream inflow, and photosynthesis by algae and submerged plants in the lake. Dissolved oxygen is consumed by organisms in the lake and by decomposition processes.

Dissolved oxygen is essential to the metabolism of all aquatic organisms and low dissolved oxygen is often the reason for fish kills. Extremely low DO concentrations at the lake bottom can also trigger a chemical reaction that causes phosphorus to be released from the sediment into the water column.

Salinity- This parameter measures the amount of dissolved salts in the water. Dissolved salts in a lake are not naturally occurring in Anoka County. High salinity measurements may be the result of inputs from other sources such as failing septic systems, spring runoff from roads, and farm field runoff.

Temperature- Fish species are sensitive to water temperature. Lake trout and salmon prefer temperatures between 46-56°F, while bass and pan fish will withstand temperatures of 76°F or greater. Temperature also affects the amount of dissolved oxygen that the water can hold in solution. At warmer temperatures, oxygen is readily released to the atmosphere and dissolved oxygen concentrations fall.

Secchi Transparency- Transparency is directly related to the amount of algae and suspended solids in the water column. A Secchi disk is a white and black disk attached to the end of a rope that is marked at 0.1-foot intervals. The disk is lowered over the shaded side of the boat until it disappears and is then pulled up to the point where it reappears again. The midpoint between these two points is the Secchi transparency. Shallow measurements indicate abundant algae and/or suspended solids.

Total Phosphorus (TP) - Phosphorus is an essential nutrient. Algal growth is commonly limited by phosphorous. High phosphorous in a lake result in abundant algal growth. This, in turn, affects a variety of chemical and ecological factors including the lake's recreational suitability, fisheries, plants, and dissolved oxygen. A single pound of phosphorus can result in 500 pounds of algal growth. Minnesota Pollution Control Agency standards designate a lake in our ecoregion as "impaired" if average summertime phosphorus is >40 µg/L (or >60 µg/L for shallow lakes).

Sources of phosphorus include runoff from agricultural land, runoff carrying fertilizer from lakeshore properties, failing septic systems, pet wastes, and storm water runoff. The lake itself can also be a source of phosphorus. High levels of phosphorus contained in the bottom sediments of lakes can be released when the sediment is disturbed through recreation or animal activity, or when dissolved oxygen levels are low.

Chlorophyll-a (Cl-a) - Chlorophyll-a is the inorganic portion of all green plants that absorbs the light needed for photosynthesis. Chlorophyll-a measurements are used to indicate the concentration of algae in the water column. It does not provide an indication of large plant (macrophytes) or filamentous algae abundance.

Lake Water Quality Monitoring Parameters

Parameter	Units	Reporting Limit	Accuracy	Average Summer Range for North Central Hardwood Forest
pH	pH units	0.01	± .05	8.6 - 8.8
Conductivity	**mS/cm**	0.01	± 1%	0.3 - 0.4
Turbidity	FNRU	1	± 3%	1-2
D.O.	mg/L	0.01	± 0.1	N/A
Temperature	°C	0.1	± 0.17 °	N/A
Salinity	%	0.01	± 0.1%	N/A
T.P.	µg/L	1	NA	23 – 50
Cl-a	µg/L	1	NA	5 – 27
Secchi Depth	ft m	NA	NA	4.9 - 10.5 1.49 – 3.2

Q- Lakes are often compared to the "ecoregion." What does this mean?

A- We compare our lakes to other lakes in the same ecoregion. The U.S. Environmental Protection Agency mapped regions of the U.S based on soils, landform, potential natural vegetation, and land use. These regions are referred to as ecoregions. Minnesota has seven ecoregions. Anoka County is in the North Central Hardwood Forest ecoregion. Reference lakes, deemed to be representative and minimally impacted by man (e.g., no point source wastewater discharges, no large urban areas in the watershed, etc.), were sampled in each ecoregion to establish a standard range for water quality that should be expected in each ecoregion.
The average summer range of water quality values in the table on the previous page are the inter-quartile range (25th to 75th percentile) of the reference lakes for the North Central Hardwood Forest ecoregion. This provides a range of values that represent the central tendency of the reference lakes' water quality.

Q- What do the lake physical condition and recreational suitability numbers mean?

A- The Minnesota Pollution Control Agency has established a subjective ranking system that ACD staff use during each lake visit (see table, this page). Ranks are based purely upon the observer's perceptions. These physical and recreational rankings are designed to give a narrative description of algae levels (physical condition) and recreational suitability of each lake. While the physical condition is straight-forward, the recreational suitability may be complicated by the impacts of both water quality and dense aquatic vegetation (the influence of these two factors is not separated in the ranking).

Lake Physical and Recreational Conditions Ranking System

	Rank	Interpretation
Physical Condition	1	crystal clear
	2	some algae
	3	definite algae
	4	high algae
	5	severe bloom
Recreational Suitability	1	beautiful
	2	minimal problems, excellent swimming and boating
	3	slightly swimming impaired
	4	no swimming / boating ok
	5	no swimming or boating

Q- What is the lake quality letter grading system?

A- The Metropolitan Council developed the lake water quality report card in 1989 (see table below). Each lake receives a letter grade, that is based on average summertime (May-Sept) chlorophyll-a, total phosphorus and Secchi depth. In the same way that a teacher would grade students on a "curve," the lake grading system compares each lake only to other lakes in the region. Thus, a lake that gets an "A" in the Twin Cities Metro might only get a "C" in northern Minnesota. The goal of this grading system is to provide a single, easily understandable description of lake water quality.

Lake Grading System Criteria

Grade	Percentile	TP (µg/L)	Cl-a (µg/L)	Secchi Disk (m)
A	**< 10**	**<23**	**<10**	**>3.0**
B	**10 - 30**	**23 – 32**	**10 - 20**	**2.2 - 3.0**
C	**30 – 70**	**32 – 68**	**20 – 48**	**1.2 – 2.2**
D	**70 – 90**	**68 – 152**	**48 – 77**	**0.7 – 1.2**
F	**> 90**	**> 152**	**> 77**	**< 0.7**

Q- What is the Carlson Trophic State Index?

A- Carlson's Trophic State Index (see figure below) is a number used to describe a lake's stage of eutrophication (nutrient level, amount of algae). The index ranges from oligotrophic (clear, nutrient poor lakes) to hypereutrophic (green, nutrient overloaded lakes). The index values generally range between 0 and 100 with increasing values indicating more eutrophic conditions. Unlike the lake letter grading system, the Carlson's Trophic State Index does not compare lakes only within the same ecoregion; it is a scale used worldwide.

There are four trophic state index values: one for phosphorus, chlorophyll-a, and transparency, plus an overall trophic state index value which is a composite of the others. The indices are abbreviated as follows:

TSI- Overall Trophic State Index.

TSIP- Trophic State Index for Phosphorus.

TSIS- Trophic State Index for Secchi transparency.

TSIC- Trophic State Index for the inorganic part of algae, Chlorophyll-a.

At the conclusion of each monitoring season, the summertime (May to September) average for each trophic state index is calculated.

Q- What does the "trophic state" of a lake mean?

A- Lakes fall into four categories, or trophic states, based on lake productivity and clarity.

1. Oligotrophic- In these lakes, nutrients (total phosphorus and nitrogen) are low. Oligotrophic lakes are the deepest and clearest of all lakes, but the least productive (i.e. lowest biomass of plants and fish due to lack of nutrients).

2. Mesotrophic- In these lakes, plant nutrients are available in limited quantities allowing for some, but not excessive plant growth. These lakes are still considered relatively clear. Northern Minnesota walleye and lake trout lakes are usually mesotrophic.

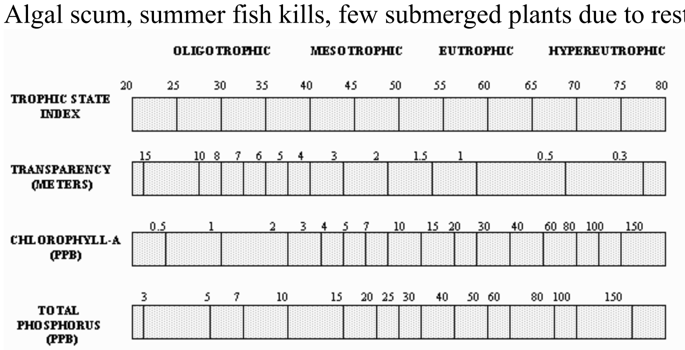
3. Eutrophic- In these lakes, the water is nutrient-rich. Productivity is high for both plants and fish. Abundant plant life, especially algae, results in poorer water clarity and can reduce the dissolved oxygen content when it decays. Algae blooms in the "dog days of summer" are commonplace. Bass and panfish are usually large components of the fish community, but rough fish can become problematic.

4. Hypereutrophic- In these lakes, nutrients are extremely abundant. Algae are grossly abundant, starving all other plants of light. The poor conditions often favor rough fish over game fish. These lakes have the poorest recreational potential.

Carlson's Trophic State Index Scale

CARLSON'S TROPHIC STATE INDEX

TSI < 30	Classic Oligotrophy: Clear water, oxygen throughout the year in the hypolimnion, salmonid fisheries in deep lakes.
TSI 30-40	Deeper lakes still exhibit classical oligotrophy, but some shallower lakes will become anoxic in the hypolimnion during the summer.
TSI 40-50	Water moderately clear, but increasing probability of anoxia in hypolimnion during the summer.
TSI 50-60	Lower boundary of classical eutrophy: Decreased transparency, anoxic hypolimnion during the summer, submerged plant growth problems evident, warm-water fisheries only.
TSI 60-70	Dominance of blue-green algae, algal scum probable, extensive submerged plant problems.
TSI 70-80	Heavy algal blooms possible throughout the summer, dense submerged plant beds, but extent limited by light penetration. Often classified as hypereutrophic.
TSI >80	Algal scum, summer fish kills, few submerged plants due to restricted light penetration.



Q- At what concentrations do total phosphorus and chlorophyll-a become a problem in lake water?

A- Lakes in the North Central Hardwood Forests have a certain criteria set for both total phosphorus and chlorophyll-a. For total phosphorus, the concentration for primary contact, recreation and aesthetics set at < 40 μg/L (<60 μg/L in shallow lakes). For chlorophyll-a, the average concentrations range from 5 to 22 μg/L, with maximums ranging from 7 to 37 μg/L. Once these set limits have been reached or exceeded, excessive algae growth will be observed.

Q- How do lakes change throughout the year and how does this affect water quality?

A- Water temperature is very important to the function of lakes. Lakes undergo seasonal changes that can influence water quality conditions. Because many Anoka County lakes are shallow (< 20 ft), some of the seasonal changes that are typical for deep lakes do not occur. The following discussion does not apply to these shallow lakes.

In the summer after the lake has warmed, deep lakes typically will be divided into three layers (stratified) based on the water's temperature and density; the well-mixed upper layer (epilimnion); the middle transition layer (metalimnion); and the cool, deep bottom layer (hypolimnion). The hypolimnion is usually depleted of oxygen because of decomposition of organic matter, the lack of photosynthesis, and because there is no contact with the surface where gas exchange with air can occur. Nutrients attached to sediment or decomposing organic material also fall into the hypolimnion where they are temporarily or permanently lost from the system. This is one reason deep lakes are usually not as nutrient rich and do not experience algae problems like shallow lakes.

In the autumn, the water near the surface eventually cools to the same temperature as the water at the bottom of the lake. When the water is of uniform temperature from top to bottom, it is easily mixed by the wind. This mixes nutrients that were formerly trapped at the bottom and may cause an autumn algal bloom. If the algal bloom is too severe, it could be detrimental to the lake during the winter when it is covered with ice. These algae will decay consuming dissolved oxygen, already decreased due to ice over, which may lead to a winter fish kill. This situation is typically observed in shallow eutrophic and/or hypereutrophic lakes.

In winter an inverse thermal stratification sets up. Ice is less dense than water and therefore floats. The coldest water is nearest the surface. Water has a maximum density at 4^{o} C, and that water is found at the bottom. The reversal of the temperature layers in spring and fall is called "turning over."

In spring, the lake "turns over" with the warmer water rising to the top and the colder sinking to the bottom. When this occurs, nutrients needed for plant growth (total phosphorus and nitrogen) are distributed throughout the lake from the bottom. As solar radiation slowly warms the deeper lakes during the spring and summer, the lake starts to stratify into the three layers again, this time with the warmest water on top.

Q- How do we determine if there is a trend of improving or worsening lake water quality?

A- Because of inherent natural variation, lake water quality is not the same each year. Sorting out this natural variation from true trends is best accomplished with statistical tests that analyze the data objectively. When at least 5 years of monitoring data are present, ACD staff test for lake trends using a Multivariate Analysis of Variance (MANOVA). MANOVA tests the vector response of correlated response variables (Secchi depth, total phosphorus, and chlorophyll-a) while maintaining the probability of making a type I error (rejecting a true null hypothesis) at $\alpha = 0.05$. In other words we are simultaneously testing the three most important measurements of lake water quality. Testing each response variable separately would increase the chance of making a type I error.

Historic Water Quality Grades for Anoka County Lakes (includes monitoring by ACD and Met Council's CAMP program, post-1980 only.)

Year→	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Cenaiko																	B	A	A	A	B	A	A	A	A	A	A	B	B	B	B	B	
Centerville	C		C					D												C	C		C	C	A								
Coon				C					C					C			C	B	A	B	C	B		C		C		C					
Coon (East Bay)				C					C	C	C		C	C	C		B	B	A	B	C	B		C	C	C	B	A	B	B	B	B	B
Coon (West Bay)																														A		A	
Crooked			C		C				C					B	C	B	B	B		B		B	B		B	B		B	B		B	A	
E. Twin	B		C						B						B		A	B	A	A		A			A			A		A	A		A
Fawn								B									A	B	A	A	A	A		A		A		A		A		A	
George	A	A		A					A					B			A	B	A	A		A			B			B			B		B
George Watch	F	D	D		D		D	D	F	D	F					F	D	F	D	D	F	D	D	F	D	F	F	D	D	D	D	F	
Golden					D	C	D	F	F	F	F		D			C	D	C	C	C	D	D	D	D	C	C	C	C	C	C			
Ham				C									A	B		A	A	B		C	C	B		B	B		B	A		B	B		A
Highland																			D	C	D	F	F	F	F	F	F						
Howard									F	F	F							F	D	D													
Island			C																				B	B	C	C	B	B	C	C	C	C	
Itasca																		A	B	B													
Laddie													B	B	B			C	B	B	B	B	B	B	B			B			B		
Linwood	C		C						C					C			C	C	C	C	C		C		C		C	C	C			C	
Lochness																											A	B		B	C	C	
Martin			D														D	D	C	D	D		D		D		D	D	D			D	
Minard																																	A
E. Moore	C	C	C	C	B	C	C							C				C	B	B	C	C	C		C								
W. Moore	C	F	C	B	C	F	C												B	B	C	C	C		C								
Mud													B						B	C													
Netta																	B	C	A		B		A	A		B	B		B	A		A	A
Peltier			D										D	F	D	D	D	D	D	D	F	F	D	D	D	F	D						
Pickerel															B		A	A	B	C										A	C		B
Reshanau																										D	D	D	D	D	D	D	
Rogers																		C		C			B			D		B	B				
Round																		B	A	B			A		B		C		C	C		A	
Sandy													D	D	D		D	D	D	D	D	F	D	D	D								D
Typo													F	F	F		F	F	F	F	F		F		F		F		F			F	

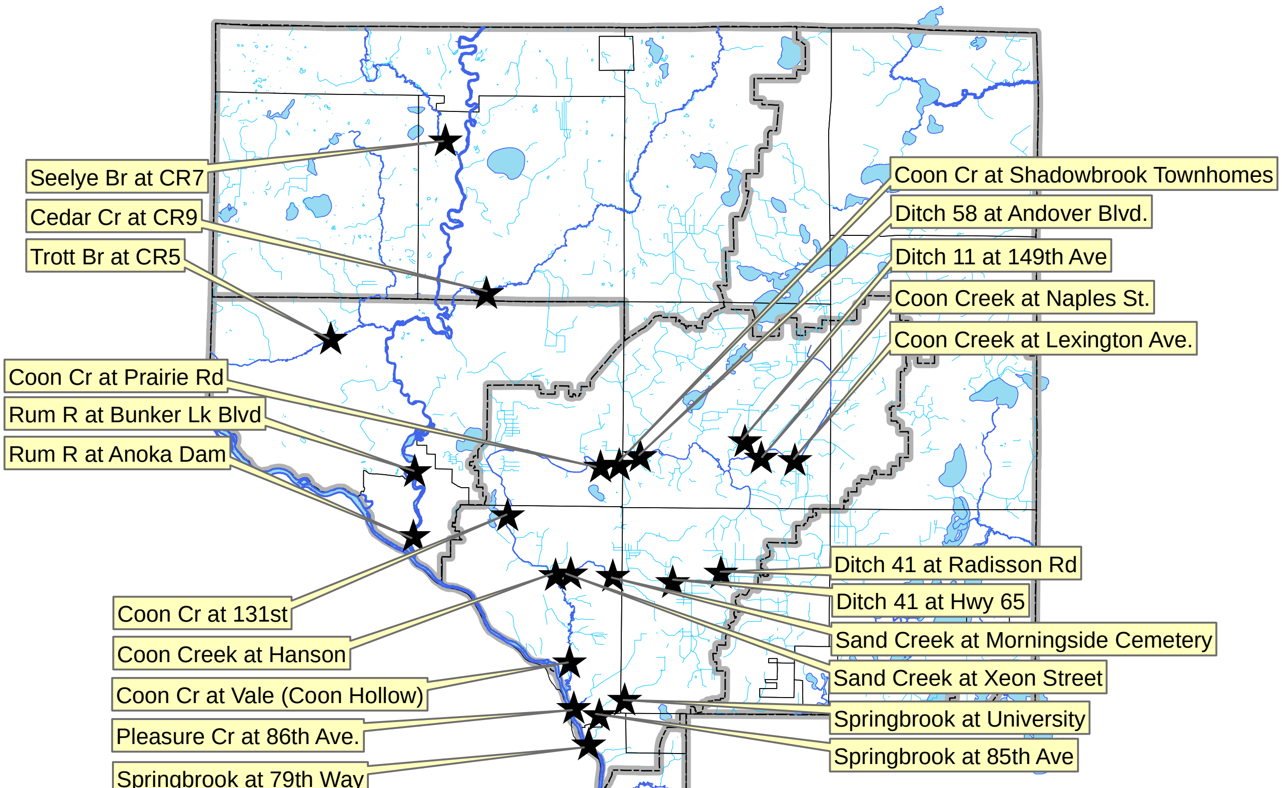
Stream Water Quality – Chemical Monitoring

Stream water quality monitoring is conducted to detect and diagnose water quality problems impacting the ecological integrity of waterways, recreation, or human health. Because many streams flow into lakes, stream water quality is often studied as part of lake improvement studies.

Chemical stream water quality monitoring in 2013 was conducted at Trott Brook, Cedar Creek, Seeyle Brook, four Sand Creek sites, eight Coon Creek sites, three Springbrook sites and Pleasure Creek. Additionally, the ACD continued a cooperative effort with the Metropolitan Council for monitoring of the Rum River at the Anoka Dam as part of the Metropolitan Council's Watershed Outlet Monitoring Program (WOMP). Those data are housed with the Metropolitan Council, and methodologies are available upon request from either organization.

The methodologies for chemical stream water quality monitoring and information on data interpretation can be found on the following pages. Monitoring results are presented in the following chapters.

2013 Chemical Stream Water Quality Monitoring Sites



STREAM WATER QUALITY MONITORING METHODS

Stream water is monitored four times during base flow conditions and four immediately following storm events between the months of April and September (some special studies have different sampling regimes). Grab samples are a single sample of water collected to represent water quality for a given moment or stream condition. A composite sample, conversely, consists of collecting several small samples over a period of time and mixing them. Grab samples are used for all stream water quality monitoring performed by the ACD. Each stream grab sample was tested for the following parameters:

- pH;
- Dissolved Oxygen (DO);
- Turbidity;
- Conductivity;
- Temperature;
- Salinity;
- Total Phosphorus (TP);
- Chlorides;
- Sulfate;
- Total hardness;
- Total Suspended Solids;
- others for some special investigations.

Conductivity, pH, turbidity, salinity, dissolved oxygen (DO), and temperature are measured in the field using a Hydrolab Quanta multi-probe. E. coli samples were analyzed by the independent laboratory (IRI). Total phosphorus, chlorides, total suspended solids, sulfate, hardness, and any other parameters were analyzed by the independent laboratory (MVTL Labs). Sample bottles were provided by the laboratory, complete with necessary preservatives. Water samples were kept on ice and delivered to the laboratory within 24 hours of collection, with the exception of E. coli samples which were delivered to the laboratory no later than 7 hours after being collected. Stream water level was noted when the sample was collected.

Stream Water Quality Monitoring Questions and Answers

This section is intended to answer basic questions about the Anoka Conservation District's methodology for monitoring stream water quality and interpreting the data.

Q- What do the parameters that you test mean?

A- pH- This test measures if the water is basic or acidic. A pH reading of greater than 7 signifies that the stream is basic and a reading of less than 7 means the stream is acidic. Many fish and other aquatic organisms need a pH in the range of 6.5 to 9.0.

Conductivity- This is a measure of the amount of dissolved minerals in the stream. Although every stream has a certain amount of dissolved matter, high conductivity readings may indicate additional inputs from sources such as storm water, agricultural runoff, or from failing septic systems.

Turbidity- This is a measure of the amount of solid material suspended in the water, due to "muddiness" or algae.

Dissolved Oxygen (DO) - Dissolved oxygen is essential to all aquatic organisms. The lower the DO concentration, the less likely a stream will support a wide range of organisms, including fish.
Sources of dissolved oxygen include the atmosphere, aeration from stream inflow, and submerged plants and algae in the lake creating oxygen through photosynthesis. Dissolved oxygen is consumed by the organisms in the stream and by decomposition within the stream. Large inputs of organic matter (manure, for example) are harmful, in part, because decomposition of these materials can reduce dissolved oxygen to harmfully low levels.

Salinity- Salinity is a measure of dissolved salts in the water. High salinity measurements may be the result of inputs from failing septic systems, spring runoff of road salts, farm field runoff, or others.

Temperature- Fish species and other aquatic life are sensitive to water temperature. Some can only survive in particular temperature ranges. Temperature also affects the amount of dissolved oxygen that the water can hold in solution. At warmer temperatures, oxygen is readily released to the atmosphere and dissolved oxygen concentrations fall.

Total Phosphorus (TP) - Phosphorus is an essential nutrient that stimulates algae growth. A single pound of phosphorus can result in 500 pounds of algal growth. Large amounts of algae reduce water clarity, deplete dissolved oxygen levels algal decomposition which impacts fish populations, and degrade aesthetics for recreation. Ideally, total phosphorus should be below 40 µg/L in lakes and 130 µg/L in streams. Sources of phosphorus include runoff from agricultural land, runoff from lakeshore properties carrying fertilizer and untreated human waste from failing septic systems, pet wastes, and storm water runoff.

Total Suspended Solids (TSS) - This is similar to turbidity, in that it measures the amount of solid material in the water. Turbidity is measured by sending a beam of light through a water sample and measuring how much of it is deflected. In this way it is particularly sensitive to large suspended particles, but not to small particles. Total suspended solids is measured by filtering a water sampling and weighing the filtered material.

Chlorides– This is a measure of dissolved chloride materials. The most common source is road salt (sodium chloride), but other sources include various chemical pollutants and sewage effluent.

Sulfates and hardness – These parameters were tested because of research findings that chloride toxicity varies with sulfates and hardness. In some states, like Iowa, the chloride water quality standard is linked to hardness and sulfates. Minnesota is likely to change their water quality standards in this way in the near future.

Analytical Limits for Stream Water Quality Parameters

Parameter	Method Detection Limit	Reporting Limit	Analysis or Instrument Used
pH	0.01	0.01	Hydrolab Quanta
Conductivity	0.001	0.001	Hydrolab Quanta
Turbidity	0.1	0.1	Hydrolab Quanta
Dissolved Oxygen	0.01	0.01	Hydrolab Quanta
Temperature	0.1	0.1	Hydrolab Quanta
Salinity	0.01	0.01	Hydrolab Quanta
Total Phosphorus	0.3	1.0	EPA 365.4
Total Suspended Solids	5.0	5.0	EPA 160.2
Chloride	0.005	0.01	EPA 325.1
Sulfate		4.0	ASTM D516-02
Hardness		na	2340.B
E. *coli*	1.0	1.0	SM9223 B-97

Q- How do you rate the quality of a stream's water?

A- We make up to three comparisons. First, with published water quality values for the ecoregion. Ecoregions are areas with similar soils, landform, potential natural vegetation, and land use. All of Anoka County is within the North Central Hardwood Forest (NCHF) Ecoregion. Mean values for our ecoregion, and for minimally impacted streams in our ecoregion are in the table below. Secondly, we compare each stream to 34 other streams the Anoka Conservation District has monitored throughout the county. The county includes urban, suburban, and rural areas so this comparison incorporates water quality expectations in all these land uses.

Third, we compare levels of a pollutant observed to state water quality standards. These standards exist for some, but not all, pollutants.

Q- What Quality Assurance/Quality Control procedures are in place?

A- QA/QC was accomplished in the following ways:

Minnesota Valley Testing Laboratories (MVTL) conducted the laboratory analysis. MVTL has a comprehensive QA/QC program, which is available by contacting them directly. ACD followed field protocols supplied by MVTL including keeping samples on ice, avoiding sample contamination, delivering samples to the lab within 24 hours of sampling, and providing duplicates and blanks. Sample bottles were provided by MVTL and included the necessary preservatives.

The hand held Hydrolab Quanta multi-probe used to conduct in-stream monitoring was calibrated at least daily.

Typical Stream Water Quality Values for the North Central Hardwood Forest (NCHF) Ecoregion and for Anoka County

Parameter	Units	NCHF Ecoregion Mean[1]	NCHF Ecoregion Minimally Impacted Stream[1]	Median of Anoka County Streams
pH	pH units		8.1	7.62
Conductivity	mS/cm	.389	.298	0.362
Turbidity	FNRU		7.1	8.5
Dissolved Oxygen	mg/L	-	-	6.97
Temperature	°F		71.6	
Salinity	%		0	0.01
Total Phosphorus	µg/L	220	130	135
Total Suspended Solids	mg/L		13.7	12
Chloride	mg/L		8	17
Sulfate	Mg/L			18.7
Hardness	mg/L CaCO3			180.5

[1]MPCA 1993 Selected Water Quality Characteristics of Minimally Impacted Streams for Minnesota's Seven Ecoregions: Addendum to Descriptive Characteristics of the Seven Ecoregions of Minnesota. McCollor & Heiskary.

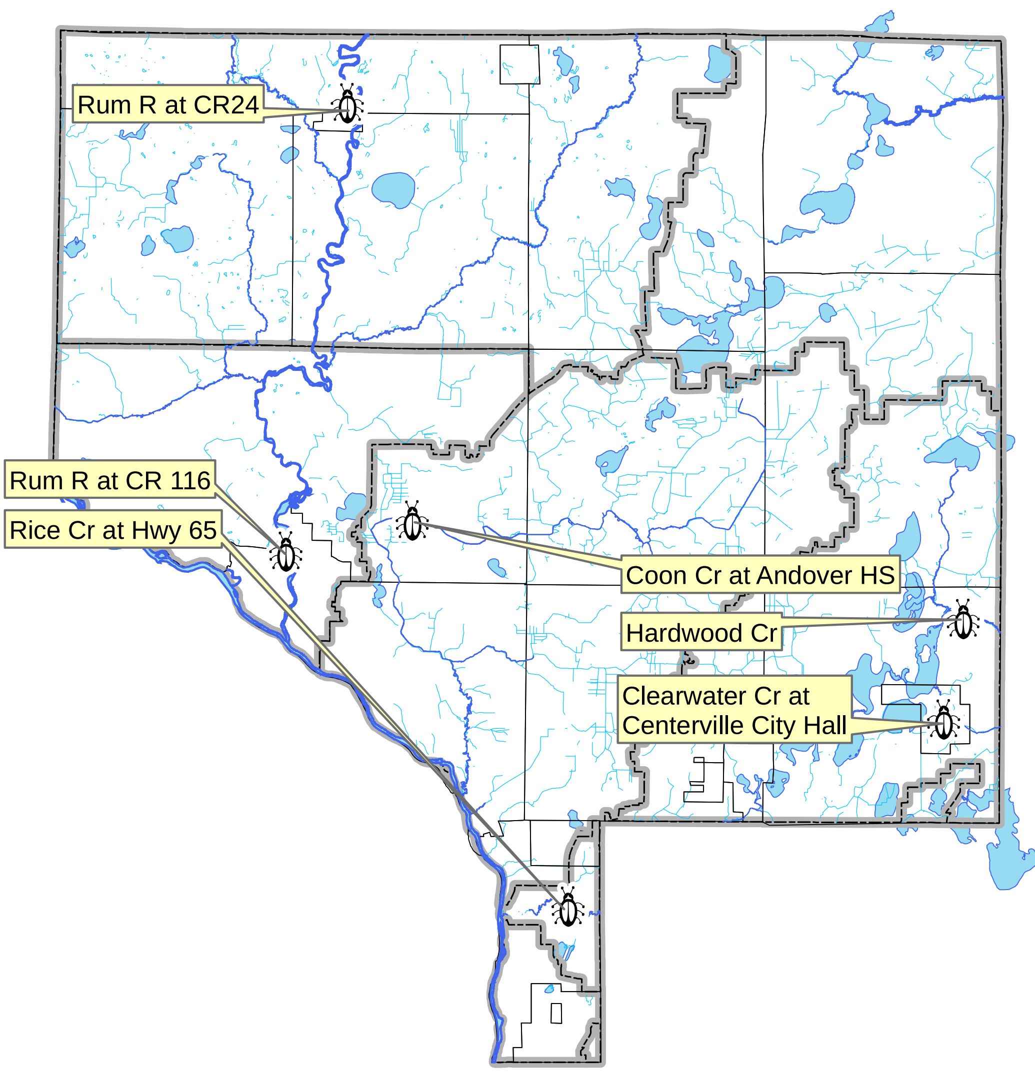
Stream Water Quality – Biological Monitoring

The stream biological monitoring program, often called biomonitoring, is both a stream health assessment and educational program. This biomonitoring program uses benthic (bottom dwelling) macroinvertebrates to determine stream health. Macroinvertebrates are animals without a backbone and large enough to see without a microscope, such as aquatic insects, snails, leeches, clams, and crayfish. Certain macroinvertebrates, such as stoneflies, require high quality streams, while others thrive in poor quality streams. Because of their extended exposure to stream conditions and sensitivity to habitat and water quality, benthic macroinvertebrates serve as good indicators of stream health.

ACD adds an educational component to the program by involving students in the biomonitoring at many of the sites. High school science classes are the primary volunteers. In 2013 there were approximately 319 students from six high schools who monitored six sites. Since 2000 approximately 4,841 students have participated. The experience affords students an opportunity to learn scientific methodologies and become involved in local natural resource management.

Results of this monitoring are separated by watershed in the following chapters.

2013 Biological Stream Water Quality Monitoring Sites



Biomonitoring Methods

ACD biomonitoring utilizes the US Environmental Protection Agency (EPA) multi-habitat protocol for low-gradient streams (www.epa.gov/owow/monitoring/volunteer/stream/). Using this methodology, individuals doing the sampling determine how much of the stream is occupied by four types of micro-habitat: vegetated bank margins, snags and logs, aquatic vegetation beds and decaying organic matter, and silt/sand/gravel substrate. Sampling is by "jabs" or sweeps with a D-frame net. Each habitat type is sampled in proportion to the prevalence of the habitat type. At least 20 jabs are taken. All macroinvertebrates are preserved and returned to the lab (or classroom) for identification to the family level. The identified invertebrates are preserved in labeled vials. From the identifications, biomonitoring indices are calculated to rank stream health. Fieldwork is overseen by Anoka Conservation District (ACD) staff and student identifications are checked by ACD staff before any analysis is done.

Biomonitoring Indices

Indices are mathematical calculations that summarize tallies of identified macroinvertebrates and known values of their pollution tolerance into a single number that serves as a gauge of stream health. The indices listed below are used in the biomonitoring program, but are not the only indices available. No single index is a complete measure of stream health. Multiple indices should be considered in concert.

Taxa Richness and Composition Measures

Number of Families: This is a count of the number of taxa (families) found in the sample. A high richness or variety is good.

EPT: This is a measure of the number of families in each of three generally pollution-sensitive orders: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). A high number of these families is good.

Tolerance and Intolerance Metrics

Family Biotic Index (FBI): The Family Biotic Index summarizes the various pollution tolerance values of all families in the sample. FBI ranges from 0 to 10, with LOWER values reflecting HIGHER water quality. Each macroinvertebrate family has a unique pollution tolerance value associated with it. The table below provides a guide to interpreting the FBI.

Key to interpreting the Family Biotic Index (FBI)

Family Biotic Index (FBI)	Water Quality Evaluation	Degree of Organic Pollution
0.00 - 3.75	Excellent	Organic pollution unlikely
3.76 - 4.25	Very Good	Possible slight organic pollution
4.26 - 5.00	Good	Some organic pollution probable
5.01 - 5.75	Fair	Fairly substantial pollution likely
5.76 - 6.50	Fairly Poor	Substantial pollution likely
6.51 - 7.25	Poor	Very substantial pollution likely

Population Attributes Metrics

% EPT: This measure compares the number of organisms in the EPT orders (Ephemeroptera - mayflies: Plecoptera - stoneflies: Trichoptera - caddisflies) to the total number of organisms in the sample. A high percent of EPT is good.

% Chironomidae: This measure compares the number of midges to the total number of organisms in the sample. A low percentage of midge larvae is good.

% Dominant Family: This measures the percentage of individuals in the sample that are in the sample's most abundant family. A high percentage is usually bad because it indicates low evenness (one or a few families dominate, and all others are rare).

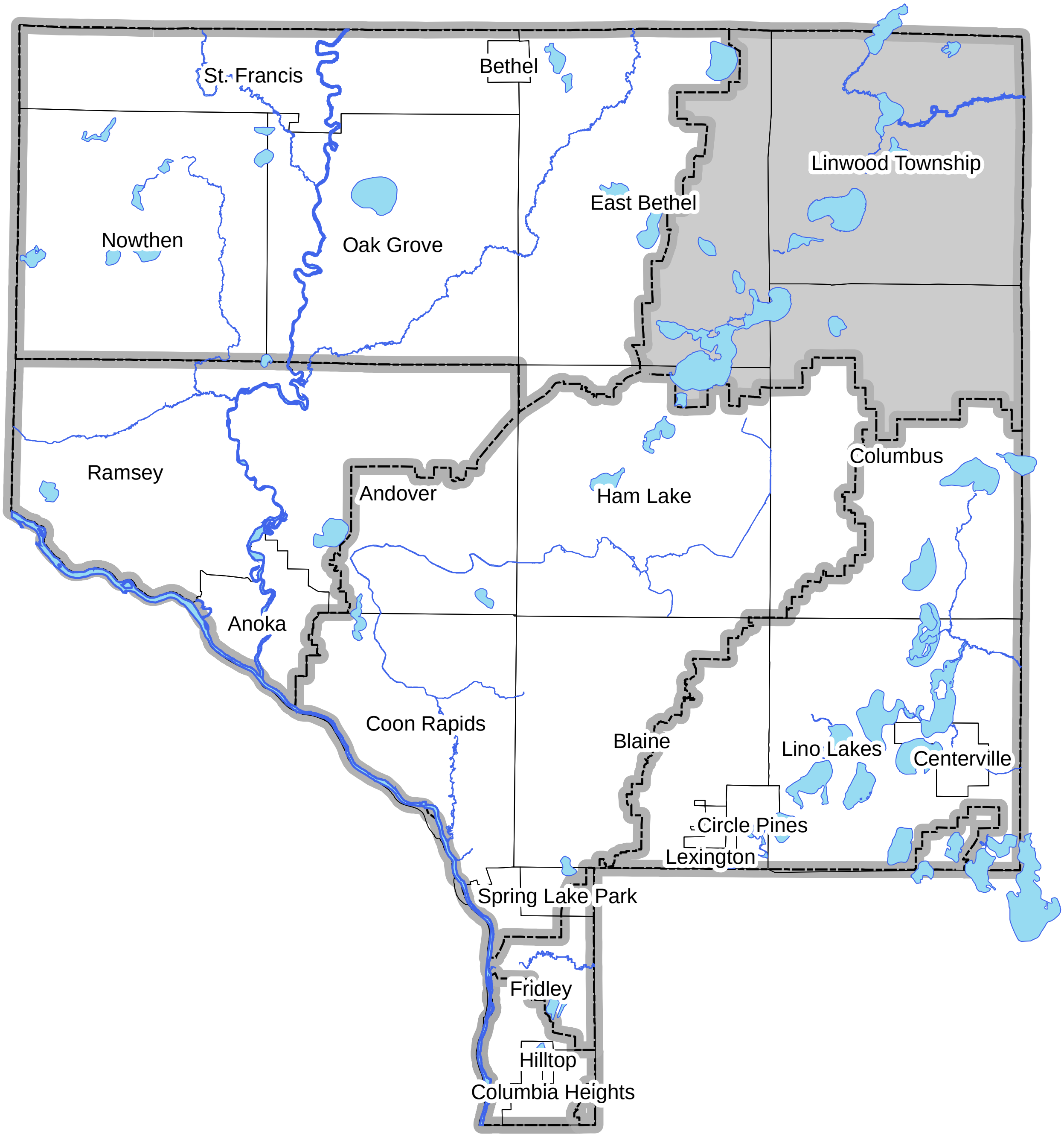
Sites

In 2013, high school classes, with ACD staff supervision, sampled six sites for benthic macroinvertebrates.

2013 Biomonitoring Sites and Corresponding Monitoring Groups

Monitoring Group	Stream
Andover High School	Coon Creek
Anoka High School	Rum River (South)
Centennial High School	Clearwater Creek
Forest Lake Area Learning Center	Hardwood Creek
St.Francis High School	Rum River (North)
Totino Grace High School	Rice Creek

Sunrise River Watershed



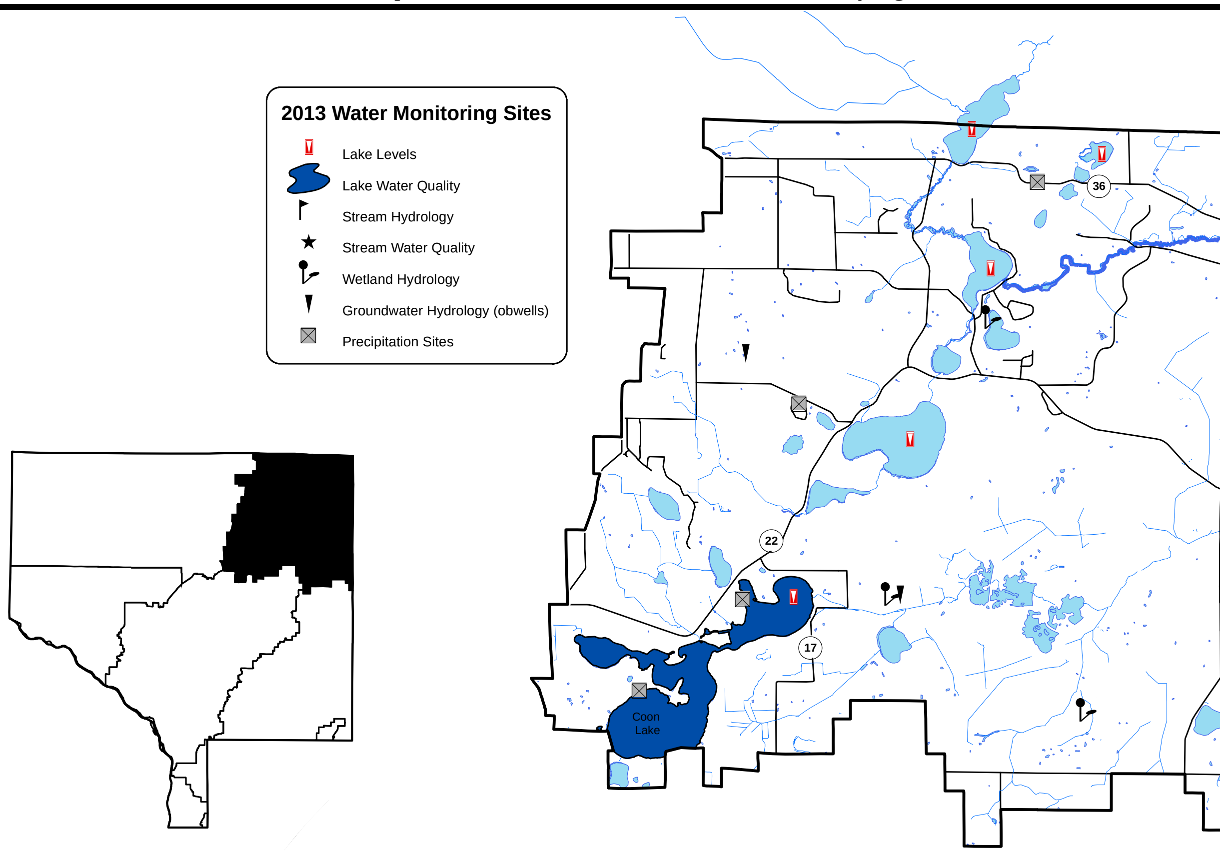
Contact Info: Sunrise River Watershed Management Organization
www.srwmo.org
763-434-9569

Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 2: SUNRISE RIVER WATERSHED

Task	Partners	Page
Lake Levels	SRWMO, ACD, MN DNR, volunteers	2-27
Lake Water Quality	SRWMO, ACD, ACAP	2-29
Wetland Hydrology	SRWMO, ACD, ACAP	2-36
Water Quality Grant Fund	SRWMO, ACD	2-40
Coon Lake Area Stormwater Retrofit Assessment	SRWMO, ACD	2-41
Carp Barriers Installation	SRWMO, ACD, Martin Lakers Assoc, DNR, Linwood Twp, et al	2-42
Lakeshore Landscaping Education	SRWMO, ACD	2-43
Annual Education Publication	SRWMO, ACD	2-45
SRWMO Website	SRWMO, ACD	2-46
Grant Search and Applications	SRWMO, ACD	2-47
SRWMO 2012 Annual Report	SRWMO, ACD	2-48
On-call Administrative Services	SRWMO, ACD	2-49
Financial Summary		2-50
Recommendations		2-50
Groundwater Hydrology (obwells)	ACD, MNDNR	See Chapter 1
Precipitation	ACD, volunteers	See Chapter 1

ACD = Anoka Conservation District, SRWMO = Sunrise River Watershed Management Organization, MNDNR = Minnesota Dept. of Natural Resources, ACAP = Anoka County Ag Preserves



Lake Levels

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all historic data are available on the Minnesota DNR website using the “LakeFinder” feature (www.dnr.mn.us.state\lakefind\index.html).

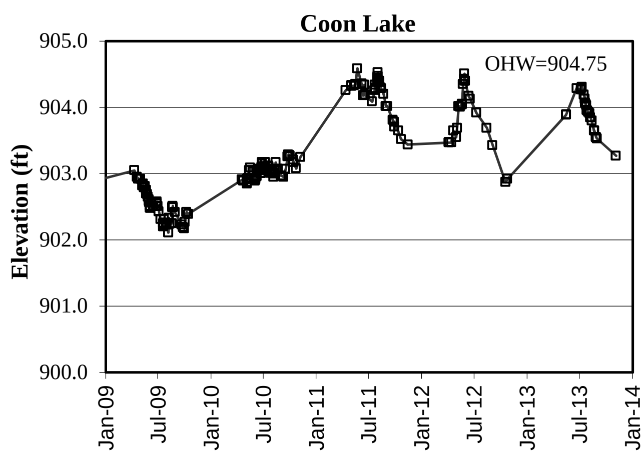
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations: Coon, Fawn, Linwood, Martin, and Typo Lakes

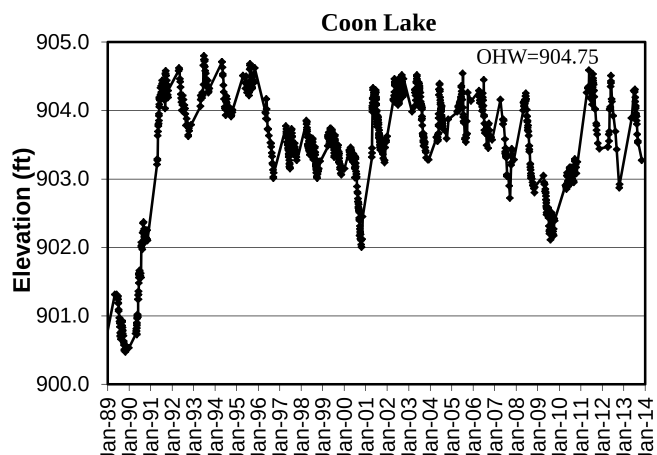
Results: Lake levels were measured by volunteers throughout the 2013 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. Lakes had sharply increasing water levels in spring and early summer 2013 when heavy rainfall totals occurred. Little rainfall fell later in the year and lake levels fell dramatically.

All lake level data can be downloaded from the MN DNR website’s Lakefinder feature. Ordinary High Water Level (OHW), the elevation below which a DNR permit is needed to perform work, is listed for each lake on the corresponding graphs below.

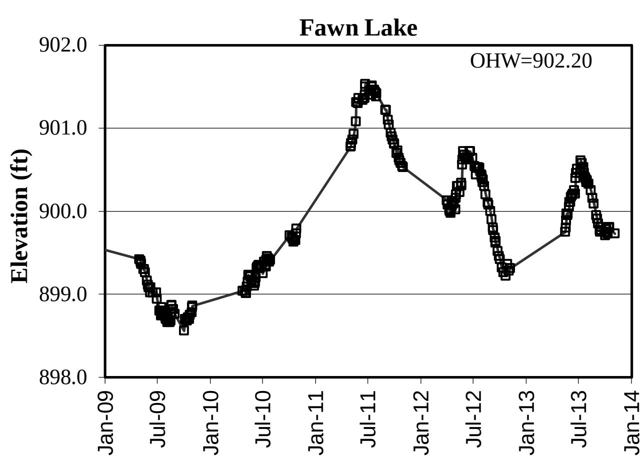
Coon Lake Levels – last 5 years



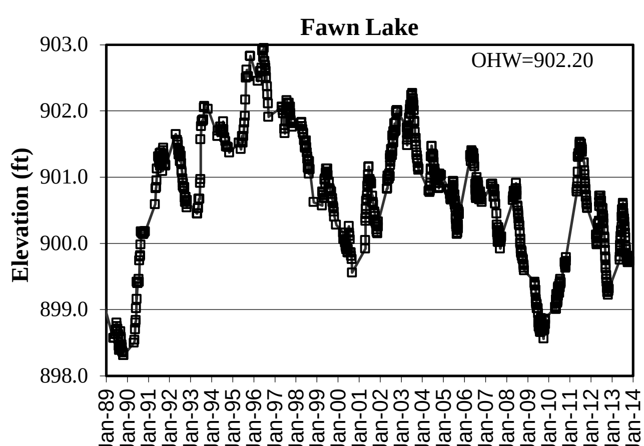
Coon Lake Levels – last 25 years



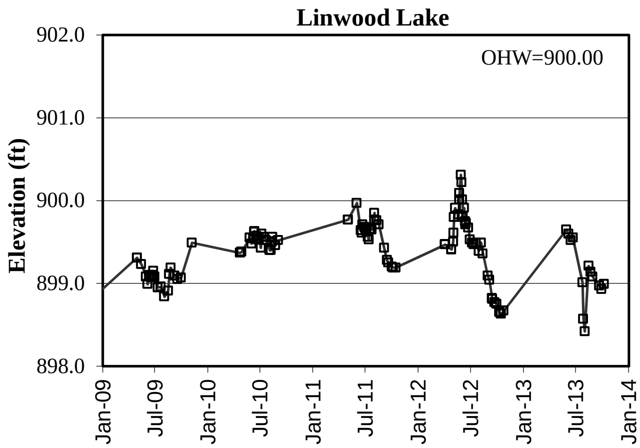
Fawn Lake Levels – last 5 years



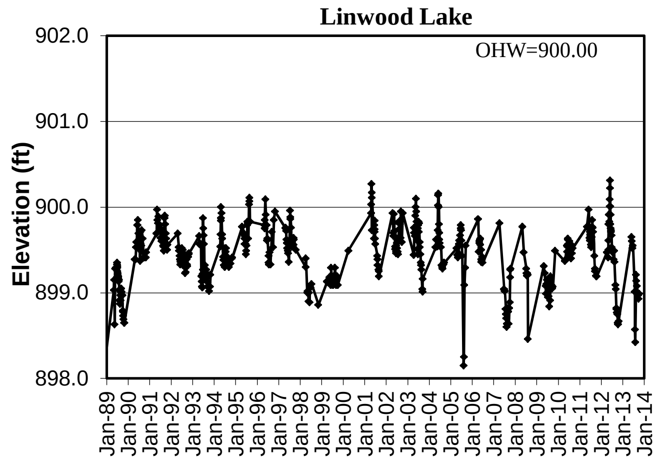
Fawn Lake Levels – last 25 years



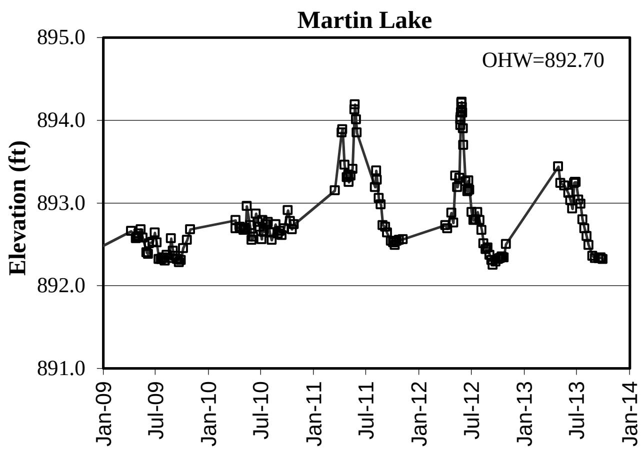
Linwood Lake Levels – last 5 years



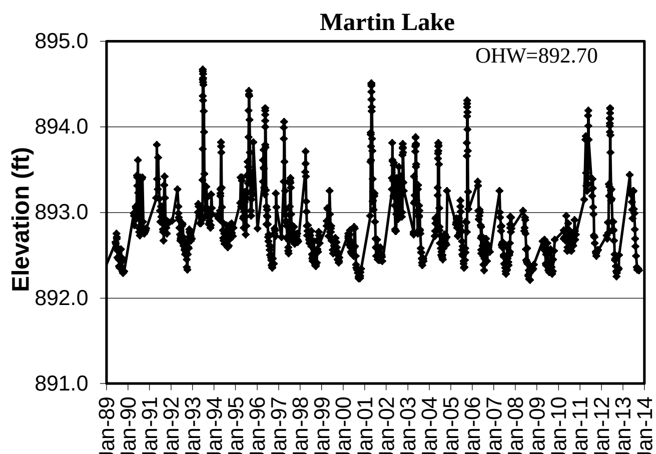
Linwood Lake Levels – last 25 years



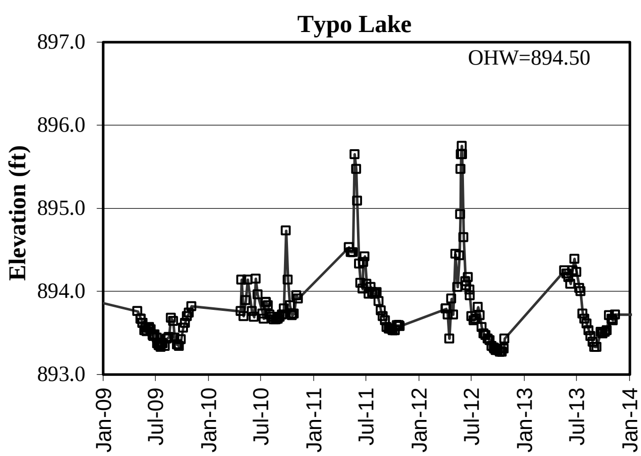
Martin Lake Levels – last 5 years



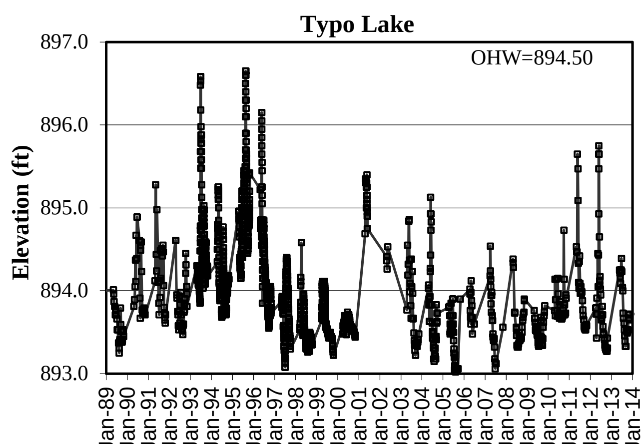
Martin Lake Levels – last 25 years



Typo Lake Levels – last 5 years



Typo Lake Levels – last 25 years



Lake Water Quality

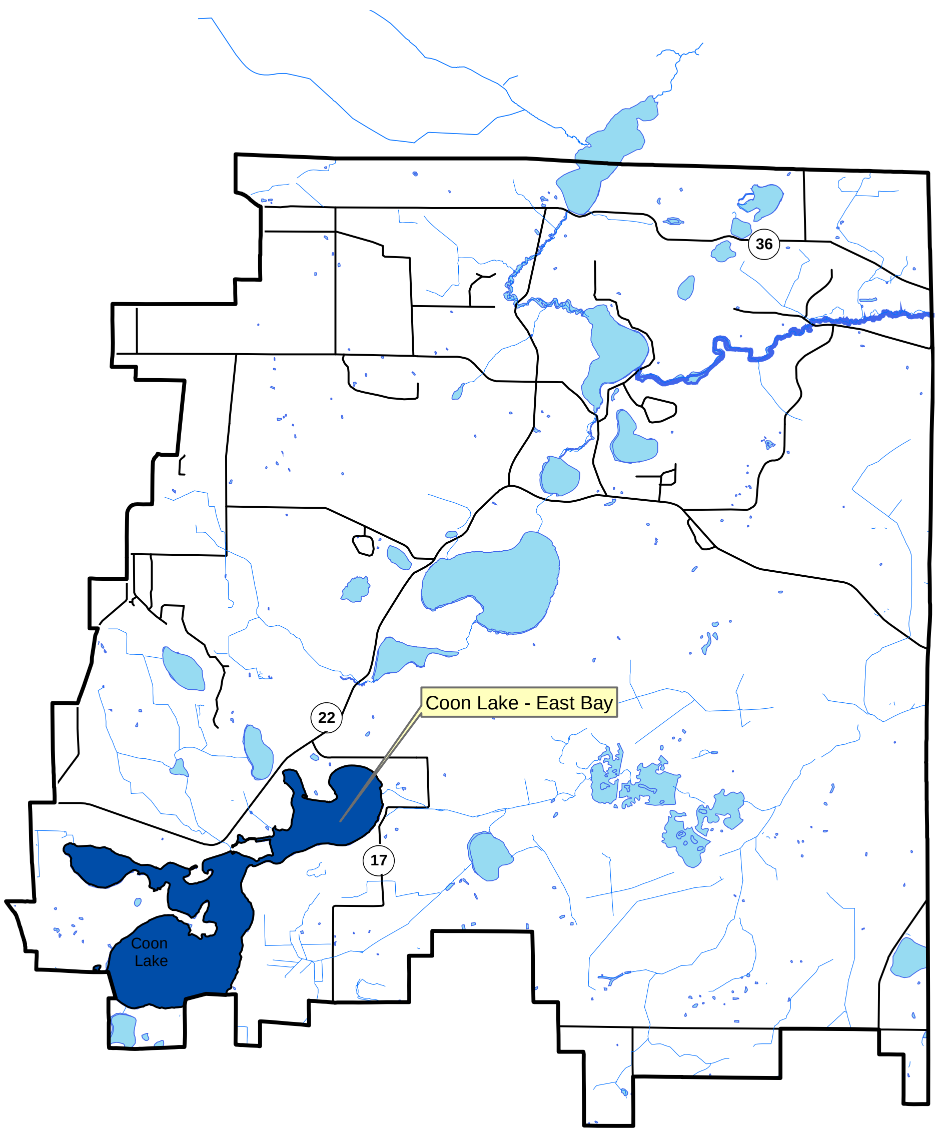
Description: May through September every-other-week monitoring of the following parameters: total phosphorus, chlorophyll-a, secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: Coon Lake East Bay

Results: Detailed data for each lake are provided on the following pages, including summaries of historical conditions and trend analysis. Previous years' data are available from the ACD. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.

Sunrise Watershed Lake Water Quality Monitoring Sites



Coon Lake –East and West Bays

City of East Bethel, City of Ham Lake & City of Columbus, Lake ID # 02-0042

Background

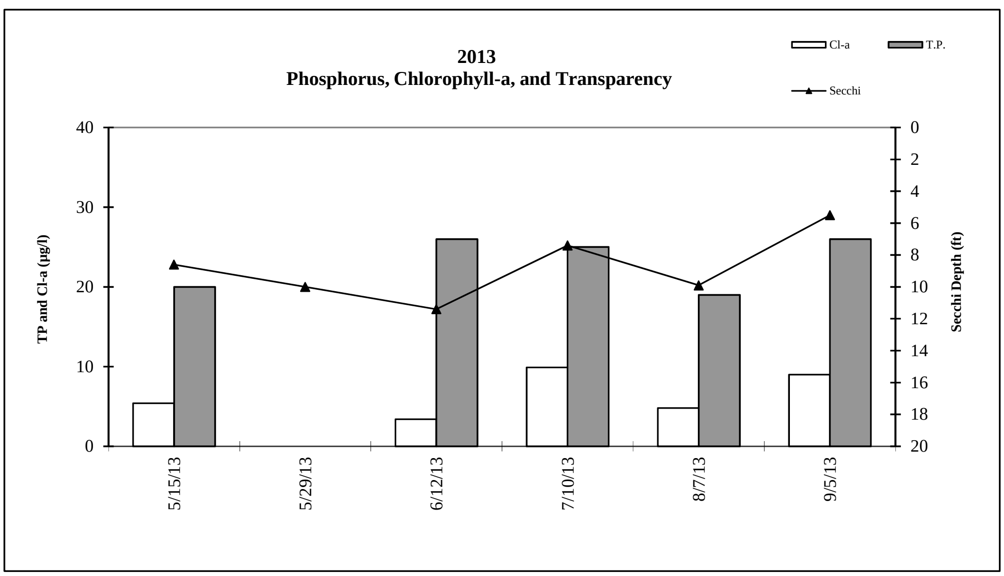
Coon Lake is located in east central Anoka County and is the county's largest lake. Coon Lake has a surface area of 1498 acres and a maximum depth of 27 feet (9 m). Public access is available at three locations with boat ramps, including one park with a swimming beach. The lake is used extensively by recreational boaters and fishers. Most of the lake is surrounded by private residences. The watershed of 6,616 acres is rural residential.

This report includes information for the East Bay (aka northeast or north bay) in 2013 and West Bay (aka southwest or south bay) of Coon Lake in 2012. The 2010-13 data is from the Anoka Conservation District (ACD) monitoring at the MN Pollution Control Agency (MPCA) monitoring site #203 for the East Bay and #206 for the West Bay. Over the years, other sites have been monitored and are included in this report's trend analysis when appropriate. When making comparisons between the two bays, please consider that both bays were monitored simultaneously only in 2010 and 2012; data from other years do not lend themselves well to direct comparisons because monitoring regimes were likely different.

2013 Results – East Bay

In 2013 the East Bay was monitored every 4 weeks. The water quality is slightly better than average for this region of the state (NCHF Ecoregion), receiving a B+ grade. Average values of important water quality parameters included 23.2 µg/L for total phosphorus, 6.5 µg/L chlorophyll-a, and Secchi transparency of 8.8 feet. Chlorophyll-a levels were the lowest of all monitored years. Phosphorus levels were the second lowest of all monitored years and have seen a drop in each of the last 4 years. Similarly, transparency results were the deepest in all monitored years and have shown improvement in each of the last 5 monitoring years. The subjective observations of the lake's physical characteristics and recreational suitability by the ACD staff indicated that lake conditions were excellent for swimming and boating.

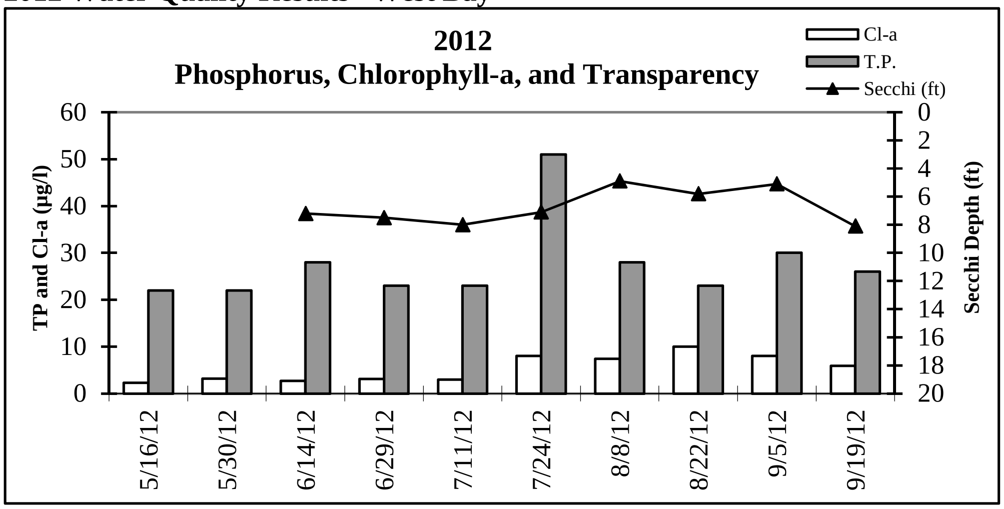
2013 Water Quality Results – East Bay



2012 Results – West Bay

In 2012 the West Bay had slightly better than average water quality for this region of the state (NCHF Ecoregion), receiving an A- letter grade. West Bay total phosphorus averaged 28.0 µg/L and chlorophyll-a averaged 5.4 µg/L. Secchi transparency could not be measured on two occasions because it exceeded basin's depth.

2012 Water Quality Results –West Bay



Comparison of the Bays

The East and West Bays of Coon Lake often have noticeably different water quality. In 2010, on every date water quality was better in the West Bay than East, with an average difference of 13 µg/L phosphorus and 5.4 µg/L chlorophyll-a (algae). In 2012, water quality in the two bays was more similar. Neither bay had consistently lower phosphorus and the average phosphorus reading differed by only 2 µg/L. Chlorophyll-a readings were more frequently lower in the West bay but the average reading only differed by 2.8 µg/L. A direct comparison of average Secchi transparency was not possible in 2010 or 2012 because transparency exceeded the lake depth on multiple occasions in the West Bay and a reading could not be obtained.

Trend Analysis

To analyze Coon Lake trends we obtained historic monitoring data from the MPCA. Over the years water quality has been monitored at 17 sites on the lake. For the trend analysis, we pooled data from five East Bay sites (#102, 203, 208, 209, and 401) and four West Bay sites (#101, 105, 206, and 207). These sites were chosen because they were all in the bay of interest, close to each other, and distant from the shoreline. The trend analysis is based on average annual water quality data for each year with data. We used data only from years with data from every month from May to September, except we allowed one month of missing data. Only data from May to September were used. Starting in 1998 only data from ACD was used for greater comparability.

<u>East Bay Trend Analysis</u>

In the East Bay twenty one years of water quality data have been collected since 1978. During the most recent 13 years that were monitored (since 1996), the data collected included total phosphorus, chlorophyll-a, and Secchi transparency. For most of the other eight years (all pre-1997) only Secchi transparency data is available. This provides an adequate dataset for a trend analysis, however given that most of the data is from the last 21 years, the analysis is not strong at detecting changes that occurred prior to 1990.

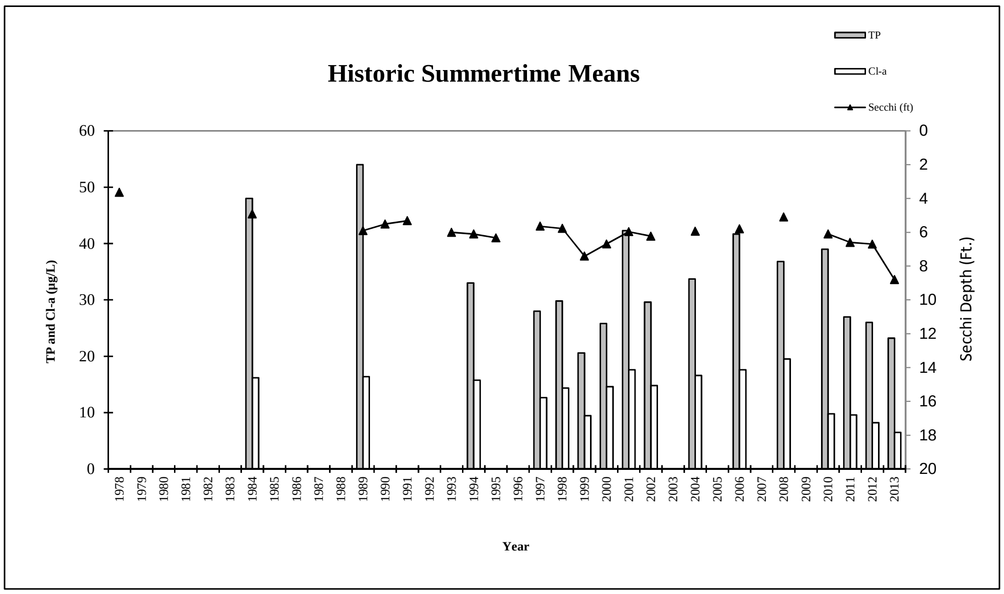
No water quality trend exists when we examined those years with total phosphorus, chlorophyll-a, and Secchi transparency, excluding the years with only Secchi transparency data. The analysis was a repeated measures

MANOVA with response variables TP, Cl-a, and Secchi depth ($F_{2,13}$=2.8, p=0.10). This is our preferred approach because it examines all three parameters simultaneously.

We also examined Secchi transparencies alone across all 18 years using a one-way ANOVA. Including all years, a significant trend of improving transparency is found ($F_{1,19}$=15.88, p=0.0008). This result appears influenced by the low transparency in 1978. Though, if we exclude 1978 and re-run the analysis we find the trend is still present and statistically significant (p=0.012), p values of 0.05 or less indicate statistical significance at the 95% confidence level). In summary, it appears that improvements in transparency have been occuring.

It is noteworthy that a water quality improvement seems to have occurred over the last few years (see graph below). The reason for such a change, if real, is unknown.

Historic Water Quality - East Bay

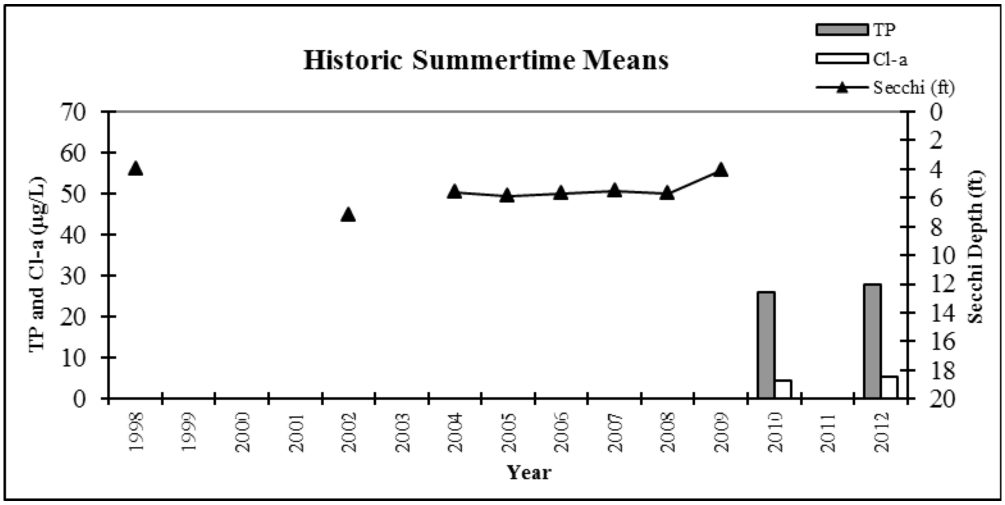


West Bay Trend Analysis

Ten years of data are available for the West Bay including only two years with phosphorus and chlorophyll-a data, so a powerful trend analysis is not possible. The dataset for Secchi transparency is longer, but data from 2010 and 2012 must be excluded because a full suite of Secchi measurements is not available due to clarity exceeding the lake depth occasionally. Therefore, a statistical analysis would not be highly meaningful. Instead, we'll use a non-analytical look at the data.

In 2012 the average secchi was 6.7 feet (excludes two measurements of >10feet). In 2010 the average secchi was 7.2 feet (excludes three measurements of >10feet). For eight monitored years in 1998-2009, seven of those years had average secchi of <6 feet. One year was 7.18 feet. It's notable that in the two most recent years the average secchi transparency was greater than in all but one of previous years. It suggests that if anything, transparency is mildly improving.

Historic Water Quality - West Bay



Discussion

While Coon Lake is not listed as “impaired” by the MN Pollution Control Agency, the East Bay has been close to the state water quality standard of 40 µg/L of phosphorus or greater in the recent past. In 2006 phosphorus averaged 42 µg/L, was 37 µg/L in 2008, and in 2010 was 39 µg/L. However, 2011 was the beginning of a 3 year consecutive decline in phosphorous levels. Phosphorous levels dropped to 27 µg/L in 2011, again to 26 µg/L in 2012, and hitting a 14 year low of 23.2 µg/L in 2013 (second lowest on record). While recent results appear to be trending in the right direction, continued efforts to improve water quality are strongly encouraged to prevent the lake from becoming designated as “impaired.” Such a designation would trigger an in-depth study under the Federal Clean Water Act.

Given the highly-developed nature of the lakeshore, the practices of lakeshore homeowners are a reasonable place to begin water quality improvement efforts. Residents should increase the use of shoreline practices that improve water quality and lake health, such as native vegetation buffers and rain gardens. Clearing of native vegetation to create a “cleaner” lakefront should be avoided because this vegetation is important to lake health and water quality. Septic system maintenance and replacement where necessary, should be a priority on an individual home basis and on a community level. This might be most beneficial in the Hiawatha Beach, Interlachen, and Coon Lake Beach neighborhoods, where the greatest frequency of septic system failures is suspected.

A final challenge for Coon Lake is the aquatic invasive species Eurasian water milfoil (EWM) and Curly Leaf Pondweed (CLP). EWM was discovered in the lake in 2003 and spread rapidly. In 2008 a Coon Lake Improvement District (CLID) was formed, with EWM management as a core of its function. EWM is actively monitored and treated with herbicide in accordance with DNR rules and a lake vegetation management plan. CLP has been present longer. CLID started treatment of CLP in 2009. In 2010 the East Bay was accepted into a five year pilot program for treatment of CLP. There is not yet enough data to say definitively, but it is possible that early season treatment of CLP could be a contributing factor in the recent decline in phosphorous levels. CLP takes up phosphorous from the soil through its root system and dies off early summer causing a spike in phosphorous. Early treatment may be shortening the time the CLP has to uptake phosphorous from the soil as well as reducing overall regrowth due to treatments occurring prior to CLP sprouting turions (a shoot vital to reproduction).

2013 Coon Lake East Bay Water Quality Data

Coon Lake East Bay
2013 Water Quality Data

	Units	R.L.*	5/15/2013 Results	5/29/2013 Results	6/12/2013 Results	7/10/2013 Results	8/7/2013 Results	9/5/2013 Results	Average	Min	Max
pH		0.1	8.22	8.57	8.38	8.69	8.96	8.84	8.61	8.22	8.96
Conductivity	mS/cm	0.01	0.145	0.189	0.186	0.175	0.17	0.202	0.178	0.145	0.202
Turbidity	FNRU	1	2	0.8	1.7	2.1	2.9	6.8	3	1	7
D.O.	mg/L	0.01	11.84	10.51	9.05	8.05	8.2	8.42	9.35	8.05	11.84
D.O.	%	1	112%		97%	102%	98%	102%	102%	97%	112%
Temp.	°C	0.1	13	16	19	25	23	23	20.0	13.1	25.4
Temp.	°F	0.1	55.6	60.5	66.2	77.8	73.9	74.1	68.0	55.6	77.8
Salinity	%	0.01	0	0.09	0.09	0.09	0.08	0.1	0.08	0.00	0.10
Cl-a	ug/L	0.5	5.4		3.4	9.9	4.8	9	6.5	3.4	9.9
T.P.	mg/L	0.010	0.02		0.026	0.025	0.019	0.026	0.023	0.019	0.026
T.P.	ug/L	10	20		26	25	19	26	23.2	19.0	26.0
Secchi	ft	0.1	8.6	10	11.4	7.4	9.9	5.5	8.8	5.5	11.4
Secchi	m	0.1	2.62	3.05	3.47	2.26	3.02	1.68	2.7	1.7	3.5
Physical			1.0	1.0	2.0	1.0	2.0	2.0	1.5	1.0	2.0
Recreational			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

*reporting limit

Coon Lake East Bay Historic Summertime Mean Values

Agency	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1978	1984	1989	1990	1991	1993	1994	1995	1997	1998	1999	2000	2001	2002	2004	2006	2008	2010	2011	2012	2013
TP		48.0	54.0				33.0		28.0	29.8	20.6	25.8	42.3	29.6	33.7	41.7	36.8	39.0	27.0	26.0	23.2
Cl-a		16.2	16.4				15.8		12.6	14.4	9.4	14.6	17.6	14.8	16.6	17.6	19.5	9.8	9.6	8.2	6.5
Secchi (m)	1.11	1.50	1.80	1.68	1.62	1.83	1.86	1.93	1.72	1.76	2.26	2.04	1.82	1.90	1.81	1.80	1.55	1.90	2.00	2.10	2.68
Secchi (ft)	3.6	4.9	5.9	5.5	5.3	6.0	6.1	6.3	5.6	5.8	7.4	6.7	6.0	6.2	5.9	5.8	5.1	6.1	6.6	6.7	8.8

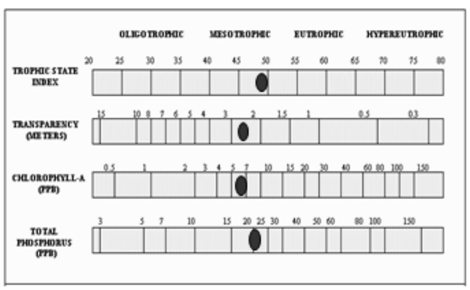
Carlsons trophic state indices

TSIP		60	62				55		52	53	48	51	58	53	55	58	56	57	52	51	49
TSIC		58	58				58		55	57	53	57	59	57	58	59	60	53	53	51	49
TSIS	58	54	52	53	53	51	51	51	52	52	48	50	51	51	51	52	54	51	50	49	46
TSI		57	57				54		53	54	50	53	56	54	55	56	57	54	51	51	48

Coon Lake Water Quality Report Card

Year	1978	1984	1989	1990	1991	1993	1994	1995	1997	1998	1999	2000	2001	2002	2004	2006	2008	2010	2011	2012	2013
TP		C	C				C		B	B	A	B	C	B	C	C	C	C	B	B	B+
Cl-a		B	B				B		B	B	A	B	B	B	B	B	B	A	A	A	A
Secchi	D	C	C	C	C	C	C	C	C	C	B	C	C	C	C	C	C	C	C	C+	B
Overall	**D**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**B**	**B**	**A**	**B**	**C**	**B**	**C**	**C**	**C**	**B-**	**B**	**B**	**B+**

Carlson's Trophic State Index



2012 Coon Lake West Bay

Water Quality Data

Coon Lake West Bay
2012 Water Quality Data

	Units	R.L.*	5/16/2012 9:30 Results	5/30/2012 9:20 Results	6/14/2012 10:45 Results	6/29/2012 9:35 Results	7/11/2012 10:00 Results	7/24/2012 10:30 Results	8/8/2012 10:40 Results	8/22/2012 10:05 Results	9/5/2012 10:15 Results	9/19/2012 9:20 Results	Average	Min	Max
pH		0.1	8.72	7.87	8.12	8.29	8.16	8.25	8.41	8.68	8.23	7.94	8.27	7.87	8.72
Conductivity	mS/cm	0.01	0.157	0.152	0.145	0.148	0.126	0.117	0.159	0.156	0.145	0.129	0.14	0.117	0.159
Turbidity	FNRU	1.0	2	2	2	3	4	3	7	7	7	2	3.90	2	7
D.O.	mg/L	0.01	9.53	8.88					8.66	9.72	7.37	8.28	8.74	7.37	9.72
D.O.	%	1.0	98%	89%					105%	112%	88%	83%	0.96	83%	112%
Temp.	°C	0.10	18.9		20.1	24.0	27.9	27.9	25.3	22.4	24.5	16.2	23.02	16.2	27.9
Temp.	°F	0.10	66.0	32.0	68.2	75.2	82.2	82.2	77.5	72.3	76.1	61.2	69.30	61.2	82.2
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	µg/L	1.0	2.3	3.2	2.7	3.1	3.0	8.0	7.4	10.0	8.0	5.9	5.36	2.3	10.0
T.P.	mg/L	0.005	0.022	0.022	0.028	0.023	0.023	0.051	0.028	0.023	0.030	0.026	0.028	0.022	0.051
T.P.	µg/L	5	22	22	28	23	23	51	28	23	30	26	28	22	51
Secchi	ft	0.1	>10.6	>10.3	7.2	7.5	8.0	7.1	4.9	5.8	5.1	8.1	NA	4.9	>9.8
Secchi	m	0.1	>3.2	>3.1	2.2	2.3	2.4	2.2	1.5	1.8	1.6	2.5	NA	1.5	>3.0
Physical			2	2.0	2.0	2.0	3.0	2.0	2.0	4.0	4.0	2.0	2.5	2.0	4.0
Recreational			2	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	2.0	2.2	2.0	3.0

*Reporting Limit

Coon Lake West Bay Historic Summertime Mean Values

Agency	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	ACD	ACD
Year	1998	2002	2004	2005	2006	2007	2008	2009	2010	2012
TP									26.0	28.0
Cl-a									4.4	5.4
Secchi (m)	1.21	2.19	1.71	1.79	1.74	1.68	1.74	1.24		
Secchi (ft)	3.97	7.18	5.61	5.87	5.71	5.51	5.71	4.07		

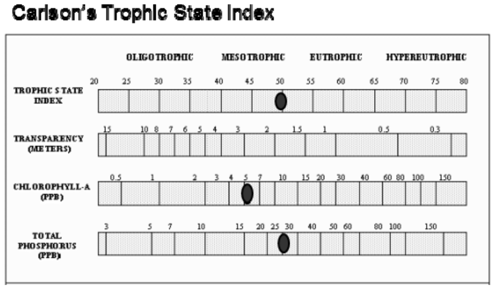
Carlsons trophic state indices

TSIP									51	52
TSIC									45	47
TSIS	57	49	52	52	52	53	52	57		
TSI									48	50

Coon Lake Water Quality Report Card

Year	98	2002	2004	2005	2006	2007	2008	2009	2010	2012
TP									B	B
Cl-a									A	A
Secchi	C	C	C	C	C	C	C	C		
Overall									**A-**	**A-**

Carlson's Trophic State Index



WETLAND HYDROLOGY

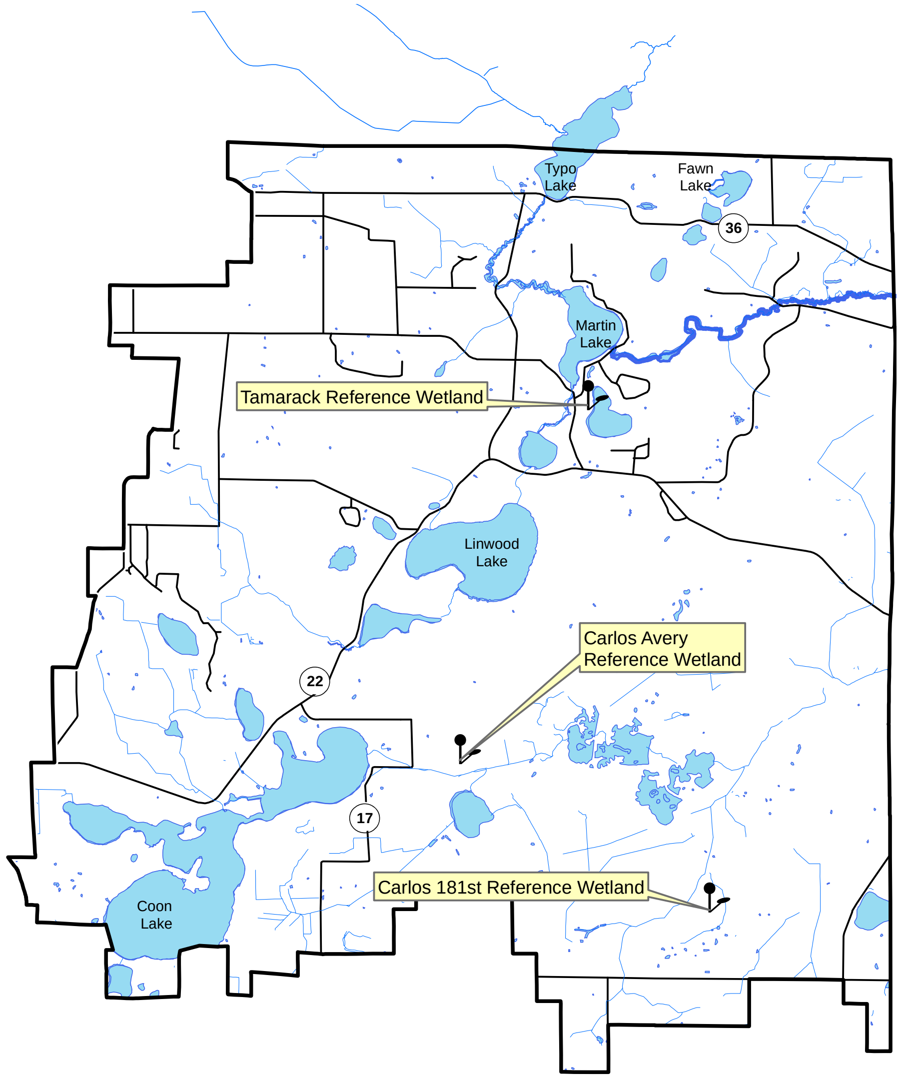
Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 18 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

Locations: Carlos Avery Reference Wetland, Carlos Avery Wildlife Management Area, City of Columbus
Carlos 181st Reference Wetland, Carlos Avery Wildlife Management Area, City of Columbus
Tamarack Reference Wetland, Linwood Township

Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

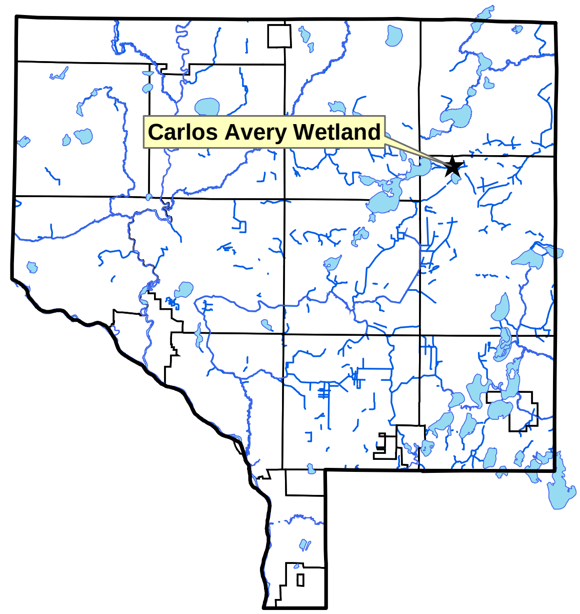
Sunrise Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

CARLOS AVERY REFERENCE WETLAND

Carlos Avery Wildlife Management Area, City of Columbus



Site Information

Monitored Since: 1997

Wetland Type: 3

Wetland Size: >300 acres

Isolated Basin? No

Connected to a Ditch? Yes

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-4	N2/0	Organic	-
Bg	4-25	10yr 5/2	Sandy Loam	25% 10yr 5/6 with organic streaking

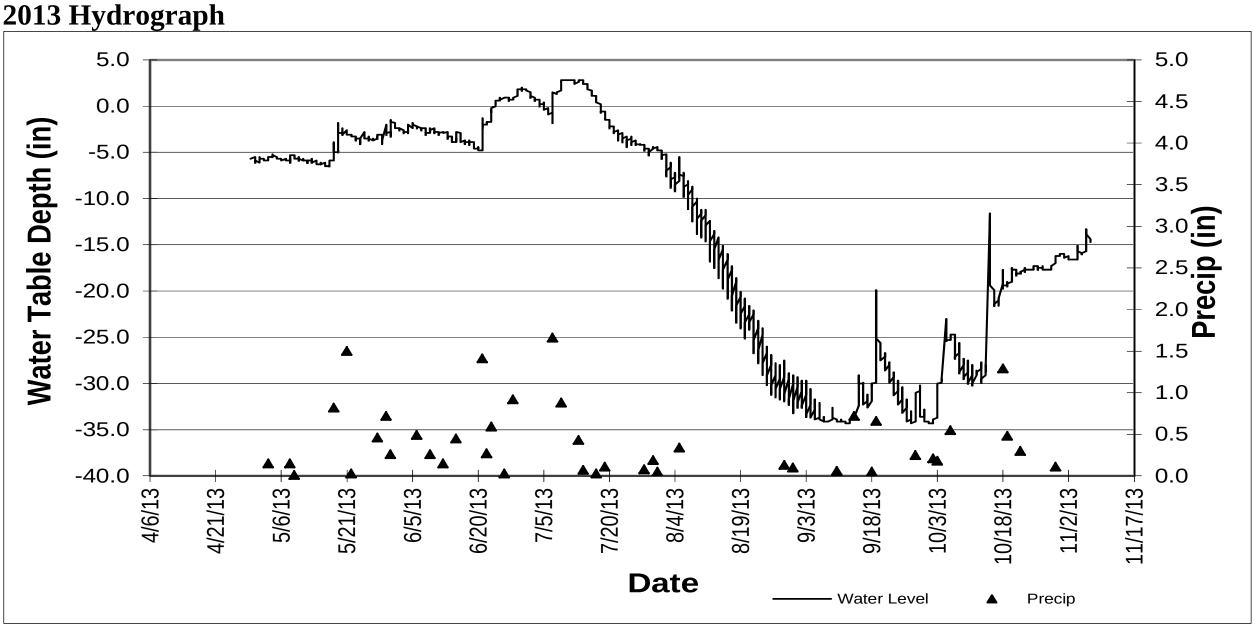
Surrounding Soils: Lino loamy fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	80
Carex Spp	Sedge undiff.	40
Quercus macrocarpa	Bur Oak	40
Sagitaria latifolia	Broad-leaf Arrowhead	20
Cornus stolonifera	Red-osier Dogwood	20

Other Notes: This is a broad, expansive wetland within a state-owned wildlife management area. Cattails dominate within the wetland.

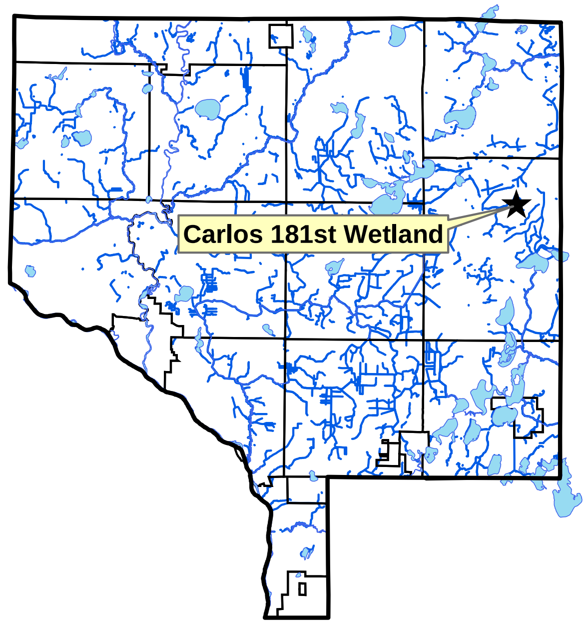
2013 Hydrograph



Well depths were 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

CARLOS 181ST REFERENCE WETLAND

Carlos Avery Wildlife Management Area, City of Columbus



Site Information

Monitored Since:	2006
Wetland Type:	2-3
Wetland Size:	3.9 acres (approx)
Isolated Basin?	Yes
Connected to a Ditch?	Roadside swale only

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-3	N2/0	Sapric	-
A	3-10	N2/0	Mucky Fine Sandy Loam	-
Bg1	10-14	10yr 3/1	Fine Sandy Loam	-
Bg2	14-27	5Y 4/3	Fine Sandy Loam	-
Bg3	27-40	5y 4/2	Fine Sandy Loam	-

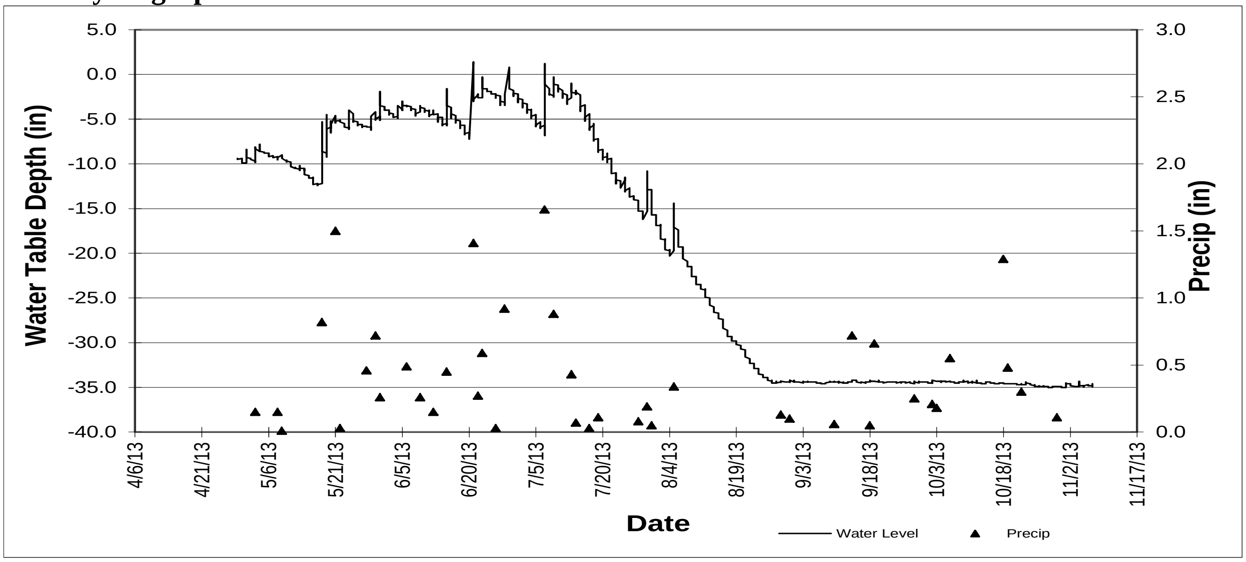
Surrounding Soils: Soderville fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Rhamnus frangula (S)	Glossy Buckthorn	40
Ulmus american (S)	American Elm	15
Populus tremulodies (T)	Quaking Aspen	10
Acer saccharum (T)	Silver Maple	10

Other Notes: The site is owned and managed by MN DNR. Access is from 181st Avenue.

2013 Hydrograph

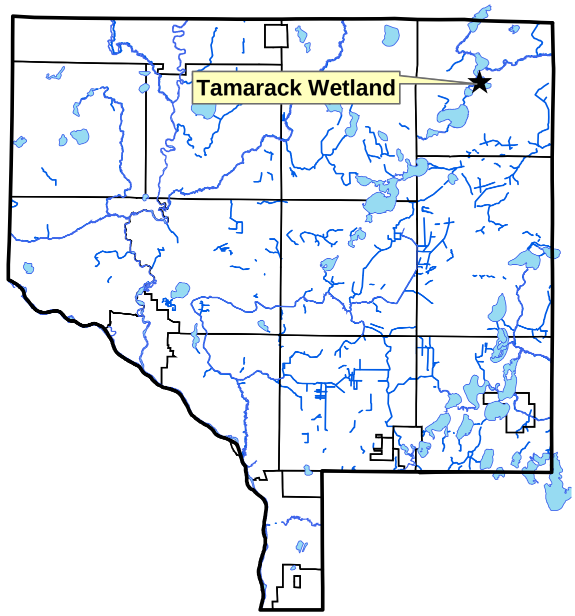


Well depths were 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

TAMARACK REFERENCE WETLAND

Martin-Island-Linwood Regional Park, Linwood Township



Site Information

Monitored Since: 1999

Wetland Type: 6

Wetland Size: 1.9 acres (approx)

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-6	N2/0	Mucky Sandy Loam	-
A2	6-21	10yr 2/1	Sandy Loam	-
AB	21-29	10yr3/2	Sandy Loam	-
Bg	29-40	2.5y5/3	Medium Sand	-

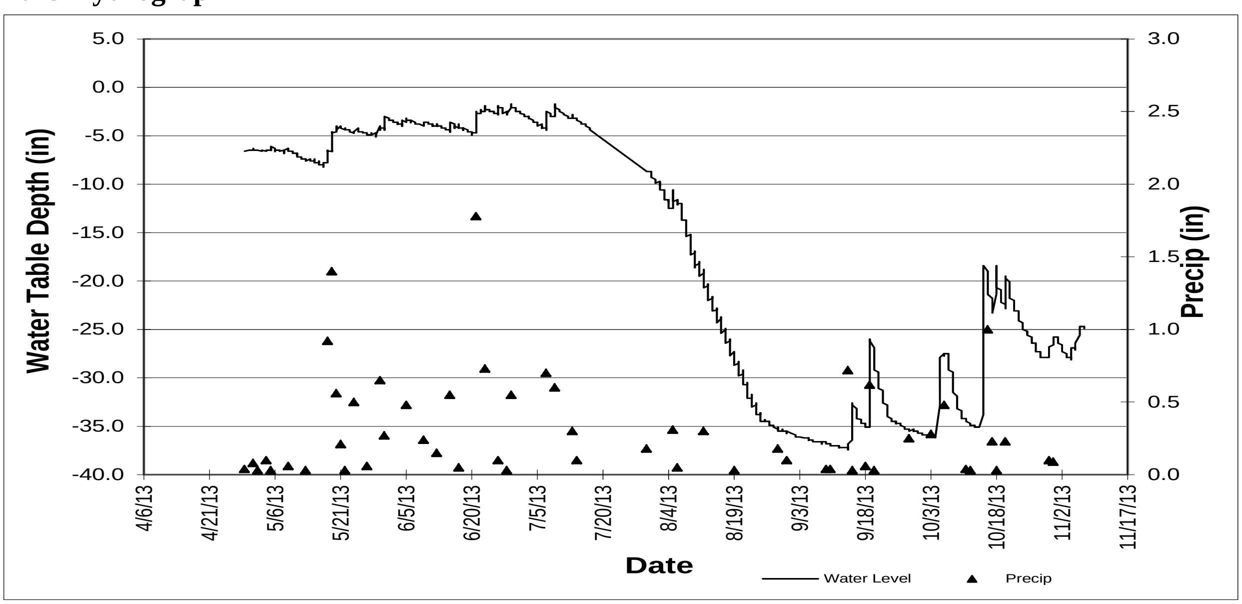
Surrounding Soils: Sartell fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Rhamnus frangula	Common Buckthorn	70
Betula alleghaniensis	Yellow Birch	40
Impatiens capensis	Jewelweed	40
Phalaris arundinacea	Reed Canary Grass	40

Other Notes: The site is owned and managed by Anoka County Parks.

2013 Hydrograph



Well depth was 35 inches, so a reading of –35 indicates water levels were at an unknown depth greater than or equal to 35 inches.

Water Quality Grant Fund

Description: The Sunrise River Watershed Management Organization (SRWMO) offers cost share grants encourage projects that will benefit lake and stream water quality. These projects include lakeshore restorations, rain gardens, erosion correction, and others. These grants, administered by the ACD, offer 50-70% cost sharing of the materials needed for a project. The landowner is responsible for the remaining materials expenses, all labor, and any aesthetic components of the project. The ACD assists interested landowners with design, materials acquisition, installation, and maintenance.

Purpose: To improve water quality in area lakes, streams, and rivers.

Locations: Throughout the watershed.

Results: In 2012 one lakeshore restoration project at Linwood Lake was awarded a grant from this fund. Additionally, $4,300 was transferred out of this fund at the discretion of the SRWMO Board and directed to the Martin and Typo Lakes Carp Barriers project.

SRWMO Cost Share Fund Summary

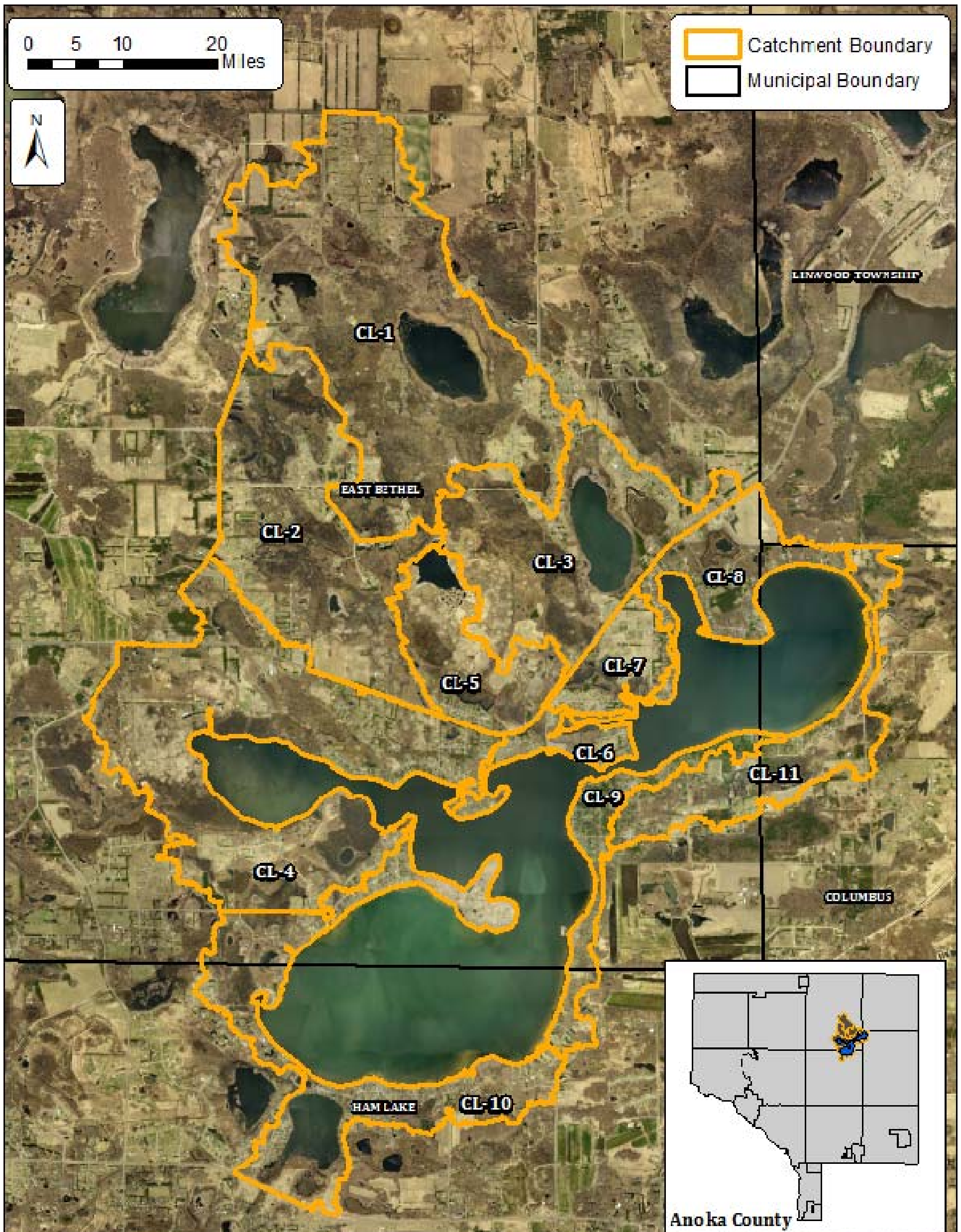
2005 SRWMO Contribution	+	$1,000.00
2006 SRWMO Contribution	+	$1,000.00
2006 Expense - Coon Lake, Rogers Property Project	-	$ 570.57
2007 – no expenses or contributions		$ 0.00
2008 SRWMO Contribution	+	$2,000.00
2008 Expense - Martin Lake, Moos Property Project	-	$1,091.26
2009 SRWMO Contribution	+	$2,000.00
2010 SRWMO Contribution	+	$1,840.00
2011 SRWMO Contribution	+	$2,000.00
2012 SRWMO Contribution	+	$2,000.00
2012 Expense – Linwood Lake, Gustafson Property Project	-	$ 29.43
2012 Expense – Transfer to Martin-Typo Lakes Carp Barriers	-	$4,300.00
2013 – no expenses or contributions		$ 0.00
Fund Balance		**$5,848.74**

Coon Lake Area Stormwater Retrofit Analysis

Description: A Stormwater Retrofit Analysis is a systematic approach of identifying opportunities for improved stormwater treatment within a subwatershed of a high priority waterbody. Once stormwater retrofit options are identified, they are modeled to determine pollutant removal benefits. Costs for each potential project are estimated. Finally, the cost effectiveness of each project is calculated and projects are ranked accordingly. The final report serves as a guide for installing water quality projects in a cost effective manner.

Purpose: To improve Coon Lake water quality.

Results: The Anoka Conservation District (ACD) was contracted to complete a Stormwater Retrofit Analysis of the Coon Lake subwatershed. ACD performed watershed-wide field reconnaissance and completed GIS analysis. Potential projects have been assembled in a comprehensive list. Report preparation is in progress and will be delivered by March of 2014. Findings will be presented to WMO and lake groups.



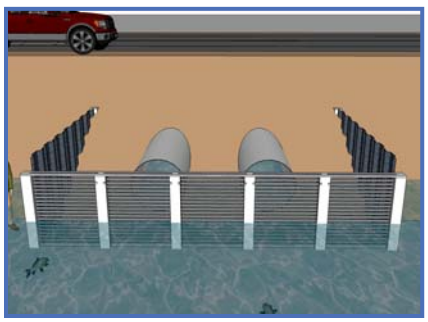
Carp Barriers Installation

Description: In 2013 the SRWMO provided $15,000 toward the installation of carp barriers in the Martin and Typo Lake system. This project will improve water quality in Martin and Typo Lakes by controlling carp with strategically placed barriers and increased commercial harvests. Both lakes fail to meet state water quality standards due to excessive phosphorus which fuels algae blooms. As a result, the lakes are often strongly green or brown and the game fishery is depressed. Carp are a major cause of poor water quality in these lakes, diminishing their value for swimming, boating, and fishing.

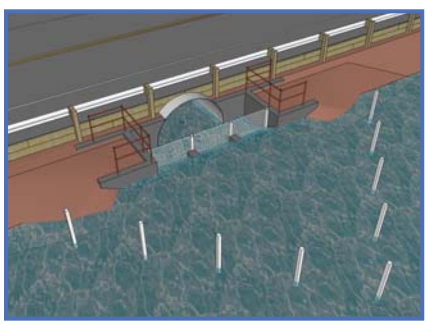
Barriers are an effective strategy for carp control because Typo and Martin Lake each provide something important for carp, and moving between the lakes is important to their success. Martin Lake is deeper, and good for overwintering. Typo Lake and Typo Creek are shallow and good for spawning. Stopping migrations between the lakes with barriers will reduce overwintering survival and spawning success. Even more, barriers will allow successful commercial carp harvests.

Purpose: To improve water quality.

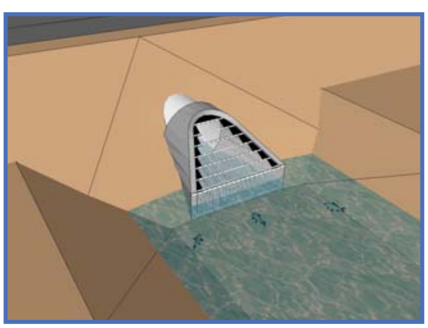
Results: Construction bidding occurred in late 2013. Bids exceeded the allowed budget. The project was placed on hold while an existing state grant was returned and a new grant was pursued. A new grant for more funds was secured in December 2013. The funds provided by the SRWMO have been held and will be used for the upcoming project construction.



Concept- Typo Lake outlet and North Inlet of Martin Lake. Horizontal screens which are removable. Top of the screens serve as an emergency overflow. A maintenance catwalk and railing (not shown) will be included.



Concept - Martin Lake outlet
Two sets of pivoting bars allow passage of debris but prevent carp from jumping from the creek into the lake. Diversion posts in the lake prevent larger debris from becoming entangled in the weir.



Concept—South Inlet of Martin Lake
Vertical swinging bars on the downstream end of culverts allow passage of debris but prevent carp from swimming upstream.

Lakeshore Landscaping Education

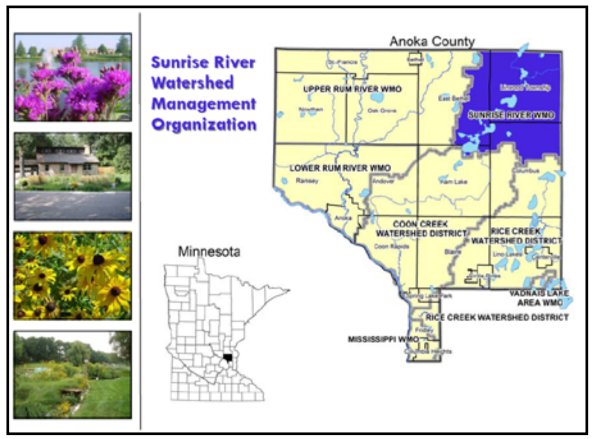
Description: One goal of the Sunrise River WMO is to encourage and facilitate lakeshore restorations with native plants. These projects, usually accomplished by homeowners with assistance from agencies like the SRWMO, are beneficial to overall lake health. By planting native plants at the shoreline runoff into the lake is filtered, and fish and wildlife habitat is substantially improved. To move toward its goal, the SRWMO does regular education and marketing of lakeshore restorations to homeowners.

Purpose: To improve lake water quality and lake health.

Results: Lakeshore Landscaping & Raingarden Display Board – ACD constructed a 3-panel self-standing display board comprised of information on both rain gardens and lakeshore landscaping. The display was presented by board members at Linwood Family Fun Day, East Bethel Booster Days, Columbus Arbor Day, and Lake Association meetings.

Postcard about grant availability **–** A postcard was designed by ACD illustrating the availability of cost share grants for water quality improvement projects in the SRWMO. These postcards were issued to SRWMO board members to be distributed at community events.

Lakeshore Restoration Brochures – ACD provided the SRWMO with brochures on lakeshore restoration to be distributed at their community event displays.



Blue Thumb membership – Blue Thumb is a consortium of Minnesota agencies, plant nurseries, landscapers, and others who share resources in their efforts to promote the use of native plants to improve water quality through shoreline stabilizations, rain gardens, and native plant gardens. Resources that are shared amongst Blue Thumb members include pre-fab marketing materials, displays, how-to manuals, and others. The ACD enrolled the SRWMO in Blue Thumb and performed all necessary administration to maintain the membership and renew it in 2013.

Blue Thumb
PLANTING FOR CLEAN WATER®

The ACD manages the SRWMO's Blue Thumb membership by submitting annual membership applications and tracking SRWMO contributions. Maintaining a Blue Thumb membership requires an annual contribution of either $1,500 cash or 30 hours of efforts. The SRWMO chooses to meet this requirement by incorporating Blue Thumb into a variety of tasks that are already planned and benefit from Blue Thumb (including those listed above). In 2013 the SRWMO exceeded the 30 hour commitment with the following work:

- Postcard with information on grant availability
- Presentations at Linwood Family Fun Day, East Bethel Booster Days, and Columbus Arbor Day
- Grant applications for potential projects.
- Martin Lake rain garden maintenance.

Annual Education Publication

Description: An annual newsletter article about the SRWMO is required by MN Rules 8410.010 subpart 4, and planned in the SRWMO Watershed Management Plan.

Purpose: To improve citizen awareness of the SRWMO, its programs, and accomplishments.

Results: In 2013 the SRWMO contracted with the ACD to write the annual newsletter and provide it to member communities for distribution in their newsletters. Topics for annual newsletter were discussed by the SRWMO Board, and the Sunrise River WRAP was chosen. The article was also to include the new SRWMO website address and general organizational information.

Limited space in city newsletters was recognized as an issue. A full length (below) and summarized version of an article were created. It was provided to member cities for their city newsletters in July.

SRWMO 2013 newsletter article, which was published in member city newsletters:

Sunrise River, Local Lakes WRAP Nears Completion

An effort is underway to protect and improve water quality in the entire Sunrise River watershed. The watershed of 381 square miles includes northeast Anoka County and parts of Chisago, Isanti, Washington, and Pine Counties. It is known for abundant lakes and wild, meandering streams. Unfortunately, it also has some water quality problems. This is concerning for its own sake but also because it drains to the St. Croix River. In Anoka County the following water bodies fail to meet state water quality standards and are deemed "impaired:"

Linwood Lake is one impaired waterbody covered by management plans under development.

- *West Branch of the Sunrise River, which flows through Martin Lake (pH, turbidity, fish, macroinvertebrates)*
- *South Branch of the Sunrise River, which flows through the Carlos Avery WMA (dissolved oxygen)*
- *Linwood, Martin, and Typo Lakes Lake (nutrients)*
- *Various others (mercury in fish tissue, addressed by other state efforts)*

Work underway is in two parts:

First, a Total Maximum Daily Load (TMDL) study is nearly complete. This technical document is required by the Federal Clean Water Act and specifies the amount by which pollutants need to be reduced to meet water quality standards.

It applies to the impaired waters listed above, except Martin and Typo Lakes which already have a separate TMDL. A public comment period will be open later this year.

Secondly, a Watershed Restoration and Protection Plan (WRAP) is being drafted. It builds from the TMDL by prescribing work needed to improve water quality, including locations and approaches. It looks at both improving impaired waters and protecting good water quality where it exists. Projects identified are eligible for greater State funding, but must be locally led.

Locally, the Sunrise River Watershed Management Organization (SRWMO) is central to managing these water bodies. The SRWMO is a joint powers organization covering Linwood Township and parts of Columbus, East Bethel, and Ham Lake. To learn more visit www.SRWMO.org.

More about these projects in the Sunrise River Watershed can be found on the MN Pollution Control website. Specific questions can be directed to Jamie Schurbon at the Anoka Conservation District – jamie.schurbon@anokaswcd.org or 763-434-2030 ext. 12.

SRWMO Website

Description: The Sunrise River Watershed Management Organization (SRWMO) contracted the Anoka Conservation District (ACD) to design and maintain a website about the SRWMO and the Sunrise River watershed.

Purpose: To increase awareness of the SRWMO and its programs. The website also provides tools and information that helps users better understand water resources issues in the area. The website serves as the SRWMO's alternative to a state-mandated newsletter.

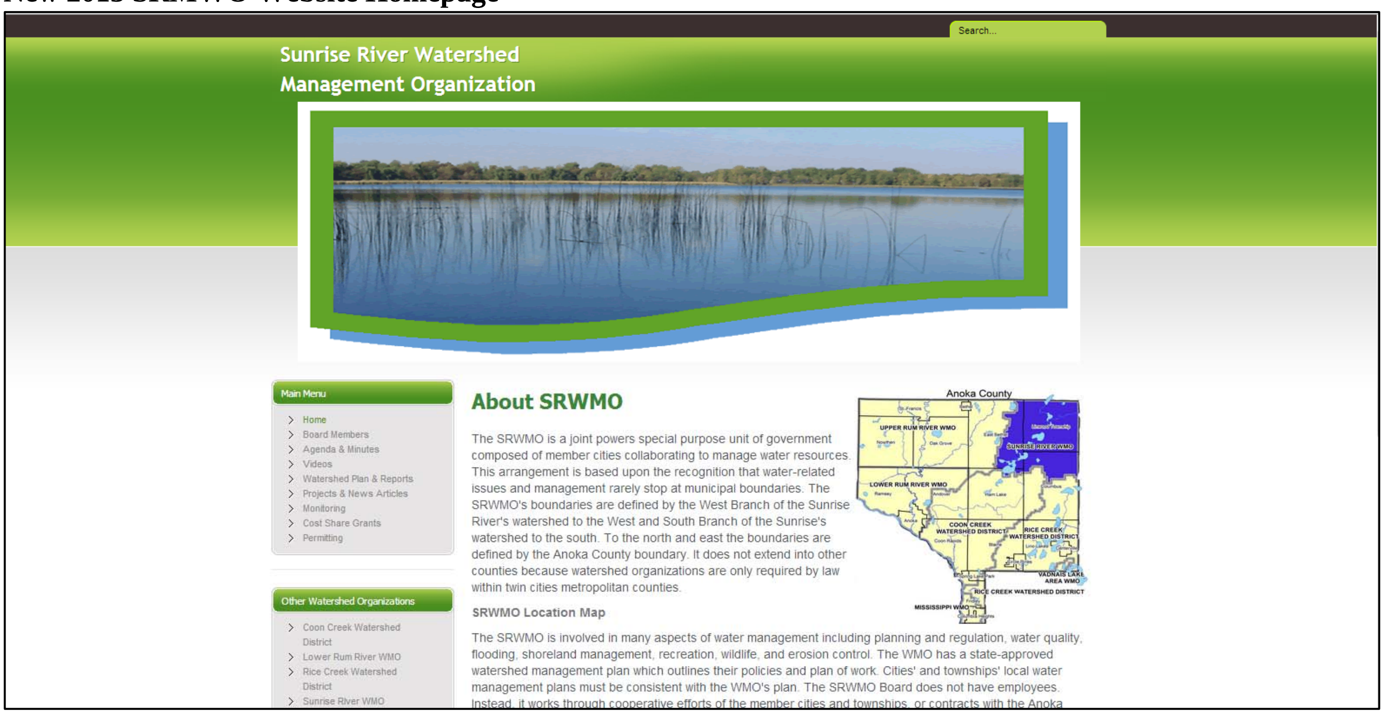
Location: www.SRWMO.org

Results: In 2013 the upgraded, redesigned, and re-launched the SRWMO website. These updates were necessary because the old website platform was incompatible with certain tablet computers and smartphones. Additionally, the old website was hosted with in the ACD website, while the new website is completely independent, offering the WMO future management choices.

Regular website updates also occurred throughout the year. The SRWMO website contains information about both the SRWMO and about natural resources in the area.
Information about the SRWMO includes:

- a directory of board members,
- meeting minutes and agendas,
- the watershed management plan and information about- plan updates,
- descriptions of work that the organization is directing,
- highlighted projects.

New 2013 SRMWO Website Homepage



Grant Searches and Applications

Description: The Anoka Conservation District (ACD) assisted the SRWMO with the preparation of grant applications. Several projects in the SRWMO Watershed Management Plan need outside funding in order to be accomplished.

Purpose: To provide funding for high priority local projects that benefit water resources.

Results: At the direction of the SRWMO Board, in 2013 ACD staff prepared one grant request in cooperation with the SRWMO – a BWSR Clean Water Fund Request for installation of Coon Lake Area Stormwater Retrofits. Work included:

- Preparing and submitting the project budget and application.
- Securing letters of support from the SRWMO, Coon Lake Improvement Association, Coon Lake Improvement District, and Coon Lake Beach Community Center.
- Securing cash in-kind matching dollars totaling $5,000 from the three Coon Lake civic groups.

The total grant request was $42,987. The outcome will be known in January 2014.

SRWMO 2012 Annual Report to BWSR and State Auditor

Description: The Sunrise River Watershed Management Organization (SRWMO) is required by law to submit an annual report to the Minnesota Board of Water and Soil Resources (BWSR), the state agency with oversight authorities. This report consists of an up-to-date listing of SRWMO Board members, activities related to implementing the SRWMO Watershed Management Plan, the status of municipal water plans, financial summaries, and other work results. The SRWMO bolsters the content of this report beyond the statutory requirements so that it also serves as a comprehensive annual report to SRWMO member communities. The report is due annually 120 days after the end of the SRWMO's fiscal year (April 30th).

The SRWMO must also submit an annual financial report to the State Auditor. They accept unaudited financial reports for financial districts with annual revenues less than $185,000.

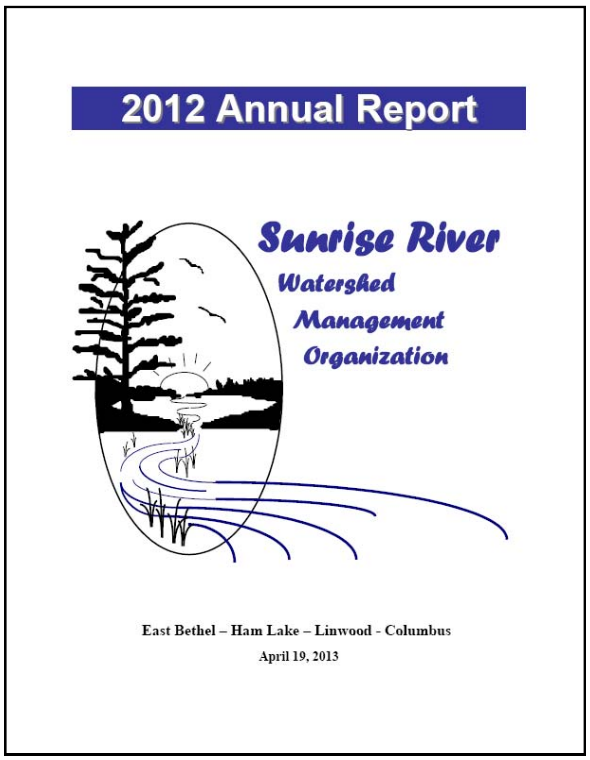
Purpose: To document progress toward implementing the SRWMO Watershed Management Plan and to provide transparency of government operations.

Locations: Watershed-wide

Results: Anoka Conservation District (ACD) assisted the SRWMO with preparation of a 2012 Sunrise River WMO Annual Report. ACD drafted the report and a cover letter. After SRWMO Board review the final draft was forwarded to BWSR on April 25, 2013. A sufficient number of copies of the report were sent to each member community to ensure that each city council person and town board member would receive a copy. The report is available to the public on the SRWMO website.

ACD simultaneously performed annual reporting to the State Auditor through their SAFES website. This report consists of a 10-worksheet Excel file.

Cover


2012 Annual Report

Sunrise River Watershed Management Organization

East Bethel – Ham Lake – Linwood - Columbus

April 19, 2013

Table of Contents

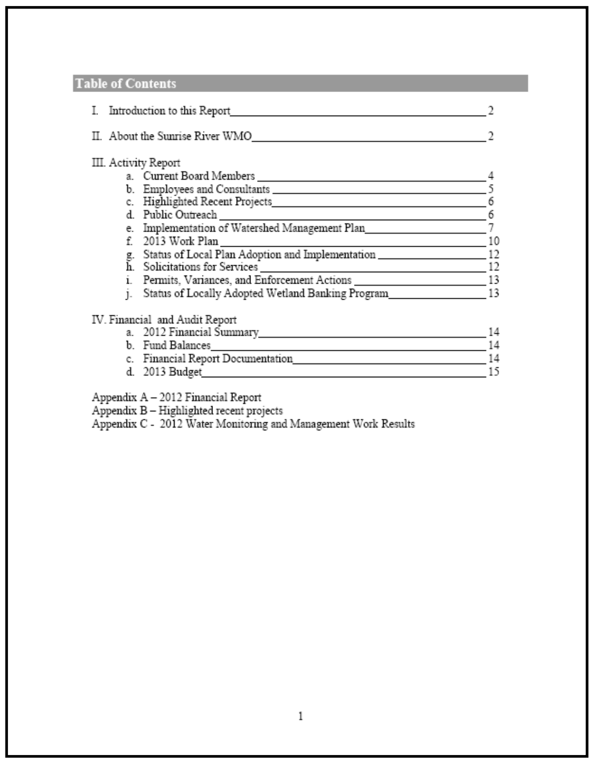


Table of Contents

1

On-call Administrative Services

Description: The Anoka Conservation District Water Resource Specialist provides limited, on-call administrative assistance to the SRWMO. Tasks are limited to those defined in a contractual agrenement.

Purpose: To ensure day-to-day operations of the SRWMO are attended to between regular meetings.

Results: In 2013 a total of 15.5 hours of administrative assistance have occurred as of December 19. Additional hours creating, presenting, and editing the 2015 budget are anticipated and will likely bring the total to the 20.5 hours allowed annually.

The following tasks were accomplished:

- 2014 budget preparation and related questions from cities.
- Annual reporting reminders to member cities and receive those reports.
- Prepared and submitted Blue Thumb member agreement.
- Meeting packet preparation and portions of meeting attendance not related to projects.
- Provide material for RFP for professional services.
- Meeting with E. Bethel council member about stormwater retrofit ideas.
- Provided Linwood & Met Council with evidence that the townshiop may adopt the WMO plan as their local water plan. This had been a reason Met Council had denied Linwood's comp plan. Fielded various other questions from Met Council about the WMO's requirements for Linwood Township.
- Occasional inquiries from contractors and developers about any SRWMO permitting requirements.
- Assist with compiling agendas and meeting packets.

Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program. We do not, however, know specifically which expenses are attributed to monitoring which sites. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer.

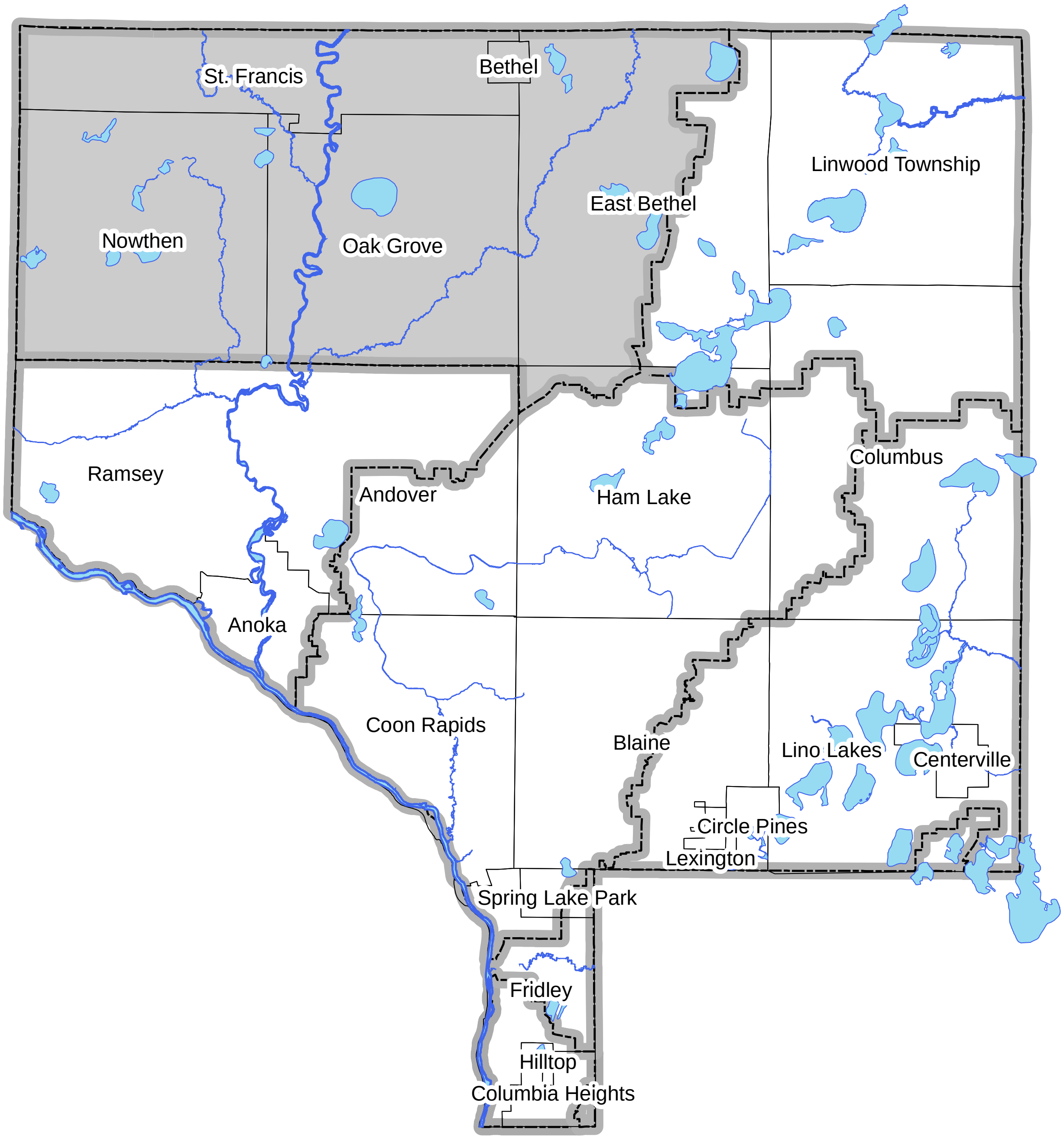
Sunrise River Watershed Financial Summary

Sunrise River Watershed	Volunteer Precip	Ref Wet	Ob Well	Lake Lvl	Lake WQ	SRWMO Admin	SRWMO On-Call Admin	WMO Annual Rpts to State	WMO Grant Search	SRWMO Outreach/Promo	WMO Website Maint	WMO Website Migration	Martin/Typo Carp Bariers	Sunrise River WRAPP	Moore Lake SRA	Coon Lake SRA	Projects	Total
Revenues																		
SRWMO	0	1680	0	1000	0	0	1500	1025	1000	1500	405	800	0	0	0	10416	0	19326
State	0	0	261	0	0	0	0	0	0	0	0	0	8540	0	0	0	0	8801
Anoka Conservation District	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anoka Co. General Services	0	0	353	0	0	0	0	0	2230	0	0	51	1193	33	0	0	0	3861
County Ag Preserves	0	0	0	0	1028	0	0	0	0	0	0	0	0	0	0	0	48	1076
Regional/Local	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Service Fees	0	0	0	0	358	0	0	0	0	0	0	0	0	2590	0	0	404	3353
BWSR Cons Delivery	0	0	0	0	0	511	0	0	0	498	0	0	0	0	0	902	0	1910
BWSR Cost Share TA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	441	441
Local Water Planning	236	0	65	7	594	0	0	0	0	0	0	0	0	0	0	0	0	902
TOTAL	236	1680	679	1007	1980	511	1500	1025	3230	1998	405	851	9734	2623	0	11318	893	39670
Expenses-																		
Capital Outlay/Equip	1	16	8	13	24	5	12	4	71	28	5	9	80	39	0	211	14	541
Personnel Salaries/Benefits	197	1014	569	857	1372	446	889	502	2571	1679	316	451	7222	2185	0	8853	740	29863
Overhead	21	67	45	58	92	27	92	47	156	106	28	29	706	152	0	746	53	2425
Employee Training	1	4	2	5	8	5	3	0	14	4	1	1	24	14	0	22	3	109
Vehicle/Mileage	3	17	9	16	24	10	12	6	44	25	5	6	105	39	0	122	12	455
Rent	12	46	29	38	62	18	54	29	110	78	18	21	422	99	0	478	36	1549
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	0	1	0	0	350	0	0	0	0	39	0	312	1000	0	0	0	1	1703
McKay Expenses	1	19	17	19	49	0	42	0	264	39	13	22	175	95	0	885	36	1676
TOTAL	236	1183	679	1007	1980	511	1104	590	3230	1998	385	851	9734	2623	0	11318	893	38321
NET	0	497	0	0	0	0	396	435	0	0	20	0	0	0	0	0	0	1349

Recommendations

- **Participate the Sunrise River Watershed Restoration and Protection Project (WRAPP)** which is led by Chisago SWCD and MPCA. It will result in TMDLs for the Sunrise River and Linwood Lake. The next SRWMO plan will likely be strongly encouraged to implement the WRAPP.
- **Install stormwater retrofits around Coon Lake.** A stormwater assessment is being completed. It identifies and ranks stormwater retrofit projects that will benefit lake water quality. A state grant has been secured.
- **Install the Martin and Typo Lake carp barriers.**
- **Continue efforts to secure grants.** A number of water quality improvement projects are being identified. Outside funding will be necessary for installation of most of these. These projects should be highly competitive for those grants.
- **Bolster lakeshore landscaping education efforts.** The SRWMO Watershed Management Plan sets a goal of 3 lakeshore restorations per year. Few are occurring. Fresh approaches should be welcomed.
- **Increase the use of web videos as an effective education and reporting tool.**
- **Continue the SRWMO cost share grant program** to encourage water quality projects.
- **Encourage communities to report water quality projects to the SRWMO.** An overarching goal in the SRWMO Plan is to reduce phosphorus by 20% (986 lbs). State oversight agencies will evaluate efforts toward this goal. Both WMO and municipal project benefits should be counted.

