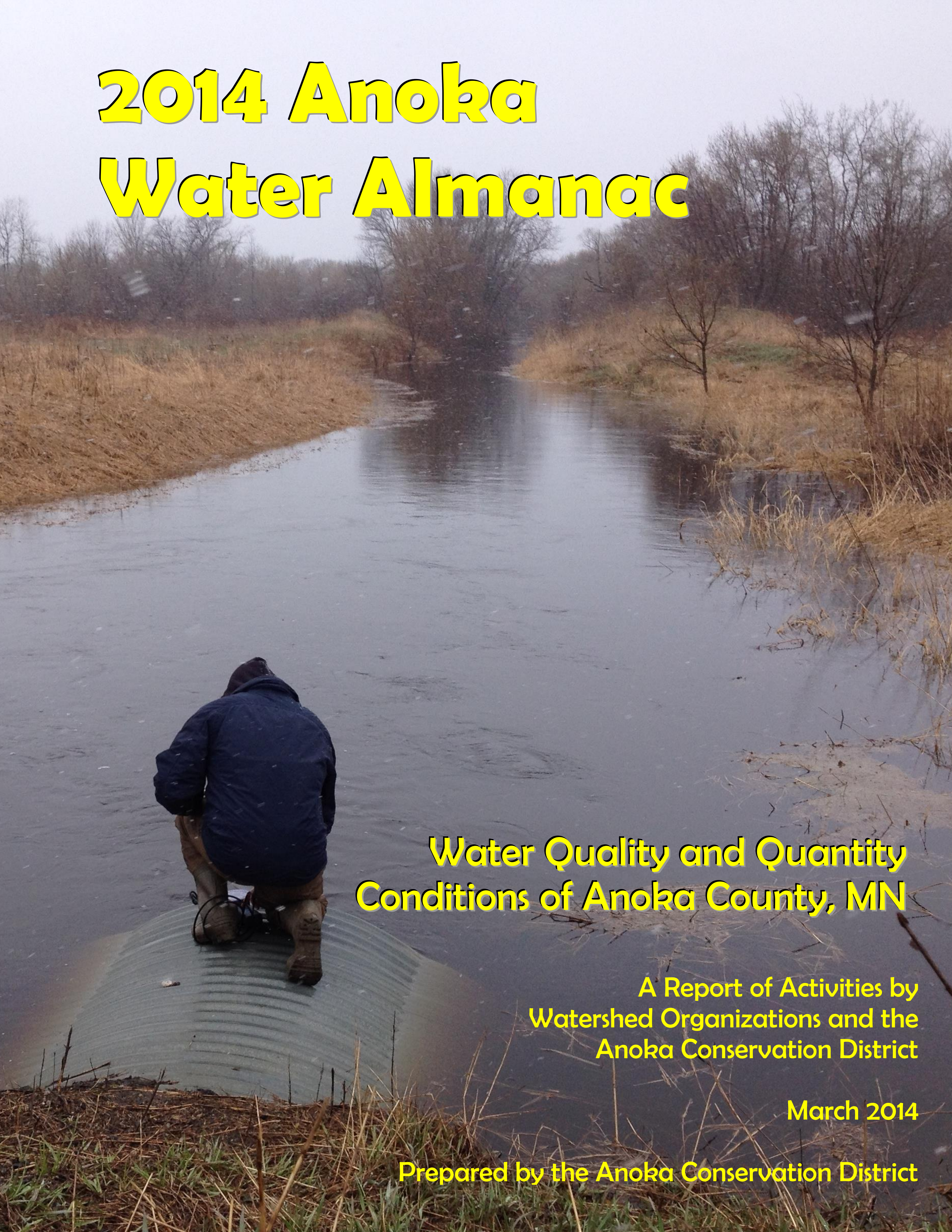

2014 Anoka Water Almanac

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

2014 ANOKA WATER ALMANAC

Water Quality & Quantity Conditions of Anoka County, Minnesota

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

March 2014

Prepared by
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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 2014. 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 2014 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 2014 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.

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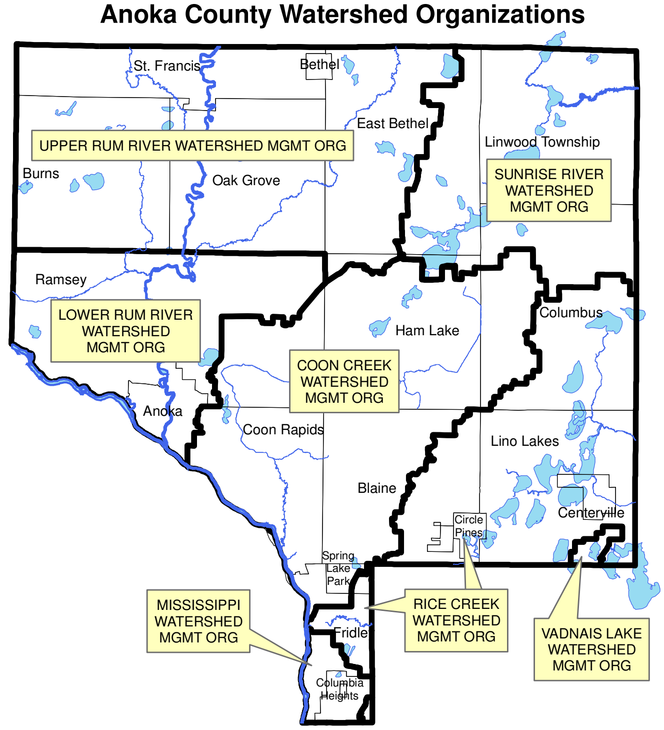
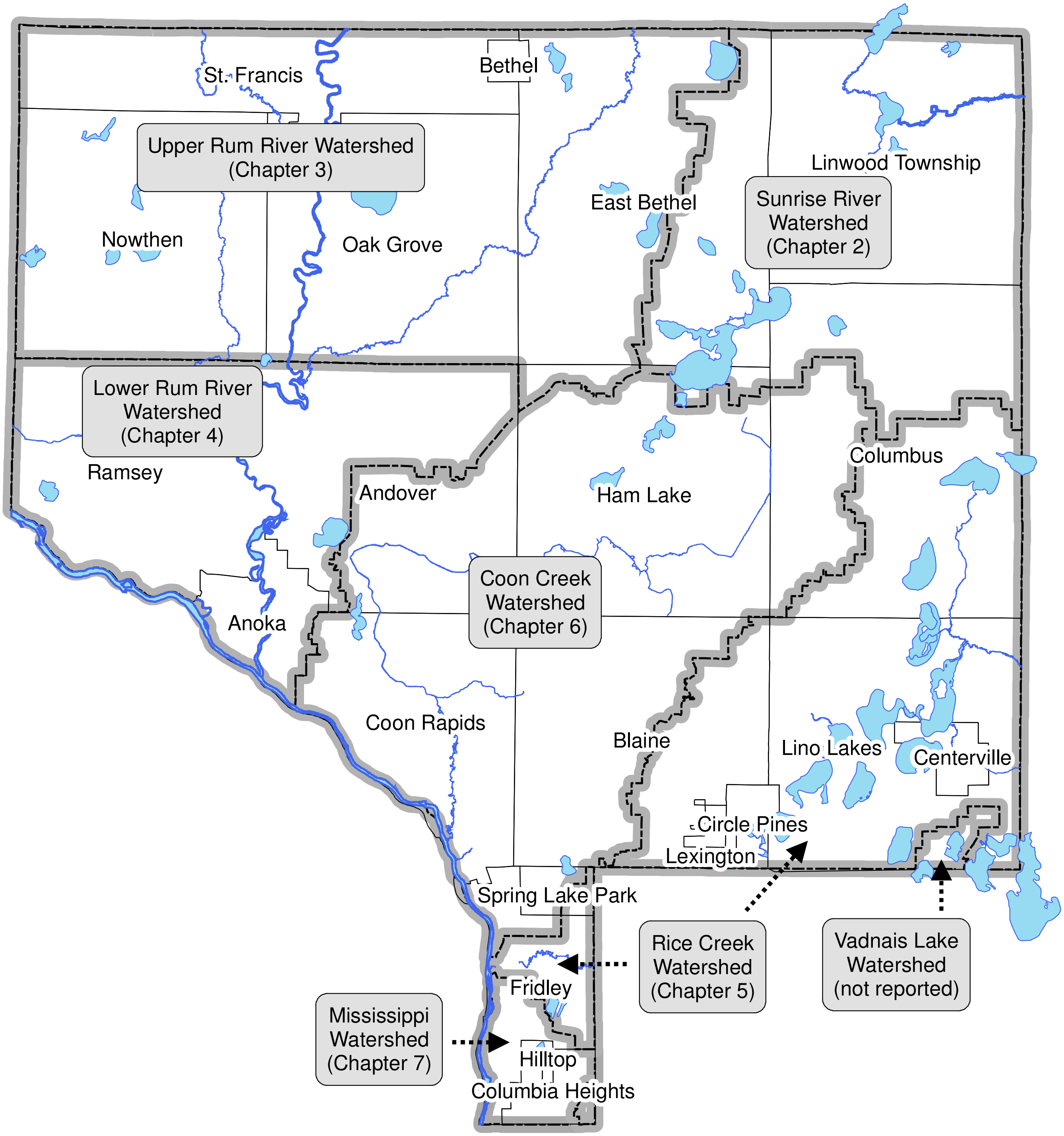
Anoka County Watershed Organizations