Upper Rum River Watershed



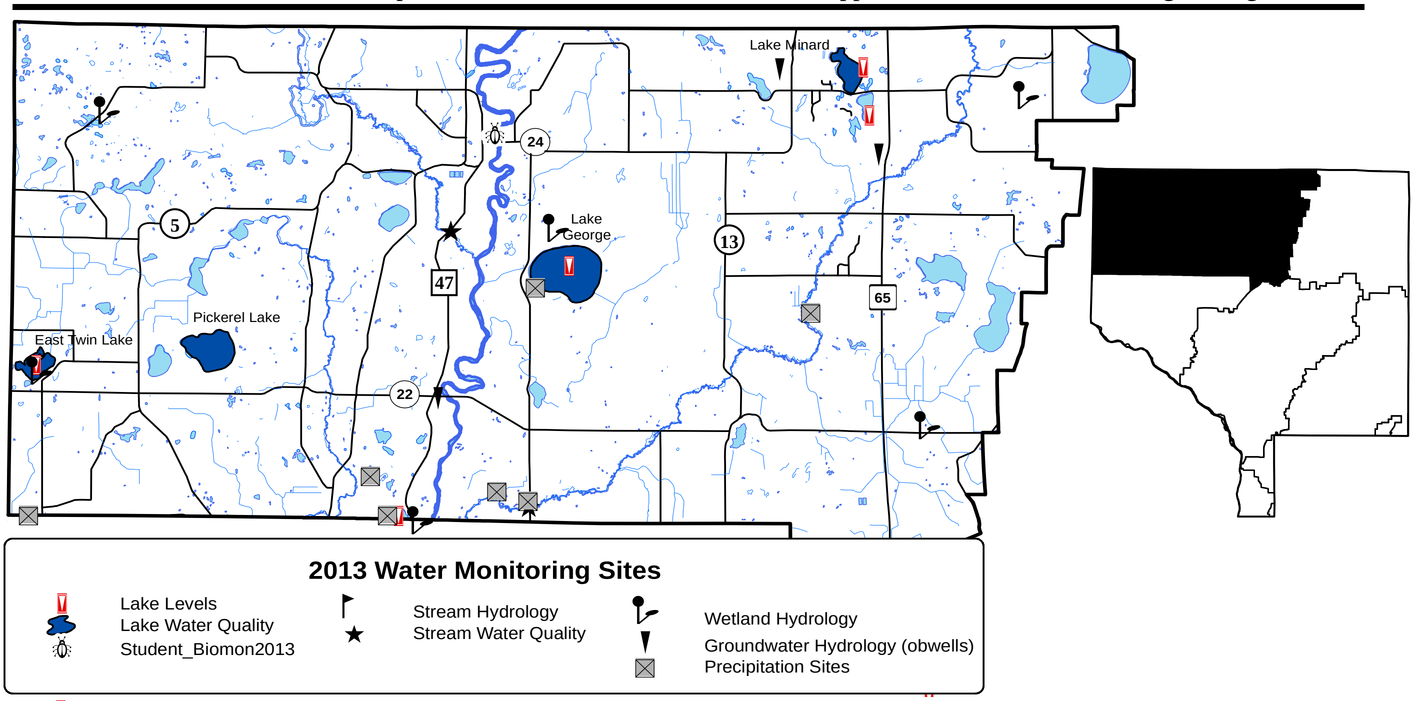
Contact Info: Upper Rum River Watershed Management Organization
www.urrwmo.org
763-753-1920

Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 3:
UPPER RUM RIVER WATERSHED

Task	Partners	Page
Lake Level Monitoring	URRWMO, ACD, MN DNR, volunteers	3-52
Lake Water Quality Monitoring	URRWMO, ACD	3-54
Stream Water Quality – Chemical Monitoring	MPCA, ACD	3-65
Stream Water Quality – Biological Monitoring	ACD, URRWMO, ACAP, St. Francis High School	3-70
Wetland Hydrology	URRWMO, ACD	3-74
Water Quality Grant Fund	URRWMO, ACD	3-80
URRWMO Website	URRWMO, ACD	3-81
URRWMO Annual Newsletter	URRWMO, ACD	3-82
2012 Annual Reports to the State	URRWMO, ACD	3-83
Financial Summary		3-84
Recommendations		3-84
Groundwater Hydrology (obwells)	ACD, MNDNR	Chapter 1
Precipitation	ACD, volunteers	Chapter 1

ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District,
LRRWMO = Lower Rum River Watershed Mgmt. Org, MC = Metropolitan Council
MNDNR = Minnesota Dept. of Natural Resources, URRWMO = Upper Rum River Watershed Mgmt. Org



Lake Levels

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all historic data are available on the Minnesota DNR website using the “LakeFinder” feature (www.dnr.mn.us.state\lakefind\index.html).

Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations: East Twin Lake, Lake George, Rogers Lake, Minard Lake, Coopers Lake

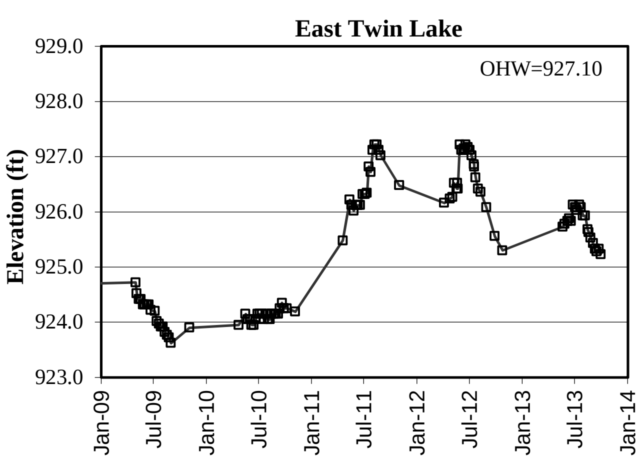
Results: Lake levels were measured by volunteers throughout the 2013 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. Lakes had sharply increasing water levels in spring and early summer 2013 when heavy rainfall occurred. Little rainfall fell later in the year and lake levels fell dramatically.

All lake level data can be downloaded from the MN DNR website’s Lakefinder feature. Ordinary High Water Level (OHW), the elevation below which a DNR permit is needed to perform work, is listed for each lake on the corresponding graphs below.

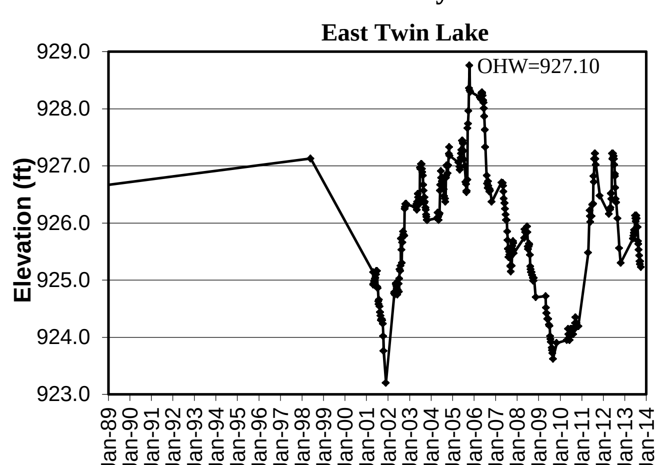
2011 and 2012 were the first years for monitoring Coopers and Minard Lakes. In recent years, there had been complaints about disproportionately low water in Coopers Lake and questions about why Minard Lake did not seem to have this problem. Indeed, both lakes have had similar maximum water levels in spring (Minard slightly higher because it is upstream). But Coopers Lake level drops rapidly by several feet in dry conditions, while Minard Lake is maintained higher. Additionally in 2013 Minard Lake saw a quick and dramatic late season rise in elevation due to dewatering projects to the east sending groundwater into the lake.

The reasons for differences between Minard and Coopers Lake are likely due to both the elevation of the culvert between the lakes, as well as differences in geology and groundwater interaction. Minard Lake can flow into Coopers Lake through a road culvert when the water is high enough. More often, Minard Lake does not outflow. It therefore maintains higher water even during drought. Coopers Lake can have surface water outflows at lower elevations; it drains to wetlands south of the lake. At very low water levels surface water runout from Coopers Lake also ceases but lake levels continue to drop. Anoka County LiDAR confirms this, suggesting geology and groundwater connections also are important.

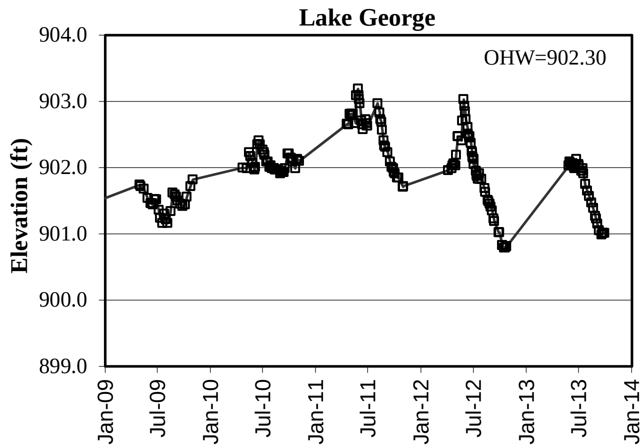
East Twin Lake Levels – last 5 years



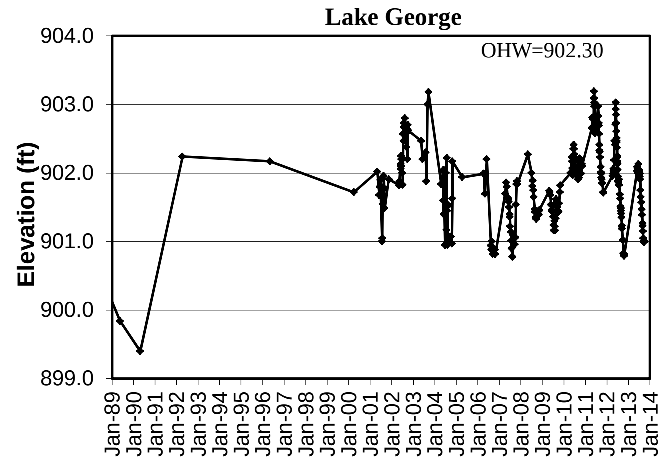
East Twin Lake Levels – last 25 years



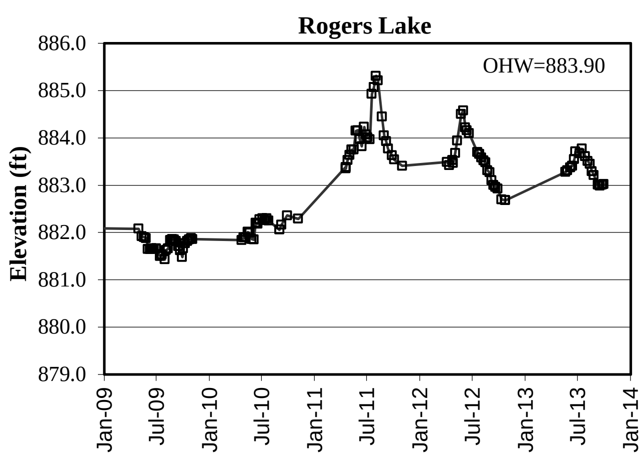
Lake George Levels – last 5 years



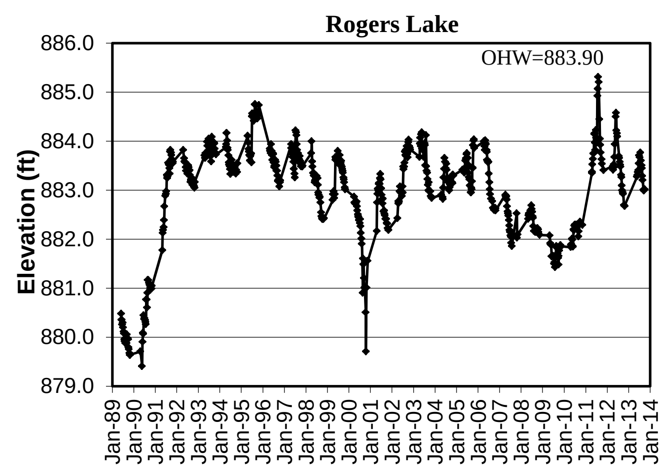
Lake George Levels – last 25 years



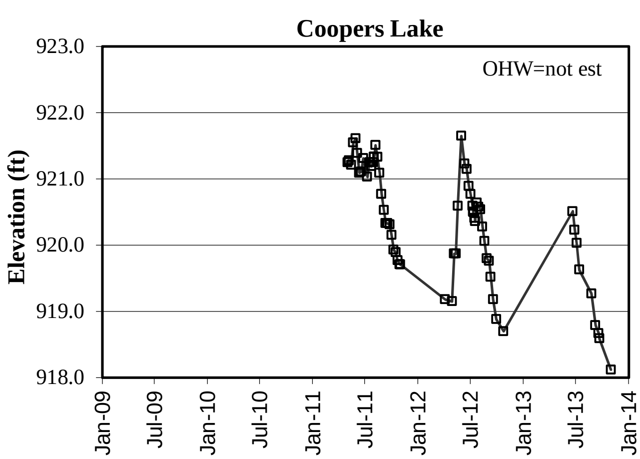
Rogers Lake Levels – last 5 years



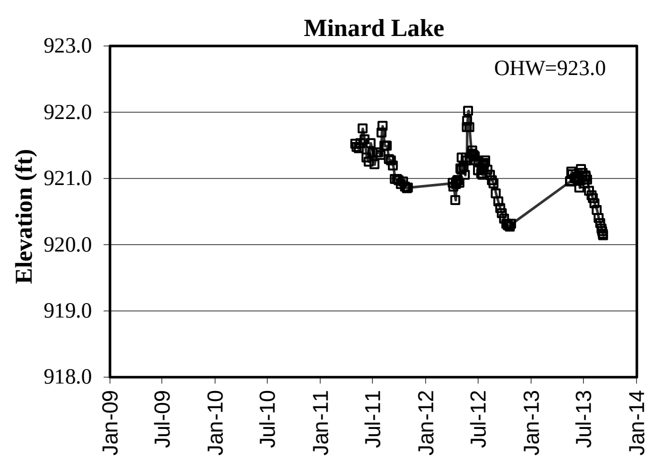
Rogers Lake Levels – last 25 years



Coopers Lake Levels – last 5 years



Minard Lake Levels – last 5 years



Lake Water Quality

Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: East Twin Lake

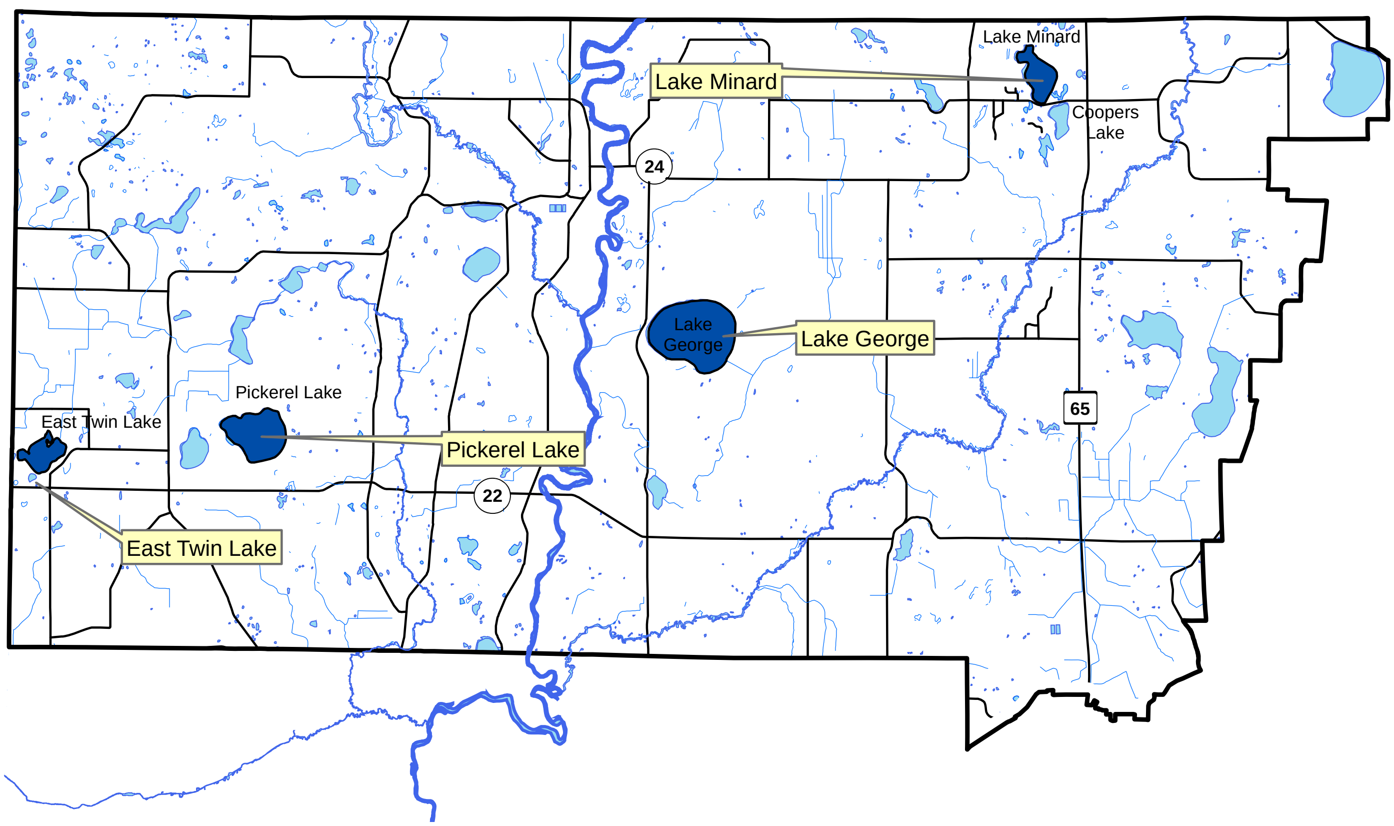
Lake George

Lake Minard

Pickerel Lake

Results: Detailed data for each lake are provided on the following pages, including summaries of historical conditions and trend analysis. Previous years' data are available at the MPCA's electronic data access website. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.

Upper Rum River Watershed Lake Water Quality Monitoring Sites



East Twin Lake

City of Nowthen, Lake ID # 02-0133

Background

East Twin Lake is located on Anoka County's western boarder in the City of Nowthen. The lake has a surface area of 116 acres with a maximum depth of 77 feet (20.1 m), making it Anoka County's deepest lake. Public access is from East Twin Lake City Park, where there is both a swimming beach and boat launch. The lakeshore is only moderately developed, with residences being mostly of low density and encompassing about half of the lake. The watershed is >75% undeveloped, with low-density residential areas. This lake is one of the clearest in the county. One exotic invasive plant is known to this lake, curly-leaf pondweed.

2013 Results

In 2013 East Twin Lake had excellent water quality for this region of the state (NCHF Ecoregion), receiving an overall A grade; the same as in 13 of the previous 14 years monitored. The lake is mesotrophic. Of particular notability is the 19.1 ft. Secchi transparency on June 12, 2013 and other exceptional clarity readings of 18.7 ft. in May of 2011, 22 ft. on May 28, 2008 and 20 ft. in spring 2002; these are the deepest at any Anoka County lake since at least 1996. Even later in summer, transparency is sometimes >10 ft. In 2013 Secchi transparency readings never fell below 10 ft. Throughout summer total phosphorus started high (>30 ug/L), then fell gradually to a summer low (17 ug/L) until late summer when it bounced back upward (28 ug/L). Chlorophyll-a was consistently at <5 ug/L. These are low and considered excellent. Subjective observation by ACD staff ranked physical and recreational conditions optimal.

Trend Analysis

Thirteen years of water quality data have been collected by the Metropolitan Council (1980, '81,'83, '95, and '98), the Minnesota Pollution Control Agency (1989), and the Anoka Conservation District (1997, '99, 2000, 2002, 2005, 2008, 2011, and 2013). Trend analyses up to 2008 found water quality significantly improved since 1980 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,9}= 7.31$, $p=0.01$). The most obvious differences are from the 1980's data and the post-1980's data. One-way ANOVAs revealed that reduction in chlorophyll-a continues to be the most important factor in this trend, but total phosphorus reductions also occurred. Secchi transparency changes have been minimal. The analysis with 2013 data finds that the trend is continuing to be statistically significant ($F_{2,11}= 4.14$, $p=0.046$). This suggests that water quality in East Twin is improving.

Discussion

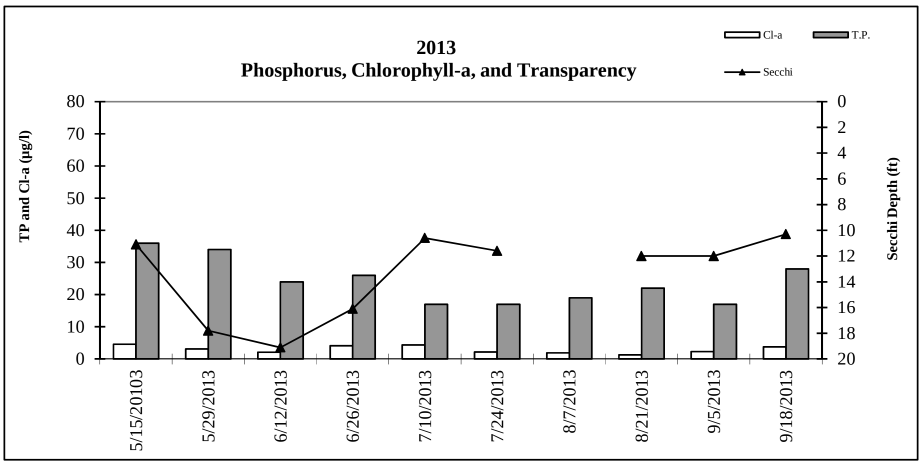
The ecology of this lake is different from that of many other Anoka County Lakes because it is deep. Sediment and dead algae can sink to the bottom and are essentially lost from the system because resuspension by wind, rough fish, and other forces is minimal. In shallower lakes, these nutrients circulate within the lake much more readily and the lake sediments can be a source of nutrients and turbidity that affect water quality. Additionally, East Twin Lake's direct watershed is small, so there is a small area from which polluted runoff might enter the lake. Aquatic vegetation is also healthy, but not so prolific as to be a nuisance, further contributing to high water quality. One exotic invasive plant is present in the lake, curly leaf pondweed (CLP), though its growth is moderate and restricted in extent due to lake depth. CLP however, unlike most vegetation does not contribute to increasing water quality.

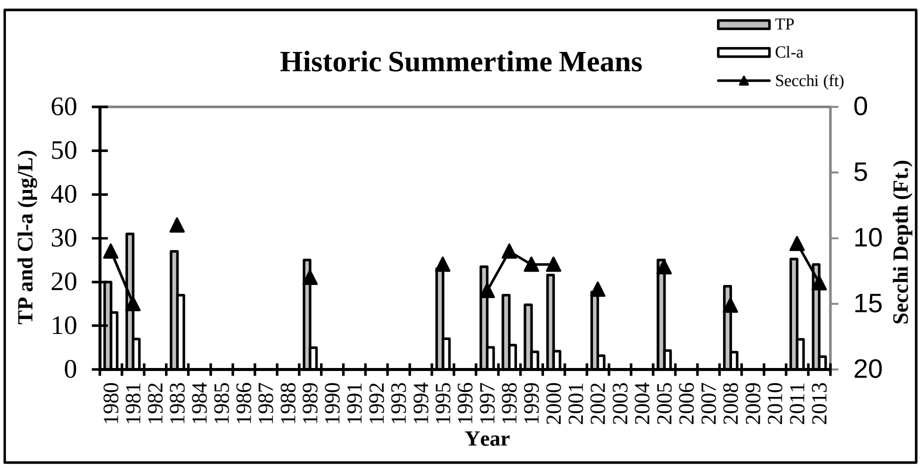
East Twin Lake Water Quality Results

East Twin Lake
2013 Water Quality Data

	Units	R.L.*	5/15/20103 Results	5/29/2013 Results	6/12/2013 Results	6/26/2013 Results	7/10/2013 Results	7/24/2013 Results	8/7/2013 Results	8/21/2013 Results	9/5/2013 Results	9/18/2013 Results	Average	Min	Max
pH		0.1	8.25	8.14	8.39	8.72	8.32	7.77	8.13	8.23	8.00	7.91	8.19	7.77	8.72
Conductivity	mS/cm	0.01	0.142	0.186	0.177	0.170	0.171	0.169	0.165	0.196	0.206	0.210	0.179	0.142	0.210
Turbidity	NTU	1	2.00	0.00	0.50	0.00	0.30	0.04	1.20	0.00	0.00	0.90	0.49	0.00	2.00
D.O.	mg/L	0.01	12.11	8.66	9.06	9.27	8.50	6.93	7.94	8.86	7.97	8.04	8.73	6.93	12.11
D.O.	%	1	121%	92%	98%	118%	107%	84%	93%	111%	98%	89%	101%	84%	121%
Temp.	°C	0.1	14.8	17.1	18.8	26.7	25.8	25.4	23.2	25.3	24.1	19.3	22.0	14.8	26.7
Temp.	°F	0.1	58.6	62.8	65.8	80.1	78.4	77.7	73.7	77.5	75.4	66.8	71.7	58.6	80.1
Salinity	%	0.01	0.00	0.09	0.09	0.08	0.08	0.08	0.08	0.10	0.10	0.10	0.08	0.00	0.10
Cl-a	ug/L	0.5	4.6	3.1	2.1	4.1	4.4	2.2	1.9	1.3	2.3	3.8	3.0	1.3	4.6
T.P.	mg/L	0.010	0.036	0.034	0.024	0.026	0.017	0.017	0.019	0.022	0.017	0.028	0.024	0.017	0.036
T.P.	ug/L	10	36	34	24	26	17	17	19	22	17	28	24	17	36
Secchi	ft	0.1	11.1	17.8	19.1	16.1	10.6	11.6		12.0	12.0	10.3	13.4	10.3	19.1
Secchi	m	0.1	3.4	5.4	5.8	4.9	3.2	3.5	0.0	3.7	3.7	3.1	4.1	3.1	5.8
Physical			1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.1	1.0	2.0
Recreational			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

*reporting limit





East Twin Lake Summertime Annual Mean

Agency	MC	MC	MC	MPCA	MC	ACD	MC	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1980	1981	1983	1989	1995	1997	1998	1999	2000	2002	2005	2008	2011	2013
TP	20.0	31.0	27.0	25.0	23.0	23.5	17.0	14.8	21.6	17.7	25.0	19.0	25.2	24.0
Cl-a	13.0	7.0	17.0	5.0	7.1	5.1	5.6	4.1	4.2	3.2	4.3	4.0	6.9	3.0
Secchi (m)	3.3	4.7	2.7	4.1	3.5	4.2	3.4	3.6	3.7	4.3	3.7	4.6	3.2	4.1
Secchi (ft)	11.0	15.0	9.0	13.0	12.0	14.0	11.0	12.0	12.0	13.9	12.2	15.1	10.4	13.4

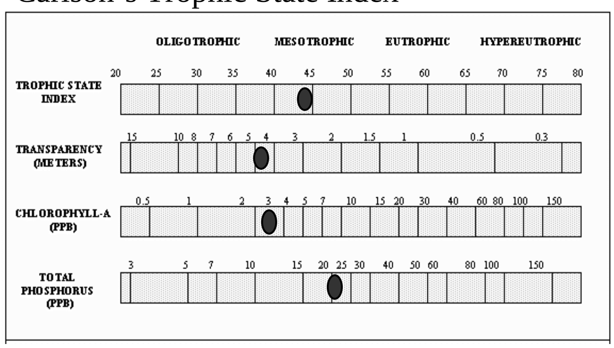
Carlson's Tropic State Indices

TSIP	47	54	52	51	49	50	45	43	48	45	51	47	51	50
TSIC	56	50	58	46	50	47	48	44	45	40	45	44	50	41
TSIS	43	38	46	40	42	39	42	42	41	40	41	38	43	40
TSI	49	47	52	46	47	45	45	43	45	42	46	43	48	44

East Twin Lake Water Quality Report Card

Year	80	81	83	89	95	97	98	99	2000	2002	2005	2008	2011	2013
TP	A	B	B	B	B	B	B	A	A	A	B	A	B	B
Cl-a	B	A	B	A	A	A	A	A	A	A	A	A	A	A
Secchi	A	A	B	A	A	A	A	A	A	A	A	A	A	A
Overall	**A**	**A**	**B**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**

Carlson's Trophic State Index



Lake George
CITY OF OAK GROVE, LAKE ID # 02-0091

Background

Lake George is located in north-central Anoka County. The lake has a surface area of 535 acres with a maximum depth of 32 feet (9.75 m). Public access is from Lake George County Park on the lake's north side, where there is both a swimming beach and boat launch. About 70% of the lake is circumscribed by homes; the remainder is county parkland. The watershed is mostly undeveloped or vacant, with some residential areas, particularly on the lakeshore and in the southern half of the watershed. Two invasive exotic aquatic plants are established in this lake, Curly-leaf pondweed and Eurasian Water Milfoil. The lake improvement district treats both with herbicide.

2013 Results

In 2013 Lake George had good water quality for this region of the state (NCHF Ecoregion), receiving an overall B grade, however it was the poorest water quality of all years monitored. The lake is mesotrophic or mildly eutrophic. Total phosphorus averaged 30.3 ug/L, the highest observed in 16 monitored years. Secchi transparency was over 15 feet in mid-May, but dropped to as low as 5.0 feet in late July. Average Secchi transparency was 8.6 feet, the second poorest observed. Chlorophyll-a averaged 6.1 mg/L, which is below the average of all years monitored. Total Phosphorous, Chlorophyll-a, and transparency were poorest in August. Phosphorus also saw a significant spike (77 ug/L) in early June following the treatment of Curly Leaf Pondweed and natural die-off. This is also observable, though not as extreme, in 2011. All other sampled years we see phosphorus levels climb gradually through the season.

2013 water quality was poorer than the Upper Rum River WMO's water quality standards. Those standards are limits which trigger further action from the organization. At this point, their standards call for another season of monitoring. Additional action may be advisable.

Trend Analysis

Fifteen years of water quality data have been collected by the Metropolitan Council (between 1980 and '94, 1998 and 2009) and the Anoka Conservation District (1997, 1999, 2000, 2002, 2005, 2008, 2011 and 2013). Water quality has not significantly changed from 1980 to 2013 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,13}$= 0.77, p>0.05). Superficially, it appears that transparency is slowly declining across years.

Discussion

Lake George remains one of the clearest of Anoka County Lakes. Lake George and nearby East Twin Lake are valuable resources because of their condition, size, suitability for many types of recreation, and public access. Lake George is especially valuable to Anoka County due to its unique ecosystem. Most metro area lakes have a biodiversity of 10-12 different aquatic plant species; Lake George is home to 24. These will be under continued or increasing stresses from recreational usage and/or development. Continued efforts are needed to maintain the lakes' quality including monitoring, education, and lakeshore and nutrient best management practices. One example is residential lakeshore restorations which have occurred on several properties. Still, many properties on Lake George aggressively manicure their lakeshore in ways that are detrimental to lake health. Around any developed lake failing septic systems can also be a threat to water quality. This concern exists at Lake George, but is reduced because many homes are served by a community sewer system.

Two exotic invasive plants are present in Lake George, Curly leaf pondweed and Eurasian Water milfoil. A Lake Improvement District has been formed to orchestrate control of these plants and multiple years of localized treatments have occurred. Concern has been voiced that plant treatments may have a negative impact on water quality. We can only speculate what the impact may be. Perhaps earlier treatment, a reduction in overall treatment area, or spreading treatments out over a period of time could be used in order to limit any impact the treatment is having. Future monitoring and modified herbicide treatments may provide insight. The lake improvement district, DNR, and Anoka Conservation District are formulating a plan that includes additional water quality monitoring especially before and after herbicide treatments, annual plant surveys, sediment coring to determine internal nutrient loading, examining fish data to determine any possible water quality impacts of fish and management strategies, and treating curly leaf pondweed earlier to minimize water quality impacts that are more likely when water is warmer.

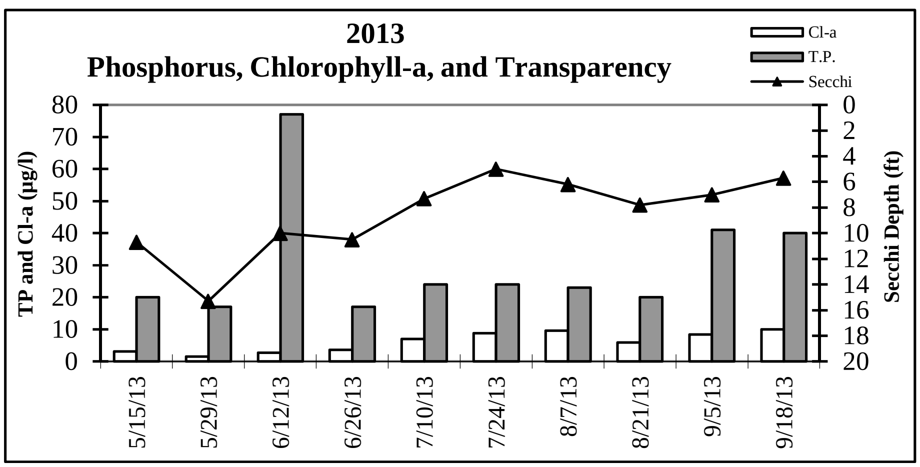
2013 Lake George Water Quality Data

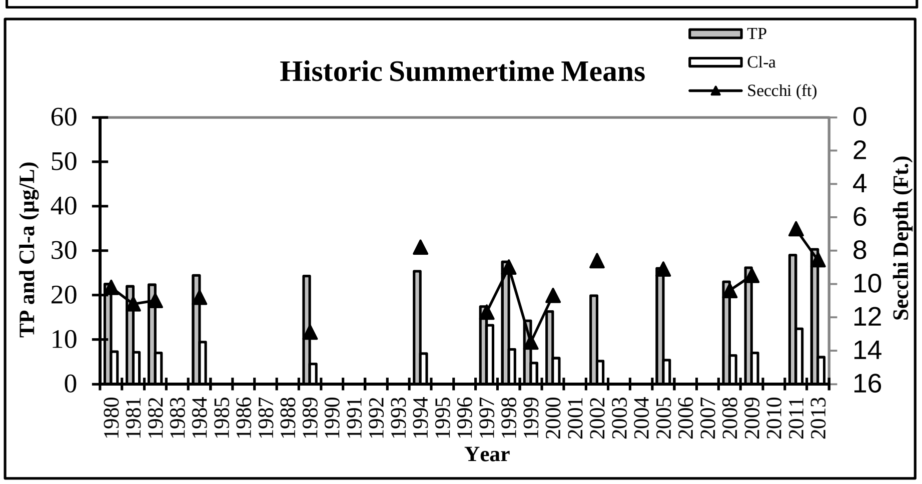
Lake George
2013 Water Quality Data

	Units	R.L.*	5/15/2013 Results	5/29/2013 Results	6/12/2013 Results	6/26/2013 Results	7/10/2013 Results	7/24/2013 Results	8/7/2013 Results	8/21/2013 Results	9/5/2013 Results	9/18/2013 Results	Average	Min	Max
pH		0.1	8.1	8.2	8.56	8.53	8.37	8.86	9.12	9.22	8.96	8.46	8.64	8.10	9.22
Conductivity	mS/cm	0.01	0.154	0.201	0.19	0.188	0.192	0.192	0.186	0.216	0.222	0.229	0.197	0.154	0.229
Turbidity	NTU	1.00	3.00	0.00	1.90	0.00	2.90	5.70	6.60	3.10	3.60	4.60	3.14	0.00	6.60
D.O.	mg/L	0.01	11.85	8.89	9.49	8.57	7.68	8	8.82	9.19	8.81	8.14	8.94	7.68	11.85
D.O.	%	1	114.0%	92.1%	99.2%	105.4%	95.7%	96.6%	102.7%	116.4%	106.4%	91.0%	102%	91%	116%
Temp.	°C	0.1	13	16	18	26	25	25	23	26	23	19	21.4	13.1	25.7
Temp.	°F	0.1	55.6	60.7	64.9	78.2	77.4	77.3	72.9	78.0	74.2	66.4	70.6	55.6	78.2
Salinity	%	0.01	0	0.1	0.09	0.09	0.09	0.09	0.09	0.11	0.11	0.11	0.09	0.00	0.11
Cl-a	ug/L	0.5	3.1	1.5	2.7	3.6	7	8.8	9.6	5.9	8.4	10	6.1	1.5	10.0
T.P.	mg/L	0.010	0.02	0.017	0.077	0.017	0.024	0.024	0.023	0.02	0.041	0.04	0.030	0.017	0.077
T.P.	ug/L	10	20	17	77	17	24	24	23	20	41	40	30	17	77
Secchi	ft	0.1	10.7	15.3	10	10.5	7.3	5	6.2	7.8	7	5.7	8.6	5.0	15.3
Secchi	m	0.03	3.26	4.66	3.05	3.20	2.23	1.52	1.89	2.38	2.13	1.74	2.6	1.5	4.7
Physical			1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	3.0	1.0	1.7	1.0	3.0
Recreational			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

*reporting limit

		2013 Median
pH		8.55
Conductivity	mS/cm	0.192
Turbidity	FNRU	3.05
D.O.	mg/l	8.82
D.O.	%	100.95%
Temp.	°C	23.09
Temp.	°F	73.56
Salinity	%	0.09
Cl-a	ug/L	6.45
T.P.	mg/l	0.02
T.P.	ug/l	23.50
Secchi	ft	7.55
Secchi	m	2.30





Lake George Summertime Annual Means

Agency	MC	MC	MC	MC	MC	MC	ACD	MC	ACD	ACD	ACD	ACD	ACD	MC	MC	ACD
Year	1980	1981	1982	1984	1989	1994	1997	1998	1999	2000	2002	2005	2008	2009	2011	2013
TP	22.5	22.0	22.3	24.4	24.3	25.4	17.4	27.5	14.2	16.3	19.9	26.0	23.0	26.2	29.0	30.3
Cl-a	7.3	7.1	7.0	9.5	4.5	6.9	13.2	7.8	4.8	5.8	5.2	5.4	6.4	7.0	12.4	6.1
Secchi (m)	3.1	3.4	3.4	3.3	3.9	2.4	3.6	2.7	4.1	2.8	2.6	2.8	3.2	2.9	1.8	2.6
Secchi (ft)	10.2	11.2	11.0	10.8	12.9	7.8	11.7	9.0	13.5	10.7	8.6	9.1	10.4	9.5	6.7	8.6

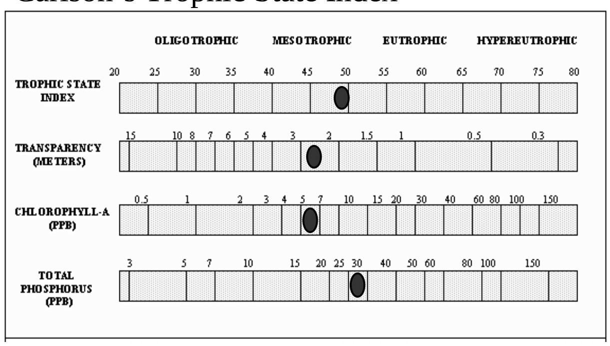
Carlson's Tropic State Indices

TSIP	49	49	49	50	50	51	45	52	42	44	47	51	49	51	53	53
TSIC	50	50	50	53	45	50	56	51	46	48	47	47	49	50	55	48
TSIS	44	42	43	43	40	48	42	45	40	45	46	45	43	45	52	46
TSI	48	47	47	49	45	49	48	49	43	46	47	48	47	49	53	49

Lake George Water Quality Report Card

Year	80	81	82	84	89	94	97	98	99	2000	2002	2005	2008	2009	2011	2013
TP	A	A	A	B	B	B	A	B	A	A	A	B	B+	B	B	B
Cl-a	A	A	A	A	A	A	B	A	A	A	A	A	A	A	B	A
Secchi	A	A	A	A	A	B	A	B	A	B	B	B	A	B	C	B
Overall	**A**	**A**	**A**	**A**	**A**	**B**	**A**	**B**	**A**	**A**	**A**	**B**	**A**	**B**	**B**	**B**

Carlson's Trophic State Index



MINARD LAKE

CITY OF EAST BETHEL, LAKE ID # 02-0067

Background

Minard Lake is located in the northern portion of the county near the City of Bethel. Public access is available only along the right of way of 237th Avenue. According to the MNDNR Lakes Database, Minard Lake has a surface area of 135 acres with a maximum depth of 7.0 feet (2.13 m). Aquatic plants grow to near the surface on much of the lake, though no invasive species were noted during 2013 sampling. The watershed is mostly undeveloped or vacant, with some residential areas on the East side of the watershed.

In 2013 this lake was monitored by the Anoka Conservation District as part of the MPCA's Rum River Watershed Restoration and Protection Project (WRAP).

2013 Results

In 2013, the overall water quality grade for Minard Lake was an A grade. The limited data available indicates that the lake is mesotrophic. In 2013 the average surface total phosphorus (TP) concentration was 23 μg/l (maximum of 35 μg/l and a minimum of 10 μg/l) receiving an A grade. The average Chlorophyll-a (Cl-a) concentration was 1.5 μg/l (maximum of 2.2 μg/l and a minimum of 1.0 μg/l) receiving an A grade. The average Secchi disk measurement was 4.7 feet (maximum of 5 ft. and a minimum of 4.2 ft.) receiving a D grade, though this is not an accurate measure of transparency because readings often could not be taken because transparency was greater than the depth at which plants obscured measurements. Therefore, Secchi transparency is not included in the overall grade for the lake.

Trend Analysis

Insufficient historical data available to conduct any trend analysis. Aside from 2013, the only available data are Secchi transparency readings from 1990, 1991, and 2008. Those readings are similar to 2013.

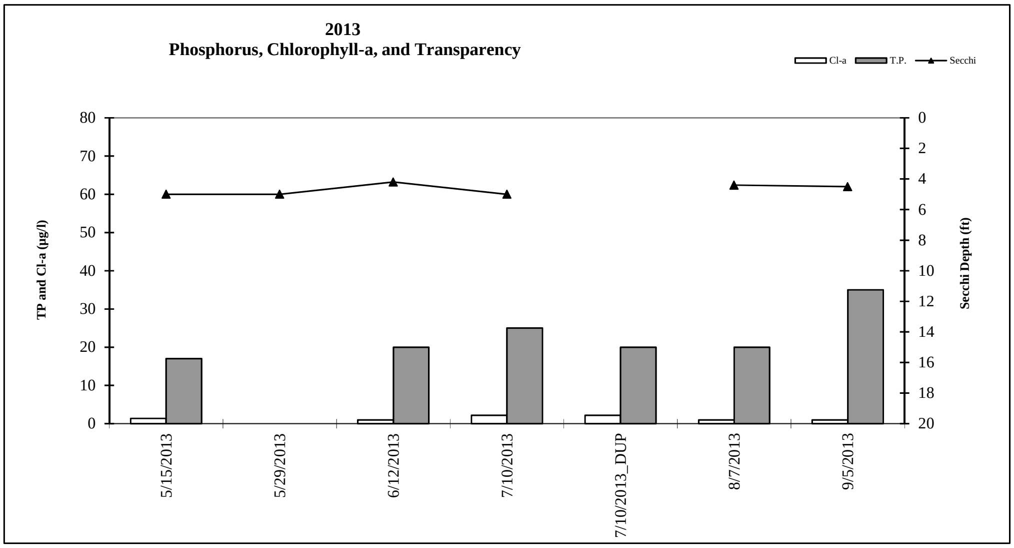
Discussion

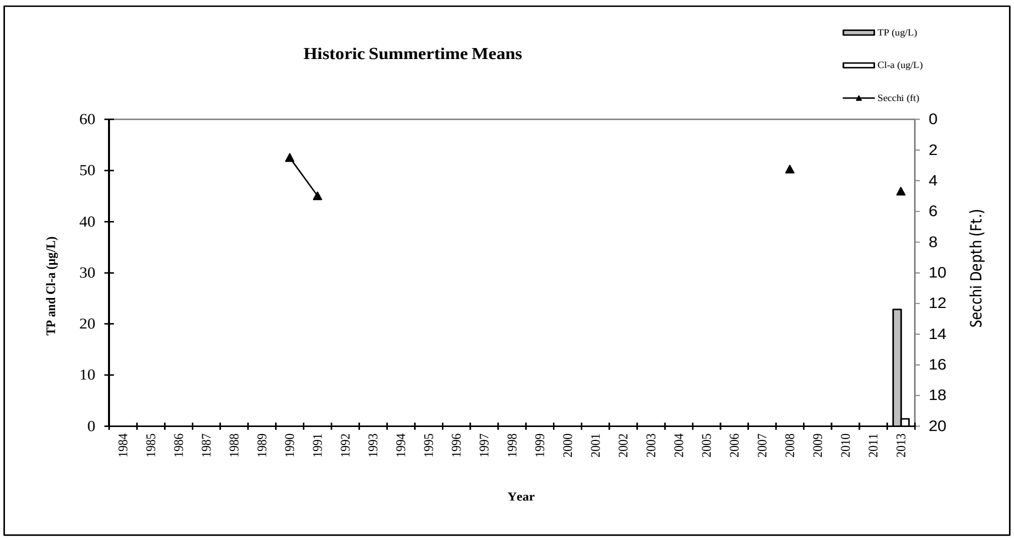
During each sampling event, the recreational suitability and physical conditions were evaluated. These rankings are based on the subjective perception of ACD staff regarding the appearance of the lake. The physical condition of the lake was consistently perceived as having an abundance of aquatic vegetation. This vegetation has a negative impact on recreation, but is indicative of a healthy shallow lake.

2013 Minard Lake Water Quality Data

Lake Minard			5/15/2013	5/29/2013	6/12/2013	7/10/2013	7/10/2013_DUP	8/7/2013	9/5/2013			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.4	7.18	7.75	8.64		9.63	8.68	8.38	7.18	9.63
Conductivity	mS/cm	0.01	0.105	0	0.144	0.119		0.125	0.188	0.114	0.000	0.188
Turbidity	NTU	1	2	0.2	42.5	1.2		1.8	3	8	0	43
D.O.	mg/L	0.01	9.75	10.4	7.5	8.48		9.45	11.72	9.55	7.50	11.72
D.O.	%	1	98.0%	107.1%	35.2%	104.6%		112.1%	136.9%	99%	35%	137%
Temp.	°C	0.1	16	21	18	24		23	22	20.7	16.0	24.5
Temp.	°F	0.1	60.8	69.0	64.8	76.0		73.5	71.1	56.8	32.0	76.0
Salinity	%	0.01	0	0.01	0.07	0.06		0.06	0.09	0.05	0.00	0.09
Cl-a	ug/L	0.5	1.4		1	2.2	2.2	1	1	1.5	1.0	2.2
T.P.	mg/L	0.010	0.017		0.02	0.025	0.02	0.02	0.035	0.023	0.017	0.035
T.P.	ug/L	10	17	0	20	25	20	20	35	13.7	0.0	35.0
Secchi	ft	0.1	5	5	4.2	>5.0		4.4	>4.5	4.7	4.2	5.0
Secchi	m	0.1	1.52	1.52	1.28	>1.50		1.34	>1.40	1.43	0.00	1.52
Physical			1.0	1.0	1.0	1.0		2.0	1.0	1.2	1.0	2.0
Recreational			1.0	1.0	2.0	3.0		3.0	4.0	2.3	1.0	4.0

*reporting limit





Lake Minard Summertime Historic Mean

Agency	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1998	1999	2000	2002	2004	2007	2008	2010	2013
TP (µg/L)									22.8
Cl-a (µg/L)									1.5
Secchi (m)							1.0		1.4
Secchi (ft)							3.2		4.7

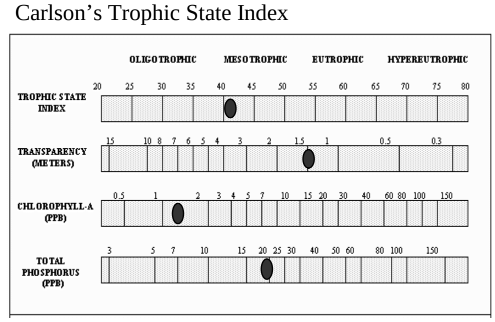
Carlson's Tropic State Indices

Year	1998	1999	2000	2003	2005	2007	2008	2010	2012
TSIP									49
TSIC									34
TSIS							60		55
TSI							60		42

Lake Minard Water Quality Report Card

Year	1998	1999	2000	2003	2005	2007	2008	2010	2013
TP (µg/L)									A
Cl-a (µg/L)									A
Secchi (m)									n/a
Overall									**A**

Carlson's Trophic State Index



The depth of Minard Lake and its aquatic vegetation prohibited representative Secchi disk measurements. This parameter was not included in the overall grade for the lake or the TSI for the data presented here.

PICKEREL LAKE

CITY OF NOWTHEN, LAKE ID # 02-0130

Background

Pickerel Lake is located in the northwest portion of the county. According to the MNDNR Lakes Database, Pickerel Lake has a surface area of 250 acres with a maximum depth of 5.5 feet (1.67 m). A public access is provided at the south end of the lake. Because of the shallow lake depth, recreation is limited to fishing and waterfowling.

In 2013 this lake was monitored by the Anoka Conservation District as part of the MPCA's Rum River Watershed Restoration and Protection Project (WRAP).

2013 Results

In 2013, Pickerel Lake had above average water quality, receiving a B+ grade. The average surface total phosphorus (TP) concentration was 29 μg/l (maximum of 78 μg/l and a minimum of 15 μg/l) receiving a B grade. TP was slightly above the historical average and the highest monitored since 2000. The average Chlorophyll-a (Cl-a) concentration was 4.1 μg/l (maximum of 9.4 μg/l and a minimum of 2.2 μg/l) falling well below the historical average and receiving an A grade. The average Secchi transparency measurement was 5.1 feet (maximum of 6 ft. and a minimum of 4.0 ft.) receiving a C grade. The shallow depth of the lake and aquatic vegetation prohibited representative Secchi disk measurements so this parameter was not included in the overall grade for the lake.

Trend Analysis

Nine years of water quality data have been collected by the Metropolitan Council (1980, 1995, 2010 and 2011) and the Anoka Conservation District (1997, 1998, 1999, 2000, and 2013). Water quality has not significantly changed from 1980 to 2013 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,6}$= 1.02, $p>0.05$).

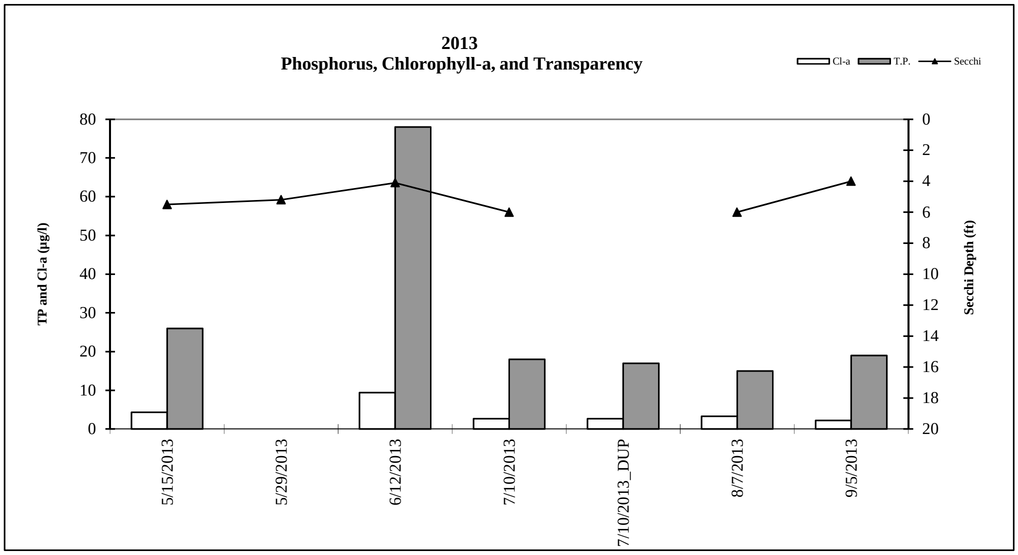
Discussion

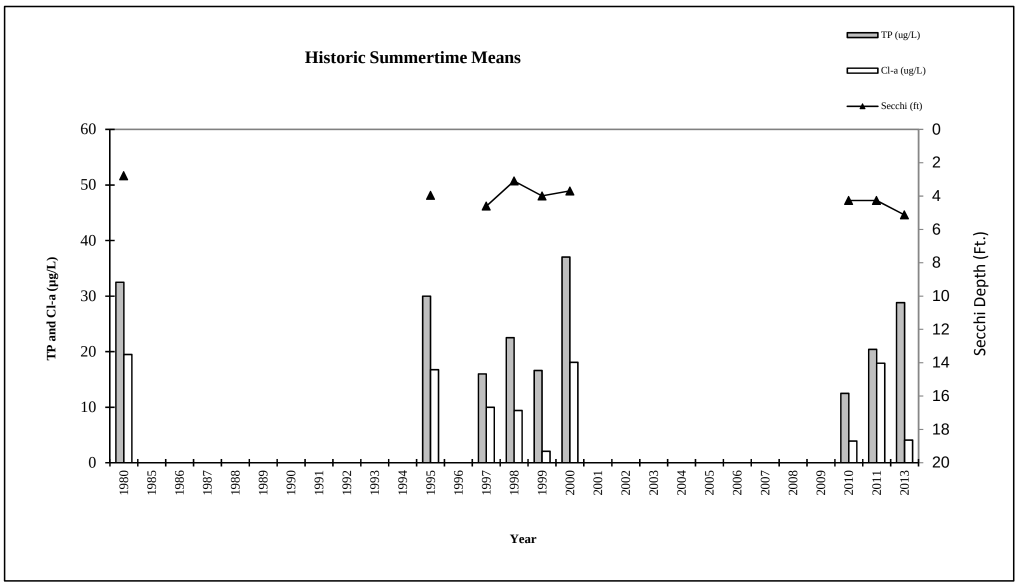
In 2013 the physical condition of the lake was consistently perceived as beautiful with occasional aesthetic issues. In terms of recreational suitability, Pickerel Lake is limited due to the abundance of rooted aquatic vegetation. This is to be expected in a healthy shallow lake, and is not problematic.

2013 Pickerel Lake Water Quality Data

Pickerel Lake	Units	R.L.*	5/15/2013 Results	5/29/2013 Results	6/12/2013 Results	7/10/2013 Results	7/10/2013_DUP Results	8/7/2013 Results	9/5/2013 Results	Average	Min	Max
pH		0.1	8.27	8.53	8.71	8.82		9.38	9.36	8.85	8.27	9.38
Conductivity	mS/cm	0.01	0.171	0.221	0.213	0.182		0.152	0.186	0.188	0.152	0.221
Turbidity	NTU	1	4	3	6.3	4		4.5	1.3	4	1	6
D.O.	mg/L	0.01	10.34	9.225	9.25	8.48		8.78	11.47	9.59	8.48	11.47
D.O.	%	1	105	106	101.3	106.1		102.7	138.5	109.93	101.3	138.5
Temp.	°C	0.1	16	17	19	25		23	24	20.9	16.4	25.2
Temp.	°F	0.1	61.5	63.4	66.8	77.4		73.7	74.4	69.5	32.0	77.4
Salinity	%	0.01	0	0.11	0.1	0.09		0.07	0.09	0.08	0.00	0.11
Cl-a	ug/L	0.5	4.3		9.4	2.7	2.7	3.3	2.2	4.1	2.2	9.4
T.P.	mg/L	0.010	0.026		0.078	0.018	0.017	0.015	0.019	0.029	0.015	0.078
T.P.	ug/L	10	26	0	78	18	17	15	19	28.8	0.0	78.0
Secchi	ft	0.1	5.5	5.2	4.1	>6		>6	>4	5.1	4.0	6.0
Secchi	m	0.1	1.68	1.58	1.25	>1.83		>1.83	>1.22	1.56	0.00	1.83
Physical			1.0	1.0	1.0	2.0		2.0	1.0	1.3	1.0	2.0
Recreational			1.0	1.0	2.0	1.0		3.0	1.0	1.5	1.0	3.0

*reporting limit





Lake Pickerel Summertime Historic Mean (Used MPCA data collected at 1 meter or less only)

Agency	MC	MC	ACD	ACD	ACD	ACD	MC	CLMP	ACD
Year	1980	1995	1997	1998	1999	2000	2010	2011	2013
TP (µg/L)	32.5	30.0	16.0	22.5	16.6	37.0	12.5	20.4	28.8
Cl-a (µg/L)	19.5	16.7	10.0	9.4	2.1	18.1	3.9	17.9	4.1
Secchi (m)	0.9	1.2	1.4	0.9	1.2	1.1	1.3	1.3	1.6
Secchi (ft)	2.8	4.0	4.6	3.1	4.0	3.7	4.3	4.3	5.1

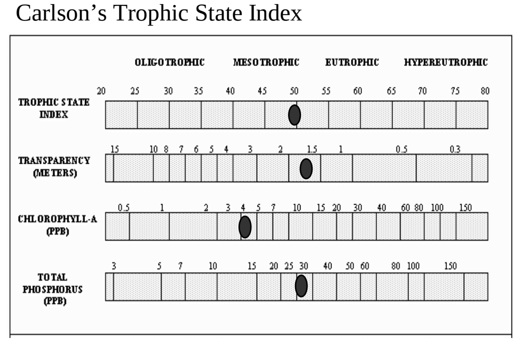
Carlson's Tropic State Indices

Year	1980	1995	1997	1998	1999	2000	2010	2011	2013
TSIP	54	53	44	49	45	56	41	48	53
TSIC	60	58	53	53	38	59	44	59	45
TSIS	62	57	55	61	57	58	56	56	54
TSI	59	56	51	54	47	58	47	54	50

Lake Pickerel Water Quality Report Card

Year	1980	1995	1997	1998	1999	2000	2010	2011	2013
TP (µg/L)	C	B	A	A	B	C	A	A	B
Cl-a (µg/L)	B	B	A	A	B	B	A	B	A
Secchi (m)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Overall	**C**	**B**	**A**	**A**	**B**	**C**	**A**	**B+**	**B+**

Carlson's Trophic State Index



Stream Water Quality - Chemical Monitoring

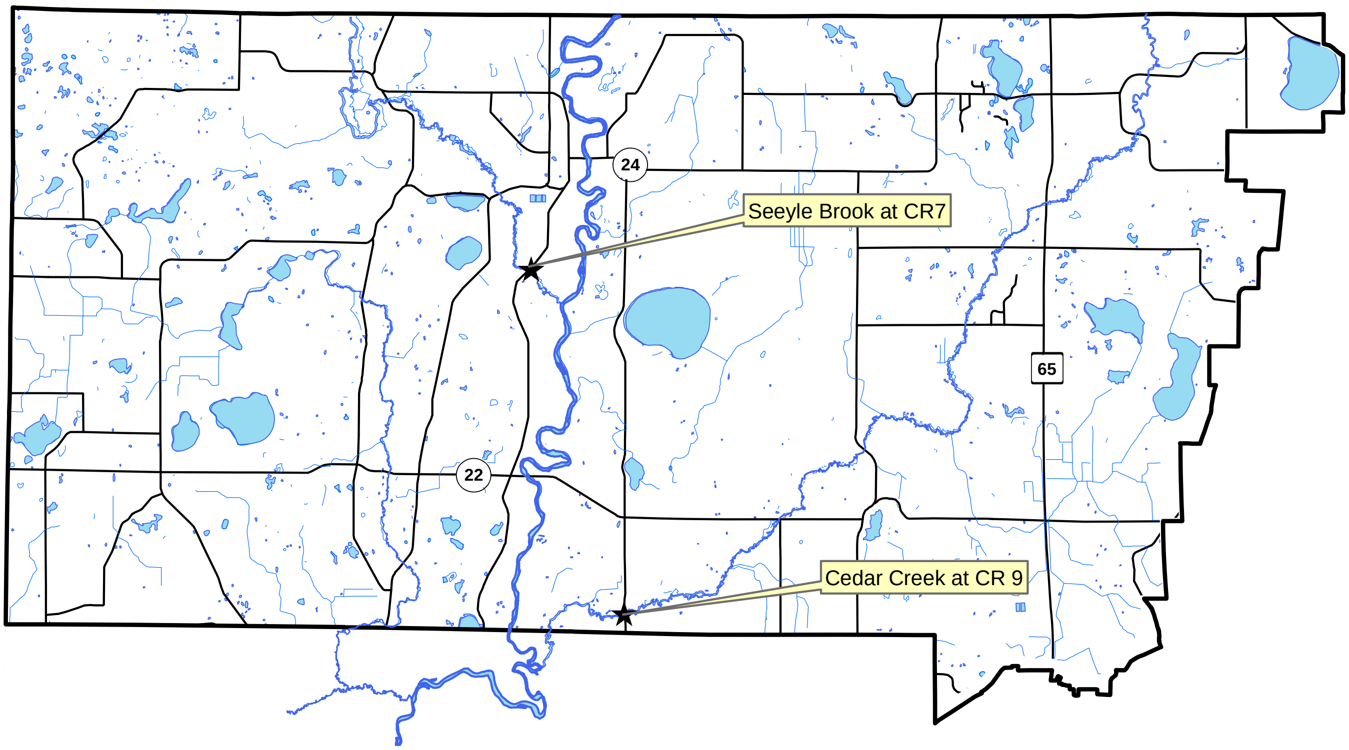
Description: The Anoka Conservation District (ACD) is conducting Surface Water Assessment Grant (SWAG) monitoring for the MPCA in 2013 and 2014. Monitoring events are scheduled May through September for of the following parameters: total suspended solids, chlorides, sulfate, hardness, calcium, magnesium, nitrogen-ammonia, total kjeldahl nitrogen, nitrate & nitrite, volatile suspended solids, e. coli, total phosphorus, Secchi tube transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

Purpose: To provide an initial assessment of water quality to be used in the completion of the Rum River Watershed Restoration and Protection Plan (WRAPP).

Locations: Cedar Creek at CR 9
Seeyle Brook at CR 7

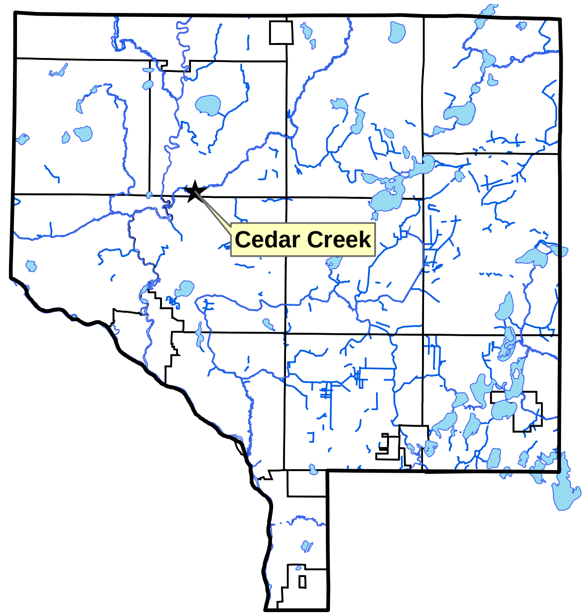
Results: Results are presented on the following pages.

Upper Rum River Watershed SWAG Water Quality Monitoring Sites



CEDAR CREEK

at Hwy 9, Oak Grove



Background

Cedar Creek originates in south-central Isanti County and flows south. Cedar Creek is a tributary to the Rum River. In north-central Anoka County it flows through some areas of high quality natural communities, including the Cedar Creek Ecosystem Science Reserve. Habitat surrounding the stream in other areas is of moderate quality overall.

Cedar Creek is one of the larger streams in Anoka County. Stream widths of 25 feet and depths greater than 2 feet are common at baseflow. The stream bottom is primarily silt. The watershed is moderately developed with scattered single family homes, and continues to develop rapidly.

Results and Discussion

This report includes data from 2013. A reason this monitoring is being performed is due to the lack of historical data for the state to determine if the creek is meeting state water quality standards. That assessment process is part of the Rum River Watershed Restoration and Protection Project (WRAPP). The following is a summary of results.

- Dissolved constituents, as measured by conductivity and chlorides, in Cedar Creek were average when compared to similar Anoka County streams. Conductivity averaged 0.362 mS/cm Maximum of 0.474 mS/cm and a minimum of 0.201 mS/cm). Chlorides averaged 26 mg/l (maximum of 32 mg/l and a minimum of 17 mg/l).
- Phosphorous averaged over the proposed MPCA water quality standard of 100 ug/l. If the proposed standard is approved Cedar Creek often exceeds the limit, even during baseflow periods. Phosphorous results in Cedar Creek averaged 130 ug/l (maximum of 239 ug/l and a minimum of 75 ug/l).
- Suspended solids and turbidity both stayed below the state standards each sampling event and averaged well below the standards. Total suspended solids averaged 13 mg/l (maximum of 26 mg/l and a minimum of 4 mg/l). Turbidity averaged 7.76 NTU (maximum of 16.30 NTU and a minimum of 1.60 NTU).
- pH and dissolved oxygen were with the range considered normal and healthy for streams in this area. However, on one sampling occasion DO fell below the 5.0 mg/l. While this sampling event did fall below the daily average standard, it did not exceed the daily minimum. pH averaged 8.15 (maximum of 8.67 and a minimum of 7.54). DO averaged 7.60 mg/l (maximum of 10.25 mg/l and a minimum of 4.51 mg/l).

For a significant number of the results below there are no current state standards. However, this data will be used as a baseline for future assessments of the watershed.

Grey Columns indicate events with E.coli samples only.

Cedar Creek at CR 9

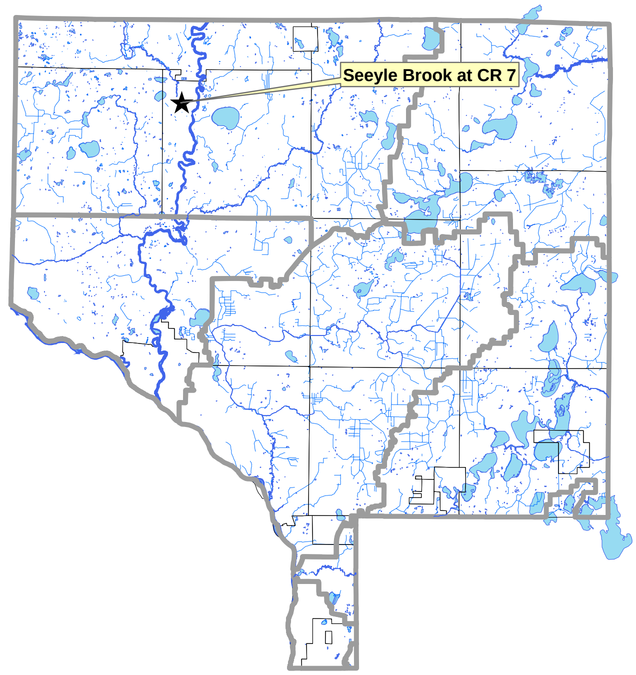
	Units	R.L.*	4/30/2013 Results	5/21/2013 Results	6/5/2013 Results	6/17/2013 Results	6/25/2013 Results	7/2/2013 Results	7/15/2013 Results	7/23/2013 Results
pH		0.1	7.76	8.00	7.99	8.67	7.54	7.92	7.83	8.14
Conductivity	mS/cm	0.01	0.201	0.210	0.358	0.365	0.286	0.354	0.372	0.394
Turbidity	NTU	1	3.0	8.0	16.3	14.2	8.5	14.1	10.6	10.3
D.O.	mg/L	0.01	6.28	6.10	7.93	7.12	4.51	6.97	7.40	7.97
D.O.	%	1	61.0	61.7	75.3	76.6	50.8	75.8	82.9	87.5
Temp.	°C	0.1	14.70	16.00	13.64	18.50	20.88	19.60	21.37	20.07
Salinity	%	0.01	0.00	0.00	0.17	0.12	0.14	0.17	0.18	0.19
T.P.	ug/L	10	75	132	201		194	239		163
TSS	mg/L	2	13	20	24		26	23		13
Cl	mg/L		19.1	23.2	26.9		17.1	22.0		26.2
Sulfate	mg/L		22.2	20.7	20.5		14.8	15.2		14.6
Hardness CaCO3	mg/L		125	133	171		142	194		205
Calcium	mg/L		36.20	39.00	50		41	56		58
Magnesium	mg/L		8.39	8.55	11.20		9.57	13.10		14.90
Secchi-tube	cm		>100	>100	77	67	>100	61	86	78
Nitrogen, Ammonia	mg/L		<0.16	0.37	<0.16		<0.16	<0.16		0.23
TKN	mg/L		1.0	2.0	1.5		2.4	1.8		1.3
Nitrate plus Nitrite	mg/L		0.24	0.62	0.54		0.30	0.41		0.43
VSS	mg/L	2	4	10	15		14	15		10
E coli	MPN				260.0	178.9	172.2	235.9	547.5	344.8
Appearance			1B	1B	3	1B	1B	2	1B	2
Recreational			2	2	2	2	1	1	1	1

	Units	R.L.*	8/6/2013 Results	8/6/2013_DUP Results	8/19/2013 Results	8/27/2013 Results	9/4/2013 Results	9/25/2013 Results	Average	Min	Max
pH		0.1	8.32		8.51	8.44	8.38	8.46	8.15	7.54	8.67
Conductivity	mS/cm	0.01	0.382		0.380	0.467	0.474	0.464	0.362	0.201	0.474
Turbidity	NTU	1	5.2		3.1	1.6	2.5	3.5	7.76	1.60	16.30
D.O.	mg/L	0.01	8.35		8.89	7.29	9.73	10.25	7.60	4.51	10.25
D.O.	%	1	86.9		99.1	91.1	102.7	102.3	81.1	50.8	102.7
Temp.	°C	0.1	17.08		19.24	24.75	16.67	14.06	18.2	13.6	24.8
Salinity	%	0.01	0.18		0.18	0.23	0.23	0.22	0.15	0.00	0.23
T.P.	ug/L	10	81	79		88	94	86	130	75	239
TSS	mg/L	2	4	6		4	5	5	13.0	4.0	26.0
Cl	mg/L		29.2	29.3		31.0	31.2	32.4	26	17	32
Sulfate	mg/L		17.6	18.5		15.9	16.3	18.7	17.7	14.6	22.2
Hardness CaCO3	mg/L		203	203		204	211	206	182	125	211
Calcium	mg/L		56.1	55		54.7	58.3	58.2	51.14	36.20	58.30
Magnesium	mg/L		15.40	15.80		16.30	15.80	14.700	13.06	8.39	16.30
Secchi-tube	cm		>100		>100	>100	>100	>100	>90	61	>100
Nitrogen, Ammonia	mg/L		<0.16	0.23		<.16	<0.16	<0.16	<0.19	<0.16	0.37
TKN	mg/L		0.7	0.7		1.1	0.4	0.6	1.23	0.40	2.40
Nitrate plus Nitrite	mg/L		0.41	0.42		0.66	0.78	0.95	0.52	0.24	0.95
VSS	mg/L	2	4	4		4	5	4	8.1	4.00	15.00
E coli	MPN		156.5	204.6	141.4				249.1	141.4	547.5
Appearance			1A		1A	1A	1A	1A			
Recreational			1		1	1	1	1	1	1	2

*reporting limit

SEEYLE BROOK

Seeyle Brook at Co. Rd. 7, St. Francis STORET SiteID = S003-204



Background

Seelye Brook originates in southwestern Isanti County and flows south through northwest Anoka County, draining into the Rum River just east of the sampling site. This stream is low-gradient, like most other streams in the area. It has a silty or sandy bottom and lacks riffle-pool sequences. It is a moderate to large stream for Anoka County, with a typical baseflow width of 20-25 feet.

The sampling site is in the road right of way of the Highway 7 crossing. The bridge footings and poured concrete are significant features of the sampling site, which is otherwise sandy-bottom. This site also experiences scour during high flow because flow is constricted under the bridge. Banks are steep and undercut.

Results

This report includes data from 2013. A reason this monitoring is being performed is due to the lack of historical data to assess. The following is a summary of results.

- Dissolved constituents, as measured by conductivity and chlorides. Conductivity results in Seeyle Brook are considered average when compared to similar Anoka County streams. However, chlorides were significantly lower than any other stream monitored (5 mg/l). Conductivity averaged 0.375 mS/cm (maximum of 0.586 mS/cm and a minimum of 0.202 mS/cm). Chlorides averaged 5.0 mg/l (maximum of 14 mg/l and a minimum of 2 mg/l)
- Phosphorous averaged over the proposed MPCA water quality standard of 100 ug/L. If the proposed standard is approved Seeyle Brook often exceeds the limit, even during baseflow periods. Phosphorous is Seeyle Brook averaged 139 ug/l (maximum of 211 ug/l and a minimum of 92 ug/l).
- Suspended solids and turbidity both stayed below the state standards early in the season. While turbidity continued to stay very low TSS increased dramatically often exceeding the limit and raising the average over 30 mg/l. Suspended solids averaged 31.5 mg/l (maximum of 58.7 mg/l and a minimum of 8.6 mg/l). Turbidity averaged 3.37 NTU's (maximum of 7.10 NTU's and a minimum of 0.00 NTU's)
- pH and dissolved oxygen averaged within the range considered normal and healthy for streams in this area. However, on three sampling occasions DO fell below the 5.0 mg/l and on one occasion even fell below the 4.0 mg/l daily minimum. pH averaged 8.04 (maximum of 8.82 and a minimum of 7.27). DO averaged 7.30 mg/l (maximum of 10.16 mg/l and a minimum of 3.04 mg/l).

For a significant number of the results below there are no current state standards. However, this data will be used as a baseline for future assessments of the watershed.

Grey Columns indicate events with E.coli samples only.

Seeyle Brook at CR 7

	Units	R.L.*	4/30/2013 Results	5/21/2013 Results	6/5/2013 Results	6/17/2013 Results	6/25/2013 Results	7/2/2013 Results	7/15/2013 Results
pH		0.1	7.75	7.74	7.93	8.82	7.48	7.73	7.27
Conductivity	mS/cm	0.01	0.202	0.202	0.345	0.367	0.234	0.367	0.268
Turbidity	NTU	1	2.0	7.0	7.1	5.6	1.2	5.3	1.5
D.O.	mg/L	0.01	7.19	6.92	7.66	7.26	3.04	4.93	4.22
D.O.	%	1	74.1	69.1	73.6	78.2	34.6	54.7	48.9
Temp.	°C	0.1	14.4	15.4	13.7	18.8	21.8	20.1	21.7
Salinity	%	0.01	0.00	0.00	0.16	0.18	0.11	0.18	0.13
T.P.	ug/L	10	118	110	129		141	211	
TSS	mg/L	2	16.7	19.7	23.3		8.6	15.4	
Cl	mg/L		8	14	7		<2	3	
Sulfate	mg/L		25.6	19.2	17		10.2	13.6	
Hardness CaCO3	mg/L		130	128	176		119	209	
Calcium	mg/L		34.60	34.60	48.20		32.00	56.70	
Magnesium	mg/L		10.50	10.00	13.40		9.57	16.40	
Secchi-tube	cm		>100	>100	>100	>100	>100	94	>100
Nitrogen, Ammonia	mg/L		0.29	0.23	0.23		<0.16	0.23	
TKN	mg/L		1.2	1.6	1.8		2.6	2.4	
Nitrate plus Nitrite	mg/L		<0.2	0.36	0.38		<0.2	0.23	
VSS	mg/L	2	2	10	6		<2	3	
E coli	MPN				93.0	161.6	224.7	86.7	488.4
Appearance			1B	1B	1B	1A	1B	2	1A
Recreational			2	2	2	1	1	1	1

*reporting limit

			7/23/2013 Results	8/6/2013 Results	8/19/2013 Results	8/27/2013 Results	9/4/2013 Results	9/25/2013 Results	Average	Min	Max
pH		0.1	7.91	8.26	8.52	8.44	8.37	8.35	8.04	7.27	8.82
Conductivity	mS/cm	0.01	0.413	0.419	0.431	0.504	0.586	0.539	0.375	0.202	0.586
Turbidity	NTU	1	6.2	3.2	1.3	0.0	1.3	2.1	3.37	0.00	7.10
D.O.	mg/L	0.01	7.12	8.04	10.16	8.44	10.07	9.83	7.30	3.04	10.16
D.O.	%	1	78.1	83.8	113.1	102.1	104.3	97.7	77.9	34.6	113.1
Temp.	°C	0.1	20.0	17.1	19.1	23.2	16.0	14.2	18.1	13.7	23.2
Salinity	%	0.01	0.20	0.20	0.20	0.24	0.28	0.26	0.16	0.00	0.28
T.P.	ug/L	10	181	97		133	137	134	139	97	211
TSS	mg/L	2	27.0	39.9		57.3	58.7	48.4	31.5	8.6	58.7
Cl	mg/L		4	2		2	5	2	5	2	14
Sulfate	mg/L		15	15.3		14.5	14.2	20.2	16.4	10.2	25.6
Hardness CaCO3	mg/L		220	203		224	210	176	180	119	224
Calcium	mg/L		58.00	52.90		56.10	53.90	46.7	47.37	32.00	58.00
Magnesium	mg/L		18.30	17.30		20.40	18.30	14.5	14.87	9.57	20.40
Secchi-tube	cm		>100	>100	>100	>100	>100	>100	>100	94	94
Nitrogen, Ammonia	mg/L		<0.16	<0.16		<0.16	<0.16	<0.16	<0.19	0.23	0.29
TKN	mg/L		1.3	0.7		0.9	0.4	0.7	1.36	0.40	2.60
Nitrate plus Nitrite	mg/L		0.52	0.52		0.94	0.85	0.76	0.57	0.23	0.94
VSS	mg/L	2	4	2		<2	5	2	<3.8	2.00	10.00
E coli	MPN		127.4	141.4	79.4				175.3	79.4	488.4
Appearance			1B	1A	1A	1A	1A	1A			
Recreational			1	1	1	1	1	1	1	1	2

Stream Water Quality – Biological Monitoring

Description: This program combines environmental education and stream monitoring. Under the supervision of ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their catch to the family level, and use the resulting numbers to gauge water and habitat quality. These methods are based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families can thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data.
To provide an environmental education service to the community.

Locations: Rum River at Hwy 24, Rum River North County Park, St. Francis

Results: Results for each site are detailed on the following pages.

Tips for Data Interpretation

Consider all biological indices of water quality together rather than looking at each alone, as each gives only a partial picture of stream condition. Compare the numbers to county-wide averages. This gives some sense of what might be expected for streams in a similar landscape, but does not necessarily reflect what might be expected of a minimally impacted stream. Some key numbers to look for include:

Families — Number of invertebrate families. Higher values indicate better quality.

EPT — Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.

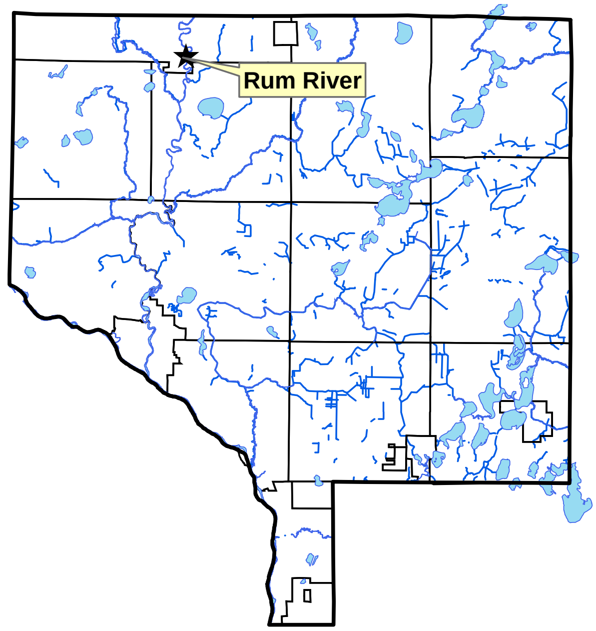
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

% Dominant Family — High numbers indicates an uneven community, and likely poorer stream health.

RUM RIVER

at Hwy 24, Rum River North County Park, St. Francis



Last Monitored

By St. Francis High School in 2013

Monitored Since

2000

Student Involvement

64 students in 2013, approximately 1,288 since 2000

Background

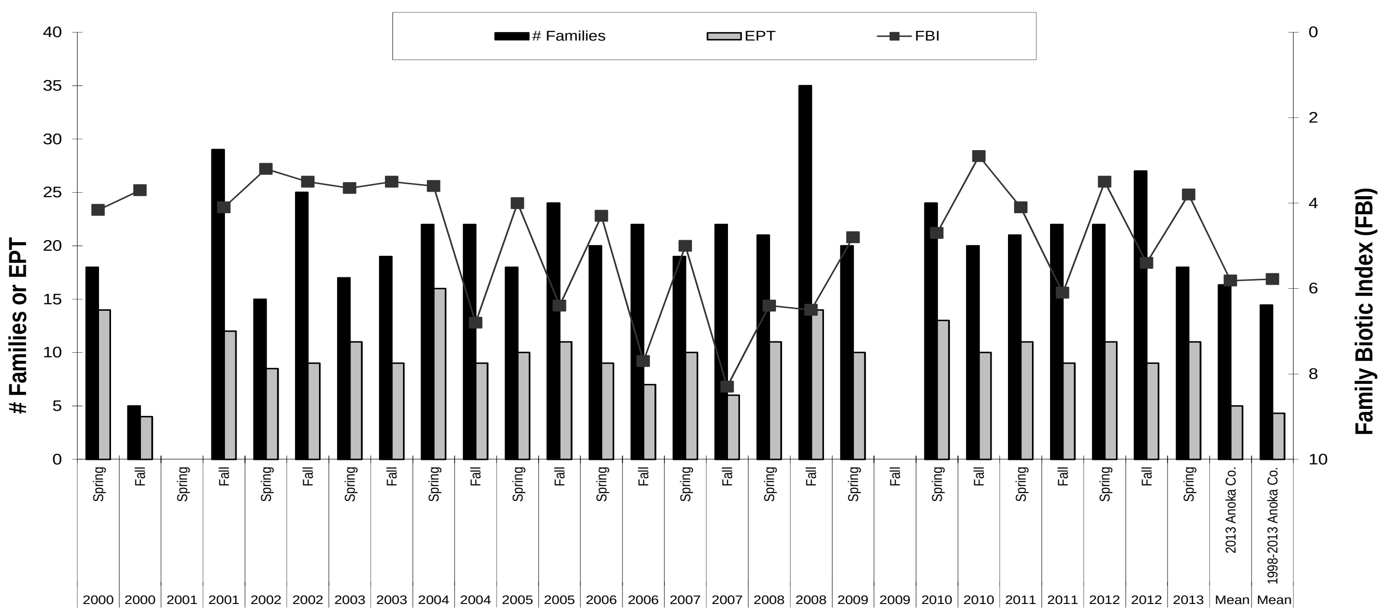
The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. Other than the Mississippi, this is the largest river in the county. In Anoka County the river has both rocky riffles as well as pools and runs with sandy bottoms. The river's condition is generally regarded as excellent. Portions of the Rum in Anoka County have a state "scenic and recreational river" designation.

The sampling site is in Rum River North County Park. This site is typical of the Rum in northern Anoka County, having a rocky bottom with numerous pool and riffle areas.

Results

St. Francis High School classes monitored the Rum River in spring 2013, with Anoka Conservation District (ACD) oversight. Biological data for 2013, and historically, indicate the Rum River in northern Anoka County has the best conditions of all streams and rivers monitored throughout Anoka County. In fall 2013, 18 families were found which is the 2nd most of any site in Anoka County, the highest amount also being on the Rum River but at another location. The number of families and number of EPT families were substantially above the county averages.

Summarized Biomonitoring Results for Rum River at Hwy 24, St. Francis (samplings by St. Francis High School and Crossroads Schools in 2002-2003 are averaged)



Biomonitoring Data for Rum River at Rum River North County Park, St. Francis

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2008	2008	2009	2009	2010	2010	2011	2011	2012	2012	2013	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	2013 Anoka Co.	1998-2013 Anoka Co.
FBI	6.40	6.50	4.80	Unusable	4.7	2.9	4.1	6.1	3.5	5.4	3.8	5.8	5.8
# Families	21	35	20	Sample	24	20	21	22	22	27	18	16.3	14.5
EPT	11	14	10		13	10	11	9	11	9	11	5.0	4.3
Date	27-May	30-Sep	29-Apr	13-Oct	27-Apr	29-Oct	10-Jun	28-Sep	22-May	27-Sep	20-May		
Sampled By	SFHS	SFHS	SFHS	SFHS	SFHS	ACD	ACD	SFHS	SFHS	SFHS	SFHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	348	156	267		142	274	418	443	144	333	247.5		
# Replicates	2	4	2		3	1	1	2	2	1	2		
Dominant Family	Corixidae	Corixidae	Corixidae		Nemouridae	Leptophlebiidae	baetidae	hydrophilidae	hydropsy	veliidae	Baetiscida		
% Dominant Family	57.5	61.4	24.3		28.1	39.4	66.3	21.4	36.6	13.8	33.5		
% Ephemeroptera	11.9	17.9	18.7		23.9	51.1	81.3	3.6	43.2	34.2	52.1		
% Trichoptera	5.9	6.9	20.2		10.8	6.2	6.0	4.3	41.1	4.2	9.1		
% Plecoptera	17.1	2.1	27.7		32.8	26.6	3.8	9.7	5.2	11.1	29.3		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	4/29/2009	10/13/2009	4/27/2010	10/29/2010	4/27/2010	9/28/2011	5/22/2012	9/27/2012	5/21/2013
pH	7.62	7.87	na	7.51	na	8.35	8.14	7.87	7.70
Conductivity (mS/cm)	0.266	0.291	0.324	0.249	0.324	0.228	0.275	0.239	0.193
Turbidity (NTU)	6	na	2	na	2	na	18	2	9
Dissolved Oxygen (mg/L)	10.53	12.22	9.14	na	9.14	8.7	8.24	8.17	7.98
Salinity (%)	0.01	0.01	0.01	0	0.01	0	0.01	0	0
Temperature (°C)	12.2	5.2	12	7.2	12	13.8	17.5	10.3	17.3

Discussion

Both chemical and biological monitoring indicate the good quality of this river. Habitat is ideal for a variety of stream life, and includes a variety of substrates, plenty of woody snags, riffles, and pools. Water chemistry monitoring done at various locations on the Rum River throughout Anoka County found that water quality is also good. Both habitat and water quality decline, but are still good, in the downstream reaches of the Rum River where development is more intense and the Anoka Dam creates a slow moving pool.

Water resource management should be focused upon protecting the Rum's quality. Some steps to protect the Rum River could include:

- Enforce the building and clear cutting setbacks from the river required by state scenic river laws.
- Retrofit stormwater conveyance systems to provide better water quality treatment in cities including St. Francis and Anoka. Older areas of some communities lack or have little stormwater treatment.
- Use the best available technologies to reduce pollutants delivered to the river and its tributaries through the storm sewer system. This should include all of the watershed, not just those adjacent to the river.
- Education programs to encourage actions by residents that will benefit the river's health.
- Continue water quality monitoring programs.

URRWMO Teacher Wins State Award for Biomonitoring!

Teacher DC Randle from St. Francis High School won a state-wide teaching award in 2013, primarily for his efforts in the stream biomonitoring program. On December 2 he accepted the MN Association of Soil and Water Conservation District's Teacher Award. The award goes to a teacher who provides outstanding natural resources instruction.

Mr. Randle's lessons are often hands on. For the last 15 years he has taken 1,224 students wading in the Rum River to monitor river health, primarily through monitoring macroinvertebrates. This was done in partnership with the URRWMO and Anoka Conservation District. He also takes students on annual float trips of the Rum River, to the Carlos Avery Wildlife Management Area, and Cedar Creek Ecosystem Science Reserve. For advanced students, he offers summer research trips to the Peruvian rain forest.

Wetland Hydrology

Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 23 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

Locations: Alliant Tech Reference Wetland, Alliant Tech Systems property, St. Francis

Cedar Creek, Cedar Creek Natural History Area, East Bethel

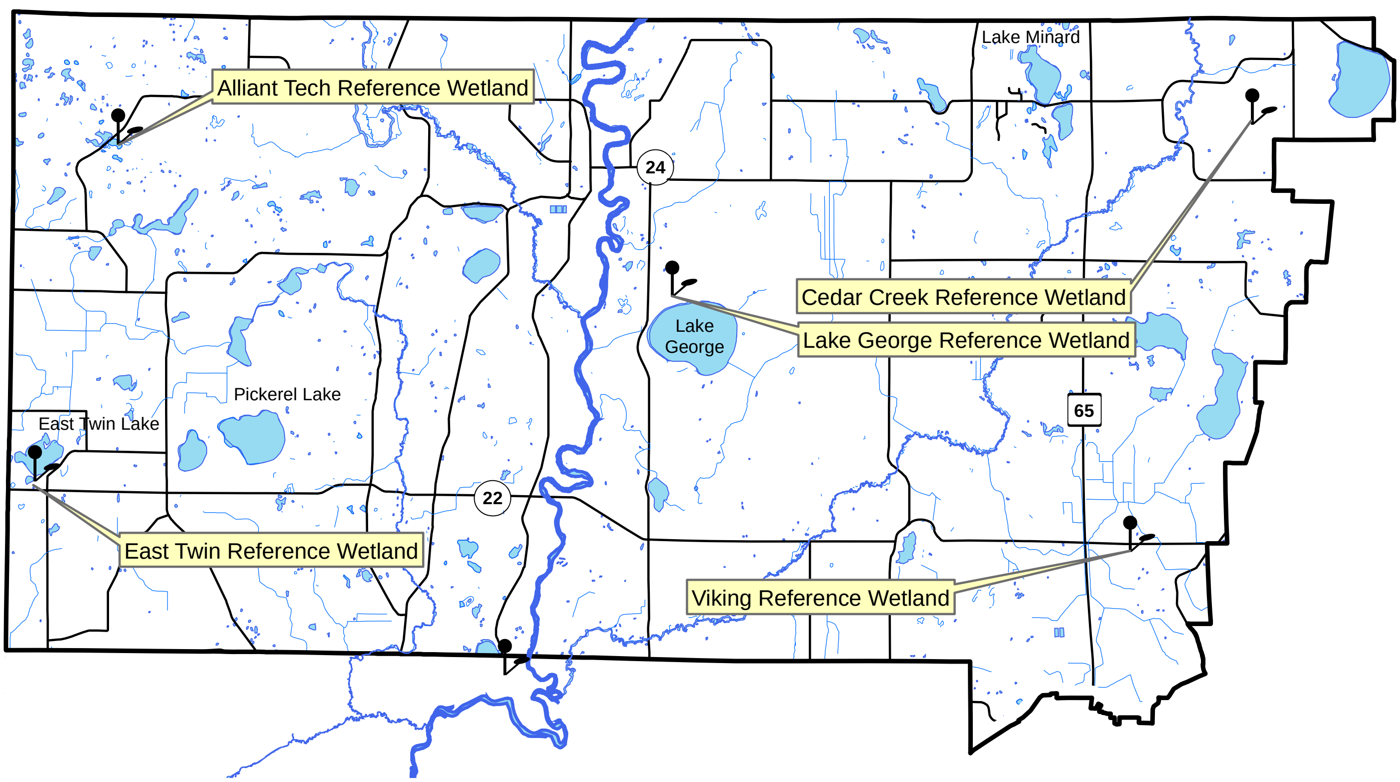
East Twin Reference Wetland, East Twin Township Park, Nowthen

Lake George Reference Wetland, Lake George County Park, Oak Grove

Viking Meadows Reference Wetland, Viking Meadows Golf Course, East Bethel

Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

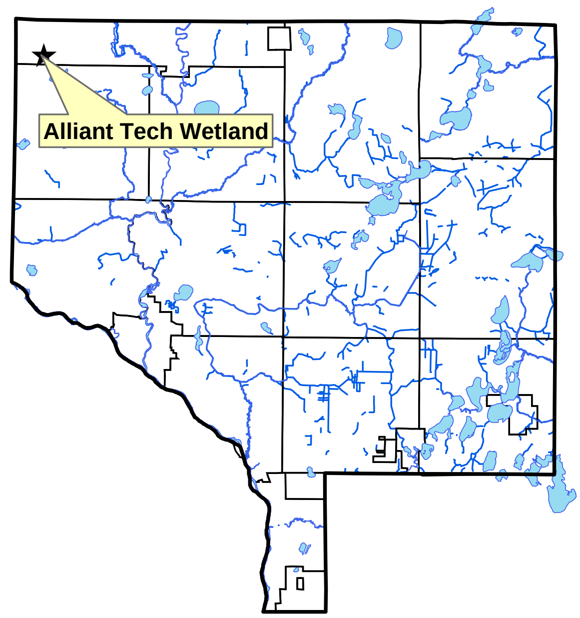
Upper Rum River Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

ALLIANT TECH REFERENCE WETLAND

Alliant Techsystems Property, St. Francis



Site Information

Monitored Since: 2001

Wetland Type: 5

Wetland Size: ~12 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-8	N2/0	Mucky loam	-
Bg	8-35	5y5/1	Sandy loam	-

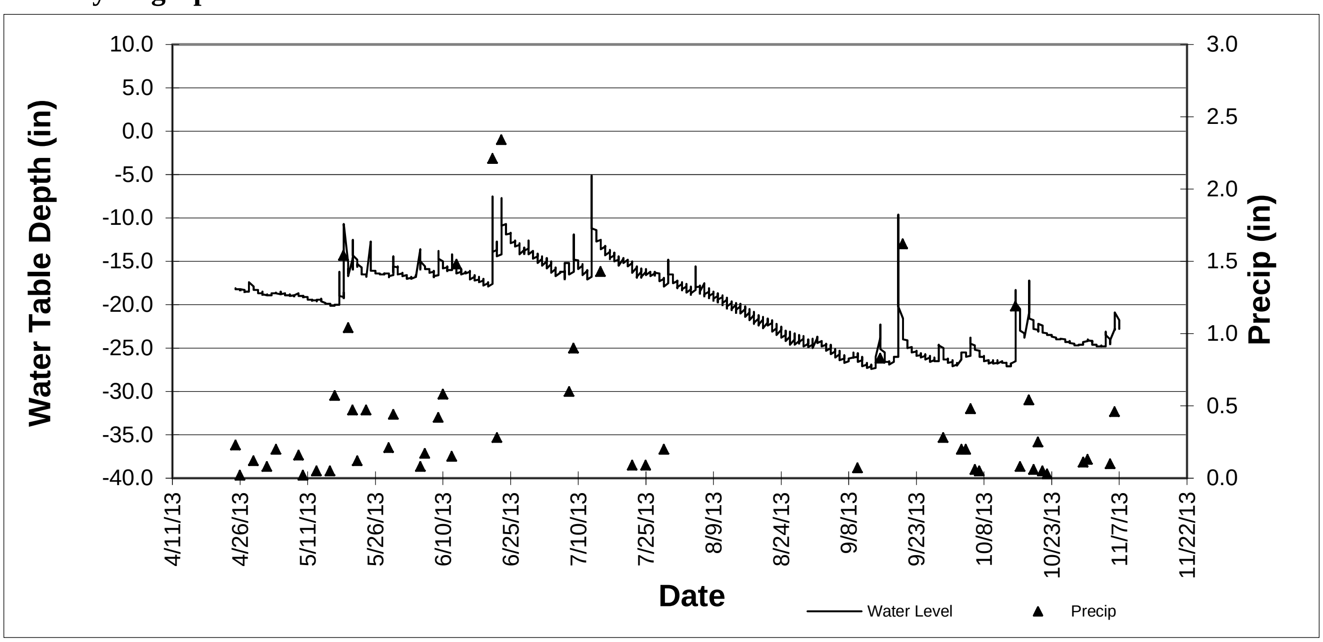
Surrounding Soils: Emmert

Vegetation at Well Location:

Scientific	Common	% Coverage
Carex Spp	Sedge undiff.	90
Lycopus americanus	American Bungleweed	20
Phalaris arundinacea	Reed Canary Grass	5

Other Notes: This wetland lies next to the highway, in a low area surrounded by hilly terrain. It holds water throughout the year, and has a beaver den.

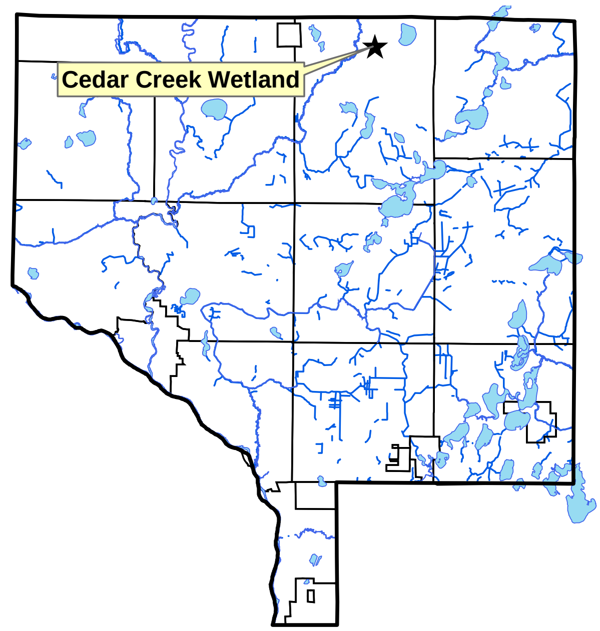
2013 Hydrograph



Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

CEDAR CREEK REFERENCE WETLAND

Univ. of Minnesota Cedar Creek Natural History Area, East Bethel



Site Information

Monitored Since: 1996

Wetland Type: 6

Wetland Size: unknown, likely >150 acres

Isolated Basin? No

Connected to a Ditch? No

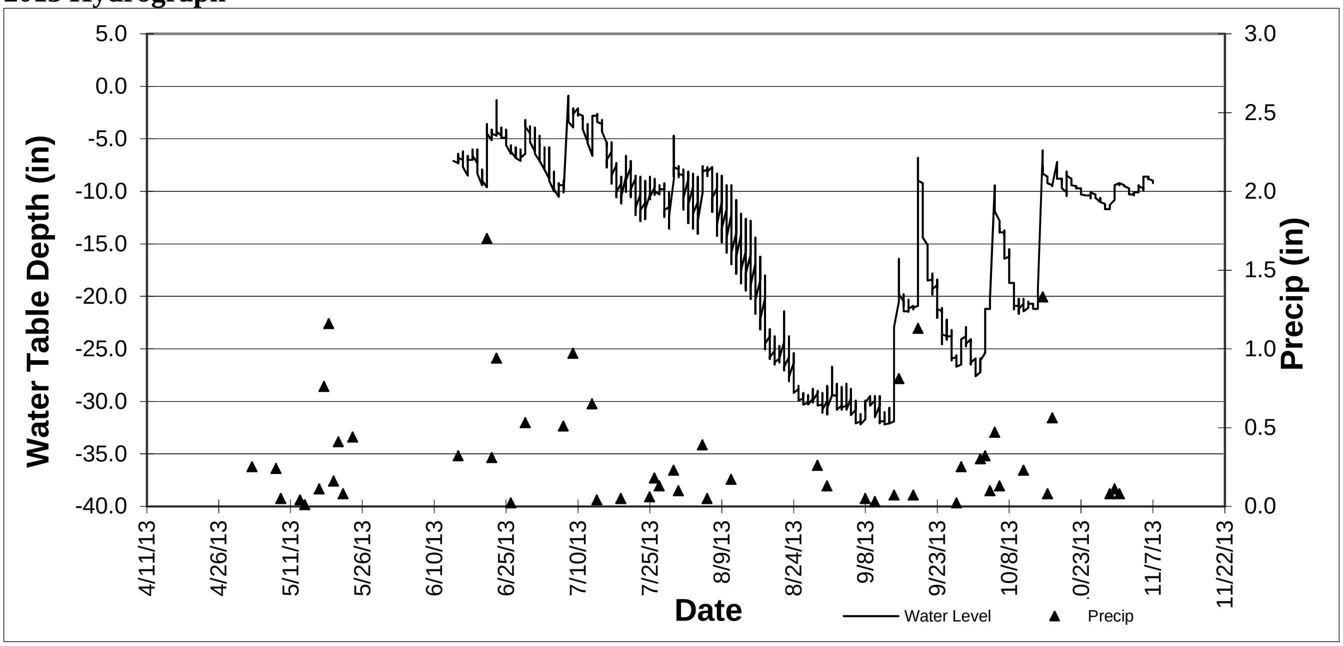
Soils at Well Location: not yet available

Surrounding Soils: Zimmerman

Vegetation at Well Location: not yet available

Other Notes: The Cedar Creek Ecosystem Science Reserve, where this wetland is located, is a University of Minnesota research area. Much of this area, including the area surrounding the monitoring site, is in a natural state. This wetland probably has some hydrologic connection to the floodplain of Cedar Creek, which is 0.7 miles from the monitoring site.

2013 Hydrograph

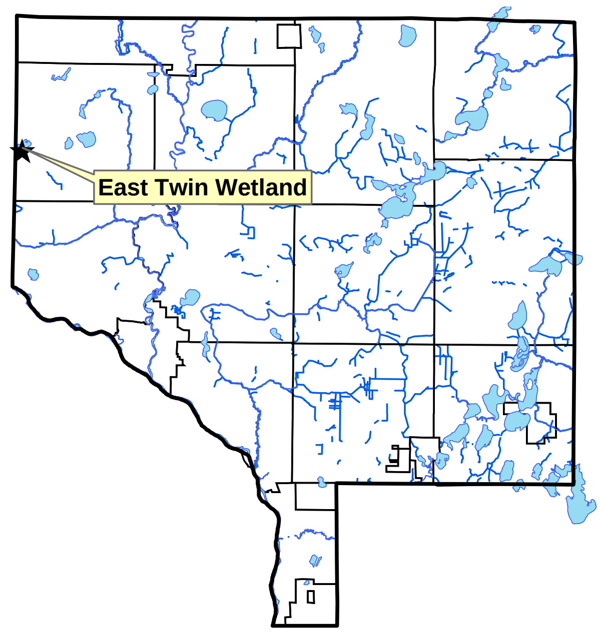


Well depth was 37 inches, so a reading of –37 indicates water levels were at an unknown depth greater than or equal to 37 inches.

Wetland Hydrology Monitoring

EAST TWIN REFERENCE WETLAND

East Twin Lake Township Park, Nowthen



Site Information

Monitored Since: 2001

Wetland Type: 5

Wetland Size: ~5.9 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-8	10yr 2/1	Mucky Loam	-
Oa	Aug-40	N2/0	Organic	-

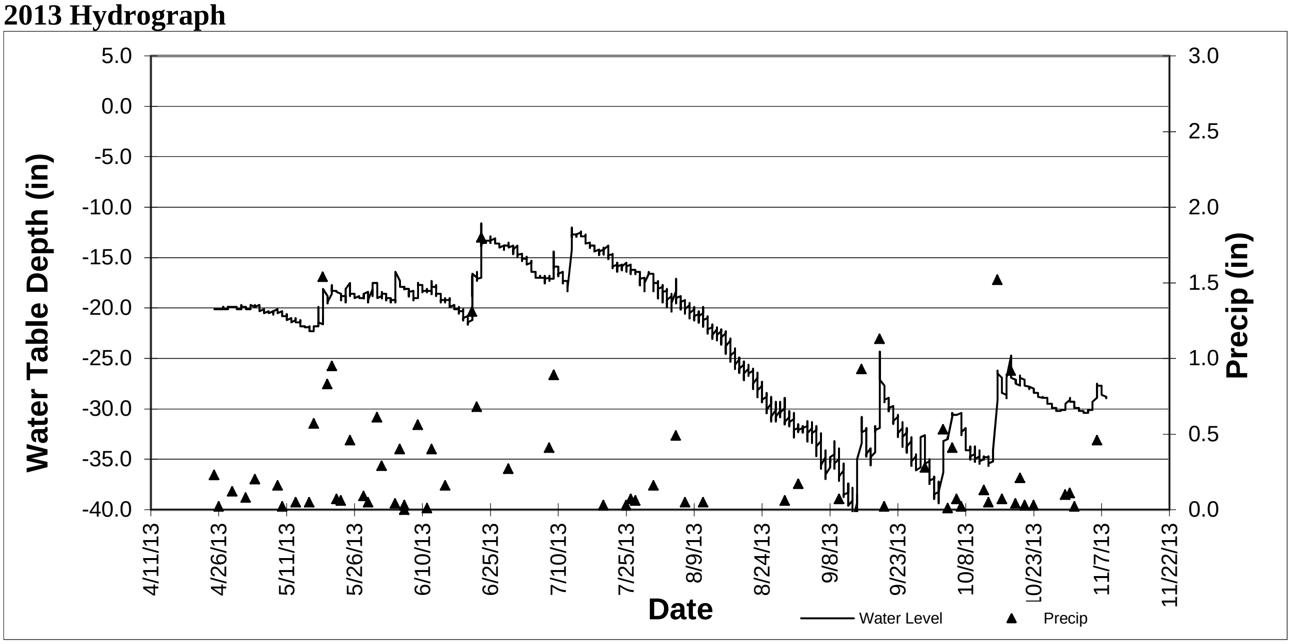
Surrounding Soils: Lake Beach, Growton and Heyder fine sandy loams

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Cornus amomum	Silky Dogwood	30
Fraxinus pennsylvanica	Green Ash	30

Other Notes: This wetland is located within East Twin Lake County Park, and is only 180 feet from the lake itself. Water levels in the wetland are influenced by lake levels.

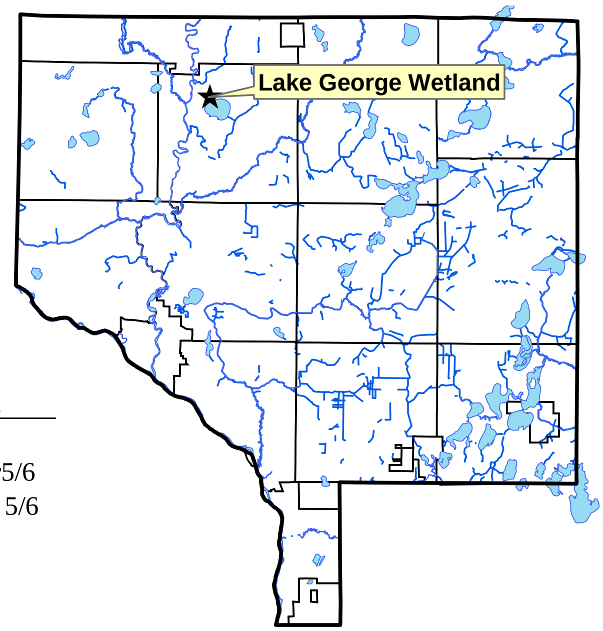
2013 Hydrograph



Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

LAKE GEORGE REFERENCE WETLAND

Lake George County Park, Oak Grove



Site Information

Monitored Since: 1997

Wetland Type: 3/4

Wetland Size: ~9 acres

Isolated Basin? Yes, but only separated from wetland complexes by roadway.

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-8	10yr2/1	Sandy Loam	-
Bg	8-24	2.5y5/2	Sandy Loam	20% 10yr5/6
2Bg	24-35	10gy 6/1	Silty Clay Loam	10% 10yr 5/6

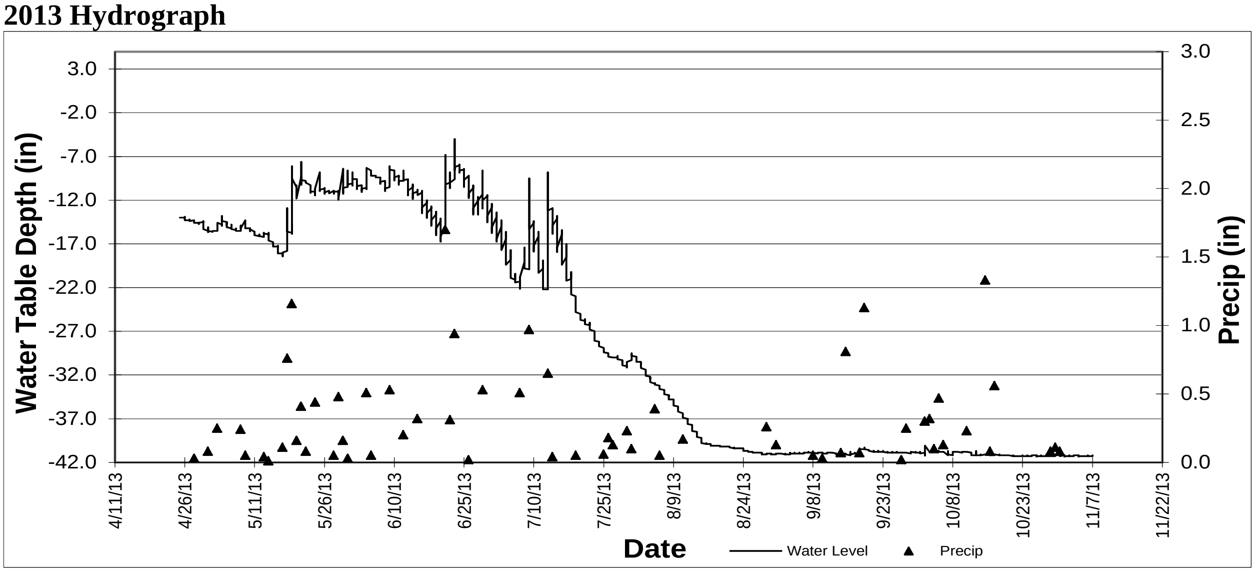
Surrounding Soils: Lino loamy fine sand and Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Cornus stolonifera	Red-osier Dogwood	90
Populus tremuloides	Quaking Aspen	40
Quercus rubra	Red Oak	30
Onoclea sensibilis	Sensitive Fern	20
Phalaris arundinacea	Reed Canary Grass	10

Other Notes: This wetland is located within Lake George County Park, and is only about 600 feet from the lake itself. Much of the vegetation within the wetland is cattails.

2013 Hydrograph

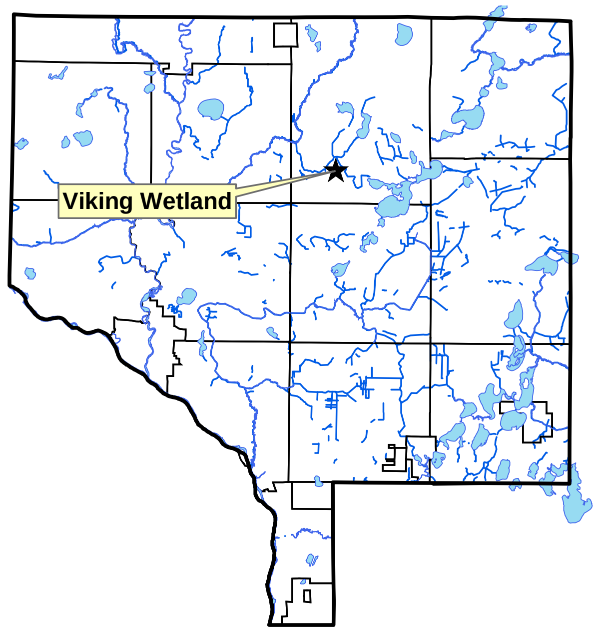


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

VIKING MEADOWS REFERENCE WETLAND

Viking Meadows Golf Course, East Bethel



Site Information

Monitored Since: 1999

Wetland Type: 2

Wetland Size: ~0.7 acres

Isolated Basin? No

Connected to a Ditch? Yes, highway ditch is tangent to wetland

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-12	10yr2/1	Sandy Loam	-
Ab	12-16	N2/0	Sandy Loam	-
Bg1	16-25	10yr4/1	Sandy Loam	-
Bg2	25-40	10yr4/2	Sandy Loam	5% 10yr5/6

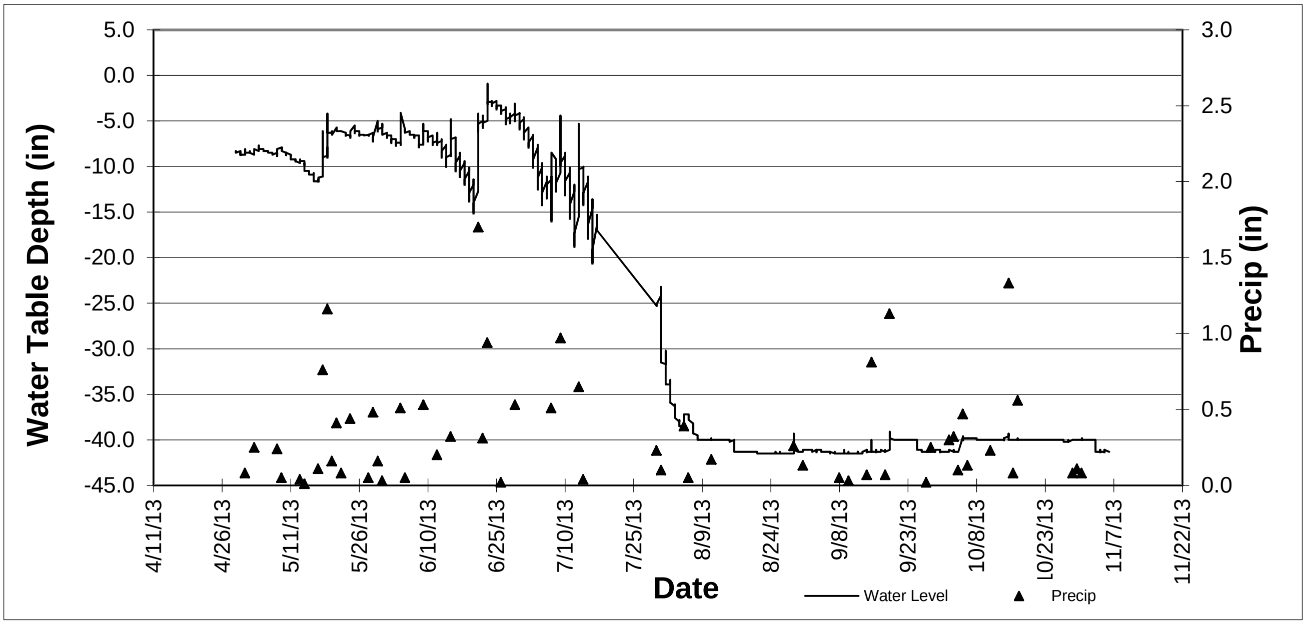
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Acer rubrum (T)	Red Maple	75
Acer negundo (T)	Boxelder	20

Other Notes: This wetland is located at the entrance to Viking Meadows Golf Course, and is adjacent to Viking Boulevard (Hwy 22).

2013 Hydrograph



Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Water Quality Grant Fund

Description: The Upper River Watershed Management Organization (URRWMO) partners with the Anoka Conservation District's (ACD) Water Quality Cost Share Program. The URRWMO contributes funds to be used as cost share grants for projects that improve water quality in lakes, streams, or rivers within the URRWMO area. The ACD provides administration of the grants. Grant awards follow ACD policies and generally cover 50% or 70% of materials (see ACD website for full policies). The ACD Board of Supervisors approves any dispersements.

Grant administration is through the Anoka Conservation District for efficiency and simplicity. The ACD administers a variety of other similar grants, thus providing a one-stop-shop for residents. Additionally, the ACD's technical staff provides project consultation and design services at low or no cost, which is highly beneficial for grant applicants. ACD staff also has expertise to process and scrutinize grant requests. Lastly, the ACD Board meets monthly, and can therefore respond to grant requests rapidly, while URRWMO meetings are much less frequent.

The Anoka Conservation District (ACD) and Upper Rum River WMO have both undertaken efforts to promote these types of projects and the availability of grants. The ACD mentions the grants during presentations to lake associations and other community groups, in newsletters, and in website postings. In order to promote these types of projects the ACD also assists landowners throughout projects, including design, materials acquisition, installation, and maintenance.

Purpose: To improve water quality in area lakes, streams and rivers.

Locations: Throughout the watershed.

Results: Projects are reported in the year they are installed. In 2013 Lake George shoreline restorations were approved and funds allocated to the Daml and Stitt properties on Lake George. These projects are to be installed in 2014.

URRWMO Cost Share Fund Summary

2006 URRWMO Contribution	+	$ 990.00
2006 Expenditures		$ 0.00
2007 URRWMO Contribution	+	$ 1,000.00
2007 Expenditures		$ 0.00
2008 Expenditures		$ 0.00
2009 Expenditures		$ 0.00
2010 URRWMO Contribution	+	$ 500.00
2011 URRWMO Contribution	+	$ 567.00
2010-11 Expenditure Petro streambank stabilization	-	$1,027.52
2011 Expenditure Erickson lakeshore restoration	-	$ 233.63
2012 Expenditure Erickson lakeshore restoration	-	$ 137.97
2012 URRWMO Contribution	+	$1,000.00
2013 URRWMO Contribution	+	$ 0
2014 Expenditure – Stitt lakeshore restoration (encumbered)	-	$1,135.50
2014 Expenditure – Daml lakeshore restoration (encumbered)	-	$ 690.00
Fund Balance		**$ 832.38**

Special note: For all funds contributed after 2013, the URRWMO has asked to re-evaluate how these grants are administered. The WMO may choose to administer the funds themselves or with other oversight of the ACD's process.

URRWMO Website

Description: The Upper Rum River Watershed Management Organization (URRWMO) contracted the Anoka Conservation District (ACD) to design and maintain a website about the URRWMO and the Upper Rum River watershed. The original website had been in operation since 2003. A new website and domain for the URRWMO was created by ACD in 2013.

Purpose: To increase awareness of the URRWMO and its programs. The website also provides tools and information that helps users better understand water resources issues in the area.

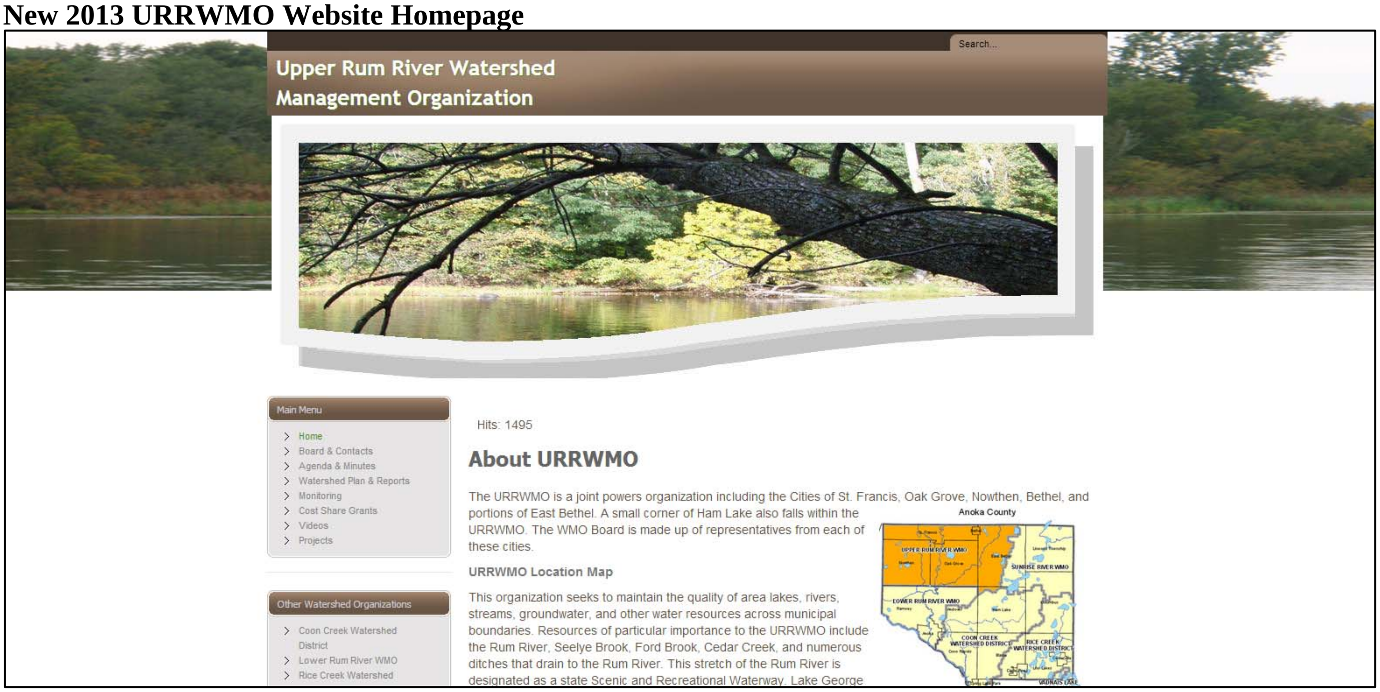
Location: www.URRWMO.org

Results: In 2013 the upgraded, redesigned, and re-launched the URRWMO website. These updates were necessary because the old website platform was incompatible with certain tablet computers and smartphones. Additionally, the old website was hosted with in the ACD website, while the new website is completely independent, offering the WMO future management choices.

The URRWMO website contains information about both the URRWMO and about natural resources in the area. Information about the URRWMO includes:

- a directory of board members,
- meeting minutes and agendas,
- watershed management plan and annual reports,
- descriptions of work that the organization is directing,
- highlighted projects.

New 2013 URRWMO Website Homepage



URRWMO Annual Newsletter

Description: The URRWMO Watershed Management Plan and state rules call for an annual URRWMO newsletter in addition to the website. The URRWMO will produce a newsletter article including information about the URRWMO, its programs, related educational information, and the URRWMO website address. This article will be provided to each member city, and they will be asked to include it in their city newsletters.

Purpose: To increase public awareness of the URRWMO and its programs.

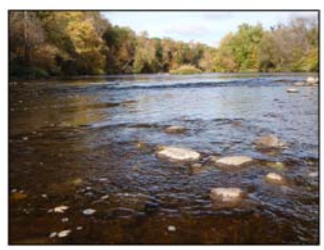
Locations: Watershed-wide.

Results: The Anoka Conservation District (ACD) assisted the URRWMO by drafting the annual newsletter article. The URRWMO discussed topics to be covered in the article. It was decided that the newsletter article would be about the Rum River Watershed Restoration and Protection Project (WRAPP).

ACD staff drafted the newsletter article and sent it to the URRWMO Board for review. The URRWMO Board reviewed and edited the draft article. The finalized article was sent to each member community in July 2013, as well as to the Independent School District 15 publication, “The Courier.” It was printed in The Courier.

2013 URRWMO Newsletter Article

Rum River Watershed Gets Check-up, Plan



An effort is underway to protect and improve water quality in the almost one million acre Rum River watershed. With its beginning at Lake Mille Lacs, most of the Rum River is a State Scenic and Recreational Waterway. The Rum is known for canoeing, smallmouth bass fishing, and high water quality. Many of the watershed’s tributaries and lakes, including lakes George and East Twin, are also of high quality.

The Rum River Watershed Restoration and Protection Project (WRAP), which just began, aims to protect all of this. Some lakes and streams in the watershed are “impaired” and fail to meet state water quality standards. For these, a plan for improvement, or Total Maximum Daily Load (TMDL) study will be completed.

The WRAP will include:

- Water quality monitoring (2013-14).
- Special investigations of water quality problems (2014).
- Computer modeling to answer “what if” questions (2013-15).
- Total Maximum Daily Load (TMDL) planning (2015-16).
- A WRAP report that prescribes future management approaches (2015-16).

After completion of the WRAP, local agencies will implement projects to protect and improve water quality. State funding, including the State Clean Water Fund from the Clean Water, Land and Legacy Amendment, will ensure financial support exists for these projects.

At the most local level, the Upper Rum River Watershed Management Organization (URRWMO) will be working for the Rum River and our lakes. The URRWMO is a joint powers organization of the Cities of Bethel, East Bethel, Ham Lake, Nowthen, Oak Grove and St. Francis. Learn more at www.URRWMO.org.

The WRAP is funded and overseen by the Minnesota Pollution Control Agency, and the Anoka Conservation District is the project lead. Nine other counties in the watershed are also involved. For more information on the Rum River WRAP project visit www.pca.state.mn.us and search for “Rum River WRAP.”

URRWMO 2012 Annual Reports to the State

Description: The Upper Rum River Watershed Management Organization (URRWMO) is required by law to submit an annual report to the Minnesota Board of Water and Soil Resources (BWSR). This report consists of an up-to-date listing of URRWMO Board members, activities related to implementing the URRWMO Watershed Management Plan, the status of municipal water plans, financial summaries, and other work results. The report is due annually 120 days after the end of the URRWMO's fiscal year (April 30th).

Additionally, the URRWMO is required to perform annual financial reporting to the State Auditor. This includes submitting a financial report and filling out a multi-worksheet form.

Purpose: To document required progress toward implementing the URRWMO Watershed Management Plan and to provide transparency of government operations.

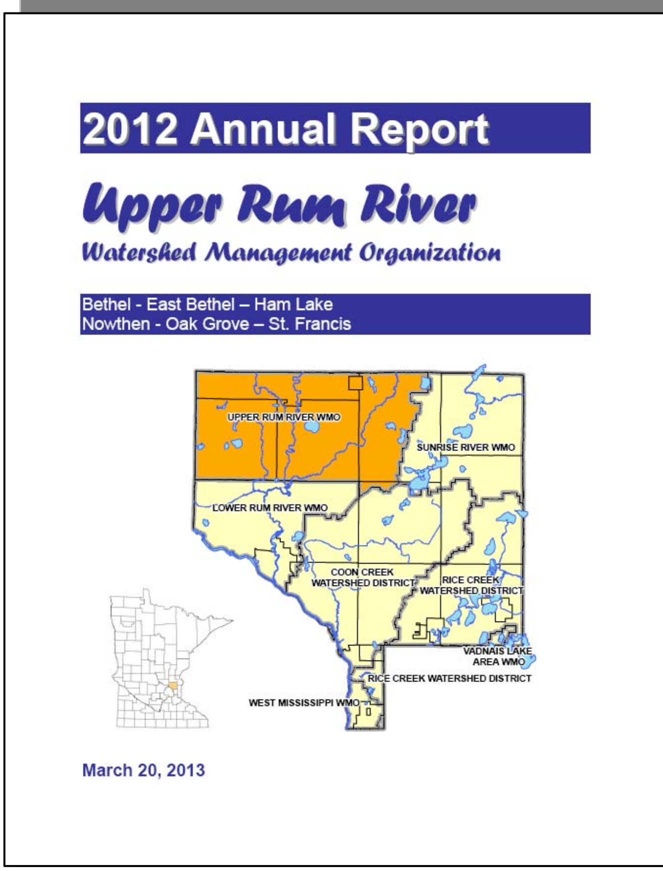
Locations: Watershed-wide

Results: The Anoka Conservation District assisted the URRWMO with preparation of a 2012 Upper Rum River WMO Annual Report to BWSR and reporting to the State Auditor. This included:

- preparation of an unaudited financial report,
- a report to BWSR meeting MN statutes
- and the State Auditor's reporting forms through the State's SAFES website.

All were completed by the end of April 2013. The report to BWSR and financial report are available on the URRWMO website.

Report to BWR Cover



2012 Annual Report

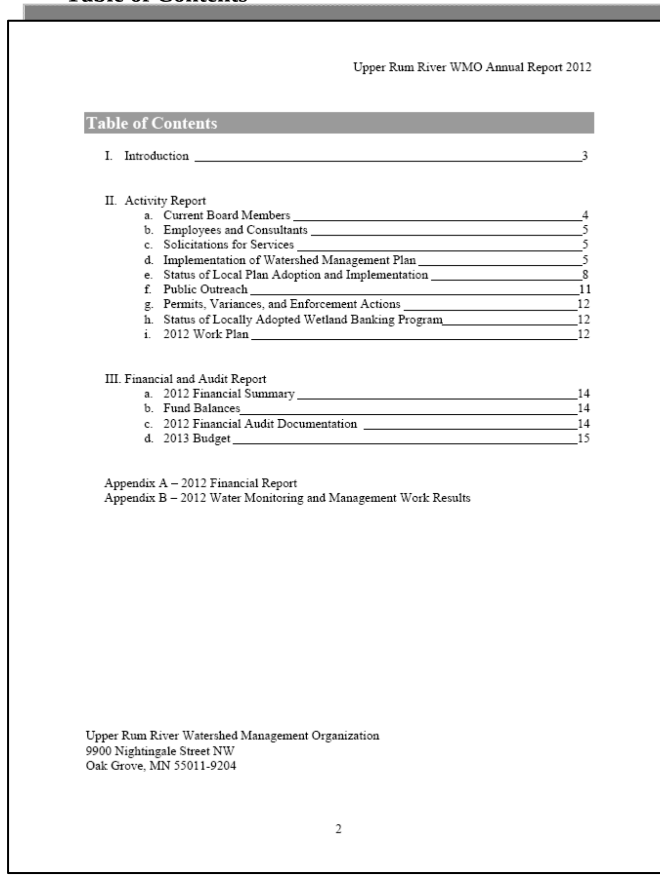
Upper Rum River

Watershed Management Organization

Bethel - East Bethel – Ham Lake
Nowthen - Oak Grove – St. Francis

March 20, 2013

Table of Contents



Upper Rum River WMO Annual Report 2012

Table of Contents

Upper Rum River Watershed Management Organization
9900 Nightingale Street NW
Oak Grove, MN 55011-9204

2

Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program. We do not, however, know specifically which expenses are attributed to monitoring which sites. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer.

Upper Rum River Watershed Financial Summary

Upper Rum River Watershed	Volunteer Precip	Ref Wet	Ob Well	Lake Lvl	Lake WQ	Lake WQ - SWAG	Stream WQ - SWAG	SWAG Admin/Reporting	WOMP	Student Biomon	URRWMO Admin	WMO Annual Rpts to State	URRWMO Outreach/Promo	WMO Website Maint	WMO Website Migration	Anoka Nat. Pres. Restoration	Rum River WRAPP	Projects	Cost Share - Local/State	Total
Revenues																				
URRWMO	0	1680	0	800	2500	0	0	0	0	825	0	1000	350	405	800	0	0	0	0	8498
State	0	0	392	0	0	2954	11545	796	0	0	0	0	0	0	0	94254	7459	0	0	117400
Anoka Conservation District	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anoka Co. General Services	0	0	530	0	0	0	0	544	0	0	1313	0	0	0	51	3692	0	0	0	6131
County Ag Preserves	0	0	0	0	759	0	0	0	0	349	0	0	0	0	0	0	0	48	0	1156
Regional/Local	0	0	0	0	0	0	0	0	720	0	0	0	0	0	0	0	0	0	0	720
Other Service Fees	0	0	0	0	264	0	0	0	0	0	0	0	0	0	0	0	0	404	0	669
BWSR Cons Delivery	0	0	0	0	0	0	0	0	38	0	0	0	0	0	0	0	0	0	0	38
BWSR Cost Share TA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	441	0	441
Local Water Planning	354	0	98	5	438	0	0	0	0	0	0	0	0	0	0	0	0	0	0	895
TOTAL	354	1680	1019	805	3961	2954	11545	1340	758	1174	1313	1000	350	405	851	97947	7459	893	0	135946
Expenses-																				
Capital Outlay/Equip	2	26	13	10	48	39	4607	21	7	11	12	4	4	5	9	47	34	14	0	4912
Personnel Salaries/Benefits	295	1689	853	686	2744	2096	3273	1114	629	992	1091	502	203	316	451	7753	2211	740	0	27639
Overhead	32	111	68	47	183	135	204	77	61	67	102	47	14	28	29	927	209	53	0	2393
Employee Training	1	7	3	4	15	7	16	5	1	8	5	0	0	1	1	7	6	3	0	91
Vehicle/Mileage	4	28	13	13	48	32	56	19	8	20	17	6	3	5	6	91	31	12	0	412
Rent	18	77	44	31	124	96	144	52	37	43	61	29	10	18	21	531	127	36	0	1498
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138
Program Supplies	0	2	0	0	700	470	3114	0	0	32	0	0	0	0	312	88513	4727	1	0	97871
McKay Expenses	1	31	25	15	99	80	131	52	14	0	25	0	8	13	22	79	112	36	0	743
TOTAL	354	1971	1019	805	3961	2954	11545	1340	758	1174	1313	590	242	385	851	97947	7459	893	0	135698
NET	0	-291	0	0	0	0	0	0	0	0	0	410	108	20	0	0	0	0	0	248

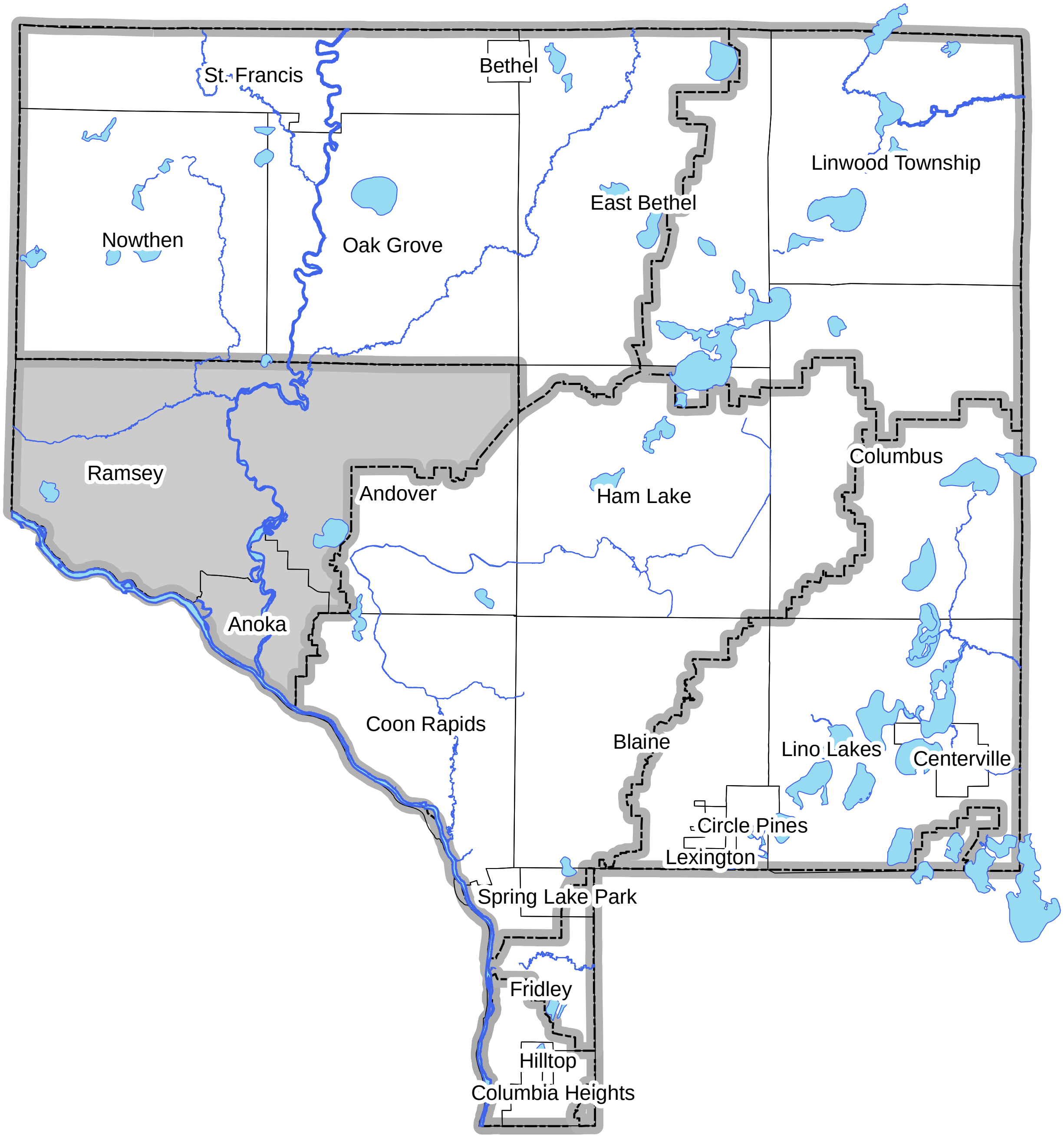
Recommendations

- **Actively participate in the MPCA Rum River WRAPP (Watershed Restoration and Protection Plan) which began in 2013.** This WRAPP is an assessment of the entire Rum River watershed. This is an opportunity for the URRWMO to prioritize and coordinate efforts with upstream entities and state agencies.
- **Consider coordinating multi-county water planning efforts thought the state's new One Watershed-One Plan initiative.** Planning funding will be available to the first watersheds that participate.
- **Add more frequent Lake George water quality monitoring.** Declining water quality is being observed, but the reason remains a mystery.
- **Consider a St. Francis stormwater assessment** that is aimed at identifying and installing cost effective stormwater treatment opportunities before water is discharged into the Rum River. The assessment should be focused on those portions of the city that are generally lacking sufficient stormwater treatment. A large portion of the funding may be available through ACD.
- **Promote groundwater conservation.** Metropolitan Council models predict 3+ft

drawdown of surface waters in parts of the URRWMO by 2030, and 5+ft by 2050.

- **Correct riverbank erosion issues discovered during the 2010 Rum River survey**. Several locations of riverbank erosion were documented. Landowners were contacted, and some responded, however none have committed to corrective work. Part of the reason is that these projects are expensive and the landowner would bear some of the cost.
- **Investigate the condition of Ditch 19, the only inlet to Lake George**. Residents have complained that condition of the ditch and water control structures are contributing to low lake water levels in recent years. Anoka County is the legal ditch authority.
- **Promote water quality improvement projects** for lakes, streams, and rivers. Cost share grants are available through the URRWMO and ACD to encourage landowners to do projects that will have public benefits to water quality. Technical assistance for landowners is available through the Anoka Conservation District.

Lower Rum River Watershed



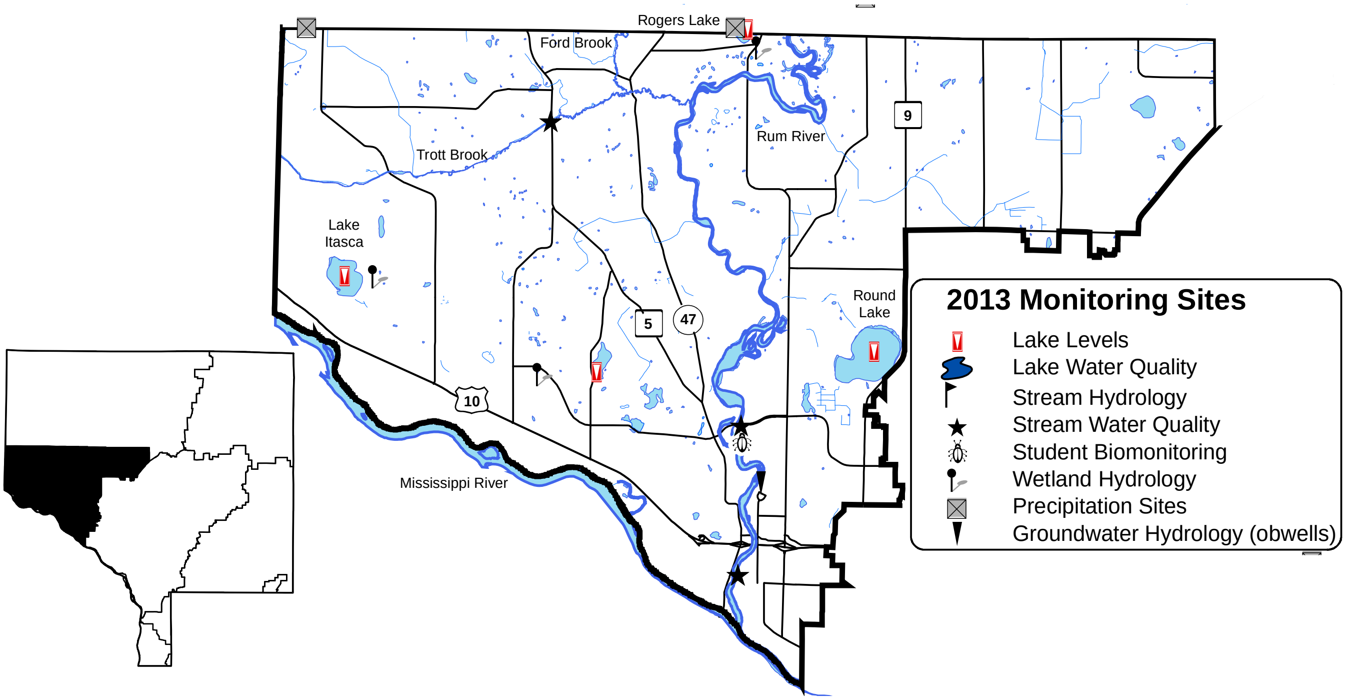
Contact Info: Lower Rum River Watershed Management Organization
www.lrrwmo.org
763-421-8999

Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 4: LOWER RUM RIVER WATERSHED

Task	Partners	Page
Lake Levels	LRRWMO, ACD, volunteers, MN DNR	4-87
Stream Water Quality – Chemical	MPCA, ACD	4-89
Stream Water Quality – Biological	LRRWMO, ACD, ACAP, Anoka High School	4-94
Stream Hydrology	LRRWMO, ACD	4-97
Stream Rating Curves	LRRWMO, ACD	4-99
Wetland Hydrology	LRRWMO, ACD	4-100
Water Quality Grant Fund	LRRWMO, ACD, landowners	4-104
Public Education – Wetlands	LRRWMO, ACD	4-105
Review Member Community Local Water Plans	LRRWMO, ACD	4-109
LRRWMO Website	LRRWMO, ACD	4-110
Financial Summary		4-111
Recommendations		4-112
Groundwater Hydrology (obwells)	ACD, MNDNR	Chapter 1
Precipitation	ACD, volunteers	Chapter 1
		Chapter 1

ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District, LRRWMO = Lower Rum River Watershed Mgmt Org, MC = Metropolitan Council, MNDNR = MN Dept. of Natural Resources



Lake Level Monitoring

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

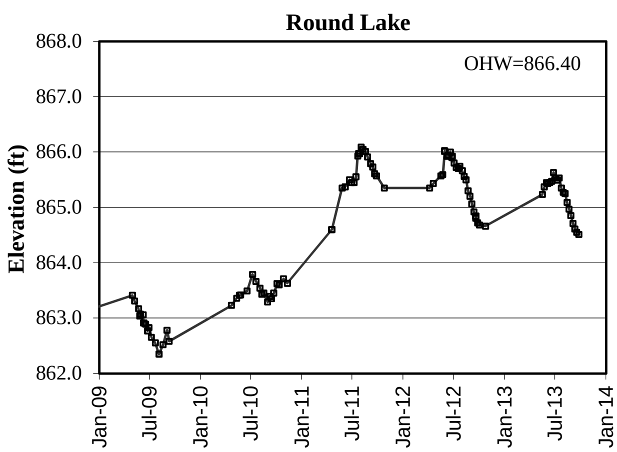
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations: Itasca, Round, Rogers, and Sunfish/Grass Lakes

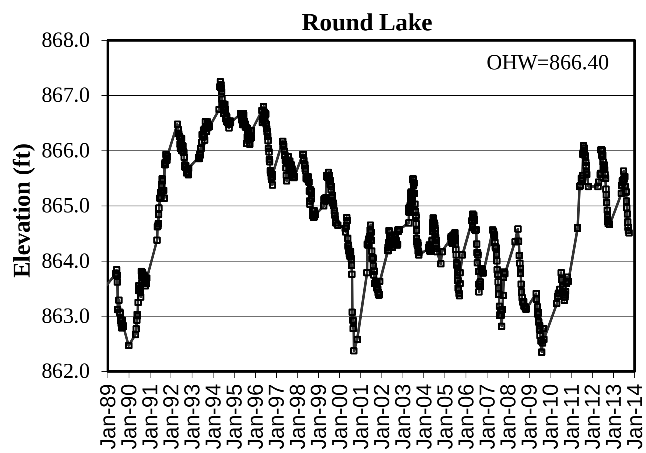
Results: Lake levels were measured by volunteers throughout the 2013 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. Lakes had sharply increasing water levels in spring and early summer 2013 when heavy rainfall totals occurred. Little rainfall fell later in the year and lake levels fell dramatically.

All lake level data can be downloaded from the MN DNR website's Lakefinder feature. Ordinary High Water Level (OHW), the elevation below which a DNR permit is needed to perform work, is listed for each lake on the corresponding graphs below.

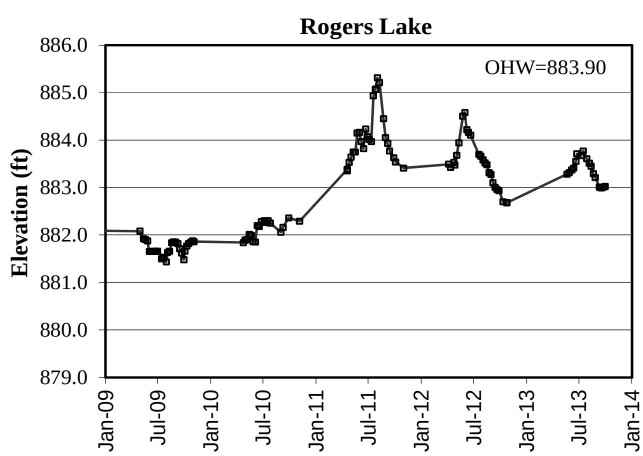
Round Lake Levels – last 5 years



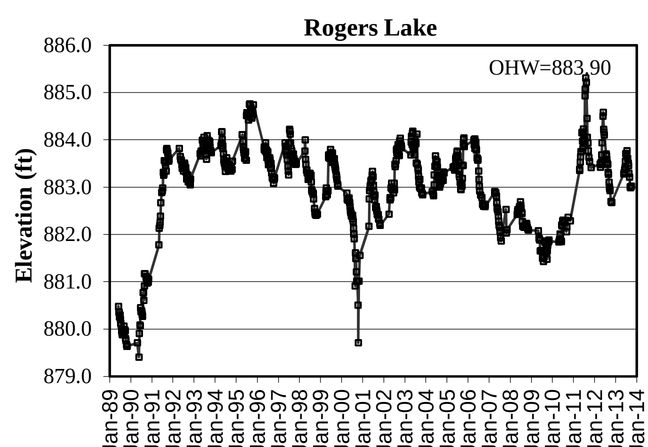
Round Lake Levels – last 25 years



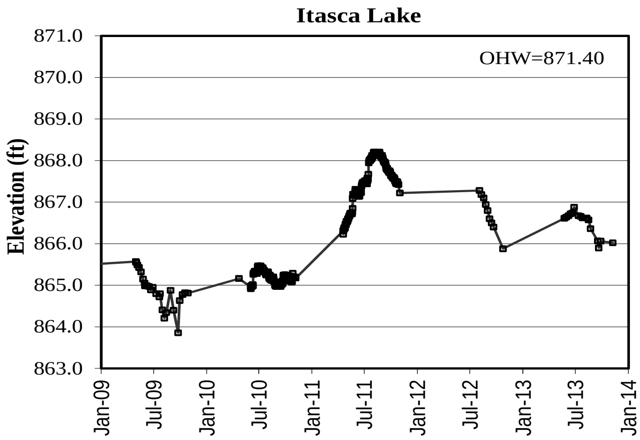
Rogers Lake Levels – last 5 years



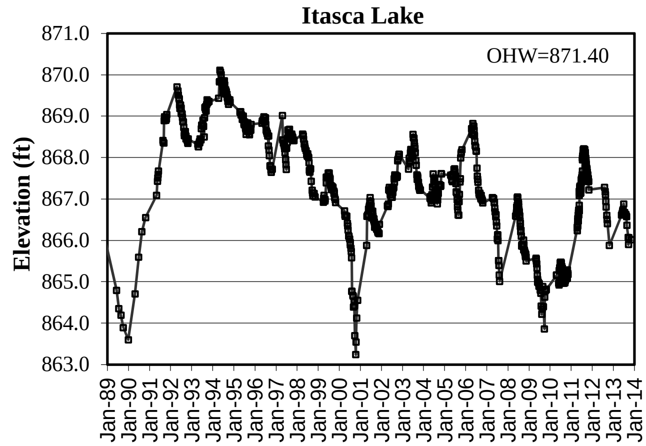
Rogers Lake Levels – last 25 years



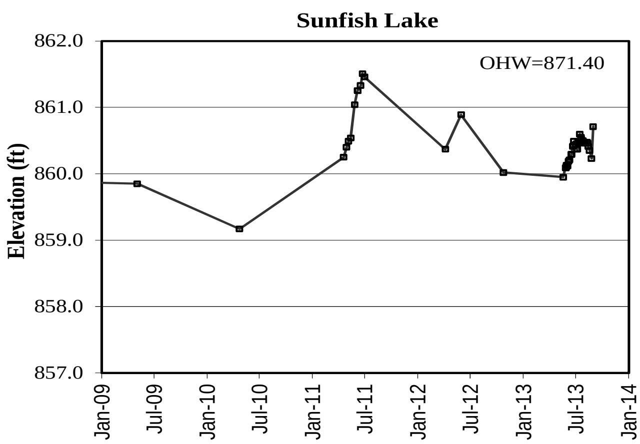
Itasca Lake Levels – last 5 years



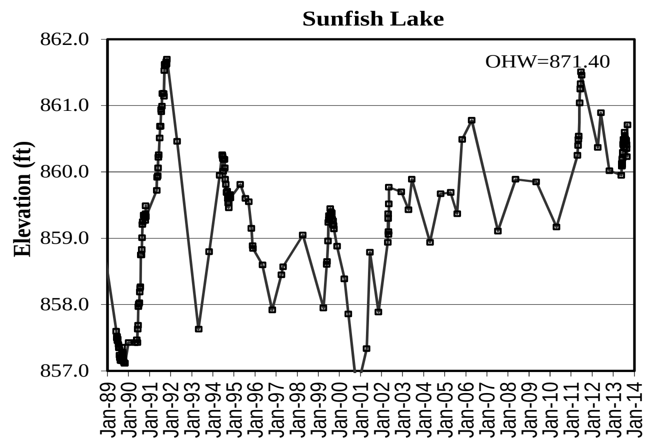
Itasca Lake Levels – last 25 years



Sunfish/Grass Lake Levels – last 5 years



Sunfish/Grass Lake Levels – last 25 years



Stream Water Quality - Chemical Monitoring

Description: The Anoka Conservation District (ACD) is conducting Surface Water Assessment Grant (SWAG) monitoring for the MPCA in 2013 and 2014. Monitoring events are scheduled May through September for of the following parameters: total suspended solids, chlorides, sulfate, hardness, calcium, magnesium, nitrogen-ammonia, total kjeldahl nitrogen, nitrate & nitrite, volatile suspended solids, e. coli, total phosphorus, Secchi tube transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

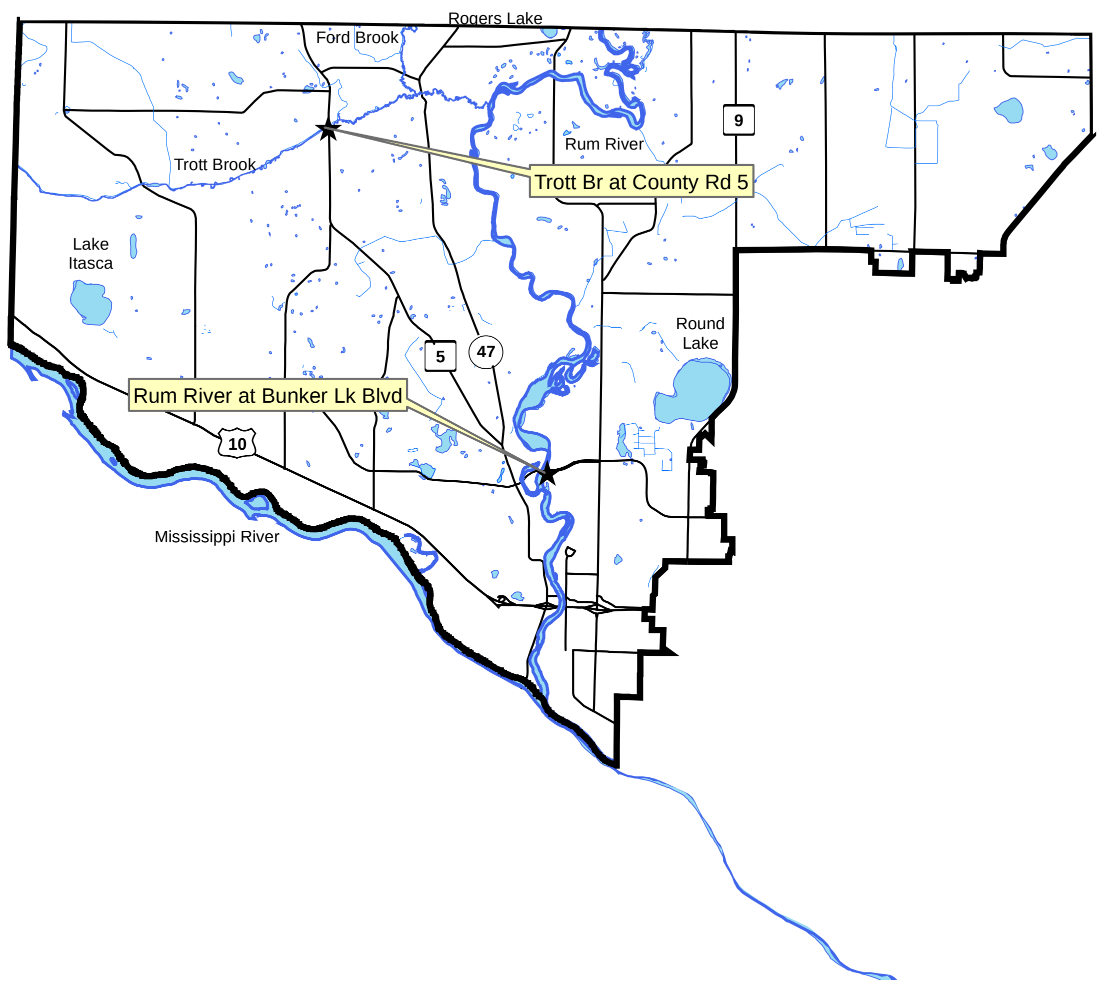
Purpose: To provide an initial assessment of water quality to be used in the completion of the Rum River Watershed Restoration and Protection Plan (WRAPP).

Locations: Trott Brook at County Road 5

Rum River at Bunker Lake Blvd

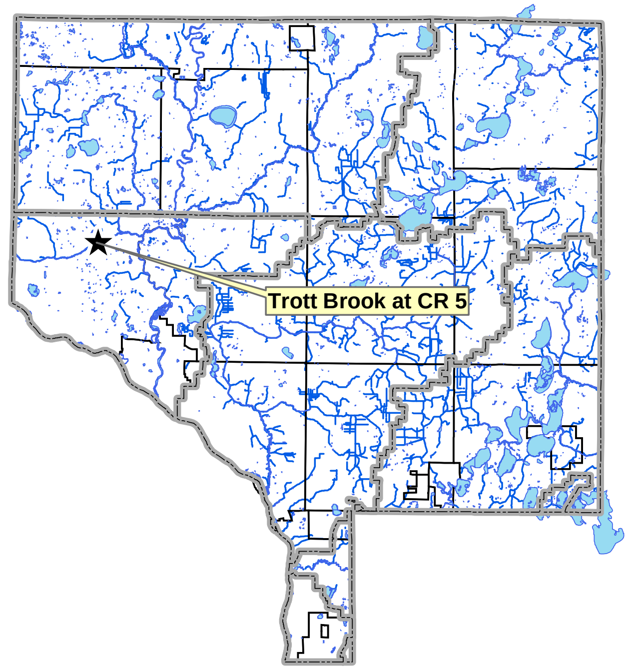
Results: Results are presented on the following pages.

2013 Lower Rum River Monitoring Sites



TROTT BROOK

Trott Brook at Co. Rd. 5, Ramsey STORET SiteID = S003-176



Years Monitored

Trott at Co. Rd. 5 1998, 2003, 2006, 2012, 2013

Background

Trott Brook is a medium-sized creek that flows south through Sherburne County, paralleling the Anoka-Sherburne County boundary before turning east through the City of Ramsey where outlets to the Rum River. Overall, the watershed is rural or suburban residential, and areas within the watershed are undergoing rapid development. The creek is about 25 feet wide and 2.5 feet deep at the monitoring site during baseflow. The monitoring site is approximately one mile upstream of Trott Brook's confluence with Ford Brook.

Results and Discussion

This report includes data from 2013. A reason this monitoring is being performed is to gain additional historical data for the state to determine if the creek is meeting state water quality standards. That assessment process is part of the Rum River Watershed Restoration and Protection Project (WRAPP). The following is a summary of results.

- Dissolved constituents, as measured by conductivity and chlorides, in Trott Brook were similar to other Anoka County streams. Conductivity averaged 0.403 mS/cm Maximum of 0.542 mS/cm and a minimum of 0.264 mS/cm). Chlorides averaged 25 mg/l (maximum of 32 mg/l and a minimum of 14 mg/l), and substantially better than state water quality standards.
- Phosphorous averaged higher the proposed MPCA water quality standard of 100 ug/l. If the proposed standard is approved Trott Brook often exceeds the limit, even during baseflow periods. Phosphorous in Trott Brook averaged 107 ug/l (maximum of 173 ug/l and a minimum of 55 ug/l).
- Suspended solids and turbidity both stayed below the state standards each sampling event. Total suspended solids averaged 7.5 mg/l (maximum of 24 mg/l and a minimum of 2 mg/l). Turbidity averaged 3.17 NTU (maximum of 11.00 NTU and a minimum of 0.00 NTU).
- pH was within the range considered normal and healthy for streams in this area. pH averaged 7.78 (maximum of 8.68 and a minimum of 7.18).
- Dissolved oxygen was periodically below the state water quality standard of 5 mg/L of dissolved oxygen (DO). Low DO in this creek was a known concern based on past monitoring. In Trott Brook five of 13 DO measurements were below 5 mg/L and all measurements averaged 5.35 mg/l (maximum of 8.23 mg/l and a minimum of 2.01 mg/l). Measurements were not taken in early morning when DO is typically lowest.

For a significant number of the results below there are no current state standards. However, this data will be used as a baseline for future assessments of the watershed.

Trott Brook Water Quality Monitoring Results for 2013.

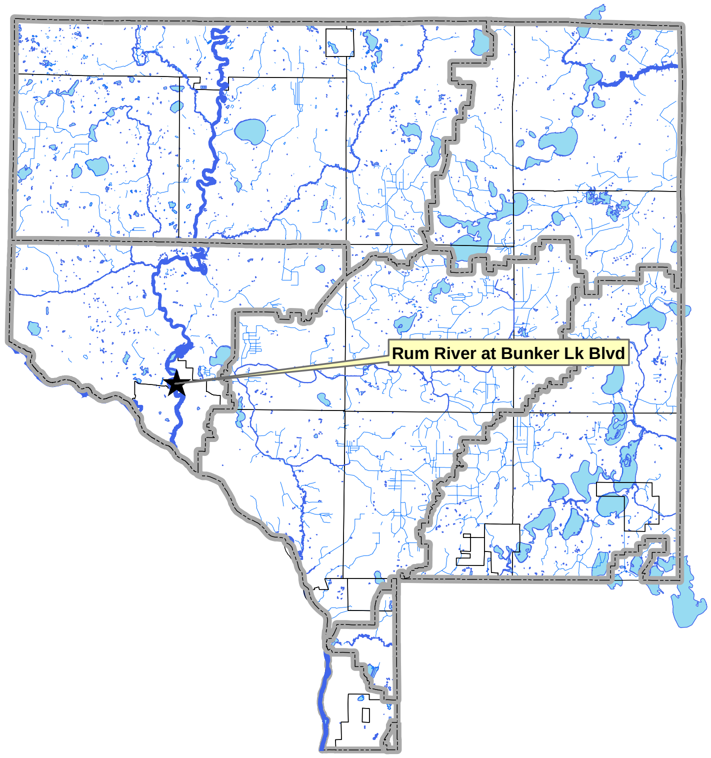
Grey columns indicate dates with E.coli samples only.

Trott Brook at CR 5	Units	R.L.*	4/30/2013 Results	5/21/2013 Results	6/5/2013 Results	6/17/2013 Results	6/25/2013 Results	7/2/2013 Results	7/15/2013 Results	7/23/2013 Results
pH		0.1	7.76	7.62	7.90	8.68	7.39	7.73	7.18	7.33
Conductivity	mS/cm	0.01	0.288	0.264	0.433	0.444	0.303	0.418	0.292	0.412
Turbidity	NTU	1	3.0	11.0	5.1	4.5	8.3	1.4	0.6	1.1
D.O.	mg/L	0.01	8.02	6.59	8.23	7.35	2.01	5.42	3.35	2.29
D.O.	%	1	74.9	61.5	70.3	76.2	22.4	56.6	26.6	25.6
Temp.	°C	0.1	12.1	12.5	12.9	17.4	20.8	18.9	21.9	20.8
Salinity	%	0.01	0.01	0.01	0.21	0.21	0.14	0.20	0.14	0.20
T.P.	ug/L	10	72	132	107		173	150		138
TSS	mg/L	2	12	24	7		12	3		3
Cl	mg/L		21.2	25.3	25.6		14.2	20.1		18.7
Sulfate	mg/L		28.0	22.0	20.9		15.1	12.8		10.0
Hardness CaCO3	mg/L		197	176	228		155	238		237
Calcium	mg/L		52.00	46.90	60.10		40.70	62.30		60.00
Magnesium	mg/L		16.20	14.40	18.90		12.90	20.00		21.10
Secchi-tube	cm		>100	>100	>100	>100	>100	>100	>100	>100
Nitrogen, Ammonia	mg/L		0.29	0.65	0.37		<0.16	<0.16		0.23
TKN	mg/L		1.1	1.9	1.5		1.9	1.7		1.1
Nitrate plus Nitrite	mg/L		1.41	0.50	0.54		<0.2	0.29		<0.2
VSS	mg/L	2	7	16	6		12	3		3
E coli	MPN				225.0	178.9	44.1	28.1	98.7	13.5
Appearance			1B	1B	1B	1A	1B	1A	1A	1A
Recreational			2	2	2	1	1	1	1	1

			8/6/2013 Results	8/19/2013 Results	8/27/2013 Results	9/4/2013 Results	9/25/2013 Results	Average	Min	Max
pH		0.1	7.75	7.90	7.95	8.00	8.01	7.78	7.18	8.68
Conductivity	mS/cm	0.01	0.428	0.426	0.462	0.527	0.542	0.403	0.264	0.542
Turbidity	NTU	1	1.7	0.2	0.0	1.1	3.2	3.17	0.00	11.00
D.O.	mg/L	0.01	5.27	4.35	3.36	6.54	6.83	5.35	2.01	8.23
D.O.	%	1	55.7	49.1	42.7	70	70.5	54.0	22.4	76.2
Temp.	°C	0.1	17.8	19.4	25.1	17.4	15.0	17.8	12.1	25.1
Salinity	%	0.01	0.21	0.20	0.22	0.25	0.26	0.17	0.01	0.26
T.P.	ug/L	10	55		93	72	74	107	55	173
TSS	mg/L	2	2		3	3	6	7.5	2.0	24.0
Cl	mg/L		27.3		30.2	30.8	32.4	25	14	32
Sulfate	mg/L		17.9		15.3	17.5	17.3	17.7	10.0	28.0
Hardness CaCO3	mg/L		249		250	241	199	217	155	250
Calcium	mg/L		60.10		58.20	57.90	49.10	54.73	40.70	62.30
Magnesium	mg/L		24.00		25.40	23.40	18.50	19.48	12.90	25.40
Secchi-tube	cm		>100	>100	>100	>100	>100	>100	0	>100
Nitrogen, Ammonia	mg/L		<0.16		<0.16	<0.16	<0.16	<0.25	<0.16	0.65
TKN	mg/L		0.7		0.7	0.4	0.7	1.17	0.40	1.90
Nitrate plus Nitrite	mg/L		<0.2		0.38	0.45	0.58	0.59	0.29	1.41
VSS	mg/L	2	2		3	3	5	6.0	2.00	16.00
E coli	MPN		21.8	8.4				77.3	8.4	225.0
Appearance			1A	1A	1A	1A	1A			
Recreational			2	1	1	1	1	1	1	2

RUM RIVER

Rum River at Bunker Lake Boulevard, Anoka STORET SiteID = S007-555



Years Monitored

Rum River at Bunker L Blvd 2013

Background

The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. In Anoka County the river has both rocky riffles (northern part of county) as well as pools and runs with sandy bottoms. The river's condition is generally regarded as excellent. Most of the Rum River in Anoka County has a state "scenic and recreational" designation. The sampling site is at the pier located in River Bend Park, southwest of the Bunker Lake Boulevard bridge.

Results and Discussion

This report includes data from 2013. A reason this monitoring is being performed is to gain additional historical data for the state to determine if the river is meeting state water quality standards. That assessment process is part of the Rum River Watershed Restoration and Protection Project (WRAPP). The following is a summary of results.

- <u>Dissolved constituents</u>, as measured by conductivity and chlorides, in the Rum River were low when compared to Anoka County streams. Conductivity averaged 0.242 mS/cm Maximum of 0.336 mS/cm and a minimum of 0.150 mS/cm). Chlorides averaged 13 mg/l (maximum of 16 mg/l and a minimum of 6 mg/l), which is better than the state water quality standard.
- <u>Phosphorous</u> was typically higher than the proposed MPCA water quality standard of 100 ug/l, even during baseflow periods. Phosphorous results in the Rum River averaged 118 ug/l (maximum of 183 ug/l and a minimum of 71 ug/l).
- <u>Suspended solids and turbidity</u> both were below the state standards each sampling event and averaged well below the standards. Total suspended solids averaged 7.7 mg/l (maximum of 16 mg/l and a minimum of 2 mg/l). Turbidity averaged 75.76 NTU (maximum of 17.60 NTU and a minimum of 0.70 NTU).
- <u>pH and dissolved oxygen</u> were with the range considered normal and healthy for streams in this area. pH averaged 8.16 (maximum of 8.70 and a minimum of 7.57). DO averaged 7.76 mg/l (maximum of 10.15 mg/l and a minimum of 5.10 mg/l).

For a significant number of the results below there are no current state standards. However, this data will be used as a baseline for future assessments of the watershed.

Rum River Water Quality Monitoring Results for 2013.
Grey columns indicate dates with E.coli samples only.

Rum River at Bunker Lk Boulevard			4/30/2013	5/21/2013	6/5/2013	6/17/2013	6/25/2013	7/2/2013	7/15/2013	7/23/2013
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results
pH		0.1	7.91	7.7	7.82	8.61	7.71	7.57	7.73	8.14
Conductivity	mS/cm	0.01	0.150	0.193	0.220	0.214	0.192	0.173	0.250	0.272
Turbidity	NTU	1	8.0	9.0	9.2	6.3	17.6	2.8	6.3	4.5
D.O.	mg/L	0.01	9.96	7.98	7.10	7.06	6.19	5.10	6.76	7.31
D.O.	%	1	95.5	82.9	72.4	78.8	72.0	58.8	79.7	86.6
Temp.	°C	0.1	13.4	17.3	16.3	20.6	22.6	22.6	24.0	24.1
Salinity	%	0.01	0.00	0.00	0.10	0.10	0.09	0.08	0.12	0.13
T.P.	ug/L	10	109	128	128		173	183		127
TSS	mg/L	2	15	16	11		14	5		6
Cl	mg/L		12.0	16.0	11.5		9.2	6.2		12.5
Sulfate	mg/L		19.1	13.7	15		10.5	11.6		9
Hardness CaCO3	mg/L		93.3	119	93.1		96.2	92.2		142.0
Calcium	mg/L		24.60	31.80	24.80		25.20	24.30		35.90
Magnesium	mg/L		7.74	9.65	7.57		8.09	7.65		12.70
Secchi-tube	cm		79	>100	92	62	84.5	83	75	80
Nitrogen, Ammonia	mg/L		<0.16	0.37	<0.16		<0.16	0.23		0.51
TKN	mg/L		0.9	1.6	1.4		1.6	1.7		1.3
Nitrate plus Nitrite	mg/L		0.35	0.27	0.25		0.37	<0.2		0.31
VSS	mg/L	2	6	16	6		8	5		5
E coli	MPN				30.9	96.0	28.0	52.9	71.7	28.8
Chl a	ug/L				6.3		1.8	1.8		5.2
Pheophytin a	ug/L				5.25		3.19	1.38		1.68
Appearance			1B	1B	1B	1A	1B	1B	3	1B
Recreational			1	1	1	1	1	1	1	1

			8/6/2013	8/19/2013	8/27/2013	9/4/2013	9/25/2013			
	Units	R.L.*	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.52	8.66	8.56	8.44	8.7	8.16	7.57	8.70
Conductivity	mS/cm	0.01	0.263	0.265	0.287	0.336	0.326	0.242	0.150	0.336
Turbidity	NTU	1	3.4	1.5	0.7	2.3	3.3	5.76	0.70	17.60
D.O.	mg/L	0.01	8.24	8.26	7.77	8.95	10.15	7.76	5.10	10.15
D.O.	%	1	92.2	98.2	102.8	101.8	108.4	86.9	58.8	108.4
Temp.	°C	0.1	20.8	22.5	28.3	20.7	17.2	20.8	13.4	28.3
Salinity	%	0.01	0.13	0.13	0.14	0.16	0.16	0.10	0.00	0.16
T.P.	ug/L	10	71		100	91	73	118	71	183
TSS	mg/L	2	2		2	4	2	7.7	2.0	16.0
Cl	mg/L		13.5		15.1	15.8	16	13	6	16
Sulfate	mg/L		<12		10.6	11	11.5	12.4	9.3	19.1
Hardness CaCO3	mg/L		141.0		141.0	152.0	122	119	92	152
Calcium	mg/L		35.20		34.50	37.90	30.90	30.51	24.30	37.90
Magnesium	mg/L		13.00		13.30	14.00	10.90	10.46	7.57	14.00
Secchi-tube	cm		>100	>100	>100	>100	>100	>89	62	>100
Nitrogen, Ammonia	mg/L		<0.16		<.16	<0.16	<0.16	<0.22	<0.16	0.51
TKN	mg/L		0.7		1.3	0.7	0.7	1.19	0.70	1.70
Nitrate plus Nitrite	mg/L		<0.2		0.44	0.42	0.43	0.36	0.25	0.44
VSS	mg/L	2	2		2	4	2	5.6	2.00	16.00
E coli	MPN		42.0	32.3				47.8	28.0	96.0
Chl a	ug/L		4.2		3.6	2.7		3.7	1.8	6.3
Pheophytin a	ug/L		2.77		1.45	<1		<2.4	<1.0	5.3
Appearance			2	1A	1A	1A	1A			
Recreational			1	1	1	1	1	1	1	1

Stream Water Quality – Biological Monitoring

Description: This program combines environmental education and stream monitoring. Under the supervision of ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their catch to the family level, and use the resulting numbers to gauge water and habitat quality. These methods are based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families can thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data.
To provide an environmental education service to the community.

Locations: Rum River behind Anoka High School, south side of Bunker Lake Blvd, Anoka

Results: Results for each site are detailed on the following pages.

Tips for Data Interpretation

Consider all biological indices of water quality together rather than looking at each alone, because each gives only a partial picture of stream condition. Compare the numbers to county-wide averages. This gives some sense of what might be expected for streams in a similar landscape, but does not necessarily reflect what might be expected of a minimally impacted stream. Some key numbers to look for include:

Families — Number of invertebrate families. Higher values indicate better quality.

EPT — Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.

Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

% Dominant Family — High numbers indicates an uneven community, and likely poorer stream health.

RUM RIVER

behind Anoka High School, Anoka
STORET SiteID = S003-189

Last Monitored

By Anoka High School in 2013

Monitored Since

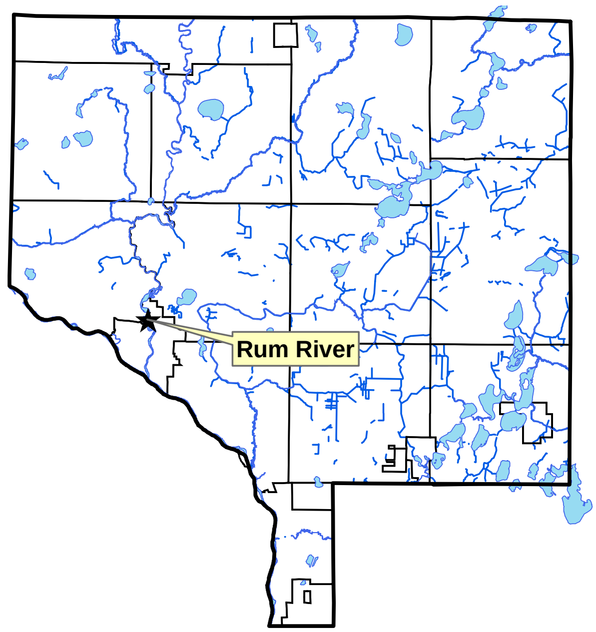
2001

Student Involvement

130 students in 2013, approximately 610 since 2001

Background

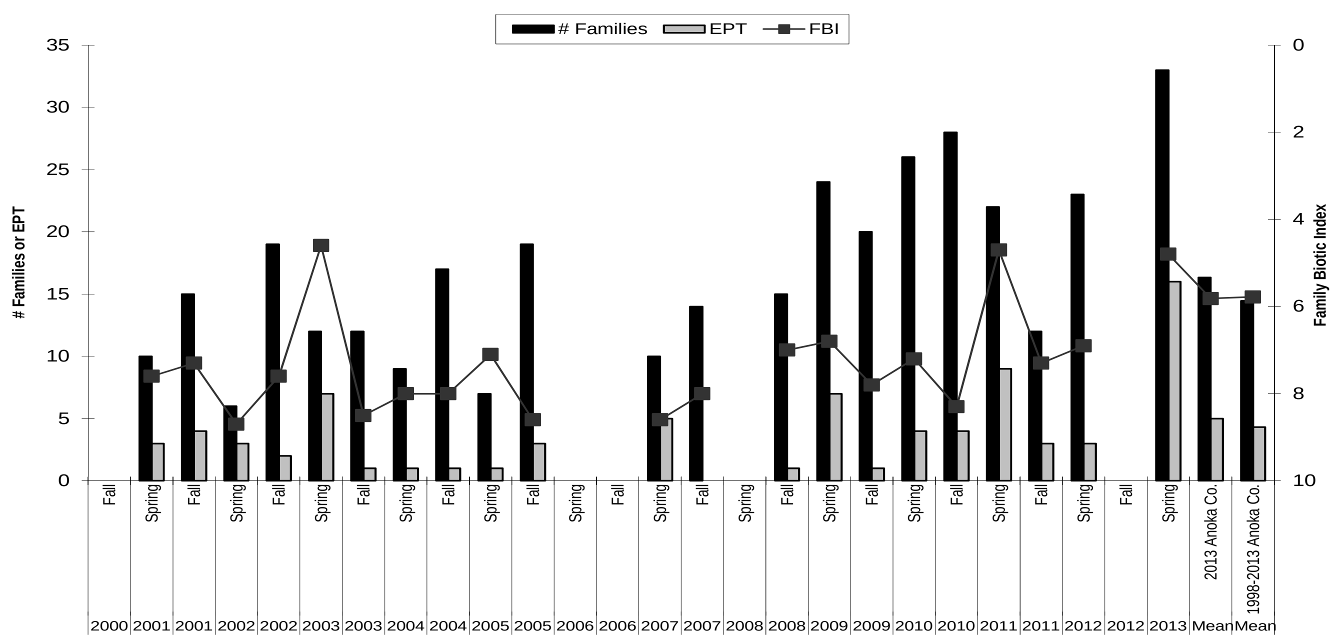
The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. In Anoka County the river has both rocky riffles (northern part of county) as well as pools and runs with sandy bottoms. The river's condition is generally regarded as excellent. Most of the Rum River in Anoka County has a state "scenic and recreational" designation. The sampling site is near the Bunker Lake Boulevard bridge behind Anoka High School. Most sampling has been conducted in a backwater rather than the main channel.



Results

Anoka High school classes monitored the Rum River in spring of 2013 with Anoka Conservation District (ACD) oversight. The results for spring 2013 were better than previous years. More families, 33 in total, were found here than in any other Anoka County stream. This should be expected as most other sites are small streams and this is a larger river. The number of sensitive EPT families (16) and the FBI score (4.8) were the best in Anoka County and substantially above the county averages.

Summarized Biomonitoring Results for Rum River behind Anoka High School



Biomonitoring Data for the Rum River behind Anoka High School

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2009	2009	2010	2010	2011	2011	2012	2013	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Spring	2013 Anoka Co.	1998-2013 Anoka Co.
FBI	6.80	7.80	7.20	8.30	4.70	7.30	6.90	4.80	5.8	5.8
# Families	24	20	26	28	22	12	23	33	16.3	14.5
EPT	7	1	4	4	9	3	3	16	5.0	4.3
Date	8-May	28-Sep	18-May	7-Oct	10-Jun	5-Oct	8-May	14-May		
Sampled By	AHS	AHS	AHS	AHS	ACD	ACD	AHS	AHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	880	585	443	816	604	188	502	449.3		
# Replicates	1	2	1	1	1	1	2	4		
Dominant Family	Siphlonuridae	Hyalellidae	Gastropoda	Hyalellidae	baetidae	hyalellidae	silphonuridae	Perlodidae		
% Dominant Family	40.7	39.1	31.8	34.1	57.5	63.3	37.8	27.1		
% Ephemeroptera	48.2	0.9	8.1	0.9	59.3	11.2	44.9	31.8		
% Trichoptera	0.1	0	0	0.2	1	0	1.2	0.05		
% Plecoptera	2.6	0	0.5	0	3.8	0.5	0	36.6		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	5/8/2009	9/28/2009	5/18/2010	10/7/2010	6/10/2011	10/5/2011	5/8/2012	5/13/2013
pH	7.91	7.82	7.24	7.22	7.84	7.98	8.10	7.69
Conductivity (mS/cm)	0.276	0.421	0.207	0.399	0.296	0.296	0.205	0.181
Turbidity (NTU)	6	5	7	7	18	10	7	5
Dissolved Oxygen (mg/L)	10.82	8.76	6.93	na	6.85	7.91	7.87	10.00
Salinity (%)	0.01	0.01	0	0.01	0.01	0.01	0.00	0.00
Temperature (°C)	17.2	15.5	14.8	12.2	20.7	15.3	15.7	13.0

Discussion

Both chemical and biological monitoring indicate the good quality of this river. Habitat is ideal for a variety of stream life, and includes a variety of substrates, plenty of woody snags, riffles, and pools. Water chemistry monitoring done at various locations on the Rum River throughout Anoka County found that water quality is also good. Both habitat and water quality decline, but are still good, in the downstream reaches of the Rum River where development is more intense and the Anoka Dam creates a slow moving pool.

Historically, biomonitoring near Anoka was conducted mostly in a backwater area that has a mucky bottom and does not receive good flow. This area is unlikely to be occupied by families which are pollution intolerant. In recent years more sampling occurred in the main channel which has more diverse habitat. This change in sampling explains the apparent improvement in the invertebrate community in recent years.

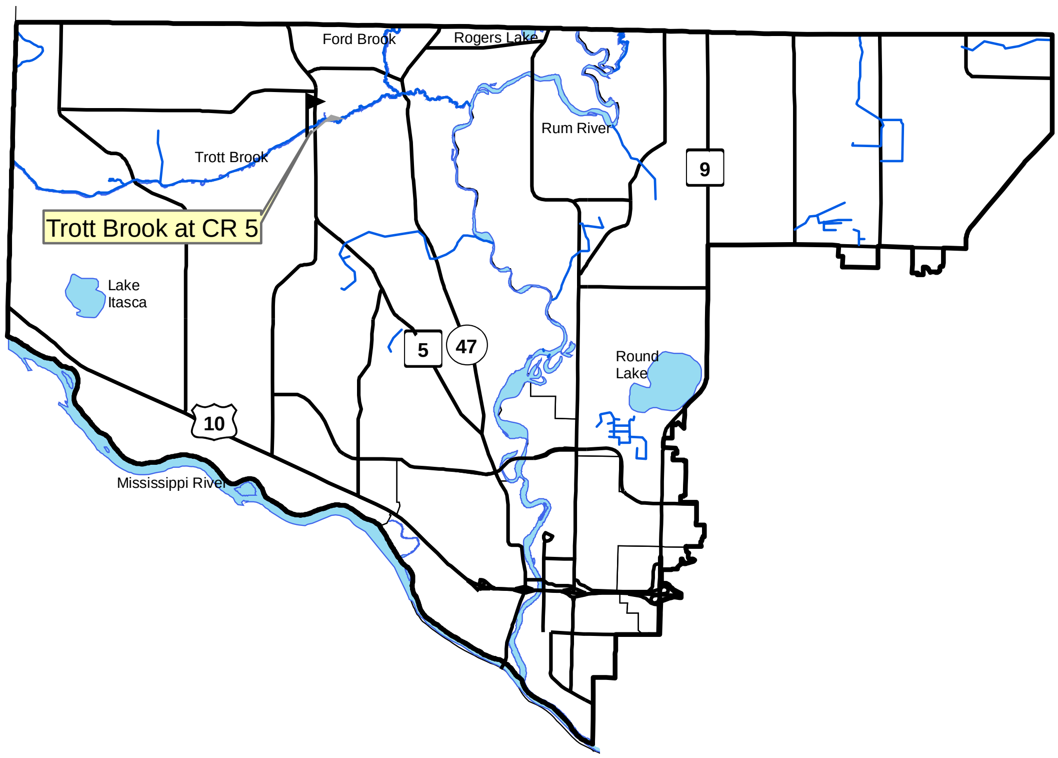
Stream Hydrology

Description: Continuous water level monitoring in streams.

Purpose: To provide understanding of stream hydrology, including the impact of climate, land use or discharge changes. These data are also needed for calculation of pollutant loads and use of computer models for developing management strategies. In the Sunrise River Watershed, the monitoring sites are the outlets of the Sunrise River Watershed Management Organization's jurisdictional area, thereby allowing estimation of flows and pollutant loads leaving the jurisdiction.

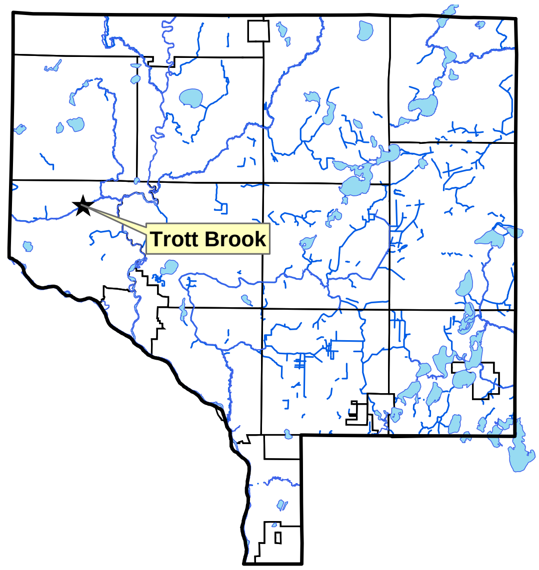
Locations: Trott Brook at County Road 5

Lower Rum River Watershed Stream Hydrology Monitoring Sites



TROTT BROOK

at County Road 5 (Nowthen Blvd NW), Ramsey
STORET SiteID = S003-176



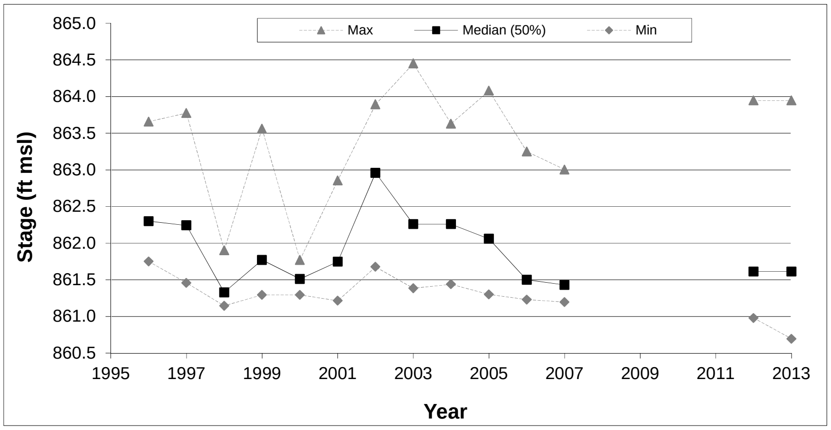
Notes

Trott Brook is a medium-sized creek that flows south through Sherburne County, paralleling the Anoka-Sherburne County boundary before turning east through the City of Ramsey where outlets to the Rum River. Overall, the watershed is rural or suburban residential, and areas within the watershed are undergoing rapid development. The creek is about 25 feet wide and 2.5 feet deep at the monitoring site during baseflow.

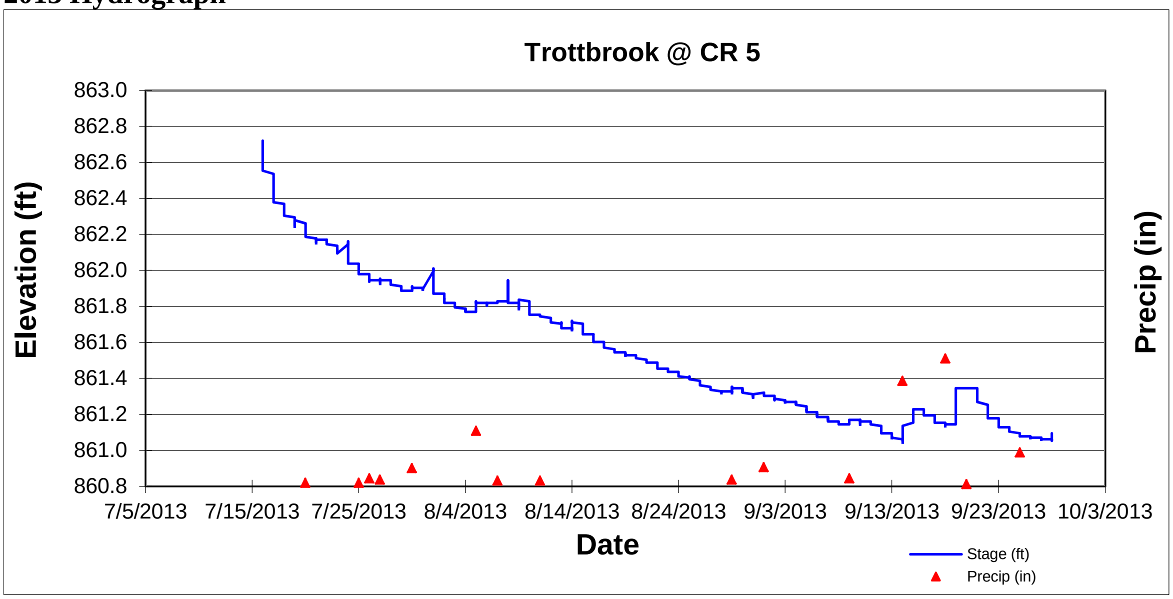
A rating curve for this site was developed in 2013:

Flow (cfs) = $16.39(\text{stage}-859)^2 - 63.716(\text{stage}-859) + 65.908$

Summary of All Monitored Years



2013 Hydrograph



Stream Rating Curves

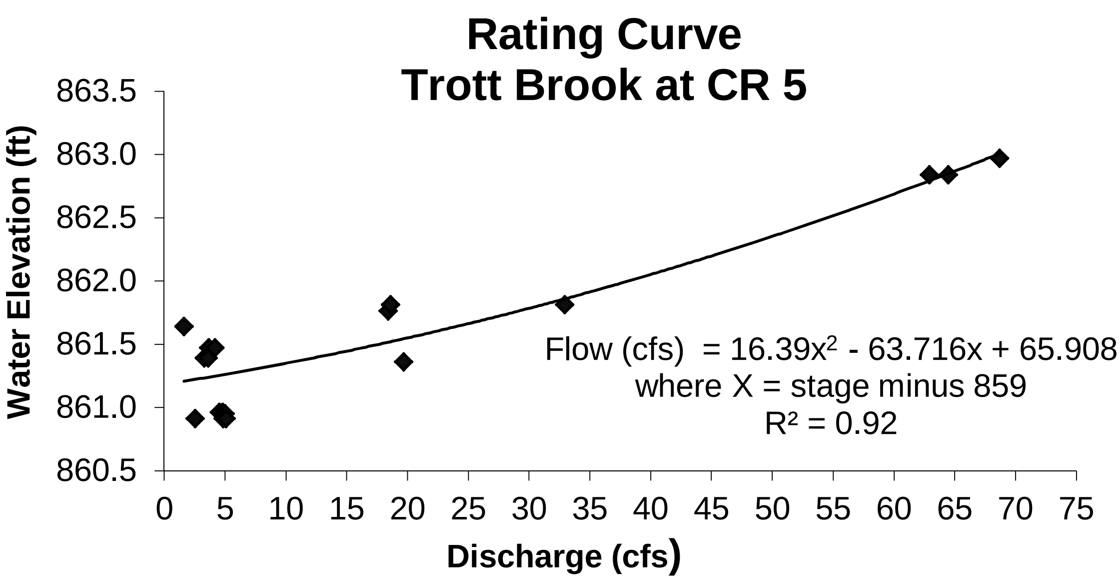
Description: Rating curves are the mathematical relationship between water level and flow volume. They are developed by manually measuring flow at a variety of water levels. These water level-flow measurements are plotted and the equation of a line best fitting these points is calculated. That equation allows flow to be calculated from water level measurements. Continuous water level monitoring in streams.

Purpose: To allow flow to be calculated from water level, which is easier to monitor.

Locations: Trott Brook at County Road 5

Results: In 2013 ACD staff manually measured flow in Trott Brook under a variety of water level conditions. 19 such measurements were used to develop the rating curve presented below. The equation was used to calculate flow from continuous stream water level monitoring measurements.

Trott Brook at County Road 5 Rating Curve



Wetland Hydrology

Description: Continuous groundwater level monitoring at a wetland boundary to a depth of 40 inches. County-wide, the ACD maintains a network of 23 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

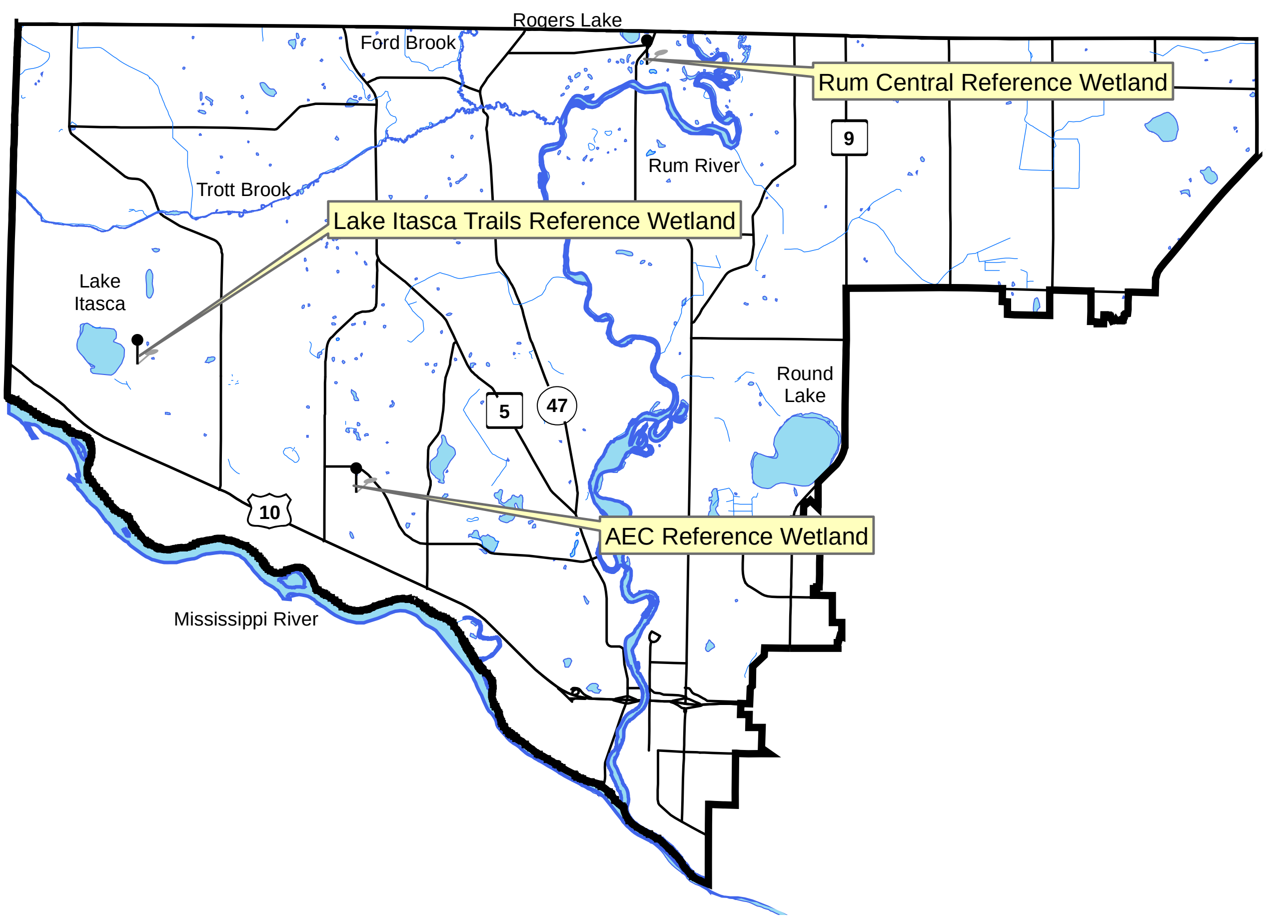
Locations: AEC Reference Wetland, Connexus Energy Property on Bunker Lake Blvd, Ramsey

Rum River Central Reference Wetland, Rum River Central Park, Ramsey

Lake Itasca Trail Reference Wetland, Lake Itasca Park, Ramsey

Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

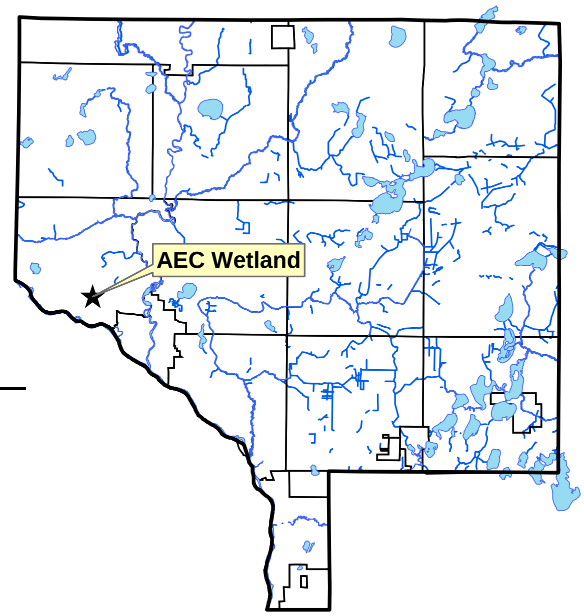
Lower Rum River Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

AEC Reference Wetland

Cottonwood Park, adjacent to Connexus Energy Offices (formerly Anoka Electric Coop), Ramsey



Site Information

Monitored Since: 1999

Wetland Type: 3

Wetland Size: ~18 acres

Isolated Basin? No, probably receives storm water

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-15	10yr2/1	Sandy Loam	-
Bw	15-40	10yr3/2	Gravelly Sandy loam	-

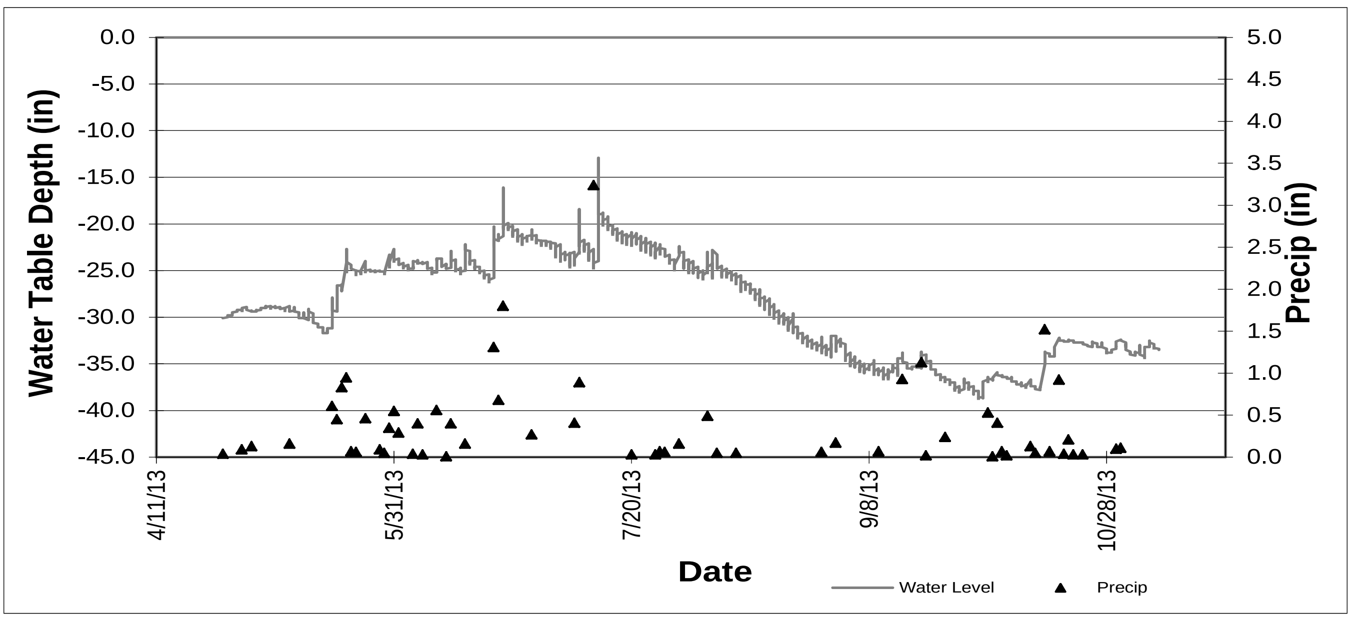
Surrounding Soils: Hubbard coarse sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Populus tremuloides	Quaking Aspen	30
Salix bebbiana	Bebb Willow	30
Carex Spp	Sedge undiff.	30
Solidago canadensis	Canada Goldenrod	20

Other Notes: Well is located at the wetland boundary.

2013 Hydrograph

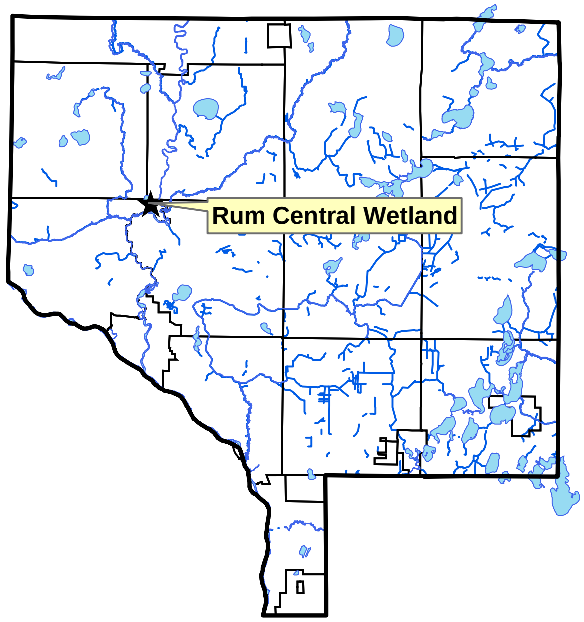


Well depth was 42 inches, so a reading of –42 indicates water levels were at an unknown depth greater than or equal to 42 inches.

Wetland Hydrology Monitoring

RUM RIVER CENTRAL REFERENCE WETLAND

Rum River Central Regional Park, Ramsey



Site Information

Monitored Since: 1997

Wetland Type: 6

Wetland Size: ~0.8 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-12	10yr2/1	Sandy Loam	-
Bg1	12-26	10ry5/6	Sandy Loam	-
Bg2	26-40	10yr5/2	Loamy Sand	-

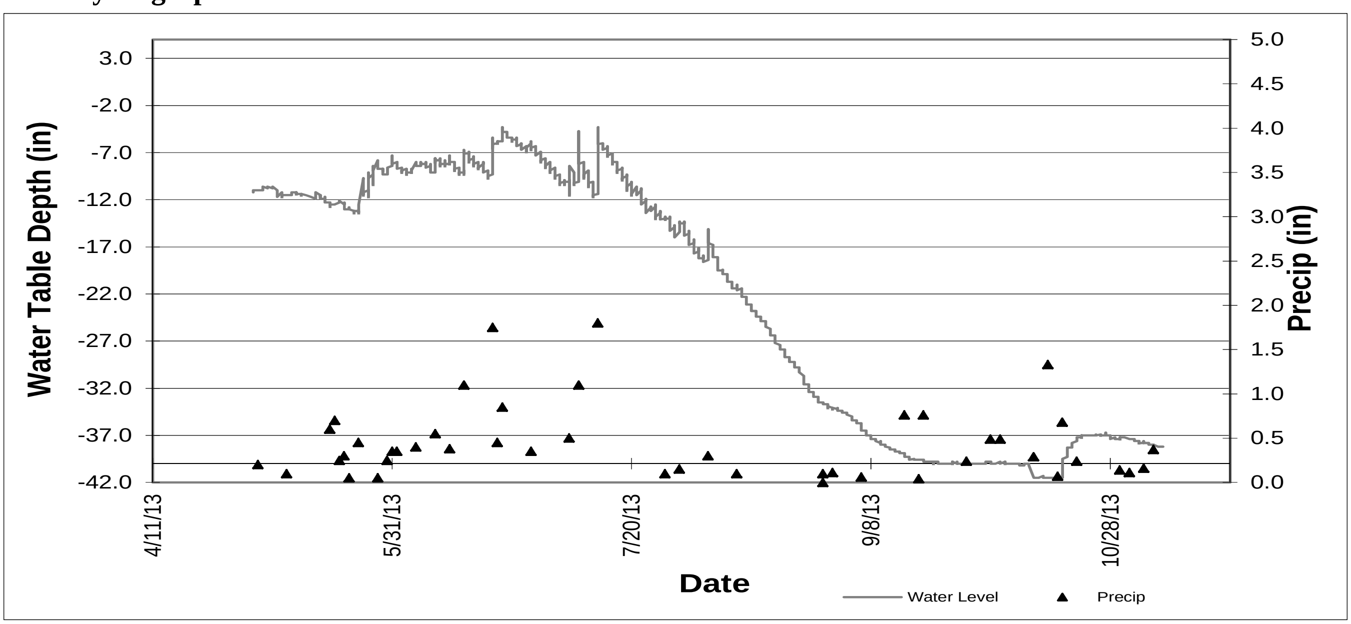
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	40
Corylus americanum	American Hazelnut	40
Onoclea sensibilis	Sensitive Fern	30
Rubus strigosus	Raspberry	30
Quercus rubra	Red Oak	20

Other Notes: Well is located at the wetland boundary.

2013 Hydrograph



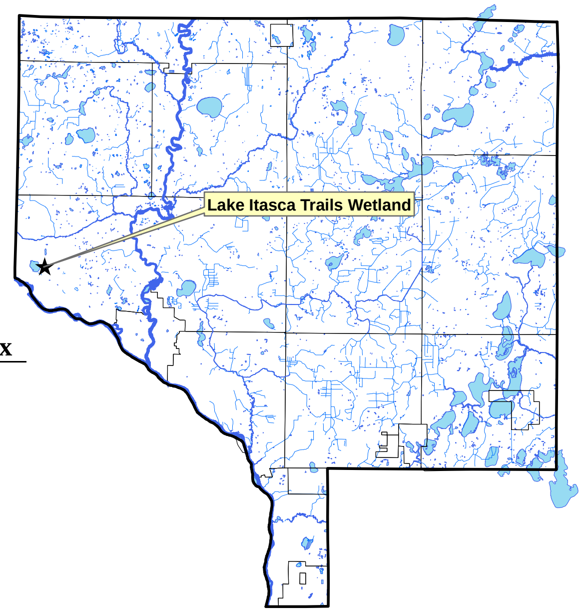
Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

LAKE ITASCA TRAILS REFERENCE WETLAND

Lake Itasca Trails Park, Ramsey

Site Information



Monitored Since: 2013

Wetland Type: 2/6

Wetland Size: ~10 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A1	0-12	10yr2/0	Mucky sand	-
A2	12-20	10ry2/1	Sand	-
B1	20-36	10yr4/1	Sand and fine gravel	-
B2	36-48	10yr6/1	Sand and fine gravel	-

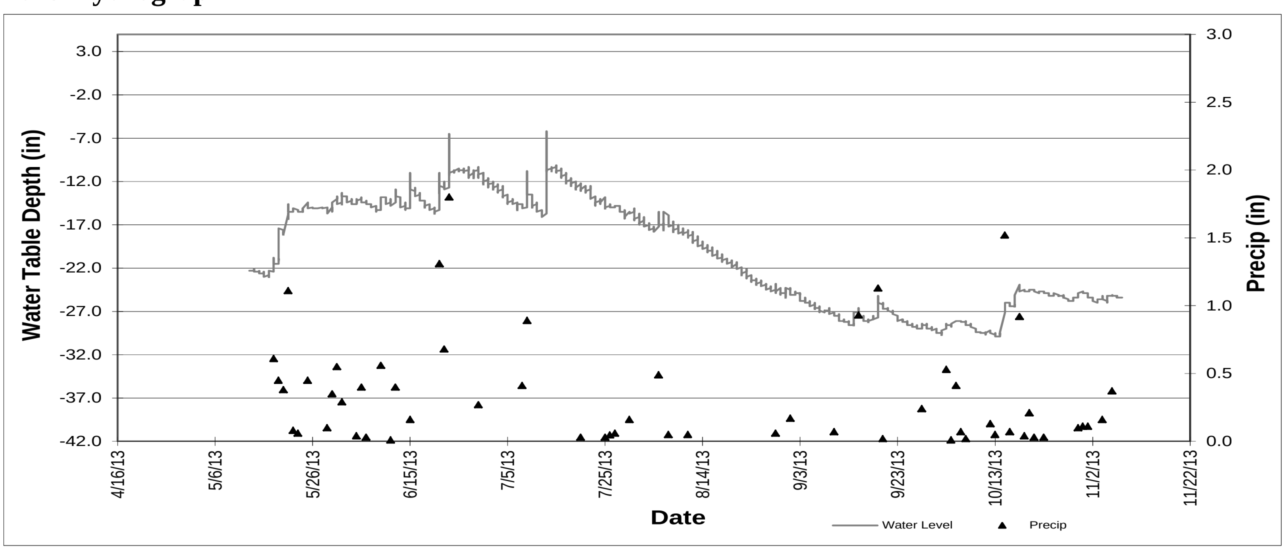
Surrounding Soils: Hubbard coarse sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Carex stricta	Hummock Sedge	80
Phalaris arundinacea	Reed Canary Grass	20
Salix sp.	Willow	20
Rubus sp.	Bristle-berry	5

Other Notes: Well is located about 10 feet east and about 6 inches downslope of the wetland boundary. DNR Public Water Wetland 2-339.

2013 Hydrograph



Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Water Quality Grant Fund

Description: The LRRWMO provided cost share for projects on either public or private property that will improve water quality, such as repairing streambank erosion, restoring native shoreline vegetation, or rain gardens. This funding was administered by the Anoka Conservation District, which works with landowners on conservation projects. Projects affecting the Rum River were given the highest priority because it is viewed as an especially valuable resource.

Purpose: To improve water quality in lakes streams and rivers by correcting erosion problems and providing buffers or other structures that filter runoff before it reaches the water bodies.

Results: Projects receiving grant funds are reported in the year they are installed. In 2013 the Geldacker Mississippi Riverbank Stabilization used $1,431.20 of LRRWMO cost share dollars.

LRRWMO Cost Share Fund Summary

2006 LRRWMO Contribution	+	$1,000.00
2008 Expense – Herrala Rum Riverbank stabilization	-	$ 150.91
2008 Expense – Rusin Rum Riverbank stabilization	-	$ 225.46
2009 LRRWMO Contribution	+	$1,000.00
2009 Expense – Rusin Rum Riverbank bluff stabilization	-	$ 52.05
2010 LRRWMO Contribution	+	$ 0
2010 LRRWMO Expenses	-	$ 0
2011 LRRWMO Contribution	+	$ 0
2011 Expense - Blackburn Rum riverbank	-	$ 543.46
2012 LRRWMO Contribution	+	$1,000.00
2012 Expense – Smith Rum Riverbank	-	$1,596.92
2013 LRRWMO Contribution	+	$1,000.00
2013 Expense – Geldacker Mississippi Riverbank	-	$1,431.20
Fund Balance		**$ 0.00**

Geldacker Mississippi River Stabilization

Funding for this project has been allocated, but not yet distributed. Work is currently underway but not yet completed. The project will stabilize approximately 100 linear feet of severely eroding riverbank on the Mississippi River. The landowner has been losing approximately 1 foot of shoreline per year. This project will reduce the sediment load directly discharged to the Mississippi by about 1,600 cubic feet/year. The use of native grasses will also provide some food/habitat along the river corridor.

Due to the project being located on a cut bank (outside bend) of the river, the project required engineering and funds were secured through NPEAP to complete the design. The design consists of hard-armoring (riprap) the toe of the slope up to the 10-year flood elevation. Above the riprap, the slope will be stabilized using a permanent turf reinforcement mat (Armormax) and a certified MNDOT native seed mix to provide long-term stabilization.

Project Funding

LRRWMO Water Quality Cost Share	$1,431.20
Ag Preserves Conservation	$1,711.31
Ag Preserves Water Quality Cost Share	$35.37
Ag Preserves Natural Resource Conservation	$4,000.00
Landowner	$27,822.12
TOTAL	$35,000.00

Wetland Public Education

Website – Wetland Regulatory Information

Description: The Lower Rum River Watershed Management Organization (LRRWMO) contracted the Anoka Conservation District (ACD) to create a one-stop-shop website with information for landowners about wetland regulation.

Purpose: To improve public understanding of wetland regulation with the aim of decreasing inadvertent violations.

Location: Watershed-wide

Results: The Anoka Conservation District (ACD) substantially increased information on the ACD's website about wetland regulation, adding pages about:

- The MN Wetland Conservation Act
- Agencies
- Request for assistance form
- Map and contact information for local governmental units (LGU's) with permitting authority
- Frequently asked questions

This website will be linked from LGU and WMO websites.

The LRRWMO discussed whether this information should be on the WMO website. It was determined it was better placed on ACD's website so that it showed and included portions of member cities that are outside of the LRRWMO.

Newsletter

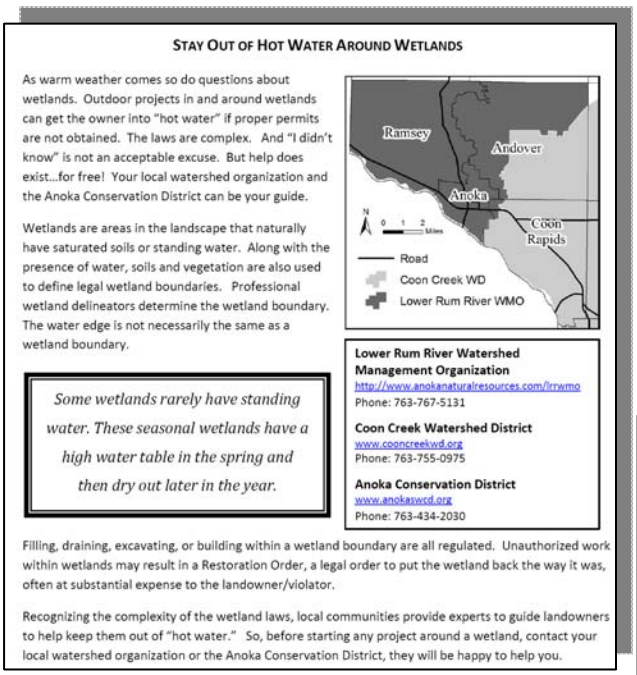
Description: The Lower Rum River Watershed Management Organization (LRRWMO) contracted the Anoka Conservation District (ACD) to create a series of public education newsletter articles.

Purpose: To improve public understanding of the LRRWMO, its functions, and accomplishments.

Location: Watershed-wide

Results: The Anoka Conservation District (ACD) drafted two newsletters and sent each to local community leaders as well as local newspapers. Each was printed in several city newspapers.

Both newsletters focused on public education regarding wetlands. The articles included information on recognizing wetlands as well as their values and benefits. Brief explanations of wetland regulations and penalties for rule violations were included in both articles. Directives on how to acquire additional information regarding wetlands were also provided.



STAY OUT OF HOT WATER AROUND WETLANDS

As warm weather comes so do questions about wetlands. Outdoor projects in and around wetlands can get the owner into "hot water" if proper permits are not obtained. The laws are complex. And "I didn't know" is not an acceptable excuse. But help does exist…for free! Your local watershed organization and the Anoka Conservation District can be your guide.

Wetlands are areas in the landscape that naturally have saturated soils or standing water. Along with the presence of water, soils and vegetation are also used to define legal wetland boundaries. Professional wetland delineators determine the wetland boundary. The water edge is not necessarily the same as a wetland boundary.

Some wetlands rarely have standing water. These seasonal wetlands have a high water table in the spring and then dry out later in the year.

Ramsey
Andover
Anoka
Coon Rapids
Road
Coon Creek WD
Lower Rum River WMO

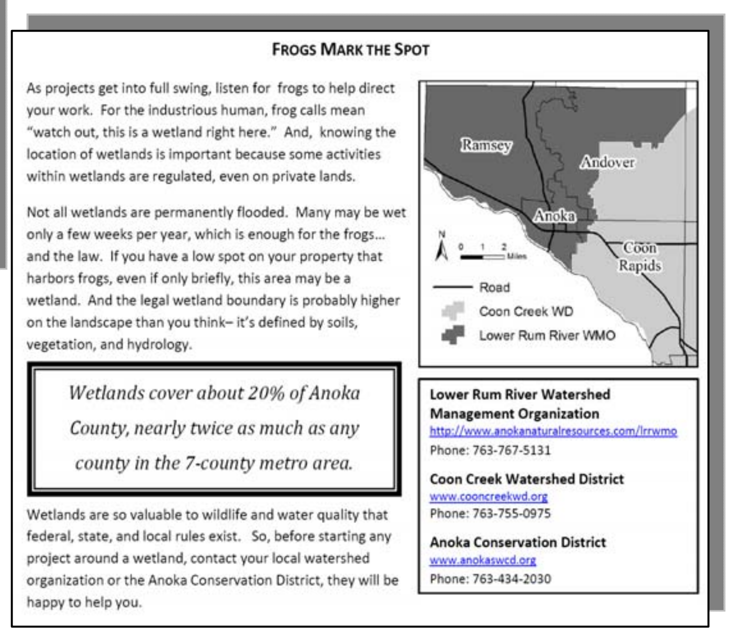
Lower Rum River Watershed Management Organization
http://www.anokanaturalresources.com/lrrwmo
Phone: 763-767-5131

Coon Creek Watershed District
www.cooncreekwd.org
Phone: 763-755-0975

Anoka Conservation District
www.anokaswcd.org
Phone: 763-434-2030

Filling, draining, excavating, or building within a wetland boundary are all regulated. Unauthorized work within wetlands may result in a Restoration Order, a legal order to put the wetland back the way it was, often at substantial expense to the landowner/violator.

Recognizing the complexity of the wetland laws, local communities provide experts to guide landowners to help keep them out of "hot water." So, before starting any project around a wetland, contact your local watershed organization or the Anoka Conservation District, they will be happy to help you.



FROGS MARK THE SPOT

As projects get into full swing, listen for frogs to help direct your work. For the industrious human, frog calls mean "watch out, this is a wetland right here." And, knowing the location of wetlands is important because some activities within wetlands are regulated, even on private lands.

Not all wetlands are permanently flooded. Many may be wet only a few weeks per year, which is enough for the frogs… and the law. If you have a low spot on your property that harbors frogs, even if only briefly, this area may be a wetland. And the legal wetland boundary is probably higher on the landscape than you think– it's defined by soils, vegetation, and hydrology.

Wetlands cover about 20% of Anoka County, nearly twice as much as any county in the 7-county metro area.

Wetlands are so valuable to wildlife and water quality that federal, state, and local rules exist. So, before starting any project around a wetland, contact your local watershed organization or the Anoka Conservation District, they will be happy to help you.

Ramsey
Andover
Anoka
Coon Rapids
Road
Coon Creek WD
Lower Rum River WMO

Lower Rum River Watershed Management Organization
http://www.anokanaturalresources.com/lrrwmo
Phone: 763-767-5131

Coon Creek Watershed District
www.cooncreekwd.org
Phone: 763-755-0975

Anoka Conservation District
www.anokaswcd.org
Phone: 763-434-2030

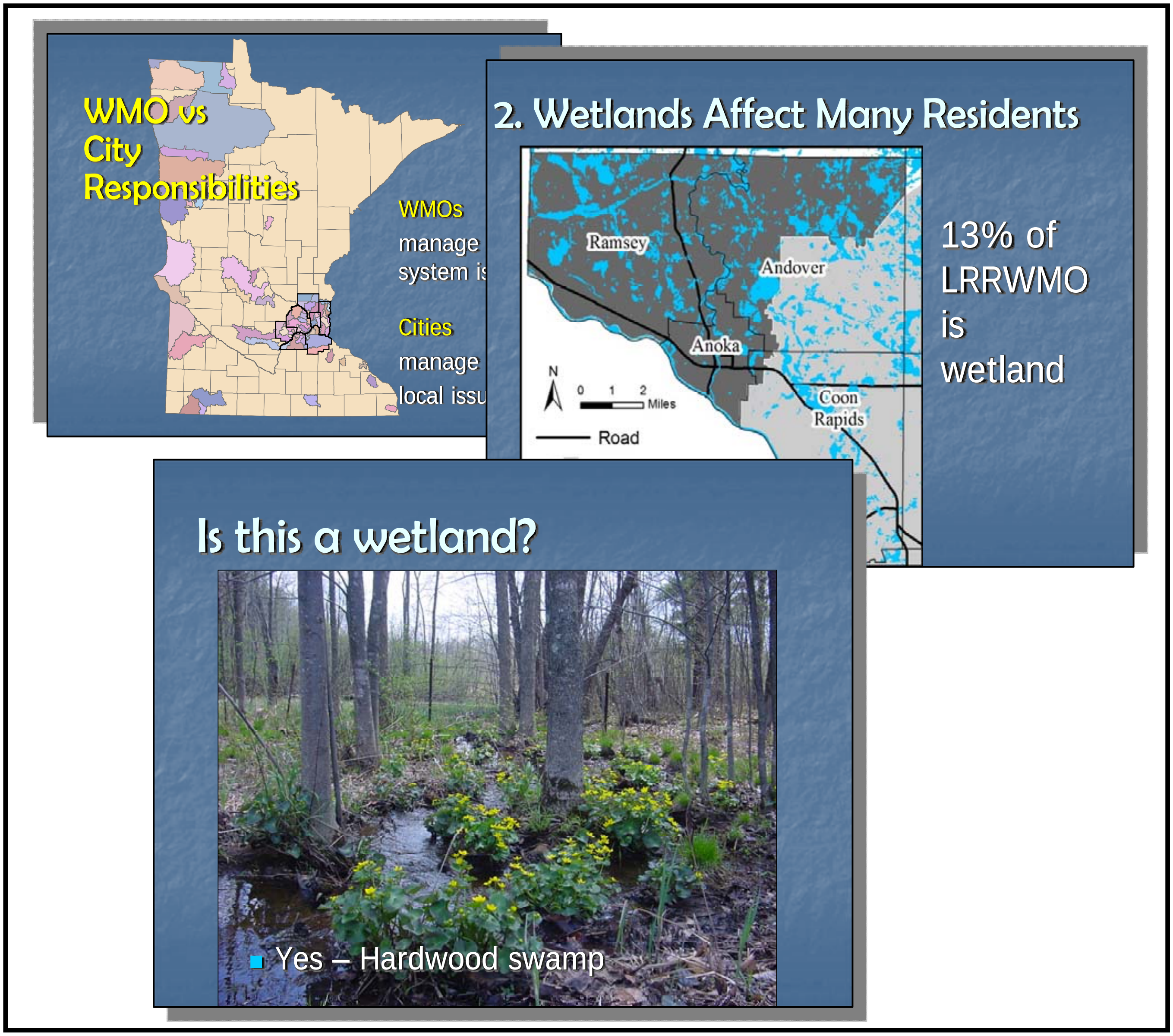
Presentation to local officials

Description: The Lower Rum River Watershed Management Organization (LRRWMO) contracted the Anoka Conservation District (ACD) to create a presentation and use it to educate local officials on wetlands as part of watershed management.

Purpose: To improve LRRWMO public officials understanding of watershed responsibilities, wetland regulation, and the Rum River WRAPP Project.

Location: Watershed-wide

Results: The Anoka Conservation District (ACD) delivered a presentation to local officials at a spring 2013 LRRWMO meeting. The presentation provided local officials with information of their land and water management responsibilities within a watershed. As part of the presentation wetland functions, regulations, and their benefit to watershed management were also covered. The presentation closed with information regarding the Rum River Watershed Restoration and Protection Plan (WRAPP).



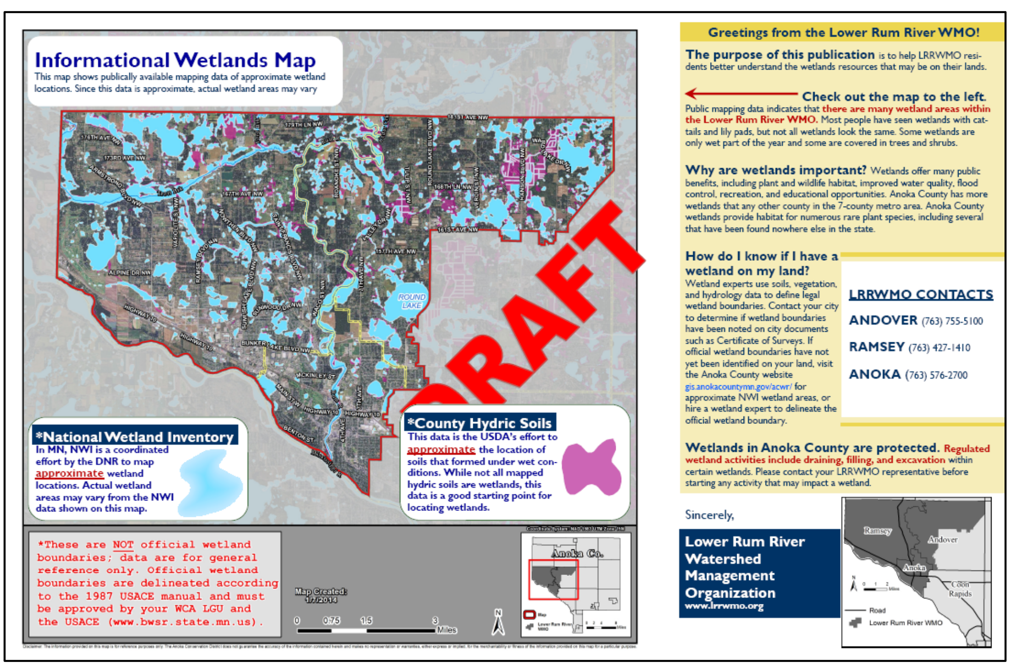
Property owner wetland education packet

Description: The Lower Rum River Watershed Management Organization (LRRWMO) contracted the Anoka Conservation District (ACD) to create a wetland education packet to be sent out to LRRWMO residents.

Purpose: To improve LRRWMO public understanding of wetlands and wetland regulation.

Location: Watershed-wide

Results: The Anoka Conservation District (ACD) sent informational brochures to over 2,000 properties containing, or adjacent to, wetlands. Each brochure contained a neighborhood level map to illustrate the locations of wetlands near them. The packet also includes educational information, illustrates the varying types of wetlands, wetland values, and regulatory/permitting information.



Review Member Communities' Local Water Plans

Description: Member cities must have local water plans and ordinances consistent with the LRRWMO 3rd Generation Watershed Management Plan (MN Rules 8410.0130 and 84100160). The LRRWMO has approval authority over the Local Water Management Plans. Once a community submits their updated Local Water Management Plan to the WMO for review, the WMO has 60 days to provide comments. The Metropolitan Council has a simultaneous 45 day review period, and the WMO's review of the Plan must include a review of Metropolitan Council's comments.

The LRRWMO has requested that the ACD assist with their review of local water plans as they are completed. It was anticipated that communities will submit plans for review in 2013.

Purpose: To ensure the policies and actions in the LRRWMO 3rd Generation Watershed Management Plan are implemented consistently across the watershed.

Location: Watershed-wide

Results: As of January 16, 2014 Anoka has submitted their local water plan updates, Ramsey will be submitting theirs in early 2014, and the submittal date for Andover has been extended.

Web Video

Description: As part of the LRRWMO's public education plan web videos are being used to convey conservation messages. The ACD was asked to create a web video about water conservation and post it on the LRRWMO website.

Purpose: To education the public about aquifer sustainability and water use.

Location: Watershed-wide

Results: ACD The web video about water conservation will be completed by the deadline of March 31, 2014.

LRRWMO Website

Description: The Lower Rum River Watershed Management Organization (LRRWMO) contracted the Anoka Conservation District (ACD) to design and maintain a website about the LRRWMO and the Lower Rum River watershed. The website has been in operation since 2003. A new website and domain for the LRRWMO was created by ACD in 2013.

Purpose: To increase awareness of the LRRWMO and its programs. The website also provides tools and information that helps users better understand water resources issues in the area.

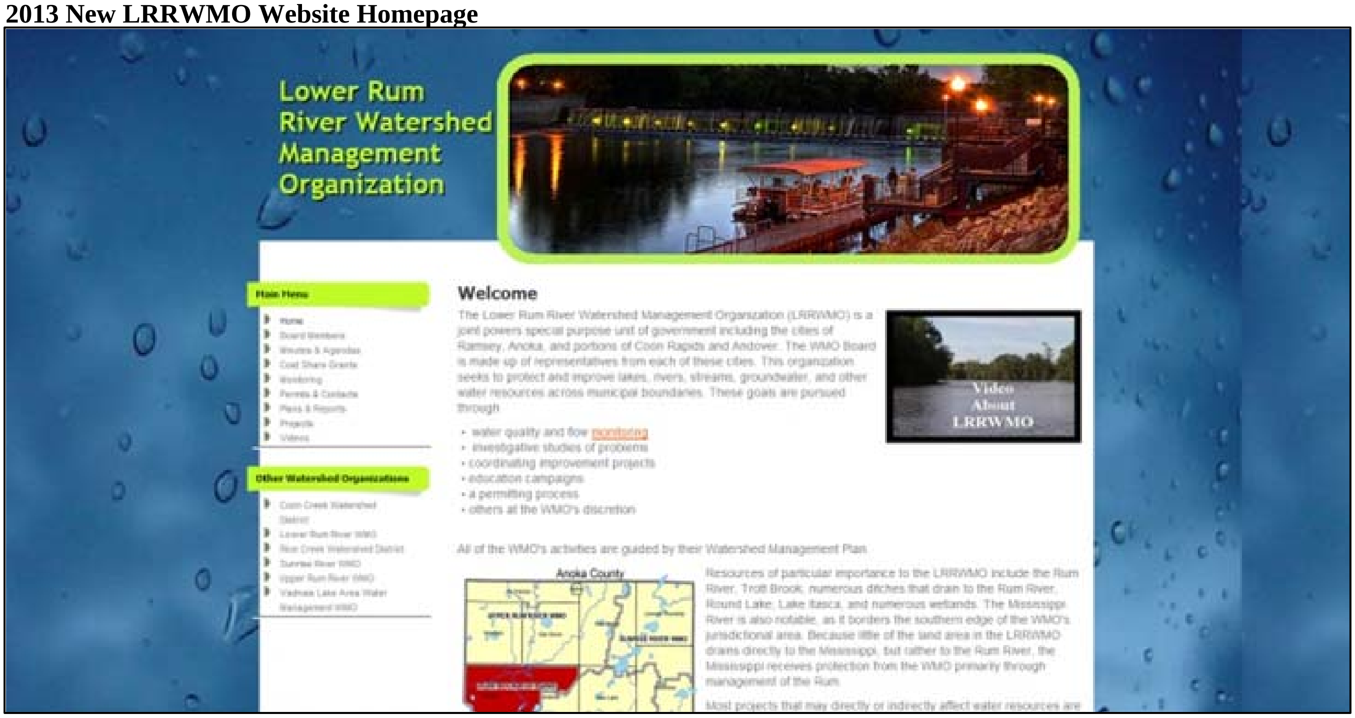
Location: LRRWMO.org

Results: In 2013 the ACD upgraded, redesigned, and re-launched the LRRWMO website. These updates were necessary because the old website platform was incompatible with certain tablet computers and smartphones. Additionally, the old website was hosted with in the ACD website, while the new website is completely independent, offering the WMO future management choices.

The LRRWMO website contains information about both the LRRWMO and about natural resources in the area. Information about the LRRWMO includes:

- a directory of board members,
- meeting minutes and agendas,
- watershed management plan and annual reports,
- descriptions of work that the organization is directing,
- highlighted projects.

2013 New LRRWMO Website Homepage



Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program. We do not, however, know specifically which expenses are attributed to monitoring which sites. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer.

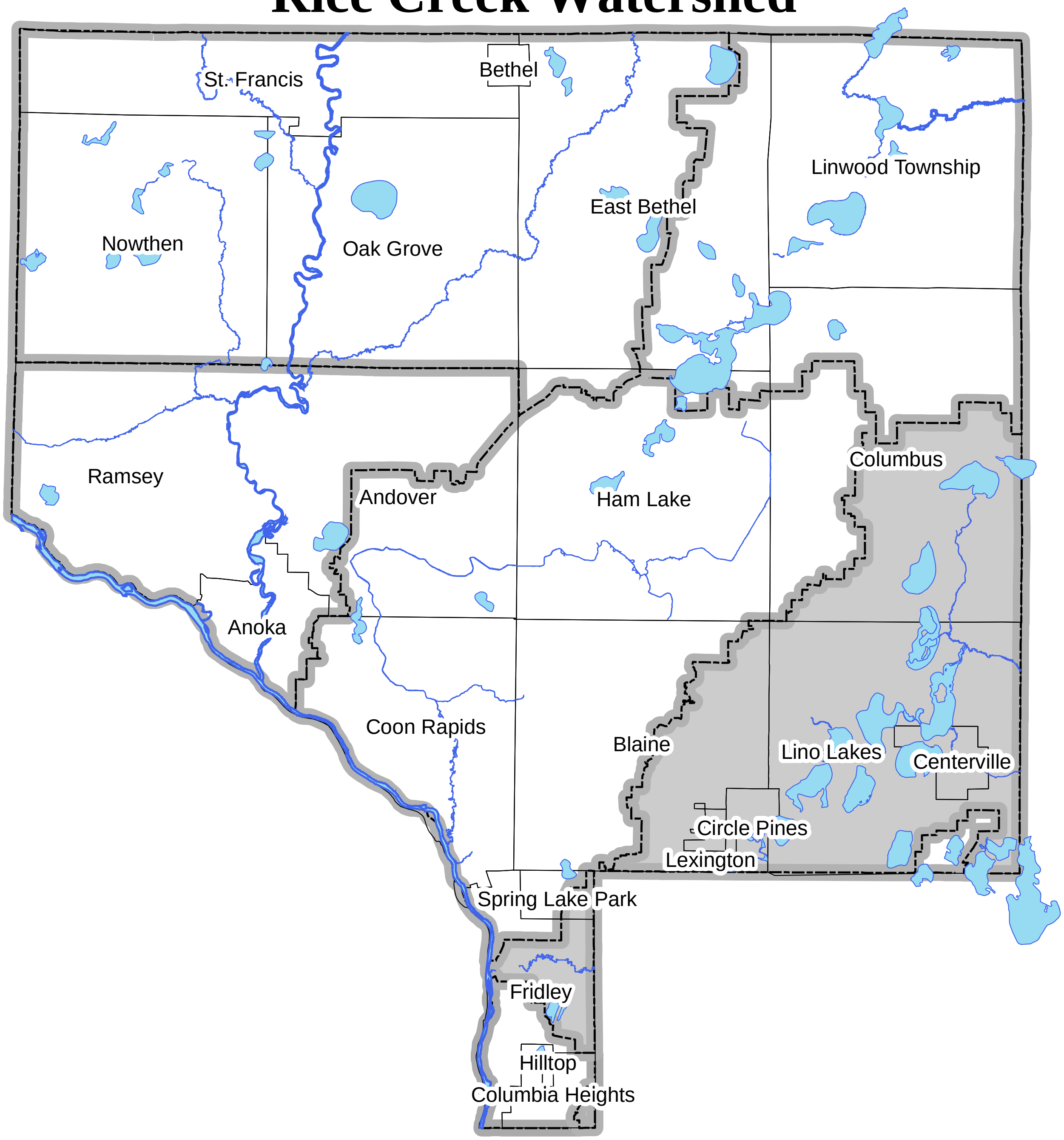
Lower Rum River Watershed Financial Summary

Lower Rum River Watershed	Volunteer Precip	Ref Wet	Ob Well	Lake Lvl	Stream WQ - SWAG	SWAG Admin/Reporting	WOMP	Student Biomon	LRRWMO Admin	WMO Annual Rpts to State	LRRWMO Outreach/Promo	WMO Website Maint	WMO Website Migration	Rum River WRAPP	Projects	Total
Revenues																
LRRWMO	0	1680	0	800	0	0	0	825	0	850	8020	525	875	0	0	13575
State	0	0	131	0	11545	796	0	0	0	0	0	0	0	7459	0	19930
Anoka Conservation District	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anoka Co. General Services	0	0	177	0	0	544	0	0	0	0	982	0	-24	0	0	1679
County Ag Preserves	0	0	0	0	0	0	0	349	0	0	0	0	0	0	48	397
Regional/Local	0	0	0	0	0	0	720	0	0	0	0	0	0	0	0	720
Other Service Fees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	404	404
BWSR Cons Delivery	0	0	0	0	0	0	38	0	256	0	0	0	0	0	0	294
BWSR Cost Share TA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	441	441
Local Water Planning	59	0	33	5	0	0	0	0	0	0	0	0	0	0	0	97
TOTAL	59	1680	340	805	11545	1340	758	1174	256	850	9002	525	851	7459	893	37537
Expenses-																
Capital Outlay/Equip	0	16	4	10	4607	21	7	11	5	4	95	5	9	34	14	4842
Personnel Salaries/Benefits	49	1014	284	686	3273	1114	629	992	208	502	7658	316	451	2211	740	20128
Overhead	5	67	23	47	204	77	61	67	14	47	605	28	29	209	53	1536
Employee Training	0	4	1	4	16	5	1	8	1	0	34	1	1	6	3	86
Vehicle/Mileage	1	17	4	13	56	19	8	20	4	6	125	5	6	31	12	325
Rent	3	46	15	31	144	52	37	43	10	29	387	18	21	127	36	998
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	0	1	0	0	3114	0	0	32	0	0	0	0	312	4727	1	8187
McKay Expenses	0	19	8	15	131	52	14	0	15	0	100	13	22	112	36	536
TOTAL	59	1183	340	805	11545	1340	758	1174	256	590	9002	385	851	7459	893	36639
NET	0	497	0	0	0	0	0	0	0	260	0	140	0	0	0	898

Recommendations

- **Actively participate in the MPCA Rum River WRAPP (Watershed Restoration and Protection Plan) which began in 2013.** This WRAPP is an assessment of the entire Rum River watershed. This is an opportunity for the LRRWMO to prioritize and coordinate efforts with upstream entities and state agencies. TMDL studies with regulatory implications will likely arise out of this project.
- **Diagnose low dissolved oxygen in Trott Brook.** A TMDL study through the Rum River WRAP project is likely.
- **Remind LRRWMO Cities that local water plans must be updated**.
- **Implement water conservation measures** throughout the watershed and promote it metro-wide. Depletion of surficial water tables are having observable, sometimes dramatic, impacts on some lake levels and wetlands. Metropolitan Council models predict 3+ft drawdown of surface waters in certain areas by 2030, and 5+ft by 2050.
- **Continue lake level monitoring, especially on Round Lake** where residents have expressed concerns with levels. Other nearby lakes should be monitored for comparison and problems.
- **Emphasize protection of Rum River water quality.** The river's water quality declines slightly in the LRRWMO and anticipated future development could cause further deterioration.
- **Complete a stormwater retrofitting assessment for the City of Anoka.** The project will identify and rank projects that improve stormwater runoff before it is discharged to the Rum River.
- **Continue the existing cost share grant program for water quality improvement projects** on private properties.

Rice Creek Watershed



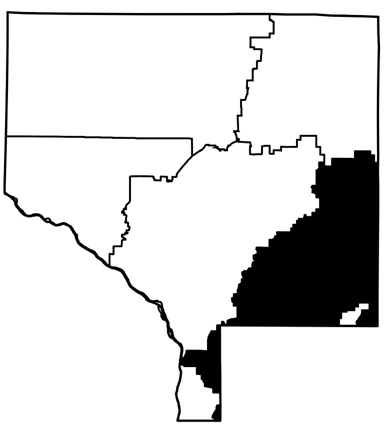
Contact Info: Rice Creek Watershed District
www.ricecreek.org
763-398-3070

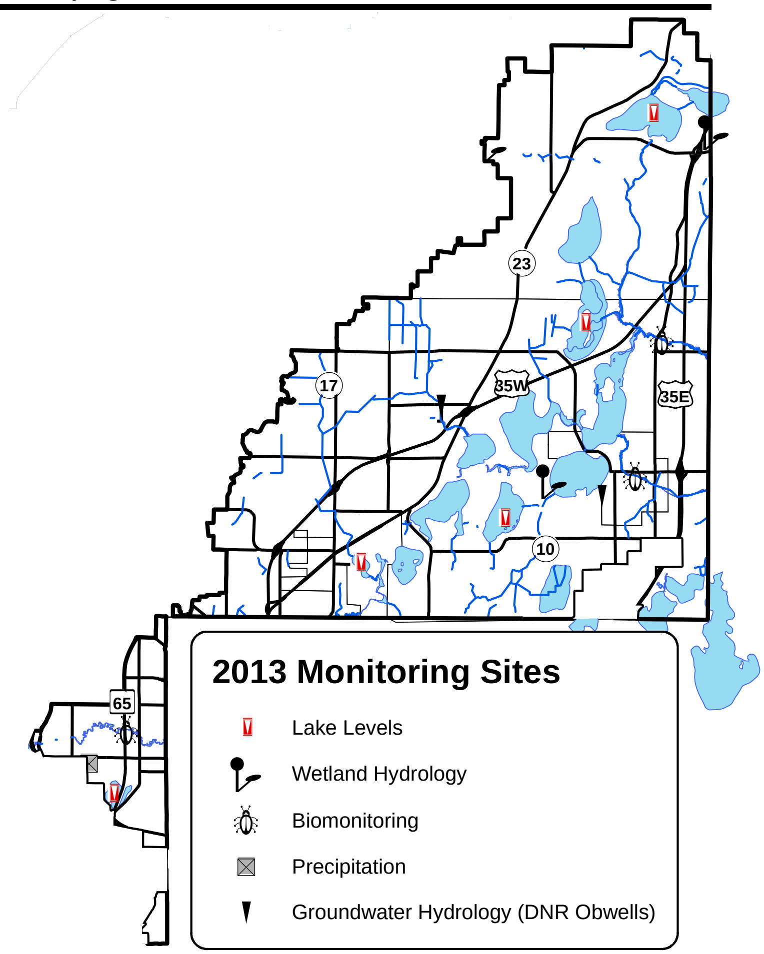
Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 5: RICE CREEK WATERSHED

Task	Partners	Page
Lake Levels	RCWD, ACD	5-114
Wetland Hydrology	RCWD, ACD	5-116
Stream Water Quality – Biological	RCWD, ACD, ACAP, Centennial HS, Forest Lake Area Learning Center, Totino Grace HS	5-119
Water Quality Grant Administration	RCWD, ACD	5-126
Stormwater Retrofit Analysis – Moore Lake	RCWD, ACD	5-127
Financial Summary		5-128
Recommendations		5-129
Precipitation	ACD, volunteers	see Chapter 1
Ground Water Hydrology (obwells)	ACD, MNDNR	see Chapter 1
Additional work not reported here	RCWD	contact RCWD

ACD = Anoka Conservation District, RCWD = Rice Creek Watershed District, MNDNR = Minnesota Dept. of Natural Resources, ACAP = Anoka County Ag Preserves





Lake Levels

Description: Weekly water level monitoring in lakes. Graphs for the past five years as well as historical data since 1990 are shown below. All data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

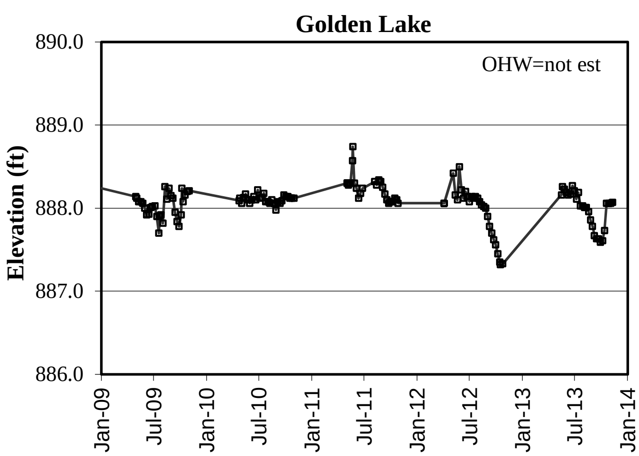
Locations: Golden Lake, Howard Lake, Moore Lake, Reshanau Lake, and Rondeau Lake

Results: Lake levels were measured by volunteers throughout the 2013 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. Lakes had sharply increasing water levels in spring and early summer 2013 when heavy rainfall totals occurred. Little rainfall fell later in the year and lake levels fell dramatically.

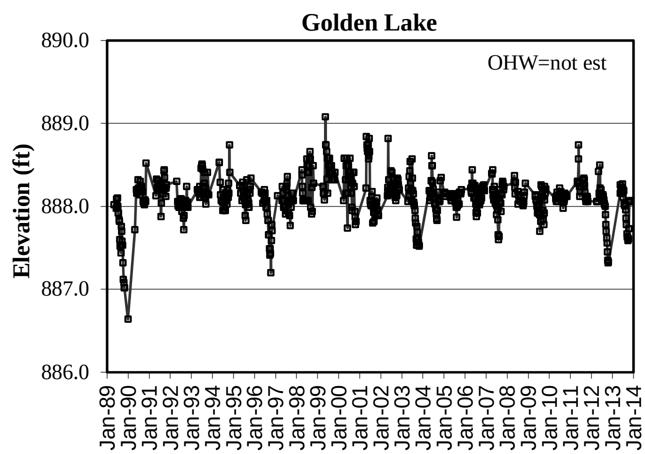
Similar to 2012, all lakes in the Rice Creek Watershed within Anoka County displayed near record low levels at the end of 2013. Most notably, Rondeau Lake set another new record low water level (884.63) on both September 9th and 16th of 2013. This is following two consecutive years of record low readings. The previous record low water levels were (884.89) set on November 28th of 2011 and (884.68) set October 8th of 2012.

All lake level data can be downloaded from the MN DNR website's Lakefinder feature. Ordinary High Water Level (OHW), the elevation below which a DNR permit is needed to perform work, is listed for each lake on the corresponding graphs below.

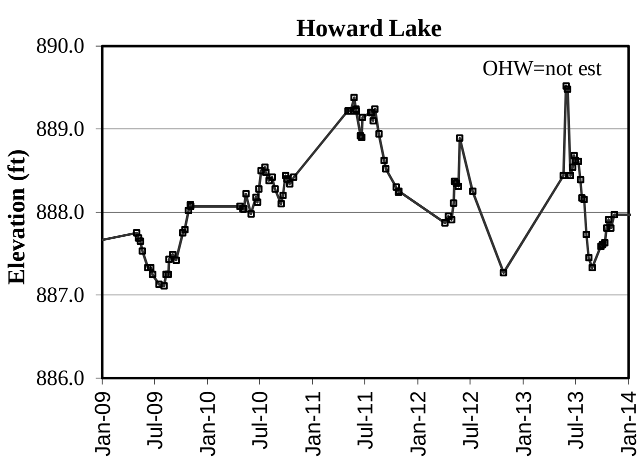
Golden Lake Levels 2009-2013



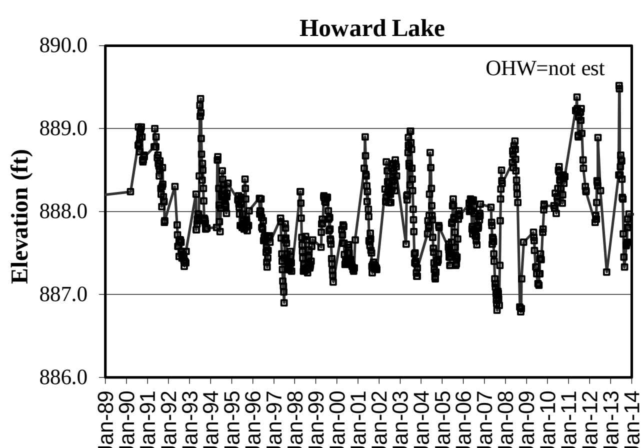
Golden Lake Levels 1989-2013



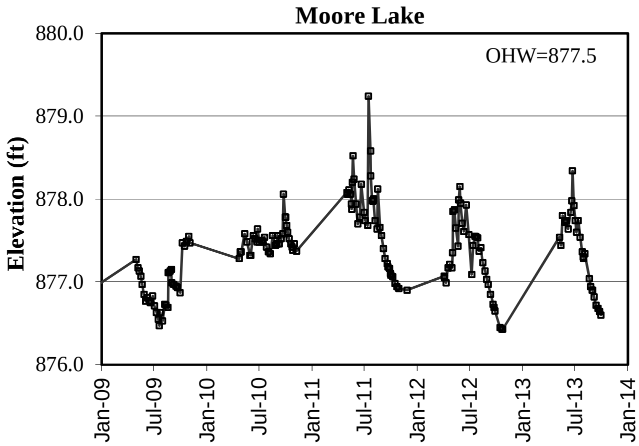
Howard Lake Levels 2009-2013



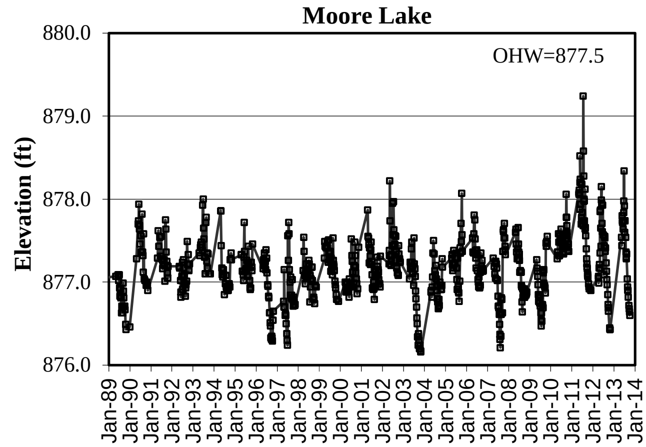
Howard Lake Levels 1989-2013



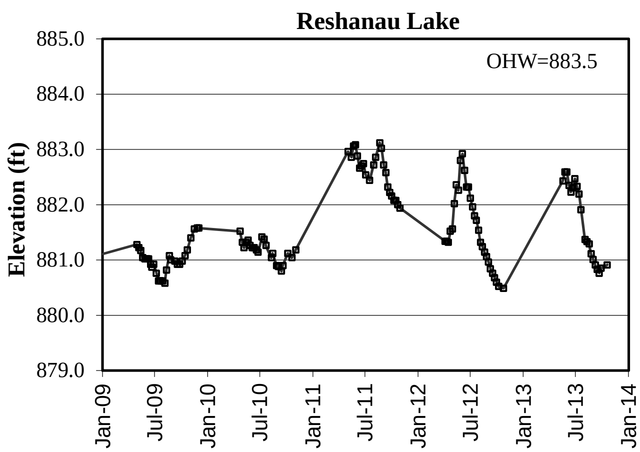
Moore Lake Levels 2009-2013



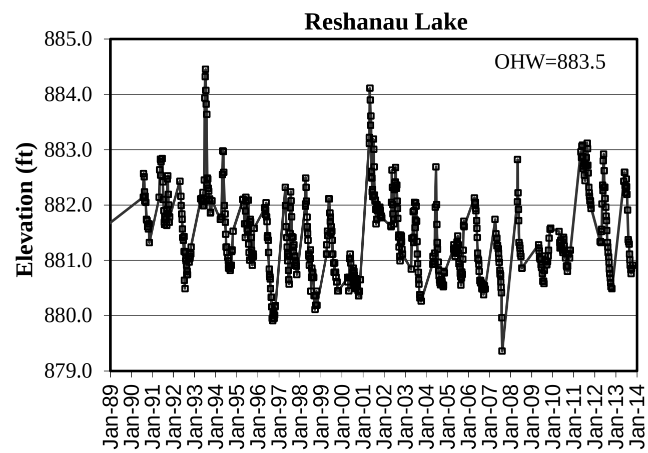
Moore Lake Levels 1989-2013



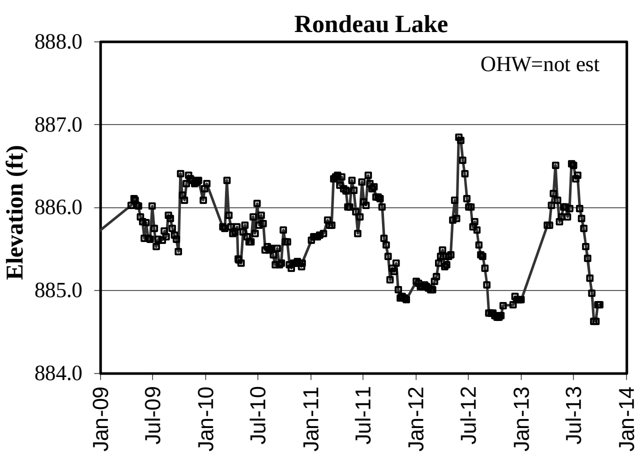
Reshanau Lake Levels 2009-2013



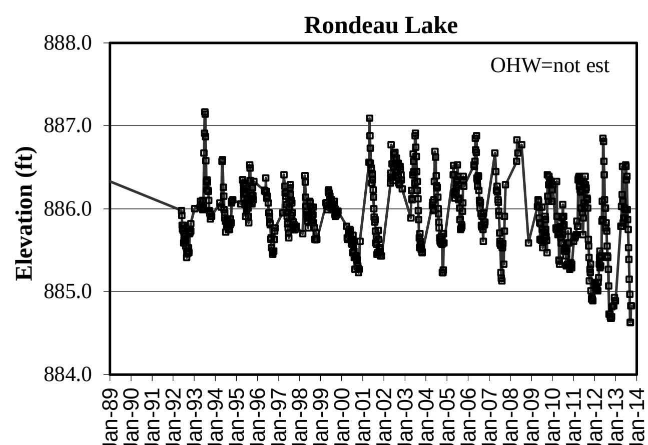
Reshanau Lake Levels 1989-2013



Rondeau Lake Levels 2009-2013



Rondeau Lake Levels 1989-2013



Wetland Hydrology

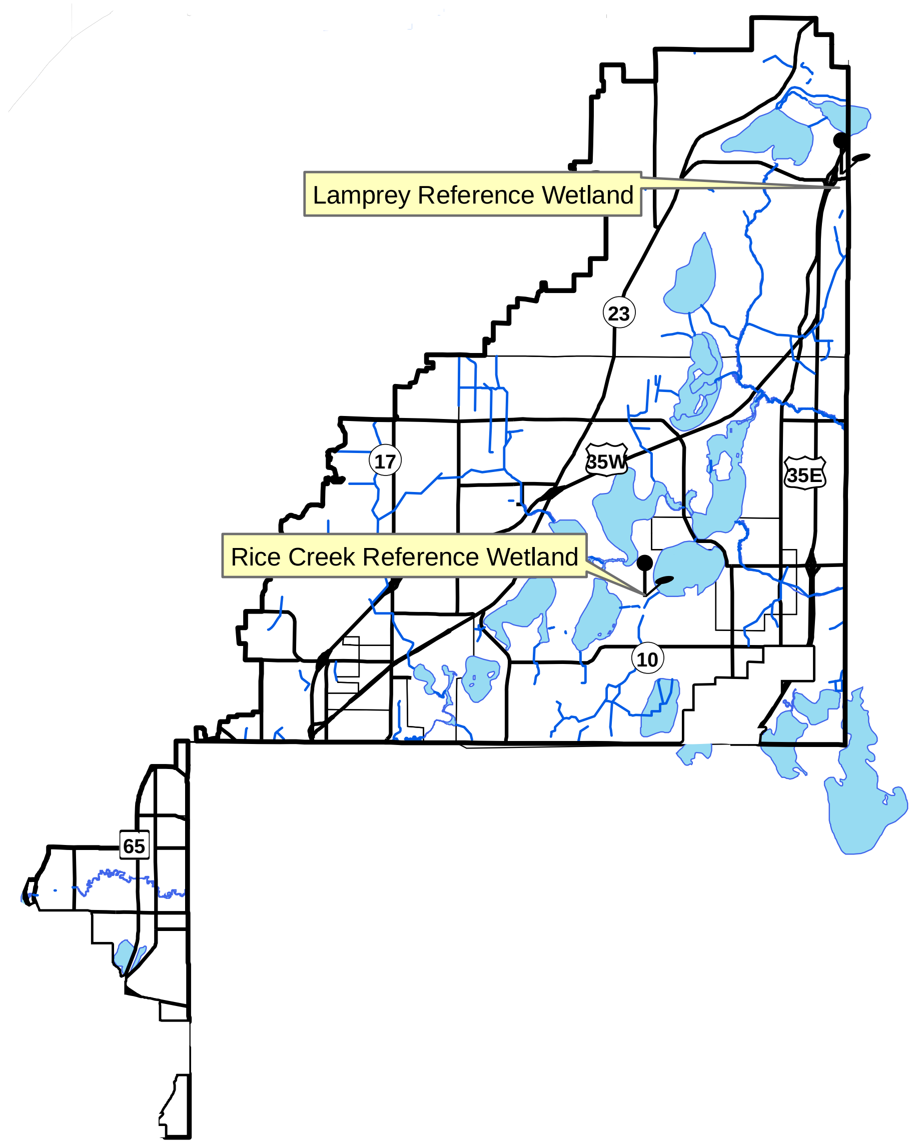
Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 23 wetland hydrology monitoring stations.

Purpose: To provide an understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

Locations: Lamprey Reference Wetland, Lamprey Pass Wildlife Management Area, Columbus
Rice Creek Reference Wetland, Rice Creek Chain of Lakes Regional Park Reserve

Results: See the following pages.

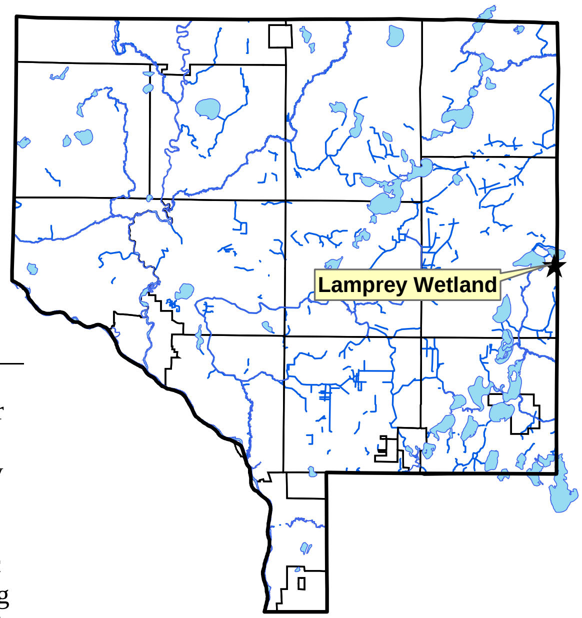
Rice Creek Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

LAMPREY REFERENCE WETLAND

Lamprey Pass Wildlife Mgmt Area, Columbus



Site Information

Monitored Since: 1999

Wetland Type: 4

Wetland Size: ~0.5 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-9	10yr 2/1	Fine Sandy Loam	-
AB	9-19	10yr 2/1	Fine Sandy Loam	2% 10yr 5/6
Bw	19-35	10ry 3/1	Loam	2% 10ty 5/4
2C1	35-42	5y 5/2	Clay Laom	5y 3/1 Organic Streaking
2C2	42-48	2.5y 5/1	Sandy Loam	2.5y 5/6

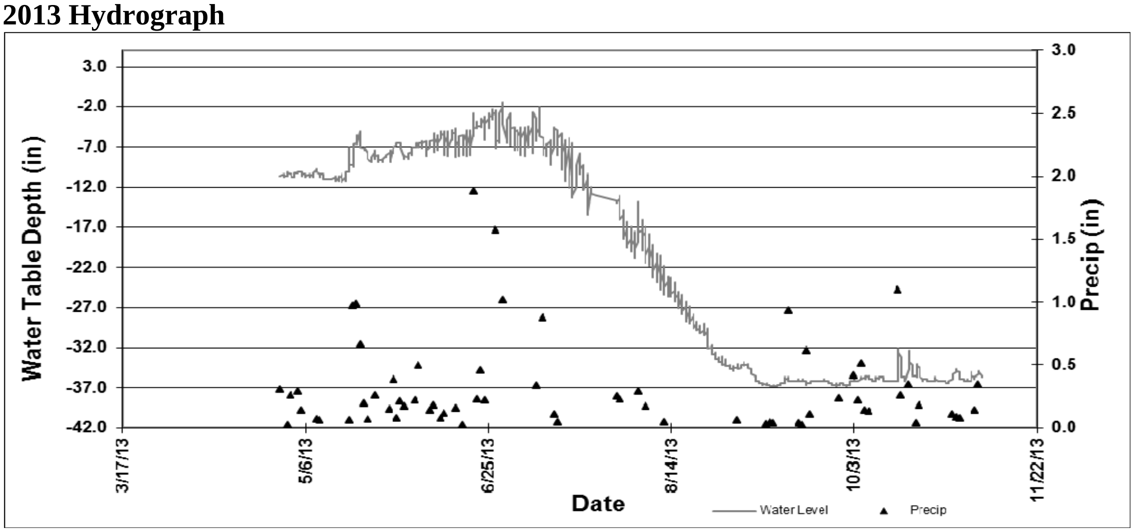
Surrounding Soils: Braham loamy fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Carex pennsylvanica	Pennsylvania Sedge	50
Cornus stolonifera (S)	Red-osier Dogwood	20
Fraxinus pennslyvanicum (T)	Green Ash	40
Xanthoxylum americanum	Pricly Ash	20
Bare Ground		20

Other Notes: Wetland is about 200 feet west of Interstate Highway 35, but within a state wildlife management area. Well is located at the wetland boundary.

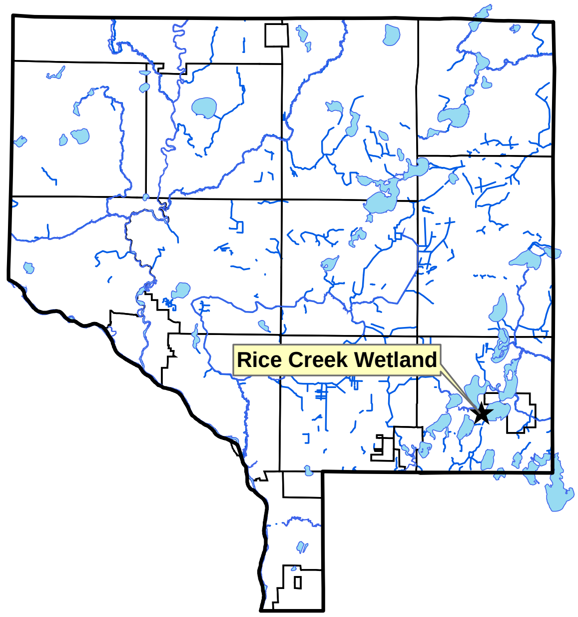
2013 Hydrograph



Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

RICE CREEK REFERENCE WETLAND

Rice Creek Chain of Lakes Regional Park, Lino Lakes



Site Information

Monitored Since: 1996

Wetland Type: 7

Wetland Size: ~0.5 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-12	10yr 3/1	Sandy Loam	-
Ab	12-16	10yr 2/1	Sandy Loam	-
Bg1	16-21	10yr4/1	Sandy Loam	-
Bg2	21-35	10yr5/2	Sandy Loam	5% 10yr 5/6
2Cg	35-42	2.5y 5/2	Silt Loam	5% 10yr 5/6

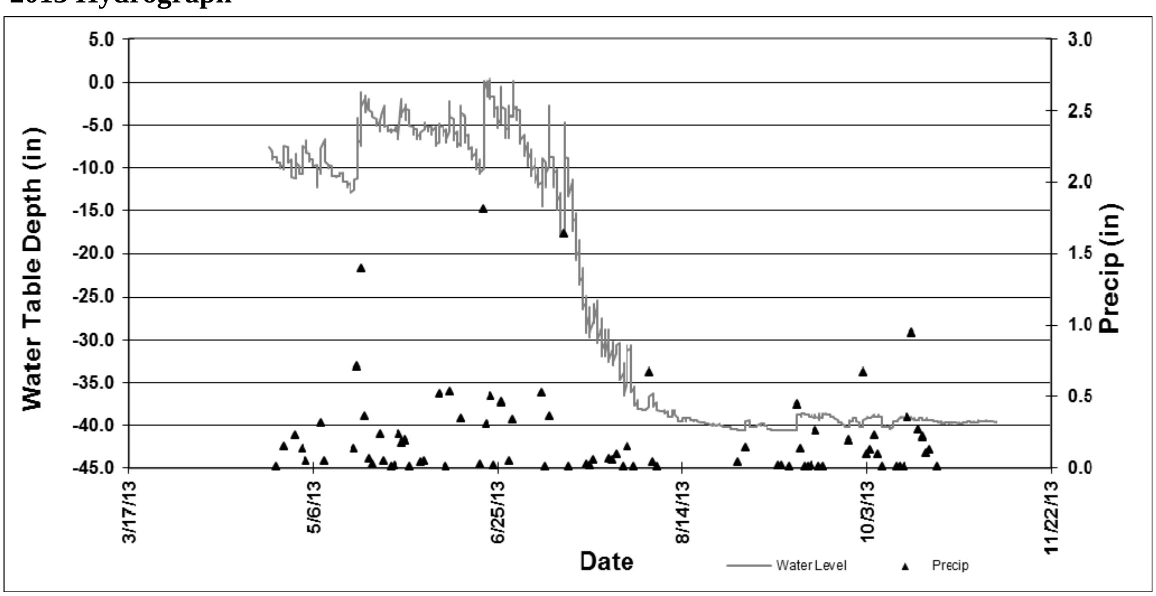
Surrounding Soils: Nessel fine sandy loam and Blomford loamy fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Rubus strigosus	Raspberry	30
Onoclea sensibilis	Sensitive Fern	20
Fraxinus pennsylvanica	Green Ash	40
Amphicarpa bracteata	Hog Peanut	20

Other Notes: This is an intermittent, forested wetland within the regional park between Centerville and George Watch Lakes. It is about 900 feet from George Watch Lake and 800 feet from Centerville Lake. Well is at wetland boundary.

2013 Hydrograph



Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Stream Water Quality – Biological Monitoring

Description: This program combines environmental education and stream monitoring. Under the supervision of ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their catch to the family level, and use the resulting numbers to gauge water and habitat quality. These methods are based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families can thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data. To provide an environmental education service to the community.