Chapter 1 – Primer



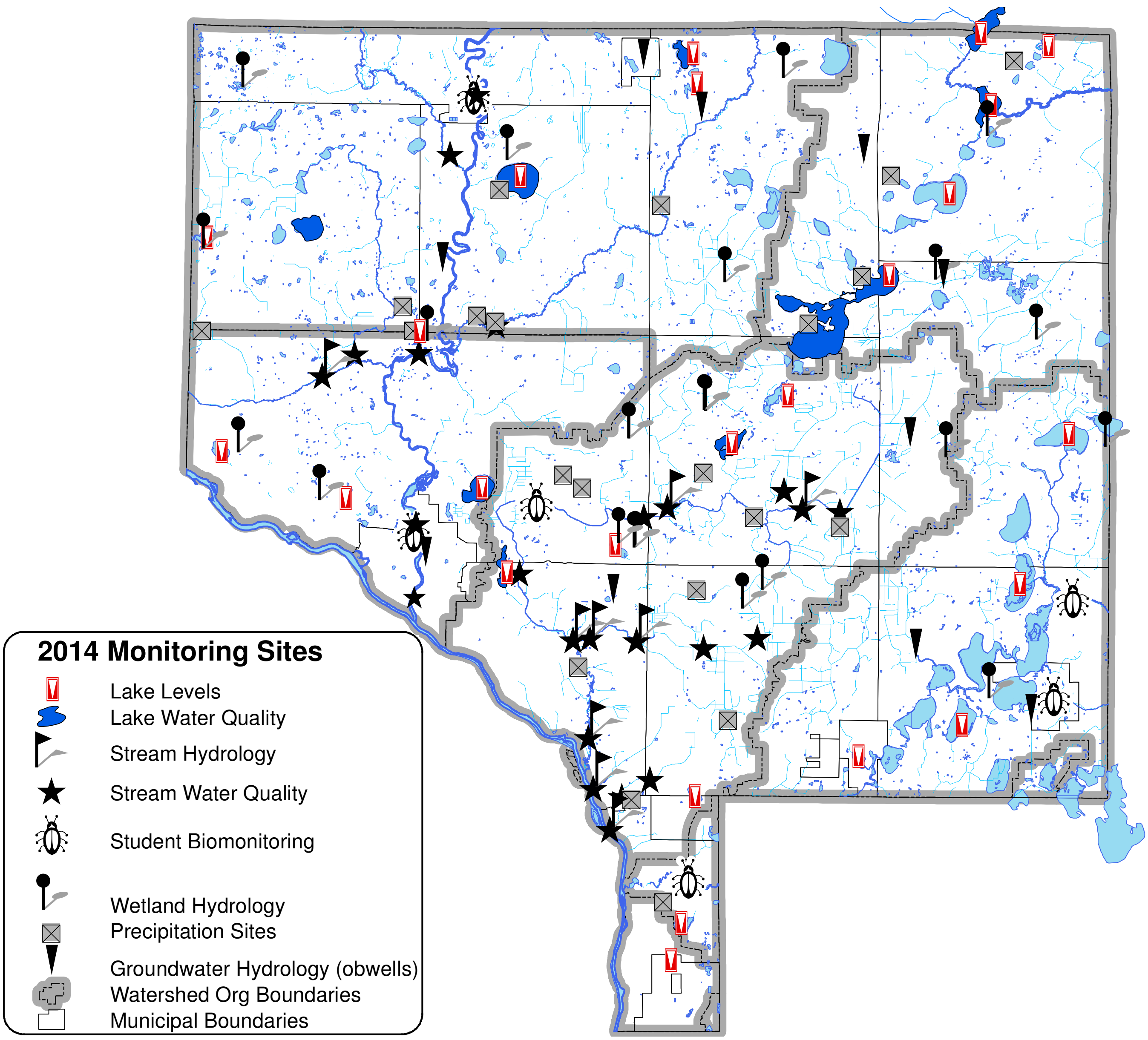
Contact Info: Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

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.

2014 Water Monitoring Sites



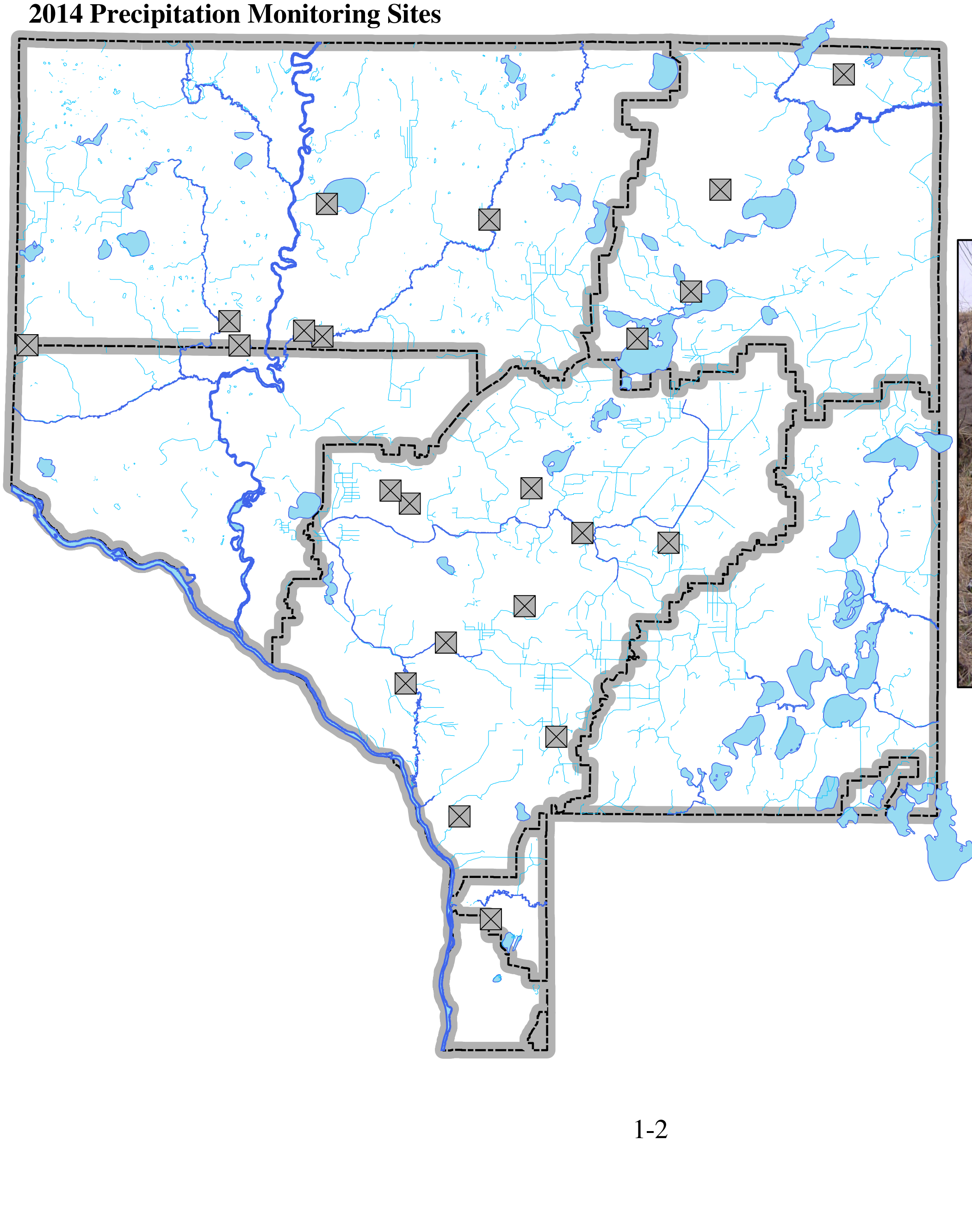
Precipitation

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.

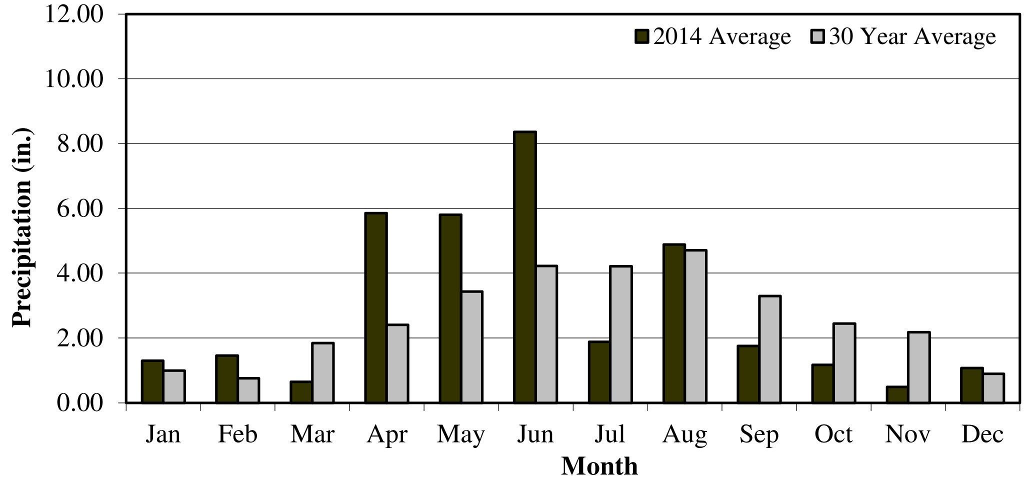
The ACD coordinates a network of 21 rain gauges countywide. Fifteen are monitored by volunteers and six are monitored using datalogging stations operated by the ACD for the Coon Creek Watershed District. The volunteer-operated stations are cylinder-style rain gauges located at the volunteer's home. Total 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.

2014 Precipitation Monitoring Sites



2014 Anoka County Average Monthly Precipitation (average of all sites)



2014 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)
Tipping bucket, datalogging rain gauges (Time and date of each 0.01" is recorded)															
Andover City Hall	Andover					8.41	2.70	1.97	6.56	1.65	0.99	0.33		22.61	21.29
Blaine Public Works	Blaine				4.55	4.69	7.98	1.96	2.65	1.78	1.16	0.22		24.99	19.06
Coon Rapids City Hall	Coon Rapids				6.31	7.20	8.33	2.58	5.26	2.02	1.10	0.33		33.13	25.39
Anoka Cons. District office	Ham Lake				6.03	6.57	9.49	2.08	6.11	1.82	1.04	0.00		33.14	26.07
Waconia Street	Ham Lake				6.09	5.67	0.07	0.00	0.00	0.30	1.20	0.31		13.64	6.04
Northern Nat. Gas substation	Ham Lake				5.68	6.08	8.84	1.96	5.58	1.34	1.13	0.22		30.83	23.80
Springbrook Nature Center	Fridley				6.20	5.31	4.93	2.85	4.41	2.26	0.77	0.32		27.05	19.76
Cylinder rain gauges (read daily)															
N. Myhre	Andover	1.23	1.13	0.92	6.96	4.48	11.69	1.72	5.54	1.86	0.95	1.58	1.03	39.09	25.29
J. Rufsvold	Burns				4.96	4.62	9.40	1.58	5.40	1.71	0.94			28.61	22.71
J. Arzdorf	Blaine			0.30	6.45	8.22	8.26	1.98	5.23	1.78	1.21			33.43	25.47
M. Gaynor	East Bethel				5.42	5.06	9.13	1.75		1.64	3.40			26.40	17.58
P. Arzdorf	East Bethel				6.12	4.90	11.32	2.20	4.70	1.44	1.02			31.70	24.56
A. Mercil	East Bethel	1.14	1.28	0.69	4.78	6.91	5.82	1.59	7.20	1.25	1.15	0.41	1.09	33.31	22.77
K. Ackerman	Fridley	1.37	1.51	0.79	7.43	5.08	8.16	2.52	4.23	1.55	1.16	1.15	1.11	36.06	21.54
B. Myers	Linwood				3.50	3.47	9.10	1.02	4.99	1.15	1.01			24.24	19.73
A. Dalske	Oak Grove	1.45	1.91	0.53	7.70	7.80	10.70	1.95	6.36	1.15	0.61			40.16	27.96
P. Freeman	Oak Grove													0.00	0.00
D. Conger	Oak Grove					3.94	10.24	2.15	5.52	2.97				24.82	24.82
ACD Office	Ham Lake				6.30	4.54	14.31	2.25	3.68	4.63	1.43			37.14	29.41
Y. Lyrenmann	Ramsey				4.99	7.29	8.39	1.63	4.35	1.03	0.79			28.47	22.69
2014 Average	County-wide	1.30	1.46	0.65	5.85	5.80	8.36	1.88	4.88	1.75	1.17	0.49	1.08	34.66	22.67
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.

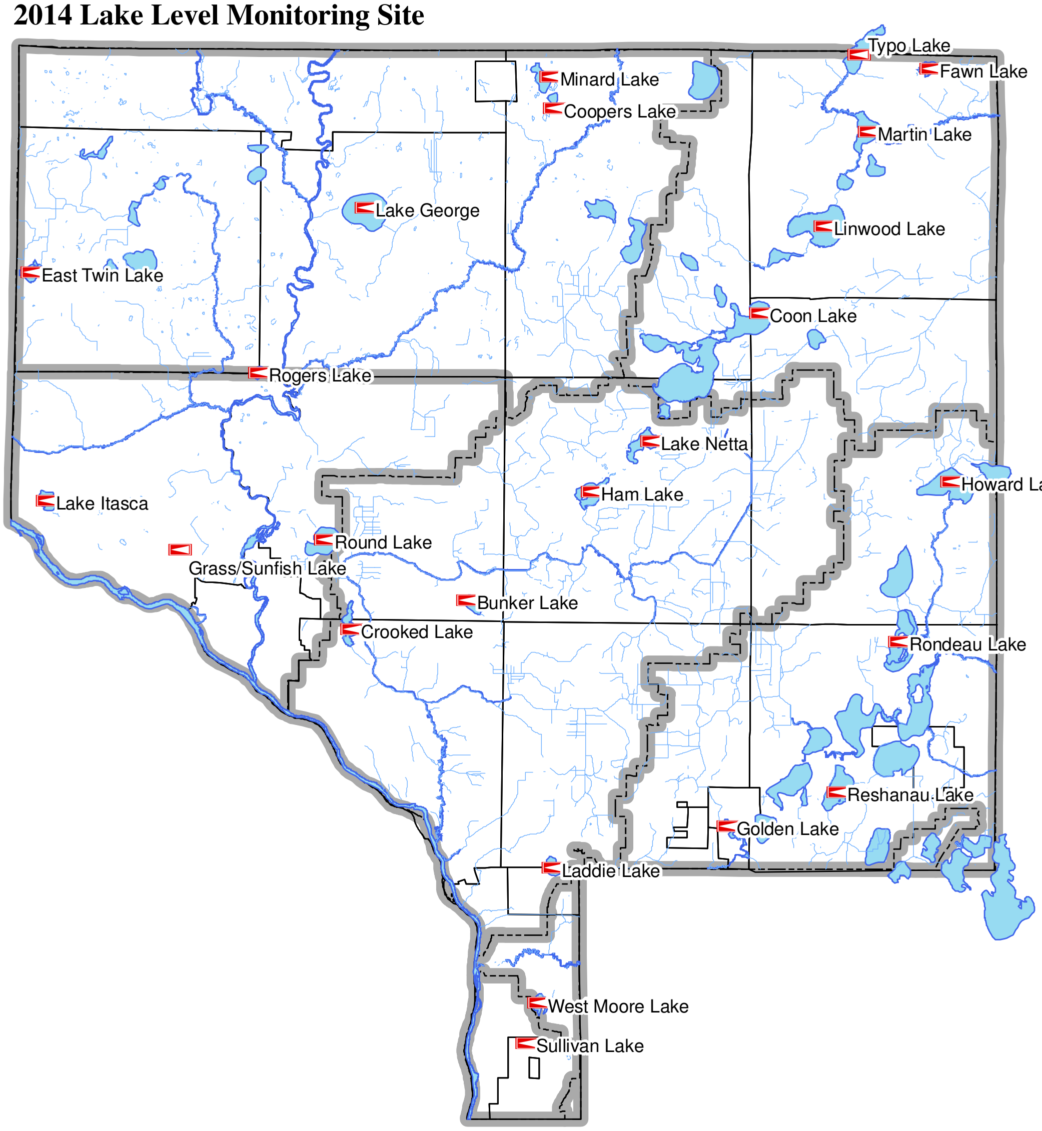
Lake Levels

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.