Locations: Clearwater Creek at Centerville City Hall, Centerville

Hardwood Creek at several locations, Lino Lakes

Rice Creek at Hwy 65, Fridley

Results: Results for each site are detailed on the following pages.

Tips for Data Interpretation

Consider all biological indices of water quality together rather than looking at each alone, as each gives only a partial picture of stream condition. Compare the numbers to county-wide averages. This gives some sense of what might be expected for streams in a similar landscape, but does not necessarily reflect what might be expected of a minimally impacted stream. Some key numbers to look for include:

Families — Number of invertebrate families. Higher values indicate better quality.

EPT — Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.

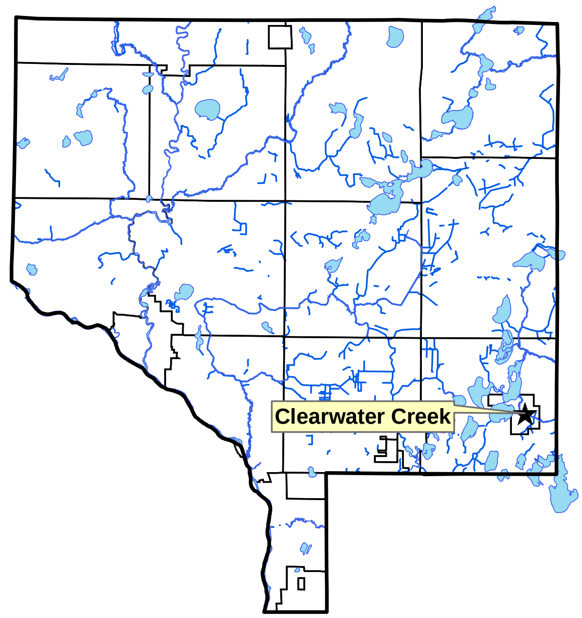
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

% Dominant Family — High numbers indicate an uneven community, and likely poorer stream health.

CLEARWATER CREEK

at Centerville City Hall, Centerville



Last Monitored

By Centennial High School in the spring of 2013

Monitored Since

1999

Student Involvement

30 students in 2013, approximately 629 since 2001

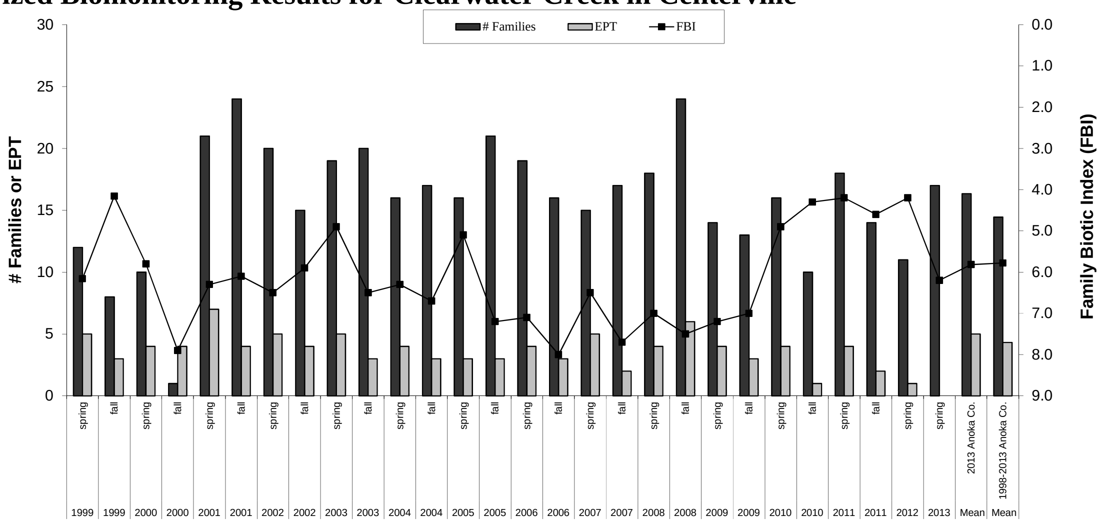
Background

Clearwater Creek originates from Bald Eagle Lake in northwest Ramsey County and flows northwest into Peltier Lake. Land use is an approximately equal mix of residential and vacant/agricultural with some small commercial sites. The land use immediately surrounding the sampling site is entirely residential and developed, however in late summer 2007 a major city reconstruction project began near the stream monitoring site in Centerville, and large areas were graded or disturbed. The stream banks are steep with erosion in spots. The streambed is composed of sand and silt with a few areas of gravel. The stream is 6-12 inches deep at baseflow and approximately 10-15 feet wide.

Results

A Centennial High School class monitored Clearwater Creek in the spring of 2013, with oversight by the Anoka Conservation District (ACD). Overall, this stream has average or slightly below average conditions based upon the invertebrate data, though fluctuations occur. Data from 2010-12 represented an interesting deviation from previous years. A dramatic decrease in the family biotic index (FBI) occurred. The lower FBI value suggests an increase in pollution intolerant species. However, 2013 FBI returned to around the county average. This is primarily due to hyalellidae being the dominant species found. While the number of families found increased from 2012, EPT families continued their downward trend and none were found in 2013. Despite the number of families observed increasing from 2012, 68% of the total invertebrates found were comprised of two families, with the most dominant family being very pollution tolerant. Comparison of total number of families and EPT from 2013 with previous years suggests a slight decrease in overall stream health.

Summarized Biomonitoring Results for Clearwater Creek in Centerville



Biomonitoring Data for Clearwater Creek in Centerville

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2008	2008	2009	2009	2010	2010	2011	2011	2012	2013	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	spring	spring	2013 Anoka Co.	1998-2013 Anoka Co.
FBI	7.00	7.50	7.20	7.00	4.9	4.3	4.2	4.6	4.2	6.2	5.8	5.8
# Families	18	24	14	13	16	10	18	14	11	17	16.3	14.5
EPT	4	6	4	3	4	1	4	2	1	0	5.0	4.3
Date	8-May	1-Oct	20-May	9-Oct	14-May	6-Oct	31-May, 6-Jun	12-Oct	17-May	28-May		
Sampled By	CHS	CHS	CHS	CHS	CHS	CHS	CHS & ACD	CHS	CHS	CHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	180	450	238	386	664	532	2003	146	273	228		
# Replicates	1	1	1	1	1	1	2	1	1	1		
Dominant Family	Simuliidae	Corixidae	Hyalellidae	Corixidae	Gammaridae	Gammaridae	Gammaridae	Gammaridae	Gammaridae	Hyalellidae		
% Dominant Family	27.8	42.3	26.1	53.9	77.7	89.7	93.5	80.1	87.9	34.2		
% Ephemeroptera	10.6	4.7	28.2	8.5	1.8	0.6	0.6	0.7	2.2	0.0		
% Trichoptera	2.2	0.7	0.8	2.8	0.6	0.0	0.1	0.7	0.0	0.0		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	5/5/2008	10/1/2008	5/20/2009	10/9/2009	5/14/2010	10/6/2010	5/31/2011	6/6/2011	10/6/2011	5/17/2012
pH	8	7.65	7.56	7.27	7.23	7.29	7.66	7.88	7.74	7.78
Conductivity (mS/cm)	0.452	0.607	0.699	0.558	0.788	0.701	0.551	0.560	0.551	0.491
Turbidity (NTU)	10	13	4	8	10	21	0	6	16	8
Dissolved Oxygen (mg/L)	11.84	8.74	4.85	9.25	10.31	na	6.32	7.98	1.42	7.58
Salinity (%)	0.01	0.02	0.02	0.02	0.03	0.04		0.02	0.02	0.02
Temperature (°C)	14.3	9.5	16.9	7.6	10.0	12.2	18.6	22.9	17.3	16.7

Discussion

This creek's biological community is probably limited by a combination of habitat, hydrology and water chemistry factors. The portion of the creek that is monitored has been ditched, and is straight with steep banks, no pools or riffles and homogeneous bottom composition. There is a strip of forested land approximately 20-50 feet wide on each side of the stream, but other areas upstream and downstream have less adjacent natural habitat. Flows are generally slow and water levels are low during much of the year, such that the stream sides are seldom submerged to provide habitat. When higher water does occur, it is usually during large storms, and the urbanized subwatershed results in a flashy hydrograph.

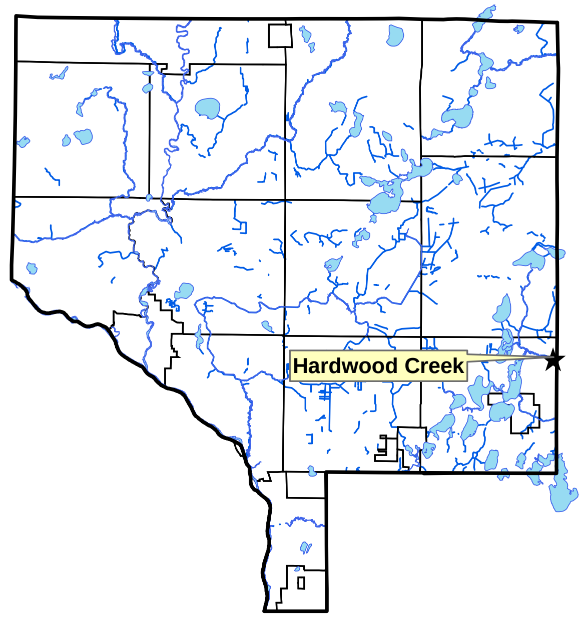
Supplemental water chemistry measurements have highlighted occasions when one or more water quality parameters are substandard, but not necessarily during storms when runoff to the creek would be greatest. For example, a highly turbid condition was noted in October 2004 during a baseflow period when the water was barely moving. Likewise, high conductivity values in 2006-2011 were during low water levels. On October 6, 2011 we found dissolved oxygen of just 1.42 mg/L, much lower than required by most aquatic life.

Overall, this creek seems to provide adequate habitat and water quality for pollution-tolerant invertebrates, but more sensitive varieties are unable to survive. Particularly in more recent years, species evenness has been low. Captures were dominated by Gammaridae, a moderately pollutation-tolerant scud. They accounted for 78%, 90%, 94%, 80% and 88% of the invertebrate community in the spring 2010 through the fall of 2012 samplings, respectively. Gammaridae was less dominant in 2013; however it still made up 34% of all invertebrates observed. Another 34% of species found were made up of Hyalellidae, a pollution tolerant amphipod. 15 other families were also found, but were in low abundance, even those that are generalists. Collectively, these data indicate a very limited invertebrate community is able to thrive in Clearwater Creek.

Centennial High School students at Clearwater Creek.

HARDWOOD CREEK

see list of monitoring locations below



Last Monitored

By Forest Lake Area Learning Center in fall of 2013

Monitored Since

1999 to fall 2007 at Hwy 140
Fall 2007 at 165th Ave NW
2008 SW of intersection of 170th St and Fenway Ave
2009-13 at Cecelia LaRoux property 600 m W of I-35

Student Involvement

6 students in 2013, approximately 234 since 2001

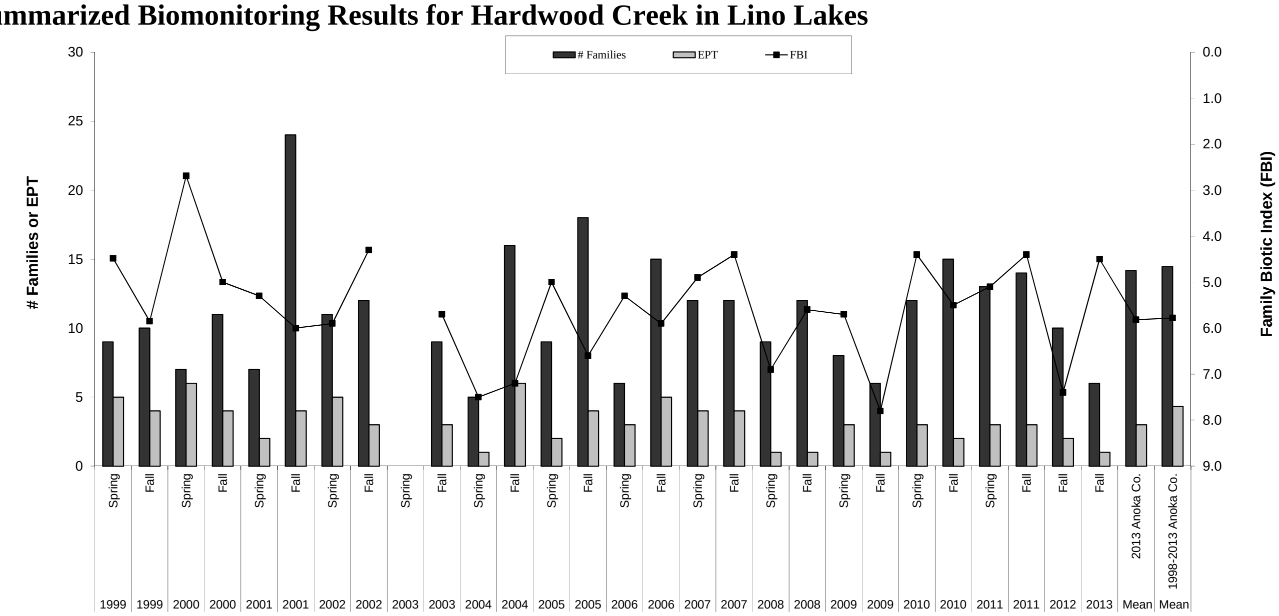
Background

Hardwood Creek originates in Washington County and flows west to Rice Creek and the Rice Creek Chain of Lakes. This is a small creek with a width at baseflow of approximately 10-15 feet and depth of approximately 6-12 inches. The surrounding land use is primarily agricultural, with some residential areas. The stream bottom is sand, gravel, and some cobble in some locations such as at Highway 140 where the creek was monitored until fall 2007. The 2009-13 monitoring site was the subject of a stream restoration project in 2008. All other monitoring sites have had poor habitat.

Results

A Forest Lake Area Learning Center class monitored Hardwood Creek in the fall of 2013, facilitated by the Anoka Conservation District. This site was the subject of a stream restoration project that included rock veins, brush bundles and willow staking. An improvement in stream health documented in 2010-11 has been followed up by consecutive years of decrease in number of families and EPT in 2012-13. A rebound in the FBI from was observed in 2013. These changes could reflect normal variation. Future monitoring will provide additional insight.

Summarized Biomonitoring Results for Hardwood Creek in Lino Lakes



Biomonitoring Data for Hardwood Creek in Lino Lakes

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2008	2008	2009	2009	2010	2010	2011	2011	2012	2013	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Fall	Fall	2013 Anoka Co.	1998-2013 Anoka Co.
FBI	6.90	5.60	5.70	7.80	4.40	5.50	5.1	4.4	7.4	4.5	5.8	5.8
# Families	9	12	8	6	12	15	13	14	10	6	14.2	14.5
EPT	1	1	3	1	3	2	3	3	2	1	3.0	4.3
Date	15-May	8-Oct	19-May	8-Oct	5-May	14-Oct	11-May	5-Oct	11-Oct	10-Oct		
Sampled By	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	440	159	400	391	290	110	237	190	83	87		
# Replicates	1	1	1	1	1	1	1	1	1	1		
Dominant Family	Simuliidae	Dystidae	Simuliidae	Corixidae	Baetidae	Gammaridae	Gammaridae	Gammaridae	Hyalellidae	Gammaridae		
% Dominant Family	49.1	57.2	67.3	74.7	68.6	51.8	50.2	62.6	73	87.4		
% Ephemeroptera	0	0.6	19.5	0.3	69	9.1	2.5	16.3	12	3.4		
% Trichoptera	0.2	0	0.8	0	1.4	0	0.4	1.1	0	0		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

	Fenway Ave Site		C. LaRoux Property						
Parameter	5/15/2008	10/8/2008	5/19/2009	10/8/2009	5/5/2010	10/14/2010	5/11/2011	10/5/2011	10/11/2012
pH	7.13	7.46	8.1	7.43	na	7.57	7.76	7.97	8.04
Conductivity (mS/cm)	0.361	0.431	0.426	0.37	0.457	0.509	0.411	0.314	0.405
Turbidity (NTU)	13	11	6	22	7	6	13	4	na
Dissolved Oxygen (mg/L)	10.88	7.14	12.3	11.5	11.6	na	9.67	7.01	5.27
Salinity (%)	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
Temperature (°C)	12.4	12.4	16.5	9.7	10.4	9.8	17.3	14.5	7.6

Discussion

Hardwood Creek is on the Minnesota Pollution Control Agency's 303(d) list of impaired waters for impaired biota and dissolved oxygen. The Rice Creek Watershed District has conducted a TMDL investigative study. Our biological monitoring does indicate a below or near average biological community, but lends only modest insight into what might be causing this impairment. Habitat seems to be an important factor. Biological indices of stream health have improved at the stream restoration site.

Three sites on this creek have been monitored and provided differing results. The earliest monitoring until 2007 was on the north side of Highway 140 (170th St, W crossing), where habitat was moderate to good and invertebrate communities indicated the best stream health. In spring 2008 it was monitored farther to the east Highway 140, near Fenway Ave, and conditions were somewhat poorer. Since that time monitoring has been just north of Hwy 140, one third mile east of County Road 20 on the C. LaRoux Property, where conditions have been mid-range. Substantial variation among samplings is seen at all sites.

Forest Lake Area Learning Center students at Hardwood Creek.

Biomonitoring

RICE CREEK

at Hwy 65, Locke Park, Fridley

Last Monitored

By Totino Grace High School in fall 2013

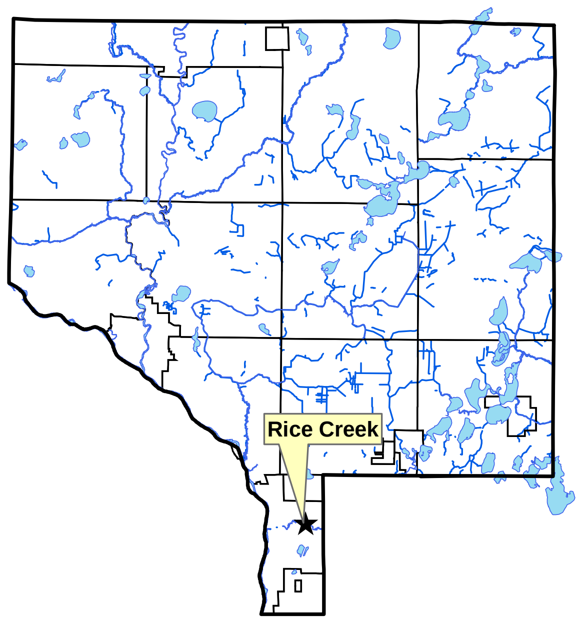
Monitored Since

1999

Student Involvement

80 students in 2013, approximately 920 since 2001

Background

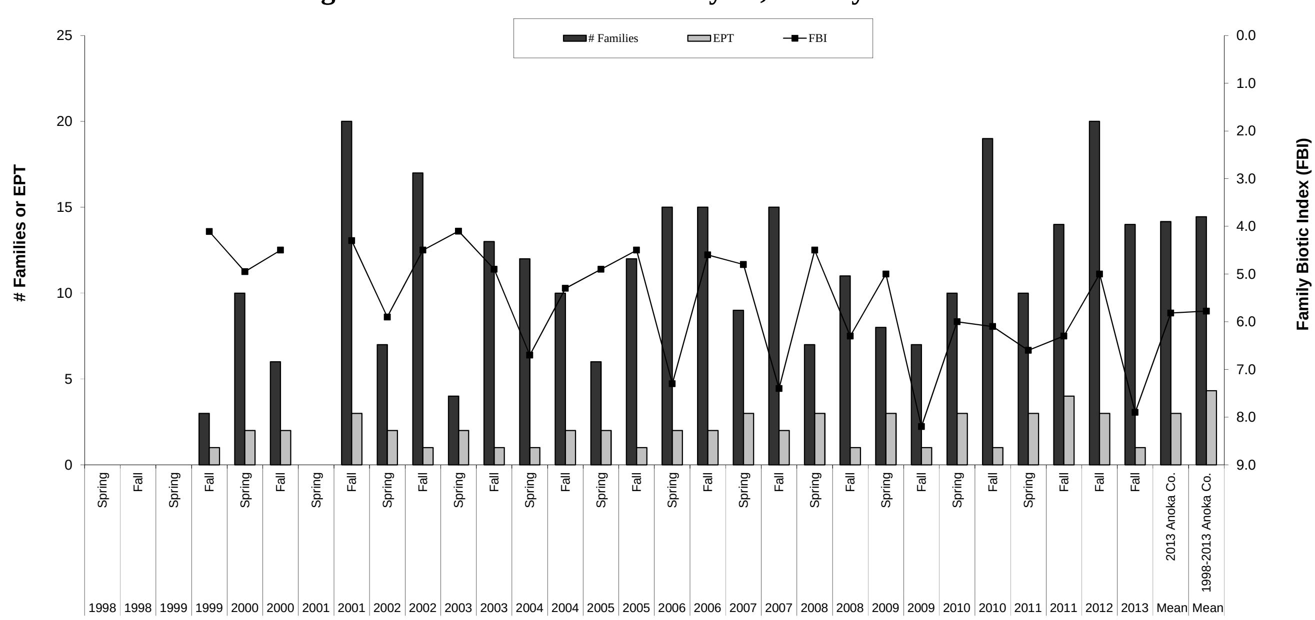


Rice Creek originates from Howard Lake in east-central Anoka County and flows south and west through the Rice Creek Chain of Lakes and eventually to the Mississippi River. Sampling is conducted in Locke Park, which encompasses a large portion of the stream's riparian zone in Fridley. This site is wooded. Outside of this buffer, though, the watershed is highly urbanized and the stream receives runoff from a variety of urban sources. The stream has a rocky bottom with pools and riffles, some due to stream bank stabilization projects.

Results

Totino Grace High School monitored this stream in fall of 2013, facilitated by the Anoka Conservation District (ACD). At this site, Rice Creek has a macroinvertebrate community indicative of poor stream health. While the number of families present has been similar to the average for Anoka County streams on several occasions (fall 2010, 2011, 2012, and 2013), most of these are generalist species that can tolerate polluted conditions. The number of EPT families present has been below the county average in all years. EPT are generally pollution-sensitive, but the EPT family most often found in Rice Creek the caddisfly Hydropsychidae, is an exception to that rule. It thrives in relatively poor environmental conditions. Hydropsychidae was the only EPT family found in Rice Creek during 2013 monitoring.

Summarized Biomonitoring Results for Rice Creek at Hwy 65, Fridley



Biomonitoring Data for Rice Creek at Hwy 65, Fridley

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2008	2008	2009	2009	2010	2010	2011	2011	2012	2013	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Fall	Fall	2013 Anoka Co.	1998-2013 Anoka Co.
FBI	4.5	6.3	5.0	8.2	6	6.1	6.6	6.3	5	7.9	5.8	5.8
# Families	7	11	8	7	10	19	10	14	20	14	14.2	14.5
EPT	3	1	3	1	3	1	3	4	3	1	3.0	4.3
Date	23-May	10-Oct	11-May	8-Oct	14-May	13-Oct	31-May	7-Oct	5-Oct			
Sampled By	ACD	TGHS	ACD	TGHS	ACD	TGHS	ACD	TGHS	TGHS	TGHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
# Individuals	180	104	148	111	154	132	126	215	248	107		
# Replicates	1	1	1	1	1	1	1	1	2	2		
Dominant Family	Baetidae	Hydropsychidae	Baetidae	Corixidae	Chironomidae	Hydropsychidae	Chronomidae	Simulidae	Philopotamidae	Corixidae		
% Dominant Family	70.0	40.0	50.0	74.8	29.2	31.1	39.7	23.3	38.0	38.0		
% Ephemeroptera	74.4	0.0	50.7	0.0	23.4	0.0	15.9	12.1	10.9	0.0		
% Trichoptera	7.2	42.3	6.8	9.0	3.2	31.1	0.8	14.0	43.1	6.4		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

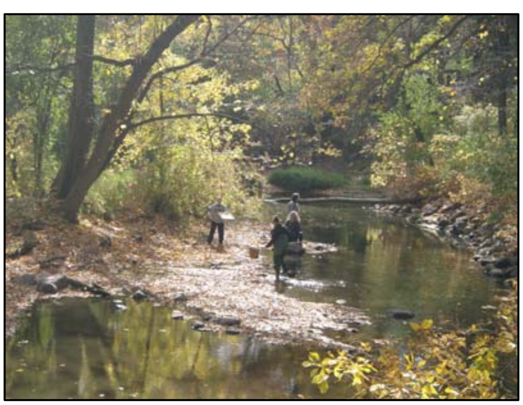
Data presented from the most recent five years. Contact the ACD to request archived data.

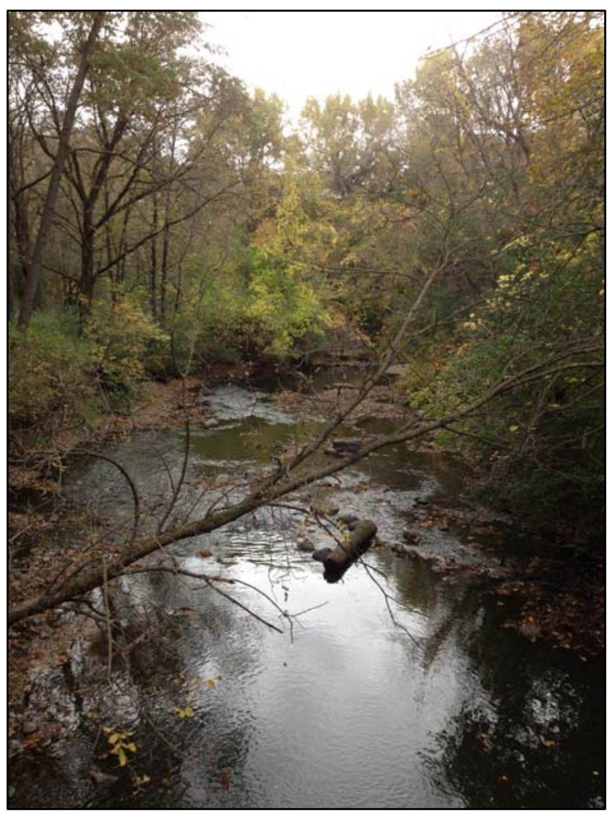
Parameter	5/23/2008	10/10/2008	5/11/2009	10/8/2009	5/14/2010	10/13/2010	5/31/2011	10/7/2011	10/5/2012
pH	8.12	7.73	8.23	4.76	7.85	7.92	7.62	8.02	8.17
Conductivity (mS/cm)	0.461	0.639	0.624	0.638	0.545	0.535	0.504	0.364	0.460
Turbidity (NTU)	15	13	16	18	13	15	0	6	na
Dissolved Oxygen (mg/L)	9.56	9.01	12.29	10.74	12.64	na	7.94	7.34	7.82
Salinity (%)	0.01	0.02	0.02	0.02	0.02	0.02	na	0.01	0.01
Temperature (°C)	19	12.9	14.5	11.2	12.8	16.5	19.6	17.1	9.6

Discussion

The poor macroinvertebrate community in this creek is likely due to poor water quality, not poor habitat. Habitat at the sampling site and nearby is good, in part because of past stream habitat improvement projects. The stream has riffles, pools, and runs with a variety of snags and rocks. The area immediately surrounding the stream is wooded, with walking trails. However, outside of this natural corridor around the stream, the watershed is urbanized and storm water inputs are likely the cause of degraded water quality.

Totino Grace High School students at Rice Creek.





Water Quality Grant Administration

Description: ACD worked with RCWD to administer the implementation of a cost-share grant program for private landowners. Tasks included landowner outreach and education, site reviews, project evaluations, BMP design, contractor assistance, construction oversight, long-term project monitoring and other services as needed to ensure a smooth-running program.

Purpose: To assist property owners with the design and installation of water quality improvement BMPs within the Rice Creek Watershed District.

Results: In 2013 ACD provided technical/design assistance valued at $20,861.50 and was reimbursed $10,000 through the Rice Creek Watershed District. Seventeen site visits were conducted, three lakeshore restorations were completed, which included design, cost-share, and installation oversight, and one additional lakeshore restoration to be installed in 2014 was designed and approved to receive cost-share.

Project Management Details. The table below provides details on ACD's efforts toward the RCWD BMP cost-share program, which are also presented in the financial summary table at the end of this chapter.

Description	Hours	Rate	Value
Services			
Administrative Hours (Specialist)	42	$73	$3,066.00
TA & Design Hours (Specialist)	95	$73	$6,935.00
TA & Design Hours (Technician)	1.5	$68	$102.00
RL-13 Rain Garden Monitoring and Repair (Manager)	20	$84	$1,680.00
RL-13 Rain Garden Monitoring and Repair (Specialist)	9.5	$73	$693.50
RL-13 Rain Garden Monitoring and Repair (Technician)	84.75	$68	$5,763.00
RL-13 Rain Garden Monitoring and Repair (Technical Support)	46	$57	$2,622.00
Locke 23 Rain Garden Design	18	$73	$1,314.00
Total Value of Services Provided			**$22,175.50**
Revenue			
Rice Creek BMP Cost-Share Service Agreement			($10,000)
2013 Locke County Park Rain Garden Service Agreement			($1,314)
Services Received At No Cost			**$10,861.50**

Example project – The photo on the left shows a lakeshore restoration on Golden Lake in Circle Pines completed in the summer of 2013. ACD provided technical/design assistance and construction oversight. The project consisted of bioengineering techniques to stabilize an actively eroding shoreline. Furthermore, native plant species were used to provide wildlife habitat. Cost-share funds were provided to the homeowner from the RCWD cost-share program.

Stormwater Retrofit Analysis – Moore Lake

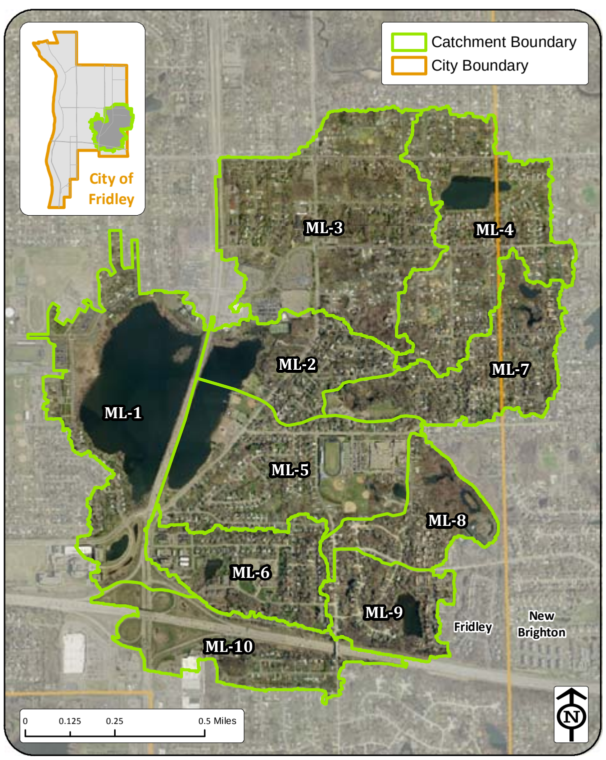
Description: This stormwater retrofit analysis takes a systematic approach to identifying and prioritizing water quality improvement projects that provide the greatest amount of stormwater treatment per dollar spent. Moore Lake was chosen because it is classified as a high quality water body by the Rice Creek Watershed District. Furthermore, it is classified as a Tier II water body by the district, which means it provides passive regional public recreation opportunities. The subwatershed consists of 936 acres, of which 659 acres are connected to Moore Lake, and is located largely in the City of Fridley, with the eastern most section of the subwatershed extending into New Brighton.

Purpose: To identify cost effective stormwater retrofits that improve stormwater quality and reduce the volume of runoff that most greatly contribute to the degradation of Moore Lake.

Results: This stormwater retrofit analysis was completed in 2013, and a full report is available at www.anokaswcd.org. The 659 acres of connected subwatershed contribute an estimated 395 acre feet of runoff, 392 pounds of phosphorus and 83,112 pounds of total suspended solids to Moore Lake each year. Twenty-five stormwater retrofit projects or groups of projects (e.g. rain garden networks) were identified. For each, pollutant reduction, volume reduction and cost were estimated. Projects were ranked by cost effectiveness (pounds of pollutant reduced per dollar spent). Project types included:

- Maintenance of, or alterations to, existing stormwater treatment practices,
- Residential curb-cut rain gardens,
- New stormwater pond opportunities,
- Permeable pavement,
- Hydrodynamic separators, and
- Stormwater redirection.

Map of the Moore Lake Stormwater Retrofit Analysis Area



Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program, such as our lake water quality monitoring program. We do not, however, know specifically which expenses are attributed to monitoring which lakes. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer. The process also takes into account equipment that is purchased for monitoring in a specific area.

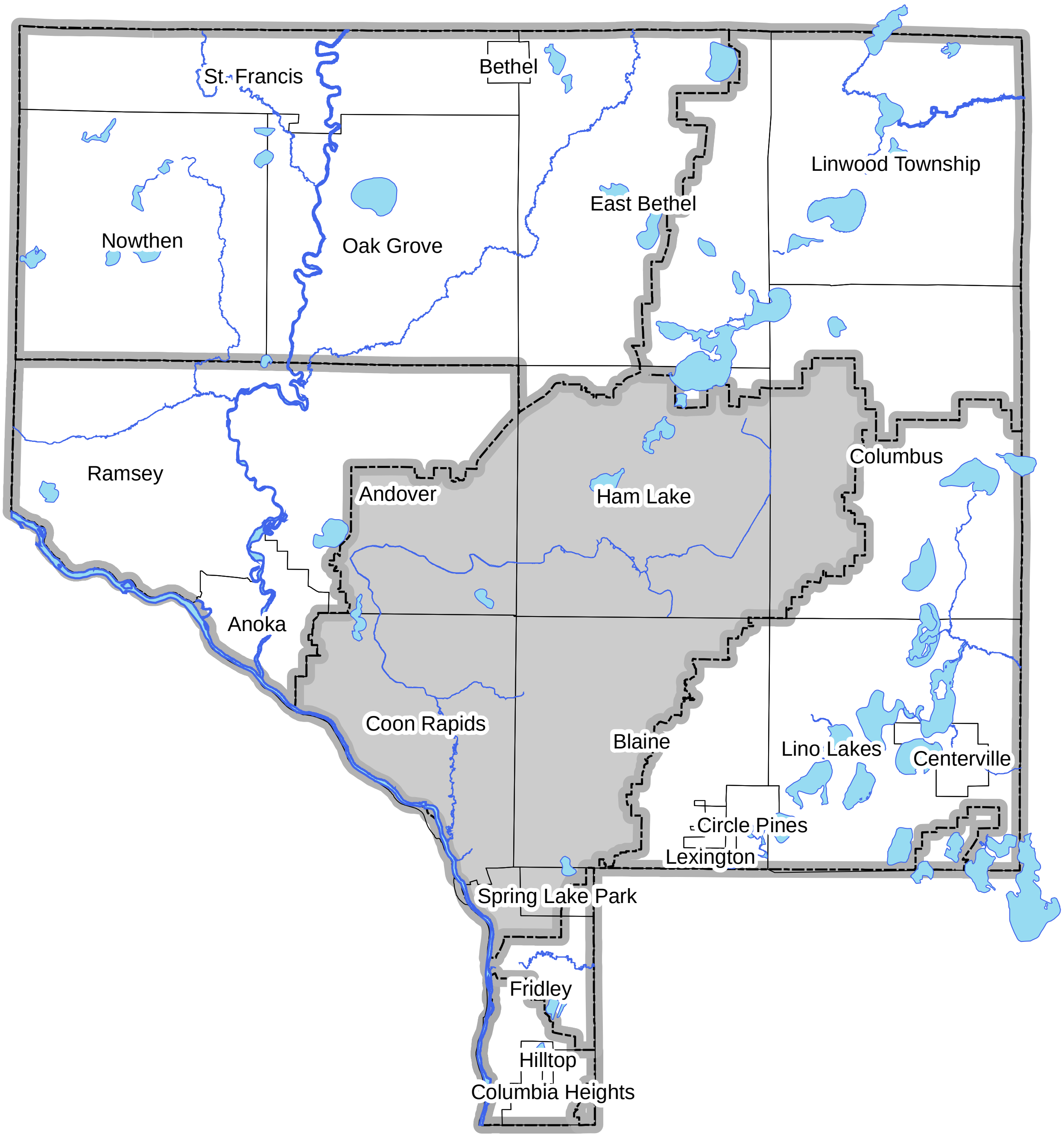
Rice Creek Watershed Financial Summary

Rice Creek Watershed	Volunteer Precip	Ref Wet	Ob Well	Lake Lvl	Student Biomon	RCWD Cost Share Admin	Moore Lake SRA	Projects	Total
Revenues									
RCWD	0	1120	0	1000	2475	2401	9000	7599	23595
State	0	0	261	0	0	0	0	0	261
Anoka Conservation District	0	0	0	0	0	0	0	0	0
Anoka Co. General Services	0	0	353	0	0	0	0	0	353
County Ag Preserves	0	0	0	0	1047	0	0	361	1407
Regional/Local	0	0	0	0	0	0	6315	0	6315
Other Service Fees	0	0	0	0	0	0	0	3029	3029
BWSR Cons Delivery	0	0	0	0	0	0	0	0	0
BWSR Cost Share TA	0	0	0	0	0	0	0	3300	3300
Local Water Planning	59	0	65	7	0	0	0	0	130
TOTAL	59	1120	679	1007	3522	2401	15315	14289	38392
Expenses-									
Capital Outlay/Equip	0	10	8	13	34	40	66	220	392
Personnel Salaries/Benefits	49	676	569	857	2977	2000	12744	11840	31713
Overhead	5	44	45	58	200	132	1485	847	2817
Employee Training	0	3	2	5	24	6	10	45	95
Vehicle/Mileage	1	11	9	16	60	30	151	187	463
Rent	3	31	29	38	129	93	859	570	1753
Program Participants	0	0	0	0	0	0	0	0	0
Program Supplies	0	1	0	0	97	0	0	9	107
McKay Expenses	0	13	17	19	0	101	0	571	720
TOTAL	59	789	679	1007	3522	2401	15315	14289	38060
NET	0	331	0	0	0	(0)	0	0	331

Recommendations

- **Install and maintain water quality improvement projects** identified through the Moore, Rice, and Golden Lake Subwatershed Retrofit Analyses.
- **Pursue projects that address water quality problems identified in the TMDLs** for Peltier and Centerville Lakes, and Lino Lakes Chain.
- **Continue to improve the ecological health of Clearwater, Hardwood, and Rice Creeks.** Clearwater Creek is designated as impaired for aquatic life based on fish and invertebrate IBI's. Hardwood Creek is impaired based on invertebrate data and low dissolved oxygen. In Anoka County Rice Creek does not have this designation, but reaches just upstream are impaired based on invertebrate and fish IBIs. The Anoka County invertebrate data for Rice Creek indicate a depleted invertebrate community.
- **Reduce road salt use.** Elevated chlorides are pervasive throughout shallow aquifers and the streams that feed them.

Coon Creek Watershed



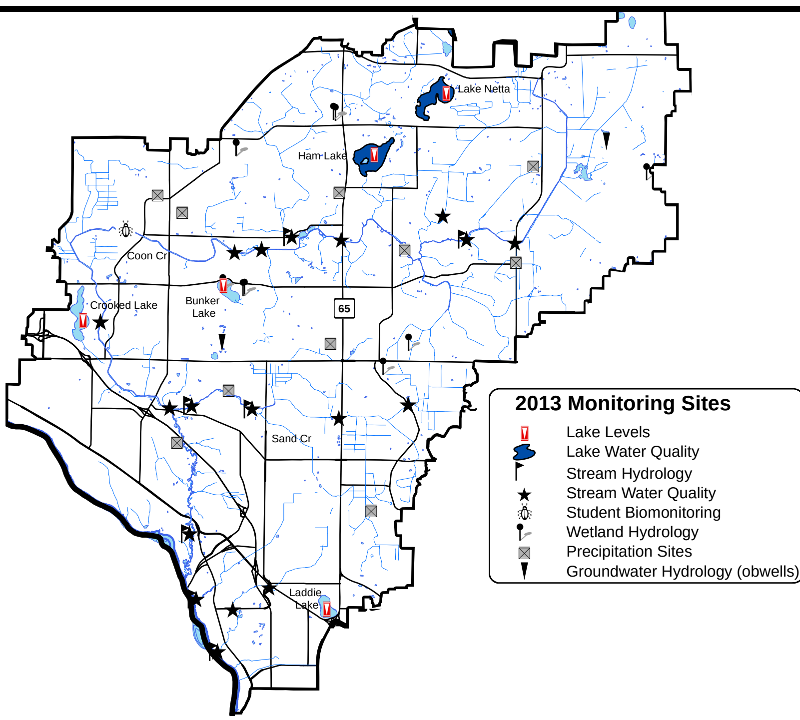
Contact Info: Coon Creek Watershed District
www.cooncreekwd.org
763-755-0975

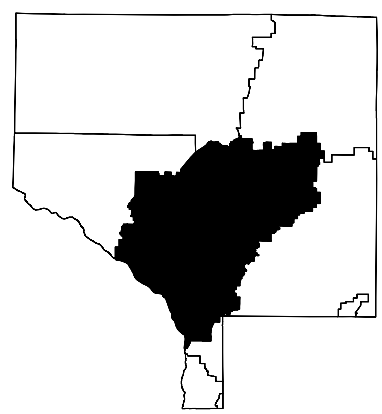
Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 6:
COON CREEK WATERSHED

Task	Partners	Page
Precipitation	CCWD, ACD, volunteers	6-131
Precipitation Analyses	CCWD, ACD	6-133
Lake Levels	CCWD, ACD, volunteers	6-135
Lake Water Quality	CCWD, ACD, ACAP	6-138
Stream Hydrology and Rating Curves	CCWD, ACD	6-143
Stream Water Quality - Chemical	CCWD, ACD	6-156
Stream Water Quality - Biological (student)	ACD, CCWD, ACAP, Andover HS	6-257
Wetland Hydrology	CCWD, ACD, ACAP	6-260
Reference Wetland Analyses	CCWD, ACD	6-270
Stormwater Retrofit Analysis – Pleasure Creek	CCWD, ACD	6-274
Stormwater Retrofit Analysis – Woodcrest Creek	CCWD, ACD	6-275
Financial Summary		6-276
Recommendations		6-277
Groundwater Hydrology (obwells)	ACD, MNDNR	see Chapter 1

ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District,
CCWD = Coon Creek Watershed District, MNDNR = MN Dept. of Natural Resources





Precipitation

Description: Continuous monitoring of precipitation with both data-logging rain gauges and non-logging rain gauges that are read daily by volunteers. Rain gauges are placed around the watershed in recognition that rainfall totals and storm phenology are spatially variable, and these differences are critical to understanding local hydrology, including flood prediction.

Purpose: To aid in all types of hydrologic analyses, predictions, and regulatory decisions within the watershed.

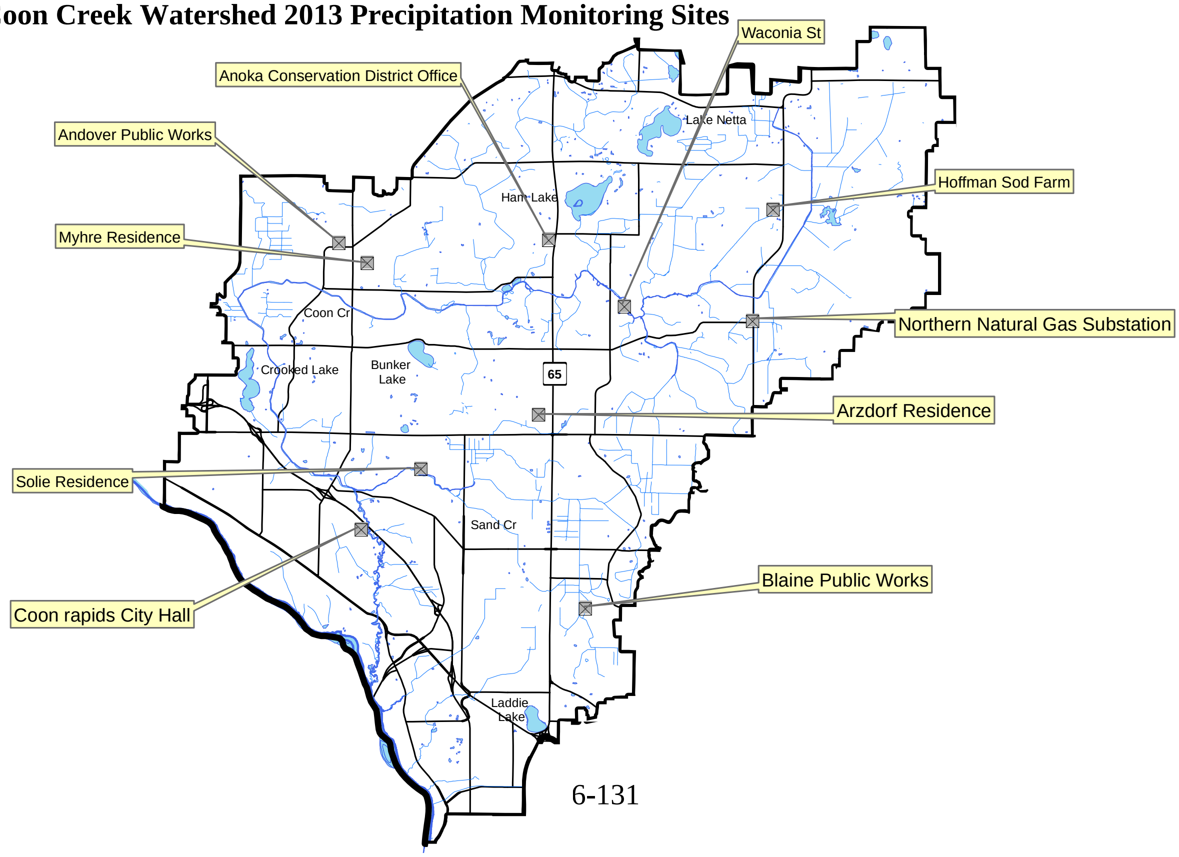
Locations:

Type	Site	City
Data Logging	Andover City Hall	Andover
Data Logging	Anoka Conservation District Office	Ham Lake
Data Logging	Blaine Public Works	Blaine
Data Logging	Coon Rapids City Hall	Coon Rapids
Data Logging	Hoffman Sod Farm	Ham Lake
Data Logging	Waconia St.	Ham Lake
Data Logging	Northern Natural Gas Substation	Ham Lake
Cylinder - Volunteer	Arzdorf residence	Blaine
Cylinder – Volunteer	Myhre residence	Andover
Cylinder – Volunteer	Solie residence	Coon Rapids

Note: Additional county-wide precipitation summaries can be found in Chapter 1.

Results: Precipitation data were reported to the Coon Creek Watershed in digital format. A summary table and graph are presented on the following page.

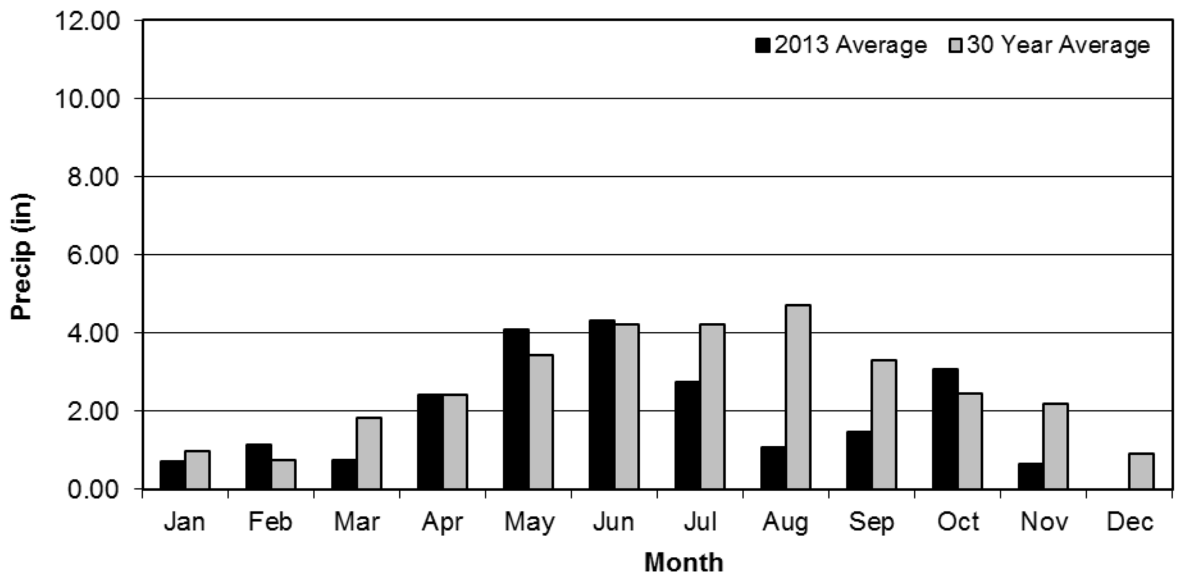
Coon Creek Watershed 2013 Precipitation Monitoring Sites



Coon Creek Watershed 2013 Precipitation Summary Table and Graph

		Month													
Location or Volunteer	**Location**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Total**	**Growing Season (May-Sept)**
Tipping bucket, datalogging rain gauges (Time and date of each 0.01" is recorded)															
Andover City Hall	Andover				2.56	4.78	0.75		1.46	1.63				11.18	8.62
Blaine Public Works	Blaine			0.60	2.18	4.49	5.05	3.07	0.92	1.16	3.32			20.79	14.69
Coon Rapids City Hall	Coon Rapids			0.66	2.69	4.81	5.54	3.71	1.14	1.53	1.77			21.85	16.73
Anoka Cons. District office	Ham Lake				0.83	0.76	2.56		0.73	1.49	3.63			10.00	5.54
Hoffman Sod Farm	Ham Lake			0.56	2.36	4.68	5.18	3.17	1.12	1.56	1.51			20.14	15.71
Northern Nat. Gas substation	Ham Lake					4.02	5.23	0.82						10.07	10.07
Cylinder rain gauges (read daily)															
N. Myhre	Andover	0.70	1.14		3.16	4.29	5.11	2.77	1.04	1.53	3.82	0.66		24.22	14.74
J. Arzdorf	Blaine			1.11	3.04	4.92	4.98	2.89	1.03	1.48	4.40			23.85	15.30
2013 Average	County-wide	0.70	1.14	0.73	2.40	4.09	4.30	2.74	1.06	1.48	3.08	0.66		22.39	13.68
30 Year Average	Cedar	0.99	0.76	1.84	2.40	3.43	4.22	4.21	4.70	3.29	2.44	2.18	0.90	31.36	19.85

precipitation as snow is given in melted equivalents



Precipitation Analyses

Description: Two different precipitation analyses were done – 1) 2013 storm analyses and 2) long term precipitation trend analysis.

1.) **2013 Storm Analyses:** Precipitation events at each of the six Coon Creek Watershed District data-logging rain gauges were analyzed. Total precipitation, storm duration, intensity, and recurrence interval were determined for all precipitation events of >0.03 inches. Storms with a recurrence that was two months or longer were analyzed further. The storm's intensity was tracked throughout the storm and graphed (similar to storm typing, but a type was not assigned). The rate of effective precipitation was determined from the rainfall intensity and surrounding soil type. Effective precipitation was defined as precipitation occurring at an intensity that is lower than the soil infiltration rate (i.e. rain that soaks in and doesn't run off).

   The results of this analysis were delivered to the Coon Creek Watershed District in digital form and are not reported here due to complexity and lengthiness.

2.) **Long Term Precipitation Trends Analysis:** Monthly rainfall deviations from normal were graphed for 1986 to present. Data utilized were from the "Coon Creek-211785" National Weather Service (NWS) station until 2005 when that station was abandoned. Thereafter, the NWS station "Andover-210190" was used. Normal precipitation totals for each month are from the NWS Cedar station. Deviation from normal during the preceding 6-, 12-, and 24-month time periods were calculated and graphed. This is presented on the following page.

Purpose: To aid in hydrologic modeling of the watershed. Also useful for all types of hydrologic analyses, predictions, and regulatory decisions within the watershed.

Locations:

Site	**City**
Andover City Hall	Andover
Anoka Conservation District Office	Ham Lake
Blaine Public Works	Blaine
Coon Rapids City Hall	Coon Rapids
Hoffman Sod Farm	Ham Lake
Waconia Street	Ham Lake
Northern Natural Gas Substation	Ham Lake

Hoffman Sod Farm site relocated to Waconia Street site in April 2013

Results:

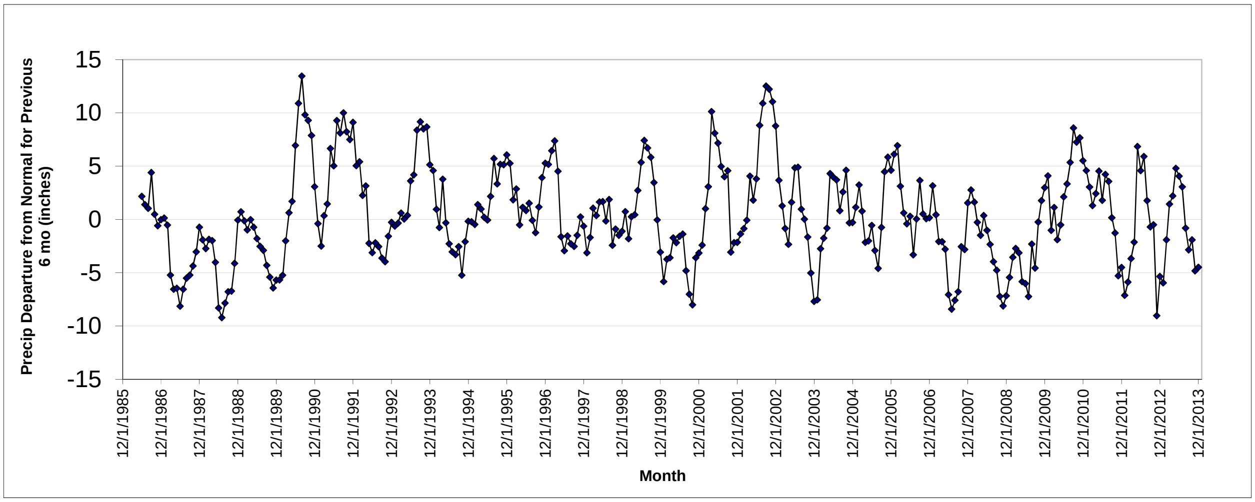
1.) **2013 Storm Analyses:** The results of these analyses were delivered to the Coon Creek Watershed District in digital form and are not reported here due to complexity and lengthiness.

2.) **Long Term Precipitation Trends Analysis:** Results are presented on the following page.

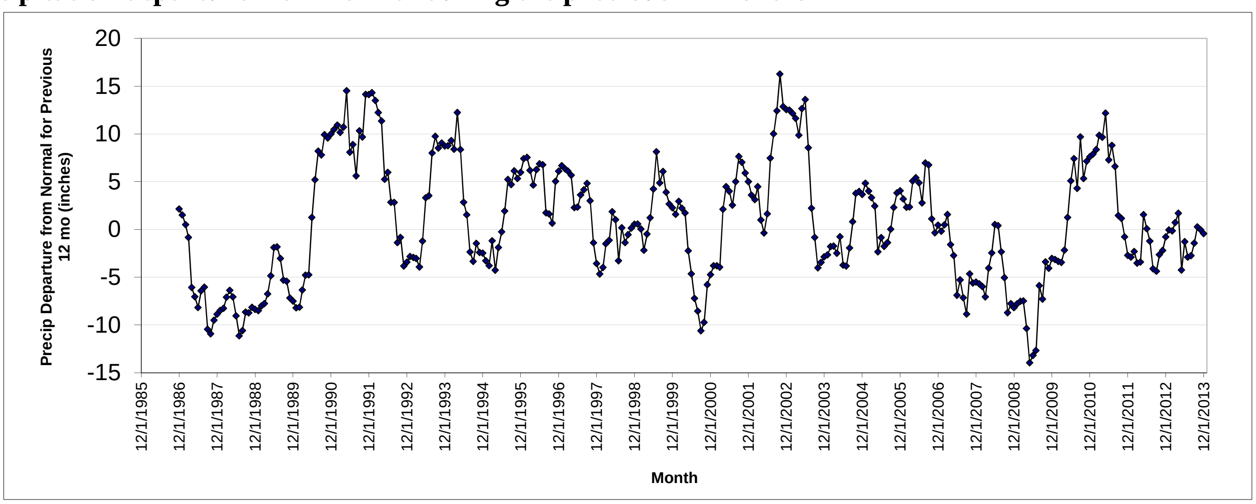
Long Term Precipitation Trends

Notes: Period is 1986 to present. Monthly precipitation totals are from the NWS station nearest the center of the Coon Creek Watershed District with available data (MN State Climatology website). Normal precipitation totals for each month are from the NWS Cedar station.

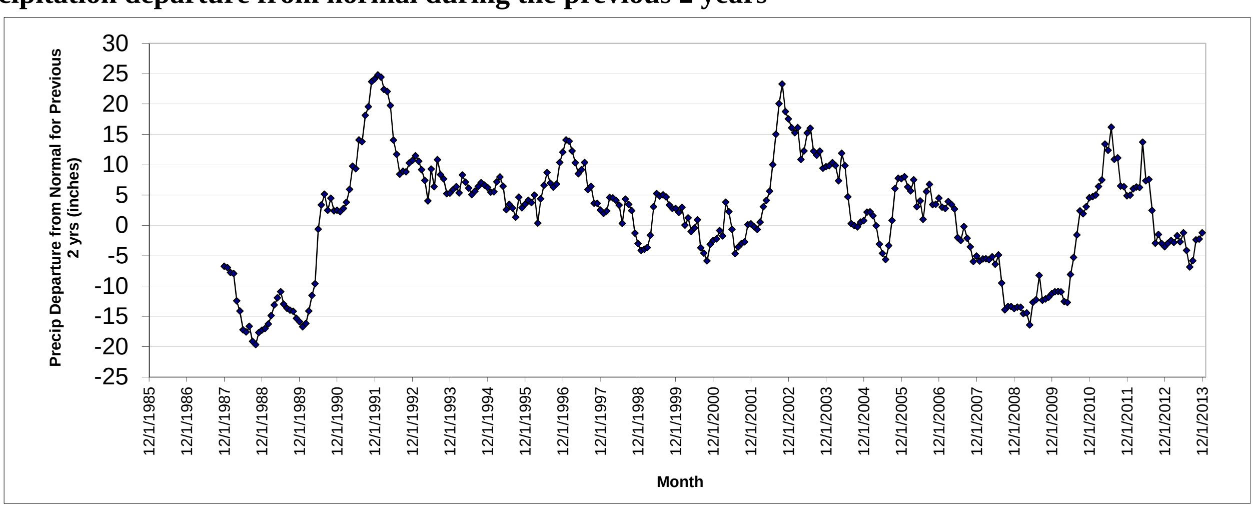
Precipitation departure from normal during the previous 6 months



Precipitation departure from normal during the previous 12 months



Precipitation departure from normal during the previous 2 years



Lake Levels

Description: Weekly water level monitoring in lakes. The past five years are shown below, and all historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

Locations:

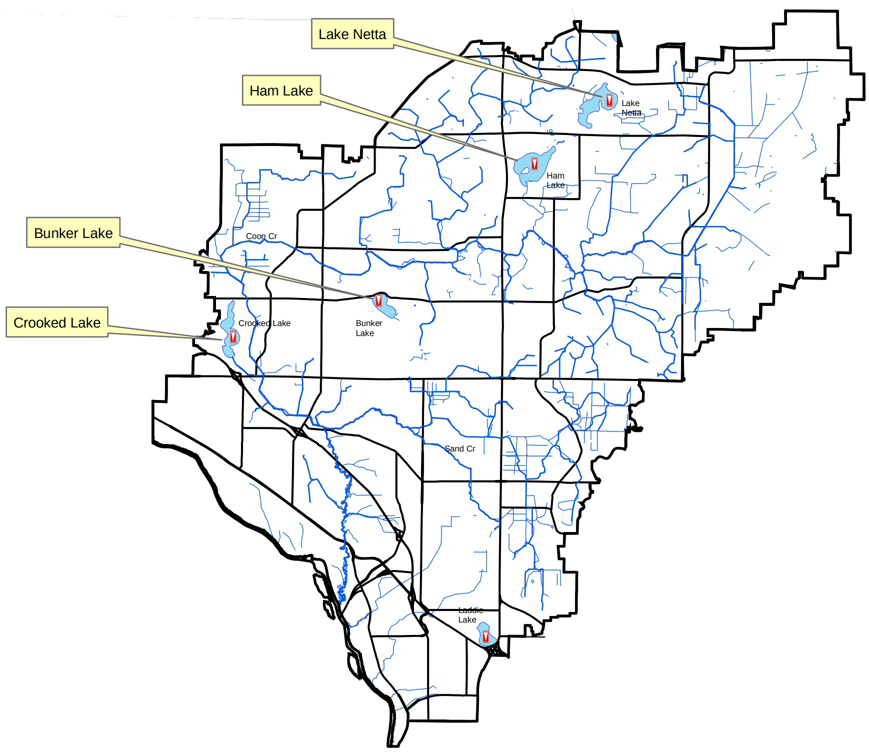
Site	City
Bunker Lake	Andover
Crooked Lake	Andover/Coon Rapids
Ham Lake	Ham Lake
Lake Netta	Ham Lake
Laddie Lake	Blaine

Results: Lake levels were measured by volunteers 37 times at Crooked Lake, 43 times at Ham Lake, 26 times at Lake Netta, and 34 at Laddie Lake. The level in Bunker Lake was monitored using an electronic gauge, which resulted in 184 days of measurements generated by averaging six readings from each day.

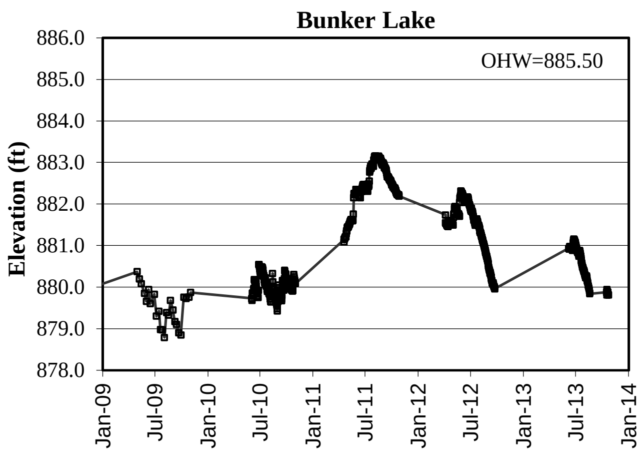
Coon Creek Watershed lake levels during 2013 exhibited trends similar to that observed in 2012. Following early spring increases due to sufficient precipitation, lake levels then dropped steadily throughout the remainder of the year. As in 2012, Bunker, Crooked, Ham, and Netta Lakes all ended 2013 with water levels lower than the beginning of 2013.

Ordinary High Water Level (OHW), the elevation below which a DNR permit is needed to perform work, is listed for each lake on the corresponding graphs below.

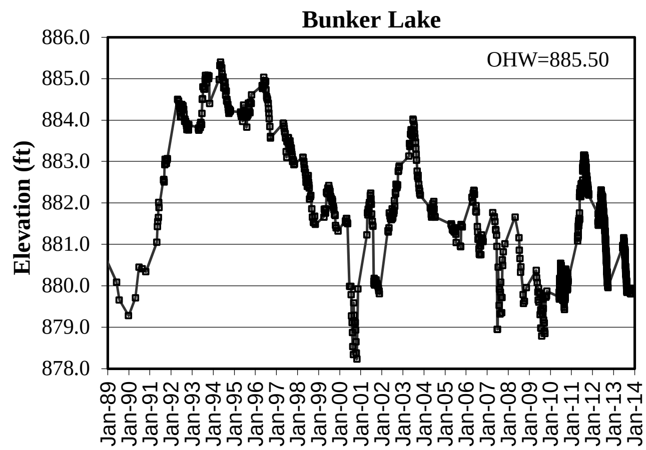
Coon Creek Watershed 2013 Lake Level Monitoring Sites



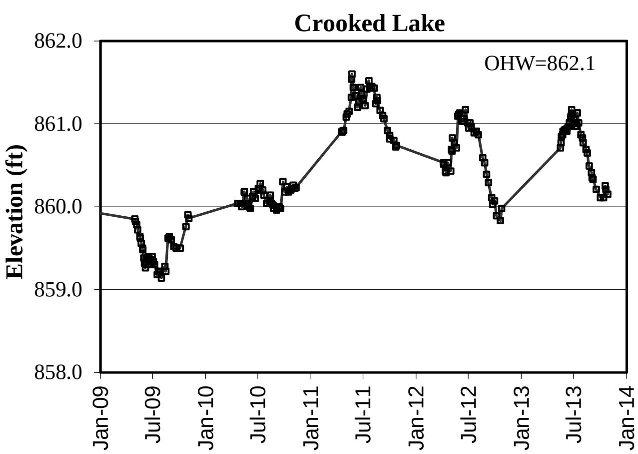
Bunker Lake Levels 2009-2013



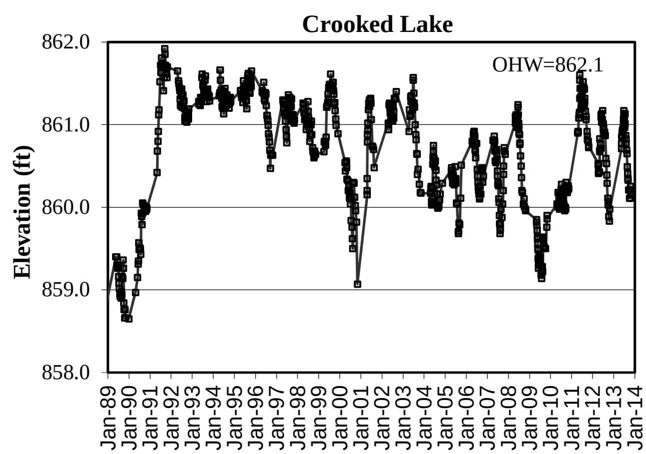
Bunker Lake Levels 1989-2013



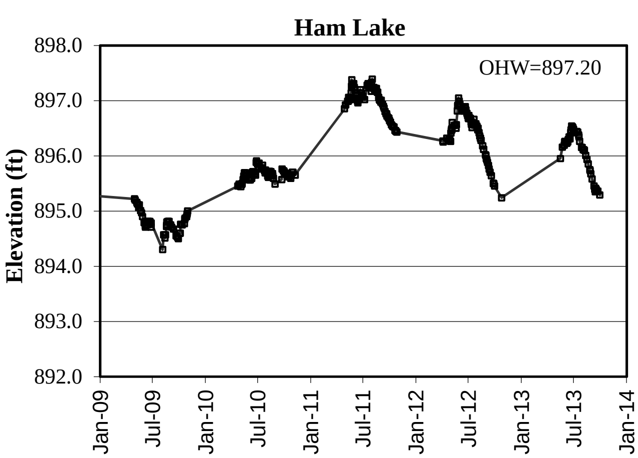
Crooked Lake Levels 2009-2013



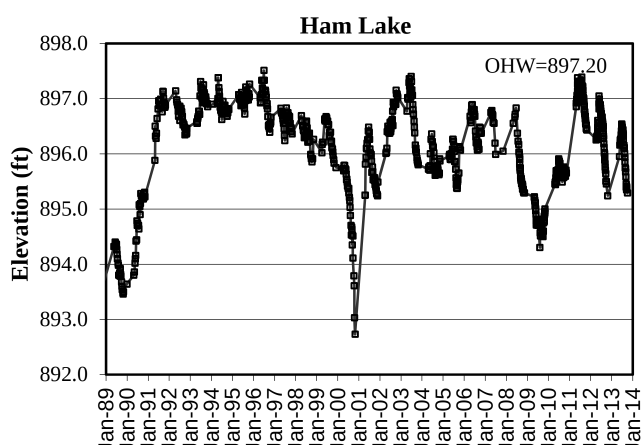
Crooked Lake Levels 1989-2013



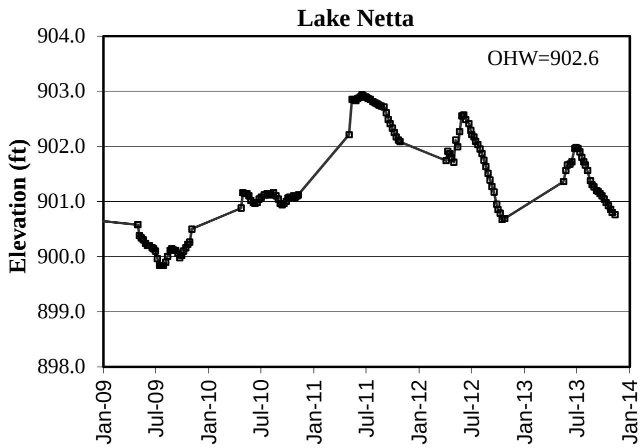
Ham Lake Levels 2009-2013



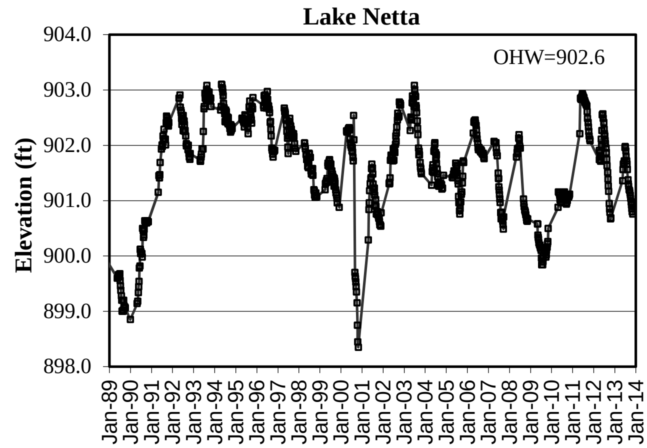
Ham Lake Levels 1989-2013



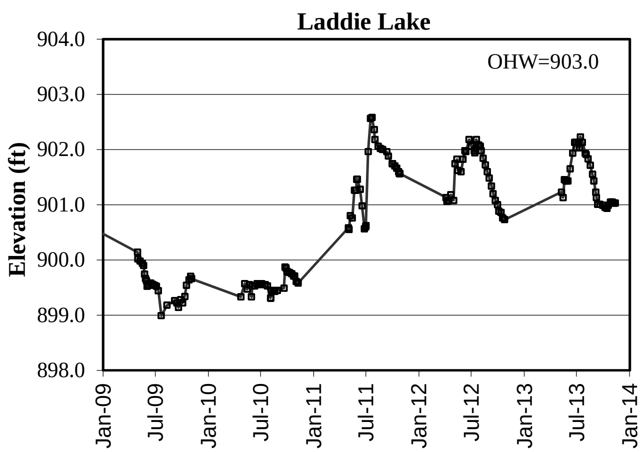
Lake Netta Levels 2009-2013



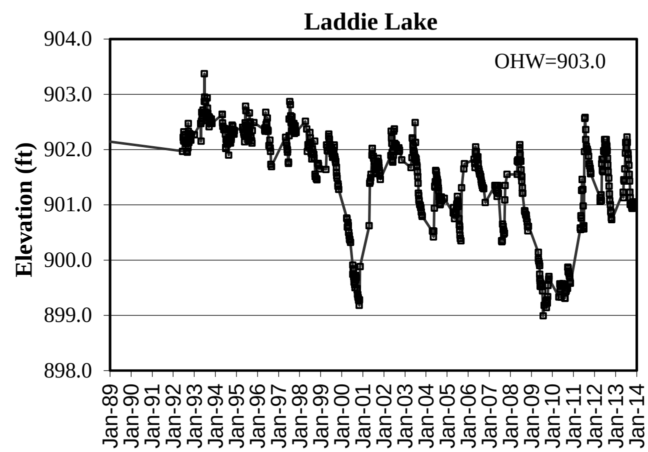
Lake Netta Levels 1989-2013



Laddie Levels 2009-2013



Laddie Levels 1989-2013



Annual average, minimum, and maximum levels for each of the past 5 years

Lake	Year	Average	Min	Max
Bunker	2008	880.41	879.57	881.66
	2009	879.52	878.79	880.37
	2010	880.01	879.43	880.54
	2011	882.40	881.08	883.15
	2012	881.45	879.96	882.32
	2013	880.57	879.81	881.17
Crooked	2008	860.75	859.96	861.24
	2009	859.47	859.14	859.90
	2010	860.12	859.96	860.30
	2011	861.19	860.72	861.60
	2012	860.64	859.83	861.17
	2013	860.76	860.11	861.17
Ham	2008	895.75	895.29	896.83
	2009	894.80	894.30	895.22
	2010	895.66	895.44	895.91
	2011	897.00	896.43	897.39
	2012	896.40	895.24	897.05
	2013	896.04	895.29	896.54

Lake	Year	Average	Min	Max
Netta	2008	901.32	900.63	902.19
	2009	900.15	899.84	900.58
	2010	901.06	900.88	901.16
	2011	902.64	902.08	902.93
	2012	901.76	900.67	902.57
	2013	901.40	900.76	901.98
Laddie	2008	901.28	900.53	902.09
	2009	899.55	898.99	900.14
	2010	899.56	899.31	899.87
	2011	901.51	900.55	902.58
	2012	901.58	900.72	902.18
	2013	901.47	900.93	902.23

Lake Water Quality

Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

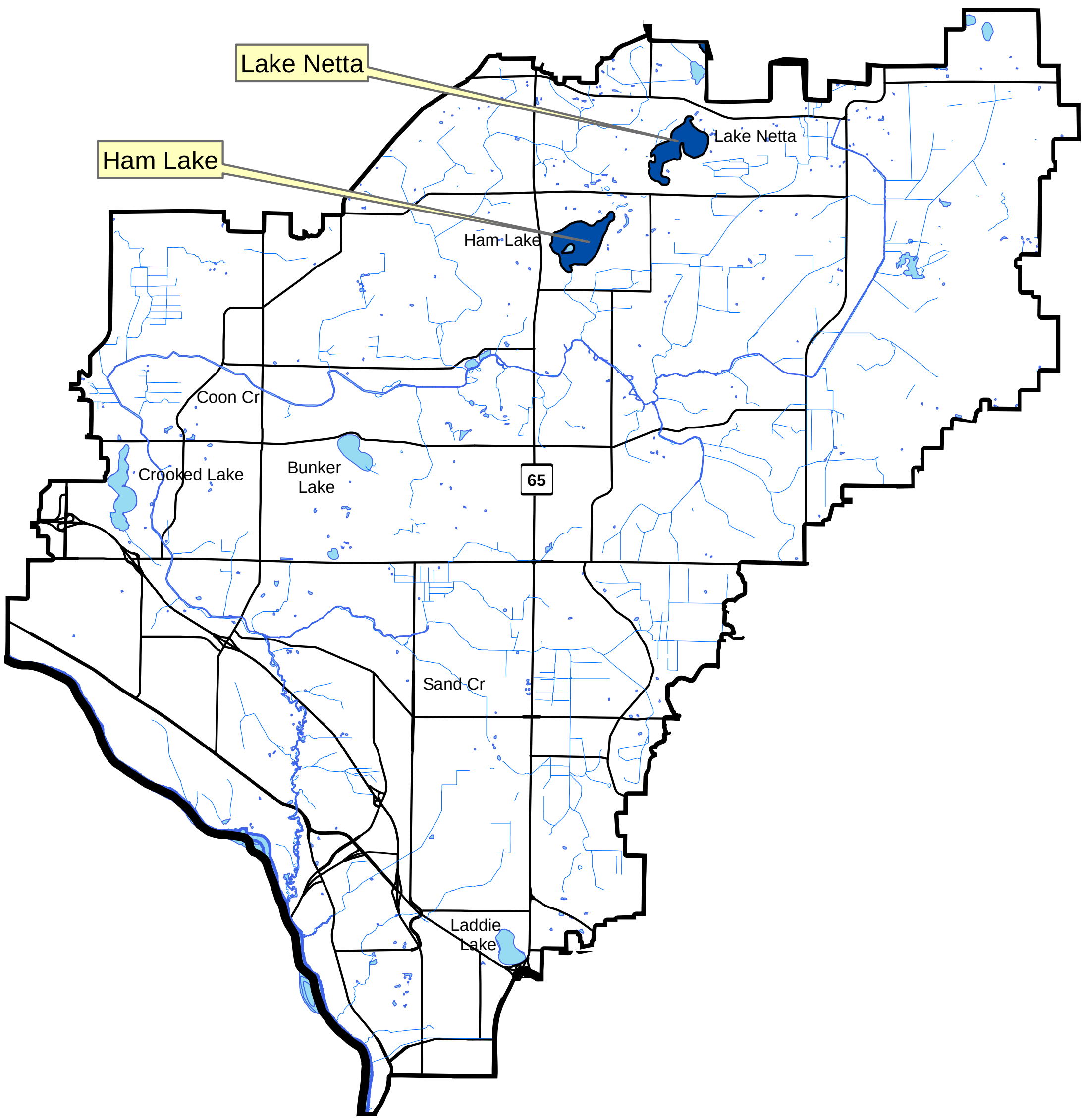
Purpose: To detect water quality trends and diagnose the cause of changes.

Locations:

Site	City
Ham Lake	Ham Lake
Lake Netta	Ham Lake

Results: Detailed data for each lake are provided on the following pages, including summaries of historical conditions and trend analysis. Previous years' data are available from the ACD. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.

Coon Creek Watershed 2013 Lake Water Quality Monitoring Sites



HAM LAKE

CITY OF HAM LAKE, LAKE ID # 02-0053

Background

Ham Lake has a surface area of 193 acres with a maximum depth of 22 feet (6.7 m). Public access is from Ham Lake City Park on the south side of the lake, which includes a boat landing. The lake is used extensively by recreational boaters and fishers. Ham Lake has a winter aeration system to prevent winter fish kills. The lake is surrounded by single-family homes of moderate density and vacant/forested land. The watershed is a mixture of residential, commercial and vacant land.

2013 Results

Ham Lake water quality received a slightly above-average rating for this region of the state (NCHF Ecoregion) in 2013, receiving an A letter grade. The average of total phosphorus results was among the lowest of all years monitored at 20.8 ug/L. Chlorophyll-a, a measure of algal growth, was the lowest of all monitored years averaging 2.6 mg/L. Chlorophyll-a stayed consistently low throughout the entire season. Transparency was similar, recording the deepest readings in all monitored years, though readings became lower after August. This is similar to the previous year when algal growth was strong in late summer, but relatively level the remaining months. Curly-leaf pondweed growth appeared less abundant in 2013 than in previous years, this may be in part due to the quick and wide infestation by another exotic species, Eurasian Water Milfoil.

Trend Analysis

Sixteen years of water quality data have been collected by the Minnesota Pollution Control Agency (between 1984 and 1997) and the Anoka Conservation District (between 1998 and 2013). Lake water quality has fluctuated from "A" to "C" back to "A" water quality grades, but there is no significant long-term trend (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,13}$ = 1.71, p = 0.22).

Discussion

Water quality in Ham Lake is very good for a metro-area lake. Current threats to lake water quality include shoreline activities, aquatic plant removal by lakeshore homeowners, curly leaf pondweed, and as of 2013 (EWM) Eurasian water milfoil. While water monitoring was being performed in June 2013, Eurasian water milfoil was discovered in Ham Lake. Since its discovery, mapping efforts estimate that approximately 12% of the littoral area of Ham Lake is infested with EWM. Lake residents have held multiple meetings and began organizing a lake association. They have elected a board and have plans to treat the lake with herbicide as early as spring of 2014. The effect of the two invasive species on water quality beyond recreational hindrance is unknown.

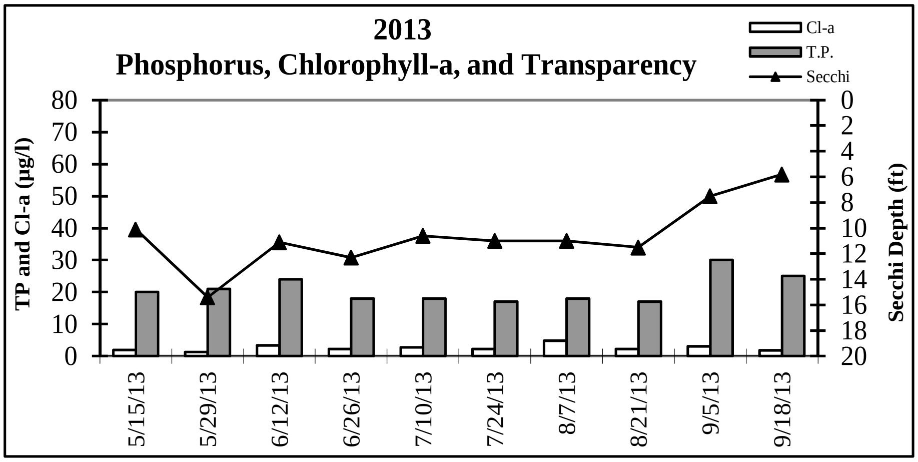
2013 Ham Lake Water Quality Data

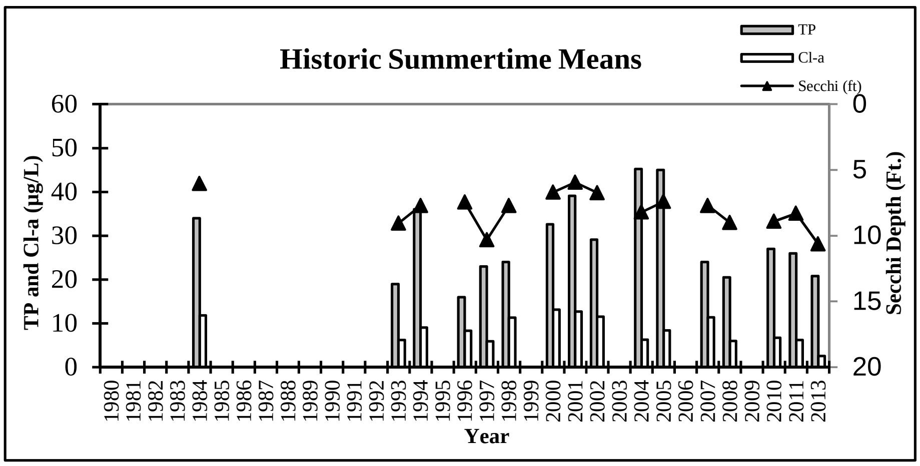
Ham Lake

2013 Water Quality Data			5/15/2013	5/29/2013	6/12/2013	6/26/2013	7/10/2013	7/24/2013	8/7/2013	8/21/2013	9/5/2013	9/18/2013			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.42	8.1	8.44	8.83	8.57	8.38	8.61	8.78	8.24	8.23	8.46	8.10	8.83
Conductivity	mS/cm	0.01	0.226	0.3	0.288	0.261	0.254	0.254	0.247	0.288	0.31	0.321	0.275	0.226	0.321
Turbidity	NTU	1.00	2.00	0.00	0.90	0.00	0.00	0.20	2.20	0.00	2.10	1.20	0.86	0.00	2.20
D.O.	mg/L	0.01	11.05	8.7	9.16	9.59	7.79	7.39	8.13	8.45	6.84	7.35	8.37	6.84	11.05
D.O.	%	1	107%	90%	103%	119%	97%	90%	94%	106%	83%	82%	97%	82%	119%
Temp.	°C	0.1	14	16	19	26	25	25	23	25	23	19	21.6	14.4	25.8
Temp.	°F	0.1	57.9	60.2	66.3	78.4	77.5	77.5	73.1	77.5	73.5	66.0	70.8	57.9	78.4
Salinity	%	0.01	0	0.14	0.14	0.13	0.12	0.12	0.12	0.14	0.15	0.15	0.12	0.00	0.15
Cl-a	ug/L	0.5	1.9	1.3	3.4	2.2	2.7	2.2	4.8	2.2	3.1	1.8	2.6	1.3	4.8
T.P.	mg/L	0.010	0.02	0.021	0.024	0.018	0.018	0.017	0.018	0.017	0.03	0.025	0.021	0.017	0.030
T.P.	ug/L	10	20	21	24	18	18	17	18	17	30	25	21	17	30
Secchi	ft	0.1	10.1	15.4	11.1	12.3	10.6	11	11	11.5	7.5	5.8	10.6	5.8	15.4
Secchi	m	0.1	3.08	4.69	3.38	3.75	3.23	3.35	3.35	3.51	2.29	1.77	3.2	1.8	4.7
Physical			1.0	1.0	2.0	2.0	2.0	3.0	2.0	1.0	2.0	1.0	1.7	1.0	3.0
Recreational			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

*reporting limit

Ham Lake Water Quality Results





Ham Lake Summertime Historic Mean

Agency	MC	MC	MC	MC	MC	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	
Year	84	93	94	96	97	98	2000	2001	2002	2004	2005	2007	2008	2010	2011	2013
TP	34.0	19.0	36.0	16.0	23.0	24.0	32.6	39.1	29.1	45.2	45.0	24.0	20.5	27.0	26.0	20.8
Cl-a	11.8	6.2	9.1	8.3	5.9	11.3	13.1	12.7	11.5	6.3	8.4	11.4	6.0	6.7	6.2	2.6
Secchi (m)	1.8	2.8	2.4	2.3	3.1	2.4	2.0	1.8	2.1	2.5	2.2	2.3	2.7	2.7	2.5	3.2
Secchi (ft)	6.0	9.1	7.7	7.4	10.3	7.7	6.7	5.9	6.7	8.2	7.4	7.7	9.0	8.9	8.3	10.6

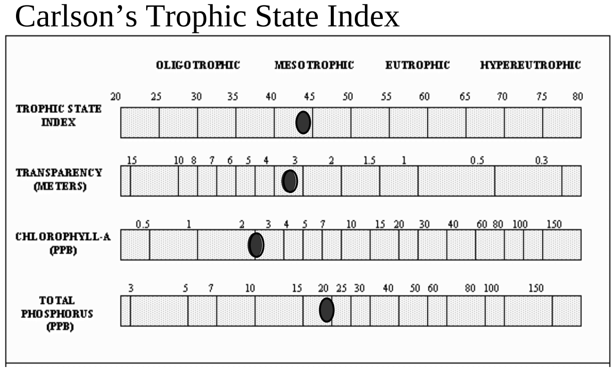
Carlson's Tropic State Indices

TSIP	55	47	56	44	49	50	54	57	53	59	59	50	48	52	51	48
TSIC	55	49	52	51	48	54	56	56	55	49	52	55	48	49	49	40
TSIS	51	45	48	48	43	48	50	51	50	47	49	48	45	46	47	43
TSI	54	47	52	48	47	51	53	55	52	52	53	51	47	49	49	44

Ham Lake Water Quality Report Card

Year	84	93	94	96	97	98	2000	2001	2002	2004	2005	2007	2008	2010	2011	2013
TP	C	A	C	A	A	B	C	C	B	C	C	B	A	B	B	A
Cl-a	B	A	A	A	A	B	B	B	B	A	A	B	A	A	A	A
Secchi	C	B	B	B	A	B	C	C	C	B	B	B	B	B	B	A
Overall	**C**	**A**	**B**	**A**	**A**	**B**	**C**	**C**	**B**	**B**	**B**	**B**	**A**	**B**	**B**	**A**

Carlson's Trophic State Index



LAKE NETTA

City of Ham Lake, Lake ID # 02-0053

Background

Lake Netta is located in the central portion of Anoka County, southwest of Coon Lake. It has a surface area of 168 acres and a maximum depth of 19 feet (5.8 m). There is a small, rugged public access on the west side of the lake in a neighborhood park. This access can accommodate canoes only. The lake receives little recreational use due to the difficulty of public access. The lakeshore is only lightly developed, with a few small lakeside neighborhoods and scattered housing elsewhere. The watershed is a mixture of residential, commercial and vacant land, but is under development pressure. No exotic plant species have been documented in Lake Netta.

2013 Results

Lake Netta again had above-average water quality for this region of the state (NCHF Ecoregion) in 2013. The overall A grade was driven by low concentrations of total phosphorus and chlorophyll *a* as well as high Secchi transparency. All of these 2013 results were the best recorded since monitoring began in 1997. Water quality parameters were similar to previous years and indicate the stability of the clear water and healthy submerged vegetation community with this system.

Trend Analysis

Twelve years of water quality data have been collected by the Anoka Conservation District (1997-1999, 2001, 2003-2004, 2006-2007, 2009-2010, 2012, and 2013), along with Secchi depth measurements by citizens five other years. Lake water quality has fluctuated between "A" and "B" grades, but there is no significant long-term trend of changing lake water quality (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,9} = 1.50$, $p = 0.27$).

Discussion

High water quality in Lake Netta has been maintained since 1997, when ACD began regularly monitoring water quality. Primary production in the lake is dominated by the submerged macrophyte (large plant) community, as opposed to being dominated by algae. The plants are essential to maintaining good water quality because they sequester nutrients from the water column, making them unavailable to algae. They also minimize sediment disturbance by wind or boats and provide refuges for zooplankton, which consume algae. Other reasons for good water quality in this lake include that it has a small watershed and receives little direct runoff. No streams of any consequence enter this lake. Maintaining good water quality in this lake will be, in large part, dependent upon protecting the in-lake aquatic vegetation, as well as maintenance of vegetated buffers near the water's edge by property owners.

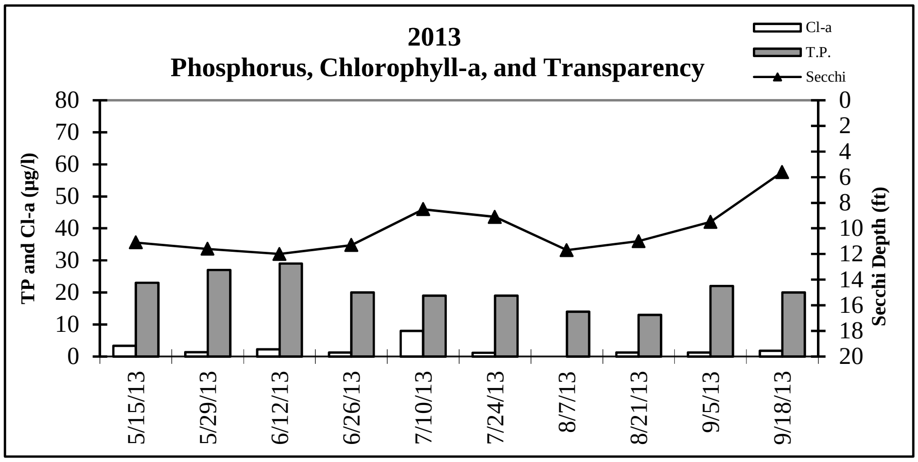
2013 Lake Netta Water Quality Data

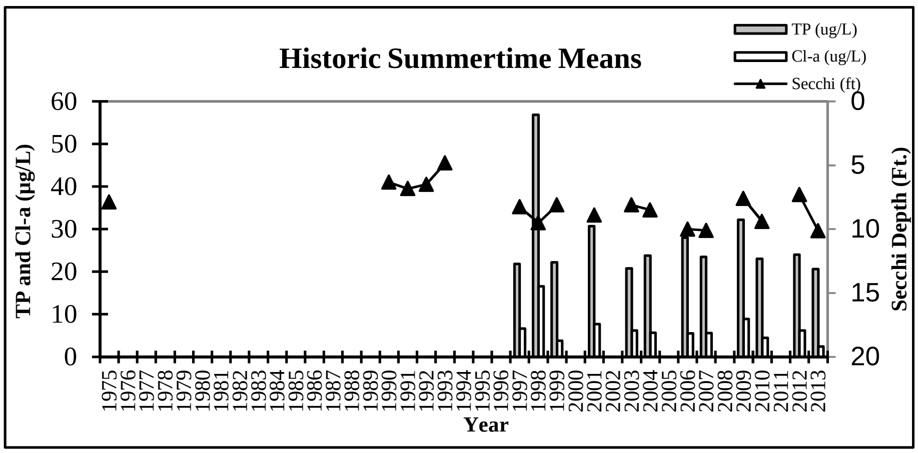
Lake Netta
2013 Water Quality Data

	Units	R.L.*	5/15/2013 Results	5/29/2013 Results	6/12/2013 Results	6/26/2013 Results	7/10/2013 Results	7/24/2013 Results	8/7/2013 Results	8/21/2013 Results	9/5/2013 Results	9/18/2013 Results	Average	Min	Max
pH		0.1	8.26	7.82	7.77	8.19	7.94	7.70	7.94	8.23	7.99	7.87	7.97	7.70	8.26
Conductivity	mS/cm	0.01	0.152	0.206	0.208	0.203	0.203	0.201	0.204	0.245	0.252	0.259	0.213	0.152	0.259
Turbidity	FNRU	1	3	0	1	0	1	0	1	0	2	1	1	0	3
D.O.	mg/L	0.01	10.02	8.64	6.33	8.20	7.42	6.25	6.83	7.62	6.95	6.70	7.50	6.25	10.02
D.O.	%	1	100	89	70	103	94	76	81	96	83	74	86	70	103
Temp.	°C	0.1	15.2	15.7	18.7	26.6	25.2	24.8	22.3	25.3	22.6	18.5	21.5	15.2	26.6
Temp.	°F	0.1	59.4	60.2	65.7	79.8	77.4	76.7	72.2	77.6	72.8	65.4	70.7	59.4	79.8
Salinity	%	0.01	0.00	0.10	0.10	0.10	0.10	0.10	0.12	0.12	0.12	0.12	0.10	0.00	0.12
Cl-a	ug/L	0.5	3.4	1.4	2.3	1.3	8.0	1.2	<1	1.3	1.3	1.8	2.4	1.2	8.0
T.P.	mg/L	0.010	0.023	0.027	0.029	0.020	0.019	0.019	0.014	0.013	0.022	0.020	0.021	0.013	0.029
T.P.	ug/L	10	23	27	29	20	19	19	14	13	22	20	21	13	29
Secchi	ft	0.1	11.1	11.6	12.0	11.3	8.5	9.1	11.7	11.0	9.5	5.6	10.1	5.6	12.0
Secchi	m	0.1	3.4	3.5	3.7	3.4	2.6	2.8	3.6	3.4	2.9	1.7	3.1	1.7	3.7
Physical			1	1	2	1	2	1	2	1	1	1	1.3	1.0	2.0
Recreational			1	1	1	1	1	2	1	1	1	1	1.1	1.0	2.0

*reporting limit

Lake Netta Water Quality Results





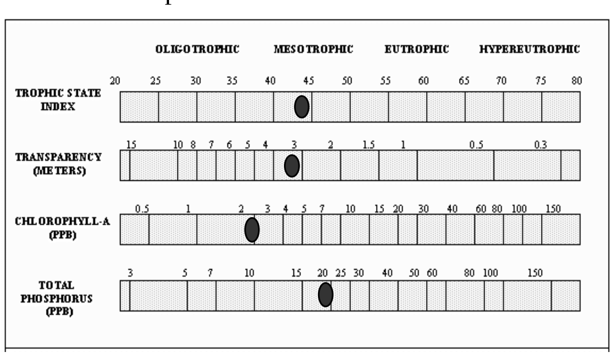
Lake Netta Historical Summertime Mean Values

Agency	CLMP	CLMP	CLMP	CLMP	CLMP	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1975	1990	1991	1992	1993	1997	1998	1999	2001	2003	2004	2006	2007	2009	2010	2012	2013
TP (µg/L)						21.8	56.9	22.2	30.7	20.8	23.8	28.0	23.5	32.2	23.0	24.0	20.6
Cl-a (µg/L)						6.7	16.6	3.8	7.7	6.2	5.7	5.5	5.6	8.9	4.5	6.2	2.4
Secchi (m)	2.4	1.9	2.1	2.0	1.5	2.5	2.9	2.5	2.7	2.5	2.6	3.0	3.1	2.3	2.9	2.2	3.1
Secchi (ft)	7.9	6.3	6.8	6.5	4.8	8.3	9.5	8.1	8.9	8.1	8.5	10.0	10.1	7.6	9.4	7.3	10.1
Carlson's Trophic State Index																	
TSIP						49	62	49	54	48	50	52	50	54	49	50	48
TSIC						49	58	44	51	48	48	47	48	52	45	48	39
TSIS	47	51	49	50	54	47	45	47	46	47	46	44	44	48	45	49	44
TSI						48	55	47	50	48	48	48	47	51	46	49	44

Lake Netta Water Quality Report Card

Year	1975	1990	1991	1992	1993	1997	1998	1999	2001	2003	2004	2006	2007	2009	2010	2012	2013
TP (µg/L)						A	C	A	B	A	B+	B	B	C	A-	B+	A
Cl-a (µg/L)						A	B	A	A	A	A	A	A	A	A	A	A
Secchi (m)	B	C	C	C	C	B	B	B	B	B	B	B+	A	B	B+	B	A
Overall						**B**	**B**	**A**	**B**	**A**	**A**	**B+**	**B+**	**B**	**A-**	**B+**	**A**

Carlson's Trophic State Index



Stream Hydrology and Rating Curves

Description: Continuous water level monitoring in streams.

Purpose: To provide understanding of stream hydrology, including the impact of climate, land use or discharge changes. These data also facilitate calculation of pollutant loads, use of computer models for developing management strategies, and water appropriations permit decisions.

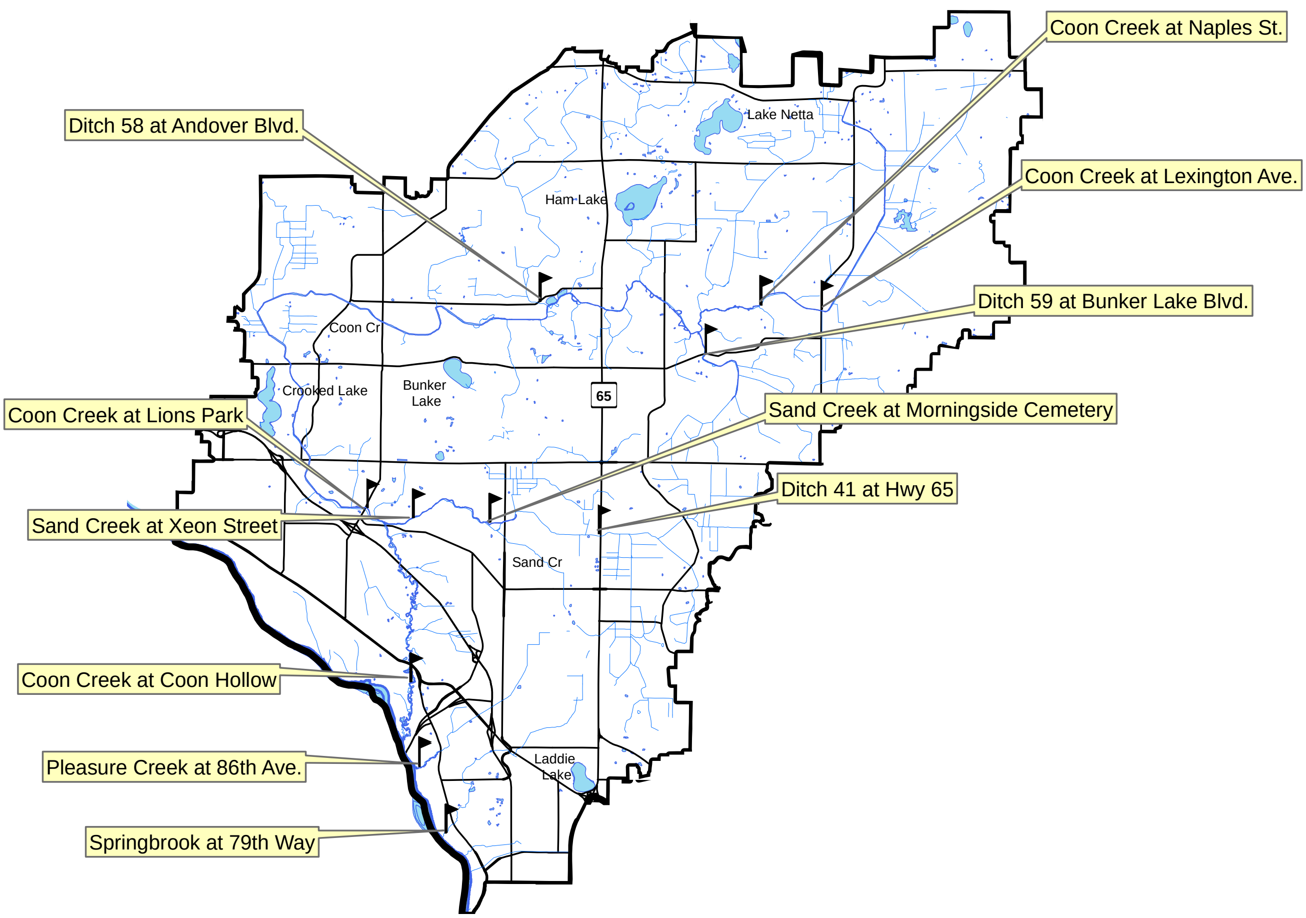
Locations:

Stream	Location	City
Coon Creek	Lexington	Ham Lake
Coon Creek	Coon Hollow	Coon Rapids
Coon Creek	Lions Park	Coon Rapids
Coon Creek	Naples St. NE	Ham Lake
Ditch 58	Andover Blvd.	Ham Lake
Ditch 41	Highway 65	Blaine

Stream	Location	City
Ditch 59	Bunker Lake Blvd.	Ham Lake
Sand Creek	Xeon St.	Coon Rapids
Sand Creek	Morningside Cemetery	Coon Rapids
Springbrook	79th Way NE	Fridley
Pleasure Creek	86th Ave. NW	Coon Rapids

Results: Results for each site are on the following pages.

Coon Creek Watershed 2013 Stream Hydrology and Rating Curves Monitoring Sites

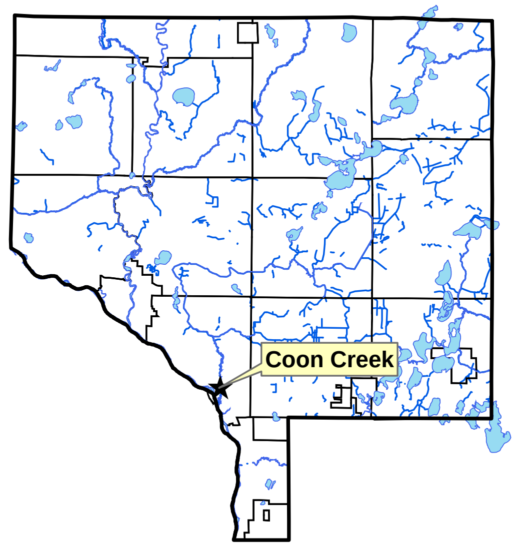


Stream Hydrology Monitoring

COON CREEK

at Coon Creek Hollow, Vale Street, Coon Rapids

Notes



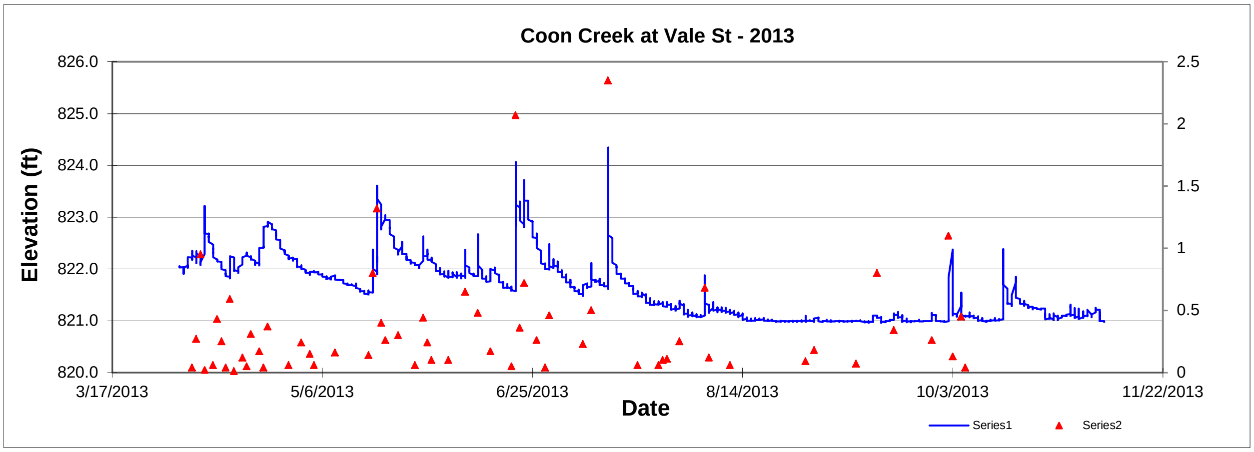
Coon Creek is a major drainage through central Anoka County. This monitoring location is the closest to the outlet to the Mississippi River that is accessible and does not have backwater effects from the Mississippi during high water. Land use in the upstream watershed ranges from rural residential upstream to highly urbanized downstream. The creek is about 30 feet wide and 1.5 to-2 feet deep at the monitoring site during baseflow. Both creek water levels and flow are available for this site.

In 2013 Coon Creek water levels spanned a range of 3.38 feet (see hydrograph on next page). Over a span of 4 ½ hours in mid-July 2013, 2.35 inches of rain resulted in the maximum observed stream level (824.35 feet), while below average rainfall from August to October resulted in little water level fluctuation and the lowest stream level of the year (<820.97).

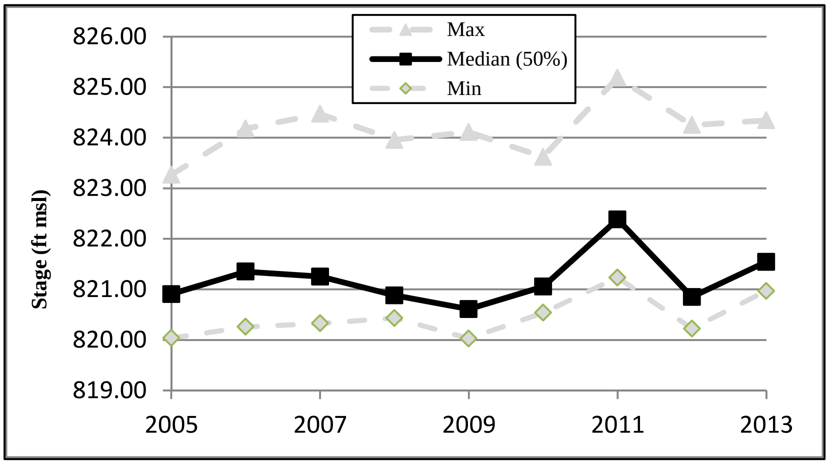
Coon Creek has flashy responses to storms, as displayed in the hydrograph on the next page. Water levels rise quickly in response to precipitation, but return to baseflow conditions more slowly. The quick, intense response to rainfall is runoff from the urbanized downstream watershed near the monitoring station. The slower return to baseflow is probably due, in large part, to water being released more slowly from the less-developed upstream portions of the watershed. Several storms in 2006-2013 serve to illustrate this phenomenon. In the few hours following larger storms, water levels can rise nearly 4 feet. During 2006's largest storm, a 2.23-inch storm on June 16, water levels rose 3.4 feet in the first 16 hours, including one two-hour period when the creek rose 2.23 feet. It took about 15 days for the water level to return to pre-storm levels, despite only three rain events of less than 0.15 inches during that time. During 2008's largest storm, 1.54-inches on August 27, creek levels rose 2.42 feet during a two hour period, rising a total of 3.46 feet in response to the storm. A 2.11-inch rainfall on August 19th, 2009 caused the creek to rise 3.62 feet within 16 hours. The largest storm of 2010, 1.62 inches on June 25th, resulted in an increase in stream elevation of 2.83 feet over approximately 10 hours. During a particularly intense rainstorm in 2011, 2.10-inches fell on August 18, creek levels rose 1.99 feet during a two hour period, rising a total of 2.42 feet in response to the storm. A 1.83-inch rain event in May of 2012 caused the stream level to rise by 2.58 feet during a six hour period. During a 4 ½ hr 2.35-inch storm on July 13, 2013 creek levels rose 2.16 feet in a two hour period, rising a total of 2.35 feet in response to the storm.

The rating curve previously developed for this site and updated in 2010 (most recently reported in the 2011 Water Almanac) has been revised and is presented on the next page. ACD staff discovered an error in the equation that has since been corrected. All past hydrology records that used the equations were also corrected.

2013 Hydrograph



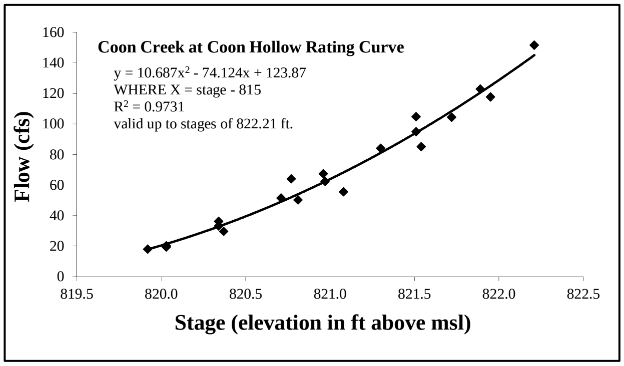
Summary of All Monitored Years



Summary of All Monitored Years

Percentiles	2005	2006	2007	2008	2009	2010	2011	2012	2013
Min	820.04	820.26	820.33	820.43	820.03	820.54	821.23	820.22	820.97
2.5%	820.06	820.42	820.40	820.52	820.12	820.64	821.27	820.28	820.99
10.0%	820.19	820.53	820.53	820.57	820.20	820.73	821.31	820.33	821.00
25.0%	820.57	820.78	820.73	820.63	820.35	820.85	821.83	820.45	821.07
Median (50%)	820.91	821.35	821.25	820.88	820.61	821.05	822.38	820.85	821.55
75.0%	821.26	821.78	821.88	821.78	820.93	821.32	822.99	821.28	822.02
90.0%	821.77	822.27	822.63	822.26	821.31	821.68	823.70	821.89	822.35
97.5%	822.92	822.76	823.21	822.79	822.05	822.33	824.56	823.60	822.95
Max	823.26	824.18	824.47	823.96	824.11	823.62	825.18	824.25	824.35

Rating Curve (2010 - updated)



COON CREEK

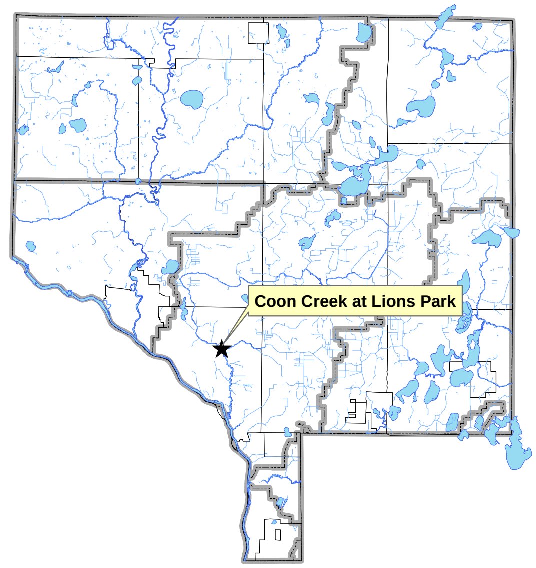
at Lions Park, Hanson Blvd., Coon Rapids

Notes

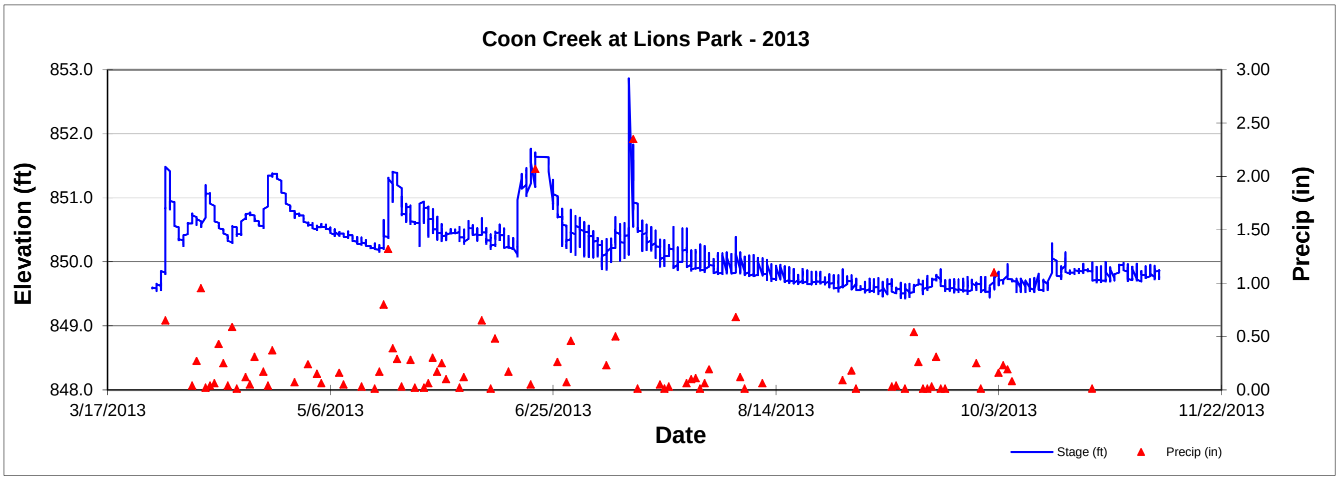
Coon Creek is a major drainage through central Anoka County. This monitoring location is within Lions Park in Coon Rapids, just downstream of the intersection of Coon Creek with Hanson Blvd. Land use in the upstream watershed ranges from rural residential to highly urbanized. The creek is approximately 35 feet wide and 2 to 2.5 feet deep at the monitoring site during baseflow. Both creek water levels and flow are available for this site.

Stream level and flow were monitored for the first time at this site in 2012. This site has a flashy hydrograph due to the urbanized watershed, similar to the Coon Creek at Coon Hollow site. In reaction to a 2.35" precipitation event on July 13th Coon Creek at Lions Park stream level rose 1.25ft in 4 hours.

Additional measurements were conducted in 2013 to refine the rating curve and are presented below.



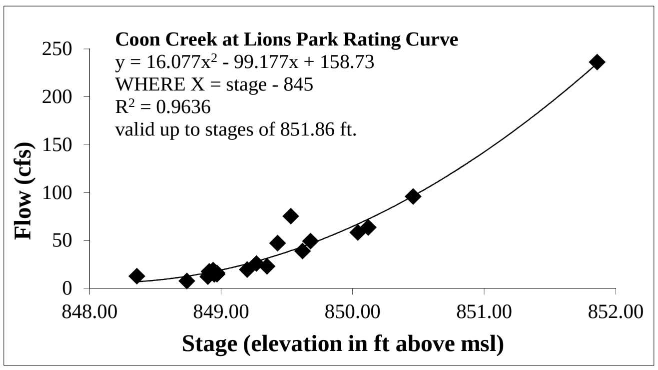
2013 Hydrograph



Summary of All Monitored Years

Percentiles	2012	2013
Min	848.87	849.43
2.5%	848.91	849.54
10.0%	848.96	849.60
25.0%	849.11	849.73
Median (50%)	849.51	850.15
75.0%	849.78	850.51
90.0%	850.31	850.78
97.5%	851.94	851.33
Max	852.35	852.87

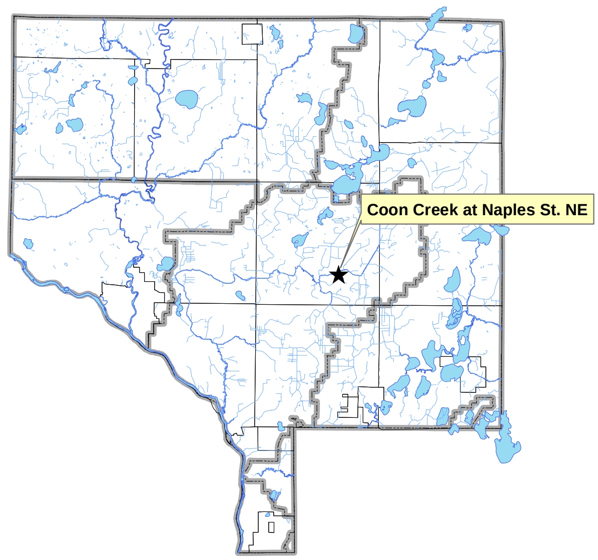
Rating Curve (2013)



COON CREEK

at Naples St. NE, Ham Lake

Notes

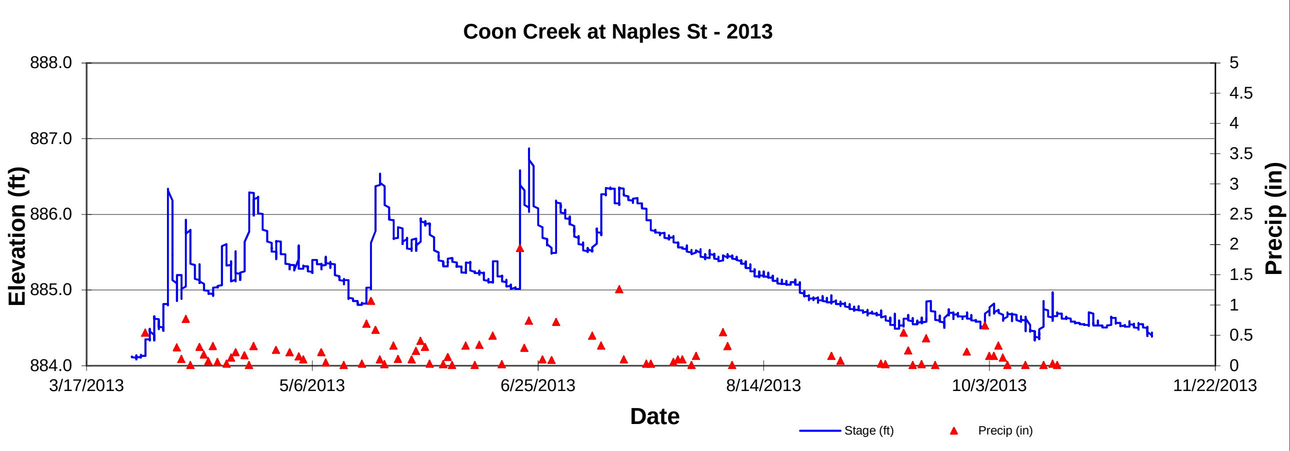


Coon Creek is a major drainage through central Anoka County. This monitoring location is just upstream of the intersection of Coon Creek with Naples St. NE and is the most upstream sampling site of the entire Coon Creek system. Land use in the upstream watershed is comprised of rural residential and sod fields. The creek is approximately 15 feet wide and 1 foot deep at the monitoring site during baseflow.

Stream level was monitored for the first time at this site in 2012. This site has a flashy hydrograph and reacts quickly to precipitation. A good example of this relationship occurred on June 21 when the stage rose 1.54ft in 12 hours in reaction to a 1.94” rain event. These flashes are illustrated well in the hydrograph below. Stream level dropped consistently from July through September due to diminished rainfall. Slight fluctuations late season are attributed to a small resurgence of rain events.

Several manual flow measurements were done in 2013 to inform rating curve development by CCWD’s consulting engineer. The engineer plans to use the stream cross section and desktop analysis for rating curve generation.

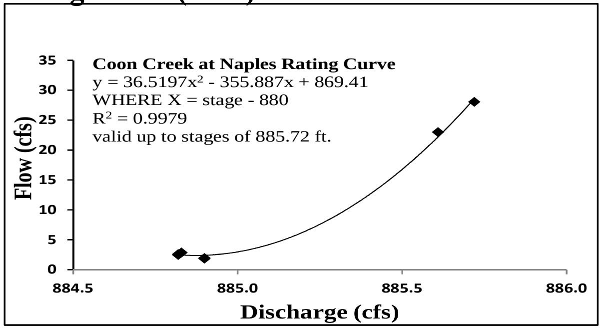
2013 Hydrograph



Summary of All Monitored Years

Percentiles	2012	2013
Min	884.61	884.09
2.5%	884.71	884.39
10.0%	884.81	884.54
25.0%	884.89	884.67
Median (50%)	885.01	885.16
75.0%	885.49	885.54
90.0%	885.89	885.99
97.5%	887.78	886.31
Max	888.09	886.87

Rating Curve (2013)

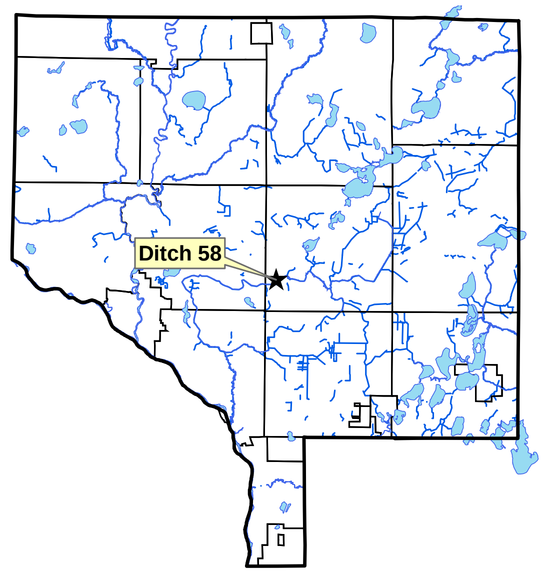


Stream Hydrology Monitoring

DITCH 58

at Andover Boulevard, Ham Lake

Notes

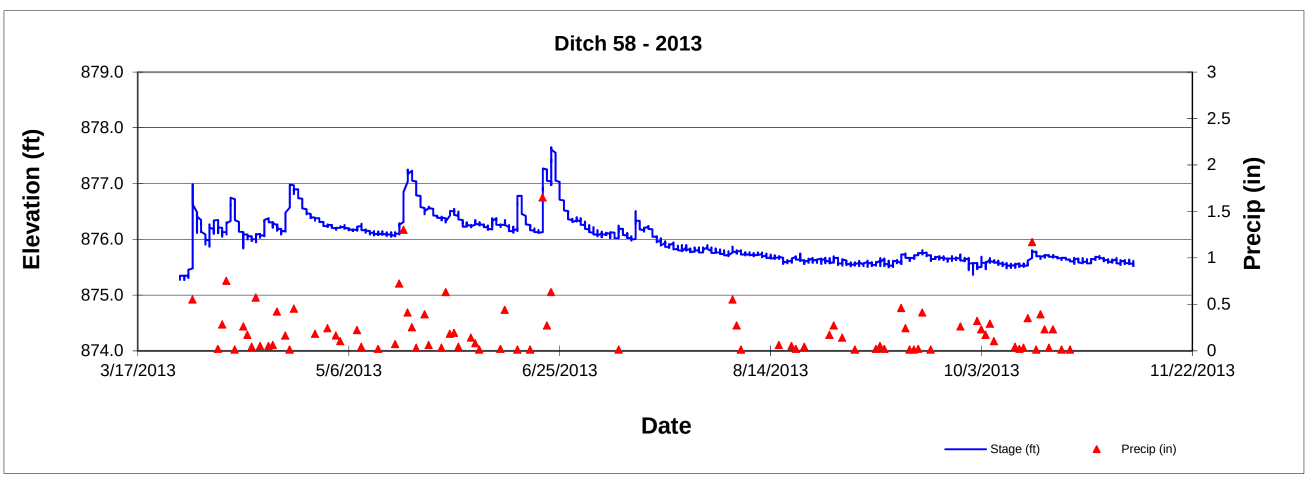


Ditch 58 is a tributary to Coon Creek. Upstream of the monitoring site are 20 miles of ditch, including many small tributaries. Its light bulb-shaped watershed is roughly delimited by Lake Netta to the northeast, Crosstown Boulevard to the northwest and southwest, and highway 65 to the southeast. Watershed land uses are primarily suburban residential and sod fields. The ditch is about 10 feet wide and 2 feet deep at the monitoring site during baseflow.

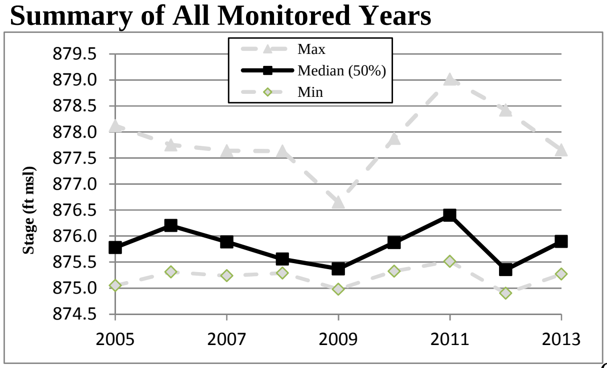
Ditch 58 water levels did not fluctuate in 2013 as much as 2011 and 2012. 2011 and 2012 were unique due to the increased frequency of larger rainfall events, while 2013 resembled previous years. Water levels spanned a range of 2.38 feet which was 1.12 feet less than 2012, but similar to 2010 & 2009. Despite overall fluctuation being less than recent years Ditch 58 remains flashy during rain events. Of particular note was a 0.62 foot increase in water level in 2 hours during a 1.65 inch rain event on June 21, 2013. The storm raised the water level 1.05 feet over a 12 hour period.

Several manual flow measurements were done in 2013 to inform rating curve development by CCWD's consulting engineer. The engineer plans to use the stream cross section and desktop analysis for rating curve generation.

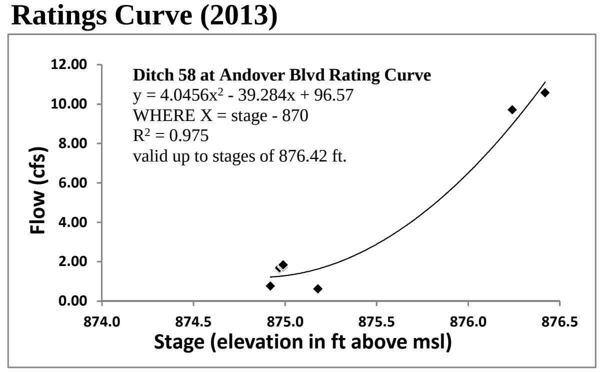
2013 Hydrograph



Summary of All Monitored Years



Ratings Curve (2013)



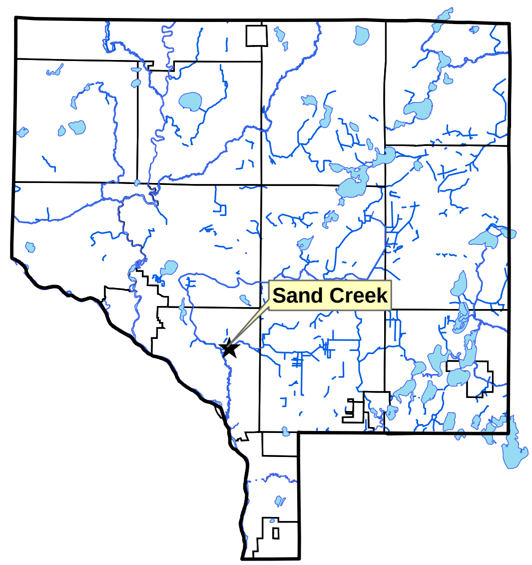
Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Min	875.29	875.81	875.28	875.23	875.05	875.31	875.24	875.29	874.98	875.33	875.52	874.90	875.27
2.5%	875.35	876.18	875.57	875.63	875.54	875.91	875.29	875.33	875.01	875.39	875.62	875.02	875.52
10.0%	875.48	876.33	875.64	875.51	875.37	875.66	875.37	875.36	875.16	875.48	875.65	875.06	875.57
25.0%	875.58	876.41	875.74	875.63	875.54	875.91	875.49	875.39	875.29	875.58	875.79	875.12	875.64
Median (50%)	875.65	876.51	876.10	875.83	875.78	876.20	875.89	875.56	875.37	875.88	876.40	875.36	875.90
75.0%	875.77	876.73	876.59	876.05	876.04	876.35	876.16	876.06	875.46	876.25	876.92	875.51	876.24
90.0%	876.23	877.42	877.01	876.45	876.22	876.47	876.40	876.28	875.54	876.49	877.67	875.79	876.48
97.5%	876.30	878.13	878.16	877.04	876.98	876.89	876.90	876.61	875.79	877.13	878.55	877.02	877.00
Max	876.48	878.13	878.19	878.03	878.12	877.75	877.64	877.63	876.65	877.88	879.02	878.42	877.65

Sand Creek

at Xeon Street, Coon Rapids

Notes

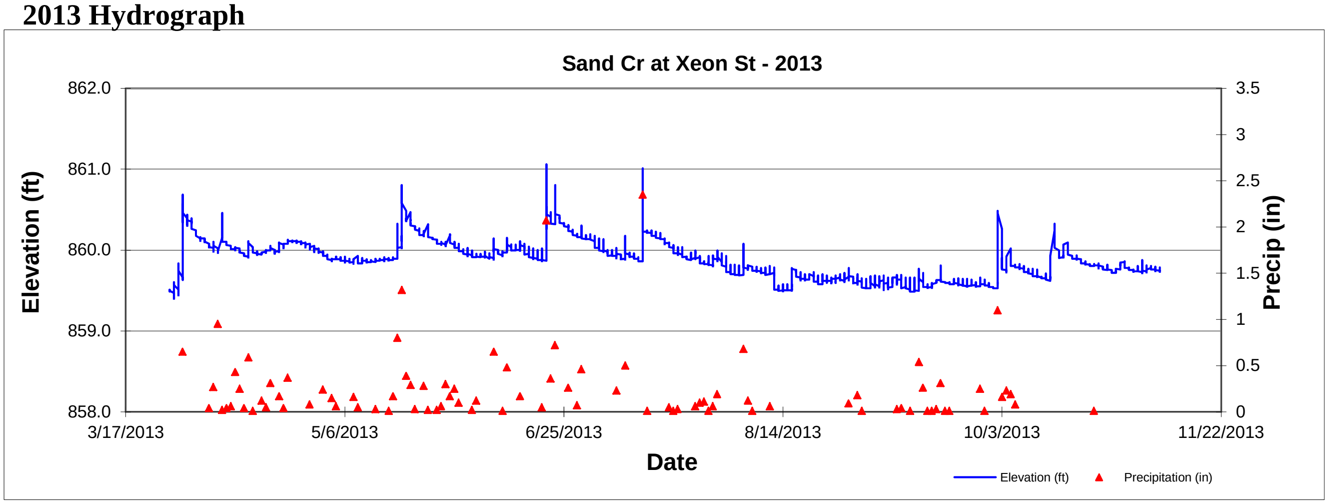


Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. The stream is about 15 feet wide and 3 feet deep at the monitoring site during baseflow.

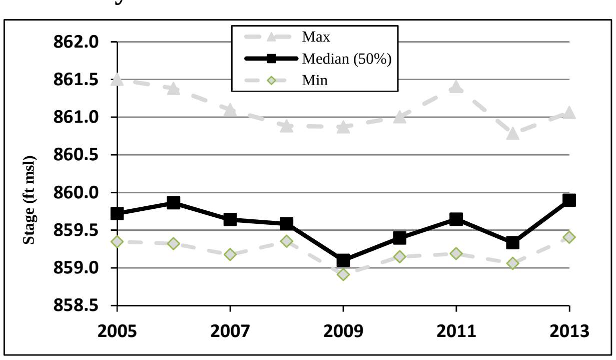
In most years, Sand Creek shows little variation in water levels. Occasionally, large storms cause water level increases of up to two feet, but these are short-lived. Still, the creek can have more dramatic hydrologic changes in the first hours immediately following larger storms. For example, in 2011 storms of 1.42 (July 30) and 2.10 (Aug 16) inches caused stream levels to rise 1.49 and 1.17 feet, respectively, within two hours and then recede. 2013 water levels reacted similarly, rising 1.16 feet over a 2 hour span in response to a 2.07 inch rain event on June 21.

Additional measurements were conducted in 2013 to refine the rating curve and are presented below.

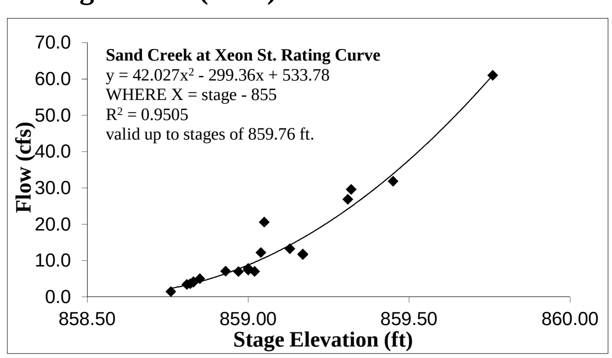
2013 Hydrograph



Summary of All Monitored Years



Ratings Curve (2013)



Summary of All Monitored Years

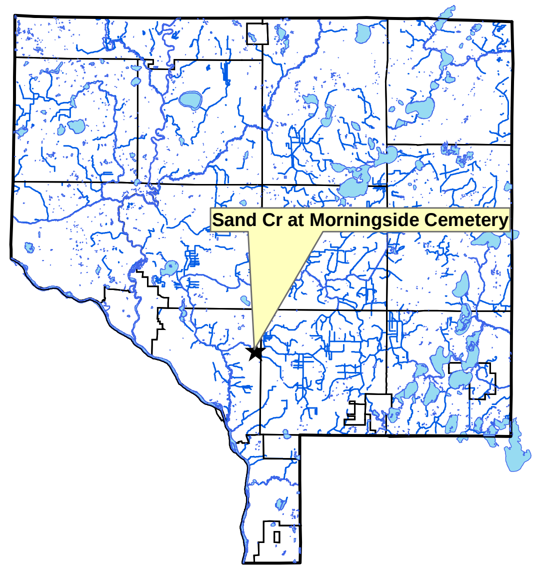
Percentiles	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Min	859.06	859.22	859.21	859.31	859.35	859.32	859.17	859.35	858.91	859.15	859.19	859.06	859.40
2.5%	859.09	859.44	859.26	859.33	859.41	859.43	859.30	859.44	858.99	859.24	859.22	859.07	859.53
10.0%	859.15	859.48	859.32	859.40	859.45	859.54	859.41	859.48	859.03	859.28	859.28	859.11	859.60
25.0%	859.23	859.61	859.41	859.46	859.55	859.70	859.47	859.53	859.05	859.33	859.47	859.18	859.70
Median (50%	859.33	859.75	859.55	859.60	859.72	859.86	859.64	859.58	859.10	859.40	859.65	859.33	859.90
75.0%	859.49	859.93	859.75	859.80	859.97	860.01	859.81	859.78	859.29	859.52	859.89	859.53	860.04
90.0%	859.54	860.09	860.00	860.03	860.21	860.12	859.98	859.94	859.38	859.60	860.08	859.76	860.18
97.5%	859.65	860.32	860.28	860.32	860.51	860.27	860.11	860.13	859.54	859.75	860.33	860.11	860.37
Max	860.00	861.22	861.13	861.27	861.50	861.38	861.10	860.88	860.87	861.01	861.40	860.78	861.06

Stream Hydrology Monitoring

SAND CREEK

at Morningside Cemetery, Coon Rapids

Notes



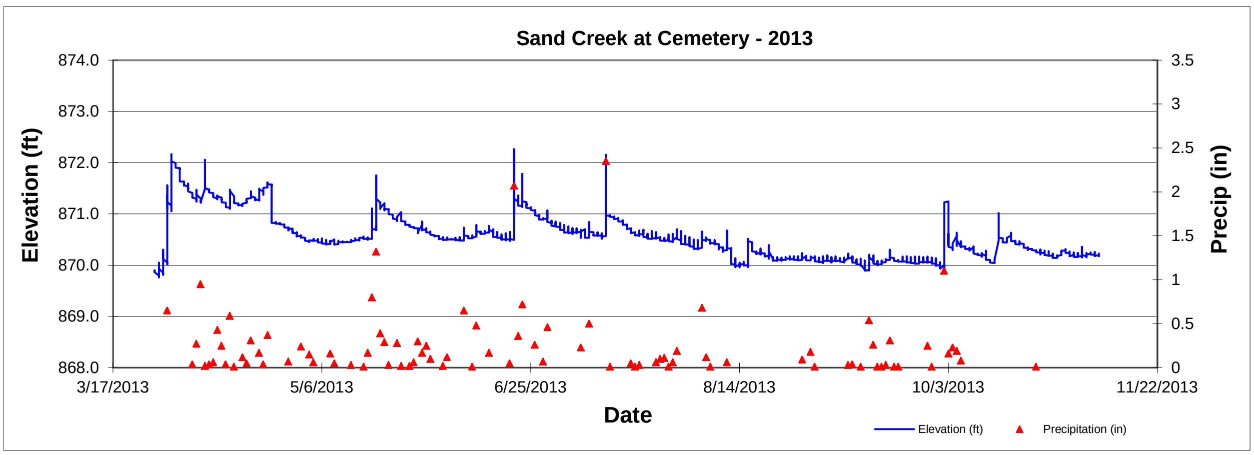
Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. The stream is approximately 8 feet wide and 3 feet deep at the monitoring site during baseflow.

Sand Creek at Morningside Cemetery was monitored for the first time in 2010. The site was added because of its position between the cities of Blaine and Coon Rapids, which provides an estimate of the stormflow contributions from Blaine. In addition, the site is located immediately downstream of the confluence of Ditch 39 with Sand Creek. Water levels in the creek fluctuated 2.51 feet between baseflow and peak flow conditions during 2013.

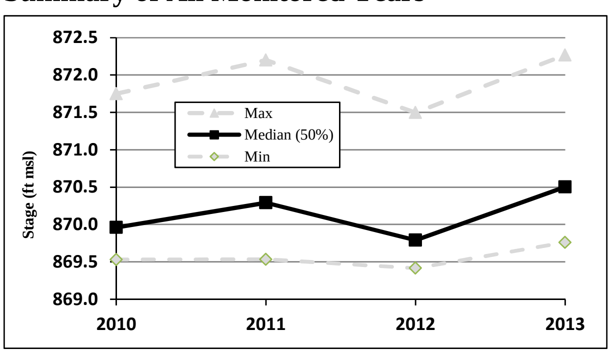
Interestingly, creek levels often rise at this site more than downstream at Xeon Street following rainstorms. It is likely that flow volumes are similar or less at the cemetery, but because the channel is narrow the vertical rise in water levels is greater.

No rating curve exists at this site.

2013 Hydrograph



Summary of All Monitored Years



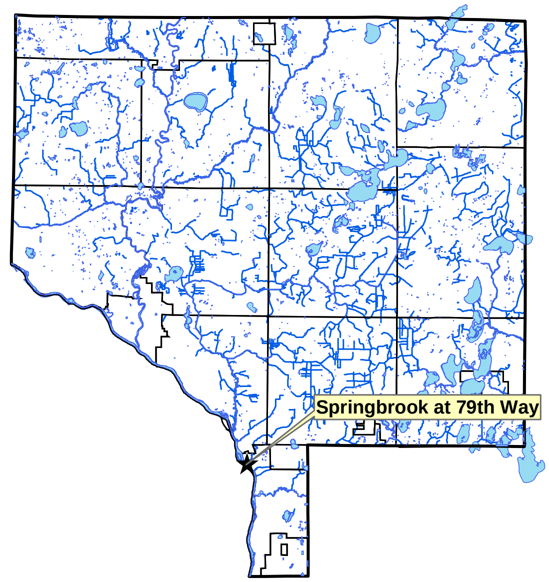
Percentiles	2010	2011	2012	2013
Min	869.53	869.53	869.42	869.76
2.5%	869.61	869.59	869.44	869.99
10.0%	869.70	869.67	869.47	870.09
25.0%	869.79	870.03	869.59	870.19
Median (50%)	869.96	870.29	869.79	870.50
75.0%	869.96	870.53	870.09	870.74
90.0%	870.29	870.86	870.38	871.23
97.5%	870.60	871.17	870.82	871.56
Max	871.75	872.20	871.50	872.27

Stream Hydrology Monitoring

SPRINGBROOK

at 79th Way, Fridley

Notes

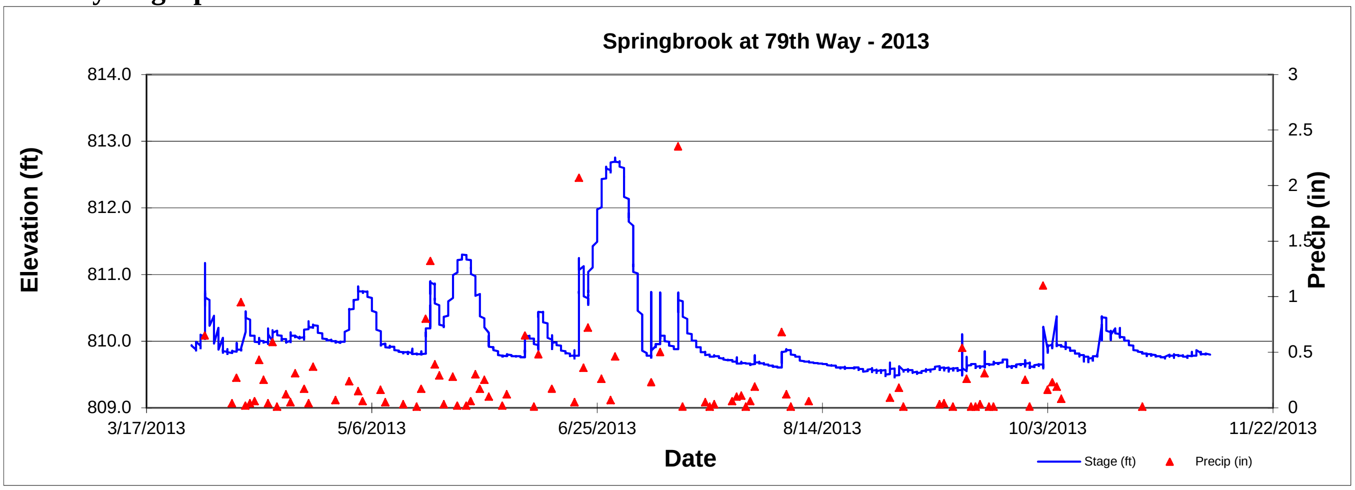


Springbrook is a small waterway draining an urbanized and highly modified subwatershed. The watershed includes portions of the Cities of Blaine, Coon Rapids, Spring Lake Park and Fridley. Several tributaries, or stormwater systems contributing to the creek, join at the Springbrook Nature Center Impoundment. From the outlet of the Nature Center, the Creek flows a short distance to the Mississippi River. At its outlet, Springbrook is about 10 feet wide and 1 foot deep at baseflow.

Springbrook at 79th Way was monitored for the first time in 2012. The stream is flashy, with water levels that increase dramatically following rainfall and quickly recede thereafter. This occurs despite the possible dampening effect of the stream flowing through the Springbrook Nature Center impoundment just upstream. An additional aspect which makes this site unique is its proximity to the Mississippi River. Influence of the river is illustrated in June of both 2012 and 2013 when the river water levels rose to such an elevation that backfilling into Springbrook occurs. This event results in the highest water level of the season and holds for a period of time until the river recedes. Because of this influence the true max water level is still unknown.

*An error was discovered in the calculation used to determine the 2012 equipment elevation, it has been corrected and data updated to reflect these changes.

2013 Hydrograph



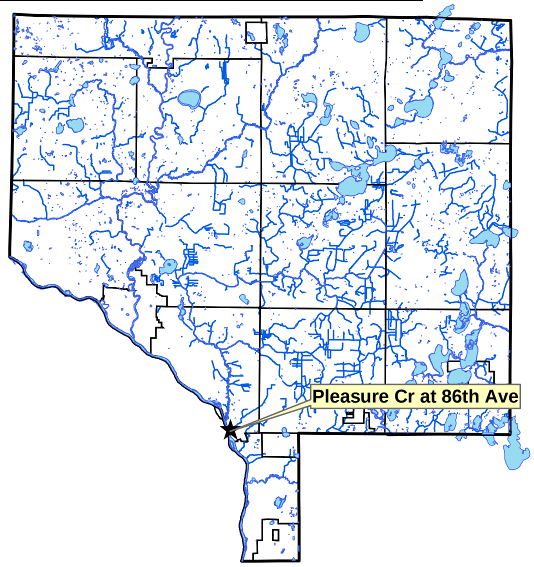
Summary of All Monitored Years

Percentiles	2012	2013
Min	809.62	809.47
2.5%	809.65	809.54
10.0%	809.69	809.60
25.0%	809.76	809.67
Median (50%)	809.97	809.84
75.0%	810.29	810.08
90.0%	811.24	810.71
97.5%	812.87	812.17
Max	813.43	812.76

PLEASURE CREEK

at 86th Ave, Fridley

Notes

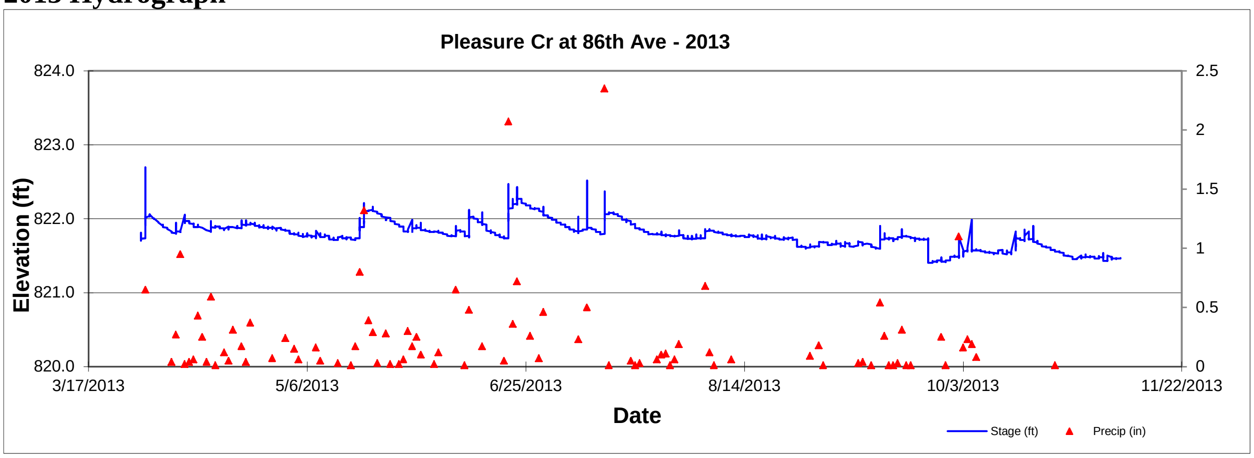


Pleasure Creek flows through the southwestern portion of Blaine and southern Coon Rapids. The watershed is urbanized. The creek is about 8-10 feet wide and 0.5 to 1 foot deep during baseflow. It flows through an interconnected network of stormwater ponds in the upper part of the watershed.

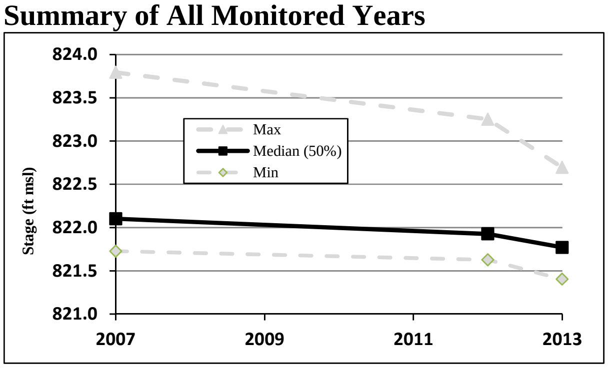
Variations in the water level at Pleasure Creek are seldom more than one foot. As an example, during a 1.21 inch storm on April 15, 2012 Pleasure Creek rose 0.52 feet in two hours, and then retreated 0.40 feet in the following two hours. A 2.07 inch storm in 2013 reacted similarly rising 0.33 feet in the first 4 hours and had an overall rise of 0.73 inches. Even storms of over two inches the stream response was less than one foot.

Several manual flow measurements were done in 2013 to inform rating curve development by CCWD's consulting engineer. The engineer plans to use the stream cross section and desktop analysis for rating curve generation.

2013 Hydrograph

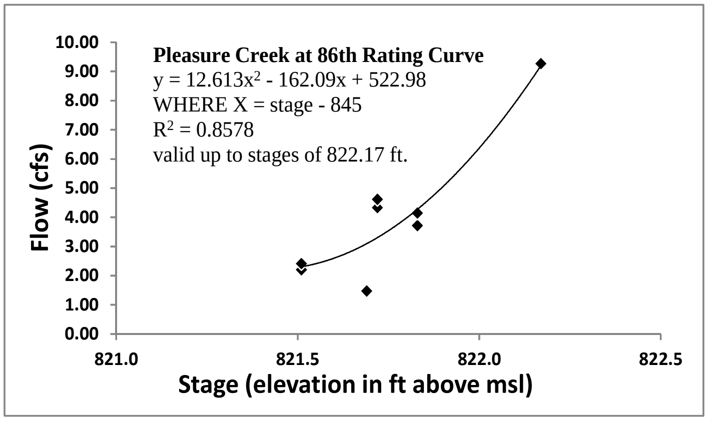


Summary of All Monitored Years



Percentiles	2007	2012	2013
Min	821.73	821.63	821.40
2.5%	821.77	821.69	821.44
10.0%	821.84	821.77	821.53
25.0%	821.95	821.80	821.66
Median (50%)	822.10	821.93	821.77
75.0%	822.32	822.04	821.88
90.0%	822.49	822.19	822.00
97.5%	822.63	822.33	822.15
Max	823.79	823.25	822.70

Ratings Curves (2013)



Stream Water Quality – Chemical Monitoring

Description: Each stream was monitored eight times during the open water season; four times during baseflow and four times during storm flow. Storm flow events were defined as an approximately one-inch rainfall in 24 hours, though totals vary from location to location. Each stream was tested for pH, conductivity, turbidity, dissolved oxygen, temperature, salinity, total suspended solids, chlorides, sulfates, hardness, and total phosphorus.

Purpose: To detect water quality trends and problems, and diagnose the source of problems.

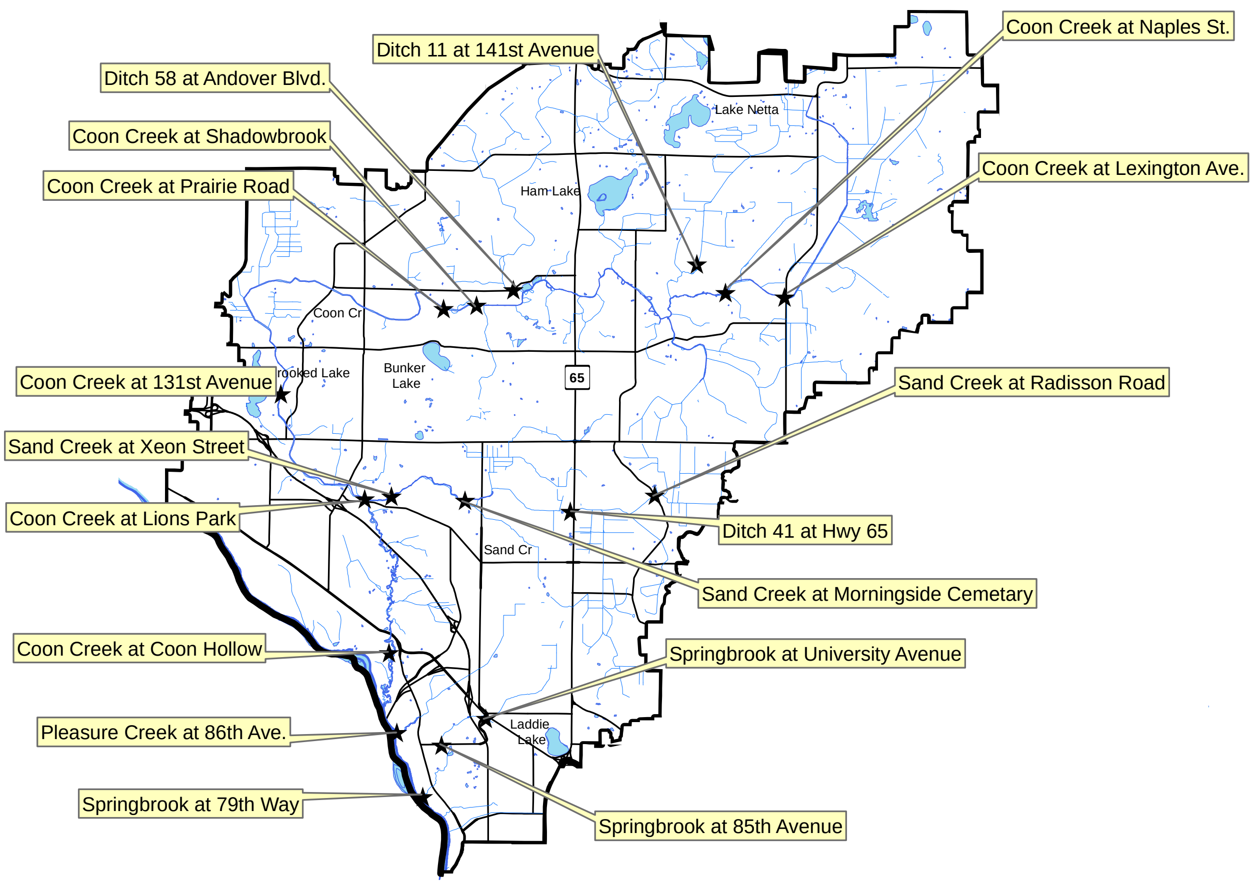
Locations:

Stream	Location	City
Coon Creek	Lexington Blvd	Ham Lake
Coon Creek	Naples	Ham Lake
Ditch 11	149st Ave.	Ham Lake
Ditch 58	Andover Blvd	Ham Lake
Coon Creek	Shadowbrook Townhomes	Andover
Coon Creek	Prairie Road	Andover
Coon Creek	131st Ave.	Coon Rapids
Coon Creek	Lions Park	Coon Rapids
Coon Creek	Coon Hollow (Vale)	Coon Rapids

Stream	Location	City
Sand Creek	Radisson Road	Blaine
Sand Creek	Hwy. 65	Blaine
Sand Creek	Morningside Cemetary	Coon Rapids
Sand Creek	Xeon Street	Coon Rapids
Pleasure Creek	86th Ave.	Coon Rapids
Springbrook	University Ave.	Blaine
Springbrook	85th Ave.	Fridley
Springbrook	79th Way	Fridley

Results: Results for each stream are presented on the following pages.

Coon Creek Watershed 2013 Stream Water Quality Monitoring Sites



Median pollutant concentrations for waterways in the Coon Creek Watershed District. The reader is warned that differing amounts of sampling have been done at each stream. Also, in some cases the extremes measurements are more important than the median values presented. Please see detailed results from each stream for more insight.

For Coon Creek, Sand Creek, Springbrook, and Pleasure Creek the numbers shown are medians of all readings from all sites. All data through 2013 are included.

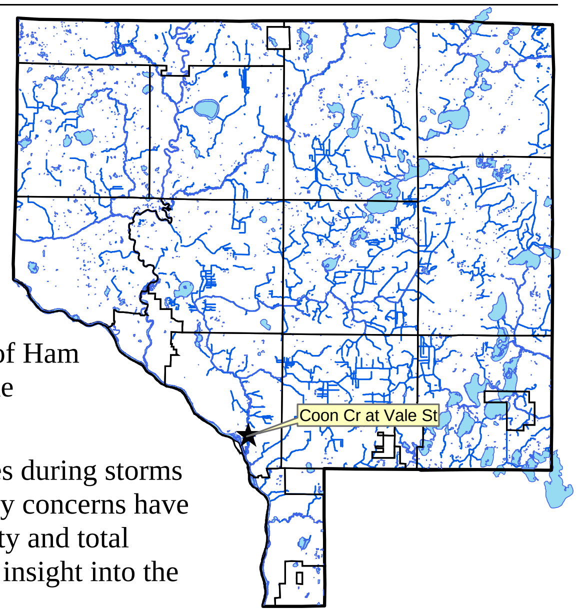
	Springbrook Cr	Pleasure Cr	Sand Cr	Coon Cr	Median for Anoka Co Streams	State Water Quality Standard
Conductivity (mS/cm)	0.730	0.812	0.711	0.510	0.362	none
Chlorides (mg/L)	159	125	67	40	17	860 - acute 230 - chronic
Turbidity (FNRU)	2	11.1	8	15	8.5	None*
Total Suspended Solids (mg/L)	4	8	6	12	12	30*
Total Phosphorus (ug/L)	112	74.5	64.5	129	135	100*
Dissolve Oxygen (mg/L)	7.58	8.28	7.91	8.11	6.97	5
pH	7.91	7.92	7.76	7.75	7.62	6.5-8.5

*Proposed new state water quality standards.

Hydrolab Continuous Stream Water Quality Monitoring

COON CREEK

Coon Creek at Vale St., Coon Rapids   STORET SiteID = S003-993



Years Monitored

Coon Creek at Vale Street 2013

Background

Coon Creek is a major drainage through central Anoka County. Development in the watershed ranges from rural residential to urbanized. Upstream reaches were ditched in the early 1900's for agriculture. There are many ditch tributaries in the upper reaches. Lower reaches of the creek were not ditched. The entire ditch serves as an important stormwater conveyance for the Cities of Ham Lake, Andover, Blaine, and Coon Rapids. The creek outlets into the Mississippi River.

Coon Creek and its tributaries have been monitored by grab samples during storms and baseflow over the course of several years. Several water quality concerns have been noted, including dissolved pollutants, phosphorus, and turbidity and total suspended solids. Continuous monitoring is needed to gain further insight into the nature and possible corrective actions for problems.

The purpose of hydrolab continuous water quality monitoring is to document water quality changes throughout a storm. This should help diagnose water quality problems and analyze differences in runoff from upper and lower parts of the watershed. Runoff that passes the monitoring site most immediately following a storm is from the lower, urbanized part of the watershed while later runoff is mostly from upper portions of the watershed.

Methods

Coon Creek at Vale Street was chosen for monitoring because it is the farthest downstream, easily accessible site on Coon Creek. Access might be achieved farther downstream, but backwater influences from the Mississippi River would be likely during high flow. This site has been used for past monitoring efforts.

Coon Creek at Vale Street was monitored immediately before, during, and after storms with a Hydrolab MS5 water quality sonde. The sonde was suspended inside a PVC pipe by a chain from a locked lid. The PVC pipe was secured to a metal fence post. The sonde sensors protruded from the bottom of the pipe approximately 6-12 inches from the stream bottom, ensuring they would stay submerged even if flow was low. The sonde was programmed to take readings every 30 minutes. Readings included pH, salinity, specific conductance, temperature, dissolved oxygen, and turbidity. The sonde was calibrated before each deployment.

Staff deploying the Hydrolab MS5. In the background are the Hydrolab casing (shorter) and a Measura continuous water level monitoring device.

The Hydrolab was deployed into the stream when a storm predicted to drop at least 0.5 inches of rain, and preferably greater, was approaching. Past grab sample monitoring had found that the greatest water quality problems occurred after storms exceeding one inch. In some instances, water level was already high before the storm and remained high after the storm. At other times, predicted rain did not fall and we were monitoring baseflow conditions. In all instances, the Hydrolab was left in the field for several days.

Water levels were continuously monitored before, during, and after all Hydrolab monitoring. A Measura WM-80 water level monitoring device recorded water levels every two hours. This stream stage is presented with the water quality data. It would be preferable to present flow, and a rating curve does exist, however during some sampling events water was exceptionally high and exceeded the capacity of the rating curve so that flow could not be accurately calculated. To make graphs from all storms comparable, stage is shown for all.

Precipitation data are provided with the water quality results. These data were taken from the datalogging rain gauge at Coon Rapids City Hall, which is approximately 2 miles north of the stream monitoring site. In our analysis we also looked at precipitation totals in other portions of the watershed and noted any large differences.

Results and Discussion

A variety of storm sizes were analyzed. Rainfall during the monitored time periods ranged from 0.08 to 3.94 inches. The wide distribution is helpful in discerning the creek's response to different storms.

The discussion below incorporates results from all years of Hydrolab monitoring, but only 2013 individual storm results are presented in this report. The individual storm results for previous years are in that year's Anoka Water Almanac, or are available upon request from the Anoka Conservation District. Each year the finding of Hydrolab analysis are reviewed and re-evaluated.

On the following pages results from each storm monitored are shown. The graphs show precipitation and the stream hydrograph approximately one day before and after water quality monitoring began. Separate graphs show each water quality parameter. The text below discusses summarizes findings across all storms for each parameter.

<u>Turbidity</u>

- For most storms there is a brief, large turbidity spike during or immediately following rainfall. This is due to the first flush of urban stormwater from the lower portions of the watershed. Turbidity retreats to much lower levels within hours, or for the largest storms, a few days.
- Turbidity remained slightly higher than observed baseflow in the days following a storm. This turbidity could be runoff from upper portions of the watershed or bed load associated with higher flows, or both. In either case, it is minor compared to the very high turbidity seen immediately following rainfall.
- Because turbidity does not closely follow stream stage, bed load is not the primary driver of high turbidity.
- Brief but intense storms of 0.3 inches or more cause dramatic increases in turbidity from single digits to 25+ NTU.
- There is substantial variability among storms. Storms with similar rainfall totals may produce dramatically different turbidity in the creek. Intervening factors include storm intensity, whether snowmelt is occurring synchronously and the amount of time since the last wash off event.

<u>Specific Conductance</u>

- Specific conductance, a measure of dissolved pollutants, is inversely related to water level. When creek water rises, conductance drops. During brief, intense rainfall the stream conductance drops sharply. The shallow groundwater that feeds the stream during baseflow has higher conductance than stormwater runoff, and storm runoff dilutes it. Infiltration of road deicing salts are a likely source of high conductance in stream baseflow year round.

<u>Dissolved Oxygen</u>

- The observed dissolved oxygen concentrations in Coon Creek stayed well within the healthy, desirable range.

- Dissolved oxygen stayed above 5 mg/L, the state water quality standard, in all but one event monitored. Below this level some fish species begin to suffer. During a 2011storm of 4.11 inches dissolved oxygen dropped with rising water levels and was maintained between four and five mg/L for an extended period.
- When stream levels rise, dissolved oxygen often drops, but not to critically low levels.

Temperature

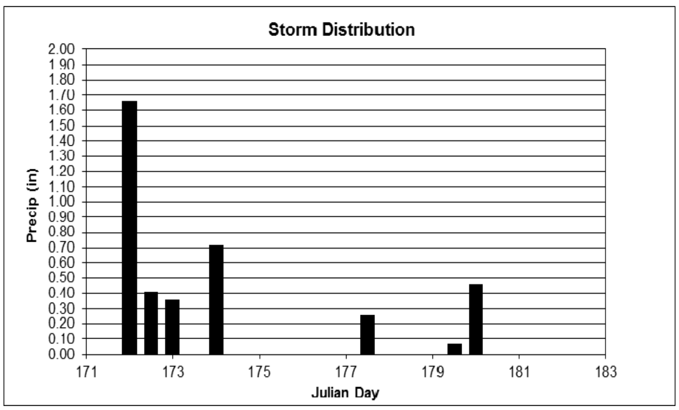
- Water temperature is generally not considered a concern in Coon Creek because there are no trout or other temperature sensitive resources.
- Cycles of day warming and night cooling are apparent in the data.

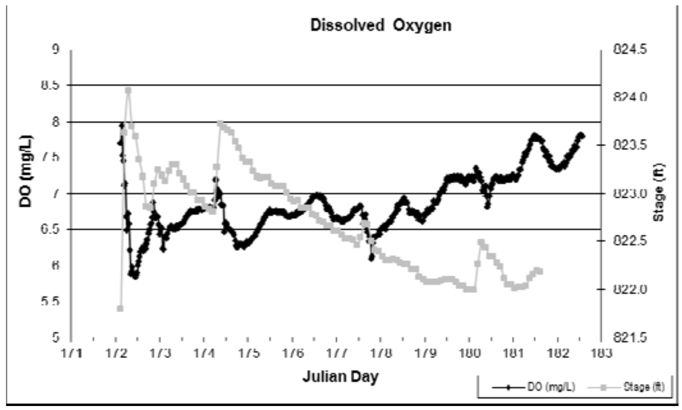
pH

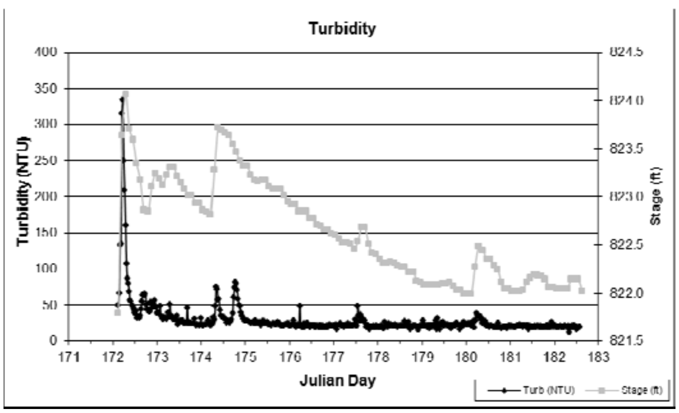
- pH is inversely related to water level in Coon Creek. When water level rises, pH declines. This is because rainwater has a lower pH than that of local shallow groundwater.
- pH frequently exceeded the desired range of 6.5 to 8.5 that is specified in state water quality standards.

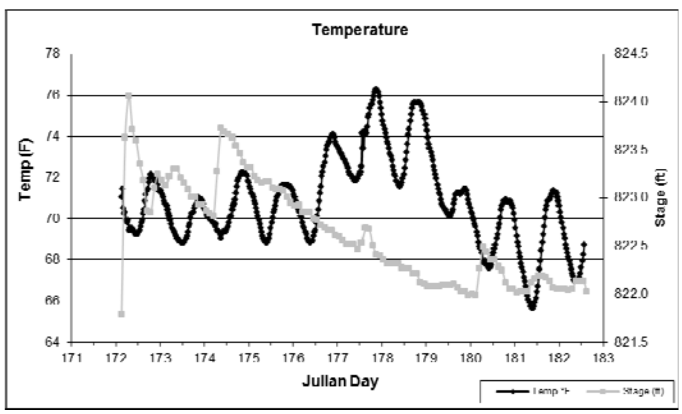
Hydrolab Continuous Monitoring
Storm 1 - 2013

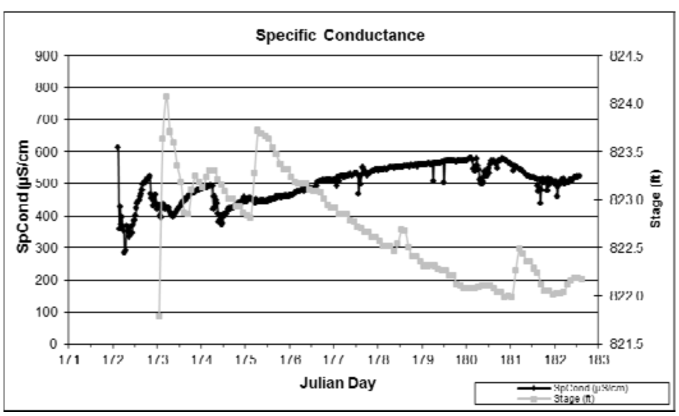
Coon Creek at Vale Street
<u>Storm Summary:</u>
Dates: 21 June 2013 (day 172) to 1 July 2013 (day 182)
Precipitation: 3.94 inches

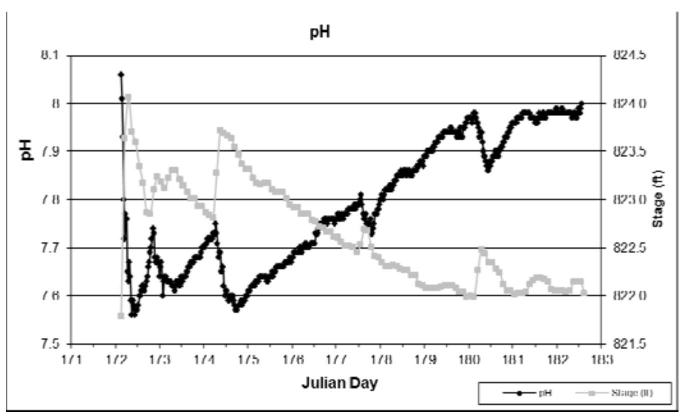






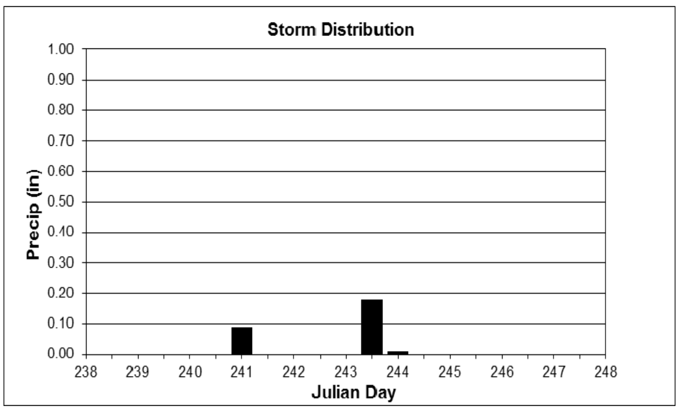


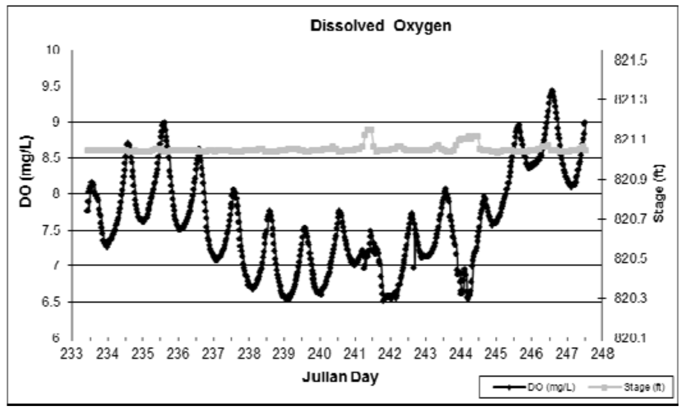


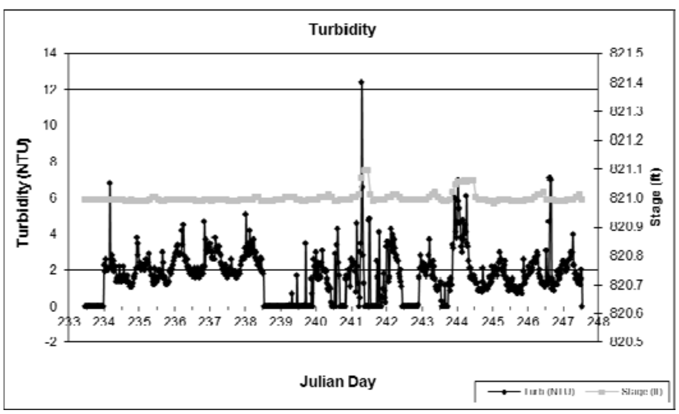


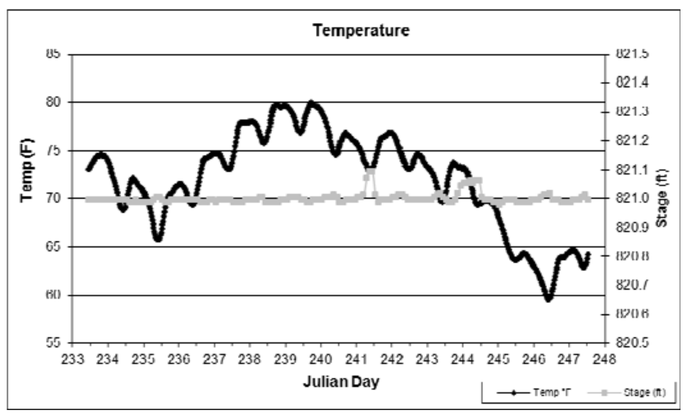
Hydrolab Continuous Monitoring
Storm 2 - 2013

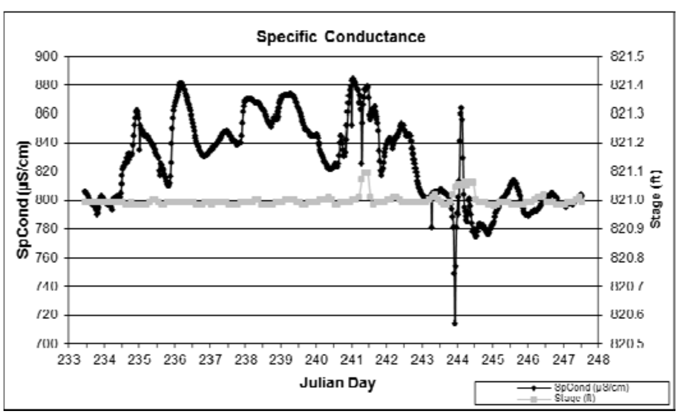
Coon Creek at Vale Street
<u>Storm Summary:</u>
Dates: 21 August 2013 (day 233) to 4 September 2013 (day 247)
Precipitation: 0.27 inches

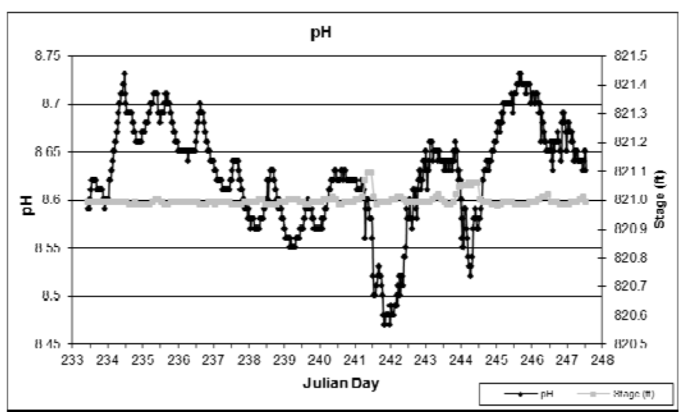












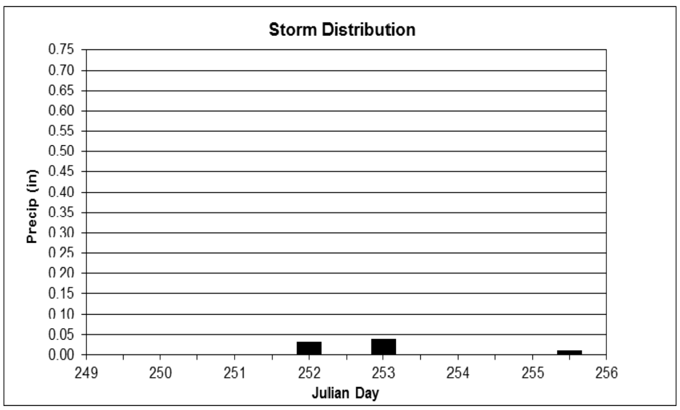
Hydrolab Continuous Monitoring
Storm 3 - 2013

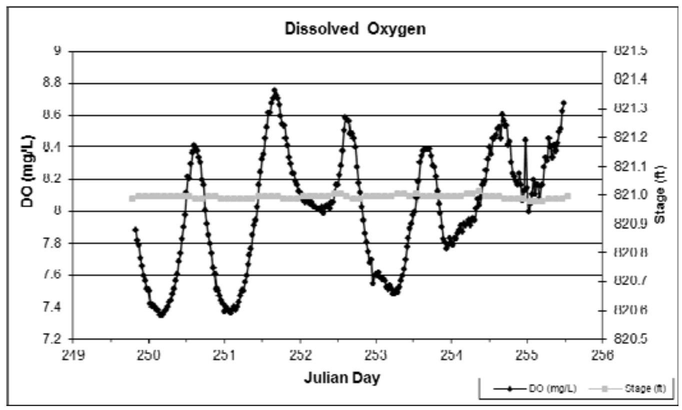
Coon Creek at Vale Street

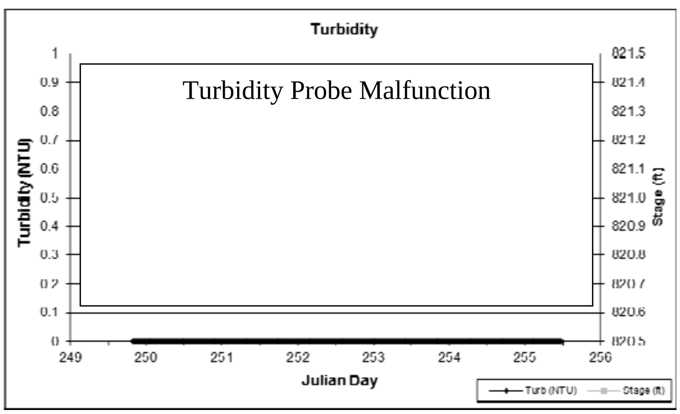
<u>Storm Summary:</u>

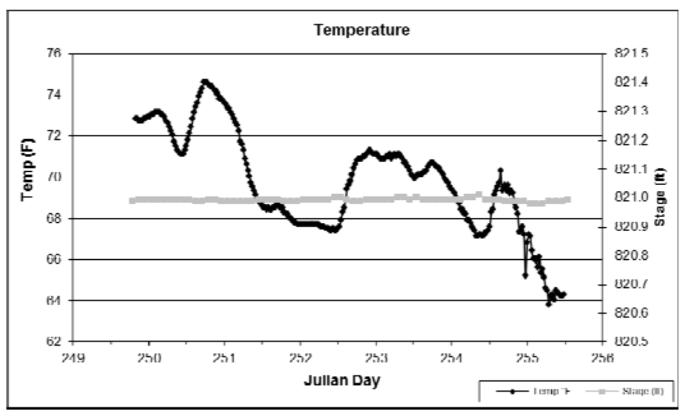
Dates: 6 September 2013 (day 249) to 12 September 2013 (day 255)

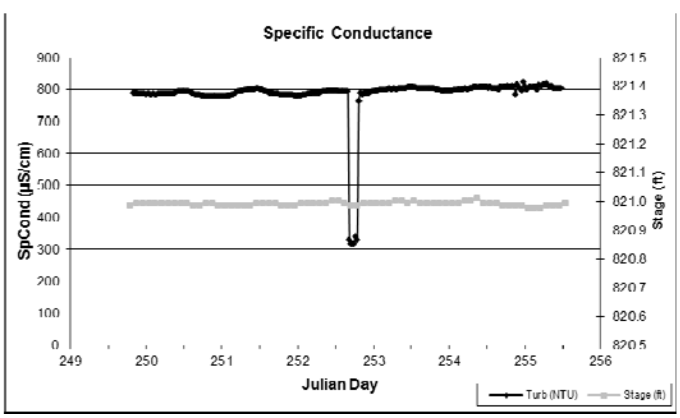
Precipitation: 0.08 inches

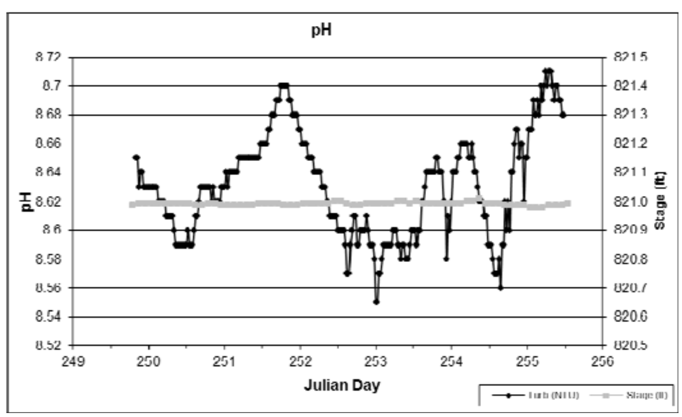






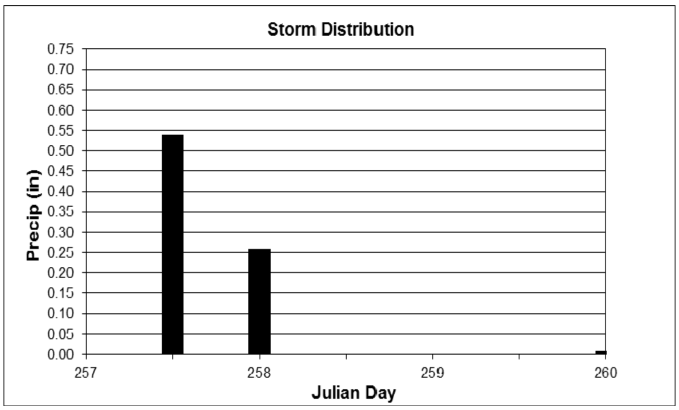


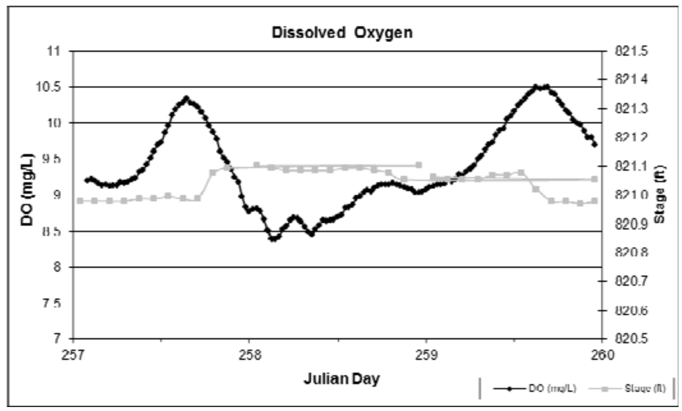


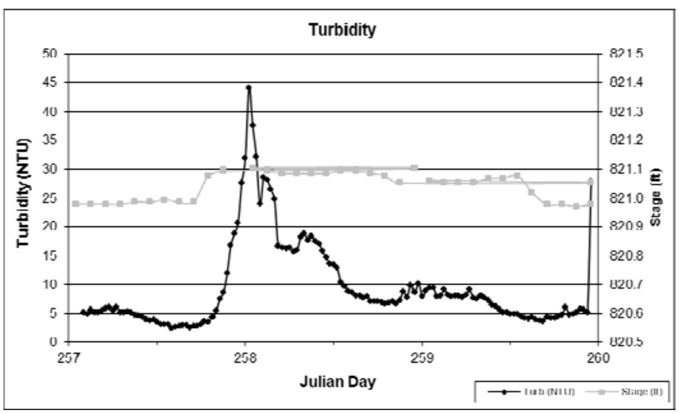


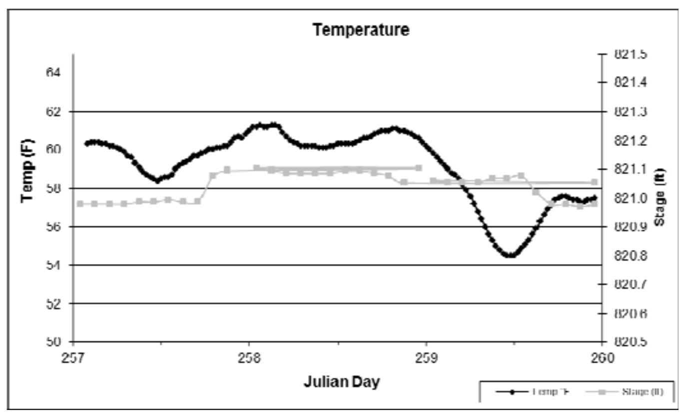
Hydrolab Continuous Monitoring
Storm 4 - 2013

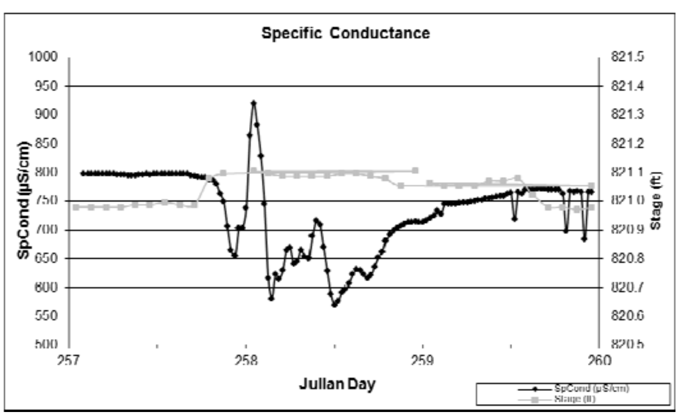
Coon Creek at Vale Street
Storm Summary:
Dates: 14 September 2013 (day 257) to 16 September 2013 (day 259)
Precipitation: 0.81 inches

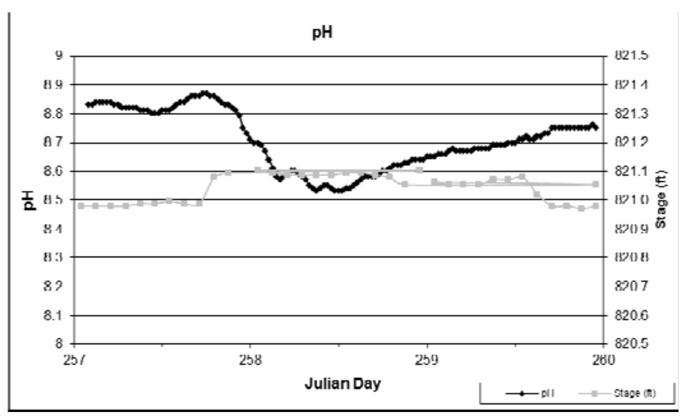












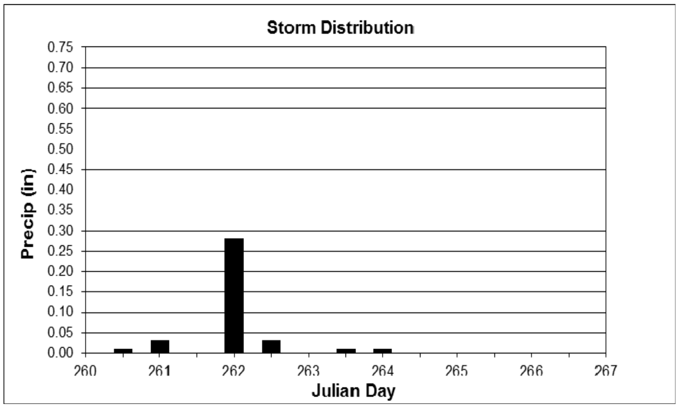
Hydrolab Continuous Monitoring
Storm 5 - 2013

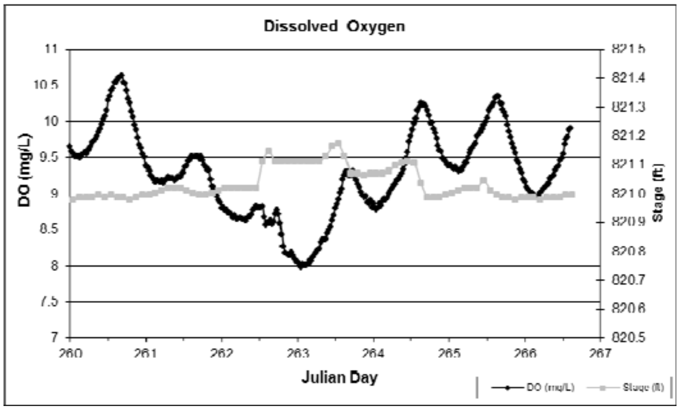
Coon Creek at Vale Street

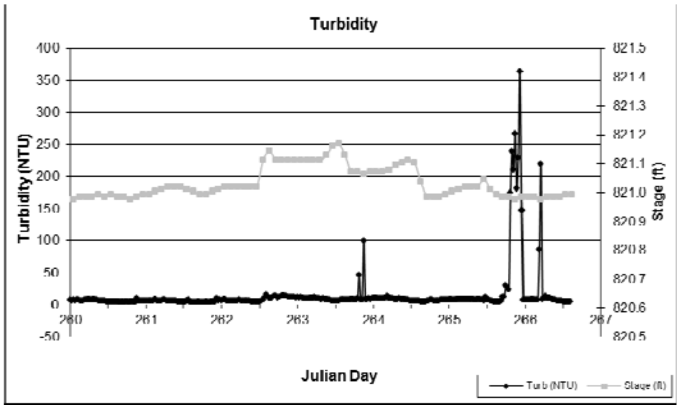
<u>Storm Summary:</u>

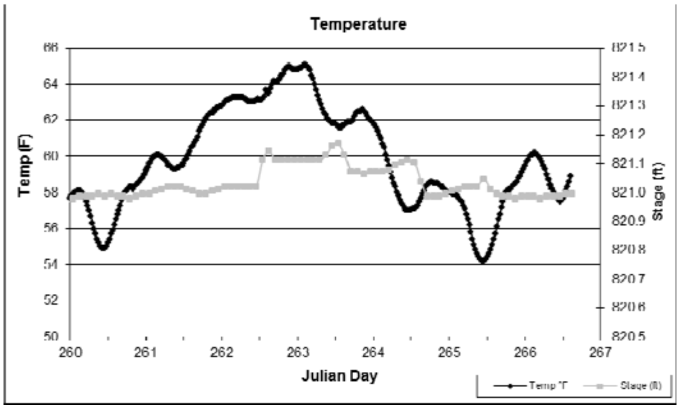
Dates: 17 September 2013 (day 260) to 23 September 2013 (day 266)

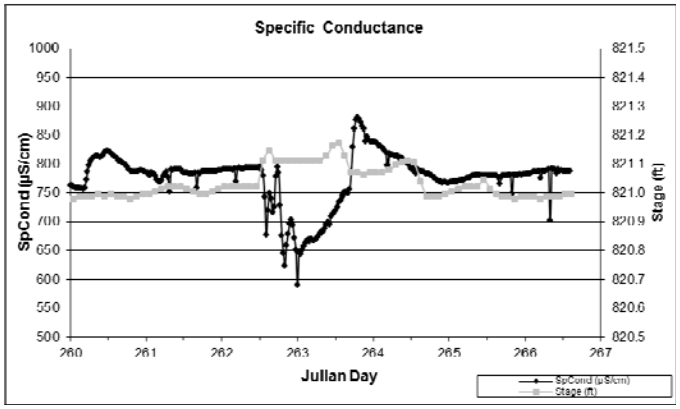
Precipitation: 0.37 inches

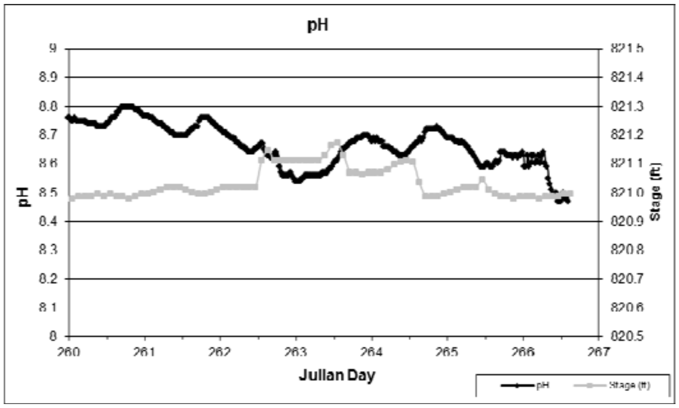






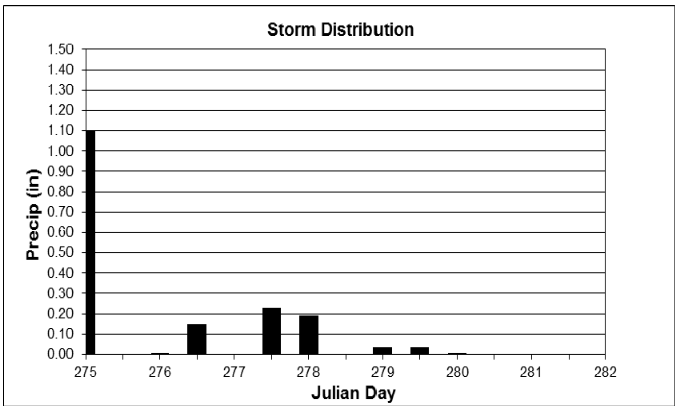


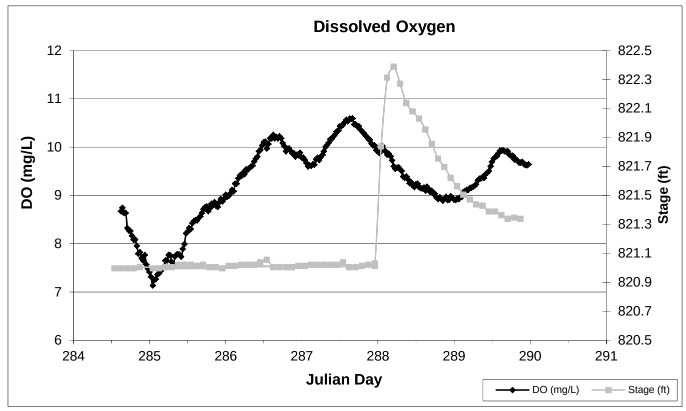


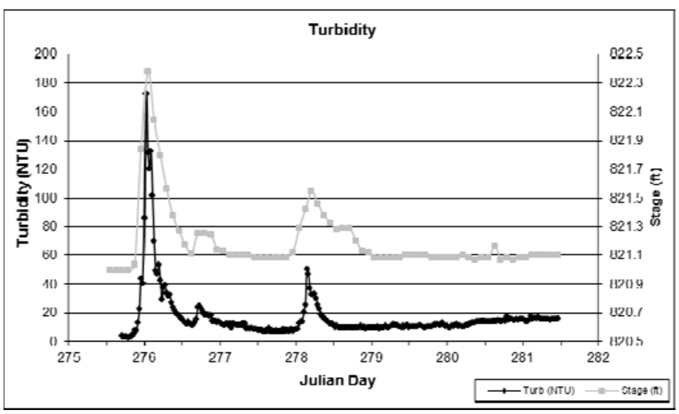


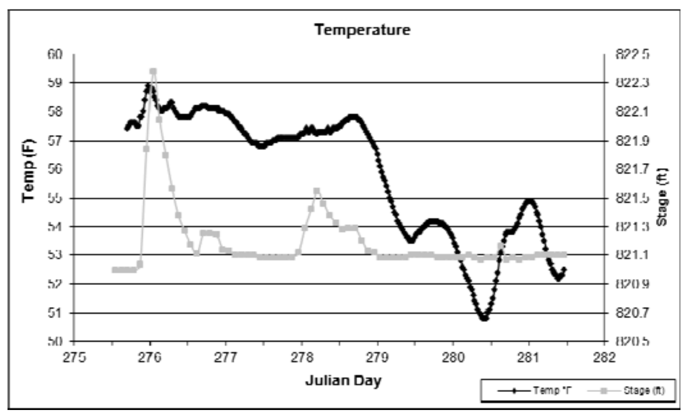
Hydrolab Continuous Monitoring
Storm 6 - 2013

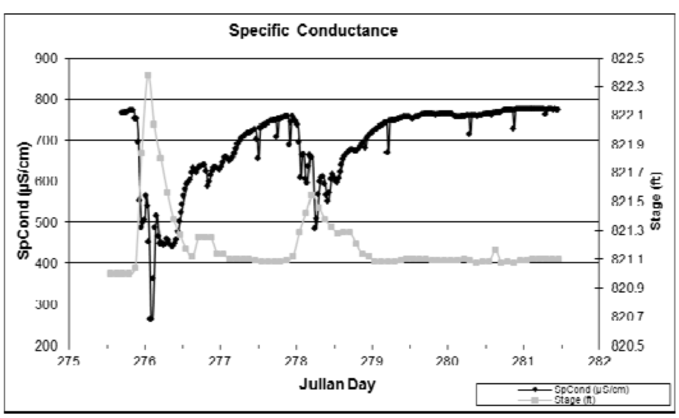
Coon Creek at Vale Street
<u>Storm Summary:</u>
Dates: 2 October 2013 (day 275) to 8 October 2013 (day 281)
Precipitation: 1.77 inches

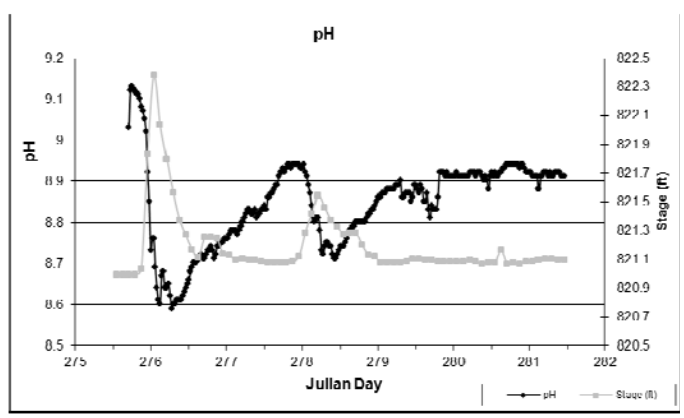






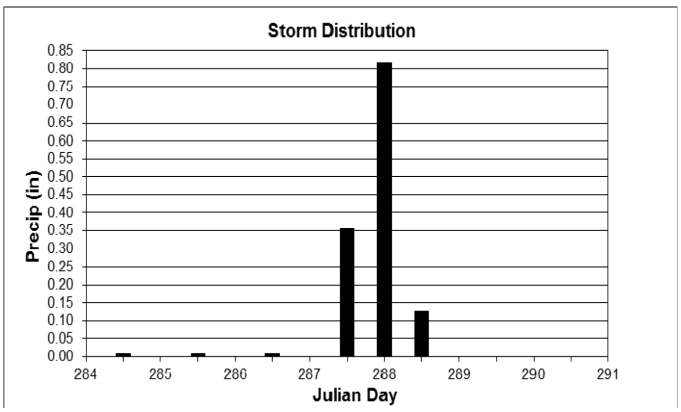


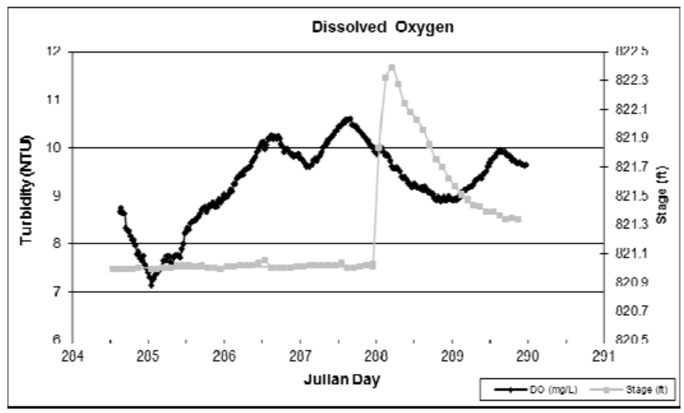


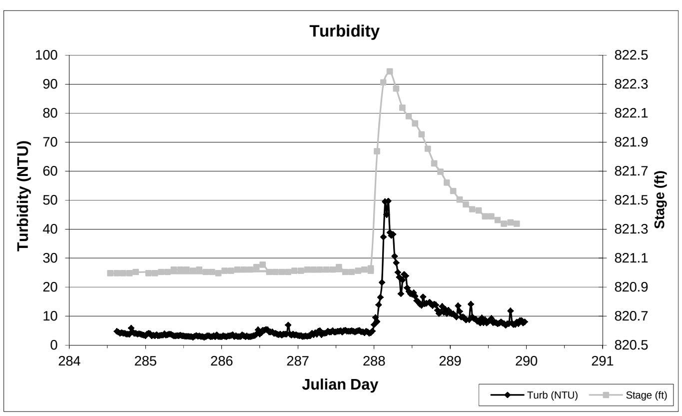


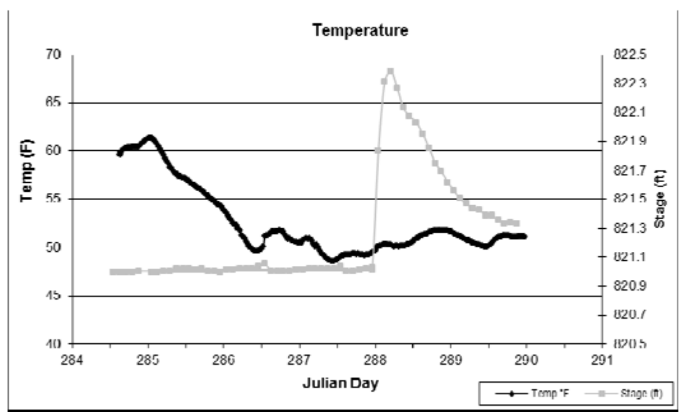
Hydrolab Continuous Monitoring
Storm 7 - 2013

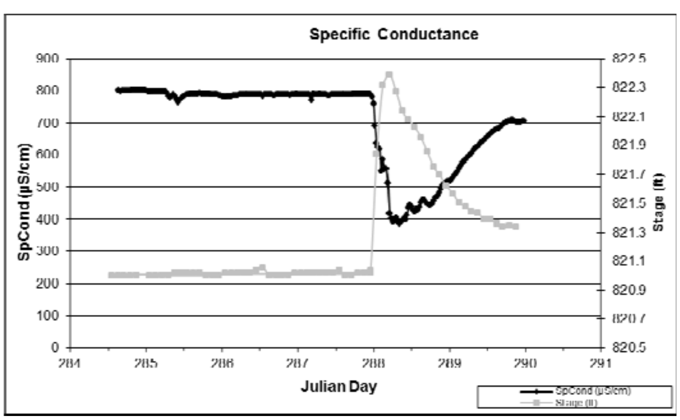
Coon Creek at Vale Street
<u>Storm Summary:</u>
Dates: 11 October 2013 (day 284) to 16 October 2013 (day 289)
Precipitation: 1.34 inches

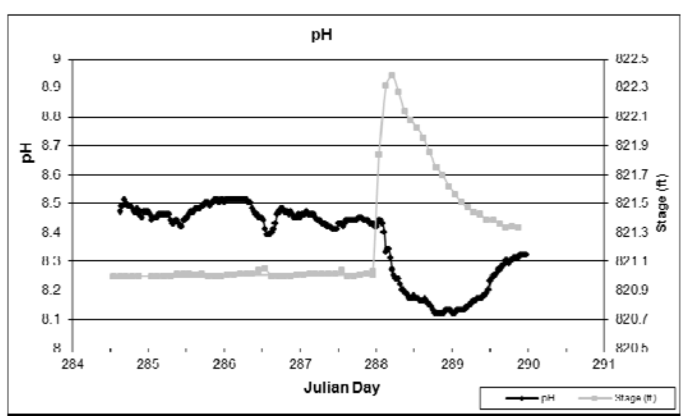












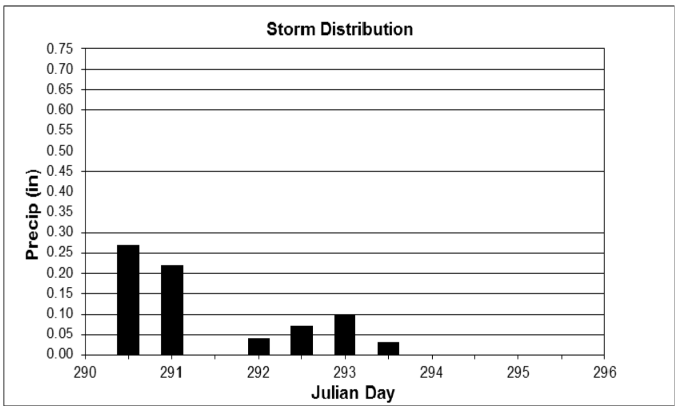
Hydrolab Continuous Monitoring
Storm 8 - 2013

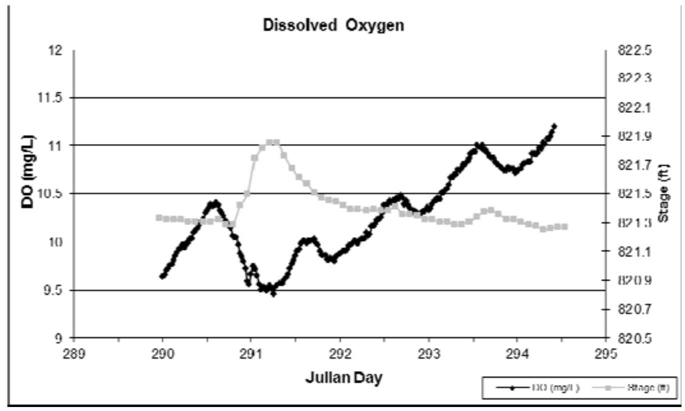
Coon Creek at Vale Street

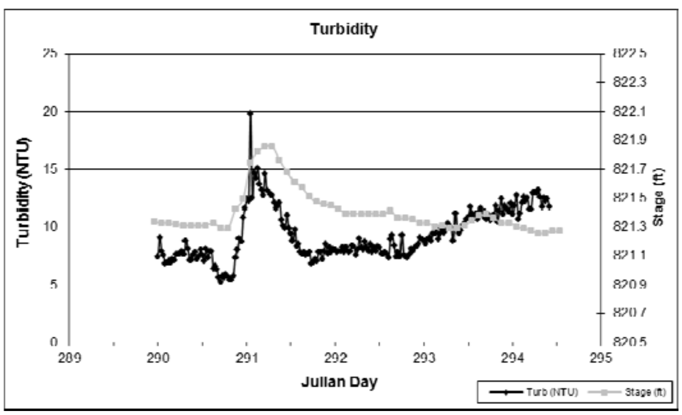
Storm Summary:

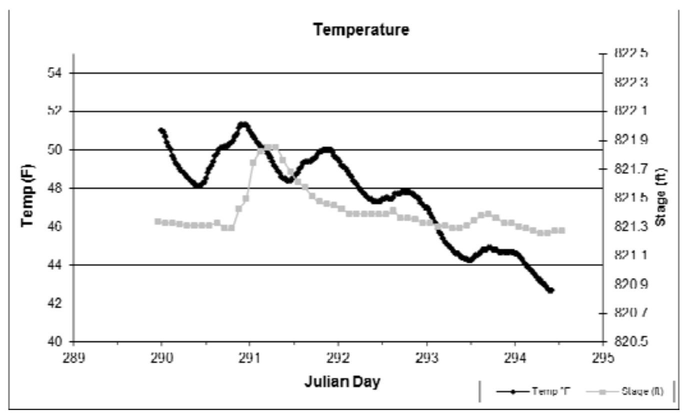
Dates: 17 October 2013 (day 291) to 21 October 2013 (day 295)

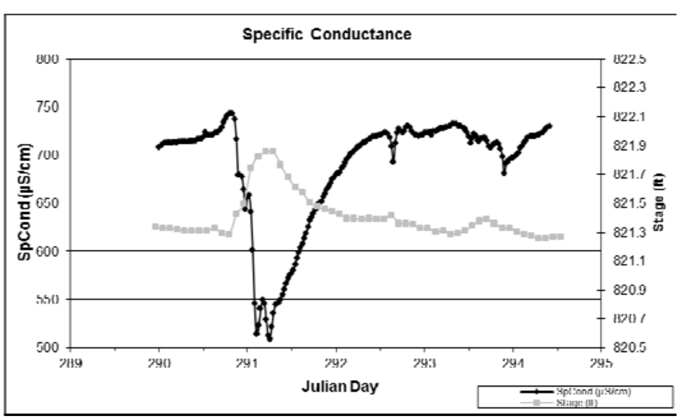
Precipitation: 0.73 inches

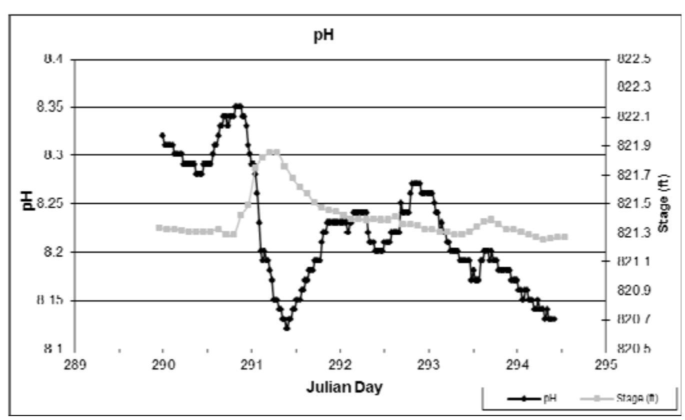












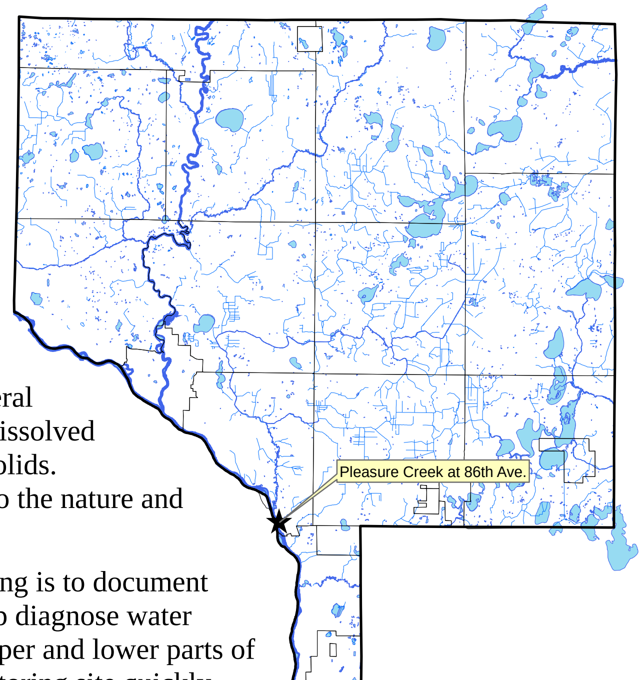
Hydrolab Continuous Stream Water Quality Monitoring

PLEASURE CREEK

Pleasure Creek at 86th., Coon Rapids STORET SiteID = S003-993

Years Monitored

Pleasure Creek at 86th Avenue 2013



Background

Pleasure Creek flows through the southwestern portion of Blaine and southern Coon Rapids. The watershed is urbanized. The creek is about 8-10 feet wide and 0.5 to 1 foot deep during baseflow. It flows through an interconnected network of stormwater ponds in the upper part of the watershed.

Pleasure Creek has been monitored by grab samples during storms and baseflow over the course of several years. Several water quality concerns have been noted, including E.coli, dissolved pollutants, phosphorus, and turbidity and total suspended solids. Continuous monitoring is needed to gain further insight into the nature and possible corrective actions for problems.

The purpose of hydrolab continuous water quality monitoring is to document water quality changes throughout a storm. This should help diagnose water quality problems and analyze differences in runoff from upper and lower parts of the watershed. Runoff from the watershed passes the monitoring site quickly following a storm.

Methods

Pleasure Creek at 86th Street was chosen for monitoring because it is the farthest downstream, easily accessible, site on Pleasure Creek. Access might be achieved farther downstream, but backwater influences from the Mississippi River would occur during high flow. This site has been used for past monitoring efforts.

Hydrolab MS5 casing (taller) and a Measura continuous water level monitoring device in Pleasure Creek. A staff gauge is shown in the middle.

Pleasure Creek at 86th Street was monitored immediately before, during, and after storms with a Hydrolab MS5 water quality sonde. The sonde was suspended inside a PVC pipe by a chain from a locked lid. The PVC pipe was secured to a metal fence post. The sonde sensors protruded from the bottom of the pipe approximately 6-12 inches from the stream bottom, ensuring they would stay submerged even if flow was low. The sonde was programmed to take readings every 30 minutes. Readings included pH, salinity, specific conductance, temperature, dissolved oxyen, and turbidity. The sonde was calibrated before each deployment.

The Hydrolab was deployed into the stream when a storm predicted to drop at least 0.5 inches of rain, and preferably greater, was approaching. In some instances, water level was already high before the storm and remained high after the storm. At other times, predicted rain did not fall and we were monitoring baseflow conditions. In all instances, the Hydrolab was left in the field for several days.

Water levels were continuously monitored before, during, and after all Hydrolab monitoring. A Measura WM-40 water level monitoring device recorded water levels every two hours. This stream stage is presented with the water quality data. It would be preferable to present flow, and a rating curve does exist, however during some sampling events water was exceptionally high and exceeded the capacity of the rating curve so that flow could not be accurately calculated. To make graphs from all storms comparable, stage is shown for all.

Precipitation data are provided with the water quality results. These data were taken from the datalogging rain gauge at Coon Rapids City Hall, which is approximately 2 miles north of the stream monitoring site. In our analysis we also looked at precipitation totals in other portions of the watershed and noted any large differences.

Results and Discussion

A variety of storm sizes were analyzed. Rainfall during the monitored time periods ranged from 0.08 to 3.99 inches. The wide distribution is helpful in discerning the creek's response to different events.

The discussion below incorporates results from 2013 Hydrolab monitoring. 2013 was the first season of Hydrolab monitoring on Pleasure Creek.

On the following pages results from each storm monitored are shown. The graphs show precipitation and the stream hydrograph approximately one day before and after water quality monitoring began. Separate graphs show each water quality parameter. The text below discusses summarizes findings across all storms for each parameter.

<u>Turbidity</u>

- For most storms there is a brief, large turbidity spike during or immediately following rainfall. For small rain events less than 0.1" the change in stream turbidity was minimal or not noticeable. For larger storms turbidity immediately rose sharply through stream water levels changed only modestly. Turbidity typically retreated to lower levels within hours or less. This suggests that most of this turbidity is coming from the lower watershed. The upper watershed is treated by large regional ponds.
- Brief but intense storms cause dramatic increases in turbidity from single digits to 200+ NTU.
- There is substantial variability among storms. Storms with similar rainfall totals may produce dramatically different turbidity in the creek. Intervening factors include storm intensity, whether snowmelt is occurring synchronously, and the amount of time since the last wash off event.

<u>Specific Conductance</u>

- Specific conductance, a measure of dissolved pollutants, is inversely related to water level. When creek water rises, conductance drops. During brief, intense rainfall the stream conductance drops sharply. The shallow groundwater that feeds the stream during baseflow has higher conductance than stormwater runoff, and storm runoff dilutes it. Infiltration of road deicing salts are a likely source of high conductance in stream baseflow year round.

<u>Dissolved Oxygen</u>

- The observed dissolved oxygen concentrations in Pleasure Creek stayed well within the healthy, desirable range.
- Dissolved oxygen stayed above 5 mg/L, the state water quality standard, in all but one event monitored. Below this level some fish species begin to suffer. During a 2013 storm of 3.99 inches dissolved oxygen dropped below the 5mg/L limit for one reading during multiple days of elevated water levels.
- When stream levels rise, dissolved oxygen often drops, but not to critically low levels.

<u>Temperature</u>

- Water temperature is generally not considered a concern in Pleasure Creek because there are no trout or other temperature sensitive resources.
- Cycles of day warming and night cooling are apparent in the data.

pH

- pH is inversely related to water level in Pleasure Creek. When water level rises, pH declines. This is because rainwater has a lower pH than that of local shallow groundwater.
- pH is commonly above the desired range of 6.5 to 8.5 that is specified in state water quality standards.

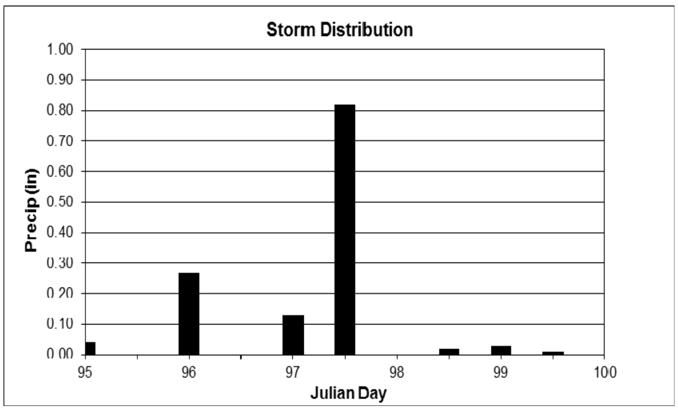
Hydrolab Continuous Monitoring
Storm 1 - 2013

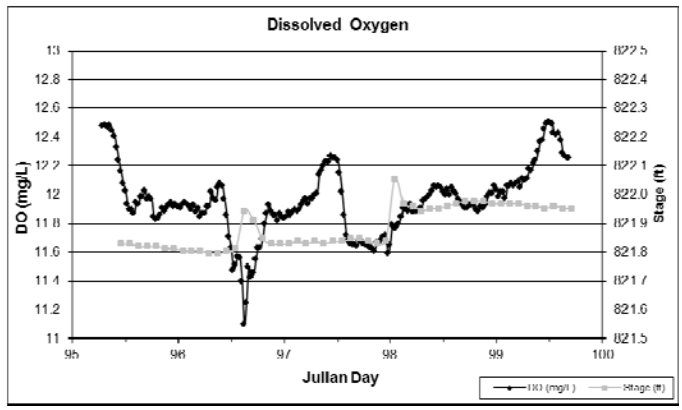
Pleasure Creek at 86th Ave

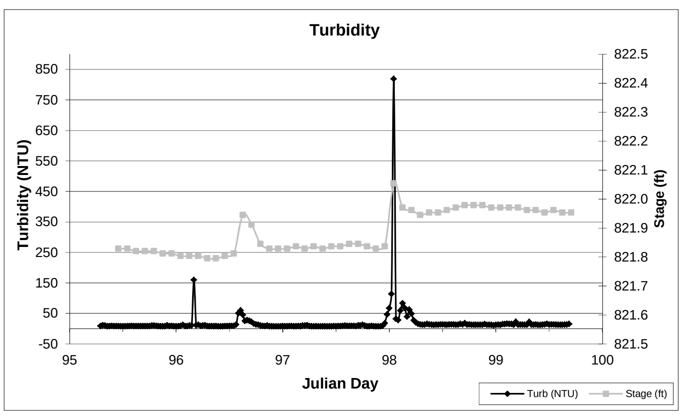
Storm Summary:

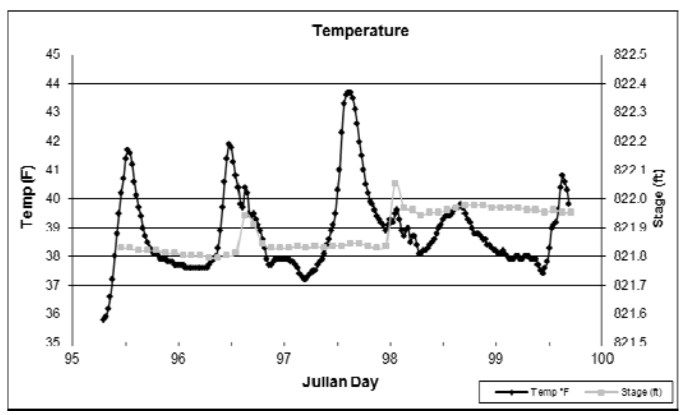
Dates: 5 April 2013 (day 95) to 9 April 2013 (day 99)

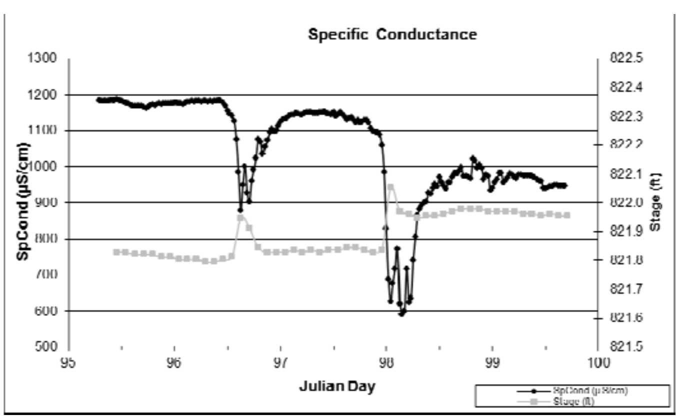
Precipitation: 1.32 inches plus snowmelt ongoing

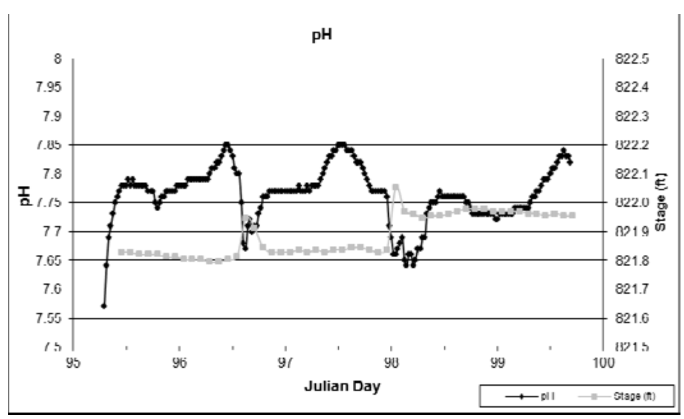






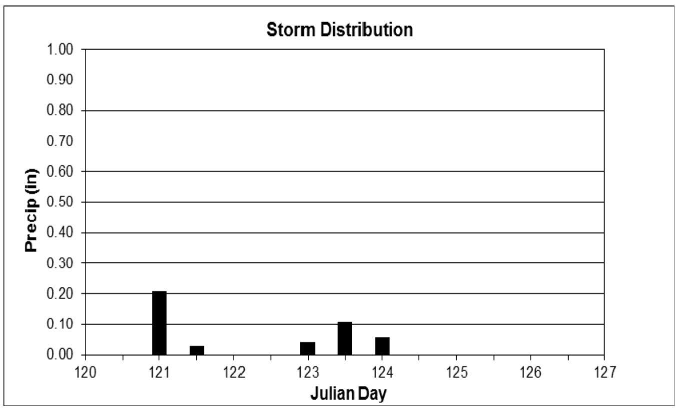


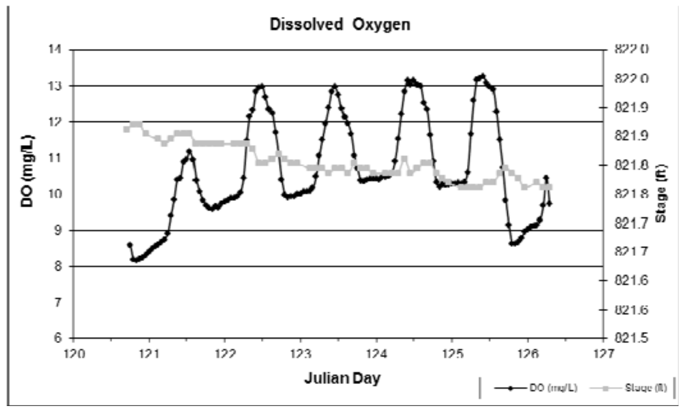


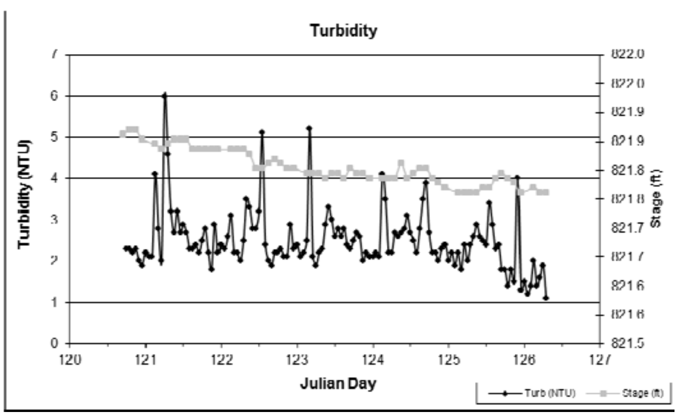


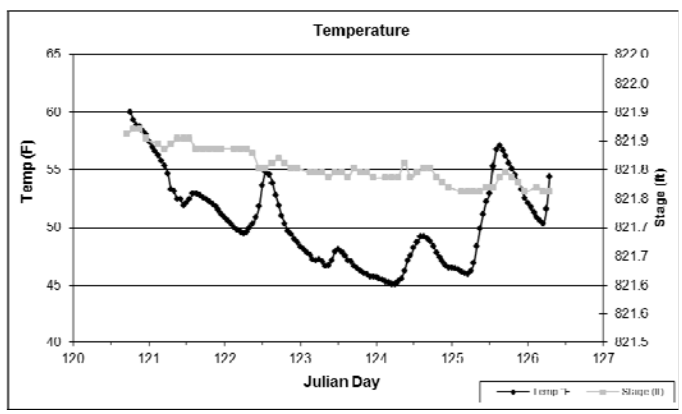
Hydrolab Continuous Monitoring
Storm 2 - 2013

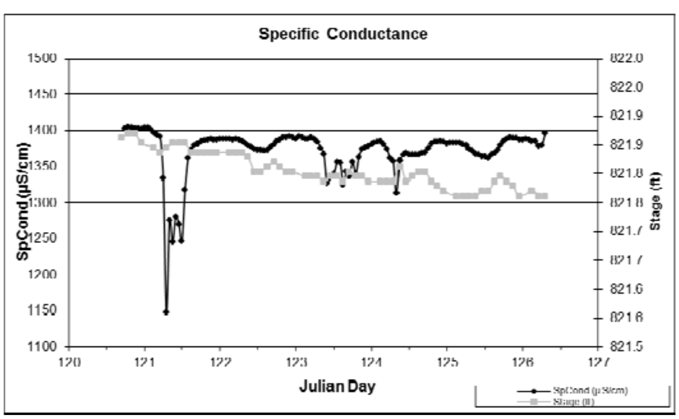
Pleasure Creek at 86th Ave
<u>Storm Summary:</u>
Dates: 30 April 2013 (day 120) to 6 May 2013 (day 126)
Precipitation: 0.45 inches

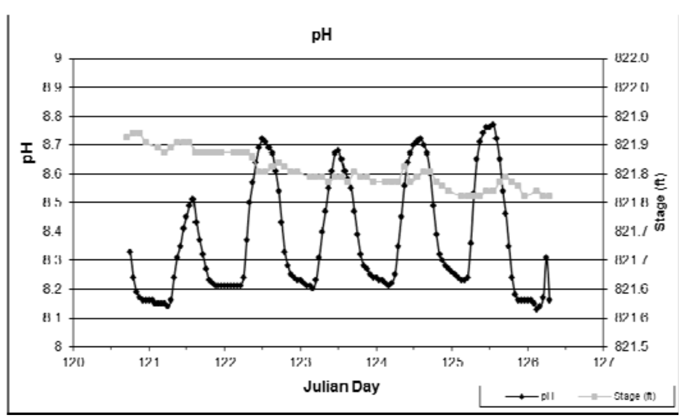












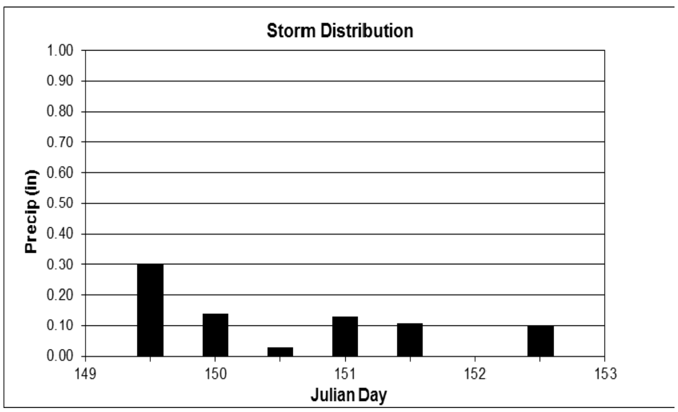
Hydrolab Continuous Monitoring
Storm 3 - 2013

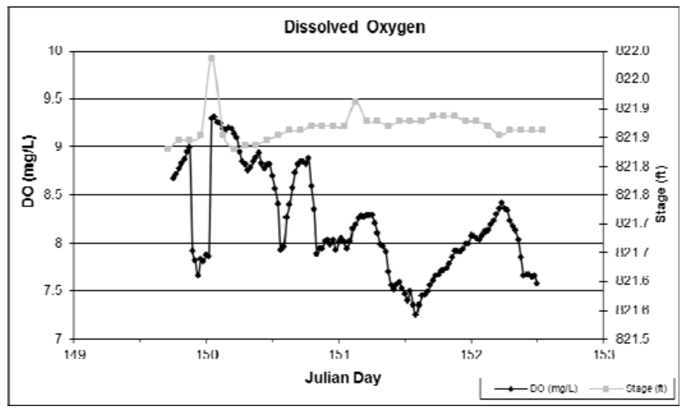
Pleasure Creek at 86th Ave

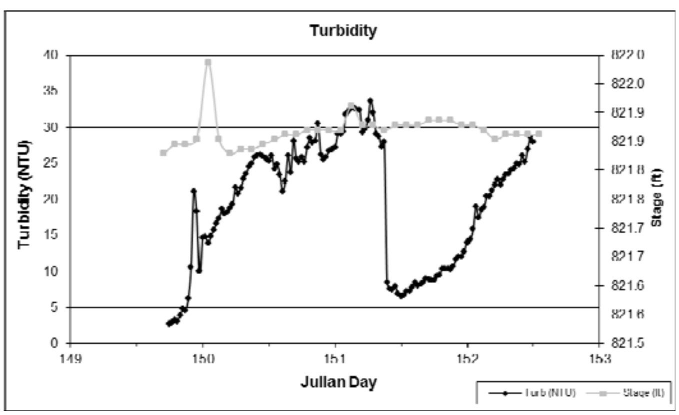
<u>Storm Summary:</u>

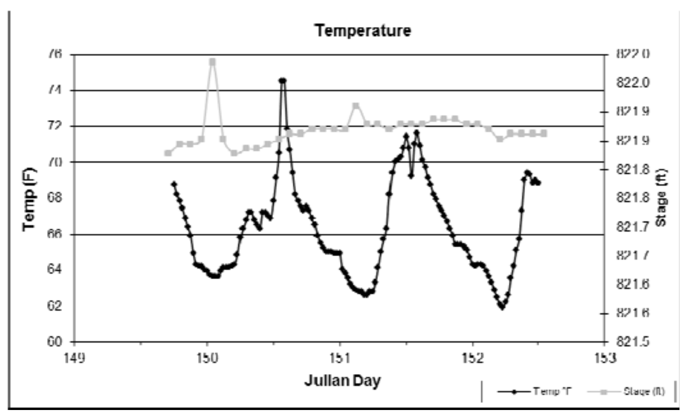
Dates: 31 May 2013 (day 149) to 1 June 2013 (day 152)

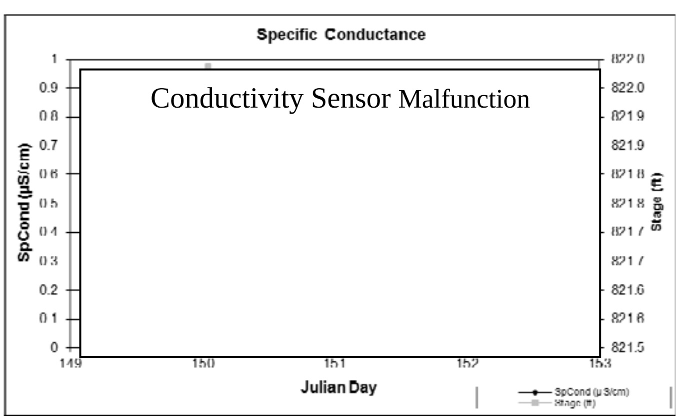
Precipitation: 0.81 inches

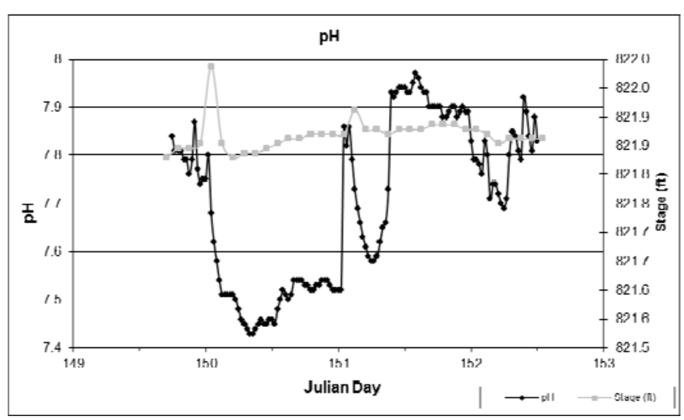












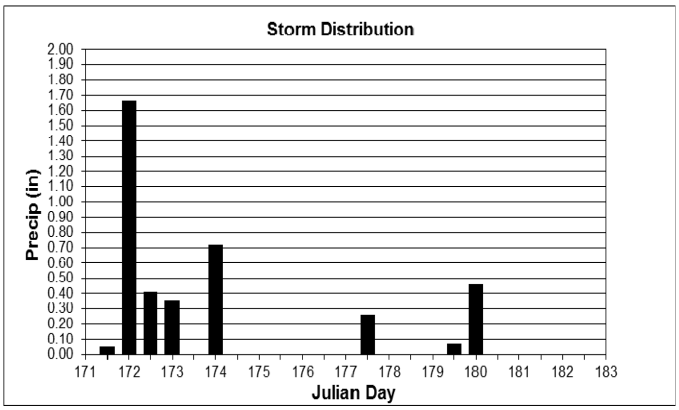
Hydrolab Continuous Monitoring
Storm 4 - 2013

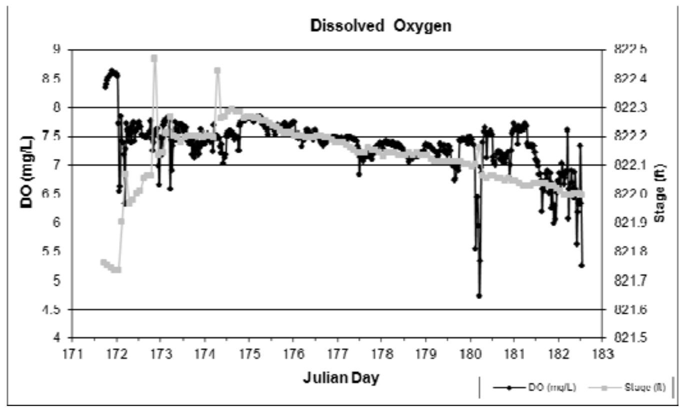
Pleasure Creek at 86th Ave

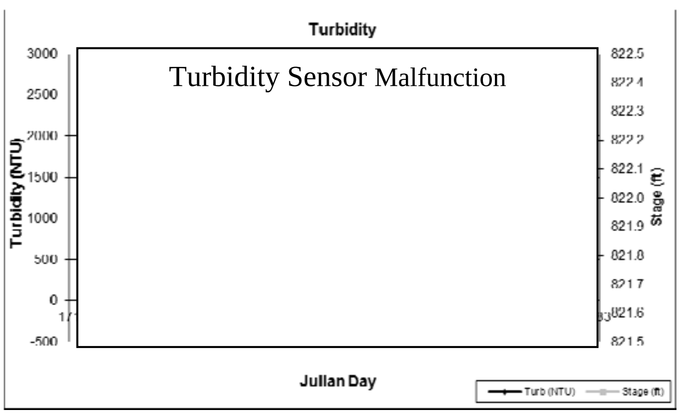
<u>Storm Summary:</u>

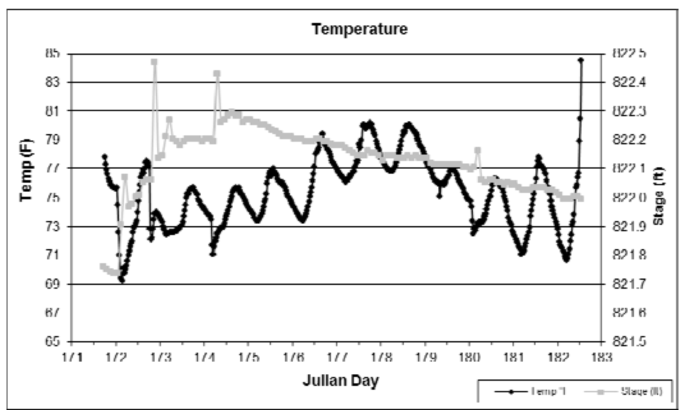
Dates: 20 June 2013 (day 171) to 1 July 2013 (day 182)

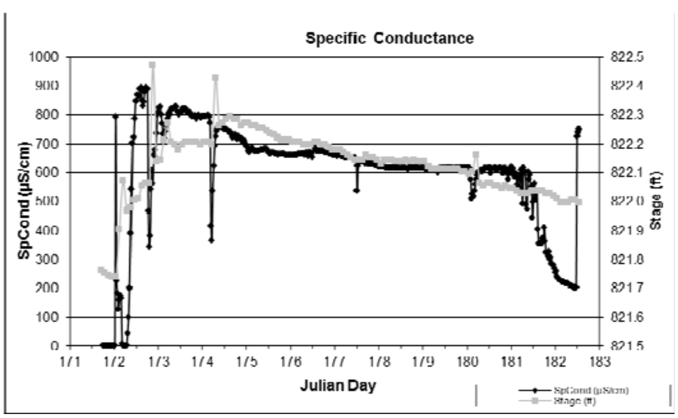
Precipitation: 3.99 inches

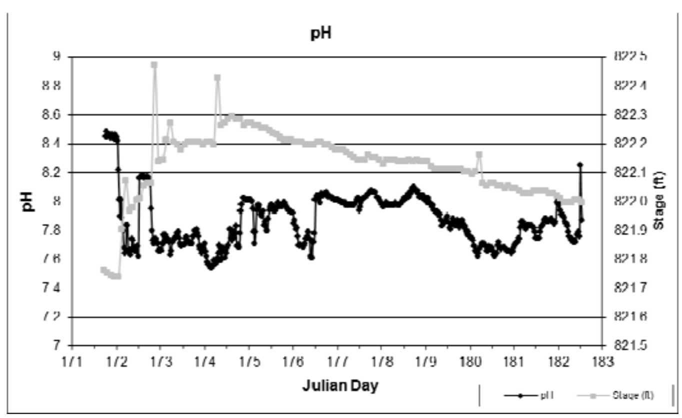












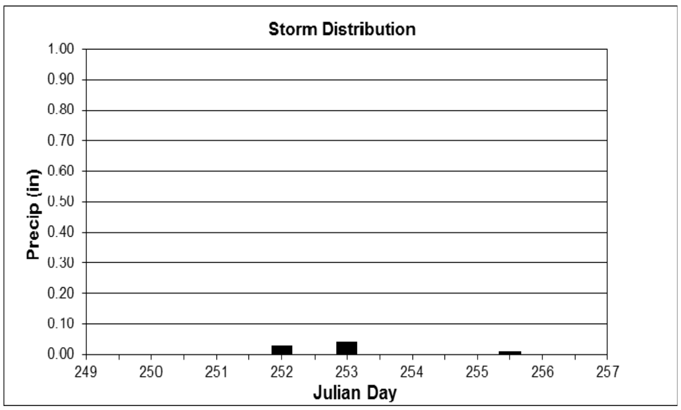
Hydrolab Continuous Monitoring
Storm 5 - 2013

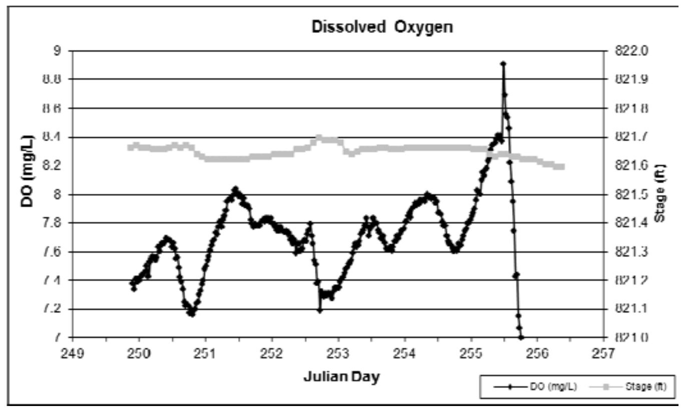
Pleasure Creek at 86th Ave

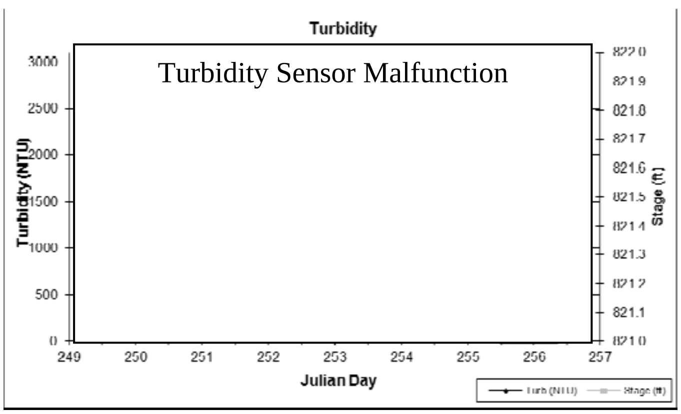
<u>Storm Summary:</u>

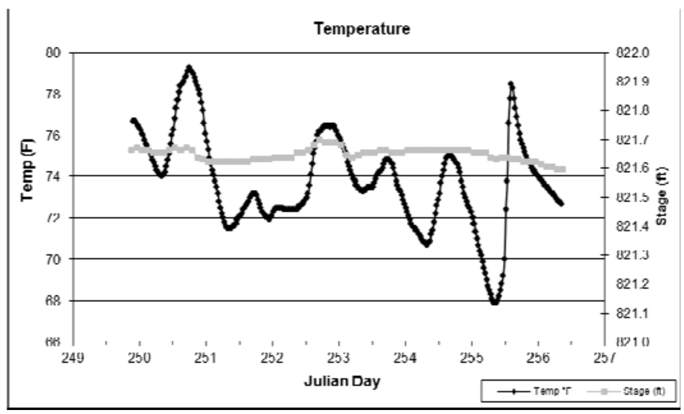
Dates: 6 September 2013 (day 249) to 13 September 2013 (day 256)

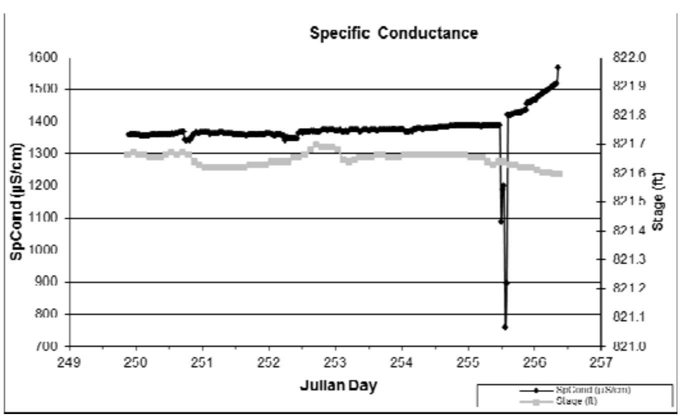
Precipitation: 0.08 inches

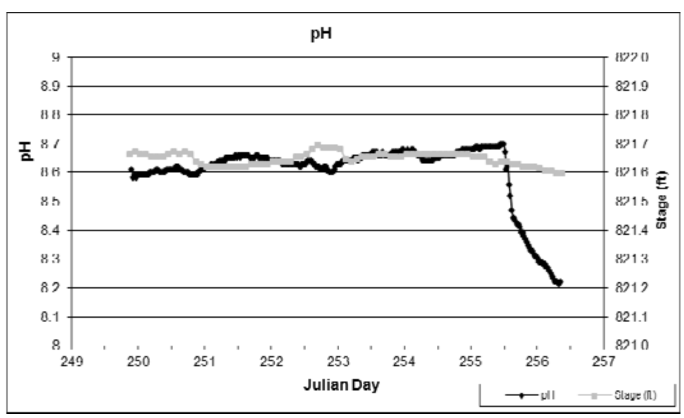












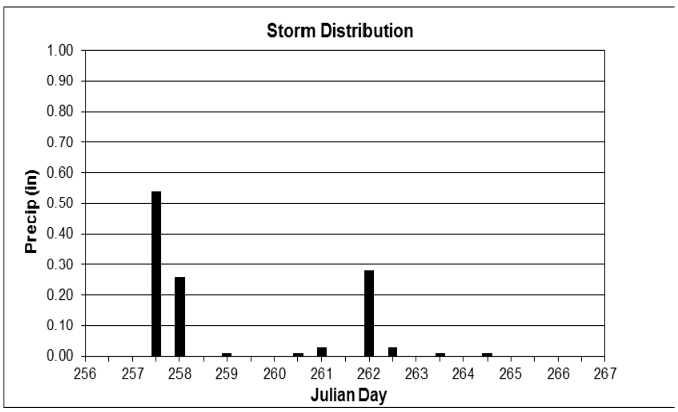
Hydrolab Continuous Monitoring
Storm 6 - 2013

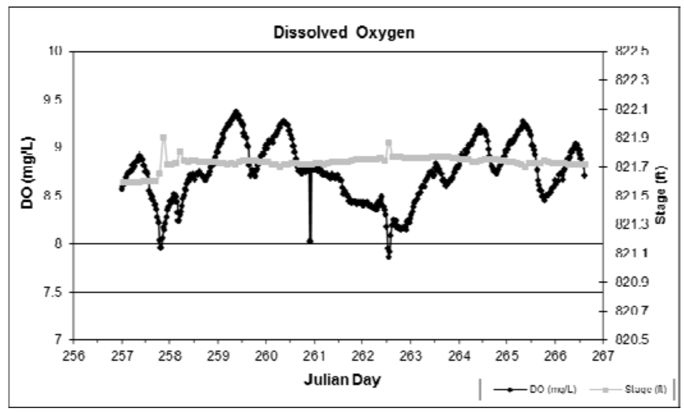
Pleasure Creek at 86th Ave

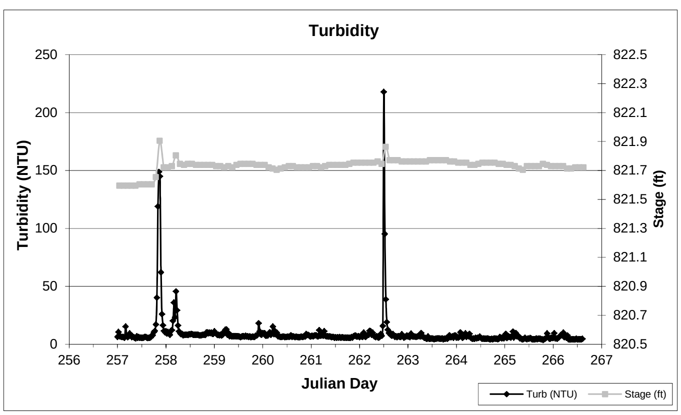
<u>Storm Summary:</u>

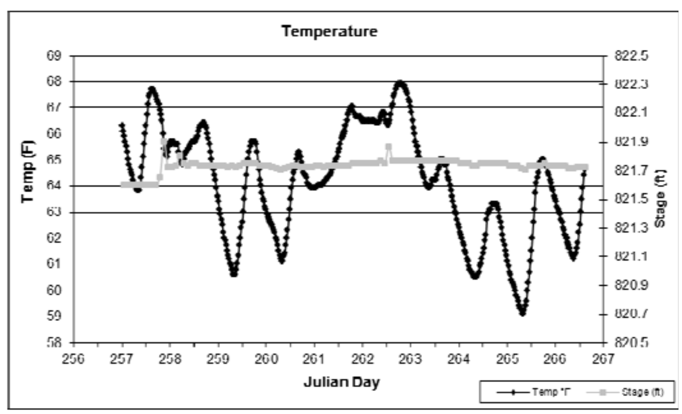
Dates: 14 September 2013 (day 257) to 23 September 2013 (day 266)

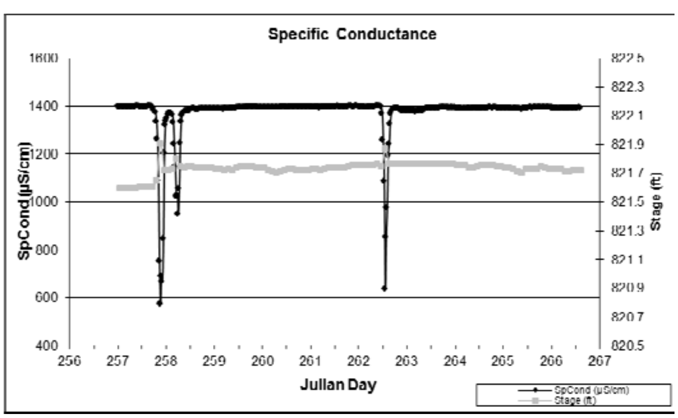
Precipitation: 1.18 inches

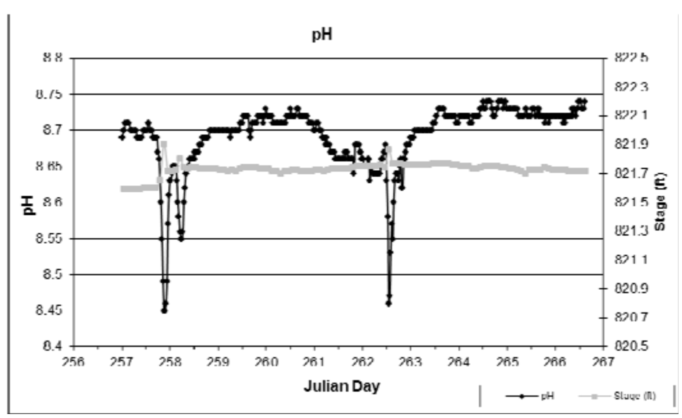






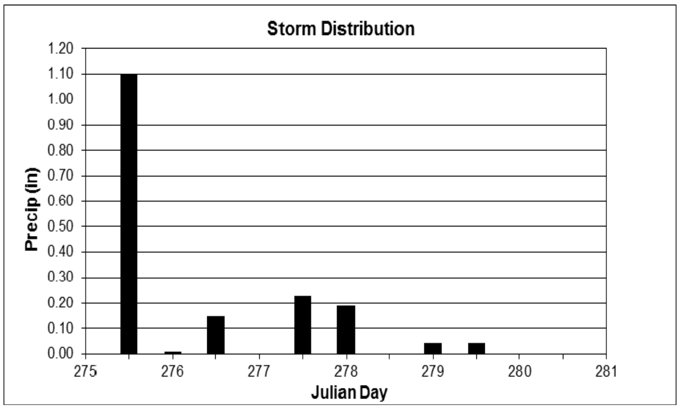


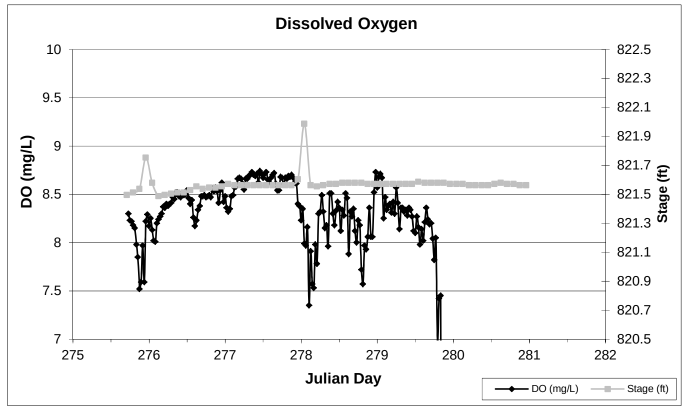


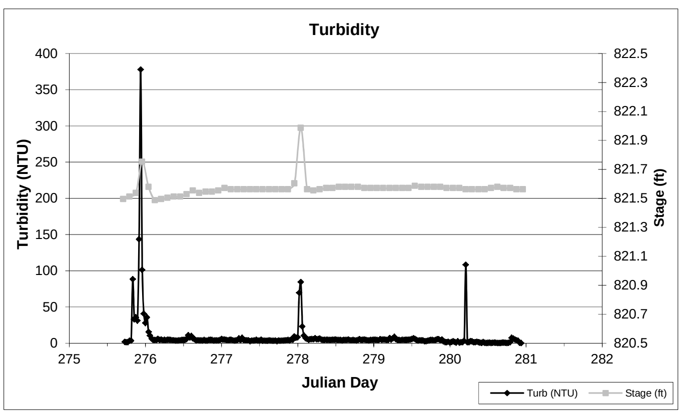


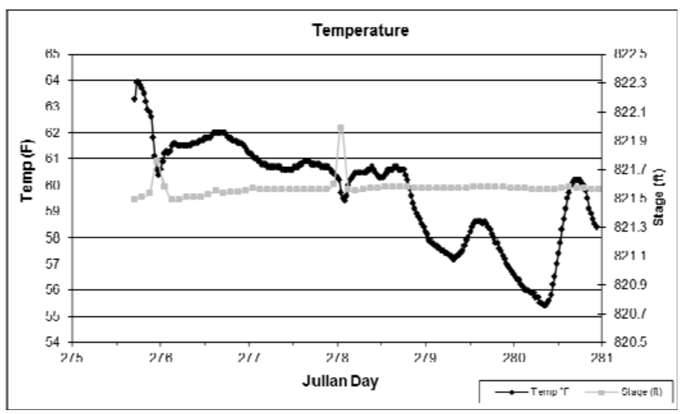
Hydrolab Continuous Monitoring
Storm 7 - 2013

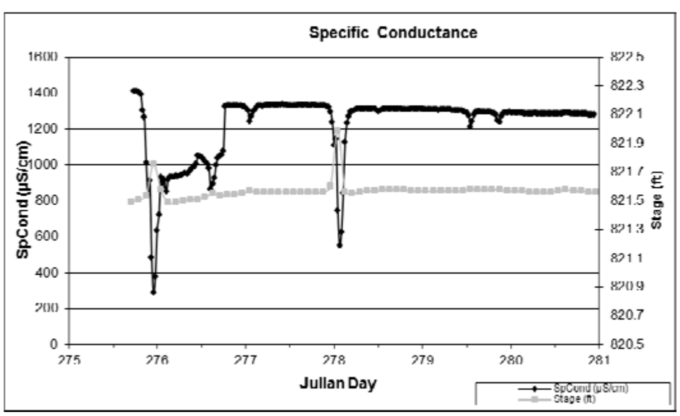
Pleasure Creek at 86th Ave
Storm Summary:
Dates: 2 October 2013 (day 275) to 7 October 2013 (day 280)
Precipitation: 1.76 inches

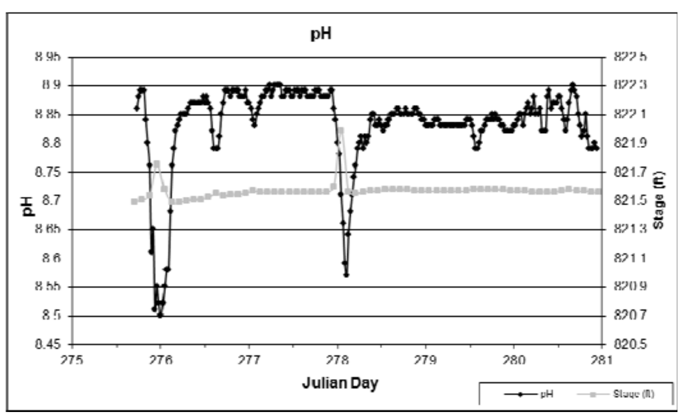












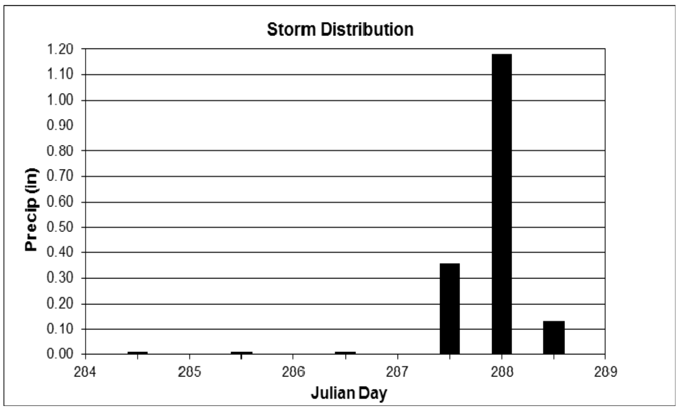
Hydrolab Continuous Monitoring
Storm 8 - 2013

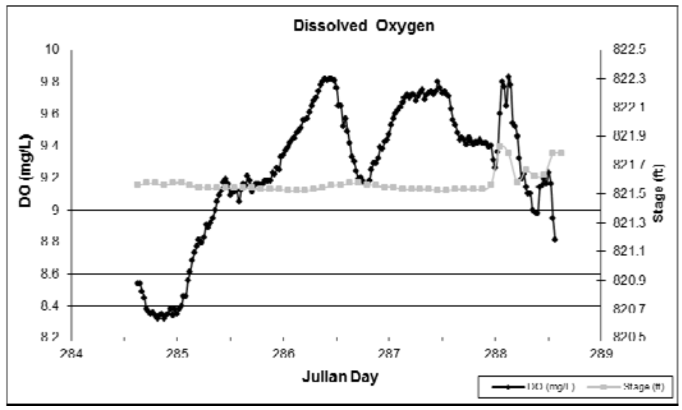
Pleasure Creek at 86th Ave

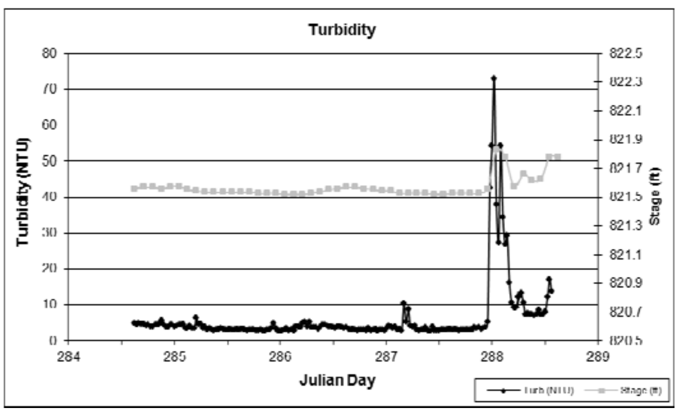
Storm Summary:

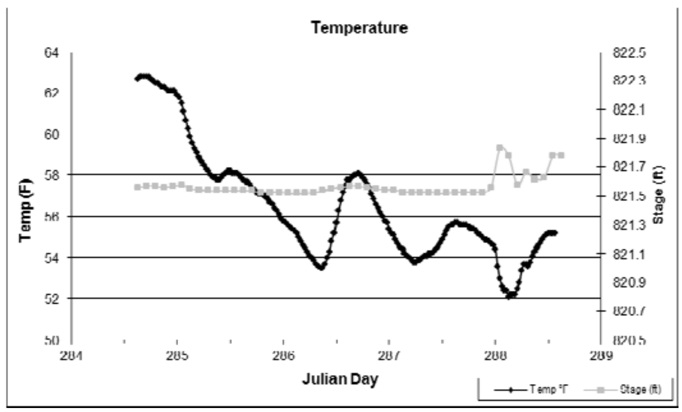
Dates: 11 October 2013 (day 284) to 15 October 2013 (day 288)

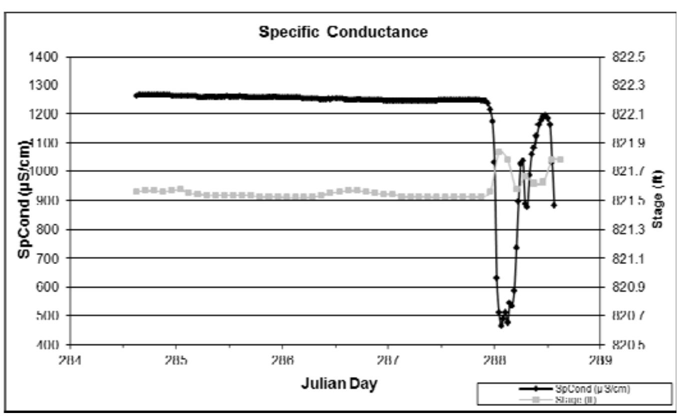
Precipitation: 1.70 inches

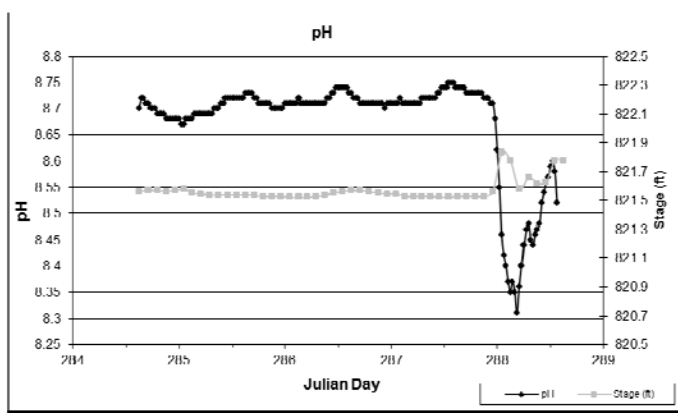












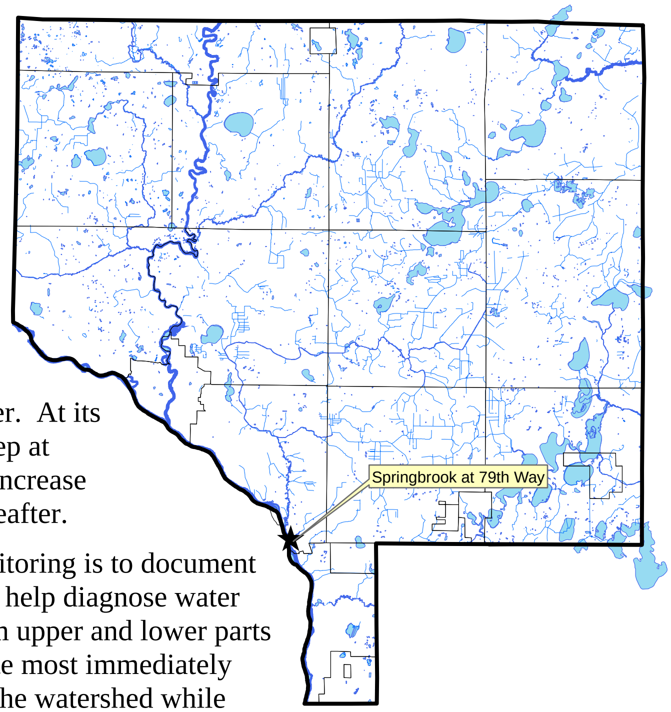
Hydrolab Continuous Stream Water Quality Monitoring

SPRINGBROOK

Springbrook at 79th., Coon Rapids   STORET SiteID = S003-993

Years Monitored

Springbrook at 79th   2013



Background

Springbrook is a small waterway draining an urbanized and highly modified subwatershed. The watershed includes portions of the Cities of Blaine, Coon Rapids, Spring Lake Park and Fridley. Several tributaries, or stormwater systems contributing to the creek, join at the Springbrook Nature Center Impoundment. From the outlet of the Nature Center, the Creek flows a short distance to the Mississippi River. At its outlet, Springbrook is about 10 feet wide and 1 foot deep at baseflow. The stream is flashy, with water levels that increase dramatically following rainfall and quickly recede thereafter.