2014 Lake Level Monitoring Site



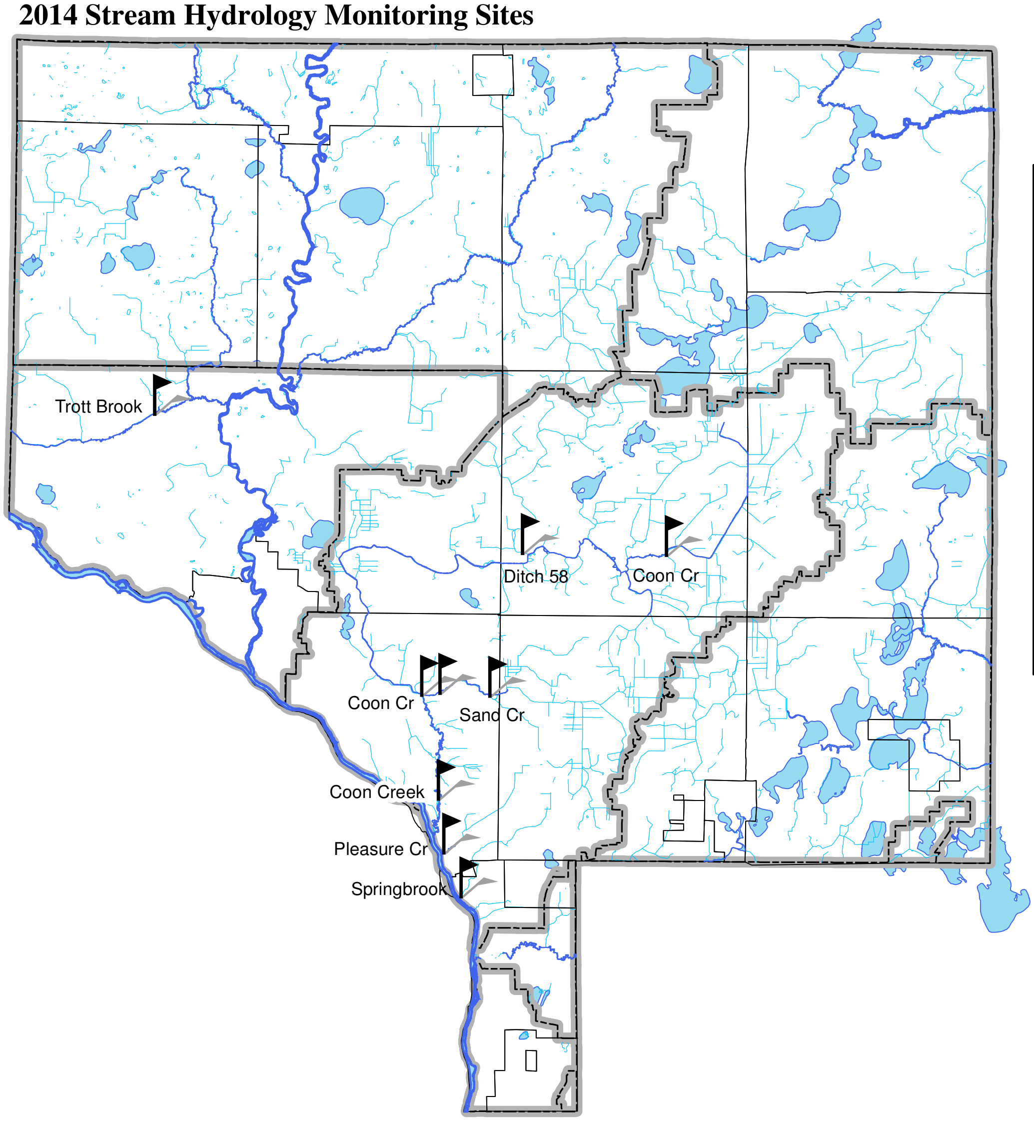
Stream Hydrology

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.

2014 Stream Hydrology Monitoring Sites



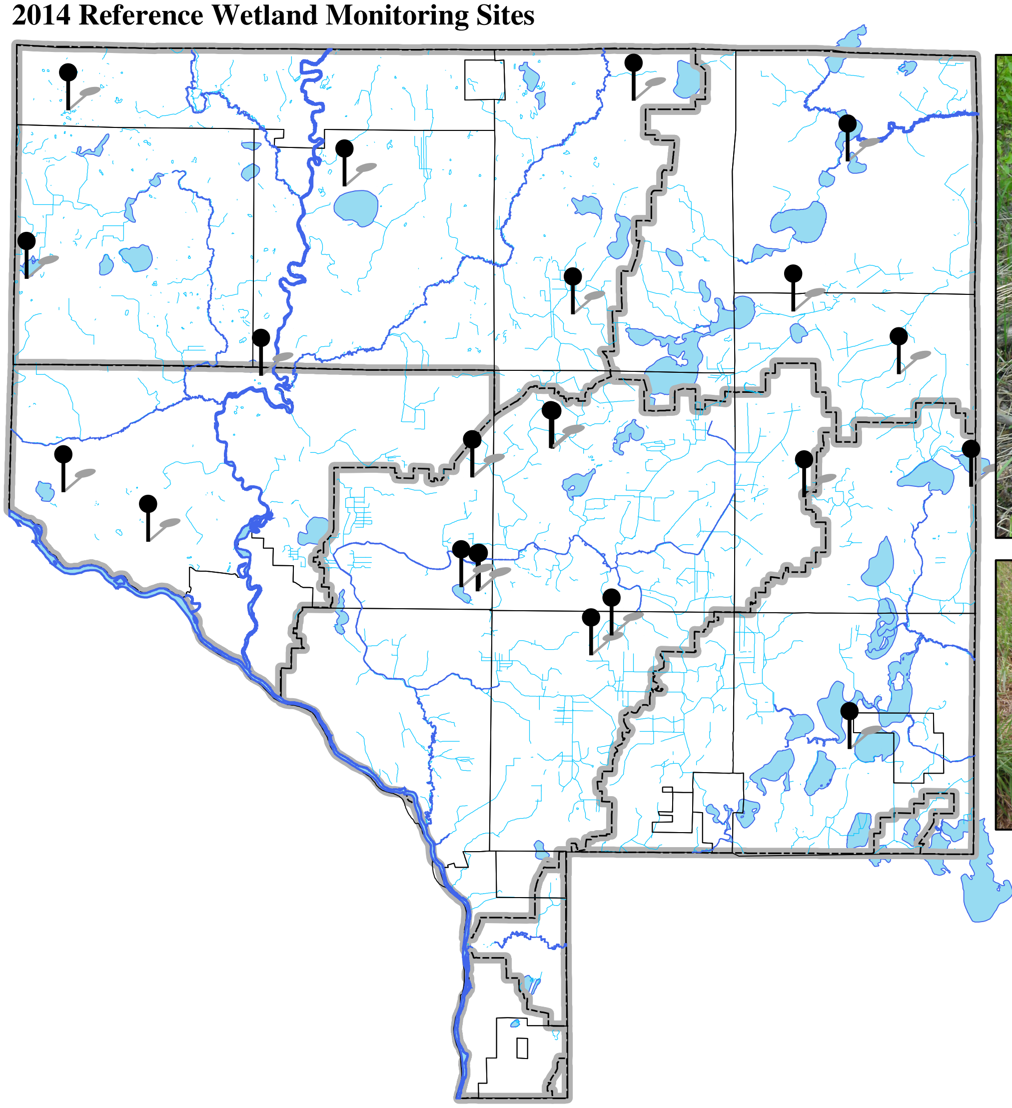
Wetland Hydrology

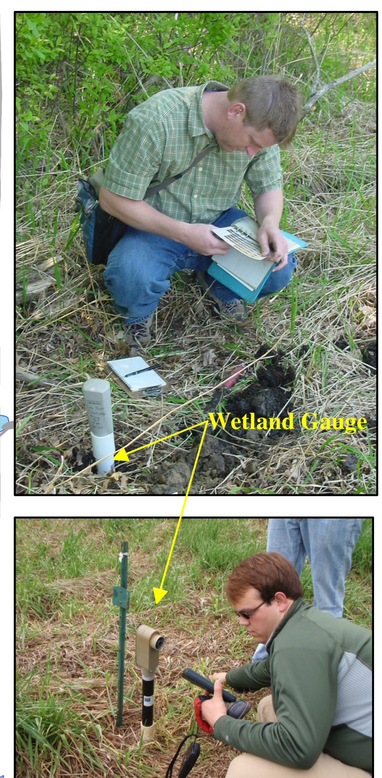
Wetland regulations are often focused upon determining whether an area is, or is not, a wetland. This is difficult at times because most wetlands are not continually wet. In order to facilitate fair, accurate wetland determinations the ACD monitors 18 wetlands throughout the county that serve as a reference 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.

2014 Reference Wetland Monitoring Sites



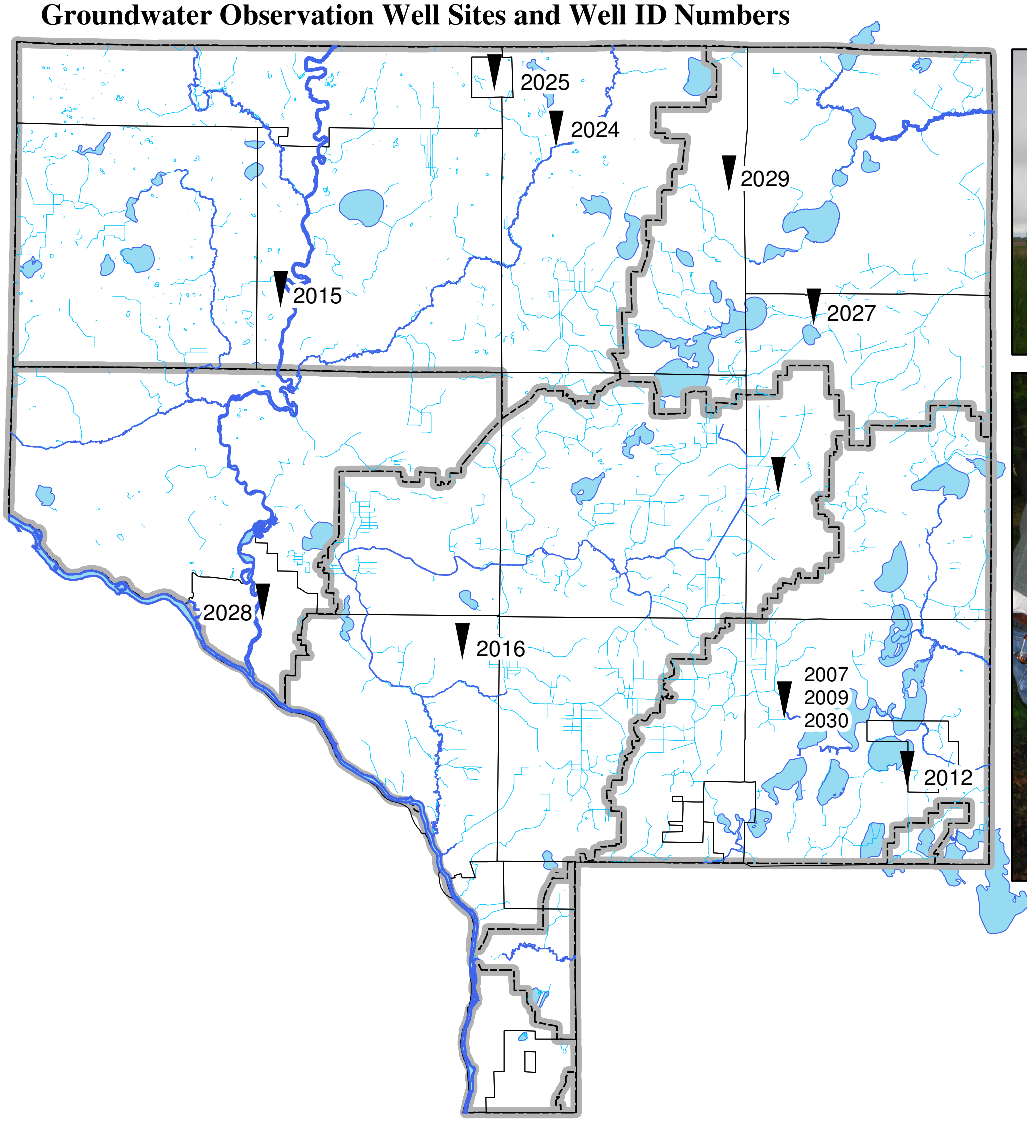


Groundwater Hydrology

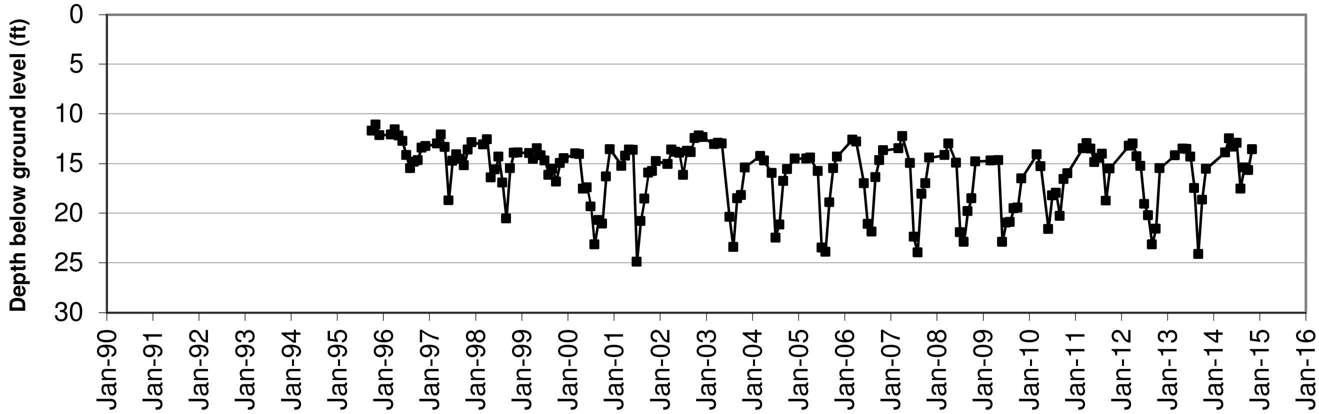
The Minnesota Department of Natural Resources (MN DNR) and ACD are interested in understanding Minnesota's groundwater quantity and flow. The MN DNR maintains a network of groundwater observation wells across the state. The ACD is contracted to take monthly water level readings in wells at 11 sites in 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 1990-2014. These results are not presented elsewhere in this report. Raw data can be downloaded from the MN DNR website.

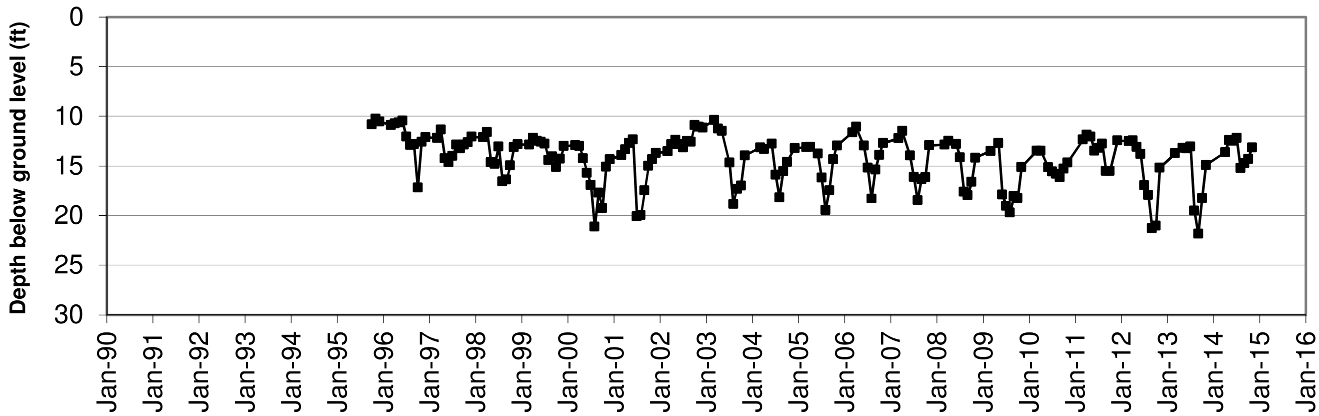
Groundwater Observation Well Sites and Well ID Numbers



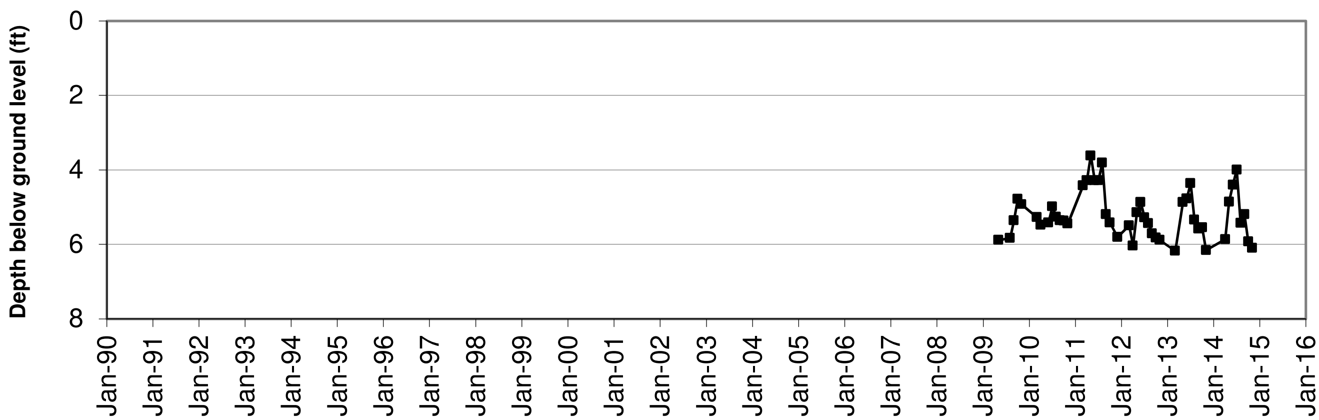
Observation Well #2007 (270 ft deep)—Lino Lakes