The purpose of hydrolab continuous water quality monitoring is to document water quality changes throughout a storm. This should help diagnose water quality problems and analyze differences in runoff from upper and lower parts of the watershed. Runoff that passes the monitoring site most immediately following a storm is from the lower, urbanized part of the watershed while later runoff is mostly from upper portions of the watershed.

Methods

Springbrook at 79th Way was chosen for monitoring because it is the farthest downstream, easily accessible site on Springbrook Creek. This site can occasionally become limited due to backwater influences from the Mississippi River can occur during high flow. This site has been used for past monitoring efforts.

Springbrook at 79th Way was monitored immediately before, during, and after storms with a Hydrolab MS5 water quality sonde. The sonde was suspended inside a PVC pipe by a chain from a locked lid. The PVC pipe was secured to a metal fence post. The sonde sensors protruded from the bottom of the pipe approximately 6-12 inches from the stream bottom, ensuring they would stay submerged even if flow was low. The sonde was programmed to take readings every 30 minutes. Readings included pH, salinity, specific conductance, temperature, dissolved oxyen, and turbidity. The sonde was calibrated before each deployment.

Hydrolab MS5 casing (taller) and a Measura continuous water level monitoring device I Springbrook Creek.

The Hydrolab was deployed into the stream when a storm predicted to drop at least 0.5 inches of rain, and preferably greater, was approaching. In some instances, water level was already high before the storm and remained high after the storm. At other times, predicted rain did not fall and we were monitoring baseflow conditions. In all instances, the Hydrolab was left in the field for several days.

Water levels were continuously monitored before, during, and after all Hydrolab monitoring. A Measura Ecotone-40 water level monitoring device recorded water levels every two hours. This stream stage is presented with the water quality data. It would be preferable to present flow, though a rating curve does not currently exist. To make graphs from all storms comparable, stage is shown for all.

Precipitation data are provided with the water quality results. These data were taken from the datalogging rain gauge at Coon Rapids City Hall, which is approximately 2 miles north of the stream monitoring site. In our analysis we also looked at precipitation totals in other portions of the watershed and noted any large differences.

Results and Discussion

A variety of storm sizes were analyzed. Rainfall during the monitored time periods ranged from 0.28 to 2.40 inches. The wide distribution is helpful in discerning the creek's response to different events.

The discussion below incorporates results from 2013 Hydrolab monitoring. 2013 was the first season of Hydrolab monitoring on Springbrook Creek.

On the following pages results from each storm monitored are shown. The graphs show precipitation and the stream hydrograph approximately one day before and after water quality monitoring began. Separate graphs show each water quality parameter. The text below discusses summarizes findings across all storms for each parameter.

<u>Turbidity</u>

- For most storms there is a brief, large turbidity spike during or immediately following rainfall. For small rain events less than 0.1" the change in stream turbidity was minimal or not noticeable. For larger storms turbidity immediately rose sharply through stream water levels changed only modestly. Turbidity typically retreated to lower levels within hours or less. This suggests that most of this turbidity is coming from the lower watershed. The upper watershed is treated by large regional ponds.
- Brief but intense storms cause dramatic increases in turbidity from single digits to 200+ NTU.
- There is substantial variability among storms. Storms with similar rainfall totals may produce dramatically different turbidity in the creek. Intervening factors include storm intensity, whether snowmelt is occurring synchronously, and the amount of time since the last wash off event.

<u>Specific Conductance</u>

- Specific conductance, a measure of dissolved pollutants, is inversely related to water level. When creek water rises, conductance drops. During brief, intense rainfall the stream conductance drops sharply. The shallow groundwater that feeds the stream during baseflow has higher conductance than stormwater runoff, and storm runoff dilutes it. Infiltration of road deicing salts are a likely source of high conductance in stream baseflow year round.

<u>Dissolved Oxygen</u>

- The observed dissolved concentrations in Springbrook Creek stayed well within the healthy, desirable range.
- Dissolved oxygen stayed above 5 mg/L, the state water quality standard, in all events monitored. Below this level some fish species begin to suffer.
- When stream levels rise, dissolved oxygen often drops, but not to critically low levels.

<u>Temperature</u>

- Water temperature is generally not considered a concern in Springbrook Creek because there is no trout or other temperature sensitive resource.

- Cycles of day warming and night cooling are apparent in the data.

pH

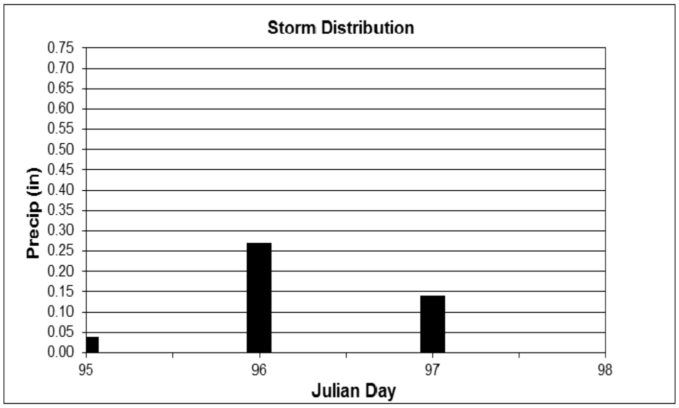
- pH is inversely related to water level in Springbrook Creek. When water level rises, pH declines. This is because rainwater has a lower pH than that of local shallow groundwater.
- pH is occasionally above the desired range of 6.5 to 8.5 that is specified in state water quality standards.

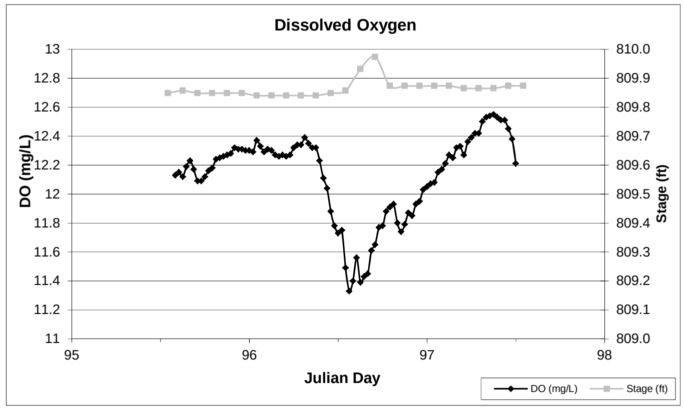
Hydrolab Continuous Monitoring
Storm 1 - 2013

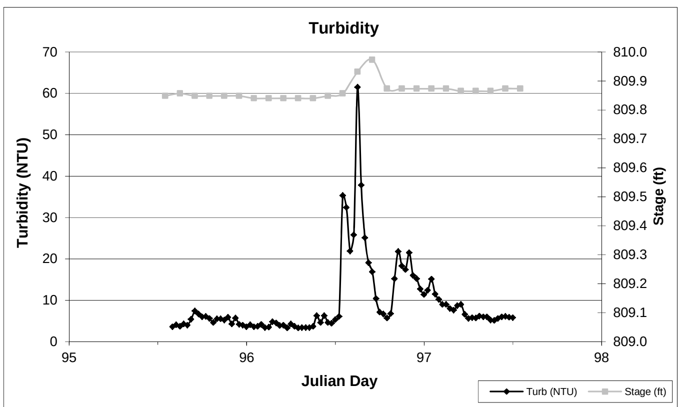
Storm Summary:

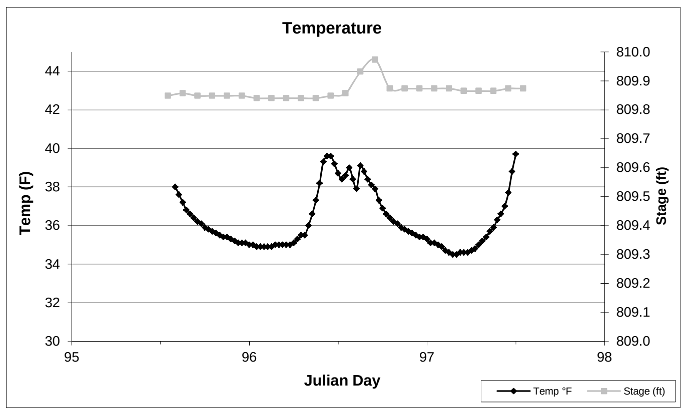
Dates: 5 April 2013 (day 95) to 7 April 2013 (day 97)

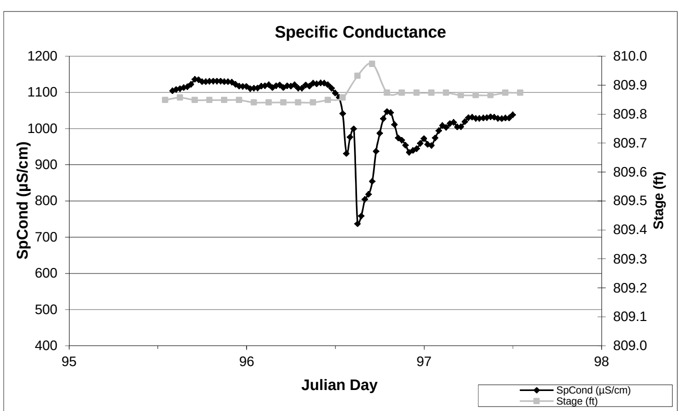
Precipitation: 0.45 inches

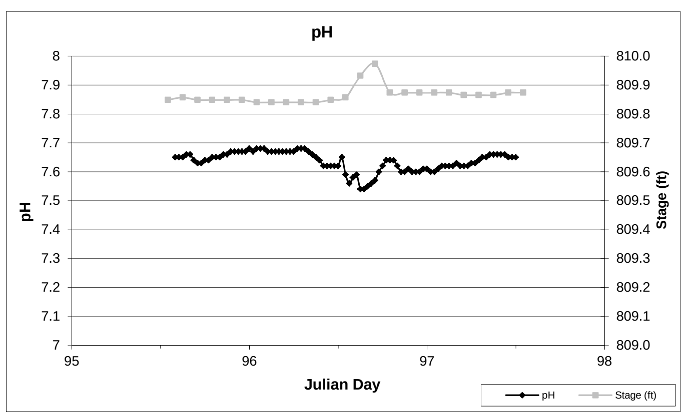








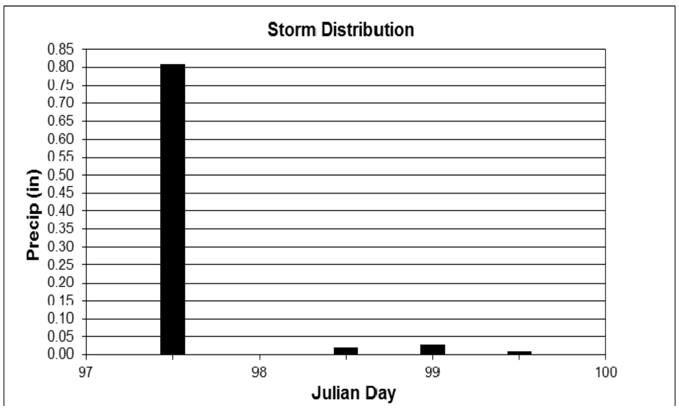


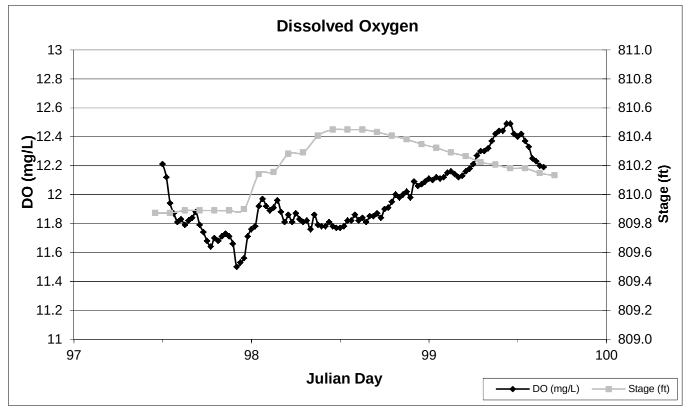


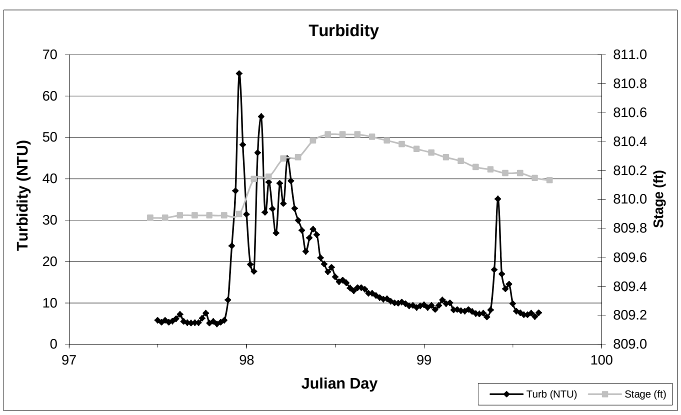
Hydrolab Continuous Monitoring
Storm 2 - 2013

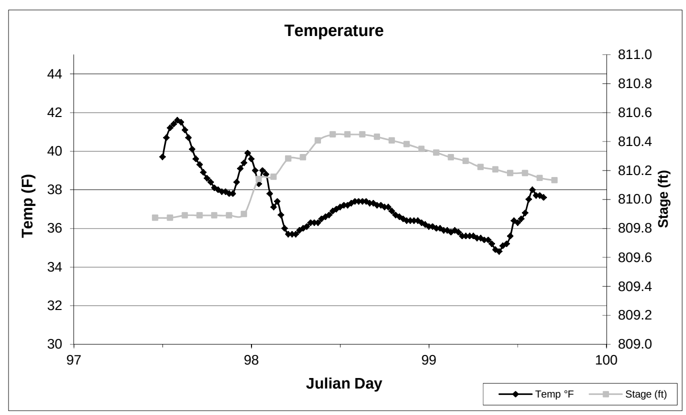
Storm Summary:

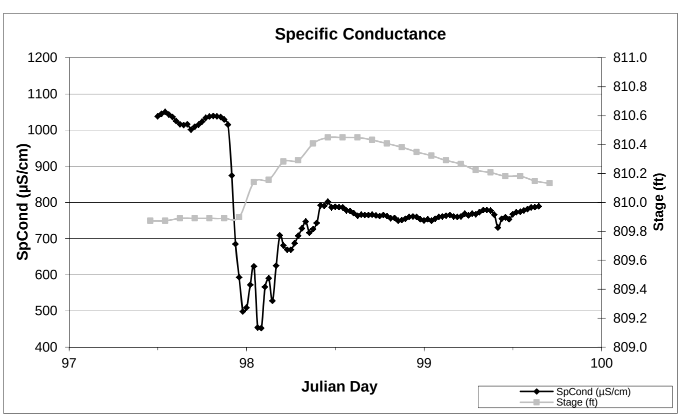
Dates: 7 April 2013 (day 97) to 9 April 2013 (day 99)
Precipitation: 0.87 inches

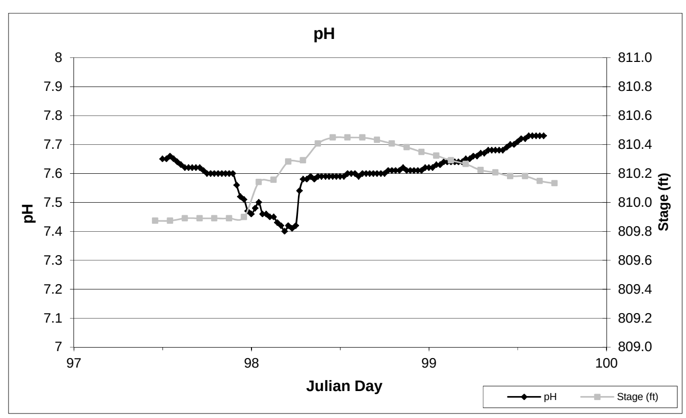






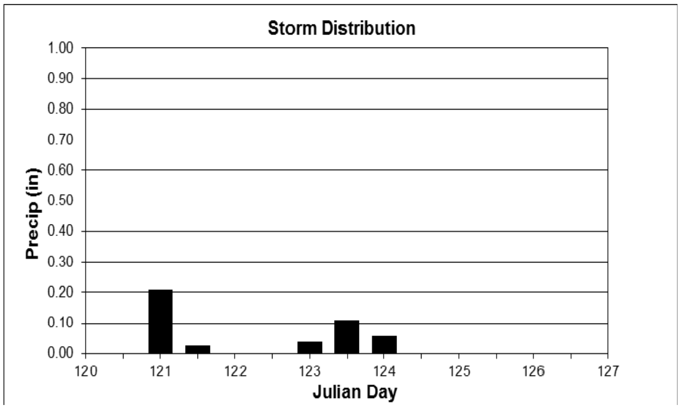


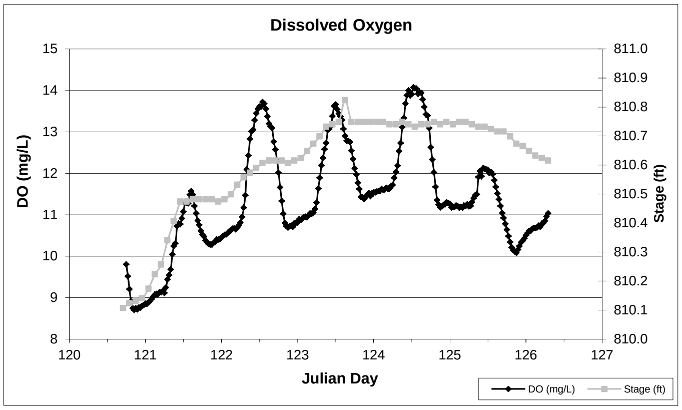


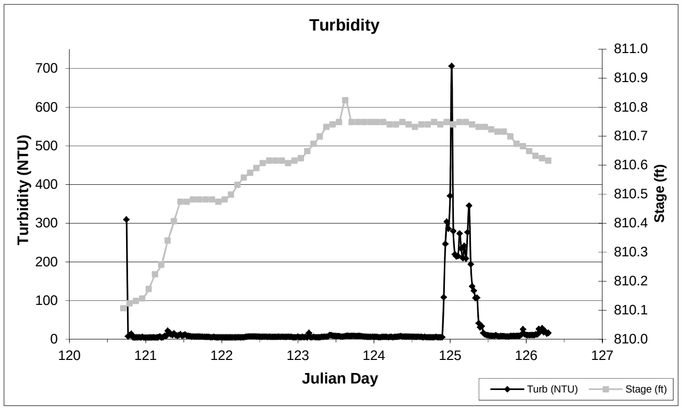


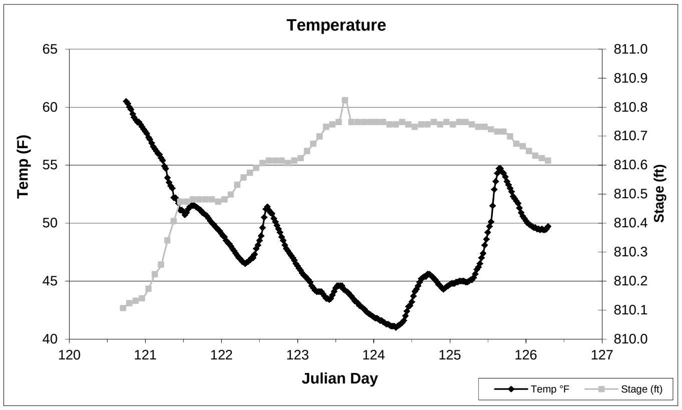
Hydrolab Continuous Monitoring
Storm 3 - 2013

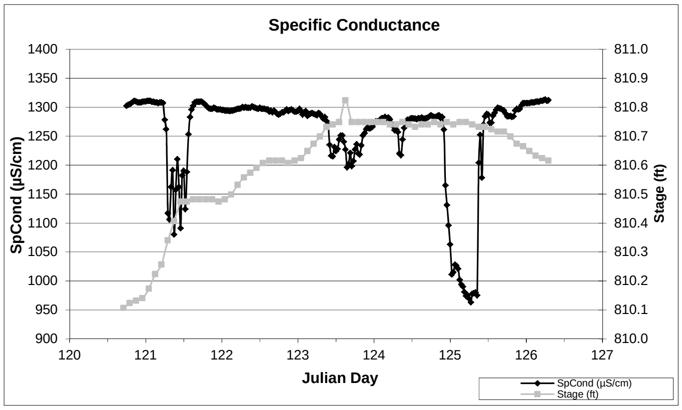
Storm Summary:
Dates: 30 April 2013 (day 121) to 6 May 2013 (day 126)
Precipitation: 0.45 inches

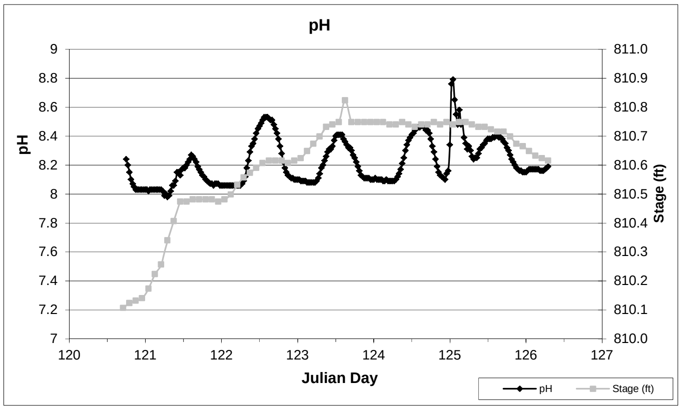






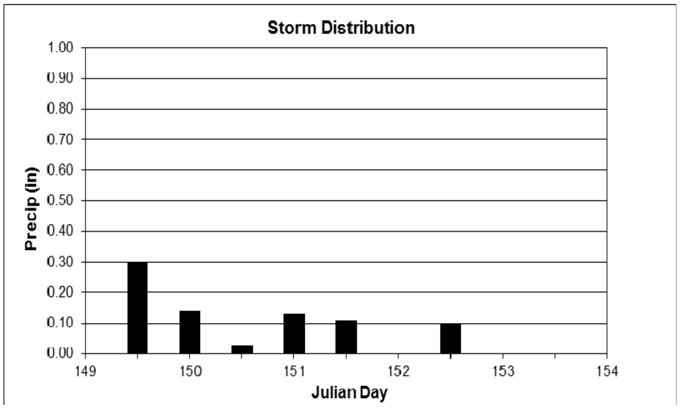


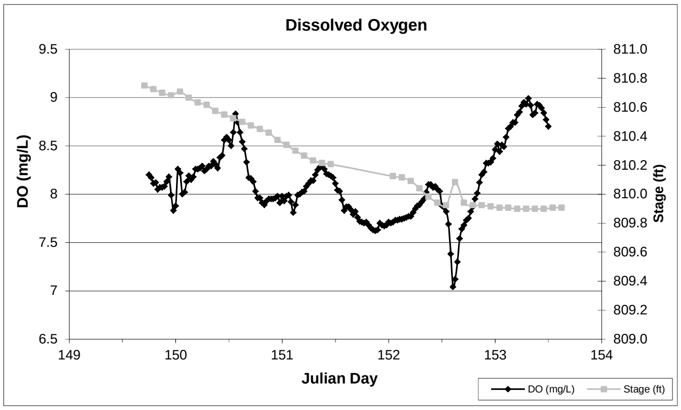


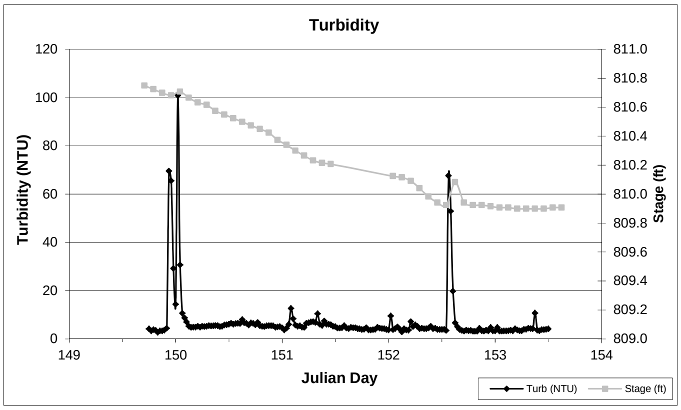


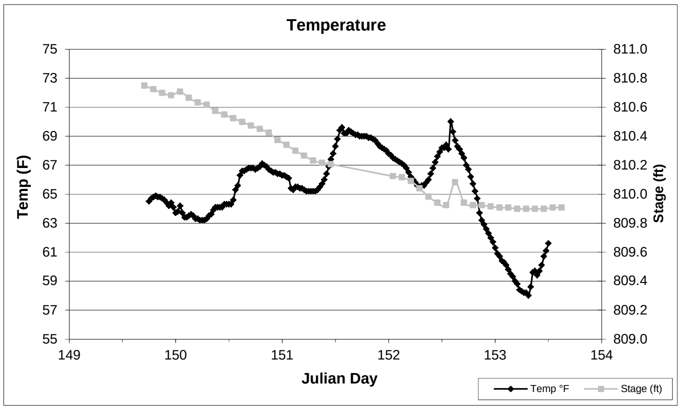
Hydrolab Continuous Monitoring
Storm 4 - 2013

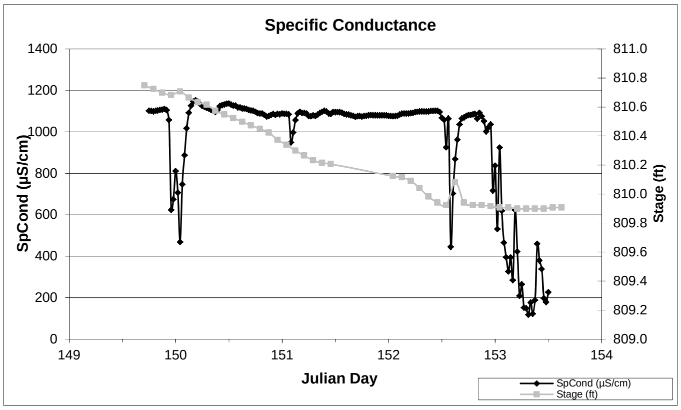
Storm Summary:
Dates: 29 May 2013 (day 149) to 2 June 2013 (day 153)
Precipitation: 0.81 inches

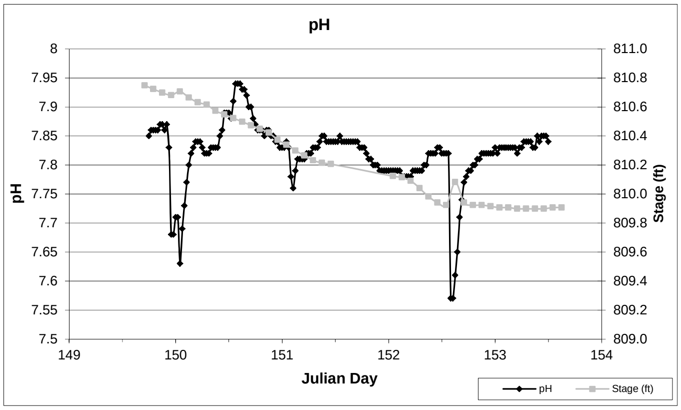










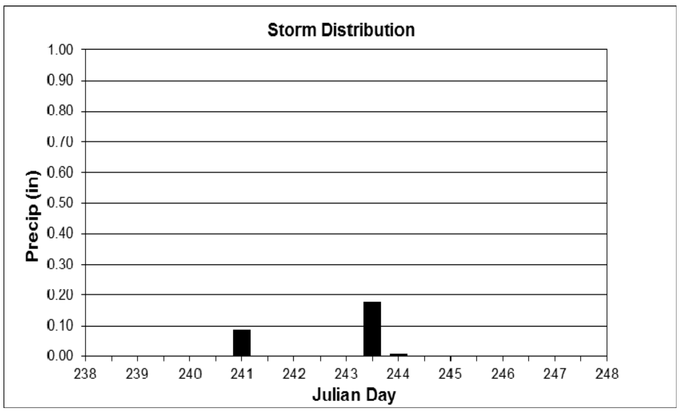


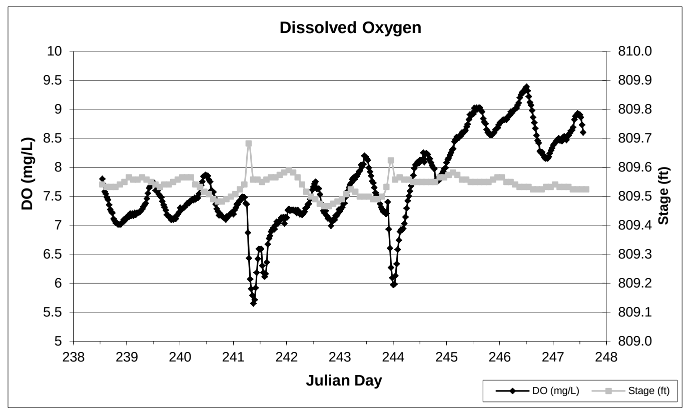
Hydrolab Continuous Monitoring
Storm 5 - 2013

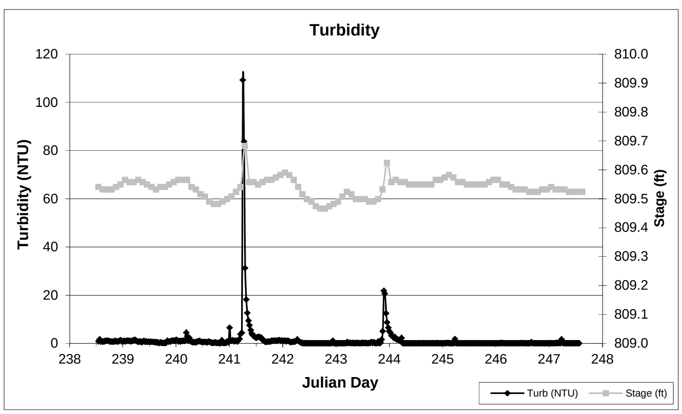
Storm Summary:

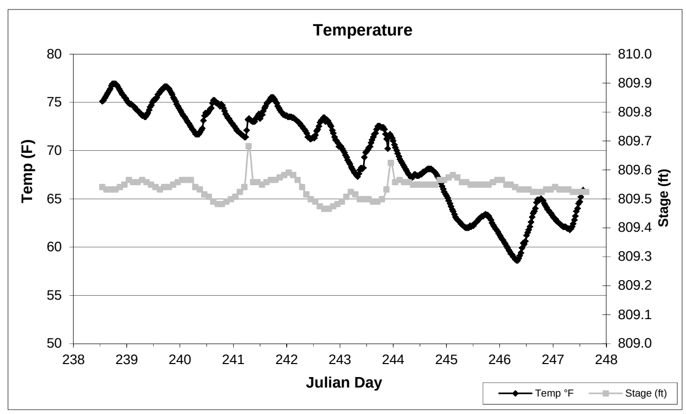
Dates: 26 August 2013 (day 238) to 4 September 2013 (day 247)

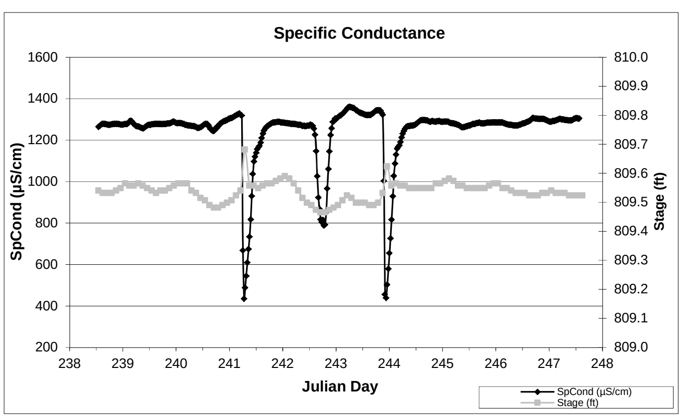
Precipitation: 0.28 inches

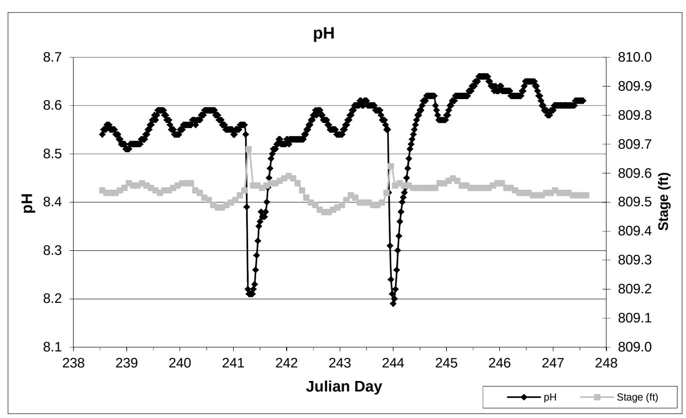










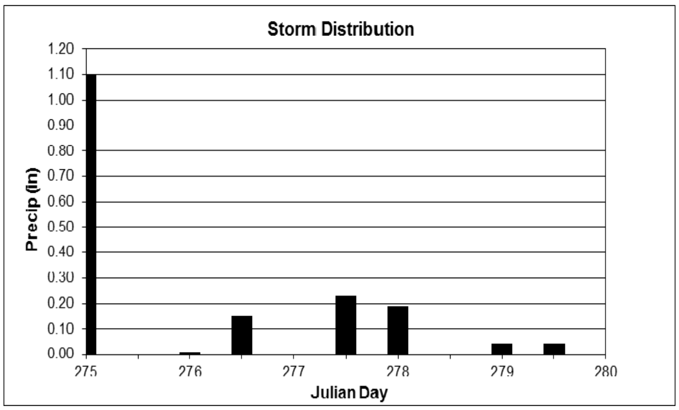


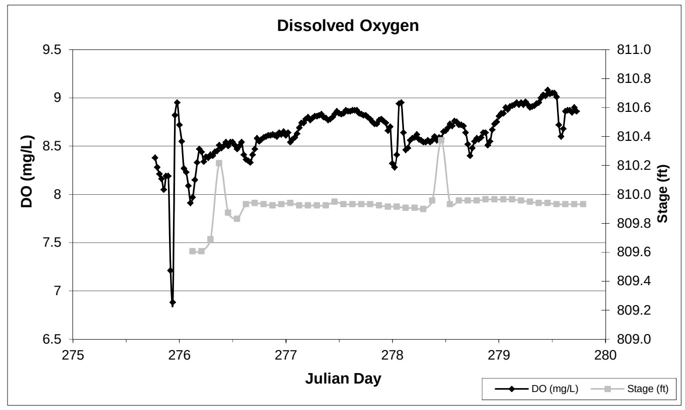
Hydrolab Continuous Monitoring
Storm 6 - 2013

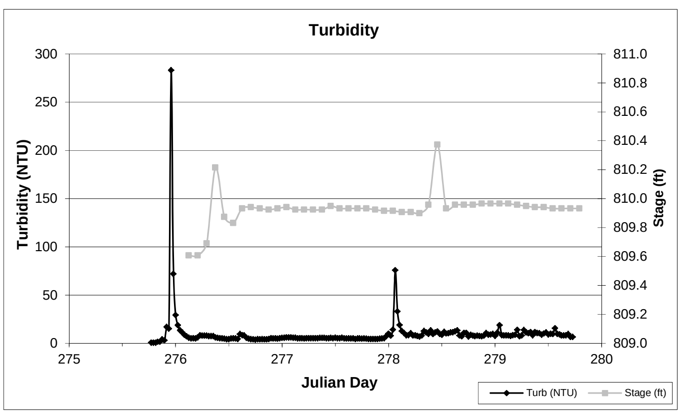
Storm Summary:

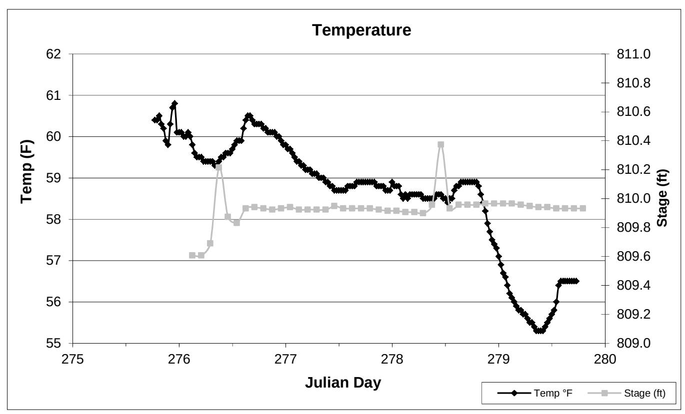
Dates: 2 October 2013 (day 275) to 6 October 2013 (day 279)

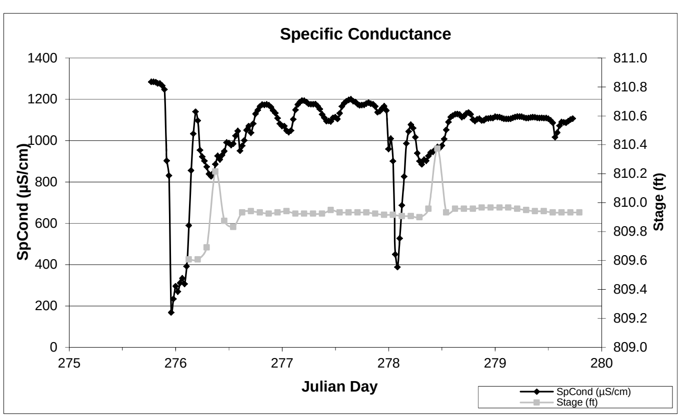
Precipitation: 1.76 inches

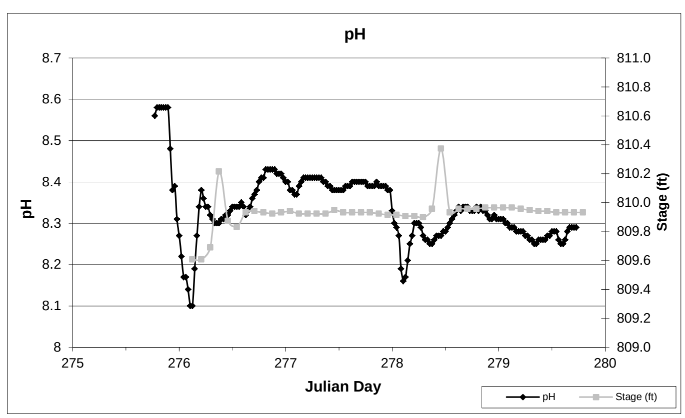










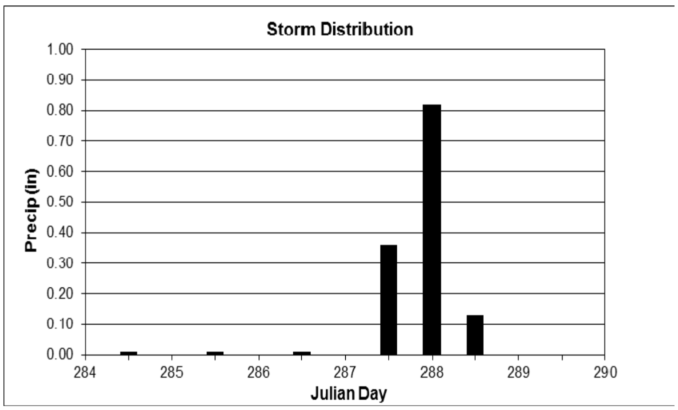


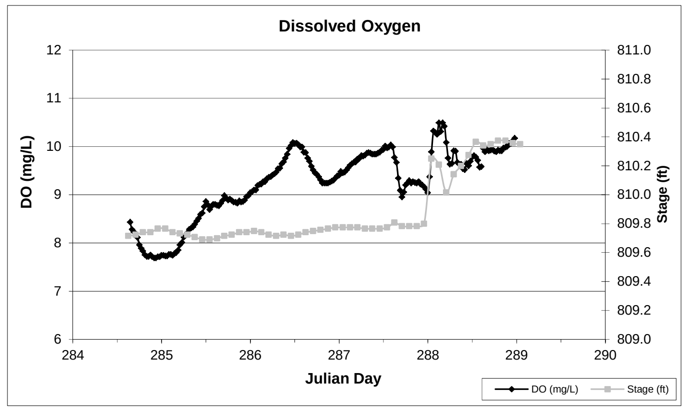
Hydrolab Continuous Monitoring
Storm 7 - 2013

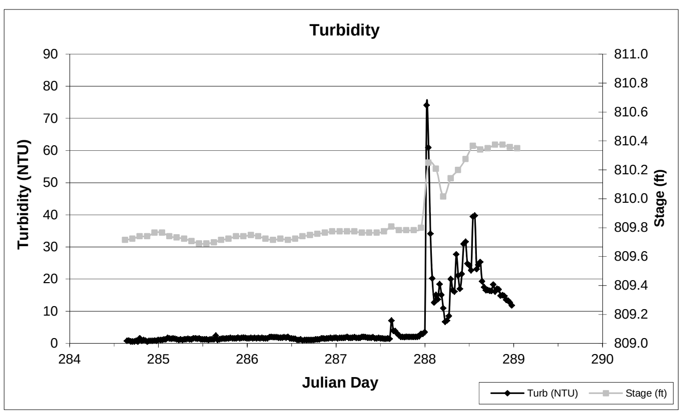
Storm Summary:

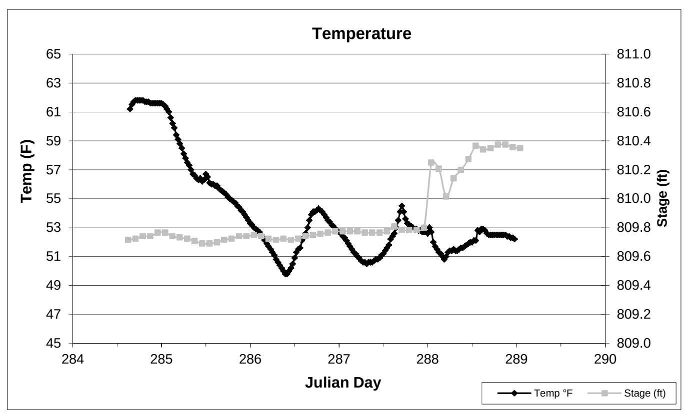
Dates: 11 October 2013 (day 284) to 15 October 2013 (day 288)

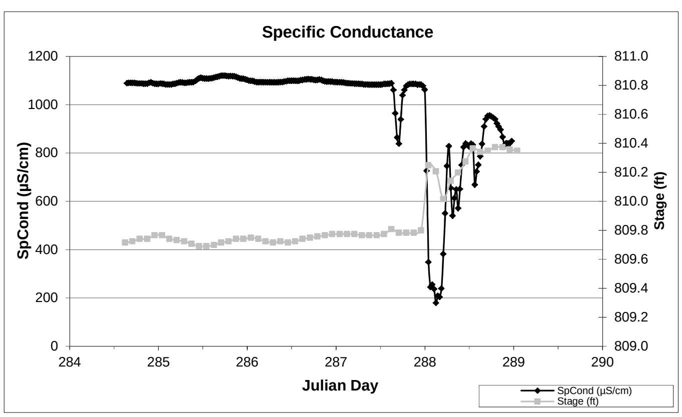
Precipitation: 1.34 inches

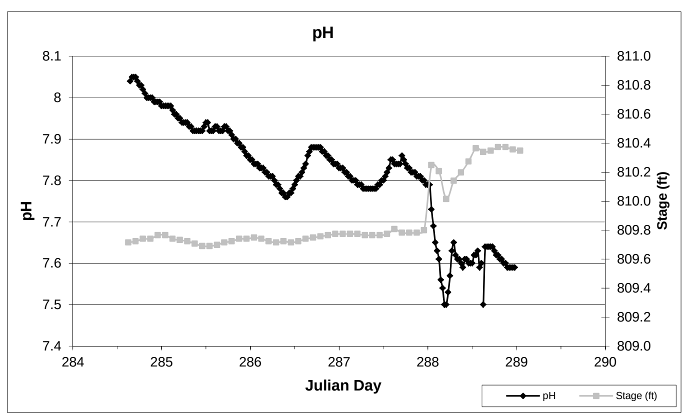






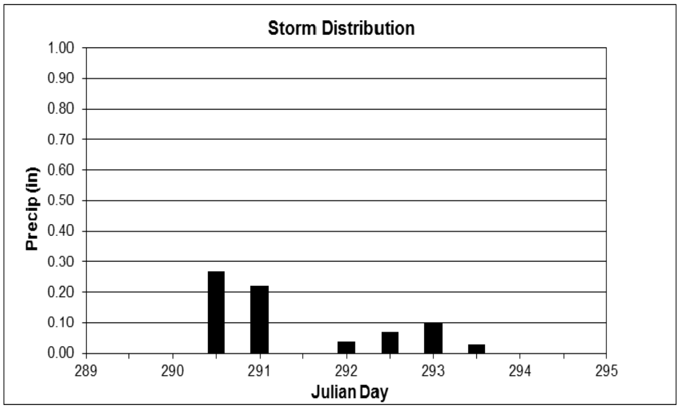


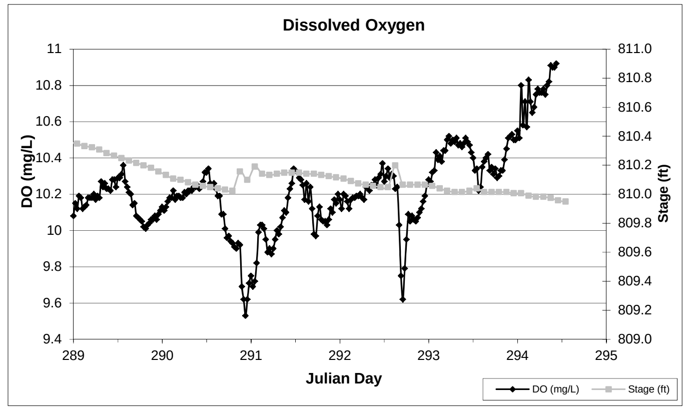


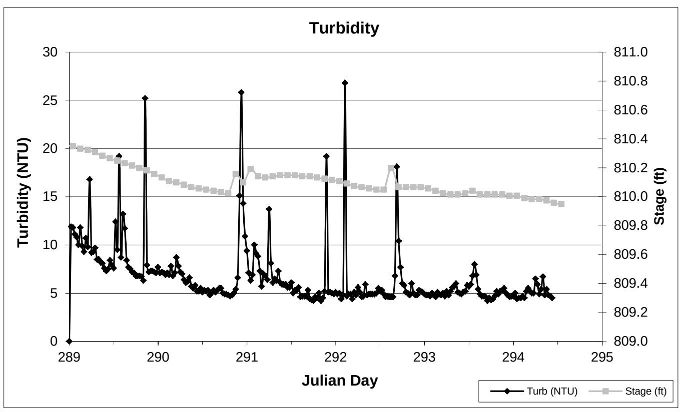


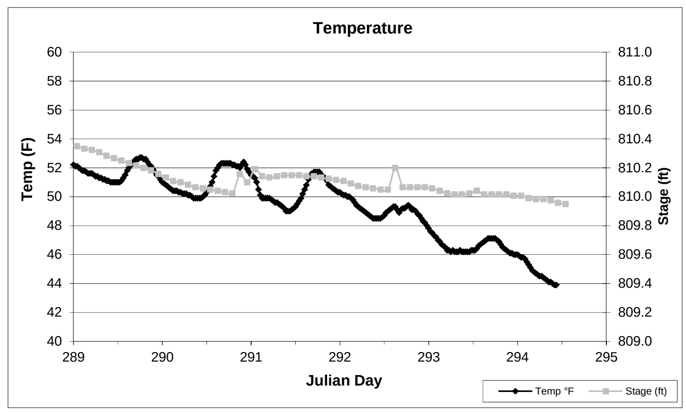
Hydrolab Continuous Monitoring
Storm 8 - 2013

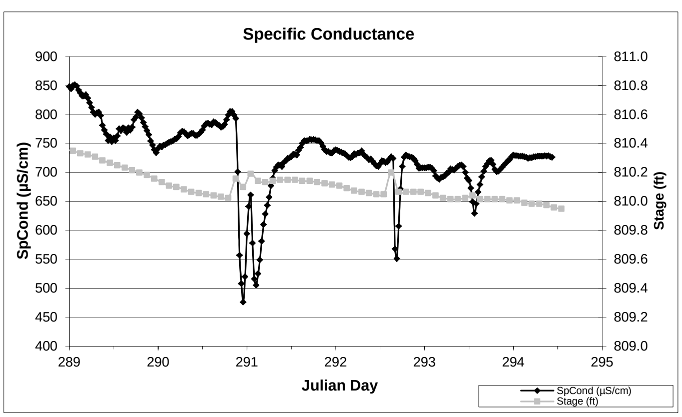
<u>Storm Summary:</u>
Dates: 16 October 2013 (day 289) to 21 October 2013 (day 294)
Precipitation: 0.73 inches

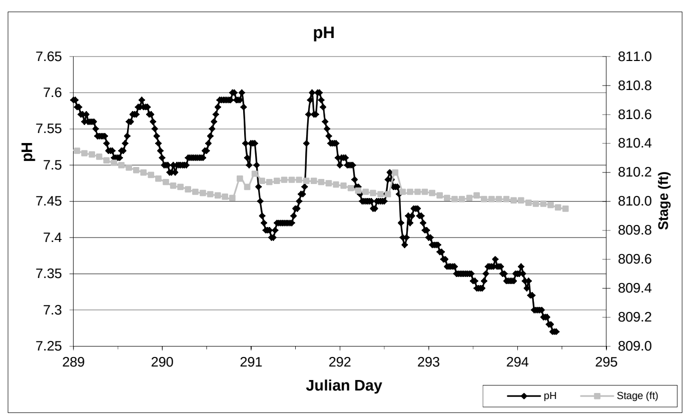












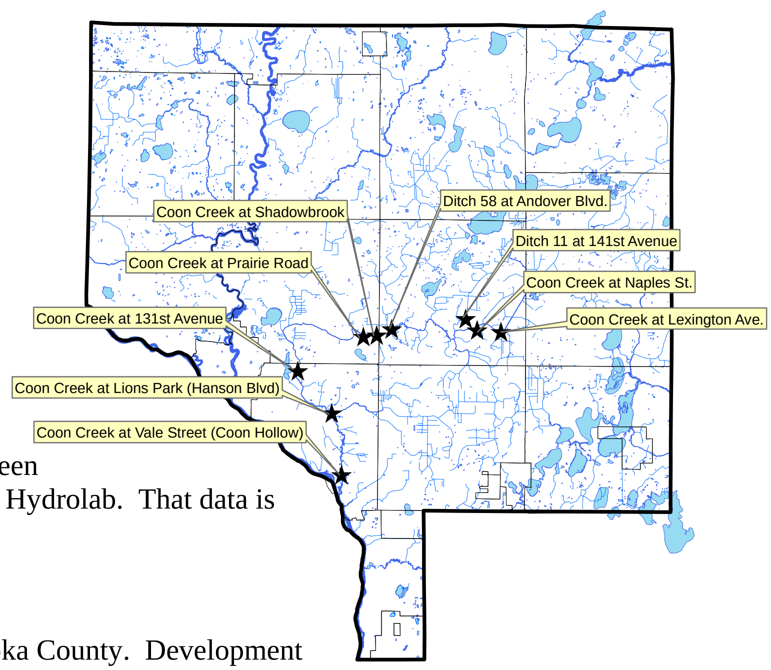
Coon Creek

Coon Creek at Lexington, Ham Lake	STORET SiteID = S007-539
Ditch 11 at 149st Avenue, Ham Lake	STORET SiteID = S007-541
Coon Creek at Naples Street, Ham Lake	STORET SiteID = S007-057
Ditch 58 at Andover Blvd, Ham Lake	STORET SiteID = S005-830
Coon Creek at Shadowbrook Townhomes, Andover	STORET SiteID = S004-620
Coon Creek at Prairie Road, Andover	STORET SiteID = S007-540
Coon Creek at 131st Avenue, Coon Rapids	STORET SiteID = S005-257
Coon Creek at Lions Park, Coon Rapids	STORET SiteID = S004-171
Coon Creek at Vale Street, Coon Rapids	STORET SiteID = S003-993

Years Monitored

Coon Cr at Lexington	2013
Ditch 11 at 149st Ave	2013
Coon Cr at Naples St	2012-2013
Ditch 58 at Andover Blvd	2013
Coon Cr at Shadowbrook Townhomes	2007-2013
Coon Cr at Prairie Rd	2013
Coon Cr at 131st Ave	2010-2013
Coon Cr at Lions Park (Hanson Blvd)	2007-2013
Coon Cr at Vale St	2005-2013

Additional, intermittent data available at some other sites



Note that continuous water quality monitoring has been conducted at Vale Street in 2011-2013 using a Hach Hydrolab. That data is reported elsewhere.

Background

Coon Creek is a major drainage through central Anoka County. Development in the watershed ranges from rural residential to urbanized. Upstream reaches were ditched in the early 1900's for agriculture. There are many ditch tributaries in the upper reaches. Lower reaches of the creek were not ditched. The entire creek serves as an important stormwater conveyance for the Cities of Ham Lake, Andover, Blaine, and Coon Rapids. It outlets into the Mississippi River.

Methods

Coon Creek was monitored during both storm and baseflow conditions by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. In some years, particularly the drought year of 2009, smaller storms were sampled because of a lack of larger storms. All storms sampled were significant runoff events.

Eleven water quality parameters were tested. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, salinity, and dissolved oxygen. Beginning in 2009 transparency tube measurements were added, as well as photo-documentation of water appearance. Parameters tested by water samples sent to a state-certified lab included total phosphorus, total suspended solids, chlorides, hardness, sulfate, and E.coli.

During every sampling the water level (stage) was recorded using a staff gauge surveyed to sea level elevations. Stage was also continuously recorded using a datalogging electronic gauge at various sites and data can in the hydrology section of this chapter.

Results and Discussion

This report includes data from all years and all sites to provide a broad view of Coon Creek's water quality under a variety of conditions. We focus upon an upstream-to-downstream comparison of water quality, a comparison of baseflow and storm conditions, and an overall assessment. There are water quality concerns throughout Coon Creek. Following is a summary, including a management discussion:

- Dissolved pollutants, as measured by conductivity and chlorides, in Coon Creek were approximately double the median for other streams in Anoka County. They are highest in downstream reaches and during baseflow. Coon Creek is well below the state water quality standard for chlorides. Chlorides were last monitored on Coon Creek in 2012.

  Management discussion: Dissolved pollutants enter the stream both directly through surface runoff and also by infiltrating into the shallow groundwater that feeds the stream during baseflow. A variety of sources appear to be likely, including road deicing salts, agricultural chemicals, and road runoff. Because these are difficult to remove, every effort should be made to minimize their release into the environment.

- Phosphorus was at acceptably low levels during baseflow, but was much more variable and generally higher during storms. During baseflow phosphorus was lower than the median for streams in Anoka County and often lower than the MPCA's soon-to-be-adopted water quality standard of 100 ug/L. However phosphorus doubles during storms, likely exceeding state standards that will soon be adopted. Phosphorus is higher in downstream reaches than upstream.

  Management discussion: Phosphorus needs to be reduced in both the upper and lower watershed, though the sources are likely different.

- Suspended solids and turbidity were low upstream and during baseflow, but increase dramatically during storms. During baseflow suspended sediment was below state standards, but increased 1.7 to 4.5-fold during storms, frequently exceeding state standards. Suspended solids were high at all sites during storms, though the source likely differs in different parts of the watershed. While bedload is a concern, Hydrolab monitoring has shown that suspended solids concentration does not follow stream flows, suggesting is it not the primary source.

  Management discussion: There are at least two sources of suspended solids and turbidity that seem to be important in Coon Creek. These will require a variety of management techniques to address. First, suspended solids and turbidity are greatest during storms and in the lower fully-developed part of the watershed, suggesting that stormwater treatment is an important way to address this problem. Storms greater than one-inch produce the worst creek water quality, so practices aimed at reducing suspended solids and phosphorus entering the creek during those storms are especially important. Most stormwater practices were designed to treat storms up to one inch in size.

  Secondly, there are probably near and in-stream sediment sources like bedload and streambank erosion. High flows are a common aggravator of this type sediment source. We would anticipate near and in-stream sources to be important in Coon Creek because much of it is ditched, and ditches generally have unstable sides, and because native soils are highly erodable. Yet continuous monitoring of turbidity with a Hydrolab during storms and in the days after storms paints a more complex picture. Turbidity does rise quickly during storms (presumably runoff from the lower watershed). Turbidity then increases slowly and continuously after the storms (presumably sediment from the upper watershed). The Hydrolab found it was common for turbidity to increase for several days after a storm, even when flows were dropping. We would expect bedload and streambank erosion to increase with flow.

- pH and dissolved oxygen were within the range considered normal and healthy for streams in this area.

- E. coli bacteria are high throughout Coon Creek, though insufficient data exists to fully compare it to state standards. During baseflow, E. coli modestly and periodically was above the state standard thresholds, and this primarily occurred in the lower portion of the watershed. E. coli was generally low in the upper watershed during baseflow. During storms E coli was much higher in all locations and generally was higher in the lower watershed.

  Management discussion: Because E. coli is pervasive in the environment and neighborhoods there will be difficulty reducing E. coli levels below state water quality standards. Addressing E. coli should be part of an effort to improve overall water quality.

Conductivity and Chlorides

Conductivity, chlorides, and salinity are all measures of a broad range of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial sources, and others. Metals, hydrocarbons, road salts, and others are often of concern in a suburban environment. Conductivity is the broadest measure of dissolved pollutants we used. It measures electrical conductivity of the water; pure water with no dissolved constituents has zero conductivity. Chlorides tests for chloride salts, the most common of which are road de-icing chemicals. Chlorides can also be present in other pollutant types, such as wastewater. These pollutants are of greatest concern because of the effect they can have on the stream's biological community, however it is noteworthy that Coon Creek is upstream from the drinking water intakes on the Mississippi River for the Twin Cities.

Median conductivity results in Coon Creek were notably higher than the median for other Anoka County streams (see table and figures below). Median conductivity in Coon Creek (all sites, all conditions) was 0.510 mS/cm compared to the countywide median of 0.362 mS/cm.

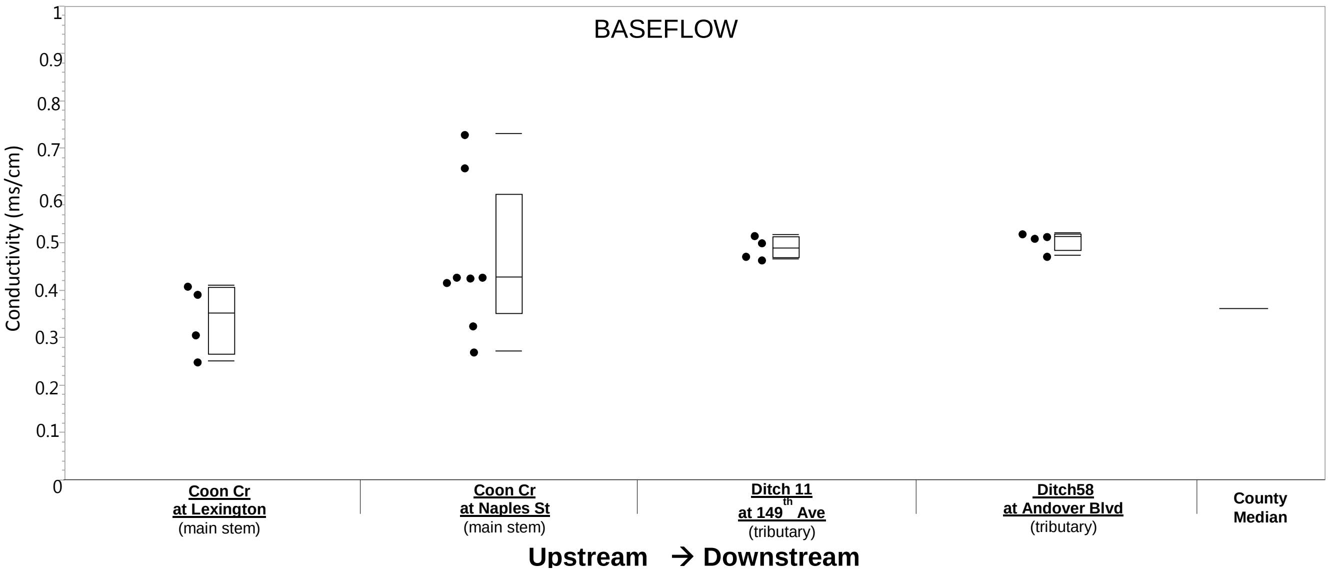
Dissolved pollutants were higher in downstream reaches of Coon Creek, where there is more impervious area (see figures below). Median conductivity increased gradually from upstream (0.3515 mS/cm) to downstream (0.599 mS/cm) during baseflow. Storm data show moderate to no difference between up and downstream conductivity and range from 0.4455 to 0.5065 mS/cm.

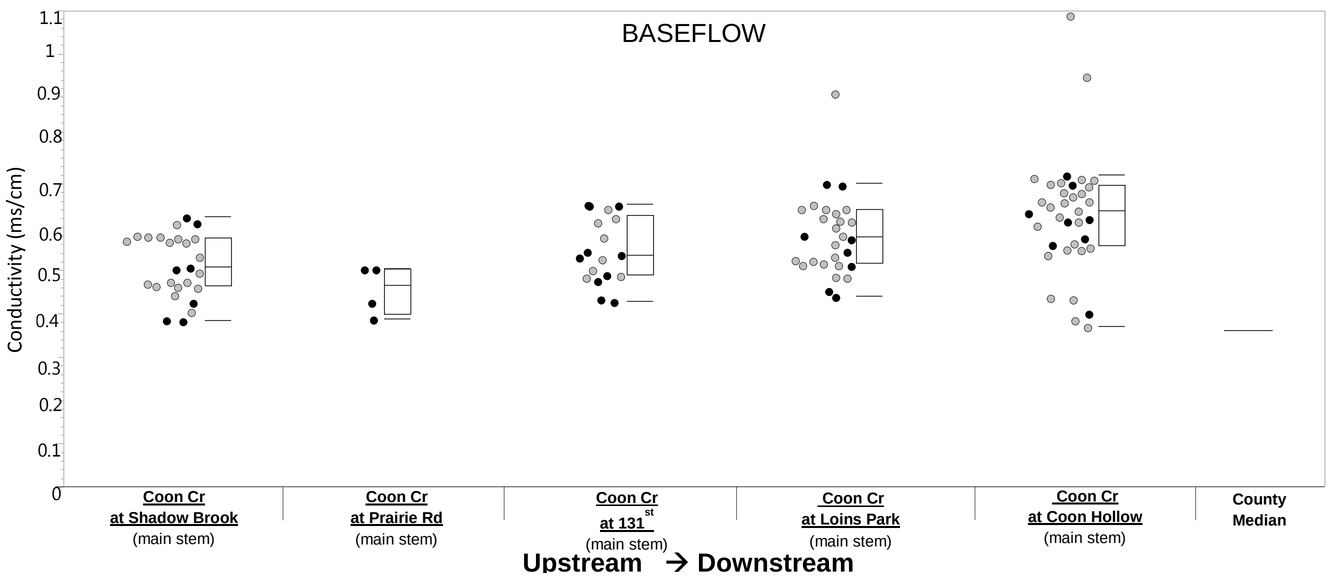
This lends some insight into the pollutant sources. If dissolved pollutants were only elevated during storms, stormwater runoff would be suspected as the primary contributor. If dissolved pollutants were highest during baseflow, pollution of the shallow groundwater which feeds the stream during baseflow would be suspected to be a primary contributor. In Coon Creek we find similar, but slightly lower dissolved pollutants during storms. In other words, both stormwater runoff and groundwater are sources of dissolved pollutants, with shallow groundwater being slightly worse. While storms dilute some of the baseflow pollutants, they also carry additional pollutants which somewhat offset the dilution. From a management standpoint, is important to remember that the sources of both stormwater and baseflow dissolved pollutants are generally the same, it is only the timing of delivery to the stream that is different. Preventing their release into the environment and treating them before infiltration should be a high priority.

Median conductivity and chlorides in Coon Creek. Data is from Vale St for all years through 2013. Chlorides not monitored in 2013.

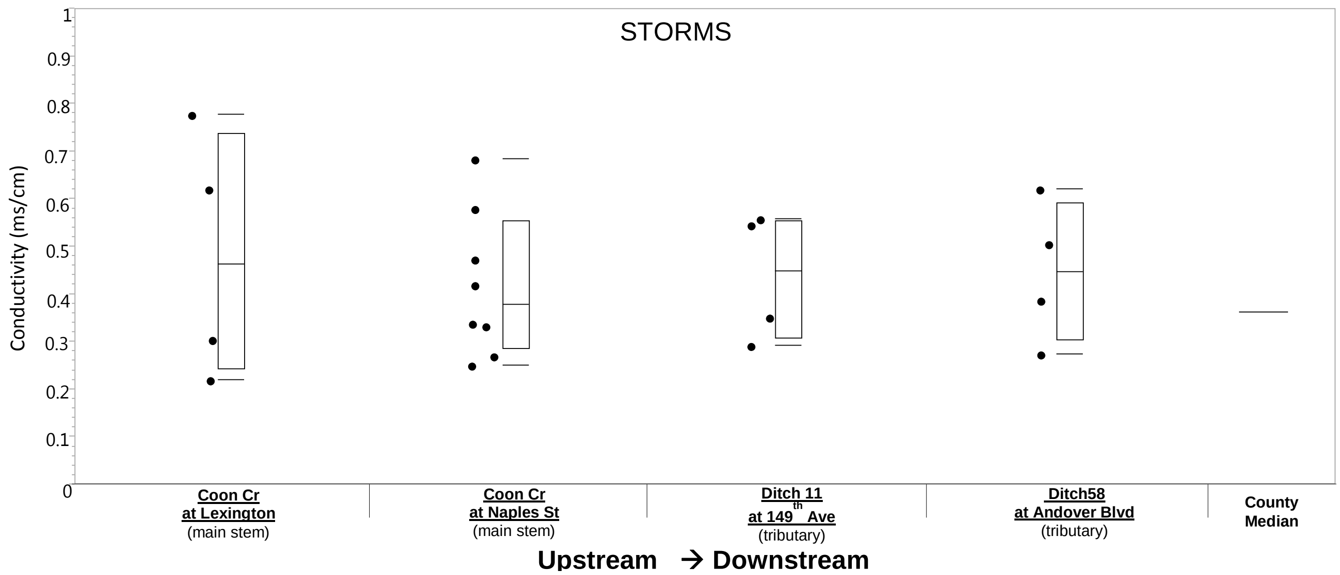
	Conductivity (mS/cm)	Chlorides (mg/L)	State Standard	N
Baseflow	0.638	62	Conductivity – none	36
Storms	0.451	40	Chlorides 860 mg/L acute, 230 mg/L chronic	36
All	0.551	52		72
Occasions > state standard				0

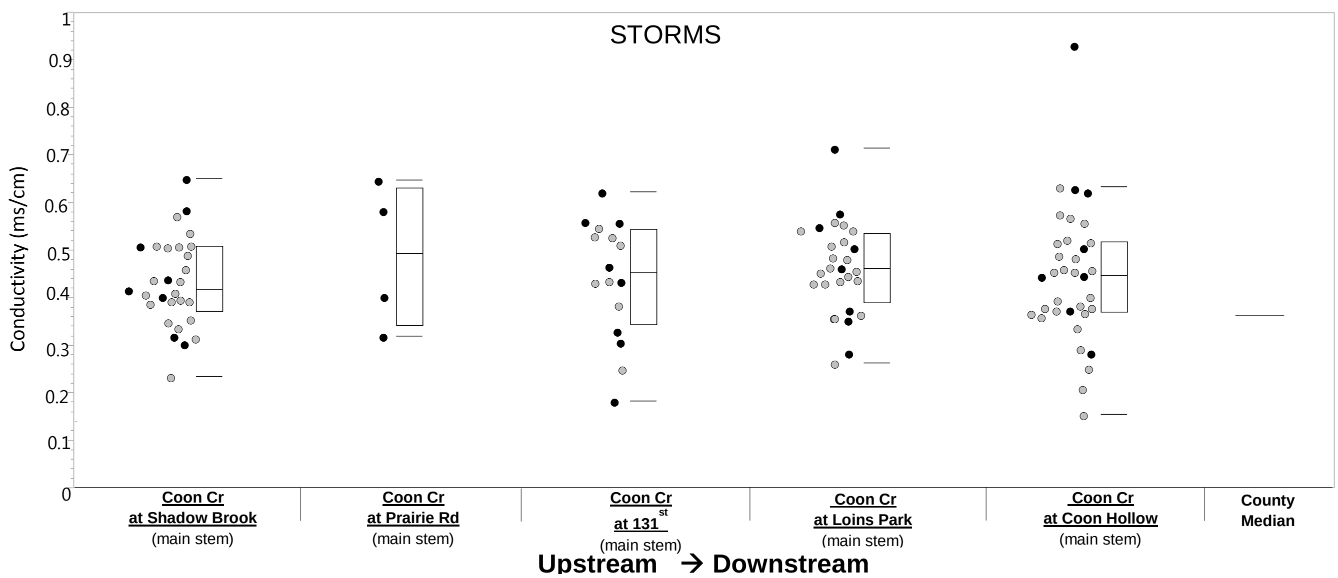
Conductivity Coon Creek. Dots are individual readings. Black dots are 2012-2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Conductivity at Coon Creek continued…





Total Phosphorus

Total phosphorus (TP) is a common nutrient pollutant. It is limiting for most algae growth. Total phosphorus in Coon Creek was consistently low during baseflow conditions, but approximately doubled during storms (see figures below). The Minnesota Pollution Control Agency is in the final stages of a TP water quality standard for streams, and Coon Creek will likely be designated as impaired for exceeding it during storms in the lower part of the watershed. Best management practices for this stream are needed to address stormwater phosphorus along the entire monitored stream length. In 2013 nine Coon Creek watershed sites were monitored (two are tributaries).

Baseflow TP was low. During baseflow the five monitoring sites had median TP of 98, 69, 79, 130, 129, 104, and 83 ug/L, respectively, from upstream to downstream. This is lower than the countywide median for streams of 135 ug/L. It is also generally lower than the not-yet-finalized state water quality standard of 100 ug/L, although 14 of 36 measurements at the Vale Street site have been above 100 mg/L. There was little variability among baseflow samples.

During storms TP was higher, and sometimes much higher. Storms also had much greater variability. The standard deviation for storm readings were, from upstream to downstream, 85, 164, 113, 160, 154, 103, and 131 ug/L. By contrast, the standard deviations during baseflow were 44, 32, 51, 46, 47, 49, and 40 ug/L, respectively, from upstream to downstream. Variation in the timing, magnitude, and intensity of the storm is likely responsible for the greater variability in TP during storms compared to baseflow.

TP was higher at downstream sites than upstream during storms. Median storm TP upstream to downstream were 77, 116, 182, 150, 231, 194, and 178 ug/L, respectively.

TP at the all downstream sites regularly exceeded the likely and not-yet-finalized state standard of 100 ug/L. At Vale Street only two of 36 TP measurements during storms have been lower than 100 ug/L. The maximum observed was 672 ug/L.

In addition to monitoring sites on the main stem of Coon Creek, two tributaries were also monitored in 2013 – Ditch 11 and Ditch 58. Median TP for both baseflow and storms were generally higher than those observed on the main stem of the creek. Median baseflow TP were 193 and 123 ug/L, respectively. Median TP during storms were 271 and 170 ug/L, with much greater variation amongst readings.

The dominant phosphorus source is likely different in upstream and downstream stream reaches. Upstream is less developed and any development has occurred more recently with more stringent stormwater treatment requirements. Here, mobilization of in-stream sediments and agricultural runoff may be an important phosphorus source, and stormwater runoff to a lesser degree. Drained, organic wetland soils may be another source; many ditch tributaries exist. Downstream parts of the watershed are fully developed and some were developed before modern-day stormwater treatment requirements. Here, flows are often higher and flashy, so mobilization of in-stream sediments may be important, but stormwater runoff from impervious surfaces is likely quite important.

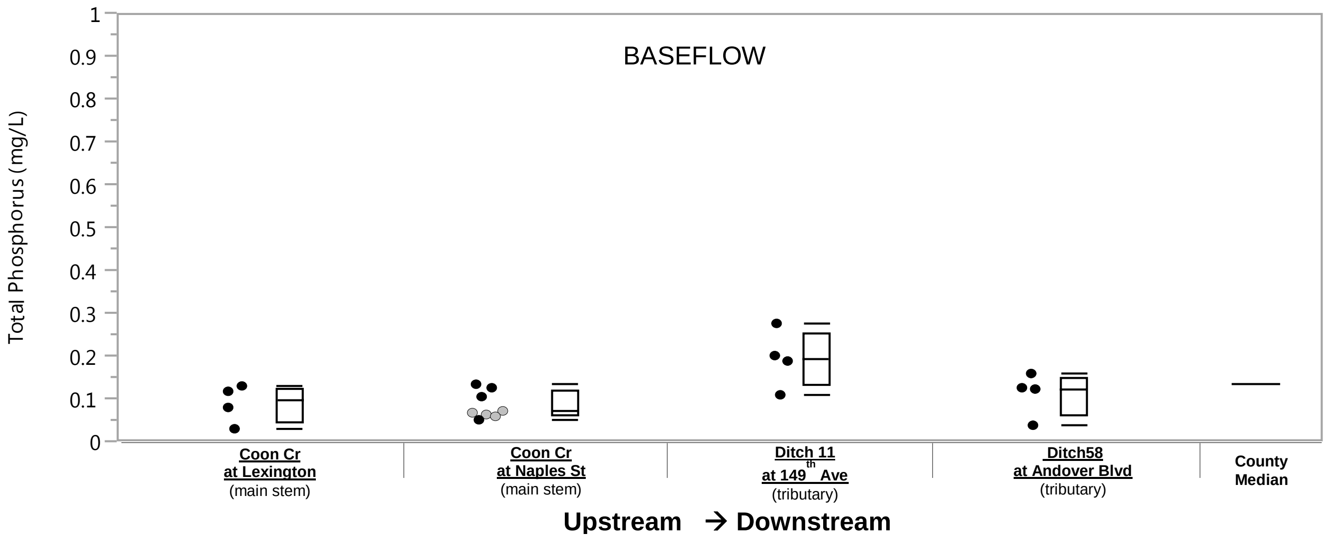
Phosphorus reduction needs to occur throughout the watershed. The highest priority should be addressing phosphorus from urban stormwater runoff in the lower portion of the watershed. This is the area with the highest TP. Also, this is the area with the highest levels of other pollutants, such as total suspended solids. Improvements to stormwater treatment in this area could address multiple problems.

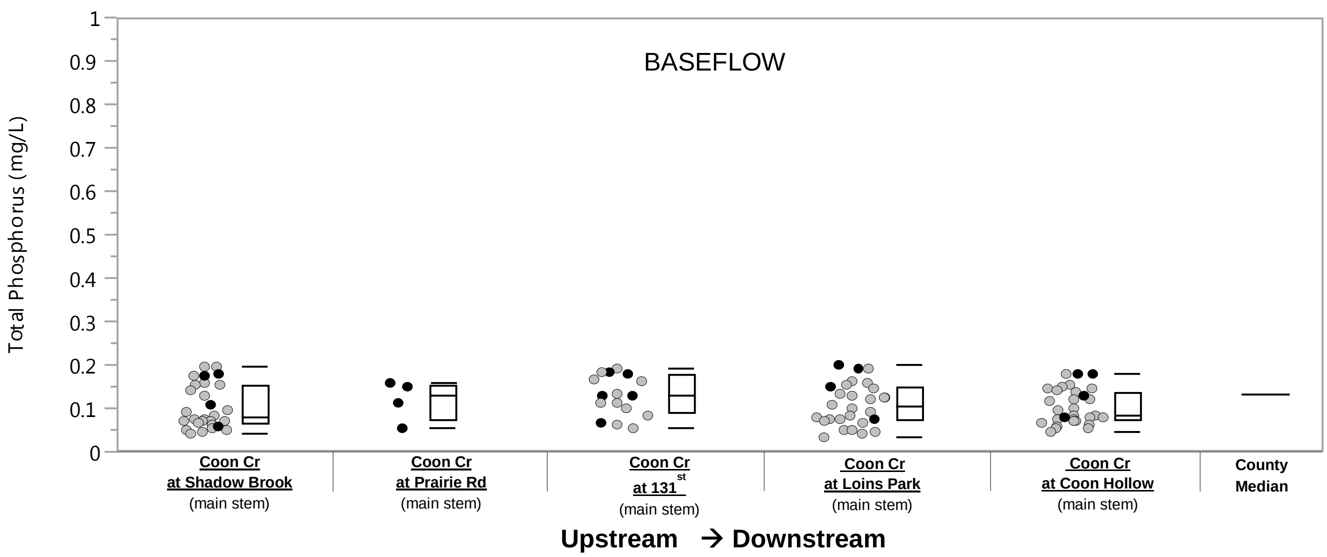
Median total phosphorus in Coon Creek. Data is from Vale St for all years through 2013.

	Total Phosphorus (ug/L)	State Standard*	N
Baseflow	83	100	36
Storms	178		36
All	132		72
Occasions > state standard			48 (34 storms, 14 baseflow)

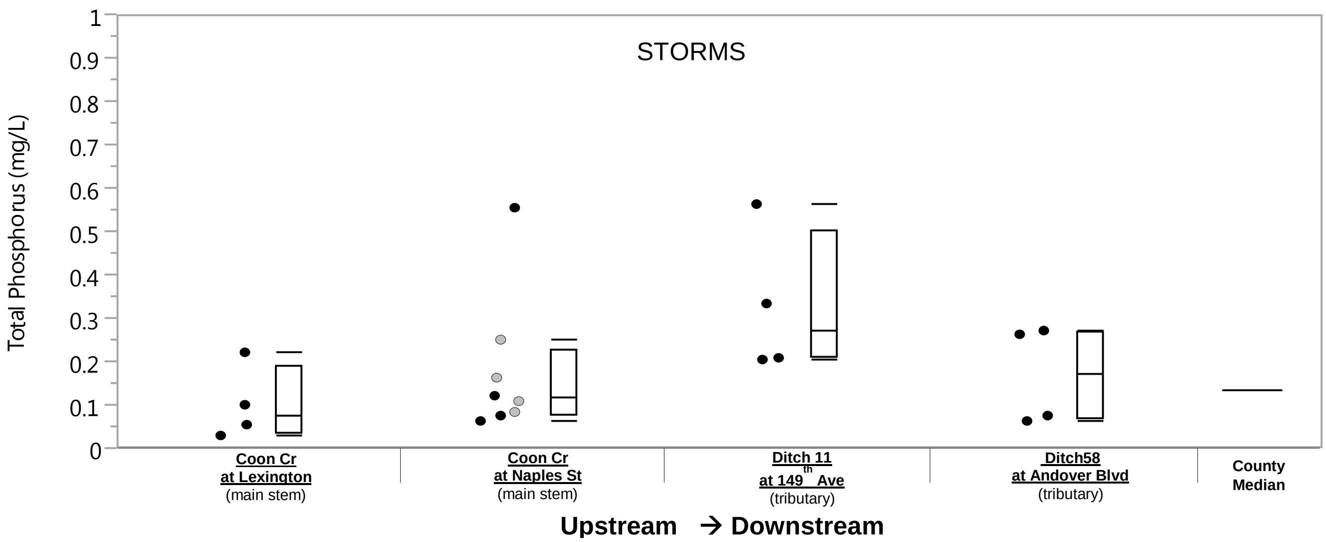
*New state standards are under development. The standard listed is the likely new threshold.

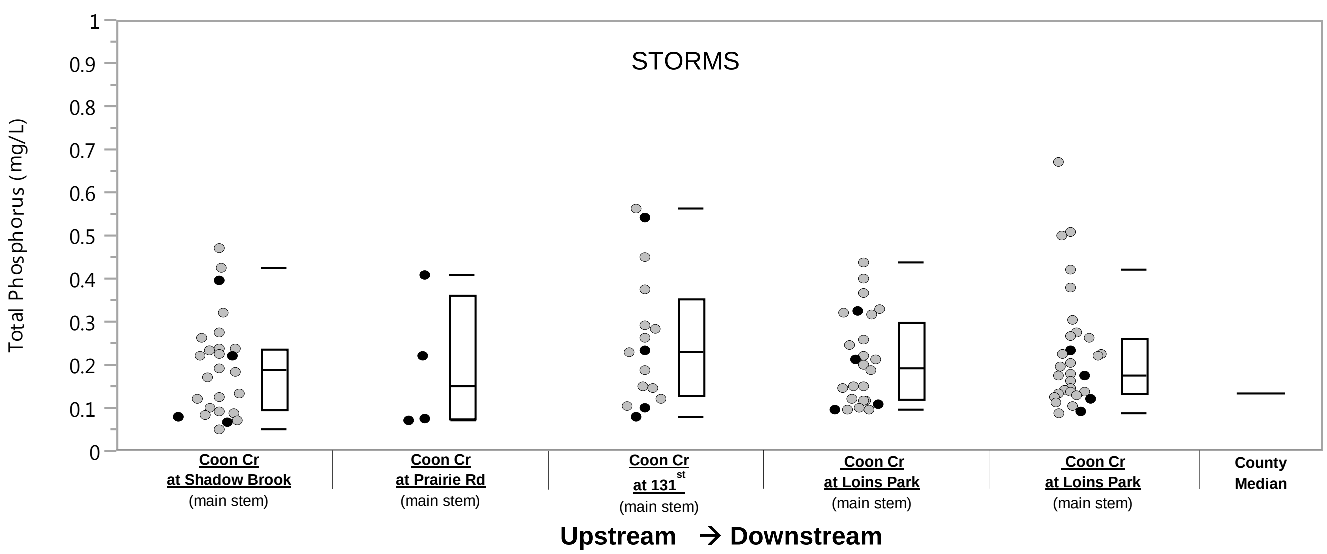
Total phosphorus at Coon Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total phosphorus at Coon Creek continued…





Total Suspended Solids and Turbidity

Total suspended solids (TSS) and turbidity both measure solid particles in the water. TSS measures these particles by weighing materials filtered out of the water. Turbidity measures by defraction of a beam of light sent though the water sample, and is therefore most sensitive to large particles.

In Coon Creek TSS and turbidity were low upstream and during baseflow, but increase dramatically during storms and in downstream reaches (see figures below). Presently the state water quality standard allows turbidity of >25 NTU during no more than 10% of measurements. That standard is being changed to TSS of 30 mg/L. In either case, the stream likely exceeds state water quality standards.

During baseflow turbidity and TSS were reasonably low and showed slight upstream to downstream increase. Median turbidity during baseflow from upstream to downstream were 5.6, 9.2, 8.5, 9.2, 14.1, 11, and 12 FRNU, respectively. This is similar to the countywide median of 8 FRNU. Six of 36 (17%) baseflow measurements are greater than MPCA's present water quality standard of 25 NTU. Median TSS during baseflow from upstream to downstream was 2, 6, 7.5, 4.5, 6, 11.5, and 9 mg/L, respectively. This is lower than the median for streams county-wide of 12 mg/L. Only 1 of 36 (3%) of TSS measurements exceeded the new, proposed water quality standard of 30 mg/L.

During storms TSS and turbidity were higher, and there was some modest increase from upstream to downstream. Median TSS and turbidity during storms were both approximately 1.6 to 6.8 times higher than during baseflow (comparison is among site medians). Median storm TSS was 6, 17.5, 13, 30.5, 19, 22.5, and 38.5 mg/L from upstream to downstream. Median storm turbidity was 17.1, 33.1, 15, 15, 34.5, 29.5, and 33 FNRU from upstream to downstream.

During storms, TSS was often similarly high at all sites (see figures below). Bank erosion, bedload transport, and stormwater runoff are likely all important sources of suspended solids. Their relative contributions likely differ across the watershed. However given that suspended solids are high throughout the watershed, it is safe to say the problem is not geographically isolated.

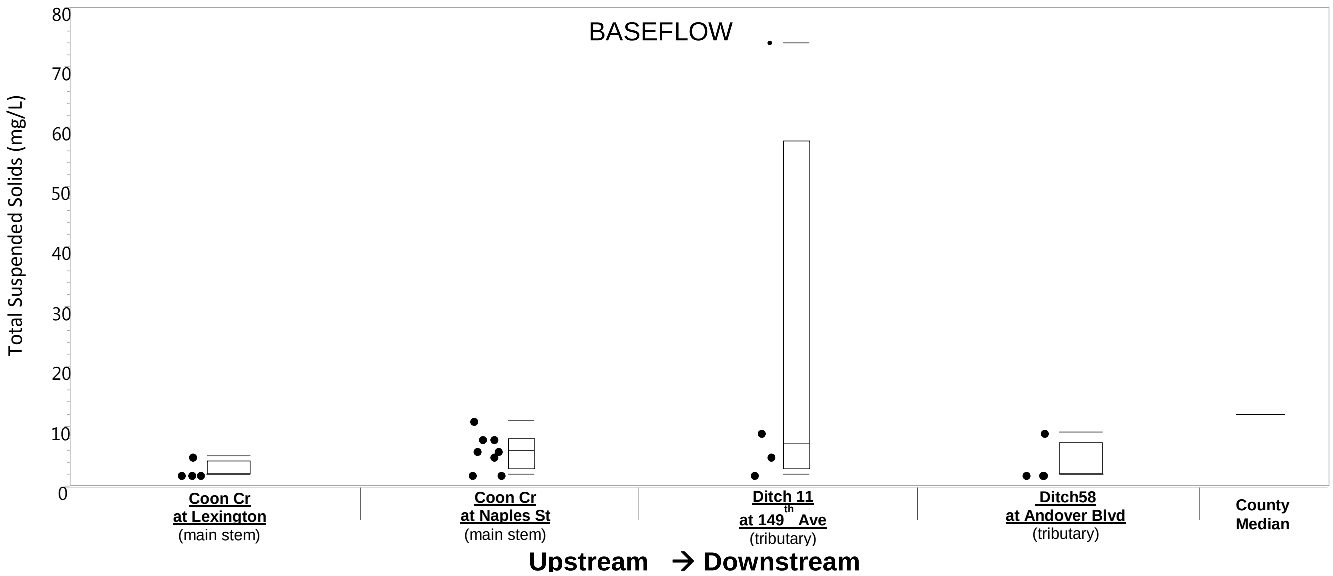
Research should be done to determine the extent to which bed load transport of sediment is contributing to high turbidity and TSS. Presently, it appears that it has the potential to be important. High suspended solids in the upper watershed, where land uses are rural residential and sod fields is surprising, given that these are not often sources of high suspended solids. This lends suspicion that near-channel and in-channel sources may be important in the upper watershed. It may be important farther downstream too. On the other hand, Hydrolab continuous turbidity monitoring during storms has found that turbidity does not increase as flow increases, as would be expected if bed load were dominant.

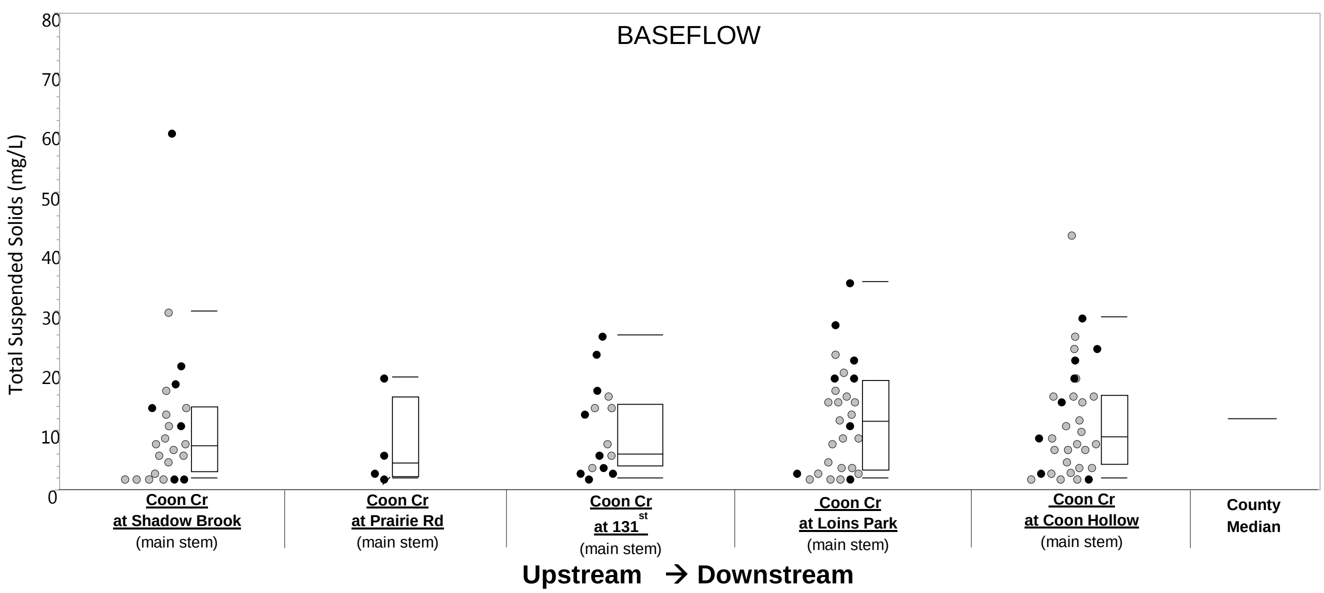
Median turbidity and suspended solids in Coon Creek. Data is from Vale St for all years through 2013.

	Turbidity (FNRU)	Total Suspended Solids (mg/L)	State Standard*	N
Baseflow	12	9.0	30 mg/L TSS	36
Storms	33	38.5		36
All	20	18		72
Occasions > new state TSS standard				21

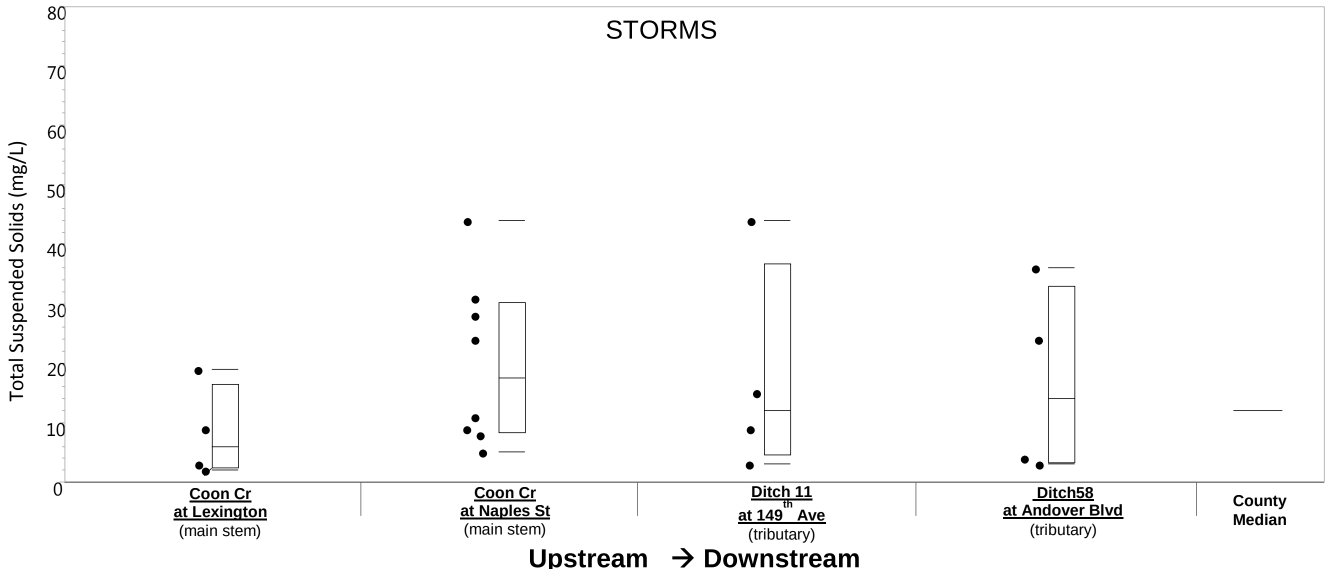
*New state standards are under development. The standard listed is the likely new threshold.

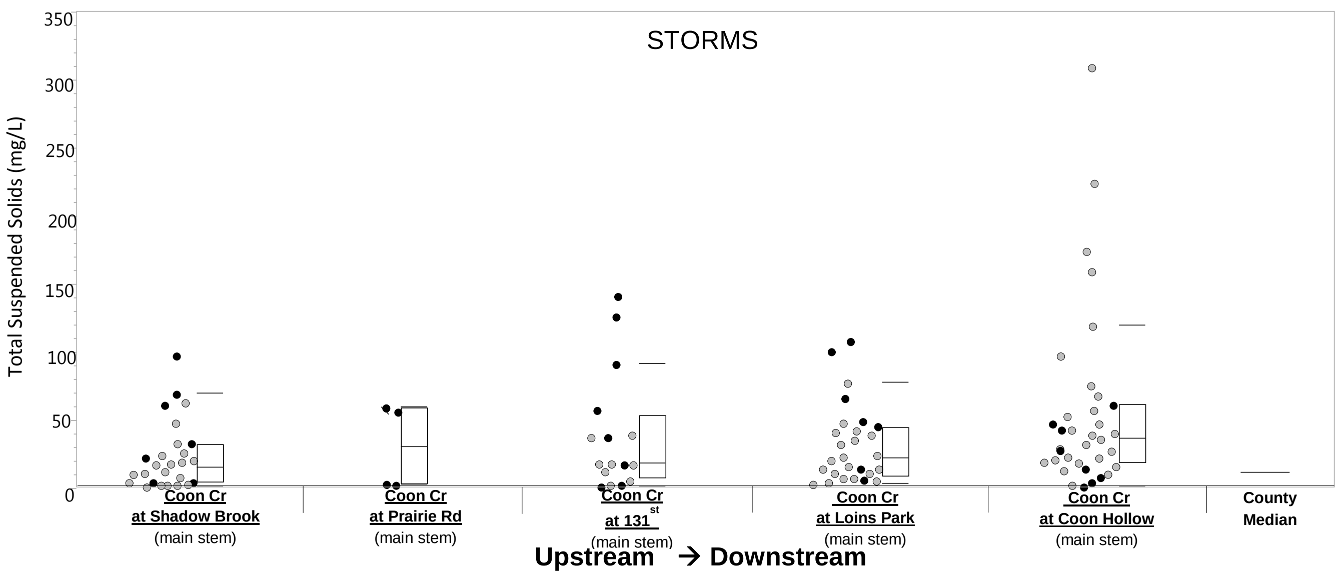
Total suspended solids at Coon Creek. Dots are individual readings. Black dots are 2012-2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



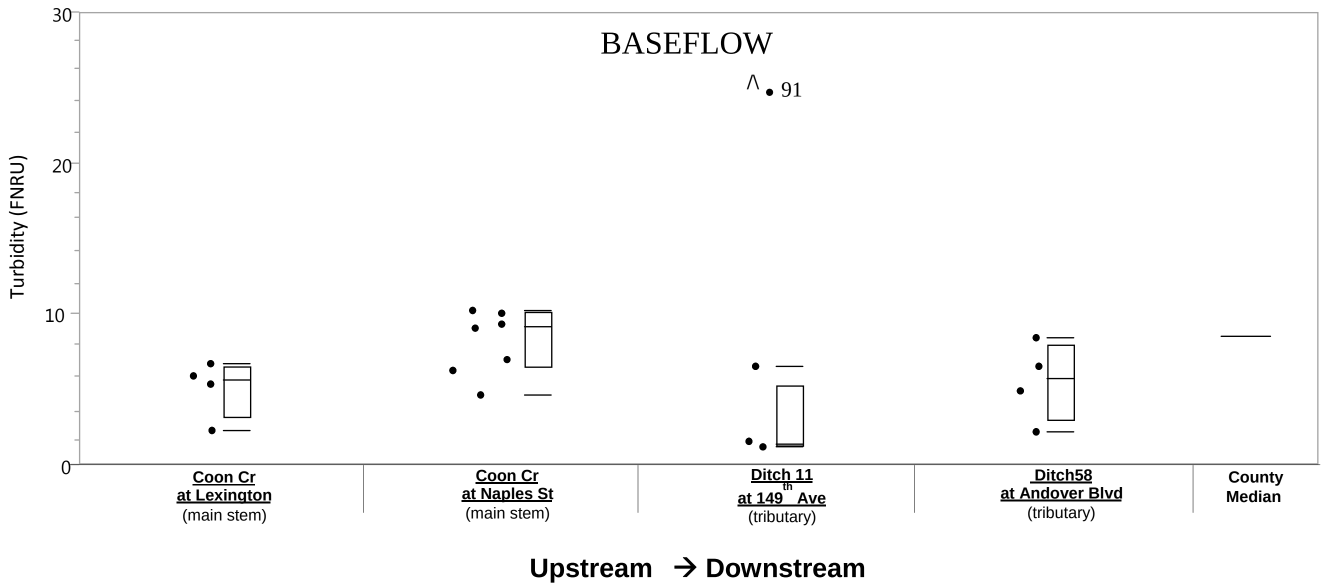


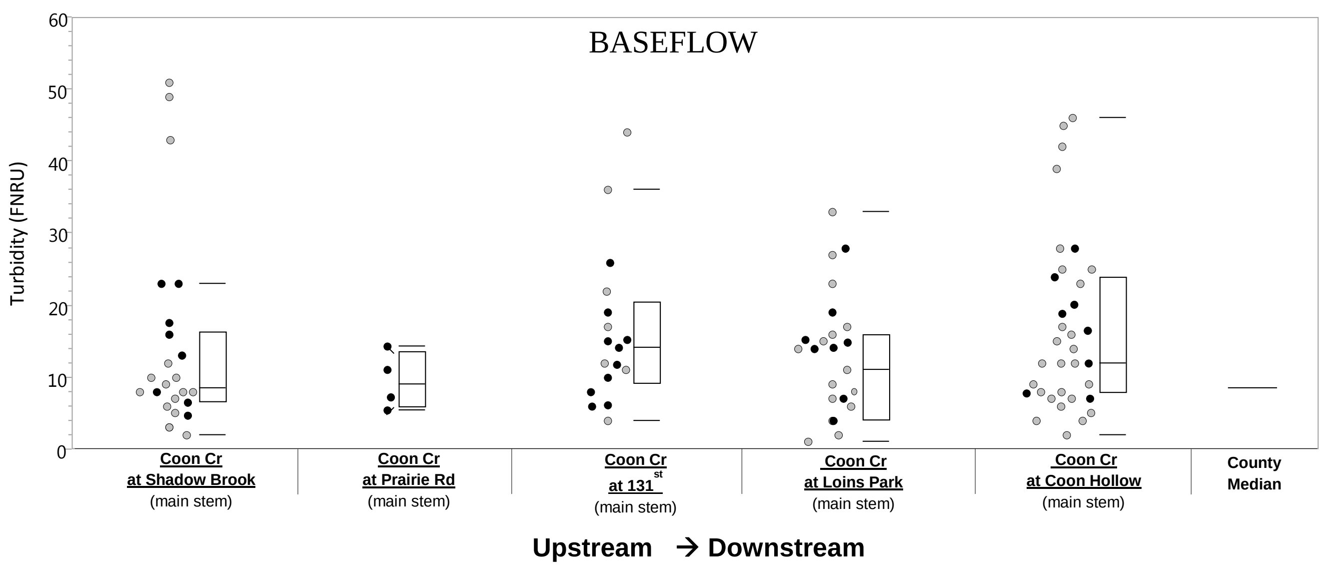
Total suspended solids at Coon Creek continued…



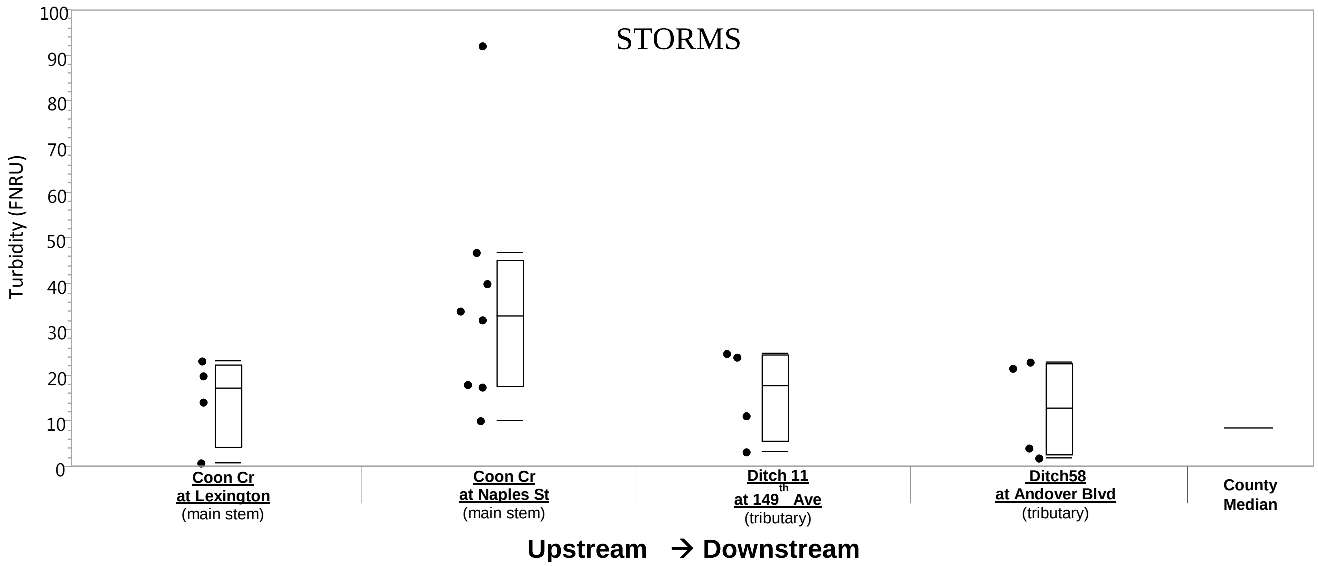


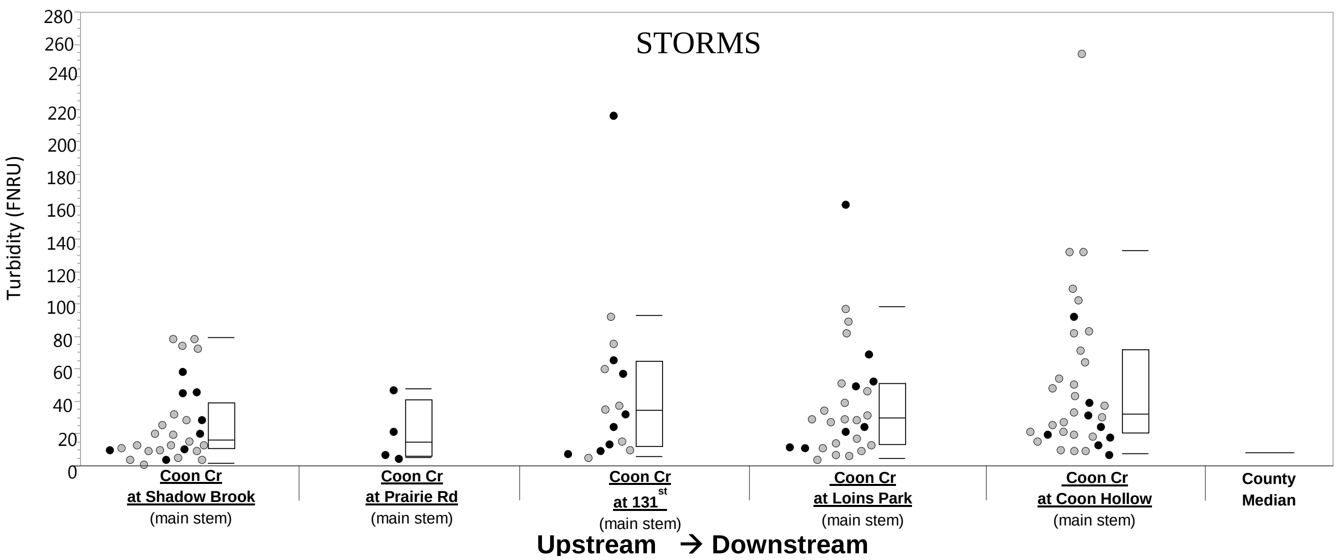
Turbidity at Coon Creek. Dots are individual readings. Black dots are 2012-2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Turbidity at Coon Creek continued…





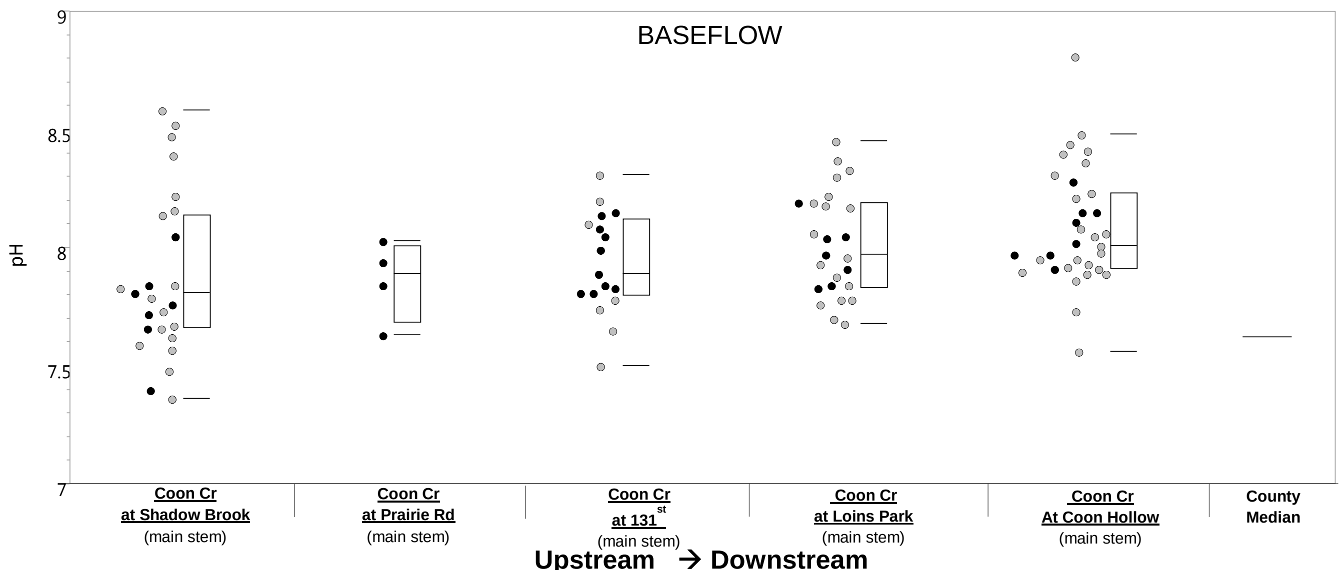
pH

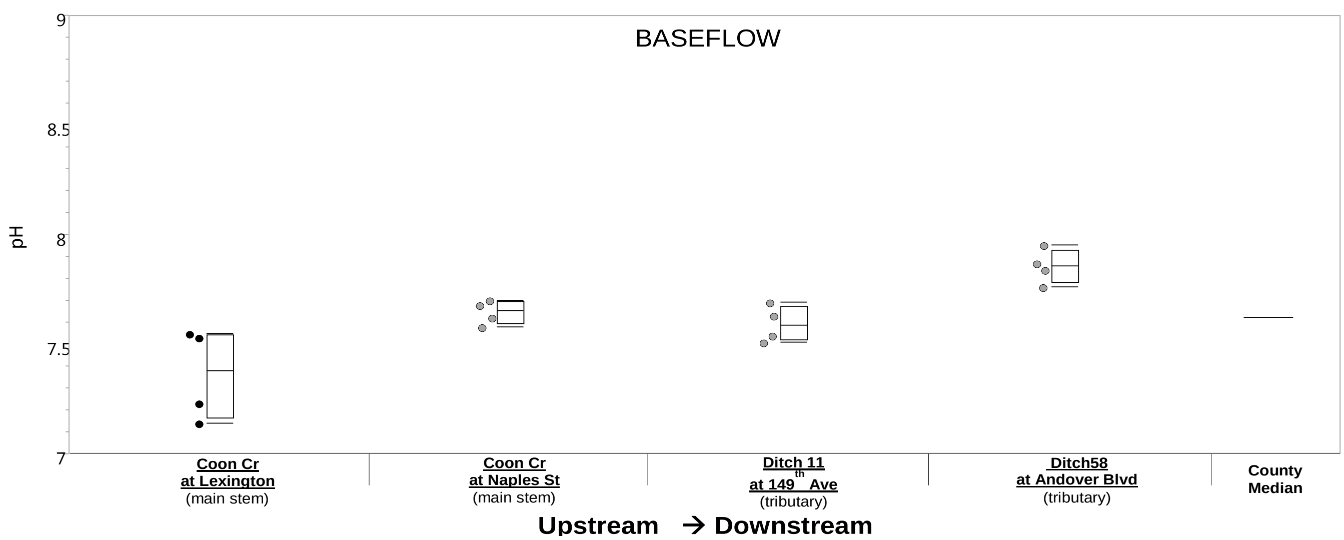
pH was within the expected range at all sites, with rare exceptions. pH is expected to be between 6.5 and 8.5 according to MPCA water quality standards. While occasional readings outside of this range did occur, they were not large departures that generate concerns. pH was notably lower during all storm events, but this is not surprising because rainfall has a lower pH and the creek serves as a stormwater conveyance for four cities.

Median pH in Coon Creek. Data is from Vale St for all years through 2013.

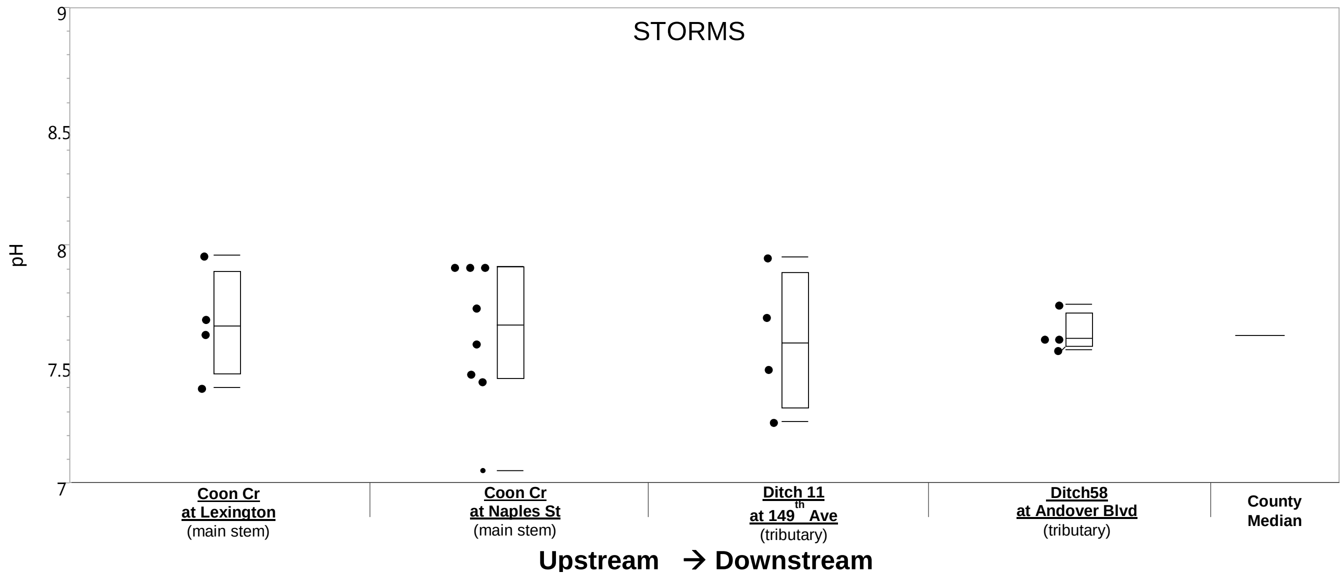
	pH	State Standard	N
Baseflow	8.01	6.5-8.5	36
Storms	7.69		36
All	7.90		72
Occasions outside state standard			4, all sites

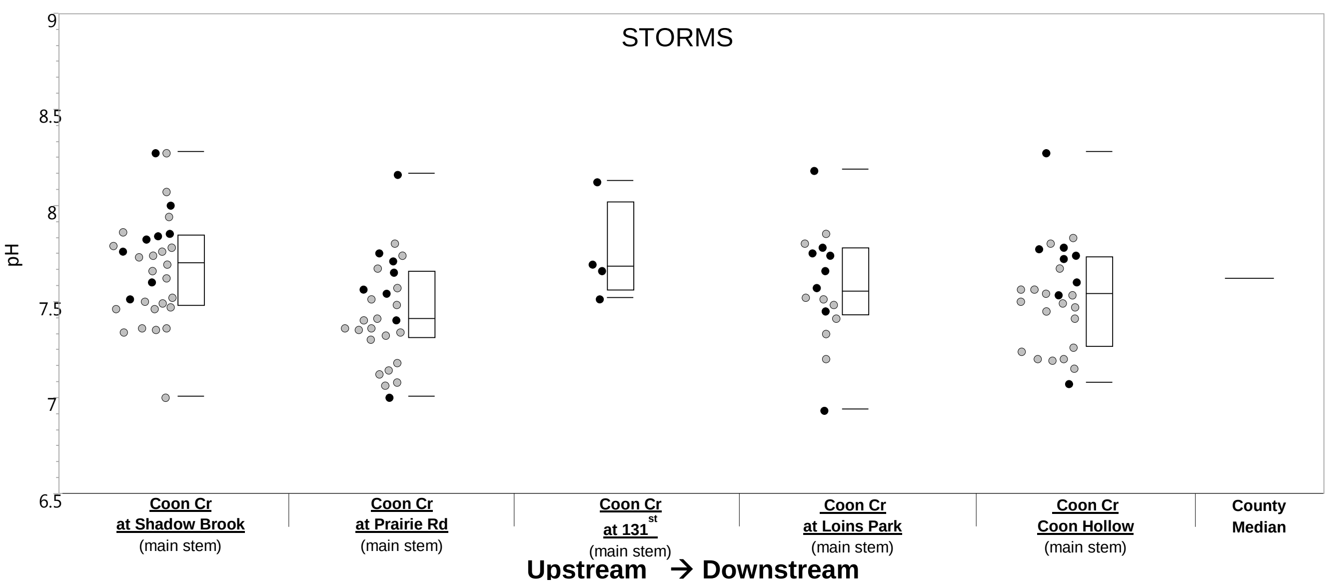
pH at Coon Creek. Dots are individual readings. Black dots are 2012-2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





pH at Coon Creek continued…





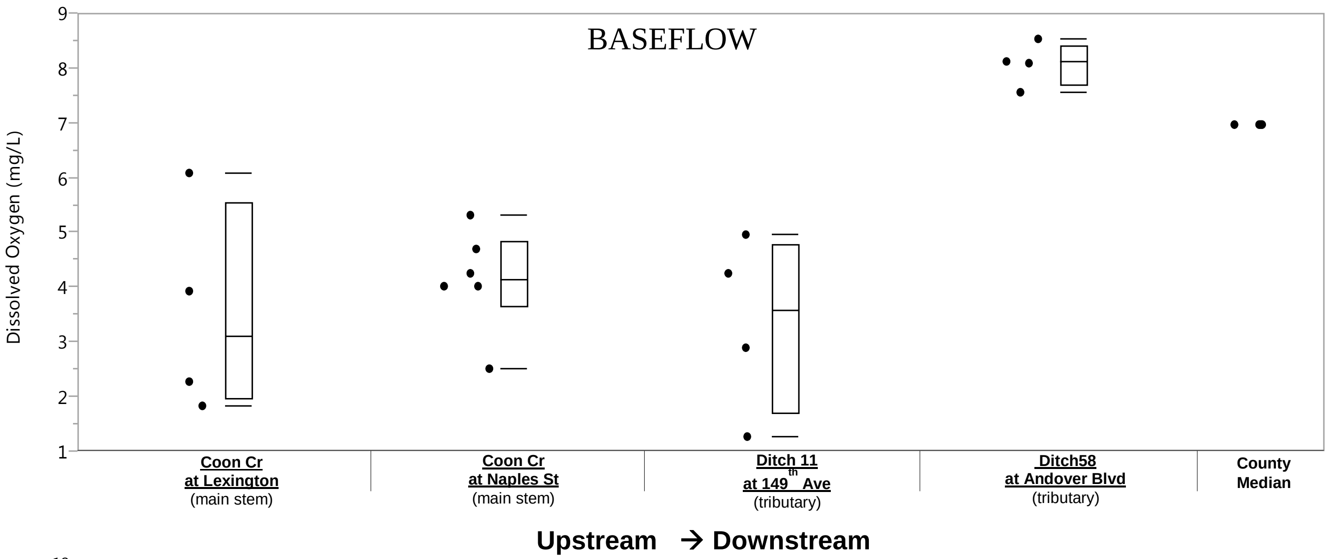
Dissolved Oxygen

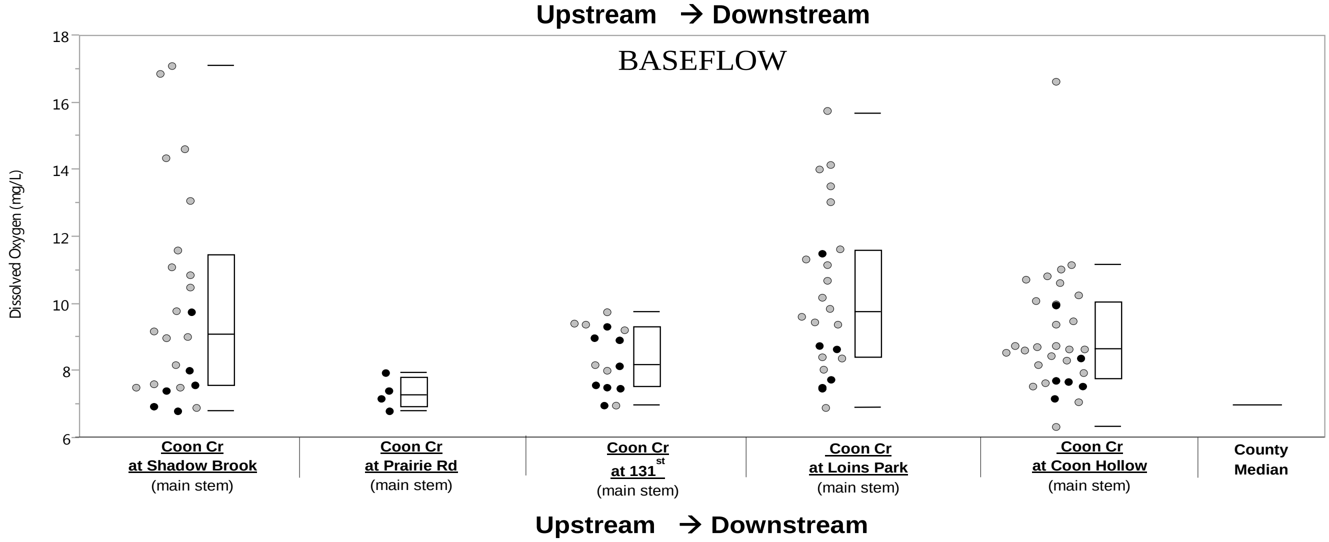
Dissolved oxygen was similar at all sites and adequate for most aquatic live (i.e. >5 mg/L). On two occasions it dropped below 5 mg/L at Shadowbrook Townhomes, two times at Lions Park, seven occasions at Naples Street, five times at Lexington Avenue, and six occasions at the Ditch 11 tributary to Coon Creek. The other sites had no instances of dissolved oxygen below 5 mg/L. In sum, any dissolved oxygen problems observed appear to be in the upper reaches of the Coon Creek system.

Median dissolved oxygen in Coon Creek. Data is from Vale St for all years through 2013.

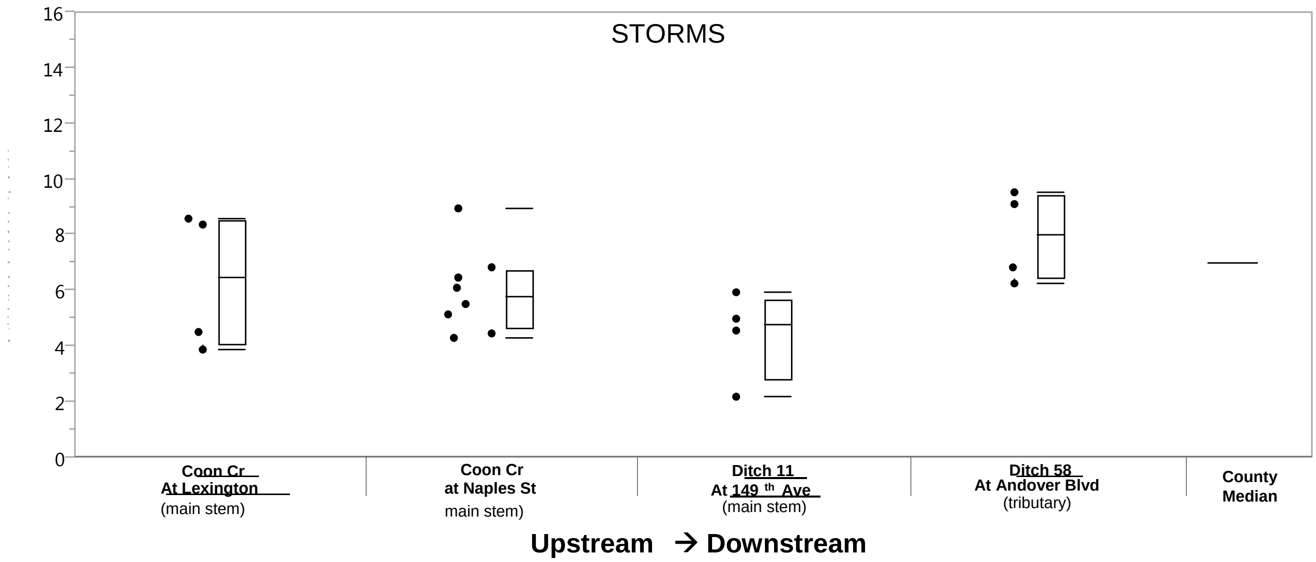
	Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	8.66	5 mg/L daily minimum	36
Storms	8.14		36
All	8.57		72
Occasions <5 mg/L			2 at Lions Park, 2 at Shadowbrook Townhomes, 7 at Naples St, 5 at Lexington, 6 at Ditch 11 tributary

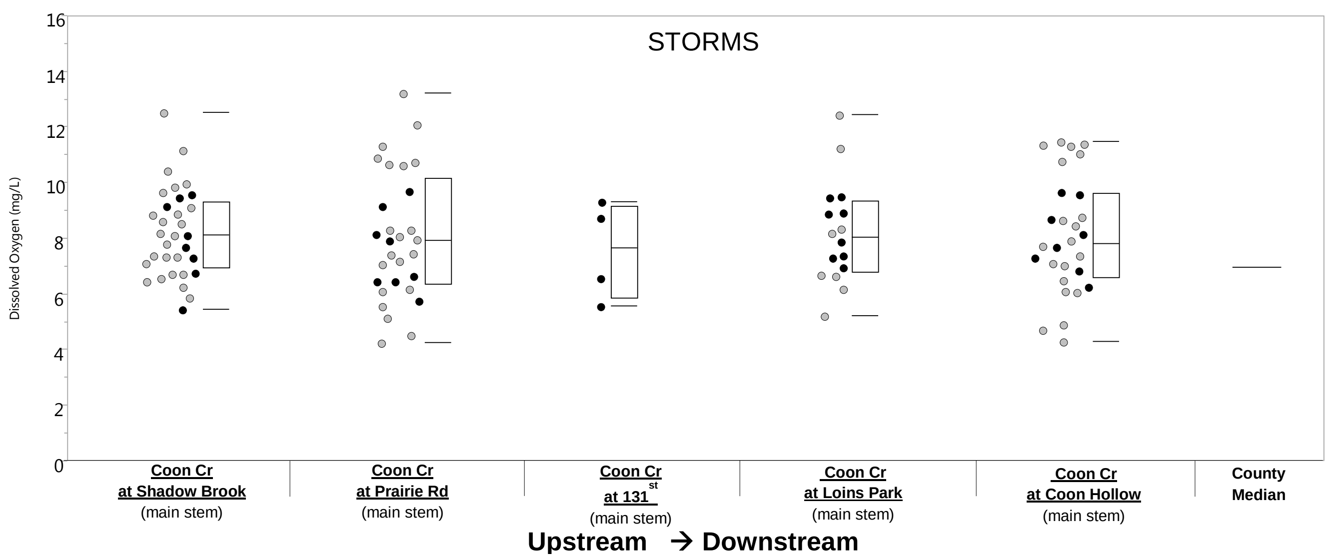
Dissolved oxygen at Coon Creek. Dots are individual readings. Black dots are 2012-2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Dissolved oxygen at Coon Creek continued…





E. coli

E. *coli* is a bacteria found in the feces of warm blooded animals. E. *coli* is an easily testable indicator of all pathogens that are associated with fecal contamination. The Minnesota Pollution Control Agency sets E. *coli* standards for contact recreation (swimming, etc). A stream is designated as "impaired" if 10% of measurements in a calendar month are >1260 colony forming units per 100 milliliters of water (cfu/100mL) or if the geometric mean of five samples taken within 30 days is greater than 126 cfu/100mL.

Our data are not sufficient to determine if the MPCA standards are met. We took samples throughout summer, often with only 1-2 samples in each month, too little for calculation of a monthly geometric mean or to reasonably say that 10% of samples in a month were in exceedence. We can, however, perform other examination of the data.

During baseflow E. *coli* was acceptably low in the lower Coon Creek system but has higher in the bottom of the watershed (at Shadowbrook townhomes and below). Median E. *coli* during baseflow from upstream to downstream were 32, 47, (94, 49 tributaries), 198, 113, 141, 211, and 215 MPN, respectively. Though the frequency requirements were not met, bacteria levels during baseflow generally were below the 126 MPN/100ml state water quality standard in the upper watershed but routinely exceeded it in the lower watershed.

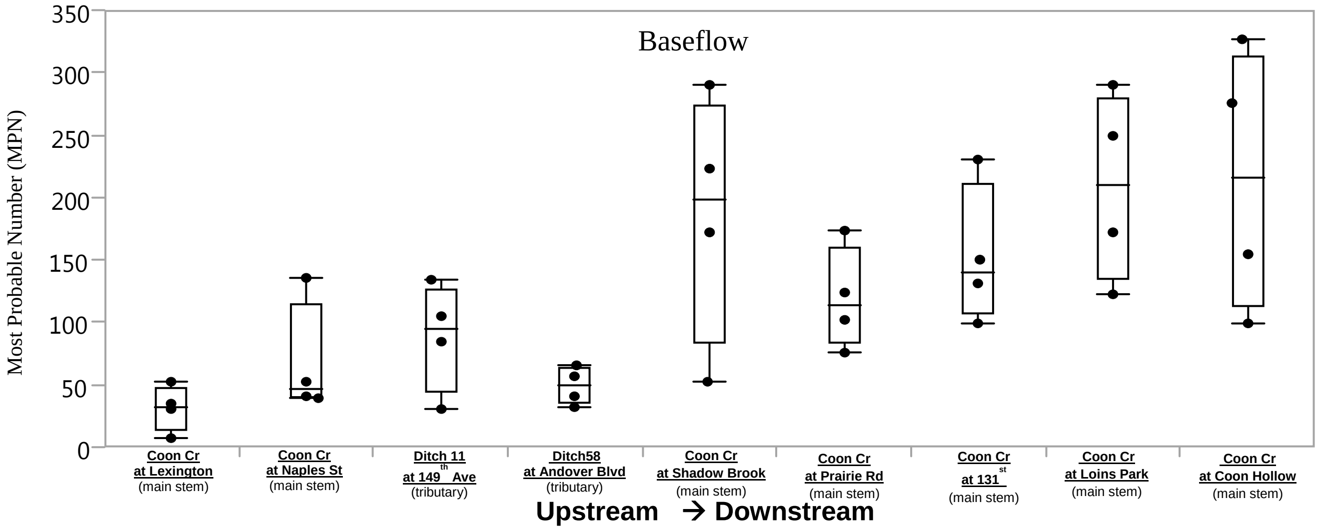
During storms E. coli was significantly higher and variable (notice the difference in Y axis scales in the graphs below). Median E. coli during storms from upstream to downstream were 232, 1454, (404, 880 tributaries), 698, 796, 676, 817, and 1415 MPN, respectively. A large part of this variability might be explained by the intensity of the storm, phenology of the storm and when during the storm the sampling was done.

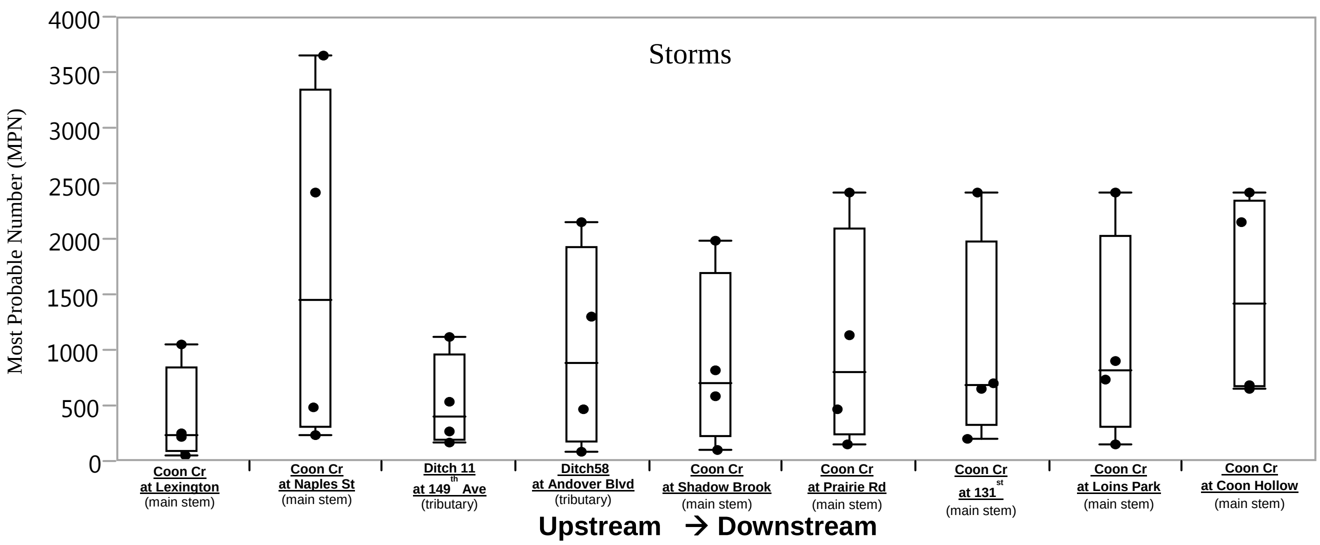
Though the frequency requirements were not met, bacteria levels during storms grossly exceed the 126 MPN/100ml state water quality standard on most occasions (92% of samples taken). Coon Creek clearly exceeded the standard of 10% of monitoring events in a month above 1260 MPN/100ml. It is notable, however, that one storm event accounted for 60% of the samples that exceeded the 1260/100ml standard.