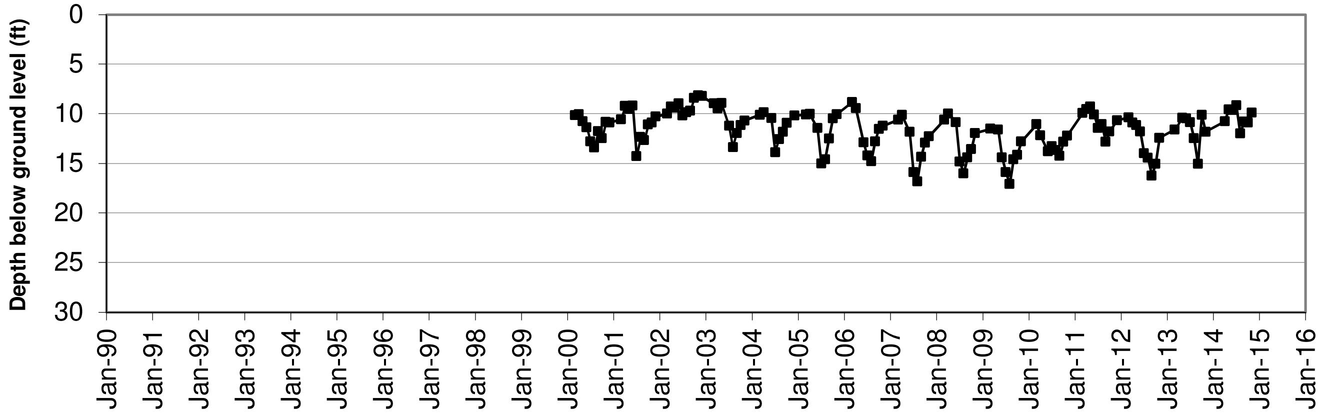
Observation Well #2009 (125 ft deep)—Lino lakes



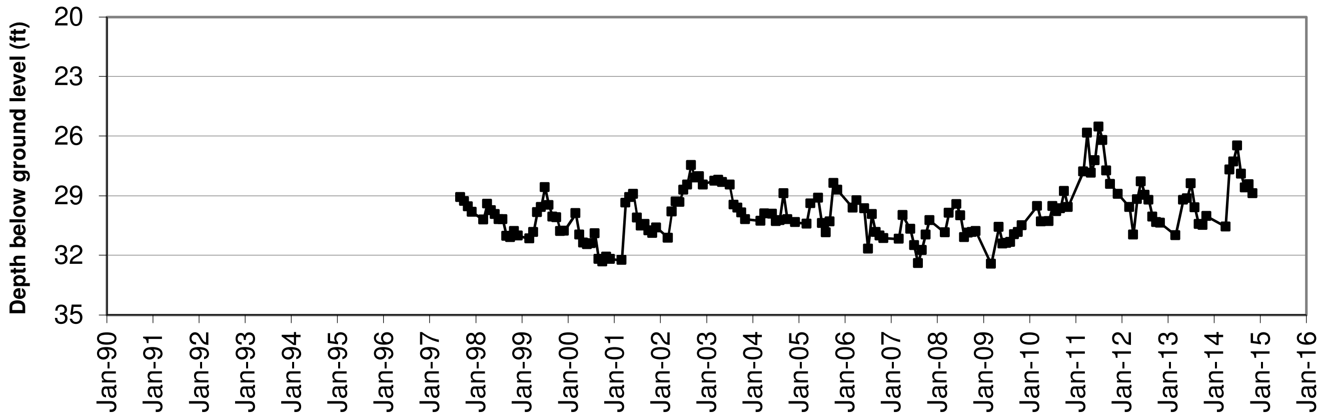
Observation Well #2030 (15 ft deep)—Lino Lakes



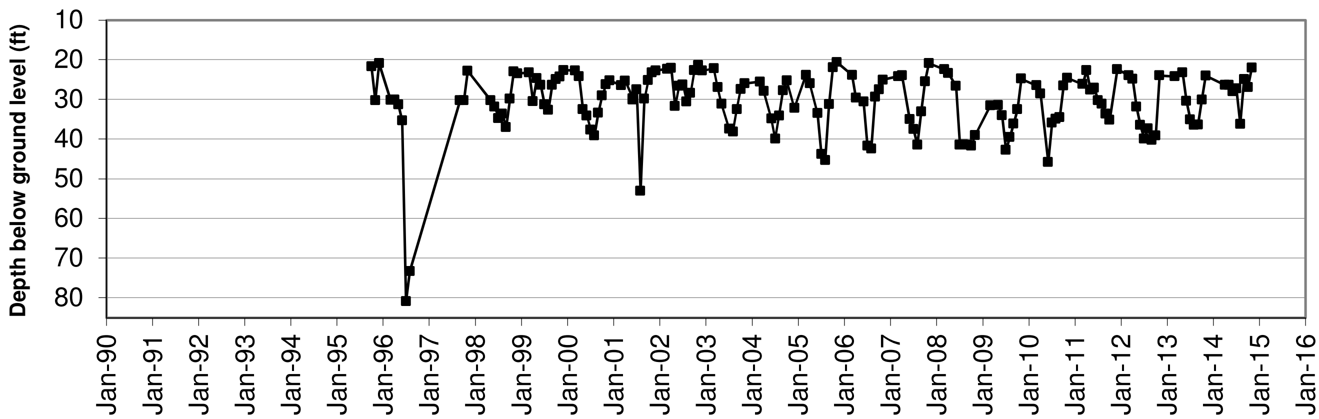
Observation Well #2012 (277 ft deep) – Centerville



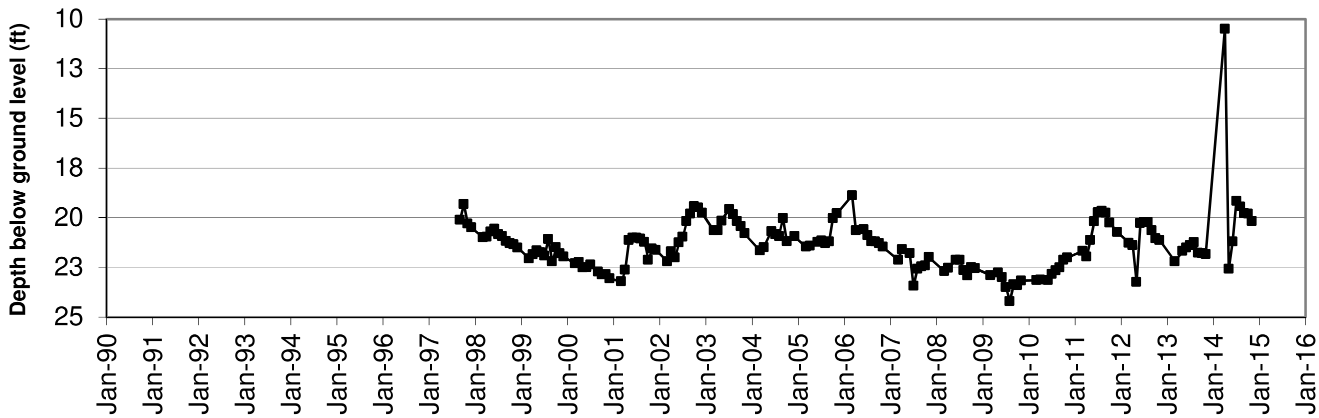
Observation Well #2015 (280 ft deep)—Ramsey



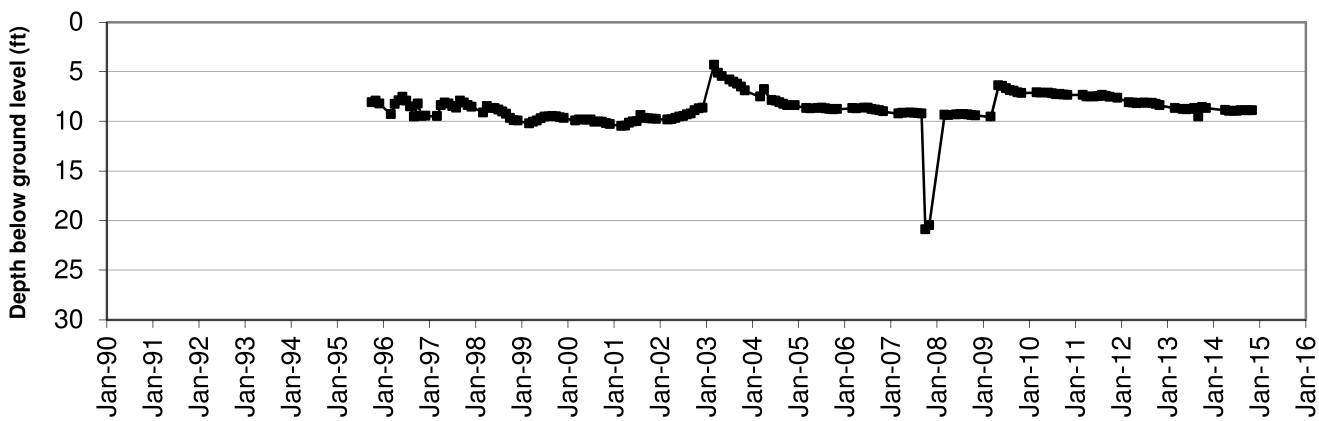
Observation Well #2016 (193 ft deep)—Coon Rapids