Median E. *coli* in Coon Creek. Data is from All Sites for 2013.

	E. *coli* (MPN)	State Standard	N
Baseflow	103	Monthly Geometric Mean >126	36
Storms	668		36
All	211		72
Occasions >126 MPN		Monthly 10% average >1260	15 baseflow, 33 storm
Occasions >1260 MPN			0 baseflow, 10 storm

E. *coli* at Coon Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



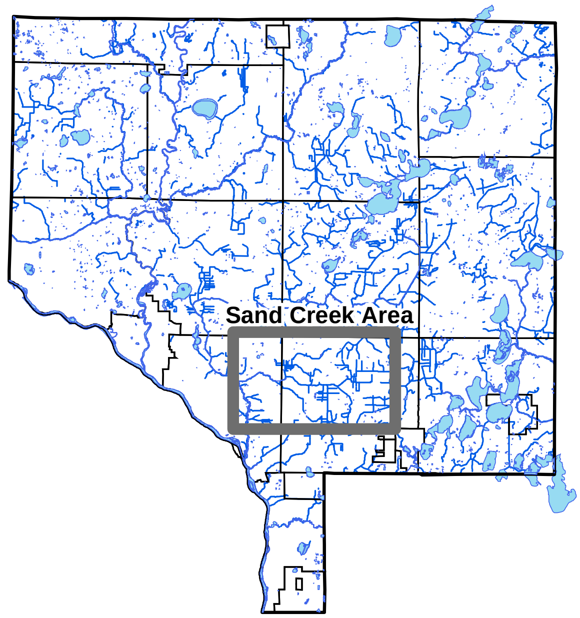


SAND CREEK SYSTEM

Sand Cr (Ditch 41) at Radisson Rd, Blaine	STORET SiteID = S006-421
Sand Cr (Ditch 41) at Highway 65, Blaine	STORET SiteID = S005-639
Sand Cr at Happy Acres Park, Blaine	STORET SiteID = S005-641
Ditch 60 at Happy Acres Park, Blaine	STORET SiteID = S005-642
Sand Cr at University Avenue, Coon Rapids	STORET SiteID = S005-264
Ditch 39 at University Avenue, Coon Rapids	STORET SiteID = S005-638
Sand Cr at Morningside Mem. Gardens Cemetery, Coon Rapids	STORET SiteID = S006-420
Sand Cr at Xeon Street, Coon Rapids	STORET SiteID = S004-619

Years Monitored

Sand Cr (Ditch 41) at Radisson Rd	2010-2013
Sand Cr (Ditch 41) at Highway 65	2009-2013
Sand Cr at Happy Acres Park	2009
Ditch 60 at Happy Acres Park	2009
Sand Cr at University Avenue	2008
Ditch 39 at University Avenue	2009
Sand Cr at Morningside Cemetery	2010-2013
Sand Cr at Xeon Street	2007-2013



Background

Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. In upper portions of the watershed (upstream of Hwy 65), the creek flows through a network of man-made ponds and lakes which serve stormwater treatment and aesthetic purposes. These areas were developed recently, after 1995. Farther downstream there are no in-line ponds and older development. A number of ditch tributaries exist throughout the watershed, and many reaches of Sand Creek itself have been ditched.

Sand Creek drains to Coon Creek, which then drains to the Mississippi River. At its confluence with Coon Creek, Sand Creek it is about 15 feet wide and 2.5-3 feet deep during baseflow. Sand Creek has not been listed as "impaired" by the MN Pollution Control Agency for exceeding any water quality parameters.

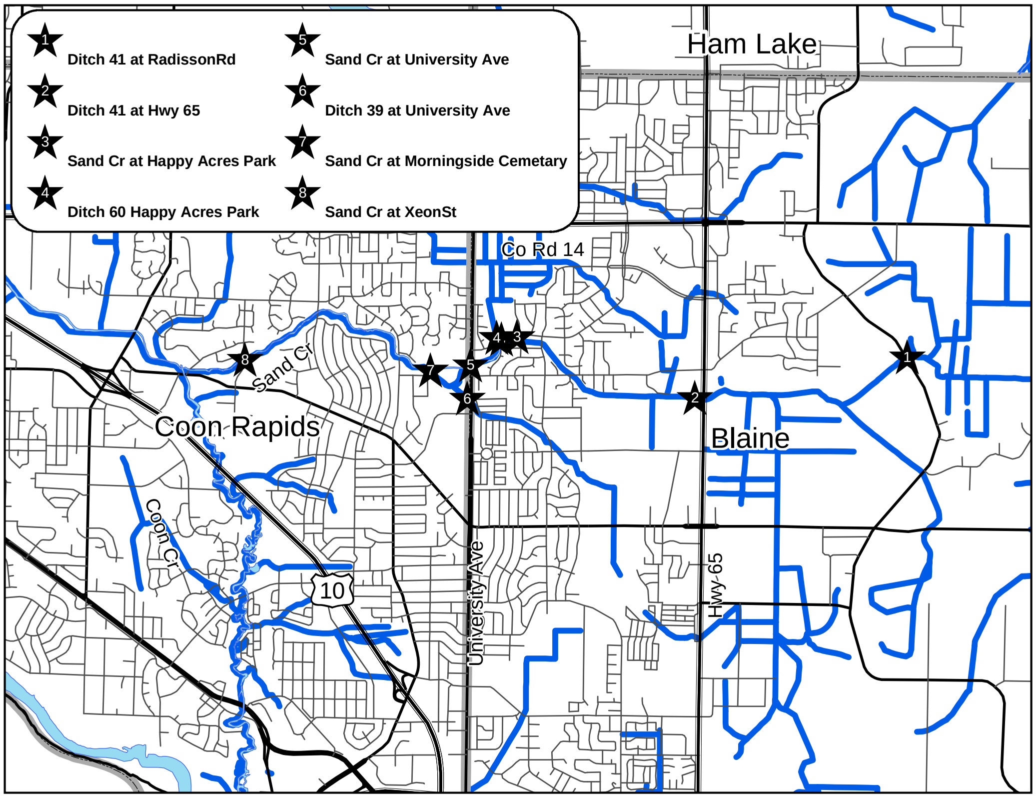
Methods

Sand Creek and its tributaries were monitored during both storm and baseflow conditions by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. During drought smaller storms were sampled because of a lack of larger storms. All storms sampled were significant runoff events.

Eleven water quality parameters were tested. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, salinity, and dissolved oxygen. Beginning in 2009 transparency tube measurements were added, as well as photo-documentation of water appearance. Parameters tested by water samples sent to a state-certified lab included total phosphorus, total suspended solids, chlorides, hardness, sulfate, and E.coli.

During every sampling the water level (stage) was recorded using a staff gauge surveyed to sea level elevations. Stage was also continuously recorded using a datalogging electronic gauge at the Morningside Cemetery and Xeon Street stream crossing (farthest downstream).

Sand Creek Monitoring Sites



Results and Discussion

The results presented below include all years of monitoring at all sites. We focus upon an upstream-to-downstream comparison of water quality, as well as an overall assessment. Overall, with the exception of dissolved pollutants water quality in Sand Creek is good, especially for a creek with a suburban watershed. Phosphorus is low.

Sand Creek water degrades Coon Creek for some parameters but not others. Sand Creek phosphorus, total suspended solids, and turbidity were all lower than Coon Creek. Dissolved pollutants were notably higher in Sand Creek than Coon Creek. Coon Creek has several water quality problems, including dissolved pollutants, phosphorus, and suspended solids.

Following is a parameter-by-parameter summary, including a management discussion:

- Dissolved pollutants, as measured by conductivity and chlorides, substantially higher than the median for other streams in Anoka County, but also much lower than state water quality standards. Conductivity was two times greater than the county median, while chlorides were four times greater. There was little change in these parameters from upstream to downstream. Both were slightly lower during baseflow than storms, indicating pollutants migrating through the shallow water table are an important source to the stream. Dissolved pollutants are at a higher concentration in Sand Creek than Coon Creek. Chlorides were not monitored on Sand Creek in 2013.

Management discussion: Dissolved pollutants enter the stream both directly through surface runoff and also by infiltrating into the shallow groundwater that feeds the stream during baseflow. A variety of sources appear to be likely, including road deicing salts, agricultural chemicals, and road runoff.

- Phosphorus was low in Sand Creek compared to other streams in the region but it may violate the proposed new state standard of 100 ug/L. 17% of Sand Creek samples violated that standard. Most of these exceedances were during storms. Phosphorus increases modestly during storms. Phosphorus does not increase noticeably from upstream to downstream in Sand Creek. Phosphorus in Sand Creek is lower than Coon Creek.

  Management discussion: Some stormwater treatment retrofits, including a new stormwater pond and network of rain gardens, were installed in 2012. These activities and others like them will be helpful at lowering storm-related phosphorus in Sand Creek. Achieving state water quality standards is within reach for Sand Creek.

- Suspended solids and turbidity are reasonably low in Sand Creek, with the exception of occasional higher readings during storms at Xeon Street (farthest downstream). Median TSS is low compared to the new proposed state water quality standard of 30 mg/L, but that standard was exceeded in 6 samples (11%). This may or may not constitute a violation of state water quality standards for the stream overall – it will be a borderline case.

  Management discussion: Because it is so close to water quality standards, and because it flows into Coon Creek which has high suspended solids, continued efforts should be made to lower these pollutants in Sand Creek. The Coon Creek Watershed District is already installing projects toward this end.

- pH and dissolved oxygen were with the range considered normal and healthy for streams in this area.
- E. coli bacteria are high throughout Sand Creek during storms.

  Management discussion: Because E. coli is pervasive in the environment and neighborhoods there will be difficulty reducing E. coli levels below state water quality standards. Addressing E. coli should be part of an effort to improve overall water quality.

Conductivity, Chlorides, and Salinity

Conductivity and chlorides are measures of a broad range of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial sources, agricultural chemicals, and others. Metals, hydrocarbons, road salts, and others are often of concern in a suburban environment. Conductivity is the broadest measure of dissolved pollutants we used. It measures electrical conductivity of the water; pure water with no dissolved constituents has zero conductivity. Chlorides measures for chloride salts, the most common of which are road de-icing chemicals. Chlorides can also be present in other pollutant types, such as wastewater. These pollutants are of greatest concern because of the effect they can have on the stream's biological community, however it is noteworthy that Sand Creek is upstream from the drinking water intakes on the Mississippi River for the Twin Cities.

Sand Creek dissolved pollutant levels are often double the level typically found in Anoka County streams, but lower than the levels that broadly impact stream biota (see table and figures below). Considering all sites in all years, median conductivity in Sand Creek is two times greater than the median for all Anoka County streams (0.711 mS/cm compared to 0.362 mS/cm). Chlorides were even higher. Sand Creek median chlorides were four times greater than the median of all Anoka County streams (67 mg/L vs 17 mg/L). This is still less than the Minnesota Pollution Control Agency's chronic water quality standard for chloride of 230 mg/L.

It's not surprising that Sand Creek, which lies in a suburban area, would have greater dissolved pollutants than the county-wide median. The county spans rural to urban areas. Sand Creek's upper watershed has an abundance of current and retired sod farms, where salt-containing chemicals are used. The watershed also has an abundance of roads which are treated regularly with deicing salts. Urban stormwater runoff, which is most abundant in the lower watershed, also contains a variety of other dissolved pollutants. Stormwater treatment practices such as catch basins and settling ponds are relatively ineffective at removing dissolved pollutants. Streams near Sand Creek in similar land use settings have similar dissolved pollutant levels.

From upstream to downstream there is little change in dissolved pollutants in Sand Creek (see figures below). This suggests dissolved pollutant concentrations in all parts of the watershed are similar. Several of the tributaries have dissolved pollutants higher than the main stem.

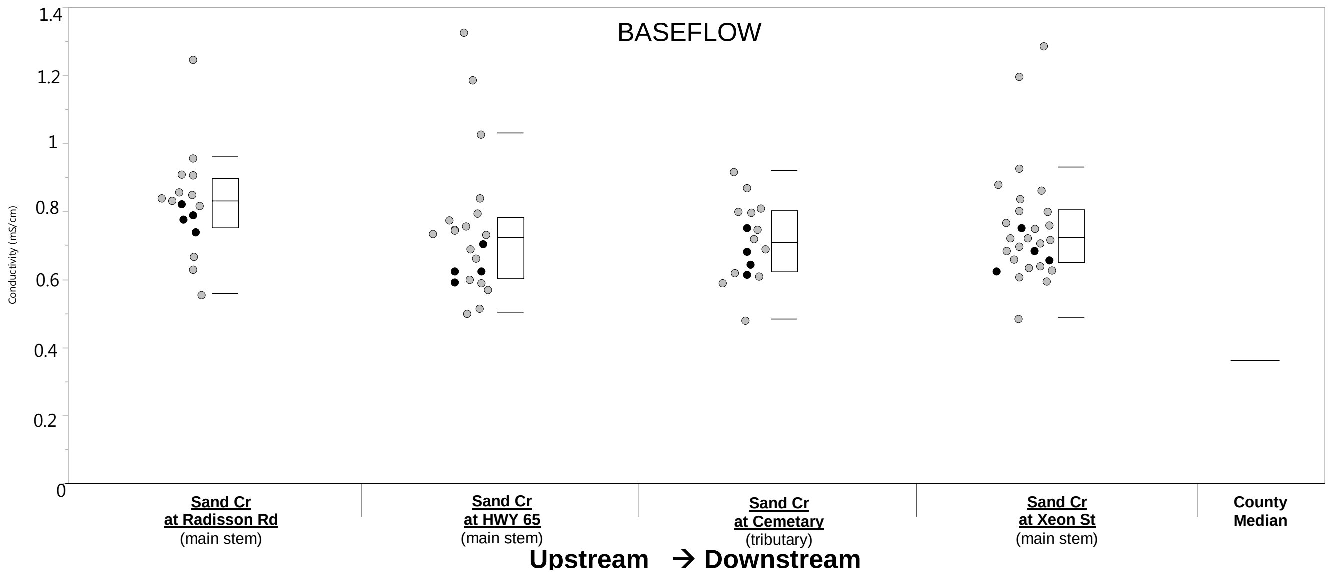
Dissolved pollutants were slightly lower during storms than during baseflow (see figures below). Dissolved pollutants can easily infiltrate into the shallow groundwater that feeds streams during baseflow. If this has occurred, dissolved pollutants will be high during baseflow. If road runoff was the primary dissolved pollutant source, then readings would be highest during storms. The median conductivity from all Sand Creek sites during baseflow was 15% higher than during storms (0.751 vs 0.654 mS/cm). The mean chlorides from all Sand Creek sites during baseflow were 11% higher than during storms (68 vs 61 mS/cm). This is not to say that rain runoff is free of dissolved pollutants; rather the concentration is lower than in the shallow groundwater. From a management standpoint, is important to remember that the sources of both stormwater and baseflow dissolved pollutants are generally the same, and preventing their release into the environment and treating them before infiltration should be a high priority.

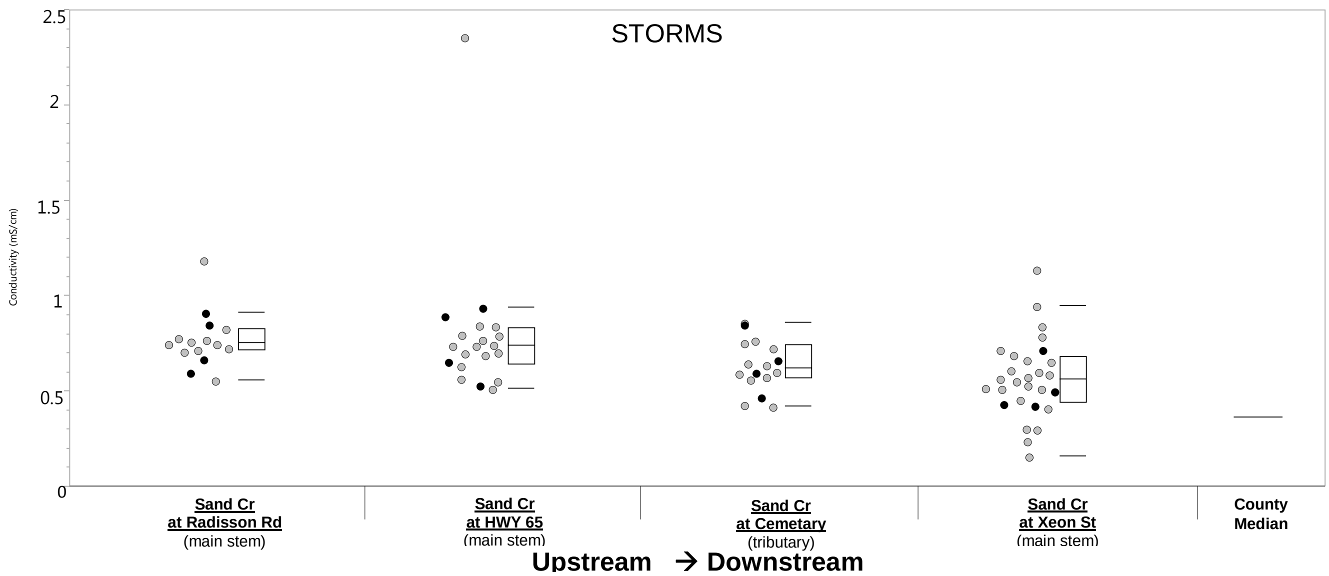
Sand Creek degrades Coon Creek with dissolved pollutants. Both creeks were monitored just before they join. Across all years monitored, Sand Creek's median conductivity was 39% higher than Coon Creek (0.711 vs 0.510 mS/cm). Sand Creek's median chlorides were 42% higher than Coon Creek (74 vs 52 mg/L).

Median conductivity and chlorides in Sand Creek. Data is from Xeon St for all years through 2013.

<table>
<tr><th></th><th>Conductivity (mS/cm)</th><th>Chlorides (mg/L)</th><th>State Standard</th><th>N</th></tr>
<tr><td>Baseflow</td><td>0.724</td><td>75</td><td rowspan="3">Conductivity – none
Chlorides 860 mg/L acute, 230 mg/L chronic</td><td>28</td></tr>
<tr><td>Storms</td><td>0.562</td><td>63</td><td>28</td></tr>
<tr><td>All</td><td>0.663</td><td>72</td><td>56</td></tr>
<tr><td>Occasions > state standard</td><td></td><td></td><td></td><td>0</td></tr>
</table>

Conductivity at Sand Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Phosphorus

Total phosphorus (TP) is a common nutrient pollutant. It is limiting for most algae growth. TP was low in Sand Creek (see table and figures below). Median Sand Creek TP for all sites in all years during baseflow (57 ug/L) and storms (74 ug/L) were below the median for Anoka County streams (135 ug/L) and below the water quality standard that the MN Pollution Control Agency is likely to adopt (100 ug/L).

Nonetheless, Sand Creek will likely be found to be in violation (impaired) for excess phosphorus. While the median phosphorus level is below 100 ug/L, the stream at Xeon Street exceeds that level in 29% of samples. Most of these exceedences (11 0f 16) occur during storms. Retrofitting stormwater treatment for improved phosphorus capture is already a priority of the Coon Creek Watershed District; a new stormwater pond and network of rain gardens were installed in 2012.

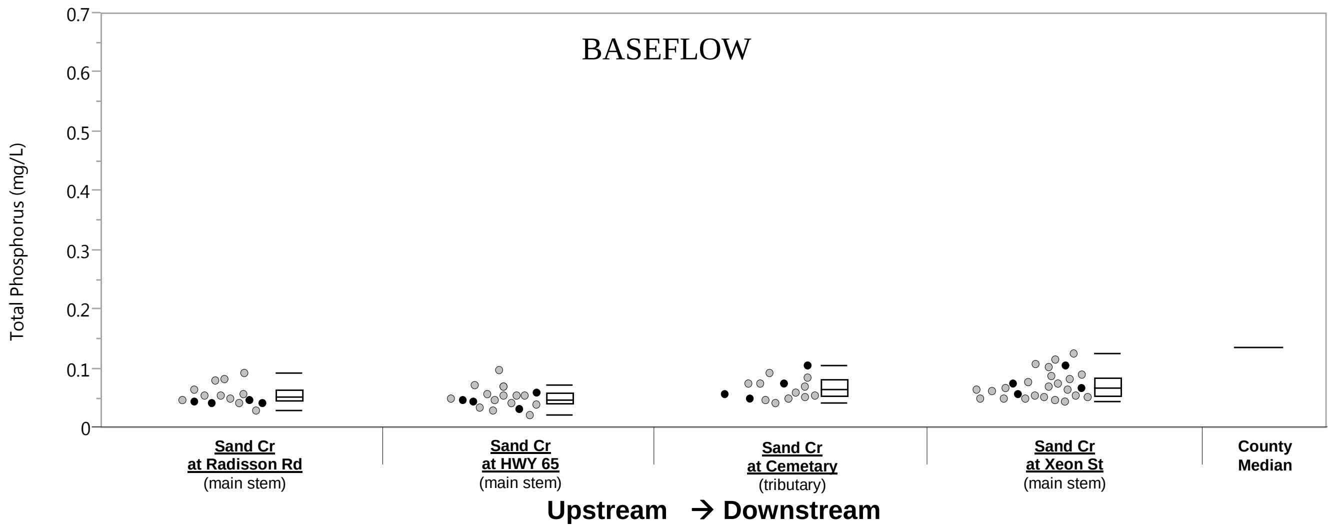
Sand Creek TP is lower than Coon Creek. In Coon Creek, just before the confluence with Sand Creek, the median TP is 129 ug/L. The median in Sand Creek at this same junction is 81 ug/L.

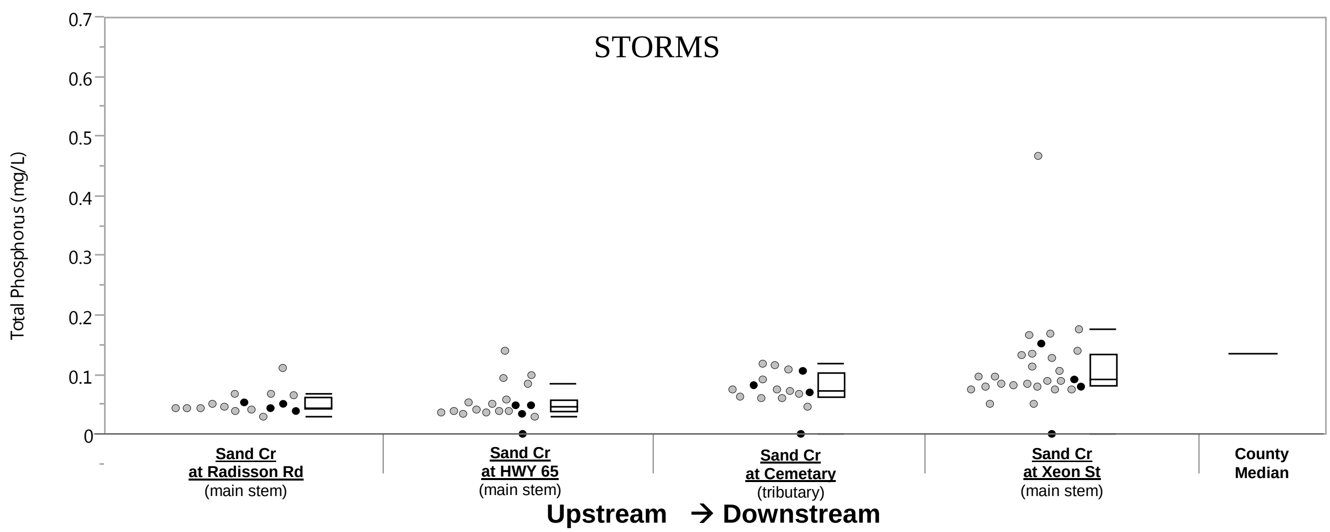
Median total phosphorus in Sand Creek. Data is from Xeon St for all years through 2013.

	Total Phosphorus (ug/L)	**State Standard***	**N**
Baseflow	66	100	28
Storms	91		28
All	81		52
Occasions > state standard			11 during storms, 5 baseflow

*New state standards are under development. The standard listed is the likely new threshold.

Total phosphorus at Sand Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Suspended Solids and Turbidity

Total suspended solids (TSS) and turbidity both measure solid particles in the water. TSS measures these particles by weighing materials filtered out of the water. Turbidity measures by defraction of a beam of light sent though the water sample, and is therefore most sensitive to large particles.

TSS and turbidity are reasonably low in Sand Creek, with the exception of occasional higher readings during storms at Xeon Street (farthest downstream). At Xeon Street, median TSS during baseflow was 5.5 mg/L, but 12.5 mg/L during storms. Both are low compared to the new proposed state water quality standard of 30 mg/L, but that standard was exceeded in 6 samples (11%). This may or may not constitute a violation of state water quality standards for the stream overall – it will be a borderline case.

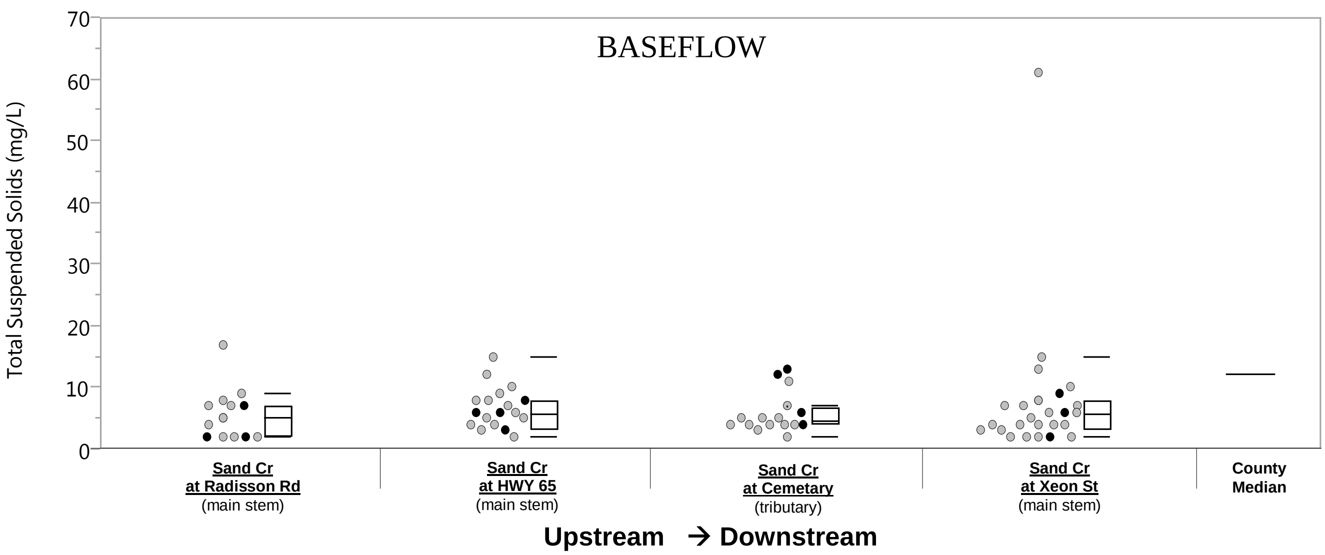
Because it is so close to water quality standards, and because it flows into Coon Creek which has high suspended solids, efforts should be made to lower these pollutants in Sand Creek. The Coon Creek Watershed District is already installing projects toward this end. Projects in the lower watershed are most needed. While there are some instances of higher turbidity in the upper watershed, this is related to algal production in upstream lakes.

Median turbidity and suspended solids in Sand Creek. Data is from Xeon St for all years through 2013.

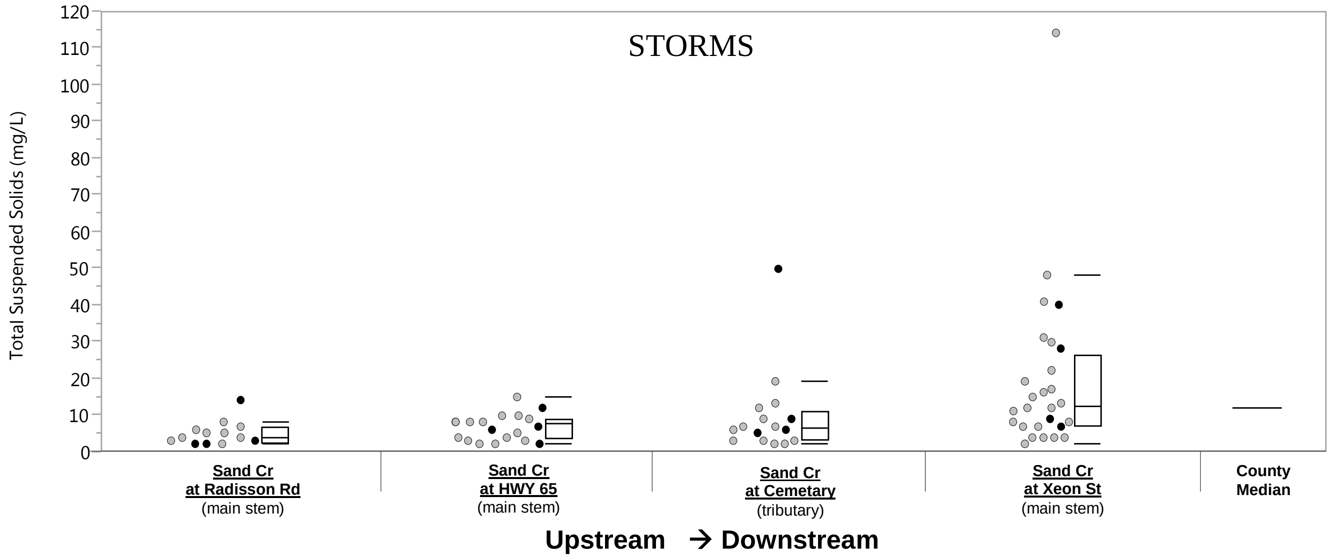
	Turbidity (FNRU)	Total Suspended Solids (mg/L)	State Standard*	N
Baseflow	5.0	4.5	30 mg/L TSS	28
Storms	12.0	12.5		28
All	9.0	7.5		52
Occasions > new state TSS standard				5 during storms, 1 baseflow

*New state standards are under development. The standard listed is the likely new threshold.

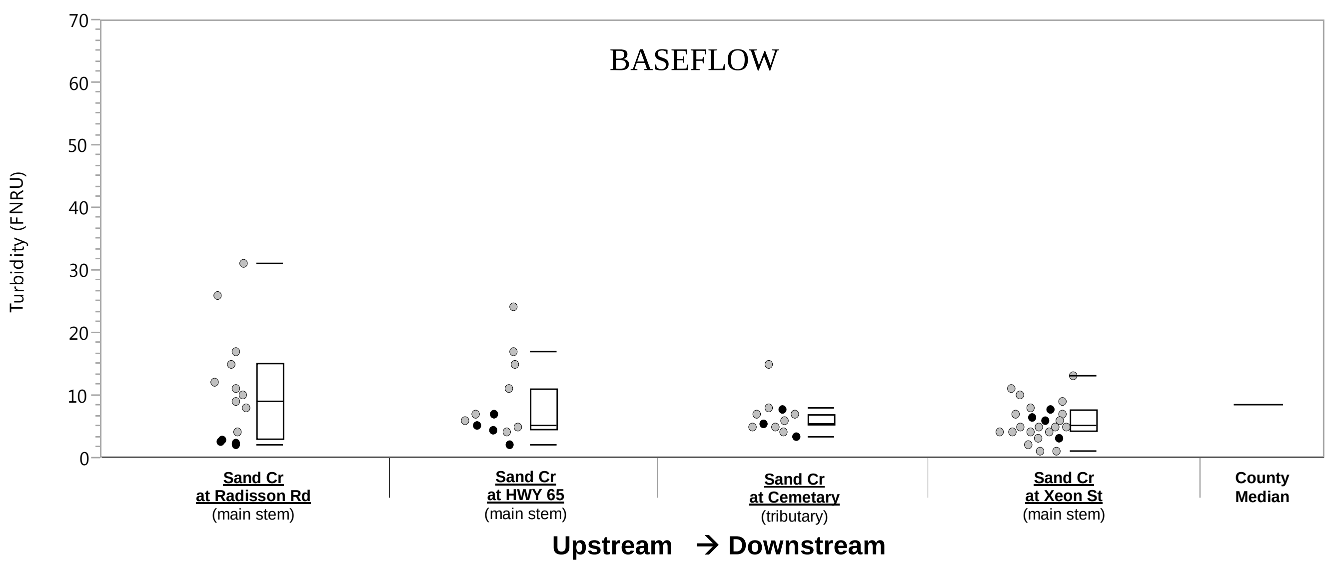
Total suspended solids at Sand Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



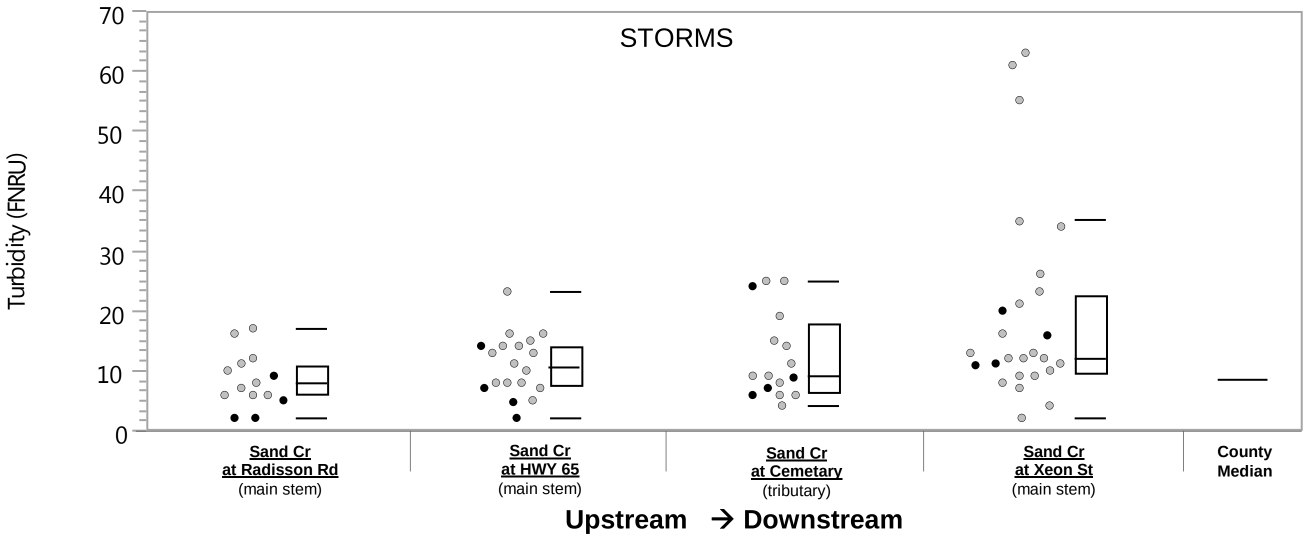
Total suspended solids at Sand Creek continued…



Turbidity at Sand Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25^{th} and 75^{th} percentile (ends of box), and 10^{th} and 90^{th} percentiles (floating outer lines).



Turbidity at Sand Creek continued…



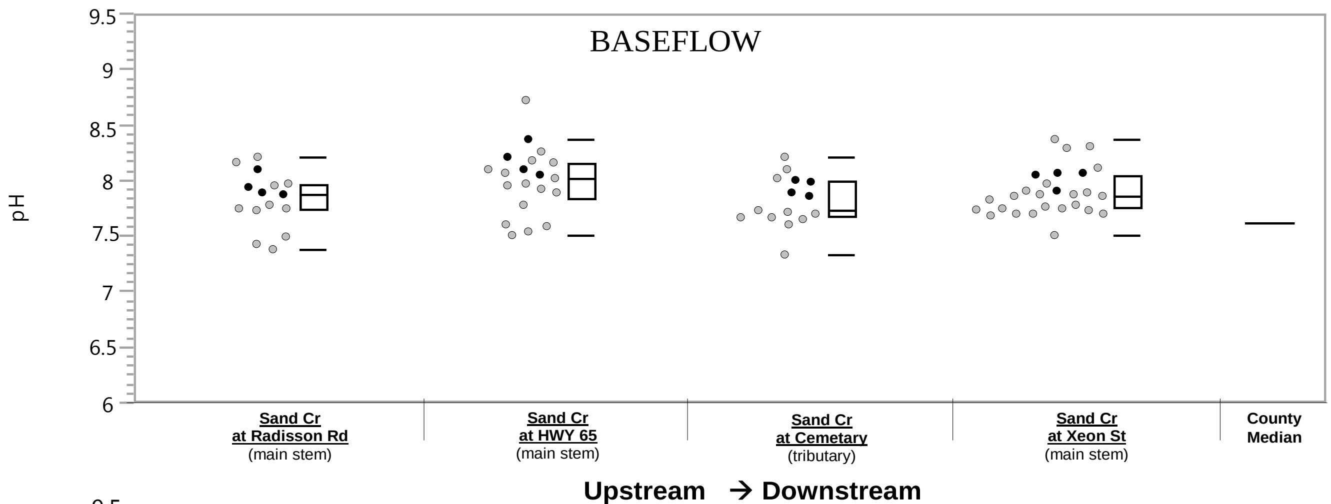
pH

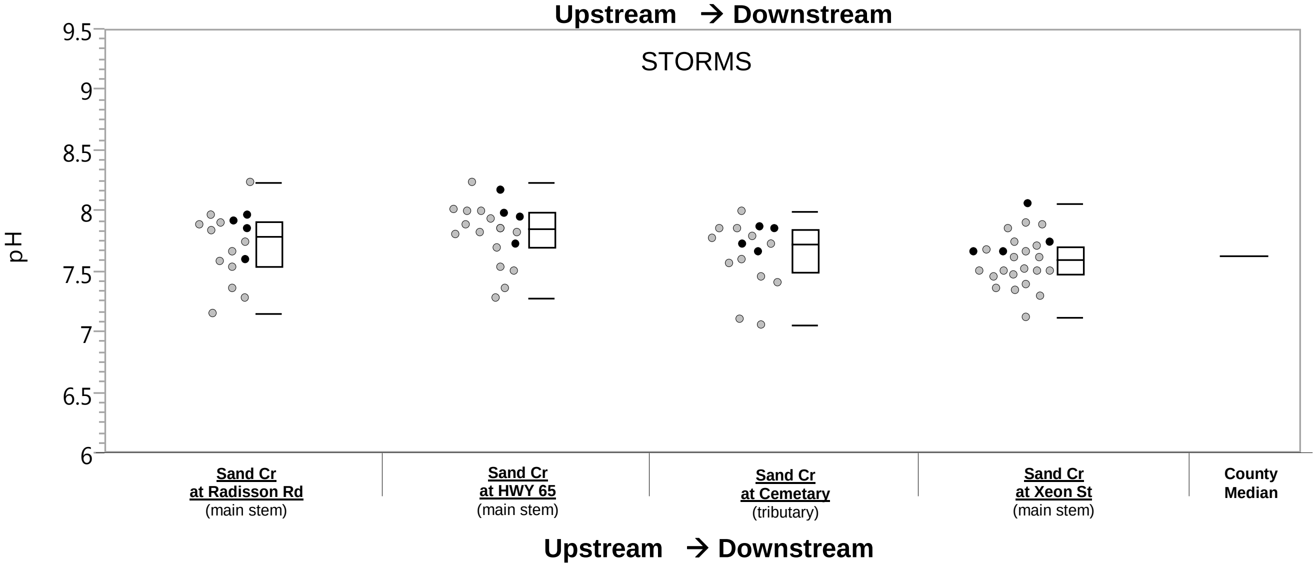
Sand Creek pH was within the expected range at all sites and during all conditions (see figures below), ranging from 7.05 to 8.71. The median was 7.74. The Minnesota Pollution Control Agency water quality standards set an expectation for pH between 6.5 and 8.5. At all sites pH was lower during storms because rainwater has a lower pH.

Median pH in Sand Creek. Data is from Xeon St for all years through 2013.

	pH	State Standard	N
Baseflow	7.86	6.5-8.5	28
Storms	7.59		28
All	7.74		52
Occasions outside state standard			1

pH at Sand Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Dissolved Oxygen

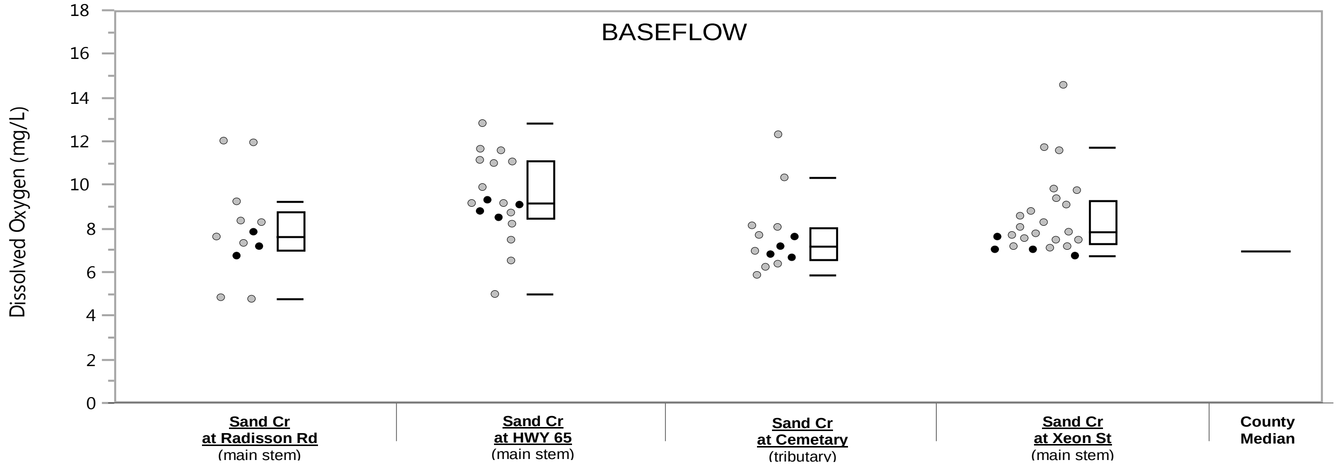
Dissovled oxygen (DO) essential for aquatic life. Fish, invertebrates, and other aquatic life suffer if DO is below 5 mg/L. Low DO can be a symptom of organic pollution, the decomposition of which reduces oxygen.

Dissolved oxygen in Sand Creek was within the acceptable level (>5 mg/L) on 96% of the site visits (see table figure below). On eight occasions it dropped below 5 mg/L, but only one of these was within the main stem. They occurred at five different sites, suggesting there is not a chronic problem at any one locality. Three were during storms and five during baseflow, suggesting the issue is not flow-dependent. Five were during drought conditions in 2009 and 2012. Overall, we do not have concerns about dissolved oxygen levels in Sand Creek.

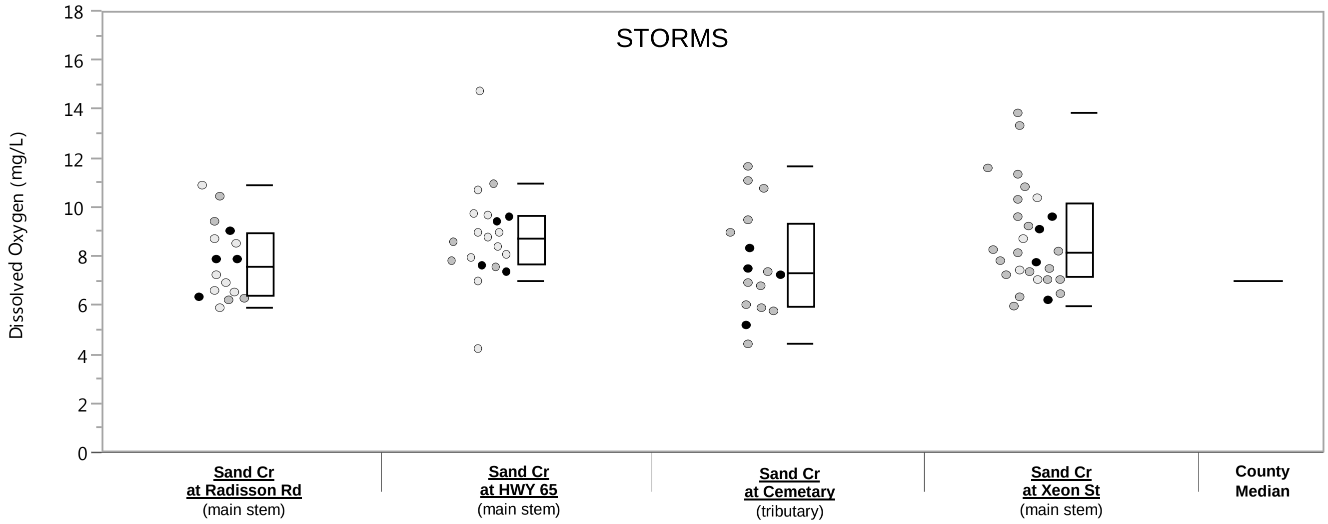
Median dissolved oxygen in Sand Creek. Data is from Xeon St for all years through 2013.

	Dissolved Oxygen (mg/L)	**State Standard**	**N**
Baseflow	7.81	5 mg/L daily minimum	28
Storms	8.16		28
All	7.94		52
Occasions <5 mg/L			0 at Xeon St., 8 at other sites

Dissolved Oxygen at Sand Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating lines).



Upstream → Downstream



Upstream → Downstream

E. coli

E. *coli* is a bacteria found in the feces of warm blooded animals. E. *coli* is an easily testable indicator of all pathogens that are associated with fecal contamination. The Minnesota Pollution Control Agency sets E. *coli* standards for contact recreation (swimming, etc). A stream is designated as “impaired” if 10% of measurements in a calendar month are >1260 colony forming units per 100 milliliters of water (cfu/100mL) or if the geometric mean of five samples taken within 30 days is greater than 126 cfu/100mL.

Our data are not sufficient to determine if the MPCA standards are met. We took samples throughout summer, often with only 1-2 samples in each month, too little for calculation of a monthly geometric mean or to reasonably say that 10% of samples in a month were in exceedence. We can, however, perform other examination of the data.

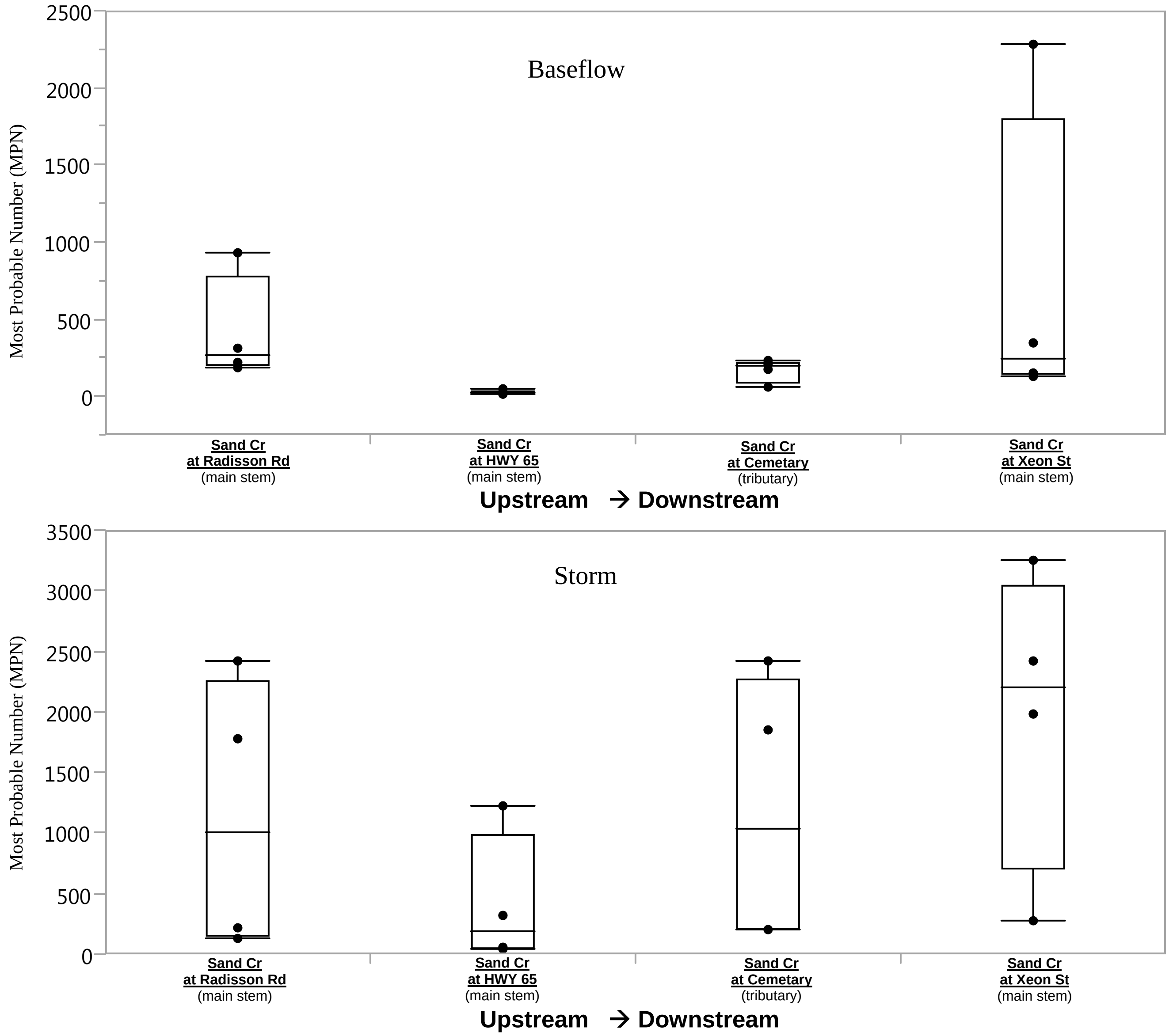
During baseflow E. *coli* was moderate and showed slight upstream to downstream increase after highway 65. Median E. *coli* during baseflow from upstream to downstream were 261, 20, 225, and 247 MPN, respectively. E. coli during baseflow exceeded 126 MPN/100ml on a regular basis (69% of samples taken). One sample also exceeded 1260 MPN/100ml.

During storms E. coli was significantly higher and more variable, and there was modest increase from upstream to downstream after Highway 65. Median E. coli during storms from upstream to downstream were 1004, 191, 1030, and 2203 MPN, respectively. E. coli levels during storms grossly exceed the 126 MPN/100ml on most occasions (88% of samples taken). .

Median E. *coli* in Sand Creek. Data is from All Sites for 2013.

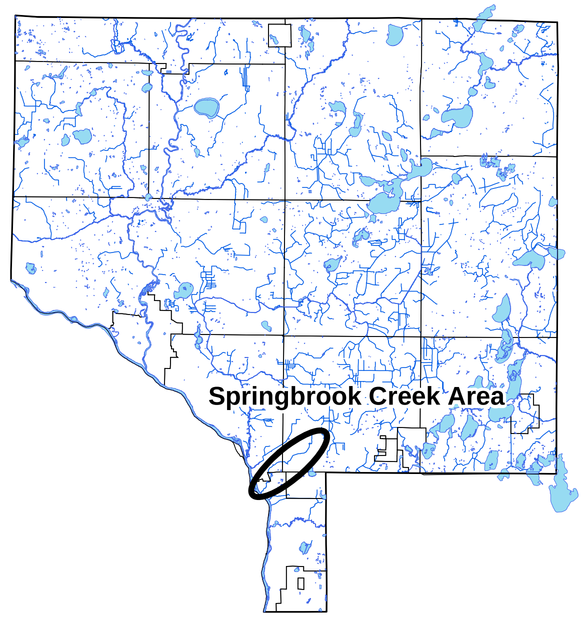
	E. *coli* (MPN)	**State Standard**	**N**
Baseflow	182	Monthly Geometric Mean >126	16
Storms	774		16
All	220		32
Occasions >126 MPN **Occasions >1260 MPN**		Monthly 10% average >1260	11 baseflow, 1 storm 14 baseflow, 7 storm

E. *coli* at Creek. Dots are individual readings. Black dots are 2013 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



SPRINGBROOK CREEK

Springbrook at University, Blaine	STORET SiteID = S007-542
Springbrook at 85th Avenue, Fridley	STORET SiteID = S007-543
Springbrook at 79th Way, Fridley	STORET SiteID = S006-140



Years Monitored

Springbrook at University 2013
Springbrook at 85th Avenue 2013
Springbrook at 79th Way 2012-2013

Other sites around the Springbrook Nature Center were monitored a few occasions in the early 2000's but are not included in this report.

Background

Springbrook is a small waterway draining an urbanized and highly modified subwatershed. The watershed includes portions of the Cities of Blaine, Coon Rapids, Spring Lake Park and Fridley. Several tributaries, or stormwater systems contributing to the creek, join at the Springbrook Nature Center Impoundment. From the outlet of the Nature Center, the Creek flows a short distance to the Mississippi River. At its outlet, Springbrook is about 10 feet wide and 1 foot deep at baseflow. The stream is flashy, with water levels that increase dramatically following rainfall and quickly recede thereafter.

In the early 2000's Springbrook was the subject of a multi-partner project to monitor and improve water quality. Funding was from a MN Pollution Control Agency grant and the City of Fridley served as a fiscal agent. During that project several projects to better treat stormwater and rehabilitate the Nature Center impoundment were initiated. Water monitoring at that time produced little data, but enough to indicate sizable water quality and hydrology problems existed.

Springbrook Creek is listed as "impaired" by the MN Pollution Control Agency for impaired biota, but new methods (Tiered Aquatic Life Standards) currently under development will take into consideration the fact that the creek is a public ditch and therefore has lower aquatic life expectations, at least in some reaches. While recent monitoring data is insufficient to officially assess Springbrook for other impairments, the data to date suggest that other impairment designations are in the near future.

Methods

Springbrook was monitored during both storm and baseflow conditions by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. In cases, especially drought years, smaller storms were sampled because of a lack of larger storms. All storms sampled were significant runoff events.

Eleven water quality parameters were tested. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, salinity, and dissolved oxygen. Parameters tested by water samples sent to a state-certified lab included total phosphorus, total suspended solids, chlorides, hardness, and sulfate. During every sampling the water level (stage) was recorded using a staff gauge surveyed to sea level elevations. Stage was also continuously recorded using a datalogging electronic gauge.

Results and Discussion

Springbrook Creek has some prominent water quality concerns. While it is currently listed as impaired by the State only for a poor invertebrate biota, these data suggest that other impairments exist. Chlorides, phosphorus, and suspended solids all approach or exceed State standards at least occasionally.

Following is a parameter-by-parameter summary, including a management discussion:

- Dissolved pollutants, as measured by conductivity and chlorides, are higher in Springbrook than any other Anoka Count stream except nearby Pleasure Creek, which is similar. Conductivity was two times greater than the median for Anoka County streams, while chlorides were nine times greater. Both were elevated during storms and baseflow, but consistently higher concentrations were during storms. On one of eight monitoring occasions the state chronic standard for chlorides was exceeded.

  Management discussion: Dissolved pollutants enter the stream both directly through surface runoff and also by infiltrating into the shallow groundwater that feeds the stream during baseflow. A variety of sources appear to be likely, including road deicing salts and road runoff. Preventing their release into the environment is important because they are not easily removed.

- Phosphorus was moderate in Springbrook Creek, and similar to other nearby waterbodies. However, a 100 mg/L state standard is likely to be established soon, which many streams including Springbrook would probably exceed. Phosphorus is consistently highest during storms in Springbrook, but often exceeds the proposed 100 ug/L limit during baseflow as well.

  Management discussion: Additional treatment within the stormwater conveyance system will help reduce phosphorus.

- Suspended solids and turbidity are low in Springbrook during baseflow, but during storms the downstream site approaches or exceeds the proposed state water quality standard.

  Management discussion: Additional treatment within the stormwater conveyance system will help reduce suspended solids.

- pH and dissolved oxygen were with the range considered normal and healthy for streams in this area.
- E. coli bacteria are high throughout Coon Creek during storms.

  Management discussion: Because E. coli is pervasive in the environment and neighborhoods there will be difficulty reducing E. coli levels below state water quality standards. Addressing E. coli should be part of an effort to improve overall water quality.

Conductivity, Chlorides, and Salinity

Conductivity and chlorides are measures of a broad range of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial sources, agricultural chemicals, and others. Metals, hydrocarbons, road salts, and others are often of concern in a suburban environment. Conductivity is the broadest measure of dissolved pollutants we used. It measures electrical conductivity of the water; pure water with no dissolved constituents has zero conductivity. Chlorides measures for chloride salts, the most common of which are road de-icing chemicals. Chlorides can also be present in other pollutant types, such as wastewater. These pollutants are of greatest concern because of the effect they can have on the stream’s biological community, however it is noteworthy that Springbrook Creek discharges into the Mississippi River just upstream from drinking water intakes for the Twin Cities.

Conductivity and chlorides in Springbrook Creek are higher than at any other stream in Anoka County, except nearby Pleasure Creek which is similar. Springbrook dissolved pollutant levels are multi-fold higher than the concentrations typically found in Anoka County streams and approaching levels that impact stream biota (see table and figures below). Median conductivity in Springbrook was two times greater than the median for all Anoka County streams (0.730 mS/cm compared to 0.362 mS/cm). Conductivity was high both during storms (median 0.645 mS/cm) and baseflow (median 0.831 mS/cm).

Chlorides were even higher – nine times higher than the average of other Anoka County streams. Springbrook median chlorides were 159 mg/L compared to 17 mg/L for other Anoka County streams. Median chlorides during storms (216 mg/L) were higher than during baseflow (129 mg/L). During one storm event, chlorides were 253 mg/L, which exceeds the Minnesota Pollution Control Agency's chronic water quality standard of 230 mg/L. No monitoring occurred during snowmelt or mid-winter, when chlorides may have been higher.

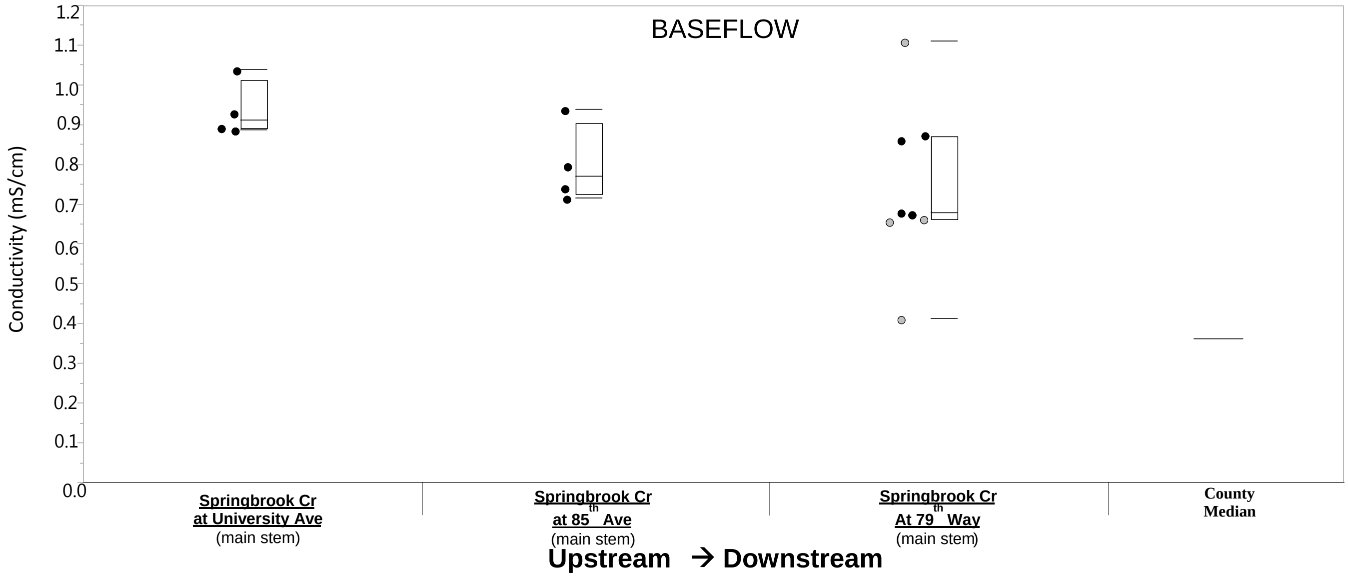
Springbrook's high dissolved pollutants are likely from stormwater runoff, with road deicing salts as one, but not the only, contributor. Greater road densities and a long history of road salting contribute to high chlorides. Chlorides are persistent in the environment; not effectively broken down by stormwater treatment or time. They migrate into the shallow groundwater which feeds the stream during baseflow. This explains why chlorides are high during baseflow. However, at Springbrook stormwater runoff carries even higher concentrations of dissolved pollutants. This is unlike most area streams where baseflow dissolved pollutants is highest, and road deicing salts are likely the largest culprit. The water washing off roads, roofs, and parking lots contains a mixture of different dissolved pollutants.

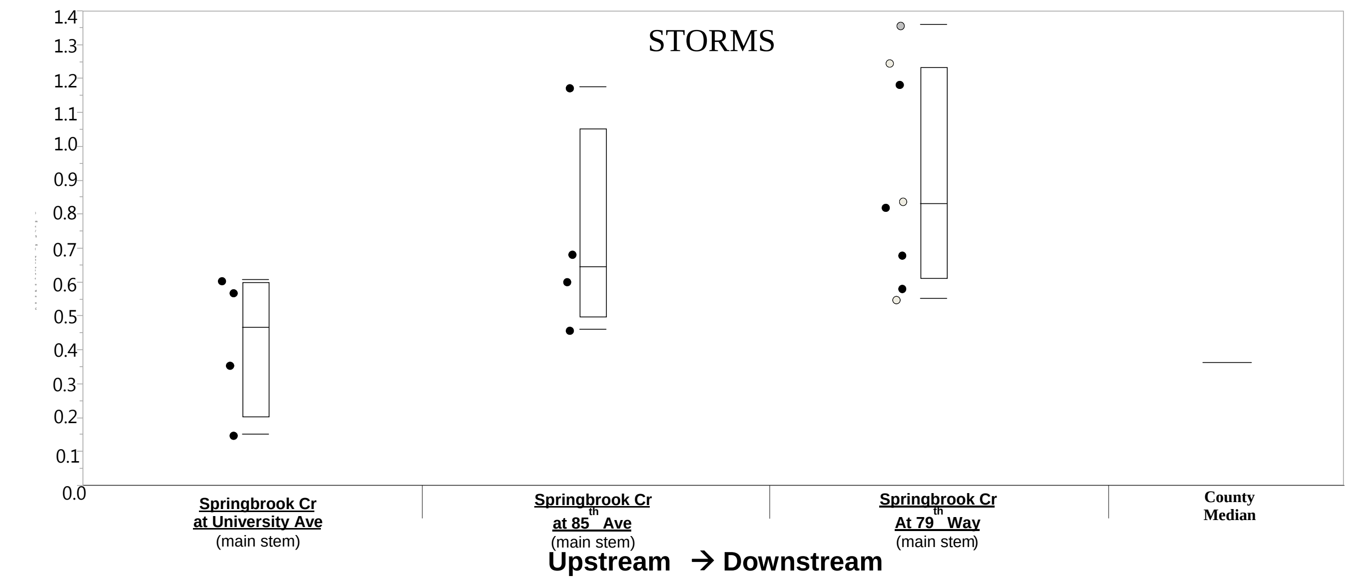
Dissolved pollutants are especially difficult to manage once in the environment. They are not removed by stormwater settling ponds. Infiltration practices can provide some treatment through biological processes in the soil, but also risk contaminating groundwater. The first approach to dissolved pollutant management must be to minimize their release into the environment.

Median conductivity and chlorides in Springbrook Creek. Data is from 79th Way for all years through 2013.

	Conductivity (mS/cm)	Chlorides (mg/L)	State Standard	N
Baseflow	0.679	129	Conductivity – none Chlorides 860 mg/L acute, 230 mg/L chronic	8
Storms	0.832	216		8
All	0.753	159		16

Conductivity at Springbrook Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Phosphorus

Total phosphorus (TP) is a common nutrient pollutant. It is limiting for most algae growth. Median Springbrook Creek TP during baseflow (0.108 mg/L) and storms (0.130 mg/L) were typical for Anoka County streams (0.135 mg/L; see table and figures below). It is interesting to note that during baseflow conditions the ponds and wetlands between all of the sites appear to be reducing phosphorous levels.

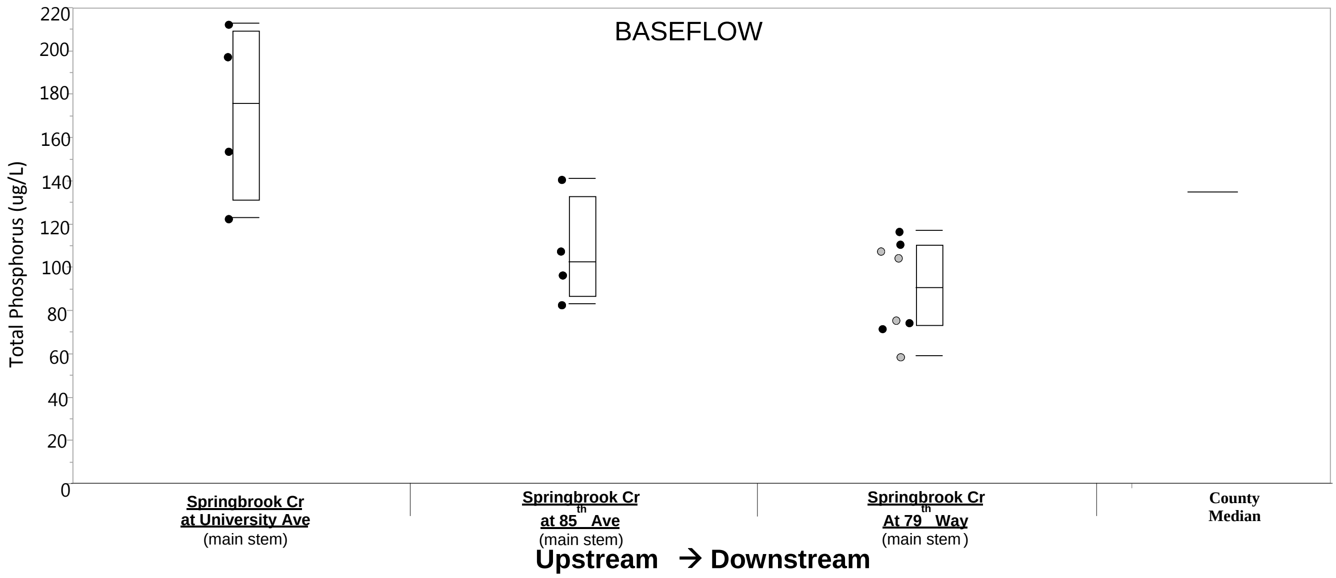
The MN Pollution Control Agency is likely to adopt 0.100 mg/L as a new phosphorus standard for streams. Based on data collected to date, Springbrook would probably violate this standard and then be designated as "impaired."

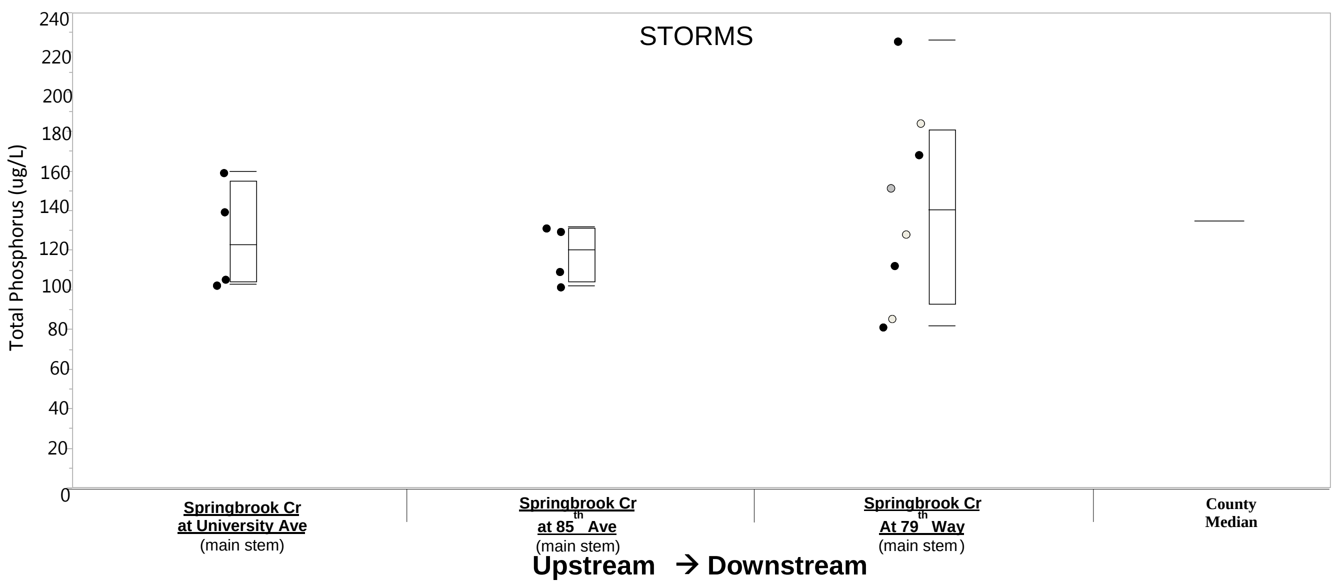
Median total phosphorus in Springbrook Creek. Data is from 79th Way for all years through 2013.

	Total Phosphorus (ug/L)	State Standard*	N
Baseflow	108	100	8
Storms	130		8
All	110		16
Occasions > state standard			10 (6 during storms)

*New state standards are under development. The standard listed is the likely new threshold.

Total phosphorus at Springbrook Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Suspended Solids and Turbidity

Total suspended solids (TSS) and turbidity both measure solid particles in the water. TSS measures these particles by weighing materials filtered out of the water. Turbidity measures by defraction of a beam of light sent though the water sample, and is therefore most sensitive to large particles. Suspended solids are important because they carry other pollutants, affect water appearance, and can harm stream biota.

TSS and turbidity were both low during baseflow and higher during storms (see table and figures below). The highest observed TSS was 56 mg/L, and the highest turbidity was 43 FNRU. During baseflow turbidity did not exceed 5. TSS during baseflow never exceeded 11 and averaged less than 5. Overall, these levels are within the desirable range for streams in this area.

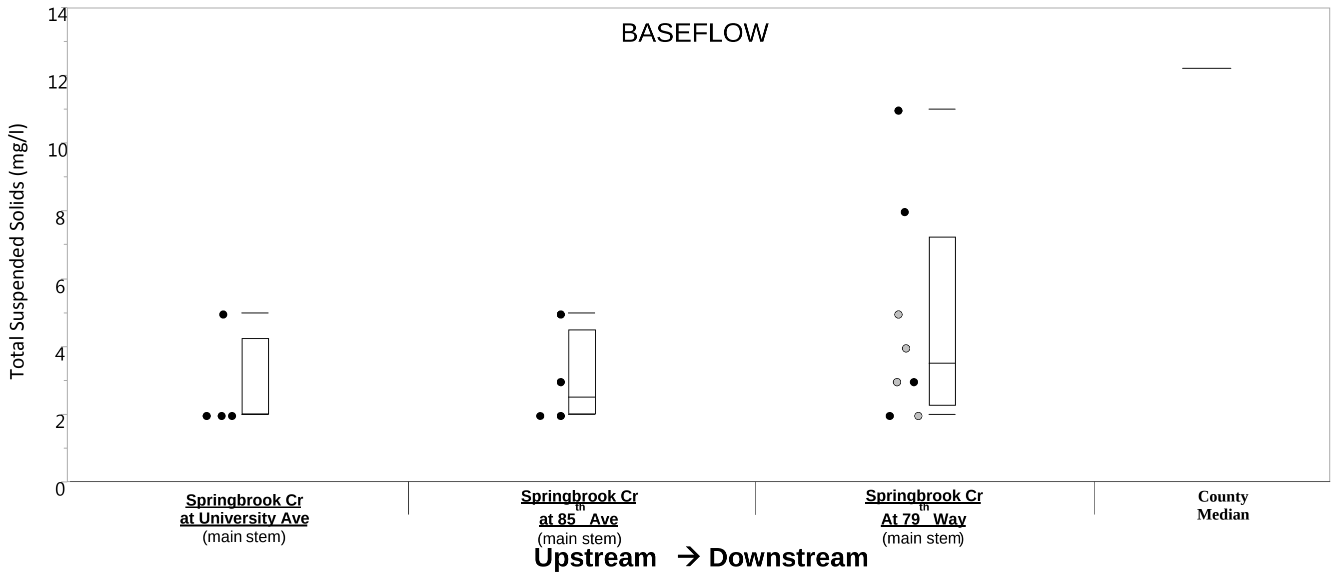
The MN Pollution Control Agency is in the process of modifying the state water quality standard in this region. The new standard will likely be 30 mg/L TSS, with no turbidity standard. Only one of thirty two samples exceeded this standard. 20 samples will be needed for the MPCA to determine if water quality standards for suspended solids are being met.

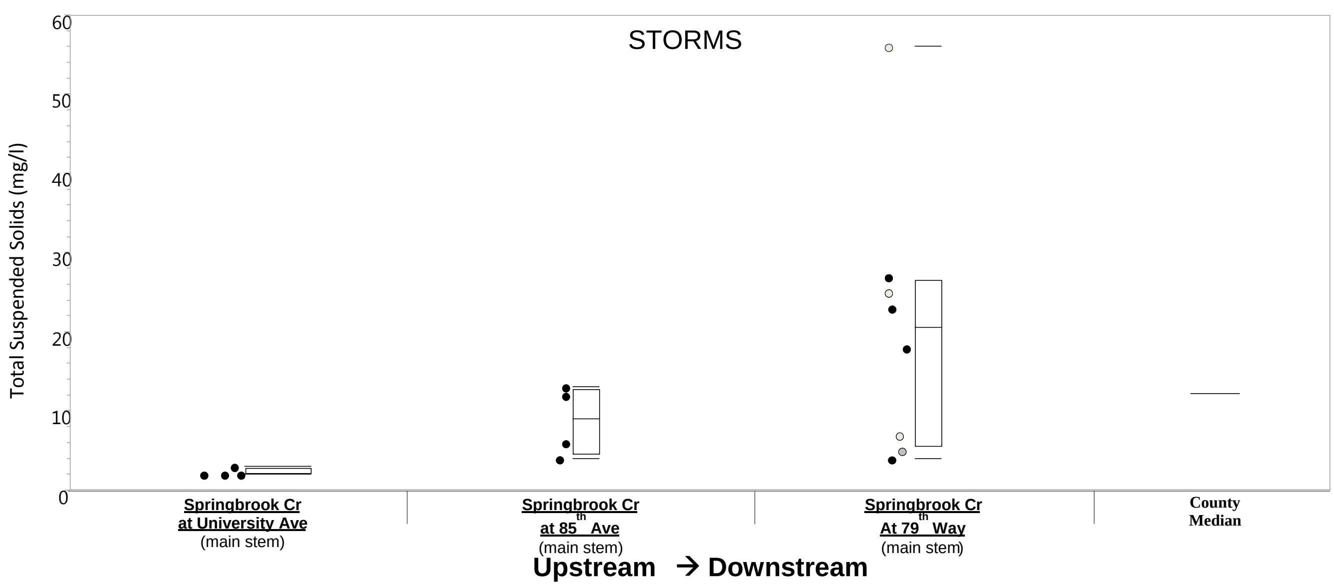
Median turbidity and suspended solids in Springbrook Creek. Data is from 79th Way for all years through 2013.

	Turbidity (FNRU)	Total Suspended Solids (mg/L)	State Standard*	N
Baseflow	1.8	3.5	30 mg/L TSS	8
Storms	15.7	21		8
All	3	6		16
Occasions > new state TSS standard				1

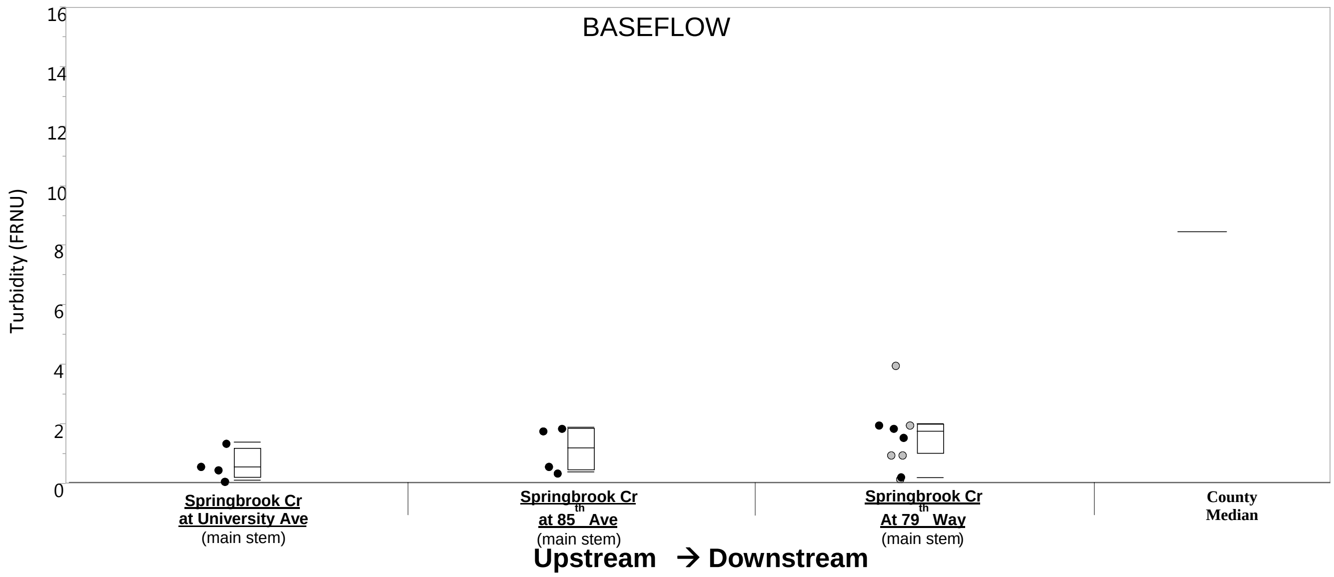
*New state standards are under development. The standard listed is the likely new threshold.

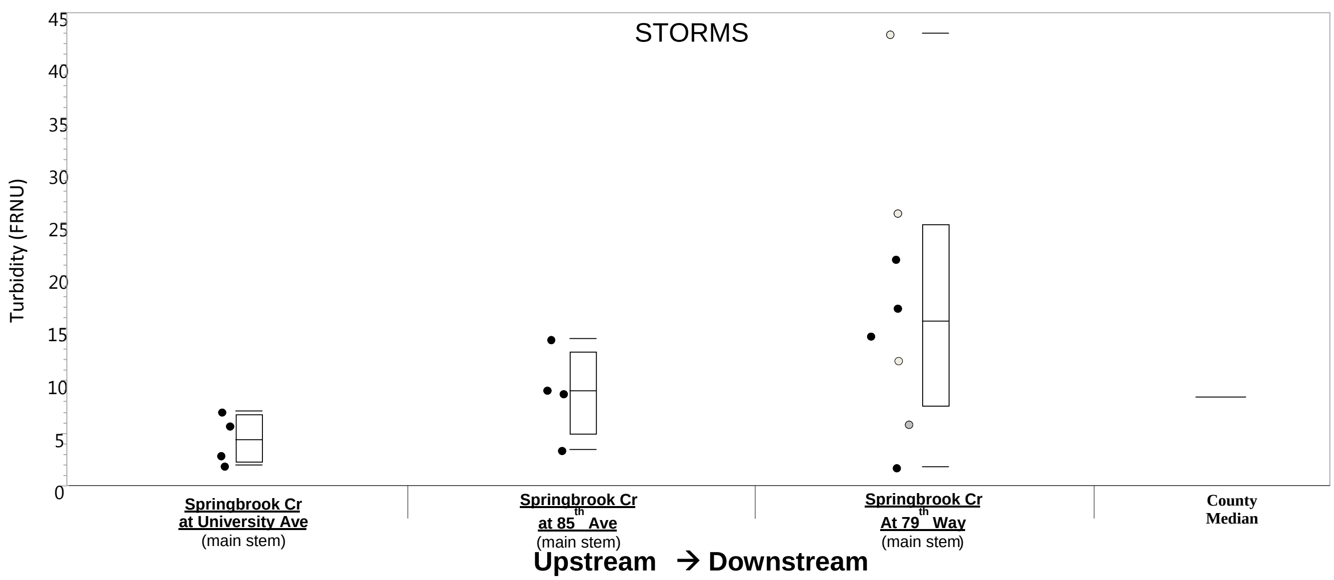
Total suspended solids at Springbrook Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Turbidity at Springbrook Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





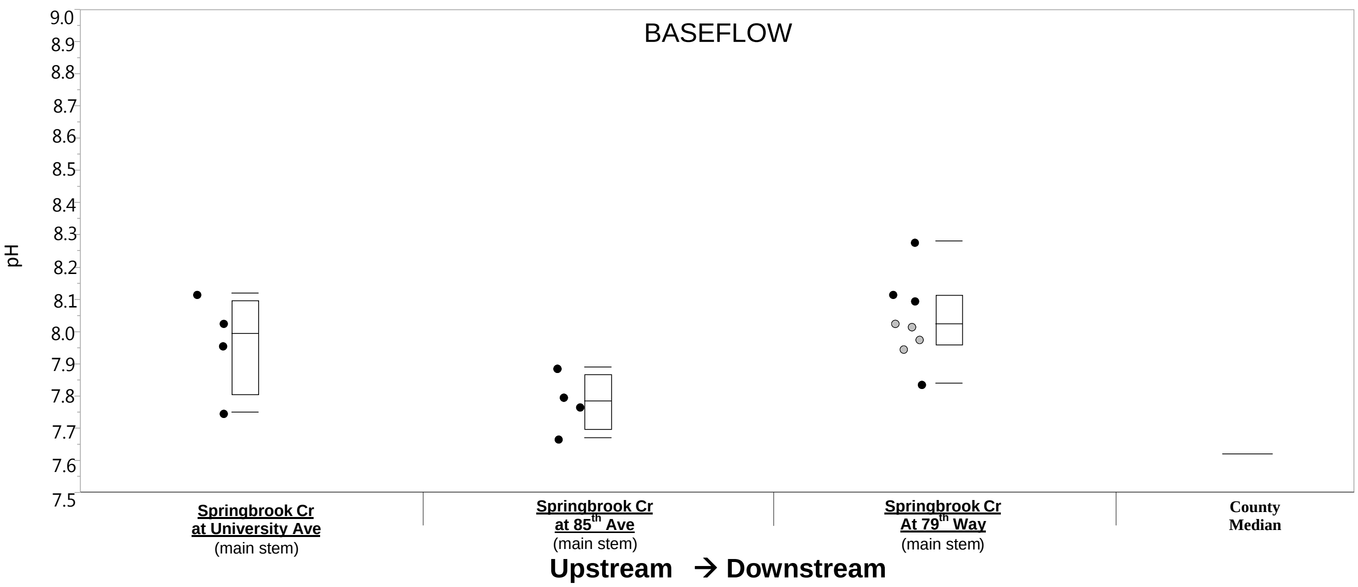
pH

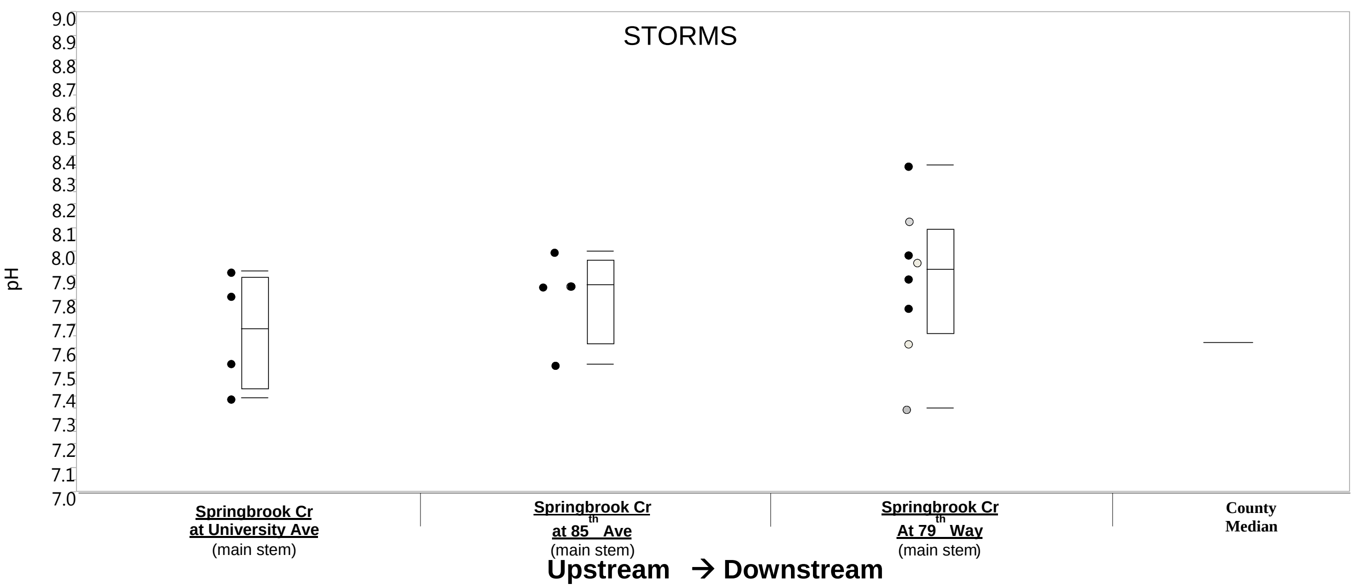
Springbrook Creek pH was within the expected range at all sites and during all conditions (see table and figure below), ranging from 7.35 to 8.36. The Minnesota Pollution Control Agency water quality standards set an expectation for pH between 6.5 and 8.5.

Median pH in Springbrook Creek. Data is from 79th Way for all years through 2013.

	pH	State Standard	N
Baseflow	8.03	6.5-8.5	8
Storms	7.93		8
All	7.99		16
Occasions outside state standard			0

pH at Springbrook Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





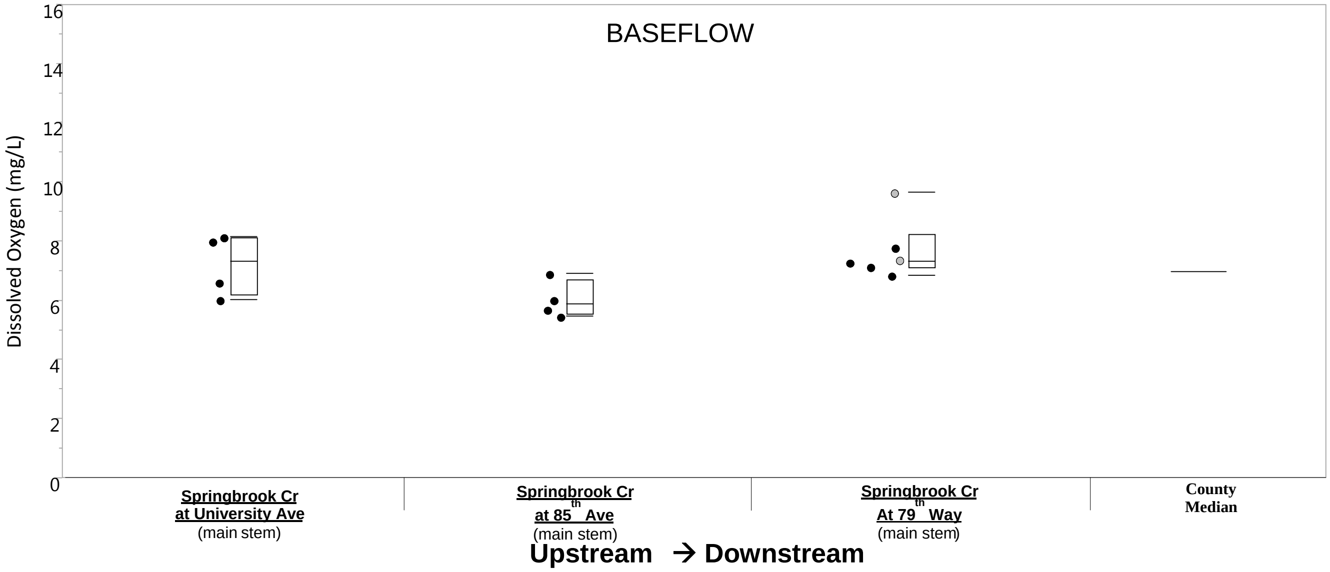
Dissolved Oxygen

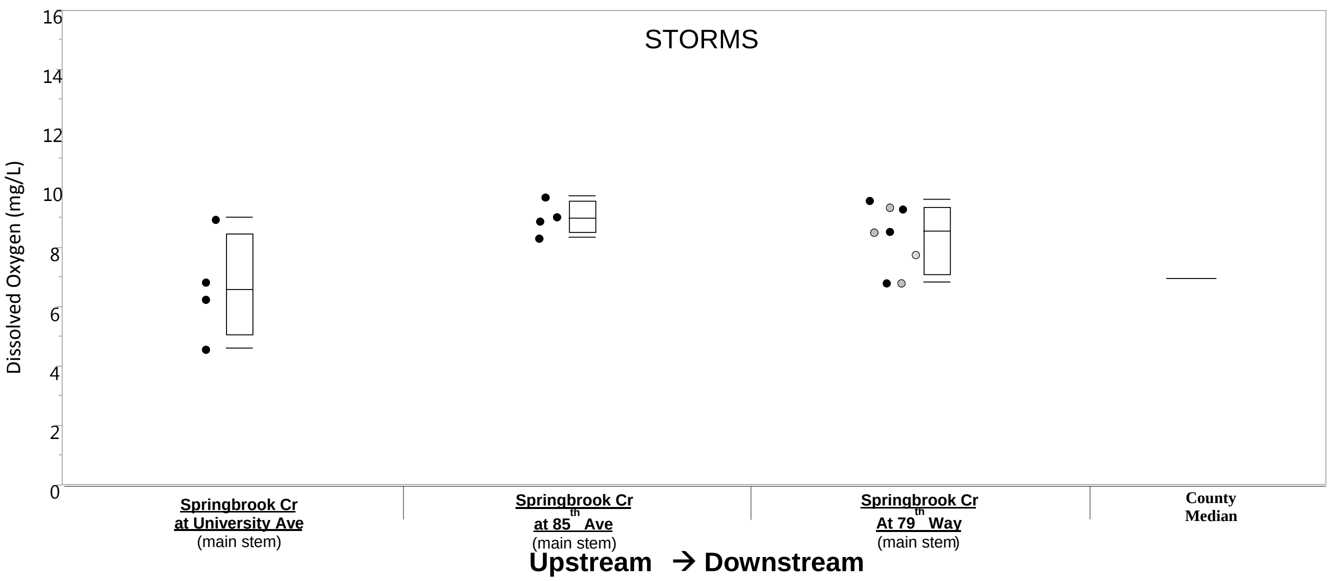
Dissovled oxygen (DO) essential for aquatic life. Fish, invertebrates, and other aquatic life suffer if DO is below 5 mg/L. Low DO can be a symptom of organic pollution, the decomposition of which reduces oxygen. Dissolved oxygen in Springbrook Creek was within the acceptable level (>5 mg/L) during all but one site visit. During a storm event the most upstream monitoring location fell to 4.61 mg/L. This appears to have been an isolated occurrence.

Median dissolved oxygen in Springbrook Creek. Data is from 79th Way for all years through 2013.

	Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	7.33	5 mg/L daily minimum	8
Storms	8.56		8
All	7.80		16
Occasions <5 mg/L			0

Dissolved Oxygen at Springbrook Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





E. coli

E. *coli* is a bacteria found in the feces of warm blooded animals. E. *coli* is an easily testable indicator of all pathogens that are associated with fecal contamination. The Minnesota Pollution Control Agency sets E. *coli* standards for contact recreation (swimming, etc). A stream is designated as “impaired” if 10% of measurements in a calendar month are >1260 colony forming units per 100 milliliters of water (cfu/100mL) or if the geometric mean of five samples taken within 30 days is greater than 126 cfu/100mL.

Our data are not sufficient to determine if the MPCA standards are met. We took samples throughout summer, often with only 1-2 samples in each month, too little for calculation of a monthly geometric mean or to reasonably say that 10% of samples in a month were in exceedence. We can, however, perform other examination of the data.

During baseflow E. *coli* was acceptably low. Median E. *coli* during baseflow from upstream to downstream were 184, 25, and 83 MPN, respectively. E. coli during baseflow minimally exceeded 126 MPN/100ml in 42% of samples taken.

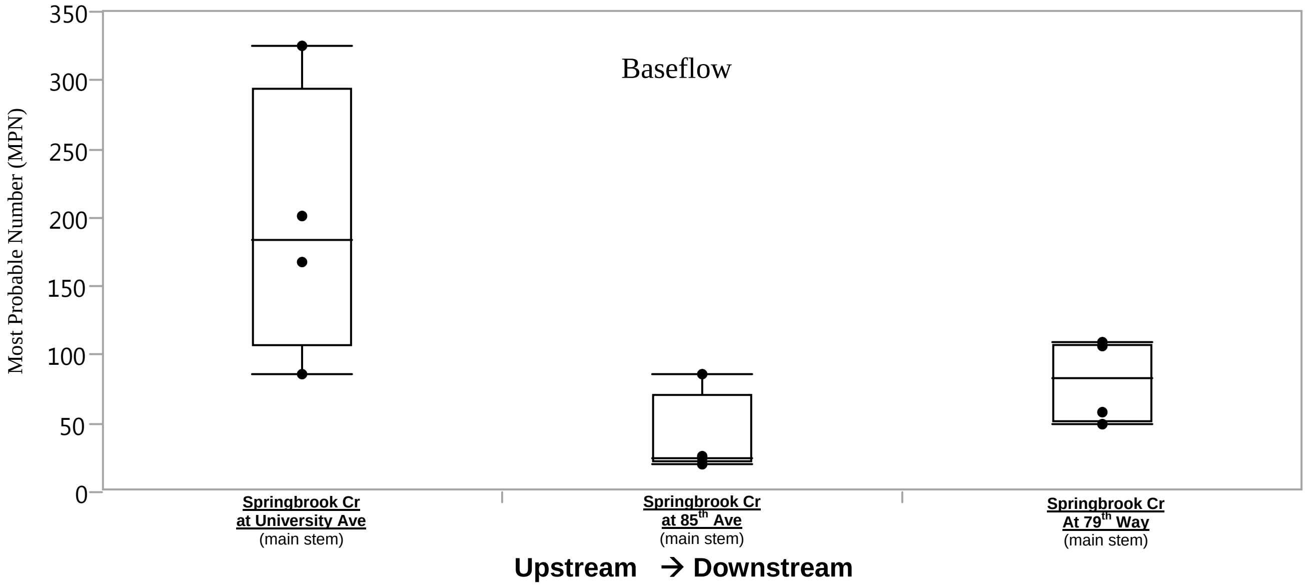
During baseflow the upstream-most at University Avenue had the highest E. coli. It appears that the ponds and wetlands between University Ave and 85th Ave sites may be providing baseflow treatment.

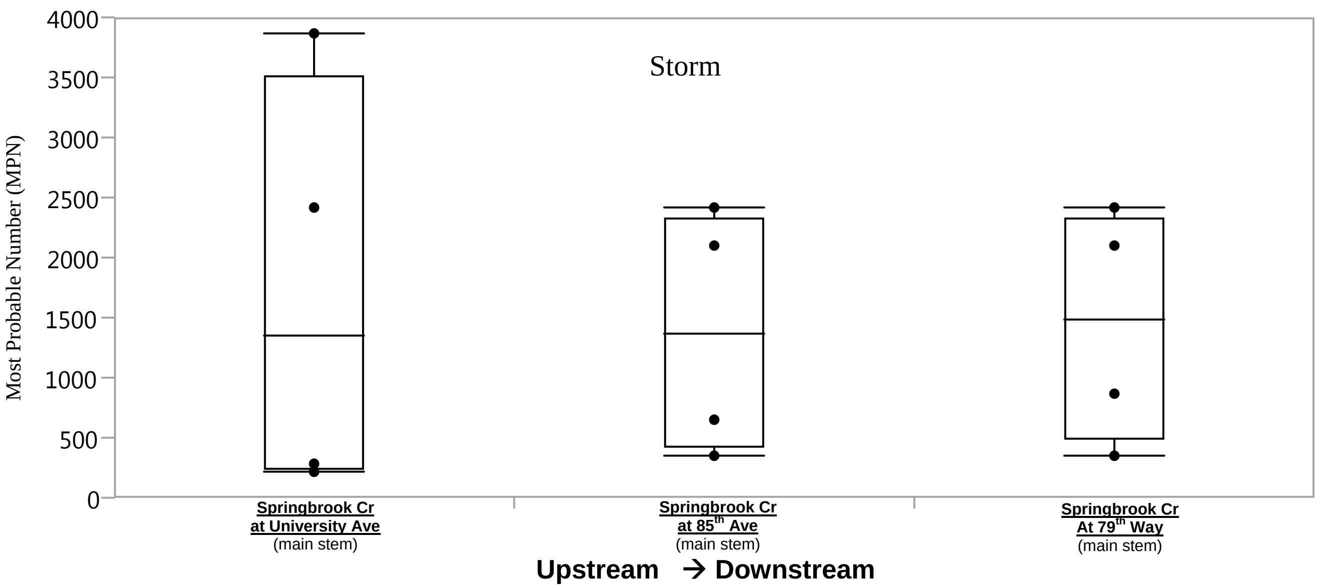
During storms E. coli was significantly higher, and there was very slight increase from upstream to downstream. Median E. coli during storms from upstream to downstream were 1348, 1373, and 1482 MPN, respectively. 63% of storm samples exceeded 126 MPN/100ml. All of the events that surpassed the 1260 MPN/ml occurred during storms (50% of all storm samples).

Median E. *coli* in Springbrook Creek. Data is from All Sites for 2013.

	E. *coli* (MPN)	**State Standard**	**N**
Baseflow	86	Monthly Geometric Mean >126	12
Storms	1482		12
All	247		24
Occasions >126 MPN **Occasions >1260 MPN**		Monthly 10% average >1260	3 baseflow, 12 storm 0 baseflow, 6 storm

E. *coli* at Coon Creek. Dots are individual readings. Black dots are 2013 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



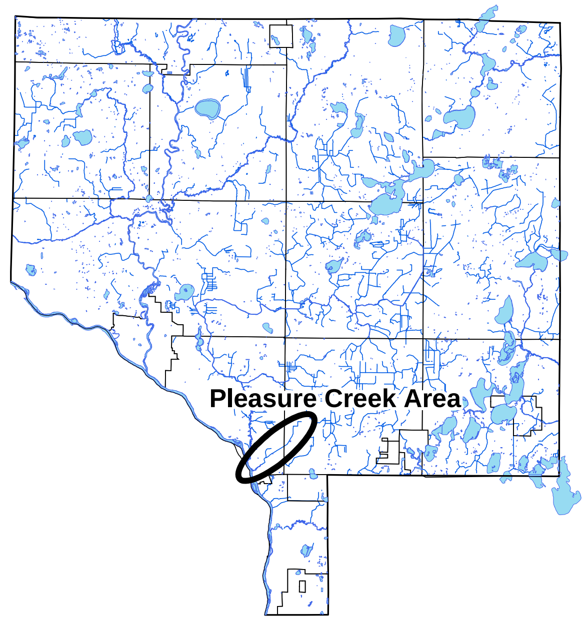


PLEASURE CREEK

Pleasure Cr at Pleasure Cr Parkway, N side of loop	STORET SiteID = S005-636
Pleasure Cr at 99th Ave	STORET SiteID = S005-637
Pleasure Cr at 96th Lane	STORET SiteID = S005-263
Pleasure Creek at 86th Avenue, Coon Rapids	STORET SiteID = S003-995

Years Monitored

Pleasure Cr at Pleasure Cr Parkway	2009
Pleasure Cr at 99th Ave	2009
Pleasure Cr at 96th Lane	2008
Pleasure Cr at 86th Ave	2006, 2007, 2012, 2013 And 1-2 measurements per year in 2002, 2003, 2004, 2005, 2008



Background

Pleasure Creek flows through the southwestern portion of Blaine and southern Coon Rapids. The watershed is urbanized. The creek is about 8-10 feet wide and 0.5 to 1 foot deep during baseflow. It flows through an interconnected network of stormwater ponds in the upper part of the watershed.

Monitoring near the creek's outlet to the Mississippi River in 2006-2007 found high levels of dissolved pollutants and E. coli. In 2008 monitoring was moved upstream to begin determining the sources of pollutants, particularly E. coli. In 2009, monitoring moved even farther upstream to further diagnose pollutant sources. In 2012 monitoring was moved back to the bottom of the watershed to continue overall water quality assessment.

Pleasure Creek is listed as "impaired" by the MN Pollution Control Agency for impaired biota, but new methods (Tiered Aquatic Life Standards) currently under development will take into consideration the fact that the creek is a public ditch and therefore has lower aquatic life expectations, at least in some reaches. While recent monitoring data is insufficient to officially assess Springbrook for most other impairments, the data to date suggest that other impairment designations are in the near future, especially E. coli and total phosphorus.

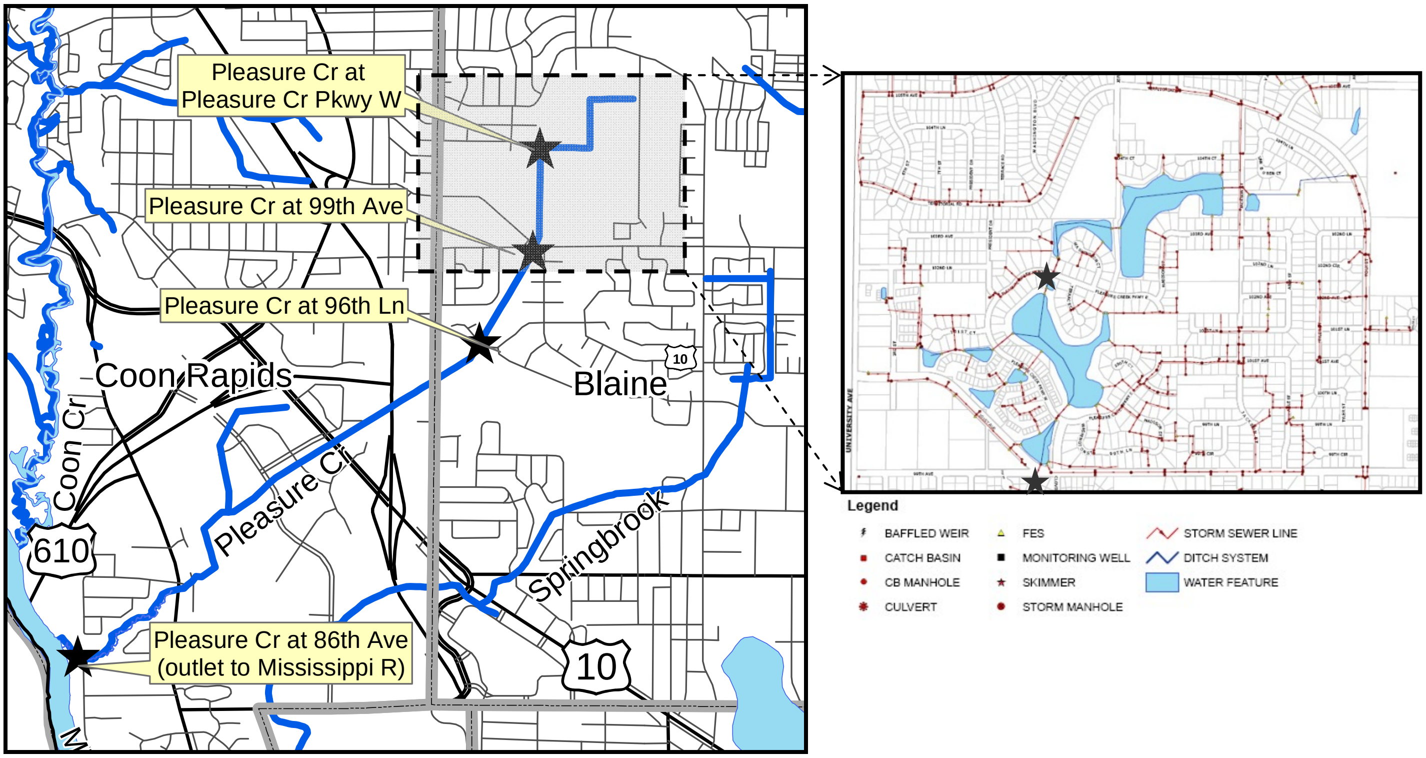
Methods

Pleasure Creek was monitored during both storm and baseflow conditions by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. In some years, particularly during drought, smaller storms were sampled because of a lack of larger storms. All storms sampled were significant runoff events.

Eleven water quality parameters were tested. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, salinity, and dissolved oxygen. Beginning in 2009 transparency tube measurements were added, as well as photo-documentation of water appearance. Parameters tested by water samples sent to a state-certified lab included total phosphorus, total suspended solids, chlorides, hardness, and sulfate. Hardness and sulfate were monitored only in 2012. Chlorides not monitored in 2013.

During every sampling the water level (stage) was recorded using a staff gauge surveyed to sea level elevations. Stage was also continuously recorded using a datalogging electronic gauge at the 86th Avenue stream crossing (farthest downstream).

Pleasure Creek Monitoring Sites



Results and Discussion

Pleasure Creek has some prominent water quality concerns. While it is currently listed as impaired by the State only for a poor invertebrate biota, these data suggest that other impairments exist, particularly for total phosphorus and E. coli bacteria.

Following is a parameter-by-parameter summary, including a management discussion:

- Dissolved pollutants, as measured by conductivity and chlorides, are higher in Pleasure Creek than any other Anoka Count stream except nearby Springbrook, which is similar. Both were elevated during storms and baseflow, but consistently higher concentrations were during storms.

  Management discussion: Dissolved pollutants enter the stream both directly through surface runoff and also by infiltrating into the shallow groundwater that feeds the stream during baseflow. A variety of sources appear to be likely, including road deicing salts and road runoff. Preventing their release into the environment is important because they are not easily removed.

- Phosphorus was relatively low in Pleasure Creek during baseflow, but higher during storms at the farthest downstream monitoring site. Due to the higher readings during storms, Pleasure Creek is likely to exceed a soon-to-be-adopted state standard of 100 mg/L. The observed readings during storms are similar to most other streams in the area.

  Management discussion: Additional treatment within the stormwater conveyance system is needed, particularly around East River Road.

- Suspended solids and turbidity were both low during baseflow and storms at the upstream sites, but higher during storms at the farthest downstream site. The low turbidity and TSS at the upstream sites is probably reflective of the effectiveness of large stormwater ponds in that area.

  Management discussion: Additional treatment within the stormwater conveyance system is needed, particularly around East River Road.

- pH and dissolved oxygen were with the range considered normal and healthy for streams in this area.
- E. coli bacteria are high throughout Pleasure Creek during storms. Investigative monitoring has been done in recent years. Human sewage does not appear to be the source. Stormwater runoff, and likely stormwater ponds themselves are sources of the bacteria.

  Management discussion: Because E. coli is pervasive in the urban environment, urban neighborhoods will have difficulty reducing E. coli levels below state water quality standards. Addressing E. coli should be part of an effort to improve overall water quality.

Conductivity, Chlorides, and Salinity

Conductivity and chlorides are measures of a broad range of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial sources, agricultural chemicals, and others. Metals, hydrocarbons, road salts, and others are often of concern in a suburban environment. Conductivity is the broadest measure of dissolved pollutants we used. It measures electrical conductivity of the water; pure water with no dissolved constituents has zero conductivity. Chlorides measures for chloride salts, the most common of which are road de-icing chemicals. Chlorides can also be present in other pollutant types, such as wastewater. These pollutants are of greatest concern because of the effect they can have on the stream's biological community, however it is noteworthy that Pleasure Creek discharges into the Mississippi River just upstream from drinking water intakes for the Twin Cities.

Conductivity and chlorides in Pleasure Creek are higher than at any other stream in Anoka County, except nearby Springbrook which is similar. Pleasure Creek chlorides are highest at the farthest downstream site (see table and figures below). Median baseflow conductivity at the three upstream sites are 0.649, 0.446, and 0.703 mS/cm (upstream to downstream). At the downstream site (86th Ave) median conductivity was 0.910, or about 29% higher. By comparison, the median for all streams in Anoka County is 0.362 mS/cm. There is no state water quality standard for conductivity.

Chlorides increased at the downstream site even more dramatically than conductivity. Median chlorides at the three upstream sites were 70, 71, and 67 mg/L (upstream to downstream). At the downstream site (86th Ave) median chlorides was 159 mg/L, or about double. The median for all streams in Anoka County is 17 mg/L. The state water quality standards for chlorides are 230 mg/L (chronic) and 860 mg/L (acute). While Pleasure Creek has only been observed to exceed the chronic standard once (262 mg/L), no monitoring occurred during snowmelt when chlorides is likely to be highest. Chlorides were not monitored 2013.

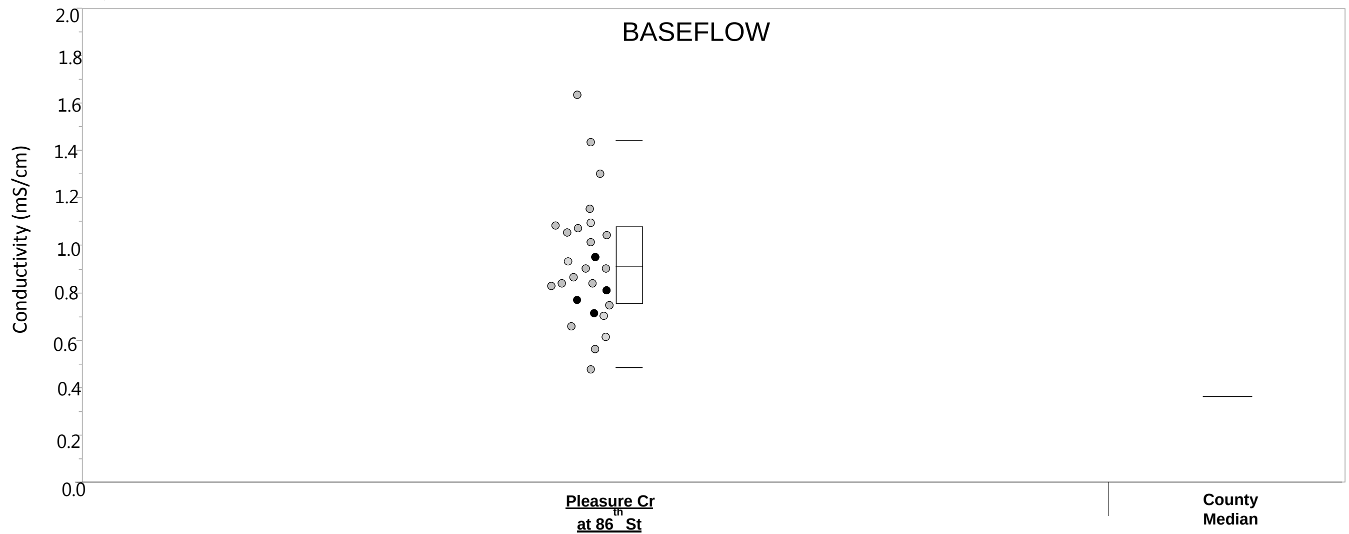
Both conductivity and chlorides where slightly higher during storms than baseflow. Median conductivity was 0.950 mS/cm during storms and 0.910 mS/cm during baseflow. Median chlorides were 178 mg/L during storms and 147 mg/L during baseflow. This result suggests that dissolved pollutants are high in the shallow groundwater that feeds the stream during baseflow, but slightly higher in stormwater runoff. Illicit discharges may be contributing during baseflow. While road deicing salts are likely a prevalent source of dissolved pollutants, they are not the only source, as evidenced by high dissolved pollutants during wash-off from mid-summer storms.

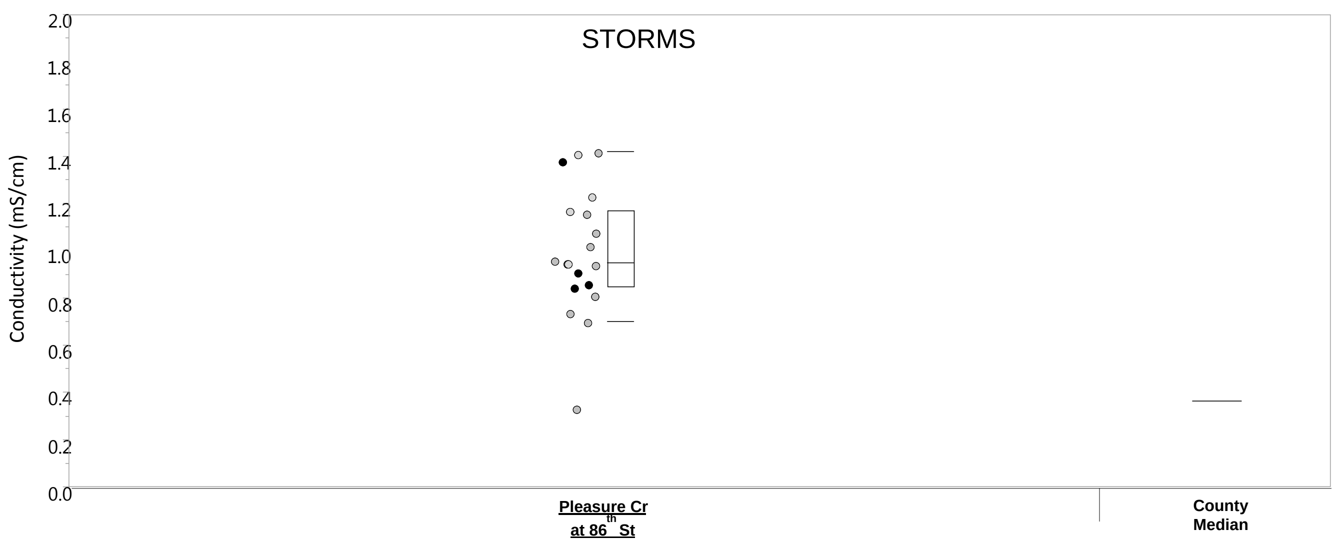
Dissolved pollutants are especially difficult to manage once in the environment. They are not removed by stormwater settling ponds. Infiltration practices can provide some treatment through biological processes in the soil, but also risk contaminating groundwater. The first approach to dissolved pollutant management must be to minimize their release into the environment.

Median conductivity and chlorides in Pleasure Creek at 86th Ave. Data is from all years through 2013.

	Conductivity (mS/cm)	Chlorides (mg/L)	State Standard	N
Baseflow	0.910	147	Conductivity – none	27
Storms	0.950	178		19
All	0.940	159	Chlorides 860 mg/L acute, 230 mg/L chronic	46

Conductivity at Pleasure Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Conductivity: All Sites, all years in mS/cm

	Pleasure Creek at Pleasure Cr Pkwy			Pleasure Creek at 99th Avne NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Baseflow	0.643	0.649	0.707	0.4	0.446	0.675	0.691	0.703	0.738	0.483	0.91	1.64
Storm	0.323	0.545	0.694	0.443	0.5285	1.26	0.414	0.507	0.795	0.332	0.95	1.42
All Events	0.323	0.643	0.707	0.4	0.509	1.26	0.414	0.697	0.795	0.332	0.94	1.64

Total Phosphorus

Total phosphorus (TP) is a common nutrient pollutant. It is limiting for most algae growth. TP was low in Pleasure Creek during baseflow, and higher during storms (see table and figures below). The phosphorus concentrations during baseflow were lower than most other streams in the area, and similar to other streams during storms.

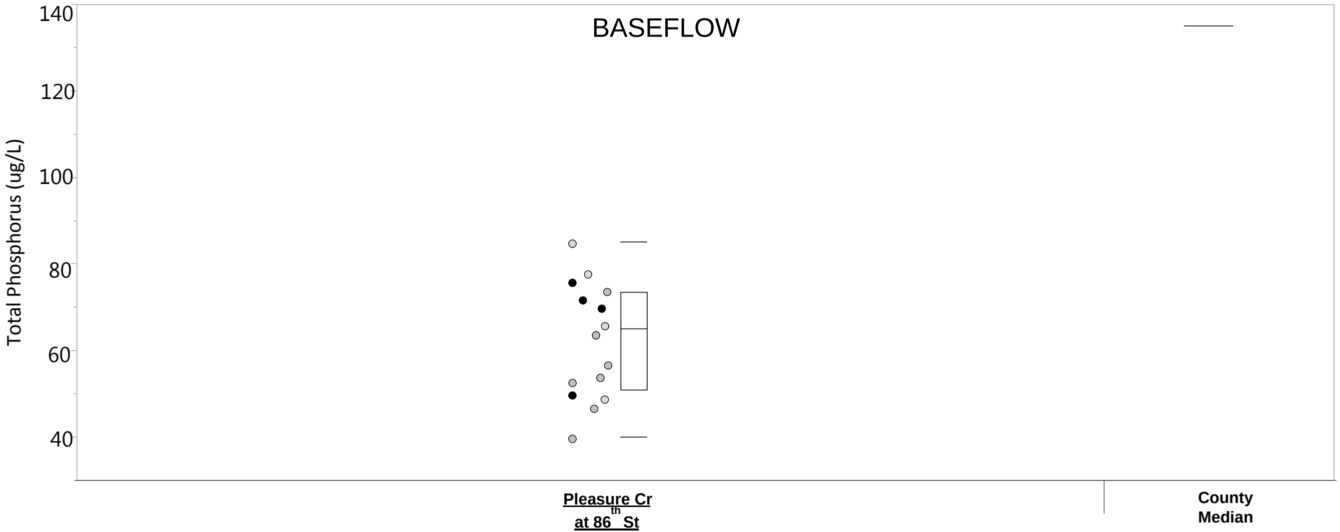
The MN Pollution Control Agency is likely to adopt 100 ug/L as a new phosphorus standard for streams. Based on data collected to date, Pleasure Creek would probably violate this standard during storms and then be designated as "impaired."

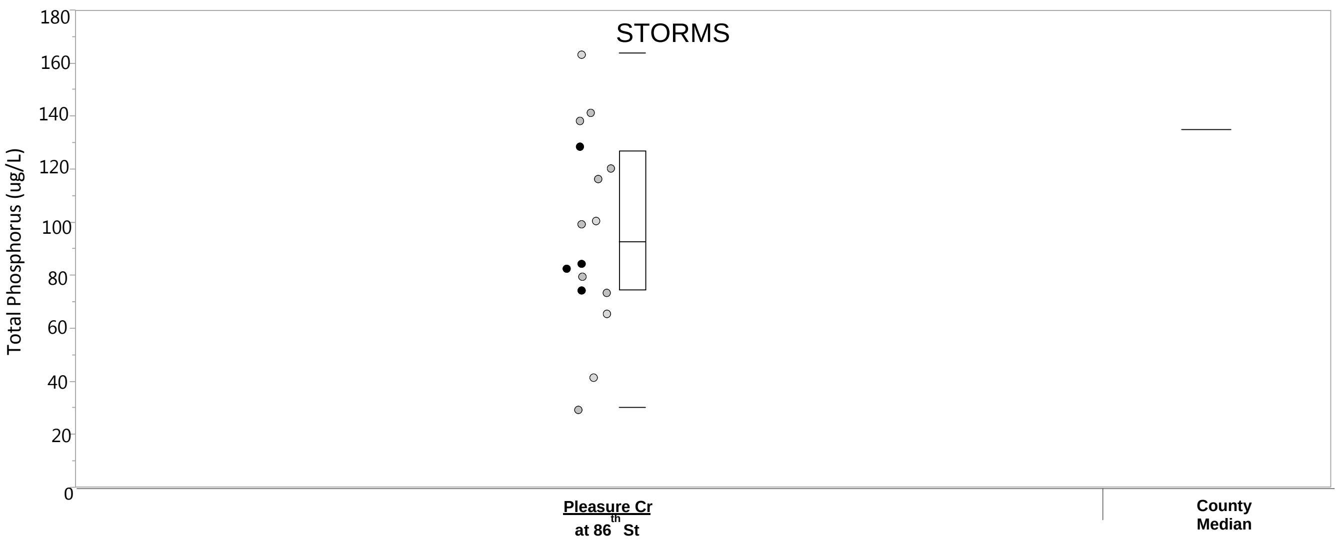
Median TP in Pleasure Creek. Data is from the 86th Avenue site and all years through 2013.

	Total Phosphorus (ug/L)	**State Standard***	**N**
Baseflow	65	100	16
Storms	92.5		16
All	74.0		32
Occasions > state standard			7, all during storms

*New state standards are under development. The standard listed is the likely new threshold.

Total phosphorus at Pleasure Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Phosphorous: All Sites, all years in ug/L

	Pleasure Creek at Pleasure Cr Pkwy			Pleasure Creek at 99th Avne NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Baseflow	74	76	78	52	66.5	81	66	73	81	40	65	85
Storm	85	127	152	44	61.5	118	44	80	104	30	92.5	164
All Events	74	117	152	44	61.5	118	44	74.5	104	30	74	164

Total Suspended Solids and Turbidity

Total suspended solids (TSS) and turbidity both measure solid particles in the water. TSS measures these particles by weighing materials filtered out of the water. Turbidity measures by defraction of a beam of light sent though the water sample, and is therefore most sensitive to large particles. Suspended solids are important because they carry other pollutants, affect water appearance, and can harm stream biota.

TSS and turbidity were both low during baseflow and storms at the upstream sites, but higher during storms at the farthest downstream site (see table and figures below). The low turbidity and TSS at the upstream sites is probably reflective of the effectiveness of large stormwater ponds just upstream of East River Road and the headwaters.

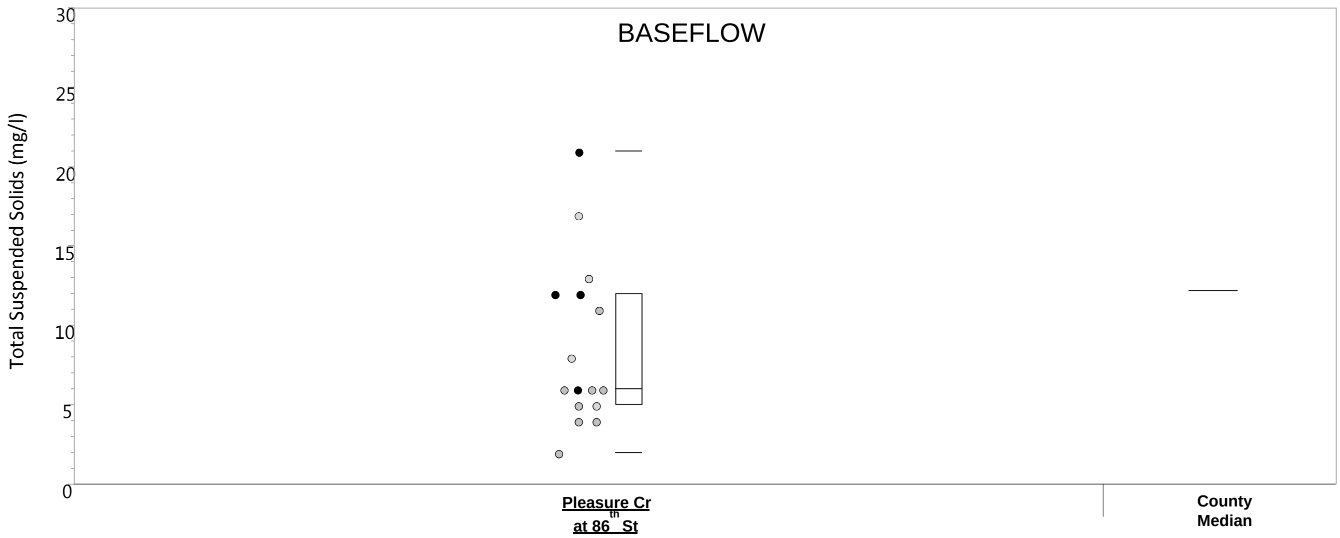
The MN Pollution Control Agency is in the process of modifying the state water quality standard in this region. The new standard will likely be 30 mg/L TSS, with no turbidity standard. At the outfall to the Mississippi River Pleasure Creek will likely exceed this standard during storms and be considered impaired. More than the required 20 samples needed for assessment have been collected, so the impaired designation will likely follow shortly after the new state standard is adopted. Additional stormwater treatment around and downstream of East River Road will be helpful at achieving the water quality standard.

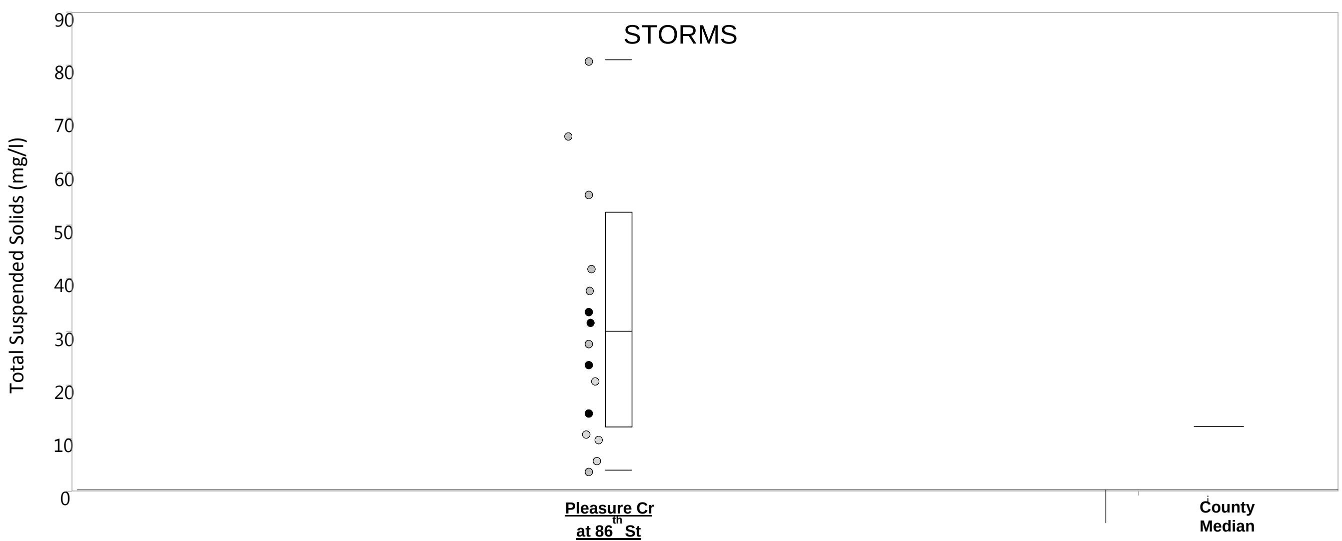
Median turbidity and suspended solids in Pleasure Creek. Data is from the 86th Avenue site and all years through 2012.

	Turbidity (FNRU)	Total Suspended Solids (mg/L)	State Standard*	N
Baseflow	8.5	6	30 mg/L TSS	16
Storms	20	30		16
All	13.5	12		28
Occasions > new state TSS standard				8, all during storms

*New state standards are under development. The standard listed is the likely new threshold.