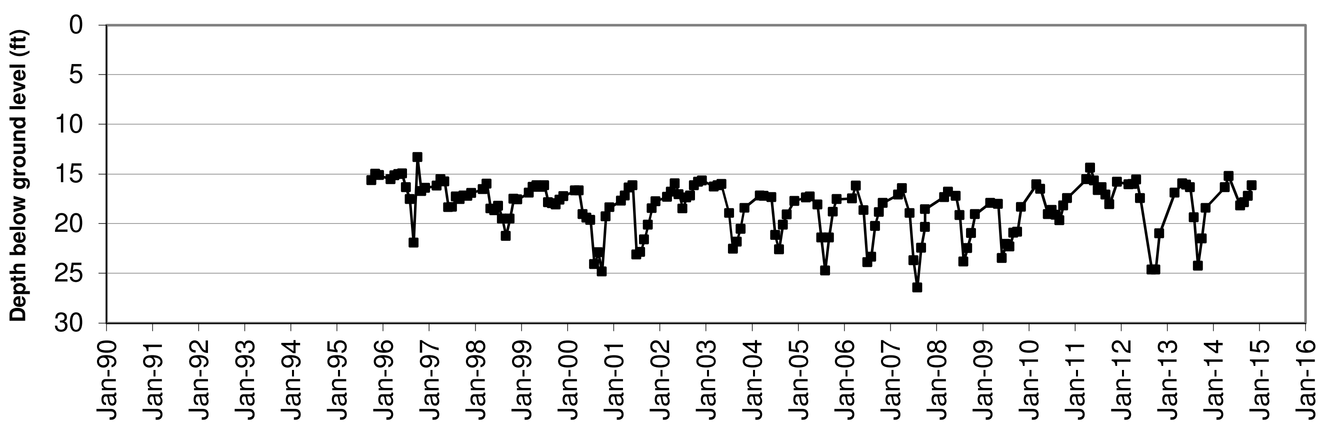
Observation Well #2024 (141 ft deep)—East Bethel



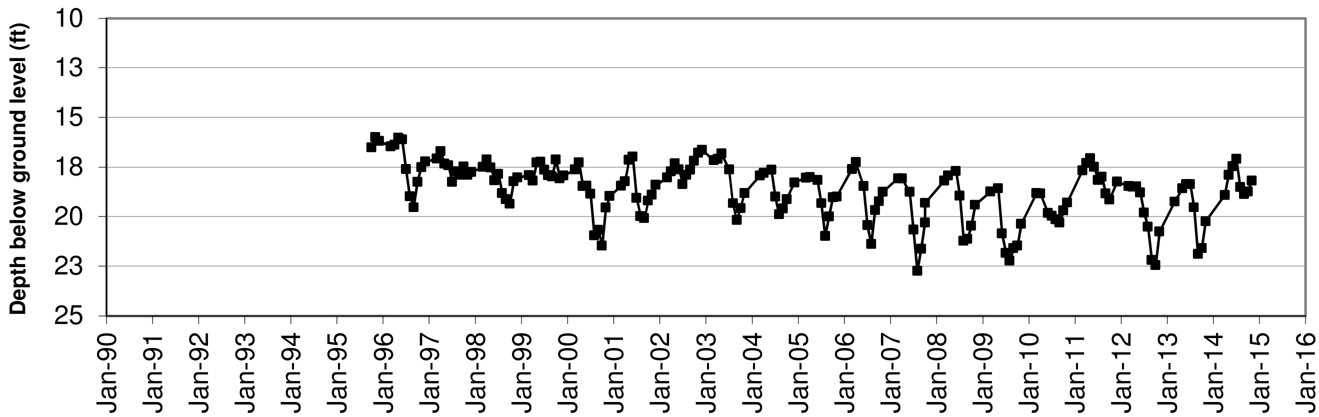
Observation Well #2025 (21 ft deep)—Bethel



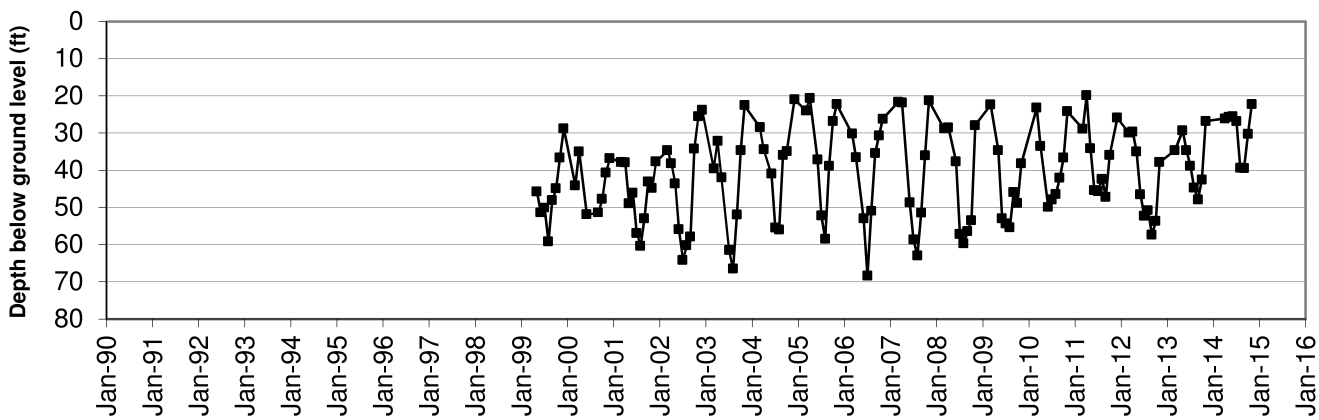
Observation Well #2026 (150 ft deep)— Carlos Avery #4



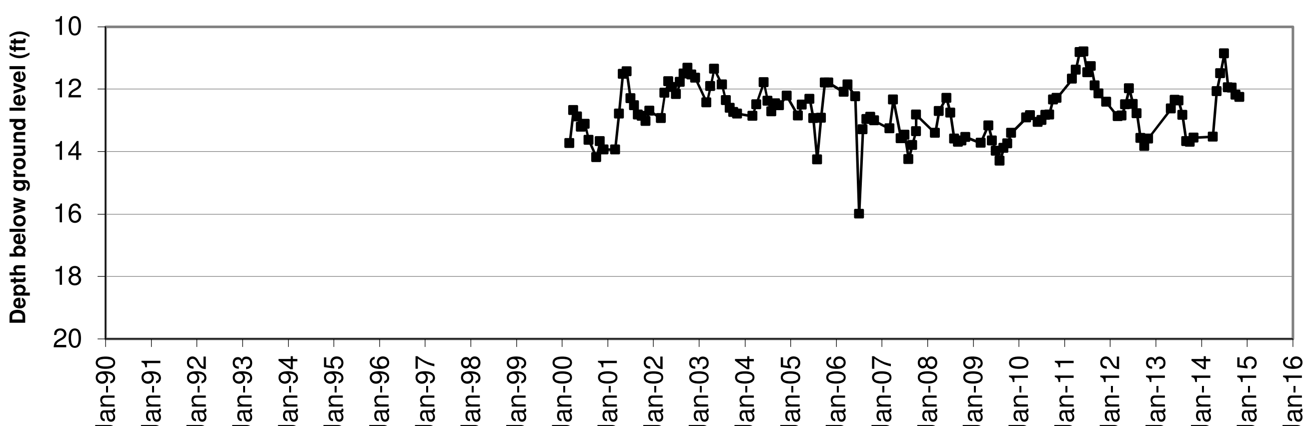
Observation Well #2027 (333 ft deep)— Columbus Twp.