Total suspended solids at Pleasure Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

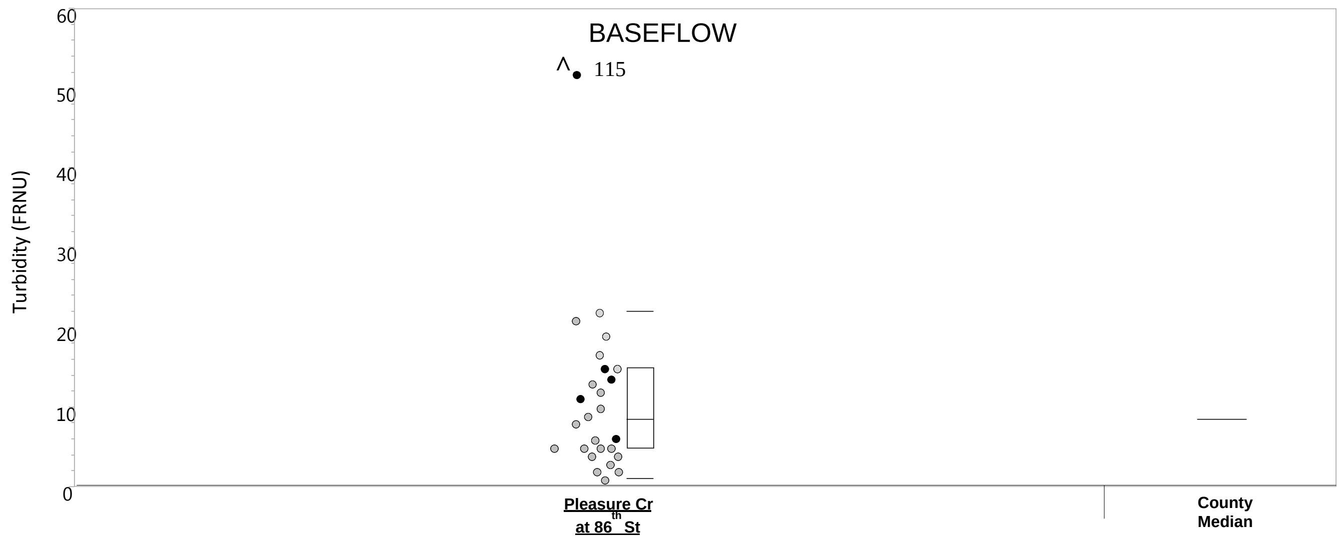


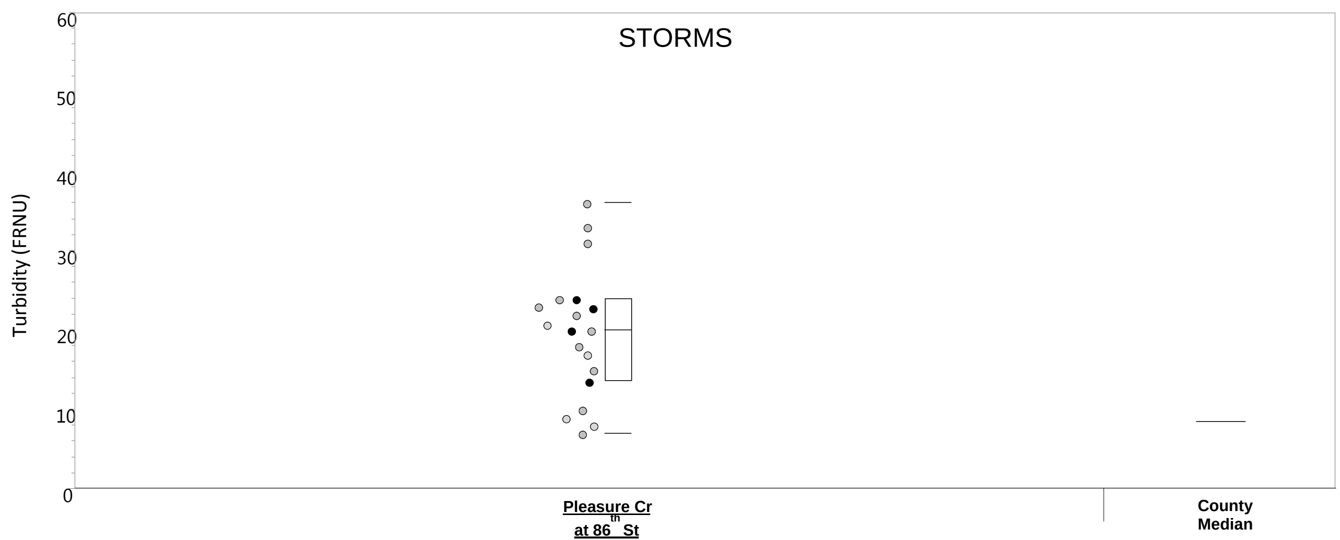


Total Suspended Solids: All Sites, all years in mg/L

	Pleasure Creek at Pleasure Cr Pkwy			Pleasure Creek at 99th Avne NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Baseflow	6	10	14	2	6	10	2	2.5	3	2	6	21
Storm	6	9	22	3	4	8	5	5.5	8	4	30	81
All Events	6	9	22	2	4	10	2	4	8	2	12	81

Turbidity at Pleasure Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Turbidity: All Sites, all years in FNU

	Pleasure Creek at Pleasure Cr Pkwy			Pleasure Creek at 99th Avne NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Baseflow	2	12	17	3	4	8	0	2	10	1	8.5	115
Storm	8	14	60	2	12.5	20	5	8.5	20	7	20	36
All Events	2	14	60	2	8	20	0	5	20	1	13.5	115

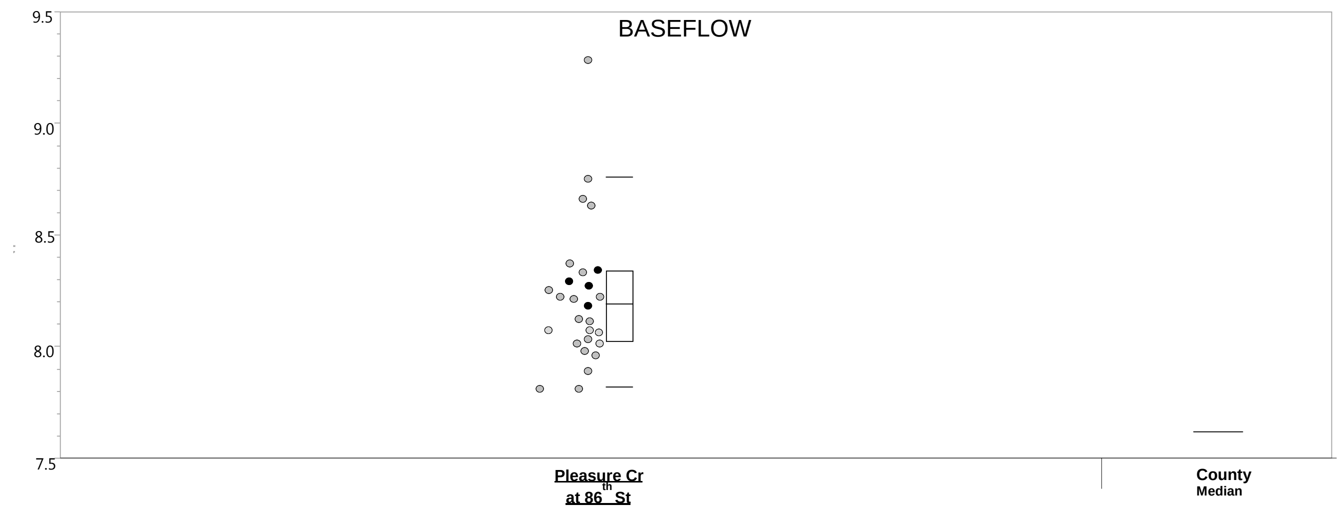
pH

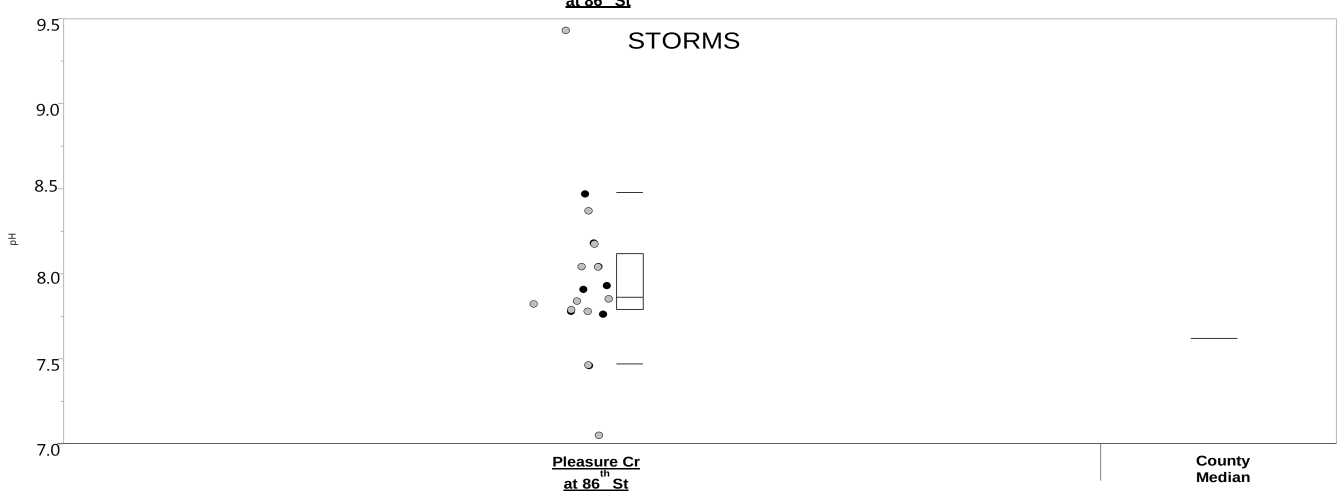
Sand Creek pH was within the expected range at all sites and during all conditions (see figures below), ranging from 6.05 to 8.71. The median was 7.92. The Minnesota Pollution Control Agency water quality standards set an expectation for pH between 6.5 and 8.5.

Median pH in Pleasure Creek. Data is from the 86th Avenue site and all years through 2013.

	pH	State Standard	N
Baseflow	8.19	6.5-8.5	27
Storms	7.86		17
All	8.08		44
Occasions outside state standard			1

pH at Pleasure Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





pH: All Sites, all years

	Pleasure Creek at Pleasure Cr Pkwy			Pleasure Creek at 99th Avne NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Baseflow	7.56	7.7	7.92	7.89	8.49	8.96	6.95	7.21	7.43	7.82	8.19	9.29
Storm	7.32	7.64	7.85	7.32	7.625	8.03	7.07	7.46	7.71	7.06	7.86	9.44
All Events	7.32	7.70	7.92	7.32	7.89	8.96	6.95	7.28	7.71	7.06	8.08	9.44

Dissolved Oxygen

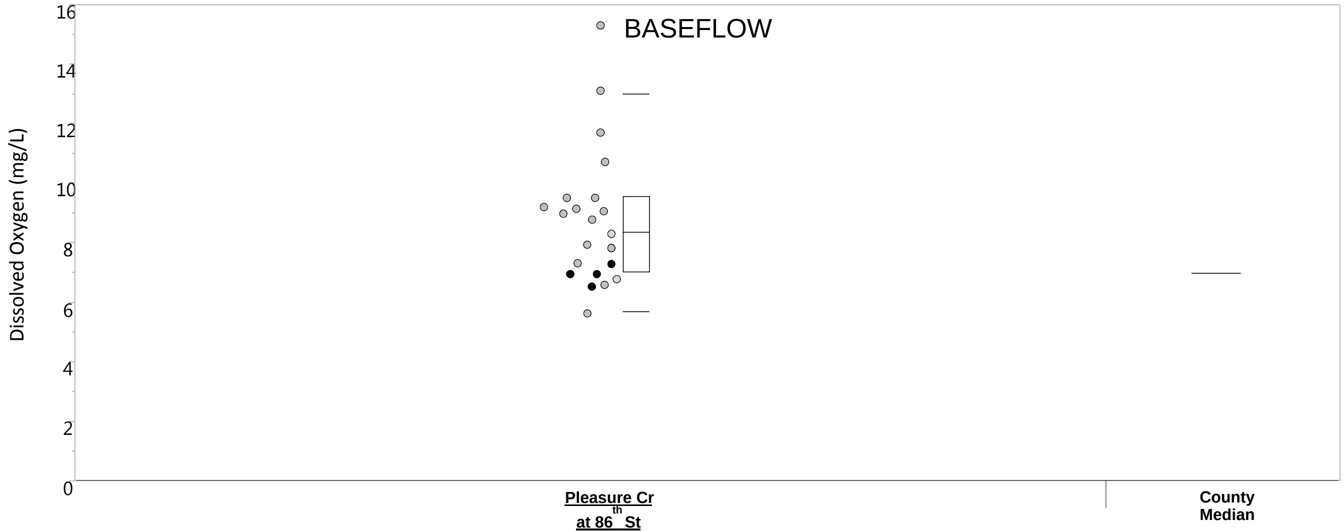
Dissovled oxygen (DO) essential for aquatic life. Fish, invertebrates, and other aquatic life suffer if DO is below 5 mg/L. Low DO can be a symptom of organic pollution, the decomposition of which reduces oxygen.

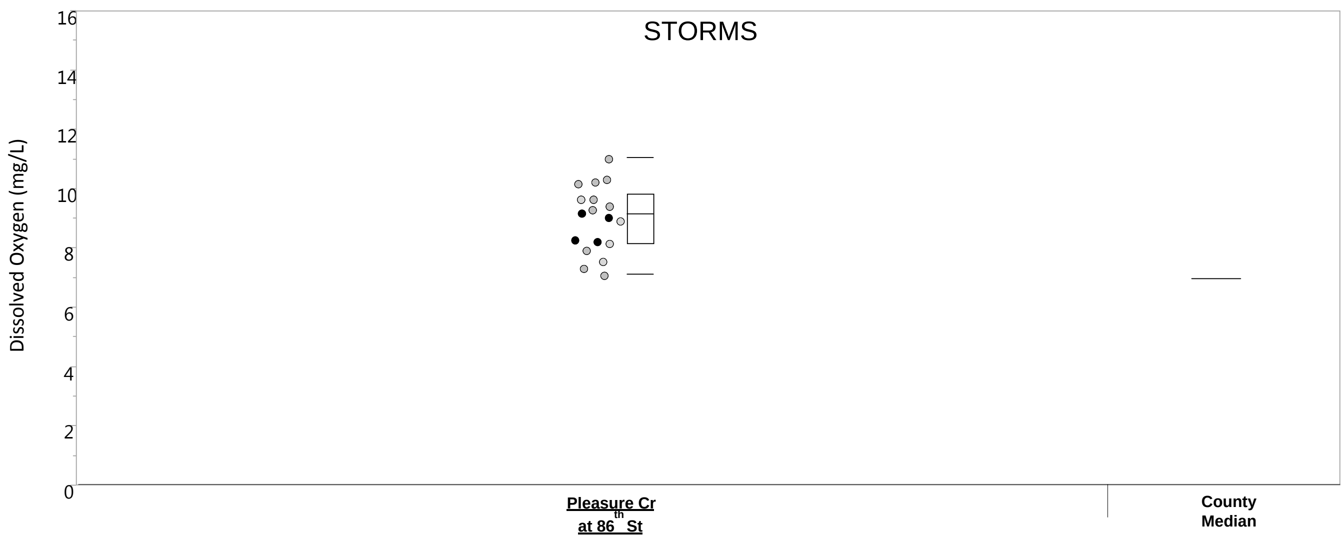
Dissolved oxygen in Pleasure Creek was generally within the acceptable level (>5 mg/L; see table and figure below). No instances of DO <5mg/L were not observed at 86th Avenue and 96th Lane. One of nine measurements at 99th Avenue was <5mg/L. Three of 9 measurements at the farthest upstream monitoring site, Pleasure Creek Parkway, were <5mg/L. The fact that one-third of measurements had low dissolved oxygen at this farthest upstream monitoring site is not particularly concerning because readings were within the inflow of a small stormwater pre-treatment basin which is sheltered (little wind mixing), had little flow, and had accumulated a lot of organic matter (its job as a pre-treatment basin).

Median dissolved oxygen in Pleasure Creek. Data is from the 86th Avenue site and all years through 2013.

	Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	8.35	5 mg/L daily minimum	22
Storms	9.15		23
All	8.94		45
Occasions <5 mg/L			0*

Dissolved Oxygen at Pleasure Creek. Dots are individual readings. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





DO: All Sites, all years in mg/L

	Pleasure Creek at Pleasure Cr Pkwy			Pleasure Creek at 99th Avne NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Baseflow	3.35	3.73	7.75	5.56	7.25	12.85	4.87	8.19	11.41	5.67	8.35	15.35
Storm	4.42	6.31	11.49	5.17	7.37	10.62	6.24	9.75	11.78	7.12	9.15	11.06
All Events	3.35	5.78	11.49	5.17	7.28	12.85	4.87	8.59	11.78	5.67	8.94	15.35

E. coli Bacteria

E. coli bacteria was monitored in several years. E. coli, a bacteria found in the feces of warm blooded animals, is unacceptably high in Pleasure Creek. E. coli is an easily testable indicator of all pathogens that are associated with fecal contamination. The Minnesota Pollution Control Agency sets E. coli standards for contact recreation (swimming, etc). A stream is designated as "impaired" if 10% of measurements in a calendar month are >1260 colony forming units per 100 milliliters of water (cfu/100mL) or if the geometric mean of five samples taken within 30 days is greater than 126 cfu/100mL. Pleasure Creek exceeds both criteria (see figure on following page). The creek has not yet been listed as "impaired" by the State, but a water quality problem exists regardless. Sources of the bacteria likely include headwaters storm water ponds and storm water runoff from throughout the watershed.

Enough data is available for the downstream monitoring site (outlet to Mississippi River) to clearly document exceedances of the "impaired" criteria. At the upstream sites not enough data has been gathered, but the E. coli values observed are similar to the downstream site. At the farthest-downstream monitoring site three of four samples in May 2007 exceeded 1260 cfu/100mL (261, 1986, and two samples exceeded the test limits of 2420 cfu/100mL). In 2006, five samples taken between 5/24 and 6/21 had a geometric mean of 318 cfu/100mL. In 2007 five samples were taken between 5/24 and 6/20, but calculating their geometric mean is impossible because two of the samples exceed the test's capacity of 2420 cfu/100mL. If we conservatively replace those readings with 2420 cfu/100mL, then geometric mean is 934 cfu/100mL. It appears the creek at 86th Avenue exceeds state standards.

Data collected in 2013 was generally lower than previous year's results. Both the baseflow median (122 MPN/100mL) and the storm event median (392 MPN/100mL) were the lowest observed. Despite this, 50% of baseflow monitoring and 75% of total events exceeded 126 MPN/100mL. All storm events exceeded 126 MPN/100mL and one storm event exceeded 1260 MPN/100mL.

E. coli levels were highest and most variable at the outlet to the Mississippi River during storms (see figures below). Average baseflow E. coli was 210 MPN/100mL (units MPN/100mL are comparable to cfu/100mL and differ in analytical method) and varied little (standard deviation 305). During storms average E. coli jumped to 690 MPN/100mL and varied widely (standard deviation 968). A large part of this variability might be explained by the intensity of the storm, phenology of the storm, and when during the storm the sampling was done. E. coli during storms is higher because storms flush bacteria from impermeable surfaces throughout the watershed, and because higher flows suspend and transport E. coli that were already present in the creek.

In 2008 monitoring occurred at the Blaine-Coon Rapids Boundary (96th Lane) to determine if the problem originated up or downstream of that point. Average baseflow E. coli was 235 MPN/100mL (n=4) and varied little (standard deviation 135). Average storm E. coli was 1102 MPN/100mL (n=3) and varied widely (standard deviation 1187). This is similar to the outlet to the Mississippi River, so it appears that an important bacteria source is within the City of Blaine. It is likely that urban runoff within Coon Rapids is also contributing E. coli to the stream.

In 2009 monitoring moved further upstream to diagnose the bacteria source. The portions of the watershed above the 2008 monitoring site are a network of stormwater ponds in the City of Blaine. 2009 monitoring was designed to determine which drainage areas to these ponds are bacteria sources or if the ponds themselves might be the source. One monitoring site split was mid-way through the pond network (Pleasure Cr Parkway W), while the other was at the outlet of the last pond (99th Avenue, see monitoring sites map above). Most monitoring (6 of 8 occasions) was during storms because the highest bacteria levels were found during storms in previous years. The results suggest that the ponds themselves are a source of E. coli, while additional bacteria may come from the neighborhoods around the ponds.

The monitoring site mid-way through the pond network (Pleasure Cr Parkway W) did have elevated E. coli during baseflow and storms, which suggests that the small drainage area upstream of this site contributes E. coli to the creek. Only two baseflow samples were taken and little flow was moving; E. coli levels were 307 and 770

MPN/100mL, which is moderately high. This would seem to suggest that bacteria levels may have a regular, non-storm related presence in the ponds (i.e. the ponds are a bacteria source). During storms, six samples had widely different E. coli levels. On the low end, one storm had only 34 MPN/100mL and another had only 122 MPN/100mL. These readings are below the state water quality standard. Two other storms had moderate E. coli levels of 307 and 387 MPN/100mL. But during the other two storms E. coli levels were so high they exceeded the laboratory's maximum test result of 2420 MPN/100mL. E. coli levels were not correlated with precipitation totals or stream water level.

The monitoring site at the bottom of the Blaine pond network (99^{th} Avenue) had low E. coli during baseflow. Only two samples were taken during baseflow, and the E. coli levels were low (55 and 58 MPN/100mL). While two samples are too few for a confident assessment, it suggests that few bacteria exit the last stormwater pond during baseflow. The last ponds are the largest and deepest, and therefore least likely to harbor bacteria and most likely to remove them during baseflow. While the smaller, shallower upper ponds may harbor E. coli, the larger, deeper lower ponds remove them during baseflow. Howerver, higher flows during storms can allow bacteria to pass through all of the ponds.

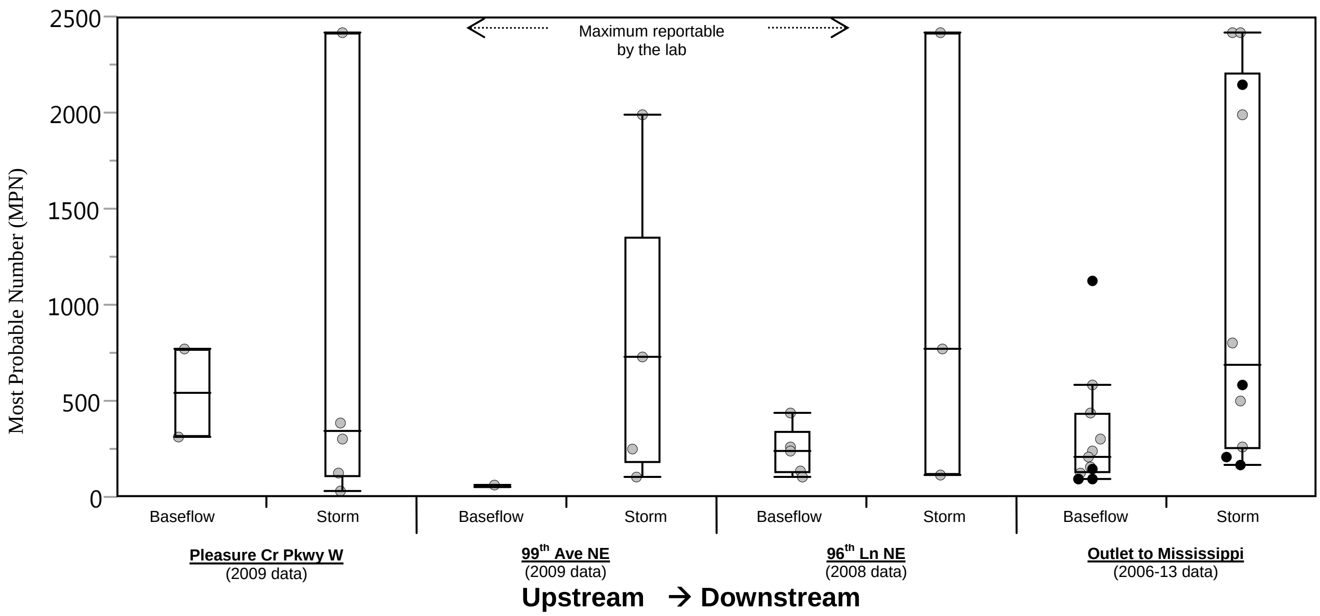
E. coli levels during storms at 99^{th} Avenue were much more variable, similar to what was found in the ponds. While one storm sample had desirably low E. coli (104 MPN/100mL), others were high (248, 435, 727, 727, and 1986 MPN/100mL). This indicates some bacteria pass through the ponds, or are flushed from them, during storms. E. coli levels were not correlated with precipitation totals or stream water level.

There is some evidence that E. coli is not associated with nutrient-rich sources such as wastewater. Phosphorus in Pleasure Creek is low, especially for an urban stream (see phosphorus section of this report). If wastewater or other nutrient rich sources were significant, phosphorus would be higher.

Median E. *coli* in Pleasure Creek. Data is from Outlet to Mississippi site only, all data through 2013.

	E. *coli* (MPN)	State Standard	N
Baseflow	210	Monthly Geometric Mean >126	11
Storms	690		10
All	300		21
Occasions >126 MPN **Occasions >1260 MPN**		Monthly 10% average >1260	9 baseflow, 10 storm 0 baseflow, 4 storm

E. coli Bacteria Results During Base and Storm Conditions. Black dots are 2013 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Fecal coliform and fecal streptococcus bacteria testing was done at 99th Avenue in 2009 to determine if the bacteria source was human sewage. The feces of different animals have different ratios of these two bacteria types (see table below). Admittedly, this is an imperfect test for several reasons. First, pollution from multiple sources can alter the ratio. Second, bacterial ratios will change over time because of different die-off rates; fecal streptococci die-off faster thereby increasing the ratio and possibly resulting in incorrect determinations that the bacterial source is human. Research has found that these bacteria types can survive and reproduce outside of the digestive tracts of warm-blooded animals. The population dynamics of these "free-living" bacteria could affect the ratio. These limitations are important to recognize when interpreting the data.

Fecal coliform to fecal streptococcus bacteria ratios in the feces of various animals. (source: Microbiological examination of water and wastewater by Csuros and Csuros, 1999)

Source	Ratio	Source	Ratio
Human	4.4	Pig	0.4
Duck	0.6	Cow	0.2
Sheep	0.4	Turkey	0.1
Chicken	0.4		

Fecal coliform to fecal streptococcus ratios consistently indicated that the bacteria source is not human feces (i.e. ratio <4.4). On average, the ratio was 0.30 (n=8, standard deviation 0.31). The highest observed ratio was 1.03 and lowest was 0.03. There was no apparent difference between storms (n=6, average 0.30, standard deviation 0.36) and baseflow (n=2, average 0.28, standard deviation 0.07).

Likely bacterial sources include:

- **Urban stormwater**. It is well documented that urban stormwater runoff has elevated E. coli. There is no reason to believe that this is not true across Pleasure Creek's watershed. The absence of a step-wise increase in bacteria downstream suggests that bacterial concentrations of stormwater entering the stream are not greater than those already in the stream.

  It should be noted that no animal concentrations for feedlots are known to exist in the watershed that would contribute significant fecal or coliform bacteria.

- **Stormwater ponds**. Although stormwater ponds generally remove pollutants by allowing settling there are many documented instances throughout the U.S. where the ponds accumulate fecal bacteria that are then flushed out during larger storms. Research has shown that these bacteria can survive and reproduce outside of the intestines of warm-blooded animals. Survival is longest when the water temperature is lower, sun exposure is less, and bacterivorous predators (nematodes, ciliates, rotifers, etc) are fewer. Some bacteria are attached to particles that settle within stormwater ponds but are still vulnerable to resuspension during storms, while others are "free" and less likely to settle.

Waterfowl congregating on Pleasure Creek near Evergreen Blvd in Coon Rapids, February 2010. 250+ ducks were present in about 350 meters of creek.

  Of particular interest are the 11 stormwater ponds that the creek flows through in its headwaters in the City of Blaine. These ponds and the developments around them were built post-1995. Some are small and shallow and serve as forebays to the larger, deeper ponds. The stormwater pond network in Blaine is likely a source of bacteria, collecting them from polluted runoff, harboring them, and releasing them (especially during storm flushing). Smaller, shallower upper ponds are the most suitable for bacterial survival. The larger, deeper lower ponds are less suitable for bacteria and seem to remove them from the system during baseflow but not during storms. While these ponds do a good job removing suspended solids in all conditions, they do not regulate water rate and volume during storms well. These storm flushes can provide a means for transporting bacteria. The fact that suspended solids seem to be captured by the ponds during storms but not bacteria seems inconsistent and deserves more research.

- **Waterfowl**. Waterfowl congregations on Pleasure Creek primarily occur in winter. During this time several hundred ducks have been observed in Coon Rapids near Evergreen Boulevard (see photo). The ducks keep the water from icing over.

  In the summer small waterfowl congregations do occur in places around the watershed, but none are large. Waterfowl usage of the network of stormwater ponds that the creek flows through in Blaine would be of greatest concern, but few birds congregate there. The ponds are encircled with a >25 foot wide buffer of unmowed vegetation designed to filter runoff, but which also discourages waterfowl. Some birds do use the ponds for resting or feeding on the water, but no concentrations of more than 10 birds were seen by staff during monitoring. The stormwater ponds in Coon Rapids near the railroad tracks have not been checked for summer waterfowl congregations.

Possible, but likely minor, bacterial sources include:

- **Stormwater sumps/catch basins**. The catch basins below many curbside gutters are designed to capture solids. The dark, moist environment with consistently moderate temperatures might be favorable for bacteria, although this is not well documented or researched to our knowledge. Any bacteria in these basins would be flushed out by larger storms. Catch basin sumps have been found to capture solids during small storms but some is flushed out during intense storms.
- **Sanitary sewer.** Sanitary sewer could contribute either through leaking pipes or if a wastewater pipe improperly intersects with a storm water pipe. The extent of this occurring is unknown. Dry-weather screening of stormwater outfalls for illicit discharges could be used to detect any such problems. The lower bacterial concentrations during baseflow suggests this may not be an issue, as does the fecal coliform to streptococcus ratio.

<u>Summary of E. coli Findings</u>

In total, the results of the monitoring efforts can be summarized as follows:

- E. coli bacteria contamination is throughout Pleasure Creek, from the headwaters to the outlet to the Mississippi River.
- Bacteria levels during baseflow minimally exceed state water quality standards on a regular basis.
- Bacteria levels during storm flows grossly exceed state water quality standards on a regular basis.
- The source is not human feces.
- Urban stormwater runoff is a likely E. coli source watershed-wide.
- The stormwater pond network in Blaine is one likely a source of bacteria, collecting them from polluted runoff, harboring them, and releasing them (especially during storm flushing). Smaller, shallower upper ponds are the most suitable for bacterial survival. The larger, deeper lower ponds are less suitable for bacteria and seem to remove them from the system during baseflow but not during storms.

We recognize that most of these conclusions cannot be supported with 100% confidence. However, the limited amount of work done to date is consistent in pointing to these conclusions.

It is worth noting that understanding of E. coli impairments and tools to effectively address them are lacking. Historically, E. coli was viewed as an indicator of sewage pollution. In some cases it is. Today we know E. coli levels are elevated in virtually every urban environment, most animal agriculture areas, and even in some forested areas. Elevated E. coli has been documented in places that are counter-intuitive, such as water draining from rooftops. E. coli's ability to survive outside of the gut of warm-blooded animals means that it may not always be a good indicator of the presence of fecal pathogens. The extreme variability in bacterial counts in Pleasure Creek during similar storms illustrates our incomplete understanding of the situation and many factors that are probably affecting it. Because E. coli is pervasive in the urban environment, urban neighborhoods will have difficulty reducing E. coli levels below state water quality standards. Addressing E. coli should be part of an effort to improve overall water quality.

Stream Water Quality – Biological Monitoring (Students)

Description: This program combines environmental education and stream monitoring. Under the supervision of ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their catch to the family level, and use the resulting numbers to gauge water and habitat quality. These methods are based upon the knowledge that different families of macroinvertebrates have different water and habitat quality requirements. The families collectively known as EPT (Ephemeroptera, or mayflies; Plecoptera, or stoneflies; and Trichoptera, or caddisflies) are pollution intolerant. Other families can thrive in low quality water. Therefore, a census of stream macroinvertebrates yields information about stream health.

Purpose: To assess stream quality, both independently as well as by supplementing chemical data.
To provide an environmental education service to the community.

Locations: Coon Creek at Crosstown Blvd. near Andover High School, Andover

Results: Results for are detailed on the following pages.

Tips for Data Interpretation

Consider all biological indices of water quality together rather than looking at each alone, as each gives only a partial picture of stream condition. Compare the numbers to county-wide averages. This gives some sense of what might be expected for streams in a similar landscape, but does not necessarily reflect what might be expected of a minimally impacted stream. Some key numbers to look for include:

Families — Number of invertebrate families. Higher values indicate better quality.

EPT — Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.

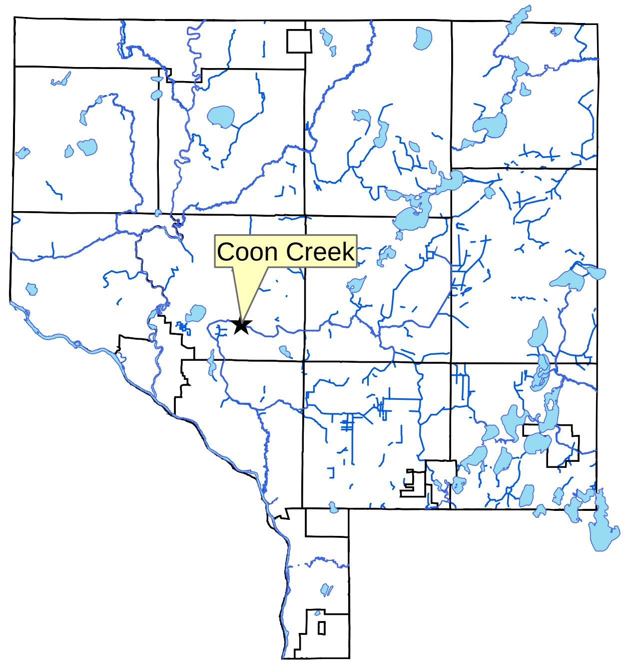
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

FBI	Stream Quality Evaluation
0.00-3.75	Excellent
3.76-4.25	Very Good
4.26-5.00	Good
5.01-5.75	Fair
5.76-6.50	Fairly Poor
6.51-7.25	Poor
7.26-10.00	Very Poor

% Dominant Family — High numbers indicates an uneven community, and likely poorer stream health.

COON CREEK

at Crosstown Blvd near Andover High School, Andover



Last Monitored

By Andover High School in 2013

Monitored Since

Fall 2003

Student Involvement

180 students in 2013, approximately 1,153 since 2003

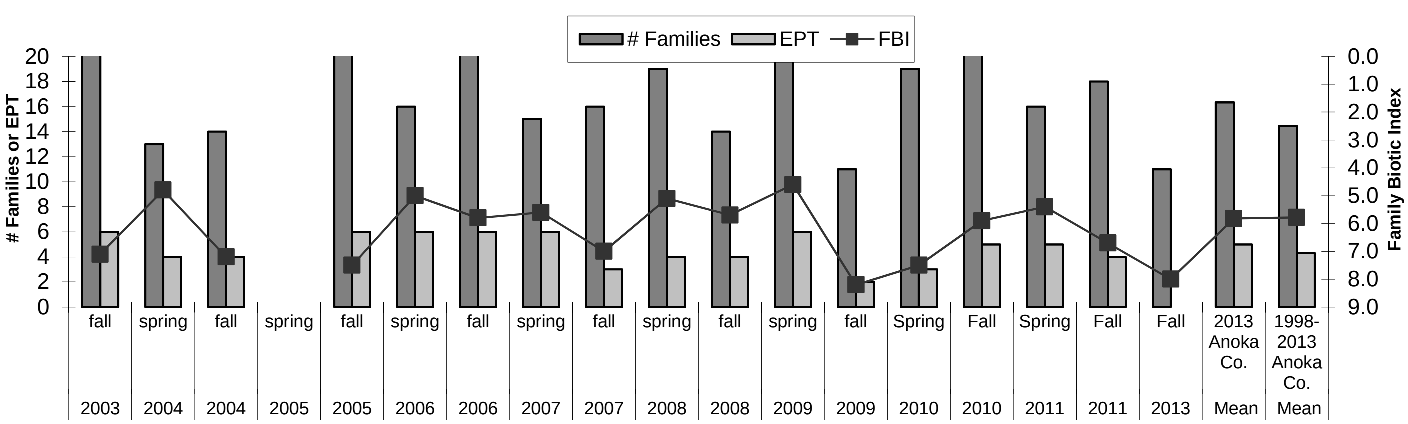
Background

Coon Creek originates in the southern part of the Carlos Avery Wildlife Management Area in the City of Columbus. It flows west, then south, and empties into the Mississippi River at Coon Rapids Dam Regional Park. Coon Creek has a number of ditch tributaries. Land use is an approximately equal mix of residential and vacant/agricultural with some small commercial sites. The land use immediately surrounding the sampling site is residential on the south side of the creek and the high school campus on the north side. A vegetated buffer 20-100 feet wide is present at the sampling site, and is typical elsewhere. The banks are steep with moderate to heavy erosion in spots. The streambed is composed of sand and silt. The stream is 1 to 2.5 feet deep at baseflow and approximately 10-15 feet wide.

Results

Andover High School classes monitored this stream in fall of 2013. Overall, the multi-year dataset suggests the health of Coon Creek at this particular site is similar to the average of other Anoka County streams. However, relatively large fluctuations in the biotic indices are observed within and across years. In 2013, fall samples produced invertebrate indices lower than the average for streams in Anoka County. It should be noted that 2013 monitoring was conducted at the latest point of any season.

Summarized Biomonitoring Results for Coon Creek in Andover



Biomonitoring data for Coon Creek in Andover

Data presented from the most recent five years. Contact the ACD to request archived data.

Year	2008	2008	2009	2009	2010	2010	2011	2011	2013	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Fall	2013 Anoka Co.	1998-2013 Anoka Co.
FBI	5.10	5.70	4.60	8.20	7.5	5.9	5.4	6.7	8.0	5.8	5.8
# Families	19	14	21	11	19	27	16	18	11	16.3	14.5
EPT	4	4	6	2	3	5	5	4	0	5.0	4.3
Date	30-May	2-Oct	15-May	29-Sep	13-Apr	5-Oct	10-Jun	23-Sep	28-Oct		
Sampled By	AHS	AHS	AHS	AHS	AHS	AHS	ACD	AHS	AHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	90.7	195	679	203	207	446	165	154	387		
# Replicates	3	1	1	1	1	1	1	1	6		
Dominant Family	Baetidae	Calopterygidae	Baetidae	Corixidae	Corixidae	Calopterygidae	Baetidae	Belostomatidae	Corixidae		
% Dominant Family	38.2	25.6	68.9	51.2	45.4	28.7	24.2	27.9	48		
% Ephemeroptera	40.4	23.1	70.3	1.5	0.5	14.1	28.5	10.4	0.0		
% Trichoptera	12.5	2.6	3.2	2.0	1.9	2.0	9.7	9.1	0.0		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	9.7	0.0	0.0		

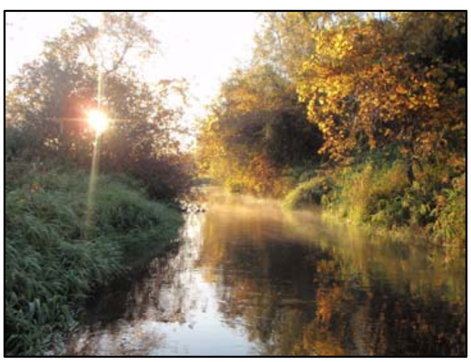
Supplemental Stream Chemistry Readings

Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	5/30/2008	10/2/2008	5/15/2009	9/29/2009	4/13/2010	10/5/2010	6/10/2011	9/23/2011	10/28/2013
pH	7.41	7.66	7.65	7.79	na	7.65	7.62	8.27	7.7
Conductivity (mS/cm)	0.458	0.609	0.582	0.64	0.553	0.634	0.538	0.470	0.583
Turbidity (NTU)	12	4	15	5	25	6	13	31	8
Dissolved Oxygen (mg/L)	8.79	9.52	8.4	8.6	10.48	na	7.31	8.59	8.72
Salinity (%)	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.28
Temperature (°C)	13	8.2	13	10	11.1	9.3	14.9	10.9	9.17

Discussion

The invertebrate community suggests Coon Creek's health is average compared to other nearby streams. The stream's habitat is relatively sparse, mostly due to past excavations aimed at making the creek perform like a ditch. The supplemental stream water chemistry readings taken during biomonitoring indicate a higher than expected level of dissolved pollutants, as measured by conductivity. Conductivity and salinity were similar to, though not as extreme as, some urbanized streams at the same time of year. The source could be road salts, failing septic systems, and/or chemical wastes. These factors, as well as the general lack of habitat in this ditched stream, probably limit the invertebrate community.



Coon Creek at Andover High School sampling site.

Andover High School Students at Coon Creek.

Wetland Hydrology

Description: Continuous groundwater level monitoring at a wetland boundary to a depth of 40 inches. County-wide, the ACD maintains a network of 23 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

Locations: Bannochie Wetland, SW of Main St and Radisson Rd, Blaine

Bunker Wetland, Bunker Hills Regional Park, Andover

(middle and edge of Bunker Wetland are monitored)

Camp Three Wetland, Carlos Avery WMA on Camp Three Road, Columbus Township

Ilex Wetland, City Park at Ilex St and 159th Ave, Andover

(middle and edge of Ilex Wetland are monitored)

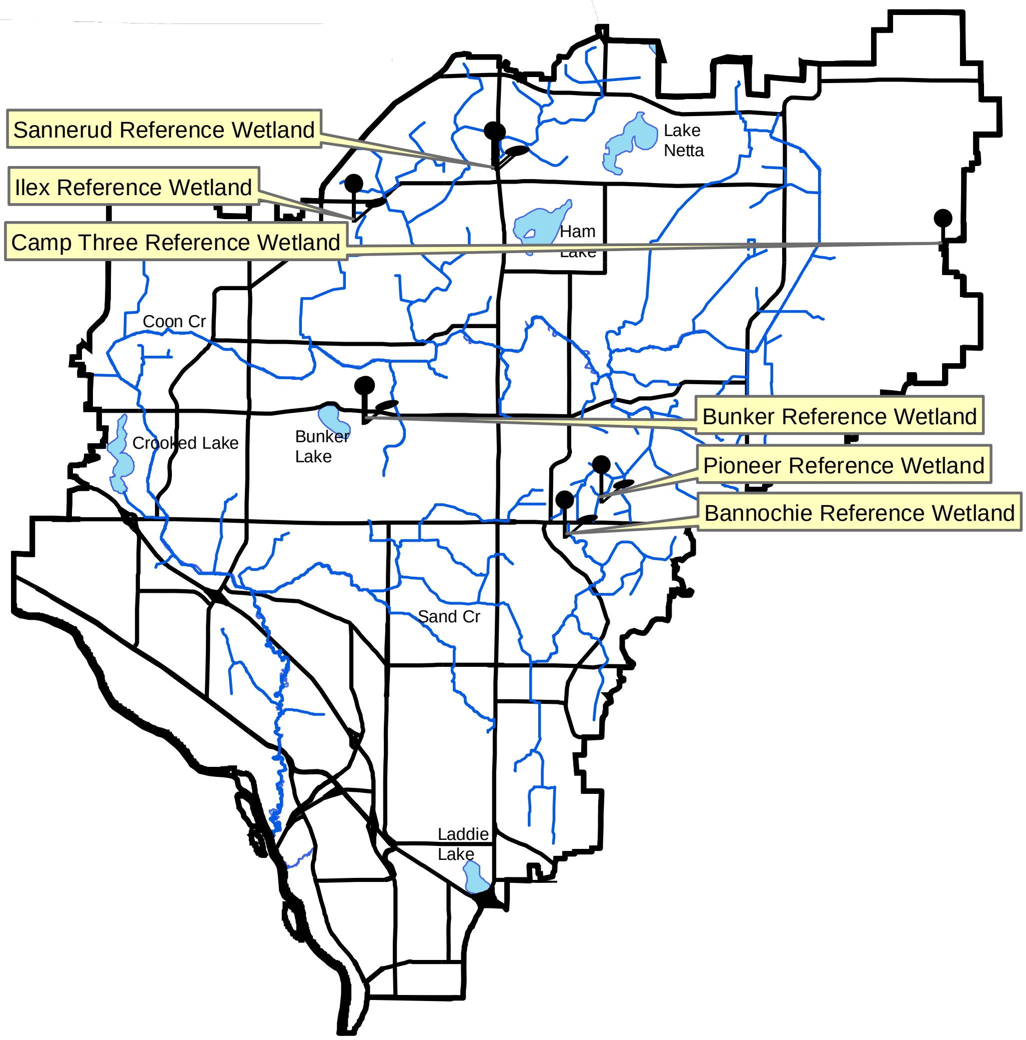
Pioneer Park Wetland, Pioneer Park off Main St., Blaine

Sannerud Wetland, W side of Hwy 65 at 165th Ave, Ham Lake

(middle and edge of Sannerud Wetland are monitored)

Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

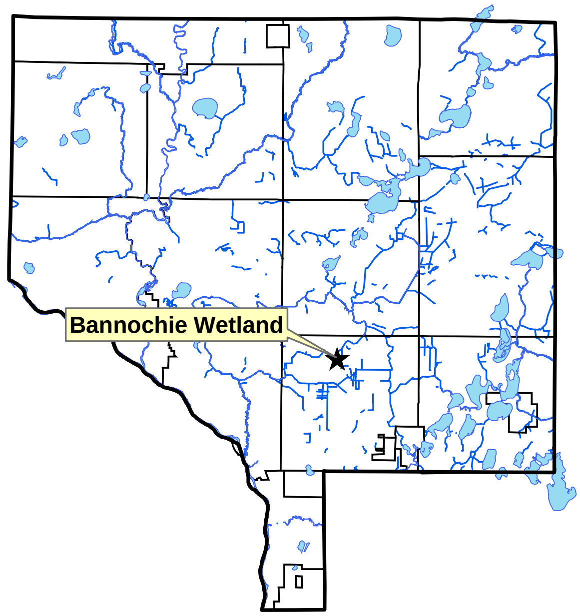
Coon Creek Watershed 2013 Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

BANNOCHIE REFERENCE WETLAND

SE quadrant of Radisson Rd and Hwy 14, Blaine



Site Information

Monitored Since: 1997

Wetland Type: 2

Wetland Size: ~21.5 acres

Isolated Basin? No

Connected to a Ditch? Yes, on edges, but not the interior of wetland

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oe1	0-6	10yr 2/1	Organic	-
Oe2	6-40	10yr 2/1-7.5yr2.5/1	Organic	-

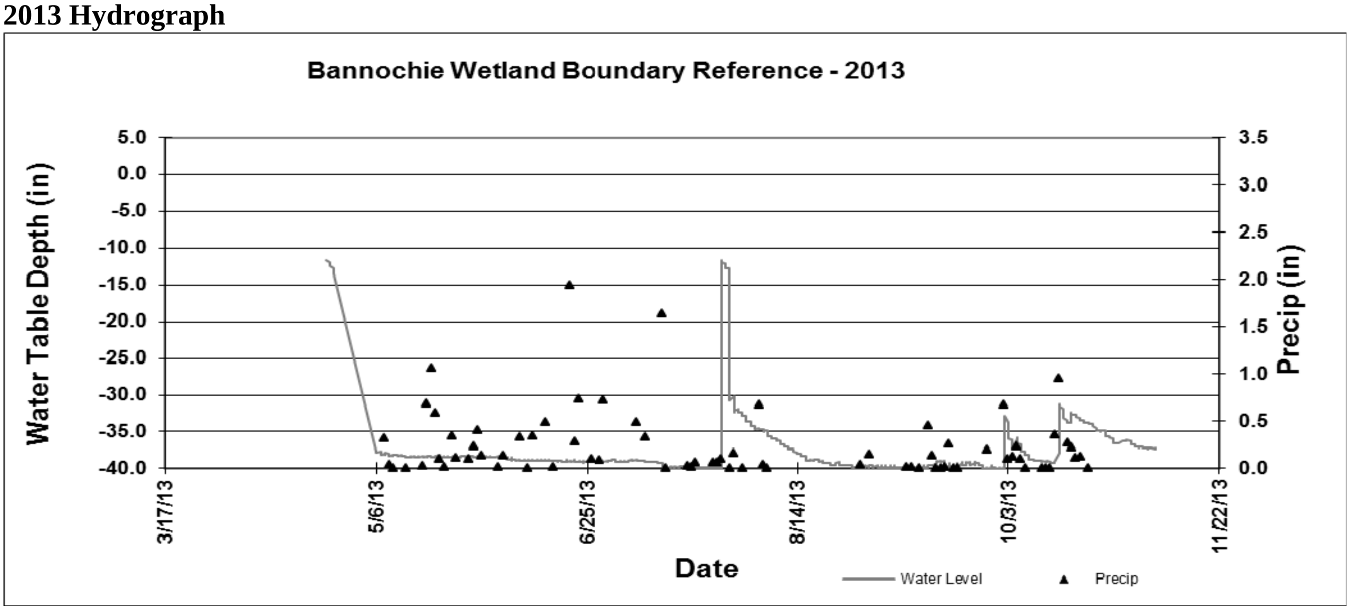
Surrounding Soils: Rifle and some Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phragmites australis	Giant Reed	80
Rubus spp.	Dewberry	100
Onoclea sensibilis	Sensitive Fern	10

Other Notes: This well is not at the wetland boundary, but rather is within the basin. Intense residential construction has occurred nearby in recent years, including construction dewatering.

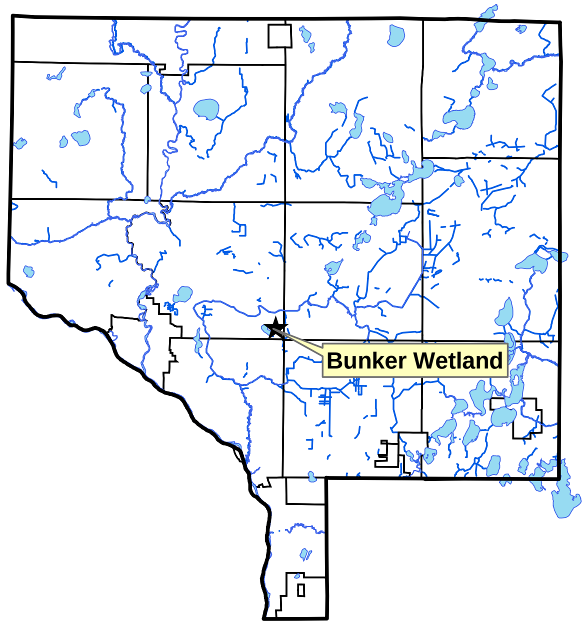
2013 Hydrograph



Well depth was 39 inches, so a reading of –39 or less indicates water levels were at an unknown depth greater than or equal to 39 inches.

BUNKER REFERENCE WETLAND - EDGE

Bunker Hills Regional Park, Andover



Site Information

Monitored Since: 1996-2005 at wetland edge. In 2006 re-delineated wetland moved well to new wetland edge (down-gradient).

Wetland Type: 2

Wetland Size: ~1.0 acre

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
AC1	0-3	7.5yr3/1	Sandy Loam	50% 7.5yr 4/6
AC2	3-20	10yr2/1-5/1	Sandy Loam	-
2Ab1	20-31	N2/0	Mucky Sandy Loam	-
2Oa	31-39	N2/0	Organic	-
2Oe	39-44	7.5yr 3/3	Organic	-

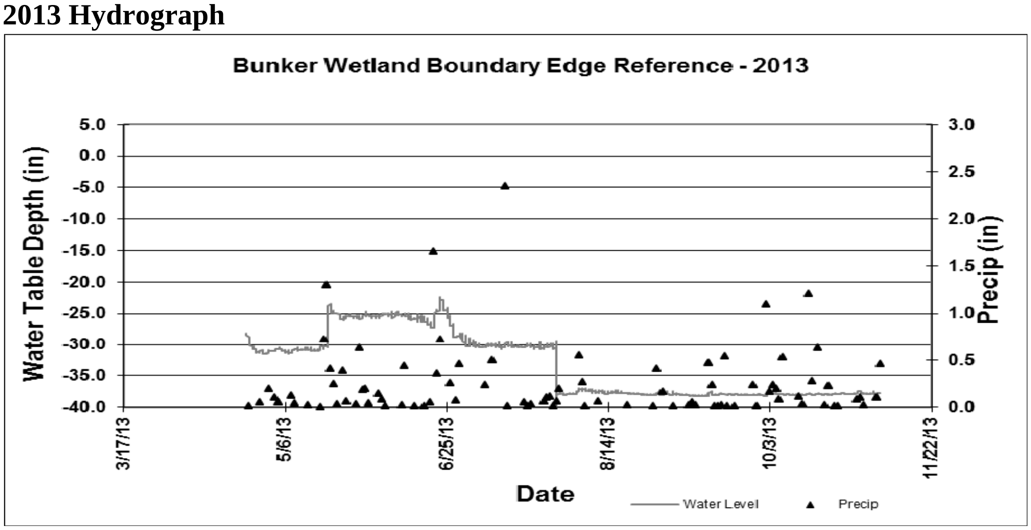
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Populus tremuloides(T)	Quaking Aspen	30

Other Notes: This well is located at the wetland boundary. In 2000-2005 the water table was >40 inches below the surface throughout most or all of the growing season. This prompted us to re-delineate the wetland and move the well down-gradient to the new wetland edge at the end of 2005. As a result, water levels post-2005 are not directly comparable to previous years.

2013 Hydrograph



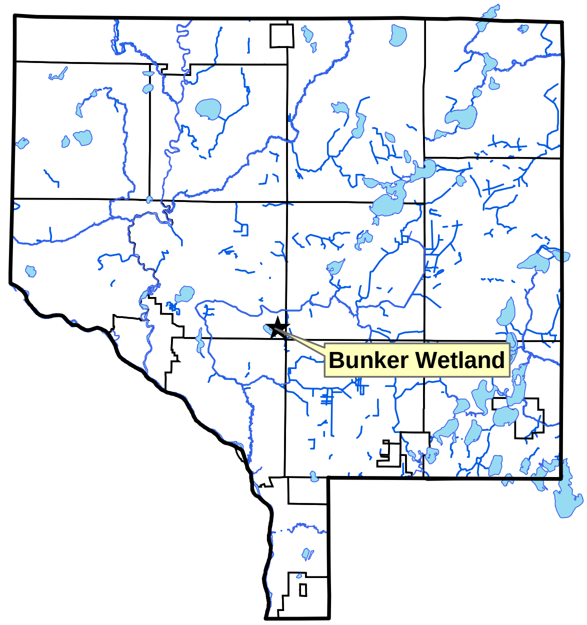
Well depth was 36 inches, so a reading of –36 indicates water levels were at an unknown depth greater than or equal to 36 inches.

Wetland Hydrology Monitoring

BUNKER REFERENCE WETLAND - MIDDLE

Bunker Hills Regional Park, Andover

Site Information



Monitored Since: Wetland edge monitored since 1996, but this well in middle of wetland began in 2006.

Wetland Type: 2

Wetland Size: ~1.0 acre

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-22	N2/0	Organic	-
Oe1	22-41	10yr2/1	Organic	-
Oe2	41-48	7.5yr3/4	Organic	-

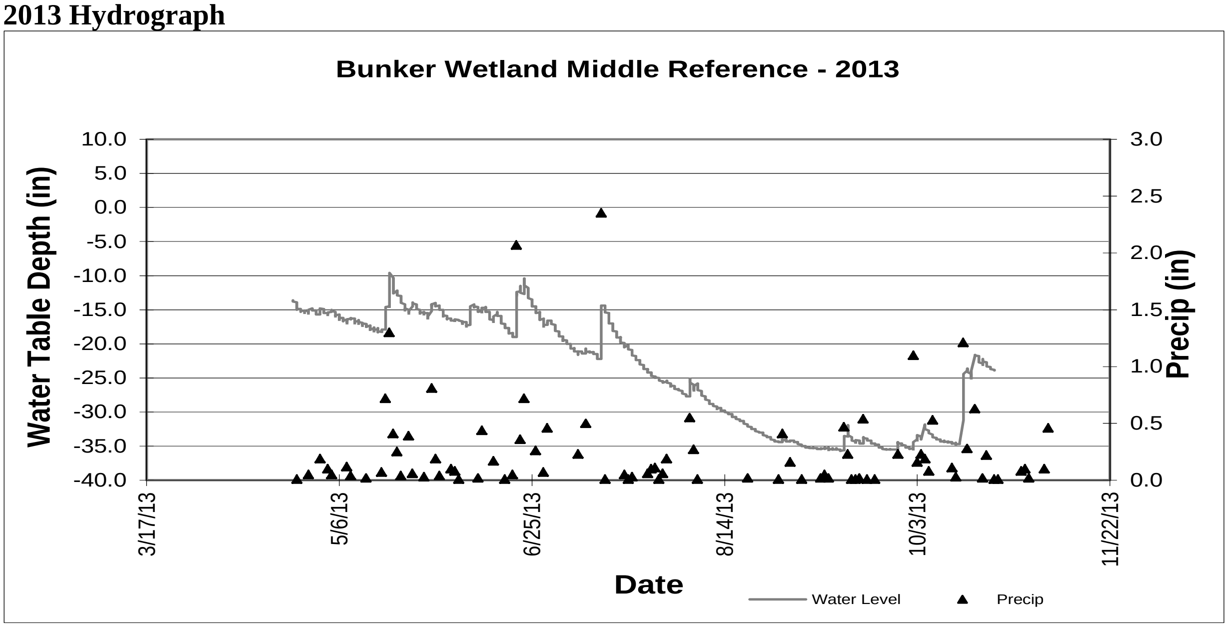
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Poa palustris	Fowl Bluegrass	90
Polygonum sagitatum	Arrow-leaf Tearthumb	20
Aster spp.	Aster undiff.	10

Other Notes: This well at the middle of the wetland and was installed at the end of 2005 and first monitored in 2006.

2013 Hydrograph

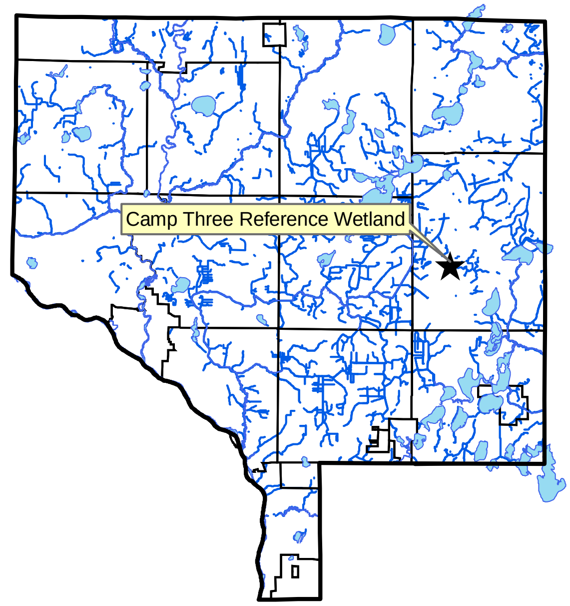


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

CAMP THREE REFERENCE WETLAND

Carlos Avery Wildlife Management Area, Columbus Township



Site Information

Monitored Since: 2008

Wetland Type: 3

Wetland Size: Part of complex > 200 acres

Isolated Basin? No

Connected to a Ditch? Yes

Soils at Well Location: Markey Muck

Horizon	Depth	Color	Texture	Redox
A	0-4	N2/0	Mucky Fine Sandy Loam	-
A2	4-13	10yr 3/1	Fine Sandy Loam	20% 5yr 5/6
Bg1	13-21	10yr 5/1	Fine Sandy Loam	2% 10yr 5/6
Bg2	21-39	10yr 5/1	Fine Sandy Loam	5% yr 5/6
Bg3	39-55	10yr 5/1	Very Fine Sandy Loam	10% 10yr 5/6

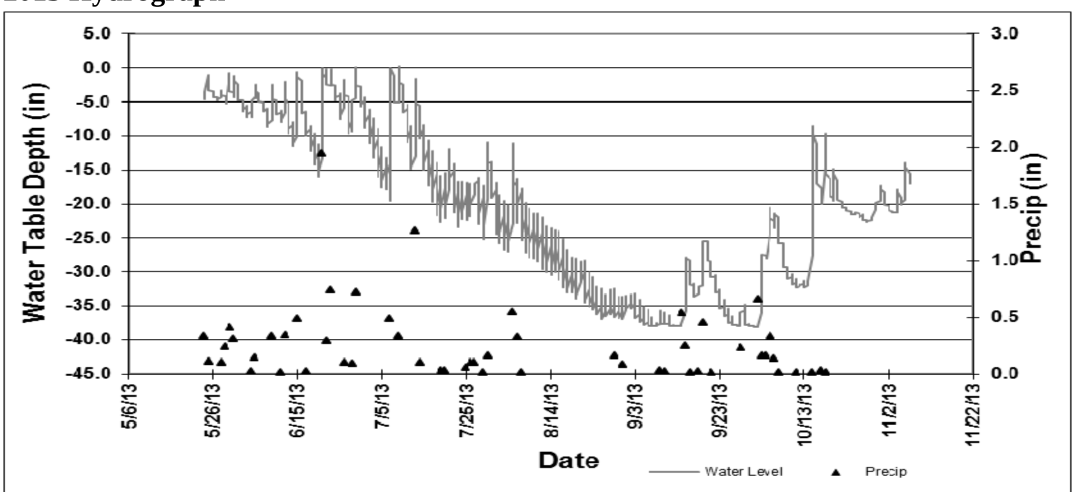
Surrounding Soils: Zimmerman Fine Sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Populus tremuloides (T)	Quaking Aspen	30
Acer negundo (S)	Boxelder	30
Acer rubrum (T)	Red Maple	10

Other Notes: This well is located at the wetland boundary. It maintained a consistent water level of -26 inches throughout summer 2008. This may have been due to water control structures elsewhere in the Carlos Avery Wildlife Management Area.

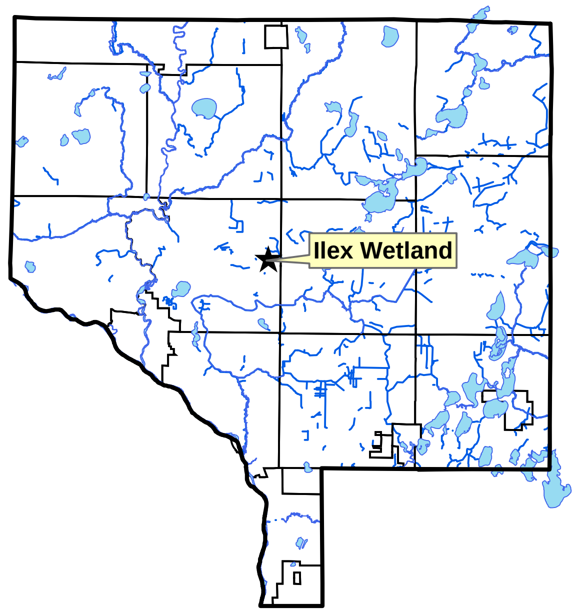
2013 Hydrograph



Well depth was 40 inches, so a reading of –40 indicates water levels at an unknown depth greater than or equal to 40 inches.

ILEX REFERENCE WETLAND - EDGE

City Park at Ilex St and 159th Ave, Andover



Site Information

Monitored Since: 1996

Wetland Type: 2

Wetland Size: ~9.6 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
A	0-10	10yr2/1	Fine Sandy Loam	-
Bg	10-14	10yr4/2	Fine Sandy Loam	-
2Ab	14-21	N2/0	Sandy Loam	-
2Bg1	21-30	10yr4/2	Fine Sandy Loam	-
2Bg2	30-45	10yr5/2	Fine Sand	-

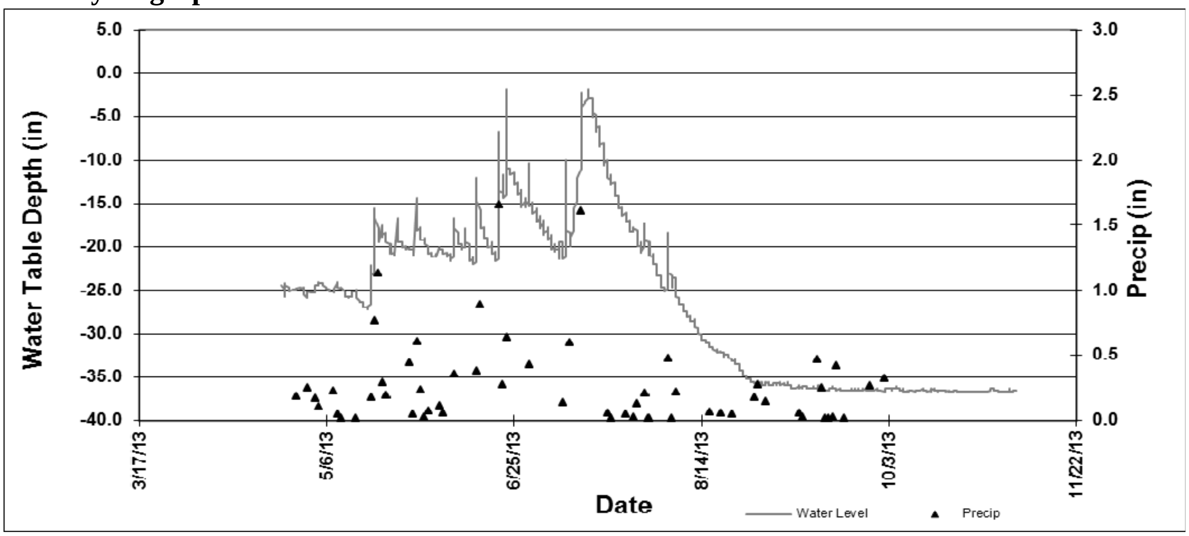
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Solidago gigantia	Giant Goldenrod	20
Populus tremuloides (T)	Quaking Aspen	20
Rubus strigosus	Raspberry	10

Other Notes: This well is located at the wetland boundary. In 2000-2005 the water table was only once within 15 inches of the surface and seldom within 40 inches. This prompted us to re-delineate the wetland and move the well down-gradient to the new wetland edge at the beginning of 2006. As a result, water levels post-2005 are not directly comparable to previous years.

2013 Hydrograph



Well depth was 40 inches, so a reading of –40 indicates water levels at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

ILEX REFERENCE WETLAND - MIDDLE

City Park at Ilex St and 159th Ave, Andover

Site Information

Monitored Since: 2006

Wetland Type: 2

Wetland Size: ~9.6 acres

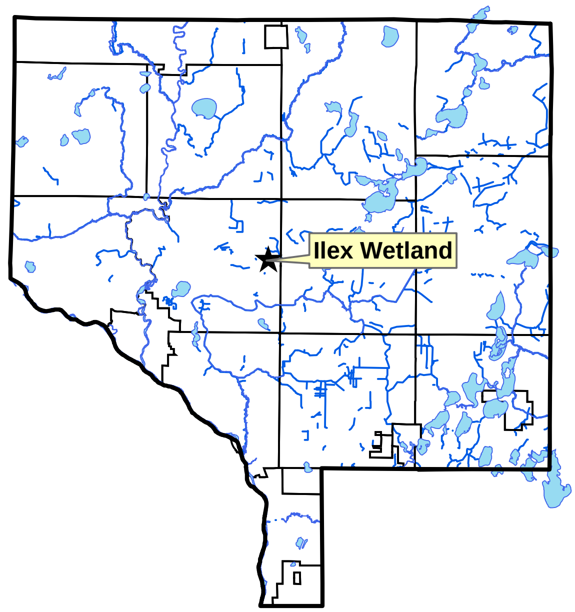
Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-9	N2/0	Organic	-
Bg1	9-19	10yr4/2	Fine Sandy Loam	-
Bg2	19-45	10yr5/2	Fine Sand	-

Surrounding Soils: Loamy wet sand and Zimmerman fine sand

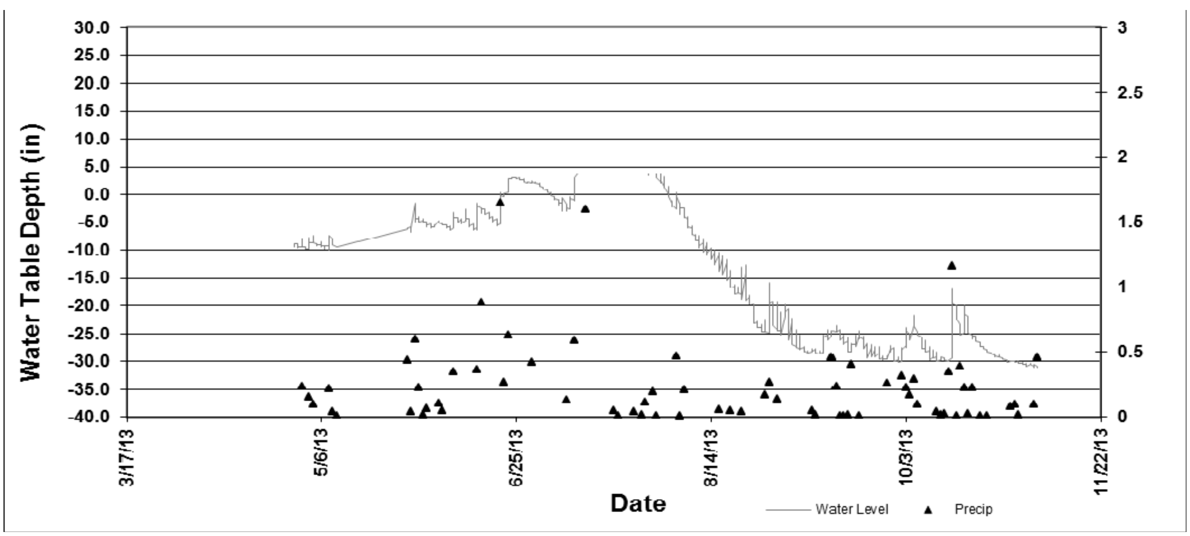


Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	80
Typha angustifolia	Narrow-leaf Cattail	40

Other Notes: This well is located near the middle of the wetland basin.

2013 Hydrograph



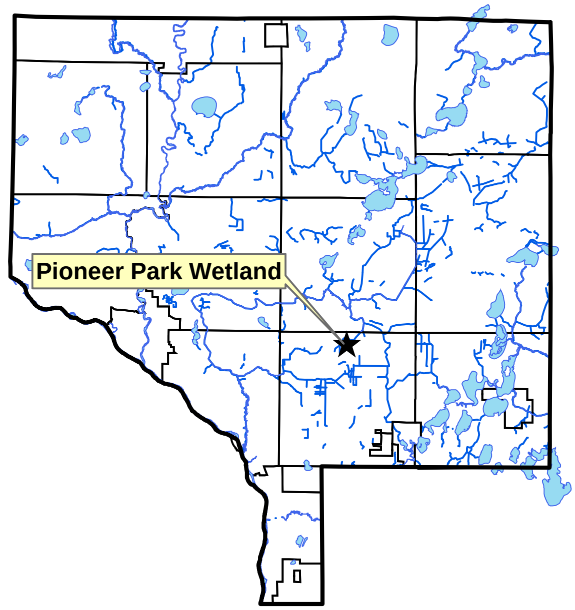
Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

PIONEER PARK REFERENCE WETLAND

Pioneer Park N Side of Main St. E of Radisson Road, Blaine

Site Information



Monitored Since: 2005

Wetland Type: 2

Wetland Size: Undetermined. Part of a large wetland complex.

Isolated Basin? No

Connected to a Ditch? Not directly.Wetland complex has small drainage ways, culverts, & nearby ditches.

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa1	0-4	10yr 2/1	Sapric	-
Oa2	4-8	N 2/0	Sapric	-
AB	8-12	10yr 3/1	Mucky Sandy Loam	-
Bw	12-27	2.5y 5/3	Loamy Sand	-
Bg	27-40	2.5y 5/2	Loamy Sand	-

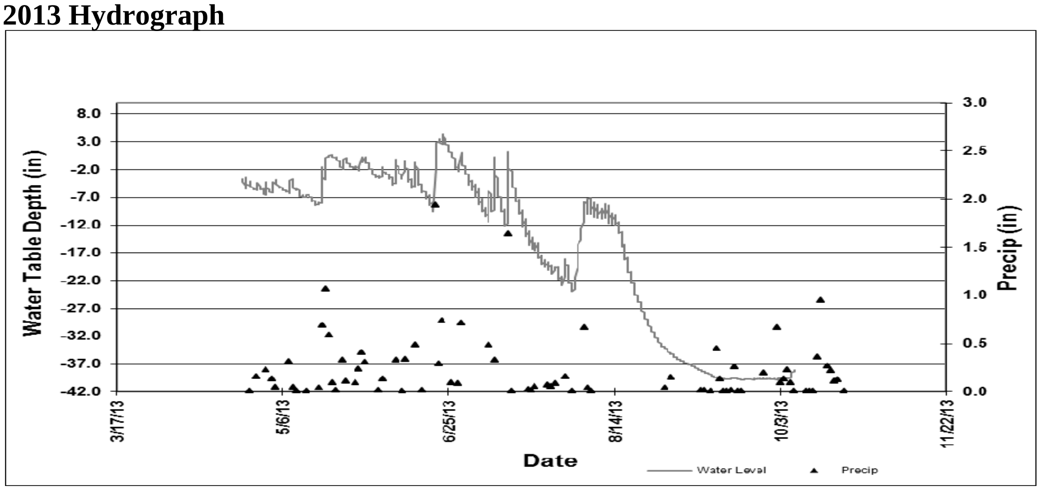
Surrounding Soils: Rifle and loamy wet sand.

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Carex lacustris	Lake Sedge	20
Fraxinus pennsylvanica (T)	Green Ash	30
Rhamnus frangula (S)	Glossy Buckthorn	20
Ulmus americana (T)	American Elm	20
Populus tremuloides (S)	Quaking Aspen	20
Urtica dioica	Stinging Nettle	10

Other Notes: This well is located within the wetland, not at the edge. City of Blaine surveyed calibration line 6-2013. Elevation = 897.366 (NGVD 29)

2013 Hydrograph

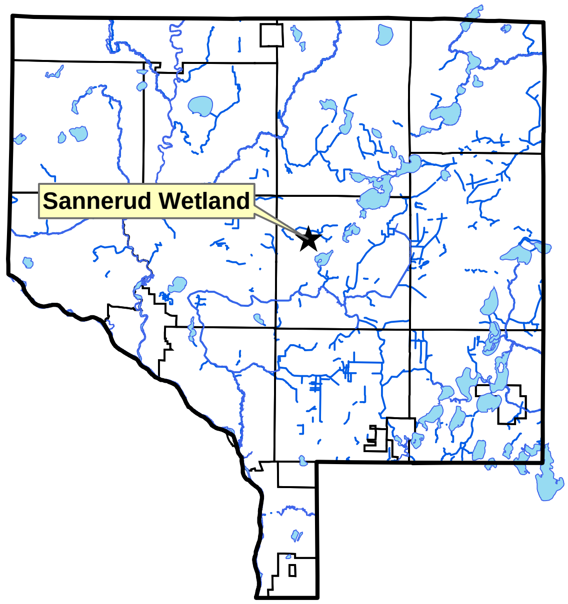


Well depth was 40 inches, so a reading of –40 indicates water levels at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

SANNERUD REFERENCE WETLAND - EDGE

W side of Hwy 65 at 165th Ave, Ham Lake



Site Information

Monitored Since: 2005

Wetland Type: 2

Wetland Size: ~18.6 acres

Isolated Basin? Yes

Connected to a Ditch? Is adjacent to Hwy 65 and its drainage systems. Small remnant of a ditch visible in wetland.

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-8	N2/0	Sapric	-
Bg1	8-21	10yr 4/1	Sandy Loam	-
Bg2	21-40	10yr 4/2	Sandy Loam	-

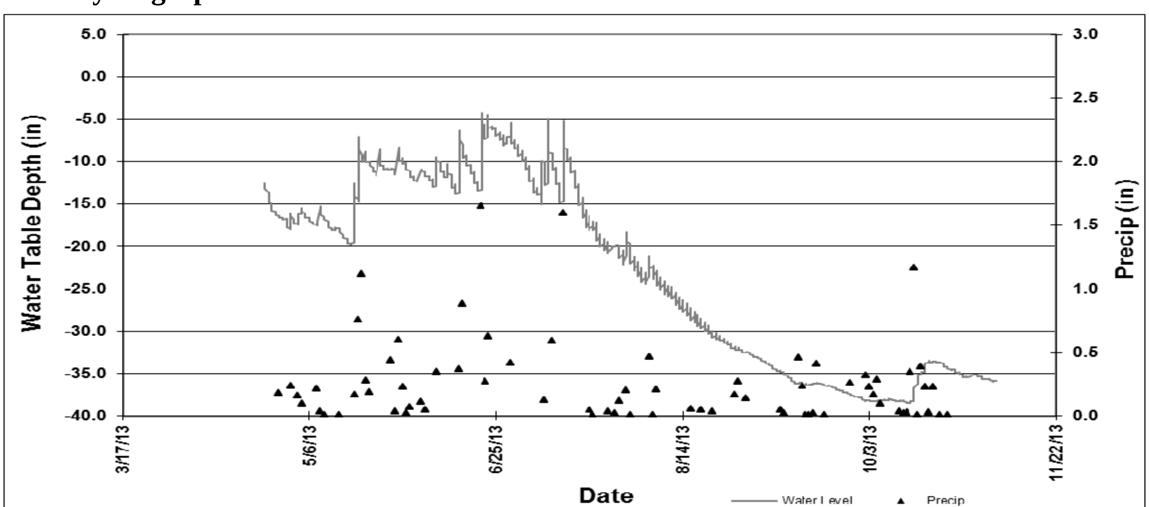
Surrounding Soils: Zimmerman and Lino.

Vegetation at Well Location:

Scientific	Common	% Coverage
Rubus spp.	Undiff Rasberry	70
Phalaris arundinacea	Reed Canary Grass	40
Acer rubrum (T)	Red Maple	30
Populus tremuloides (S)	Quaking Aspen	30
Betula papyrifera (T)	Paper Birch	10
Rhamnus frangula (S)	Glossy Buckthorn	10

Other Notes: This is one of two monitoring wells on this wetland. This one is at the wetland's edge, while the other is near the middle. The wetland edge well is slightly deeper than most reference wetland wells, at 43.5 inches deep.

2013 Hydrograph

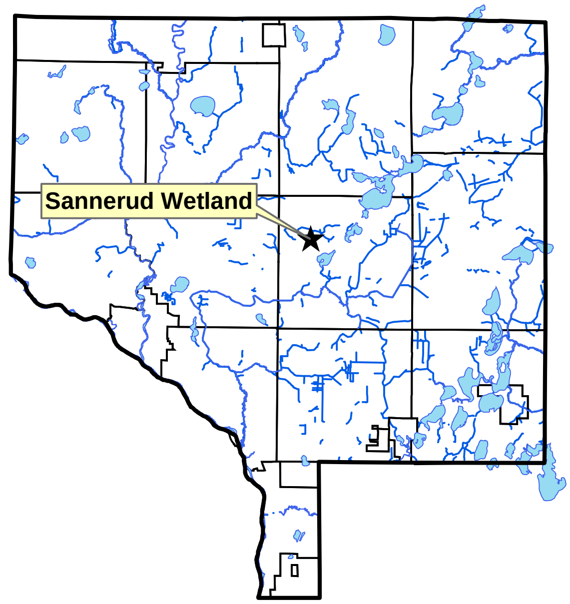


Well depth was 43.5 inches, so a reading of –43.5 indicates water levels were at an unknown depth greater than or equal to 43.5 inches.

SANNERUD REFERENCE WETLAND - MIDDLE

W side of Hwy 65 at 165th Ave, Ham Lake

Site Information



Monitored Since: 2005

Wetland Type: 2

Wetland Size: ~18.6 acres

Isolated Basin? Yes

Connected to a Ditch? Is adjacent to Hwy 65 and its drainage systems. Small remnant of a ditch visible in wetland.

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oe	0-3	7.5yr 3/1	Organic	-
Oe2	18-Mar	10yr 2/1	Organic	-
Oa	18-48	10yr 2/1	Organic	-

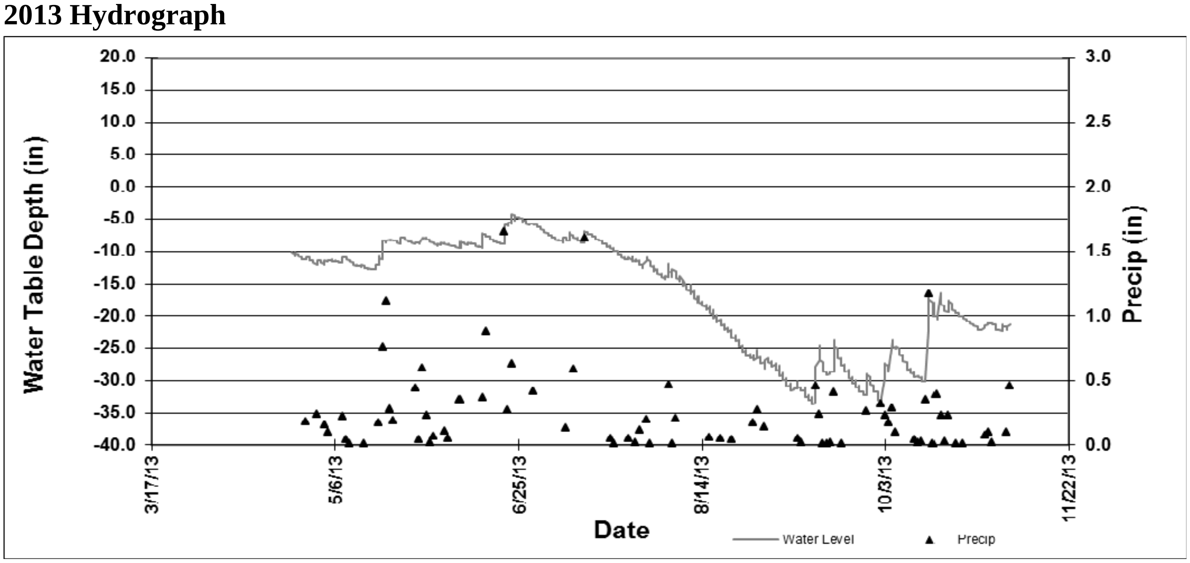
Surrounding Soils: Zimmerman and Lino.

Vegetation at Well Location:

Scientific	Common	% Coverage
Carex lasiocarpa	Wooly-Fruit Sedge	90
Calamagrostis canadensis	Blue-Joint Reedgrass	40
Typha angustifolia	Narrow-Leaf Cattail	5
Scirpus validus	Soft-Stem Bulrush	5

Other Notes: This is one of two monitoring wells on this wetland. This one is near the center of the wetland, while the other is at the wetland's edge.

2013 Hydrograph



Well depth was 38.5 inches, so a reading of –38.5 indicates water levels were at an unknown depth greater than or equal to 38.5 inches.

Reference Wetland Analyses

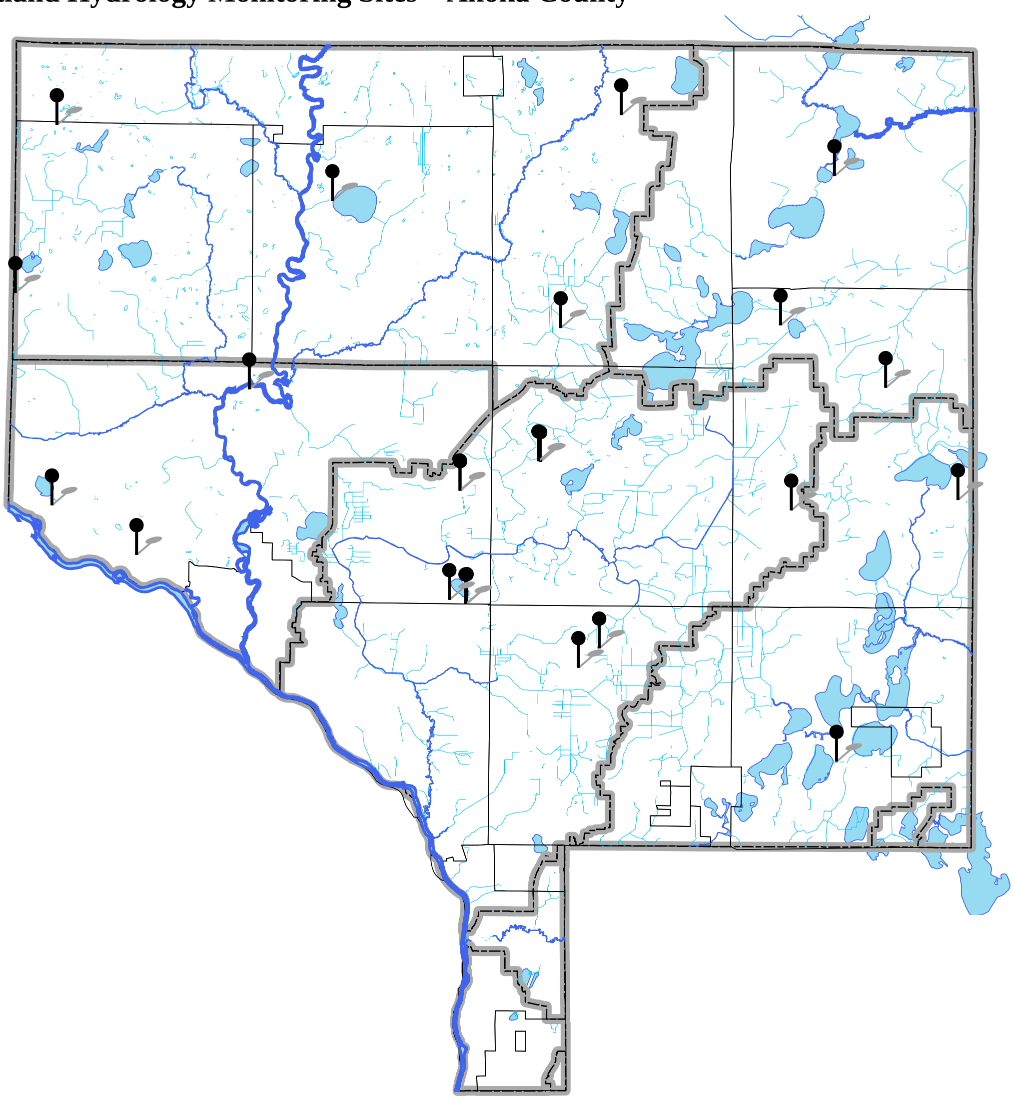
Description: This section includes analyses of wetland hydrology data of 23 reference wetland sites collected at 19 locations. Shallow groundwater levels at the edge of these wetlands are recorded every four hours. Many have been monitored since 1996. These analyses summarize this enormous multi-year, multi-wetland dataset. In the process of doing this analysis, a database summarizing all of the data was created. This database will allow many other, more specific, analyses to be done to answer questions as they arise, particularly through the wetland regulatory process.

Purpose: To provide a summary of the known hydrological conditions in wetlands across Anoka County that can be used to assist with wetland regulatory decisions. In particular, these data assist with deciding if an area is or is not a wetland by comparing the hydrology of an area in question to known wetlands in the area. The database created to produce the summaries below can be used to answer other, more specific, questions as they arise.

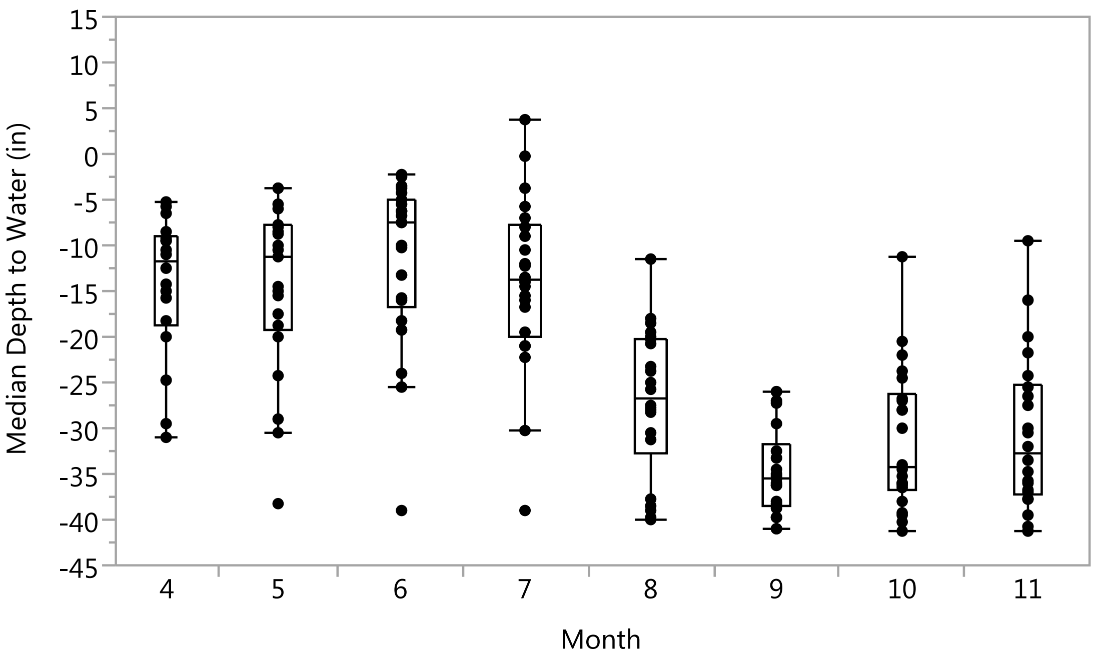
Locations: All 23 reference wetland hydrology monitoring sites in Anoka County.

Results: On the following pages. Data has been summarized for the most recent year alone, as well as across all years with available data.

Reference Wetland Hydrology Monitoring Sites – Anoka County



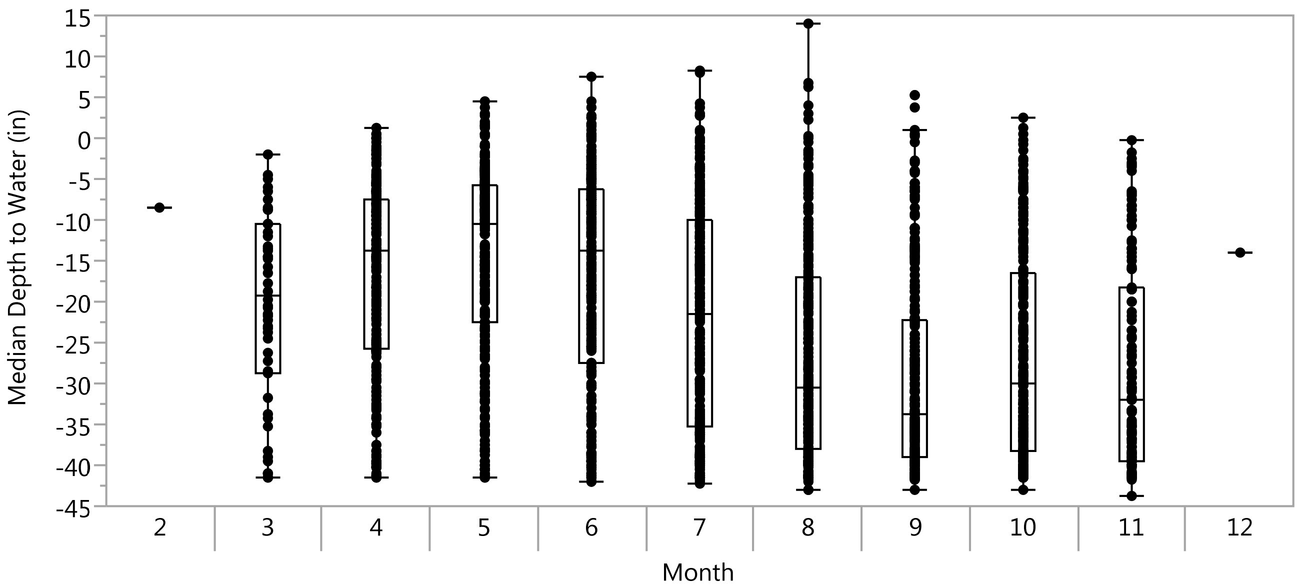
2013 Reference Wetland Water Levels Summary: Each dot represents the median depth to the water table at the edge of one reference wetland for a given month in 2013. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines). Maximum well depths were 40 to 45 inches, so a reading <40 inches likely indicates water was below the well at an unknown depth.



Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
4	-31.1	-29.57	-18.7	-11.6803	-9.04638	-5.74158	-5.21579
5	-38.3	-30.18	-19.3	-11.1736	-7.79516	-4.18	-3.82796
6	-38.9	-25.08	-16.65	-7.60964	-4.90875	-2.69983	-2.13722
7	-39.1	-27.9	-19.9391	-13.8048	-7.675	-1.3222	3.7
8	-39.9	-39.6155	-32.825	-26.6328	-20.2038	-18.11	-11.5
9	-41.0122	-40.57	-38.4421	-35.5619	-31.6822	-26.33	-25.9
10	-41.2	-39.93	-36.85	-34.275	-26.2625	-20.915	-11.25
11	-41.3	-40.3444	-37.25	-32.7772	-25.1625	-17.17	-9.5

1996-2013 Reference Wetland Water Levels Summary: Each dot represents the mean depth to the water table at the edge of one reference wetland for a month between 1996 and 2013. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines). Maximum well depths were 40 to 45 inches, so a reading <40 inches likely indicates water was below the well at an unknown depth.



Quantiles

Month	Minimum	10%	25%	Median	75%	90%	Maximum
2	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
3	-41.6	-39.54	-28.625	-19.3	-10.575	-6.4	-1.9
4	-41.6	-35.12	-25.7	-13.8	-7.4	-4.14	1.2
5	-41.6	-34.48	-22.5	-10.6	-5.8	-3.07	4.6
6	-42	-38.56	-27.4	-13.8	-6.2	-2.4	7.4
7	-42.2	-39.8	-35.3	-21.4	-10	-3.7	8.3
8	-43	-40.8	-38.05	-30.5	-17	-7.2	13.9
9	-43	-40.97	-39.075	-33.8	-22.15	-9.33	5.3
10	-43.1	-40.54	-38.35	-29.9	-16.45	-6.46	2.4
11	-43.8	-41.1	-39.4	-32.0543	-18.3	-8.3	-0.2
12	-14	-14	-14	-14	-14	-14	-14

Discussion:

The purpose of reference wetland data is to help assure that wetlands are accurately identified by regulatory personnel, as well as to aid understanding of shallow groundwater hydrology. State and federal laws place restrictions on filling, excavations, and other activities in wetlands. Commonly, citizens wish to do work in an area that is sometimes, or perhaps only rarely, wet. Whether this area is a wetland under regulatory definitions is often in dispute. Complicating the issue is that conditions in wetlands are constantly changing—an area that is very wet and clearly wetland at one time may be completely dry only a few weeks later (dramatically displayed in the graphs above). As a result, regulatory personnel look at a variety of factors, including soils, vegetation, and current moisture conditions. Reference wetland data provide a benchmark for comparing moisture conditions in a disputed, thereby helping assure accurate regulatory decisions. Likewise, it allows us to compare current shallow water levels to the range of observed levels in the past; this is useful for purposes ranging from flood prediction to drought severity indexing. The analysis of reference wetland data is a quantitative, non-subjective tool.

The simplest use of the reference wetland data in a regulatory setting is to compare water levels in the reference wetlands to water levels in a disputed area. The graphics and tables above are based upon percentiles of the water levels experienced at known wetland boundaries. The quantile boxes in the figures delineate the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles. Water table depths outside of the box have a low likelihood of occurring, or may only occur under extreme circumstances such as extreme climate conditions or in the presence of anthropogenic hydrologic alterations. If sub-surface water levels in a disputed area are similar to those in reference wetlands, there is a high likelihood that the disputed area is a wetland.

This approach can be refined by examining data from only the year of interest and only certain wetland types. This removes much of the variation that is due to climatic variation among years and due to wetland type. Substantial variation in water levels will no doubt remain among wetlands even after these factors are accounted for, but this exercise should provide a reasonable framework for understanding what hydrologic conditions were present in known wetlands during a given time period.

Water table levels are recorded every 4 hours at all 18 reference wetlands (except during winter), and the raw water level data are available through the Data Access tool at www.AnokaNaturalResources.com, or from the Anoka Conservation District.

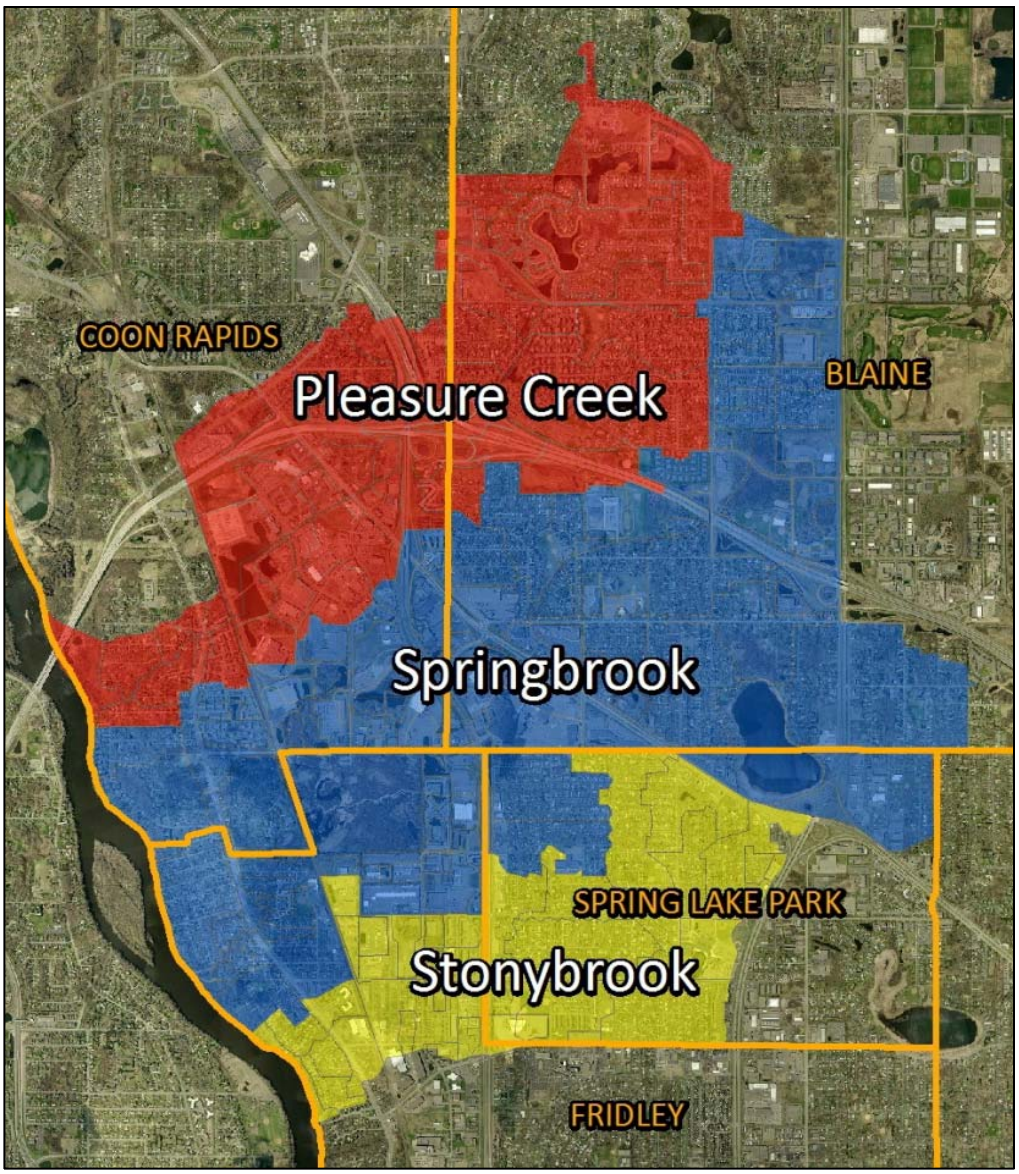
Stormwater Retrofit Analyses – Pleasure Creek, Springbrook, and Stonybrook

Description: Stormwater retrofit analyses began in 2013 for the Pleasure Creek, Springbrook, and Stonybrook subwatersheds. These analyses systematically identify and prioritize potential water quality improvement projects that will improve water quality by reducing runoff volume, total phosphorus, and/or total suspended solids. The three subwatersheds were selected for study because known water quantity and quality issues exist.

Purpose: To improve stormwater quality and reduce the volume of runoff that most greatly contribute to the degradation of Pleasure Creek, Springbrook, Stonybrook, and the Mississippi River.

Results: Field work and preliminary modeling were completed in 2013. Potential retrofit modeling and reporting will be completed in 2014.

Map of Pleasure Creek, Springbrook, and Stonybrook subwatersheds with city boundaries.



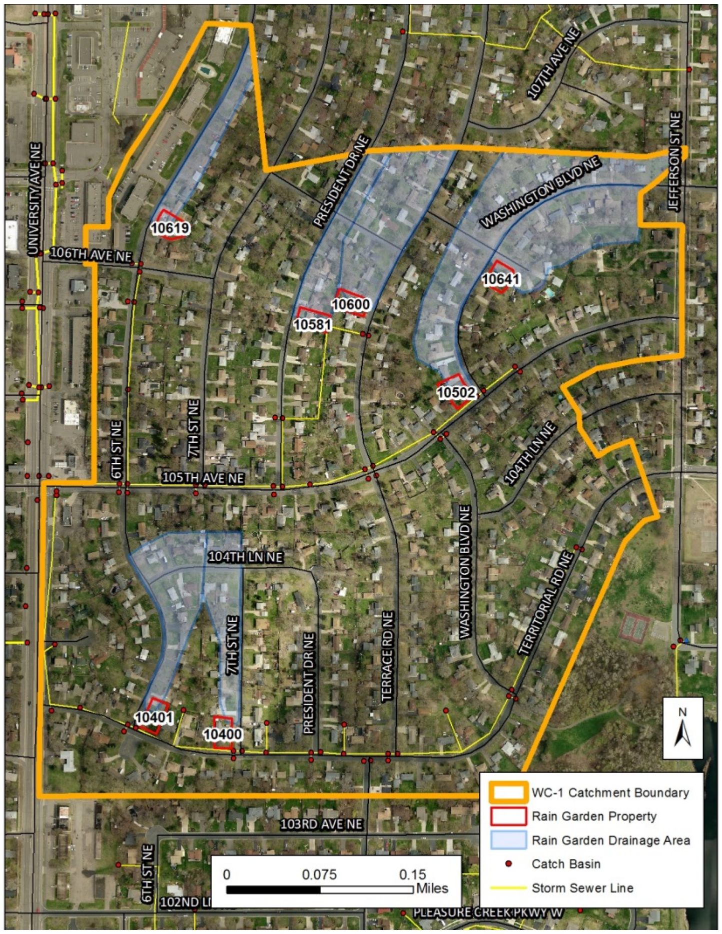
Woodcrest Creek Rain Garden Promotion and Design

Description: The Coon Creek Watershed District (CCWD) contracted with ACD to manage the promotion, design, and construction oversight of a rain garden project in the WC-1 catchment of the Woodcrest Creek subwatershed.

Purpose: To improve stormwater quality and reduce the volume of runoff generated within the WC-1 catchment. All stormwater runoff from this catchment previously discharged directly into the stormwater system without receiving treatment, which contributes to the degradation of Woodcrest Creek and Coon Creek.

Results: ACD staff targeted approximately 65 priority properties in the residential neighborhood located within catchment WC-1 to identify landowners interested in participating in the rain garden program. Interested landowners attended an educational meeting held by ACD. Those landowners with favorable rain garden sites and willingness to move forward with the program entered into contracts with the CCWD for rain garden construction. ACD staff provided design and construction management for the installation of seven rain gardens throughout the WC-1 catchment. The rain gardens were installed at strategic locations to ensure sufficient contributing drainage areas and maximize treatment. Long-term maintenance will be provided by the landowners under an agreement with the CCWD. Cumulatively, these seven rain gardens provide treatment to 15% of the WC-1 catchment and reduce stormwater runoff volumes into Woodcrest Creek by 6.1 acre-ft/yr, total suspended solids by 2,771 lbs/yr, and total phosphorus by 8.6 lbs/yr.

Sites of seven rain gardens installed in the WC-1 catchment of the Woodcrest Creek subwatershed in 2013.



Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program, such as our lake water quality monitoring program. We do not, however, know specifically which expenses are attributed to monitoring which lakes. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer. The process also takes into account equipment that is purchased for monitoring in a specific area.

Note in the table below that all precipitation related work, including monitoring and analysis, is grouped as CCWD rain. Likewise, all reference wetland work, including monitoring, analysis, and vegetation mapping, are grouped as Ref Wet.

Coon Creek Watershed Financial Summary

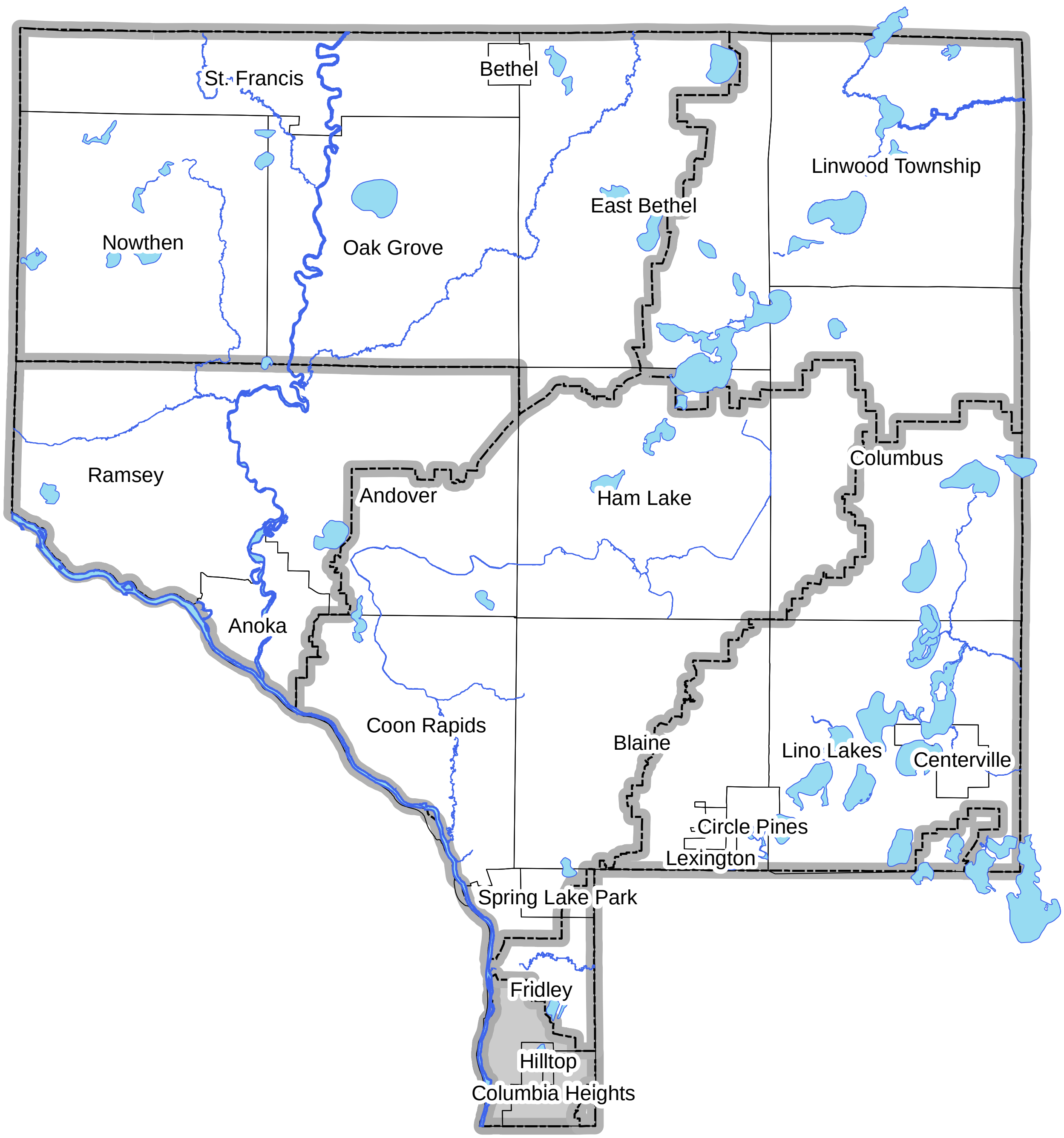
* Financial summary for these items includes both 2012 and 2013 because revenues were received from CCWD in 2012.

Coon Creek Watershed	CCWD Rain	Ref Wet	CCWD Veg Survey	Lake Lvl	Stream Level	Rating curve	Lake WQ	Stream WQ	CCWD Hydrolab	Student Biomon	Pro Biomon	CCWD Pollutant Load	Lower Coon Cr Retro Assess	Oak Glen Creek Assessment	Oak Glen Creek Corridor Admin	Oak Glen Creek Corridor Project Development	Oak Glen Creek Corridor TA/Engineering	Sand Cr Retro Promo	Sandcreek Retro Install	Mississippi River Inventory	Total
Revenues																					
CCWD	4150	3850	1085	510	4400	3600	2190	14630	1330	795	7650	0	0	0	0	0	0	0	4480	0	48670
State	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5000	5000
Anoka Conservation District	0	0	0	0	0	0	0	0	781	0	0	287	15631	9431	1164	5894	1861	1569	0	1367	37986
County Ag Preserves	0	0	0	0	0	0	649	0	0	145	0	0	0	0	0	0	0	0	0	0	794
Regional/Local	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Service Fees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Local Water Planning	0	0	0	63	0	0	432	1902	220	0	0	0	0	0	0	0	0	0	0	0	2617
TOTAL	4150	3850	1085	573	4400	3600	3270	16532	2331	940	7650	287	15631	9431	1164	5894	1861	1569	4480	6367	95066
Expenses-																					
Capital Outlay/Equip	39	28	11	5	23	46	28	102	27	11	92	6	91	2	18	38	33	3	61	115	779
Personnel Salaries/Benefits	3343	2581	595	491	3409	2665	2059	8770	1918	745	5062	239	13268	7946	990	5108	1614	1320	2677	5584	70385
Overhead	239	205	71	39	276	204	179	718	180	60	470	29	1221	722	95	383	96	124	274	368	5953
Employee Training	6	6	1	1	12	2	3	25	3	1	11	0	51	57	1	12	2	9	1	5	211
Vehicle/Mileage	74	57	9	10	74	53	45	174	38	16	81	4	276	146	18	123	30	24	44	101	1394
Rent	138	114	30	23	176	99	86	417	86	30	233	10	725	558	41	231	55	89	103	194	3439
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	10	19	0	3	109	0	872	6327	79	77	164	0	0	0	0	0	32	0	0	0	7693
McKay Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3850	3009	718	573	4081	3071	3270	16532	2331	940	6114	287	15631	9431	1164	5894	1861	1569	3159	6367	89853
NET	300	841	367	0	319	529	0	0	0	0	1536	0	0	0	0	0	0	0	1321	0	5214

Recommendations

- **Continue installing stormwater retrofits for water quality improvement.** Water quality monitoring shows most water quality problems are associated with storms; baseflow water quality is good in most locations.
- **Complete the Coon Creek Watershed Restoration and Protection Project (WRAPP),** which will include TMDL's for impaired waters and protection plans for those in good condition.
- **Continue monitoring and water quality improvement for Pleasure and Springbrook Creeks**, which have recently become part of the Coon Creek Watershed District. Past work on these waterbodies has been limited, but substantial problems are known.
- **Increase the usage of reference wetland data** among wetland regulatory personnel as a means for efficient, accurate wetland determinations. It is also use for analyzing long term trends in shallow water table hydrology.
- **Reduce road salt use.** Elevated chlorides are pervasive throughout shallow aquifers and the streams that feed them.
- **Continue hydrolab continuous water quality monitoring of creeks.** This continuous data is useful for diagnosing pollutant magnitudes, sources, and developing management strategies.

Mississippi Watershed



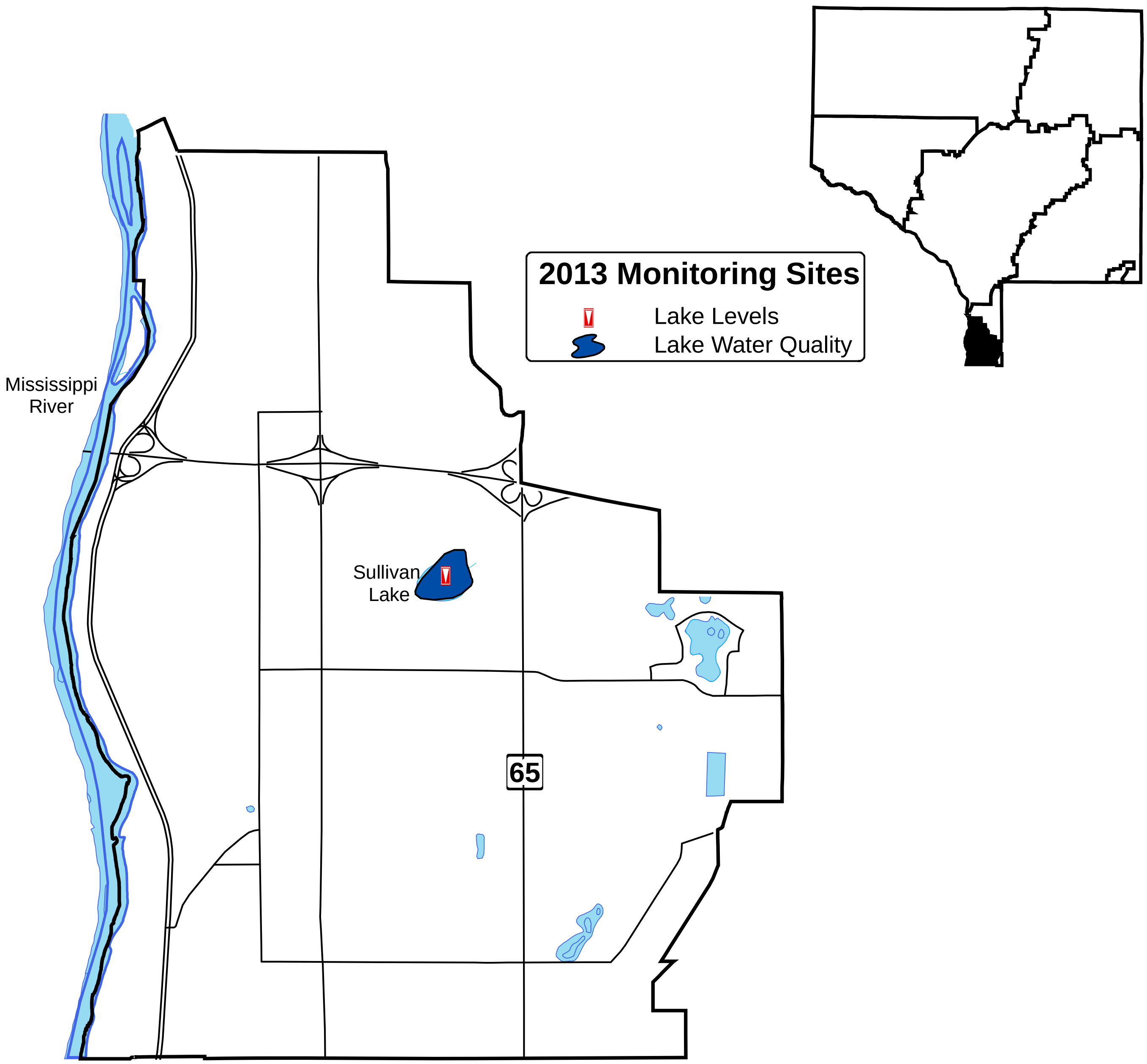
Contact Info: Mississippi Watershed Management Organization
www.mwmo.org
612-465-8780

Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 7: MISSISSIPPI WATERSHED

Monitoring	Partners	Page
Lake Levels	ACD, MNDNR, volunteers	7-279
Lake Water Quality	MWMO, ACD, ACAP	7-280
Financial Summary		7-284
Recommendations		7-284

ACD = Anoka Conservation District, MNDNR = Minnesota Department of Natural Resources, MWMO = Mississippi Watershed Management Organization, ACAP = Anoka County Ag Preserves



Lake Levels

Description: Weekly water level monitoring in lakes. These data, as well as all additional historic data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

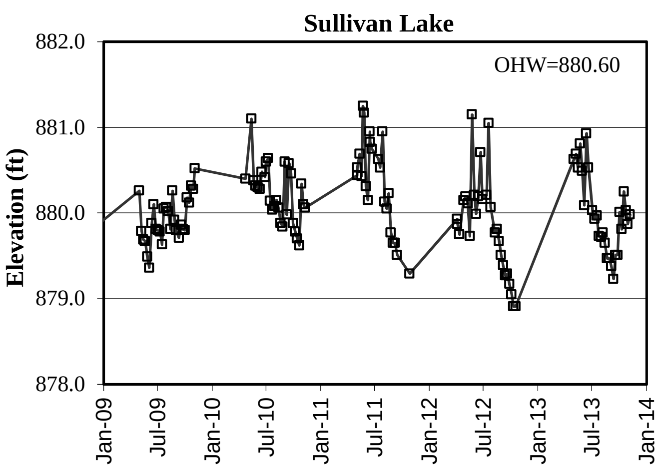
Purpose: To provide understanding of lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake hydrology manipulation decisions.

Locations: Sullivan/Sandy Lake

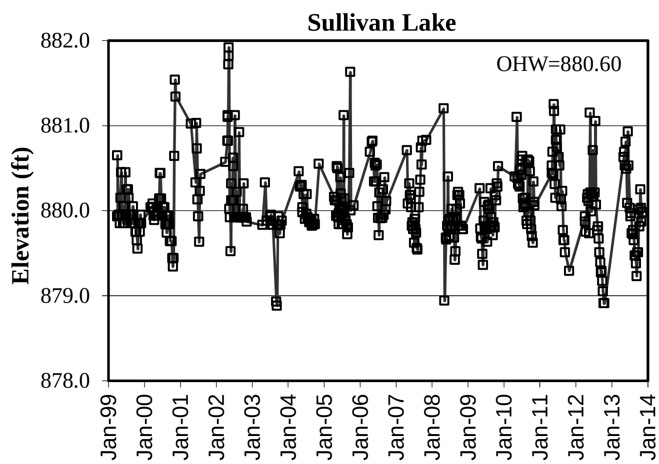
Results: Lake levels were measured 27 times for Sullivan Lake. Readings were taken at least weekly. Sullivan water levels fluctuate frequently, routinely bouncing by half a foot in response to rainfall because it receives a large amount of storm water relative to its size and its outlet releases water in all but the lowest water conditions.

Raw lake level data for all sites and all years can be downloaded from the Minnesota DNR website using the "LakeFinder" tool. Ordinary High Water Levels (OHW), the elevation below which a DNR permit is needed to perform work, are listed for each lake on the graph below.

Sullivan/Sandy Lake Levels 2009-2013



Sullivan/Sandy Lake Levels 1999-2013



Lake Levels Summary

Lake	Year	Average	Min	Max
Sullivan	2008	880.22	879.42	881.24
	2009	879.92	879.36	880.52
	2010	880.23	879.62	881.10
	2011	880.36	879.29	881.25
	2012	879.86	878.91	881.15
	2013	880.00	879.23	880.93

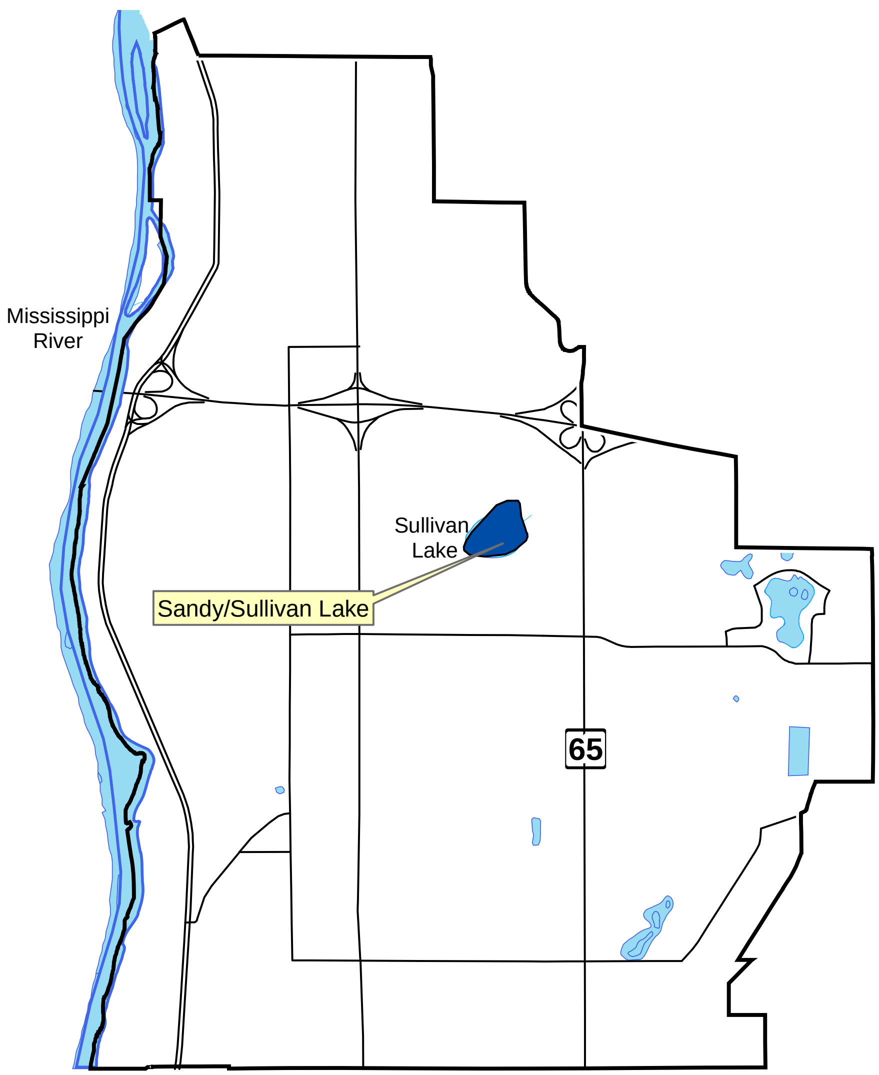
Lake Water Quality

Description: May through September monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, chloride, secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: Sullivan/Sandy Lake

Results: Detailed data for Sandy/Sullivan Lake are provided on the following pages, including summaries of historical conditions and trend analysis. Previous years' data are available from ACD. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.



Sullivan/Sandy Lake

City of Columbia Heights, Lake ID # 02-0080

Background

Sullivan Lake, also known as Sandy Lake, is located in south central Anoka County. It has a surface area of 16.8 acres and a maximum depth of 9 feet (2.7 m). A walking trail system/park circumscribes the lake. Adjacent to the trail is a mix of residential, commercial, and retail uses. The walking trail around the lake is used extensively, but the lake itself is used very little for swimming, fishing, or boating because there are few places with clear access to the water. This lake's watershed is highly urbanized, and the lake essentially serves as a flow-through storm water pond. It is connected directly to the curb and gutter storm water system. Water exiting this lake is discharged to the Mississippi River via storm water conveyances.

2013 Results

In 2013 Sullivan Lake had poor water quality compared to other lakes in this region (NCHF Ecoregion), receiving an overall D grade. This was similar to the previous twelve monitored years. The lake is highly eutrophic, and phosphorus levels are two to three times the threshold for an "impaired" designation by the Minnesota Pollution Control Agency. The lake is unsuitable for swimming during the entire growing season. ACD staff's subjective observations were that algae levels were "high" or "severe" and the lake was unsuitable for swimming during the entire period from May through September. Past depth profiles indicate that dissolved oxygen is too low for most fish (<4 mg/L) below four feet, and is too low for most aquatic life (<1 mg/L) near the bottom. This is likely due to oxygen consumption by decomposition of expired algae.

Trend Analysis

Thirteen years of water quality data have been collected by the Metropolitan Council (1993-2003) and Anoka Conservation District (2004, 2005, & 2013). Water quality is showing a significant downward trend (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,10}$=8.21, p=0.0078). We examined each of the response variables separately to gain insight into which might be responsible for the trend. Both phosphorus and chlorophyll-a have been increasing over time.

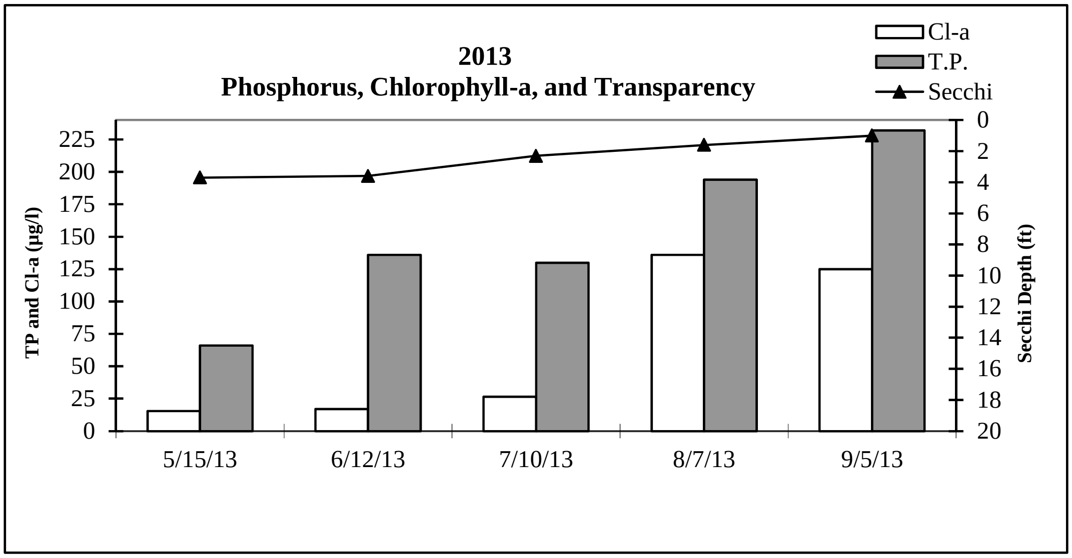
Discussion

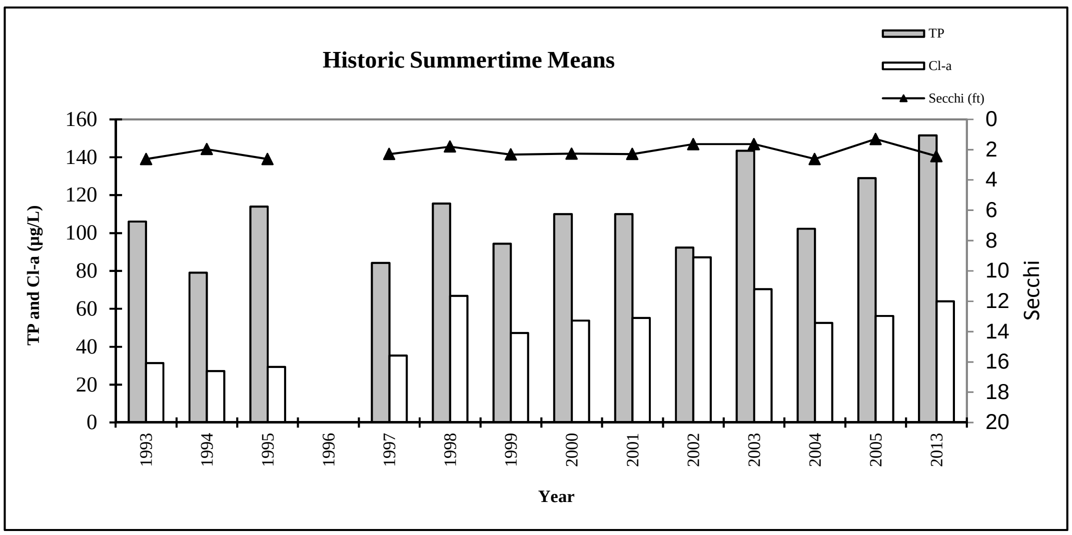
Sullivan Lake likely has poor water quality because of the composition of the stormwater that it receives. Stormwater from urbanized areas can be high in sediment, nutrients and other pollutants. Improvements to the storm water system that could benefit Sullivan Lake should be explored.

2013 Sullivan Lake Water Quality Data

	Units	R.L.*	5/15/2013 Results	6/12/2013 Results	7/10/2013 Results	8/7/2013 Results	9/5/2013 Results	Average	Min	Max
pH		0.1	8.31	7.33	8.66	9.30	9.15	8.55	7.33	9.30
Conductivity	mS/cm	0.01	0.886	0.604	0.356	0.331	0.385	0.512	0.331	0.886
Turbidity	NTU	1	10	10	13	45	74.90	30	10	75
D.O.	mg/L	0.01	12.9	5.06	10.72	12.56	12.95	10.83	5.06	12.95
D.O.	%	1	130%	53%	143%	138%	155%	124%	53%	155%
Temp.	°C	0.1	16.6	18.2	28.4	22.7	24.0	21.98	16.60	28.41
Temp.	°F	0.1	61.9	64.7	83.1	72.8	75.2	71.6	32.0	83.1
Salinity	%	0.01	0.0	0.3	0.2	0.2	0.2	0.2	0.0	0.3
Chloride	ug/L	0.1	372.0	197.0	94.5	89.4	103.0	171.2	89.4	372.0
Cl-a	mg/L	0.5	16	17	27	136	125	64.0	15.5	136.0
T.P.	ug/L	0.010	0.066	0.136	0.130	0.194	0.232	0.152	0.066	0.232
T.P.	ft	10	66	136	130	194	232	152	0	232
Secchi	m	0.1	3.7	3.6	2.3	1.6	1.0	2.4	1.0	3.7
Secchi		0.1	1.1	1.1	0.7	0.5	0.3	0.7	0.0	1.1
Physical			3.0	3.0	2.0	4.0	4.00	3.2	2.0	4.0
Recreational			3.0	3.0	4.0	4.0	2.00	3.2	2.0	4.0

Sullivan Lake Water Quality Results

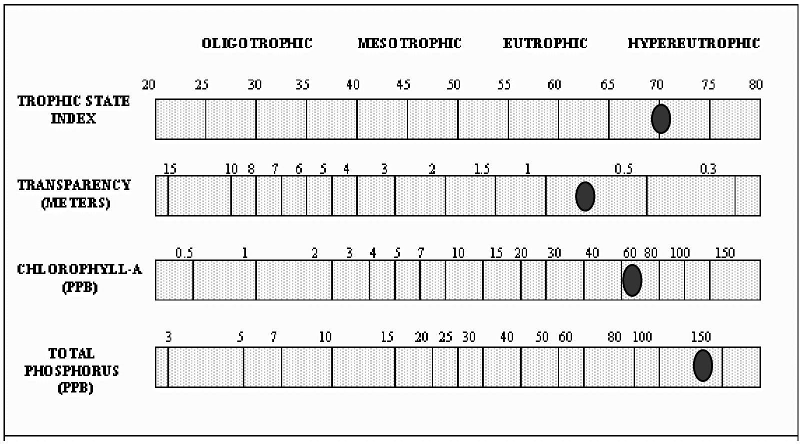




Sullivan Lake Historic Summertime Mean Values

Agency	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	ACD	ACD	ACD
Year	93	94	95	97	98	99	2000	2001	2002	2003	2004	2005	2013
TP	106.0	79.1	114.0	84.2	115.5	94.4	110.0	110.0	92.4	143.4	102.3	129	151.6
Cl-a	31.4	27.2	29.4	35.3	66.8	47.3	53.8	55.2	87.2	70.3	52.6	56.3	64.0
Secchi (m)	0.80	0.60	0.80	0.70	0.55	0.71	0.69	0.70	0.50	0.50	0.80	0.40	0.7
Secchi (ft)	2.6	2.0	2.6	2.3	1.8	2.3	2.3	2.3	1.6	1.6	2.6	1.3	2.4
Carlson's Tropic State Indices													
TSIP	71	67	72	68	73	70	72	72	69	76	71	74	77
TSIC	65	63	64	66	72	69	70	70	75	72	70	70	72
TSIS	63	67	63	65	69	65	65	65	70	70	63	73	64
TSI	66	66	67	66	71	68	69	69	71	73	68	73	71
Sullivan Lake Water Quality Report Card													
Year	93	94	95	97	98	99	2000	2001	2002	2003	2004	2005	2013
TP	D	D	D	D	D	D	D	D	D	D	D	D	D
Cl-a	C	C	C	C	D	C	D	D	F	D	D	D	D
Secchi	D	F	D	D	F	D	D	D	F	F	D	F	D
Overall	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**F**	**D**	**D**	**D**	**D**

Carlson’s Trophic State Index



Financial Summary

ACD accounting is organized by program and not by customer. This allows us to track all of the labor, materials and overhead expenses for a program, such as our lake water quality monitoring program. We do not, however, know specifically which expenses are attributed to monitoring which lakes. To enable reporting of expenses for monitoring conducted in a specific watershed, we divide the total program cost by the number of sites monitored to determine an annual cost per site. We then multiply the cost per site by the number of sites monitored for a customer. The process also takes into account equipment that is purchased for monitoring in a specific area.

MWMO Financial Summary

Mississippi Watershed	Lake Lvl	Lake WQ	MWMO SRA	Total
Revenues				
MWMO	160	912	0	1072
State	0	0	0	0
Anoka Conservation District	0	0	0	0
Anoka Co. General Services	0	0	0	0
County Ag Preserves	0	555	0	555
Regional/Local	0	0	0	0
Other Service Fees	0	193	0	193
BWSR Cons Delivery	0	0	241	241
BWSR Cost Share TA	0	0	0	0
Local Water Planning	41	320	0	362
TOTAL	201	1980	241	2423
Expenses-				
Capital Outlay/Equip	3	24	1	27
Personnel Salaries/Benefits	171	1372	199	1743
Overhead	12	92	24	128
Employee Training	1	8	1	9
Vehicle/Mileage	3	24	3	30
Rent	8	62	13	83
Program Participants	0	0	0	0
Program Supplies	0	350	0	350
McKay Expenses	4	49	0	53
TOTAL	201	1980	241	2423
NET	0	0	0	0

Recommendations

- Investigate storm water conveyances draining to Sullivan Lake and determine ways to incrementally improve the water that reaches it. Sullivan Lake's water quality is extremely poor.