Observation Well #2028 (510 ft deep)—Anoka



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

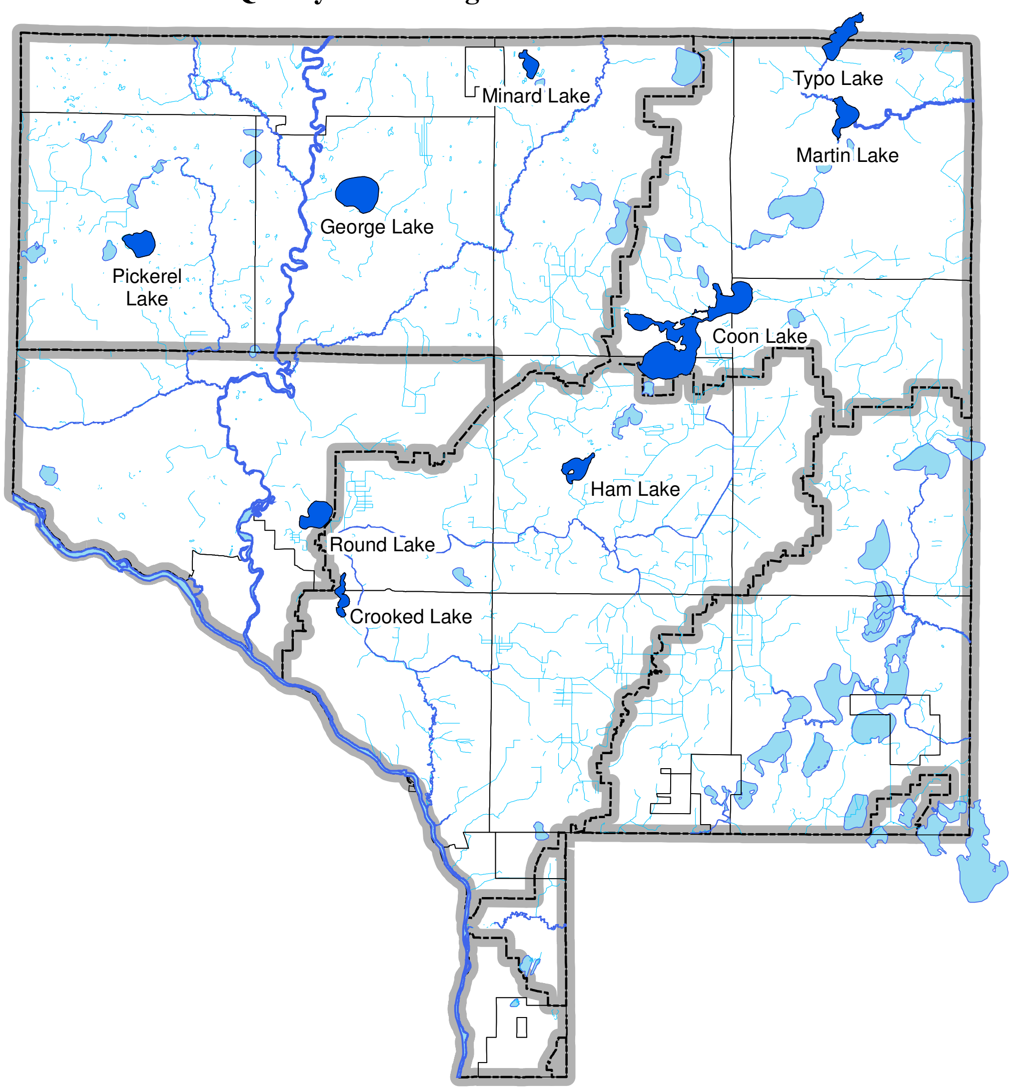


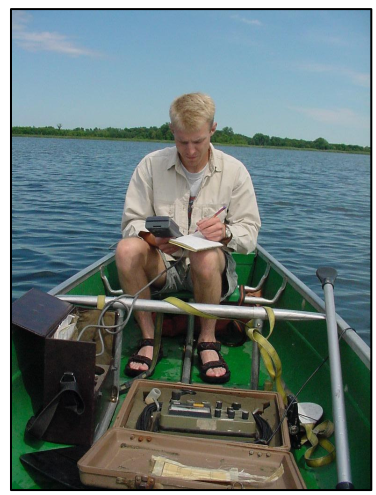
Lake Water Quality

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.

2014 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.

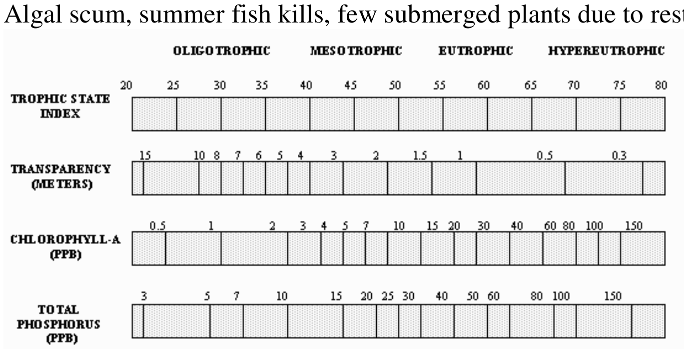
3. Eutrophic- In these lakes, the water is nutrient-rich. Productivity is high for both plants and fish. Abundant plant life, especially algae, results in poorer water clarity and can reduce the dissolved oxygen content when it decays. Algae blooms in the "dog days of summer" are commonplace. Bass and 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	2014
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 (E. Bay)				C					C	C	C		C	C	C		B	B	A	B	C	B		C	C	C	B	A	B	B	B	B	B	A
Coon (W. Bay)																														A		A		B
Crooked			C		C				C					B	C	B	B	B		B		B	B		B	B		B	B		B	A		A
East 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	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	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		C
Minard																																	A	A
East Moore	C	C	C	C	B	C	C							C				C	B	B	C	C	C		C									
West 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	A
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		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		D

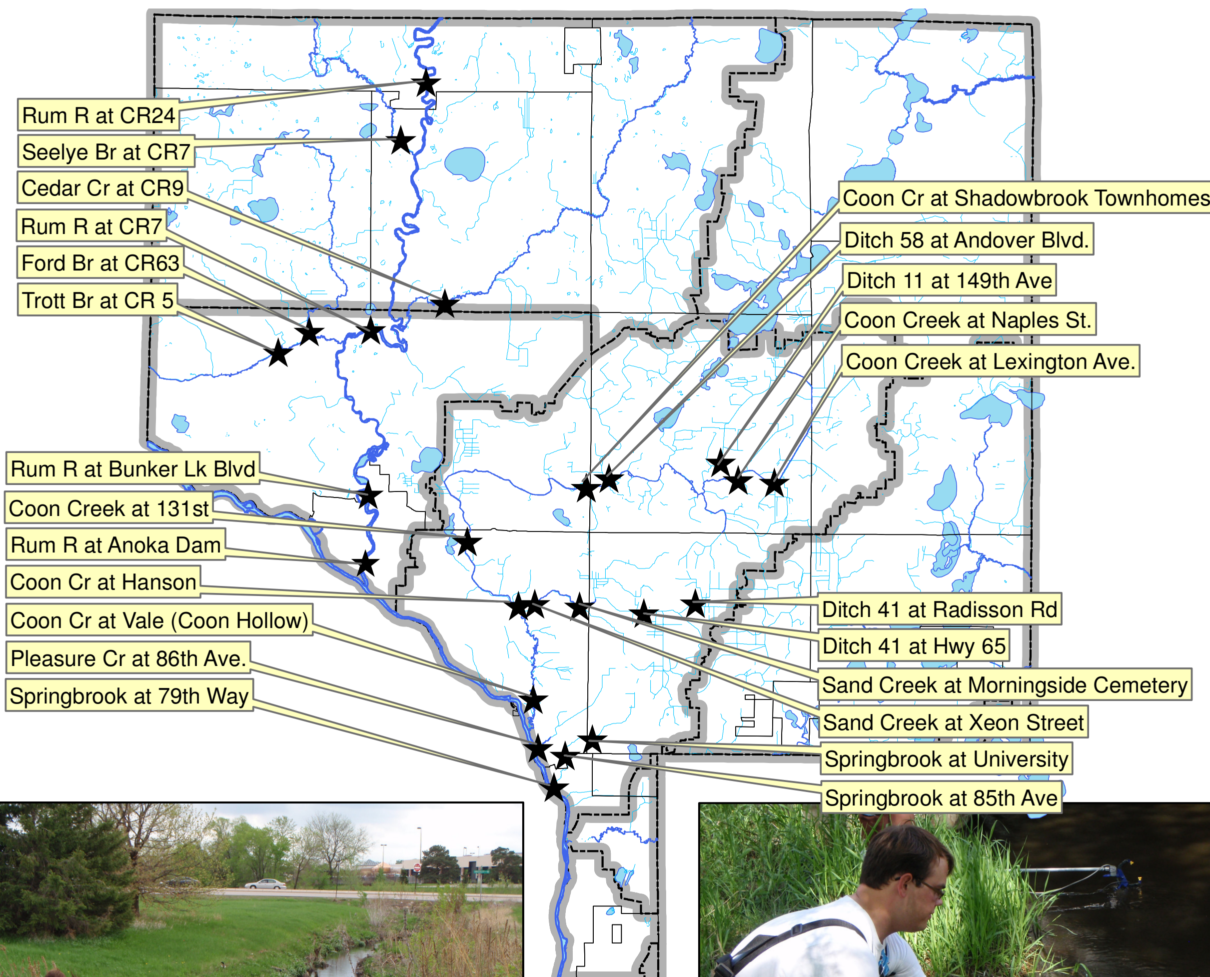
Stream Water Quality – Chemical Monitoring

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.

2014 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.

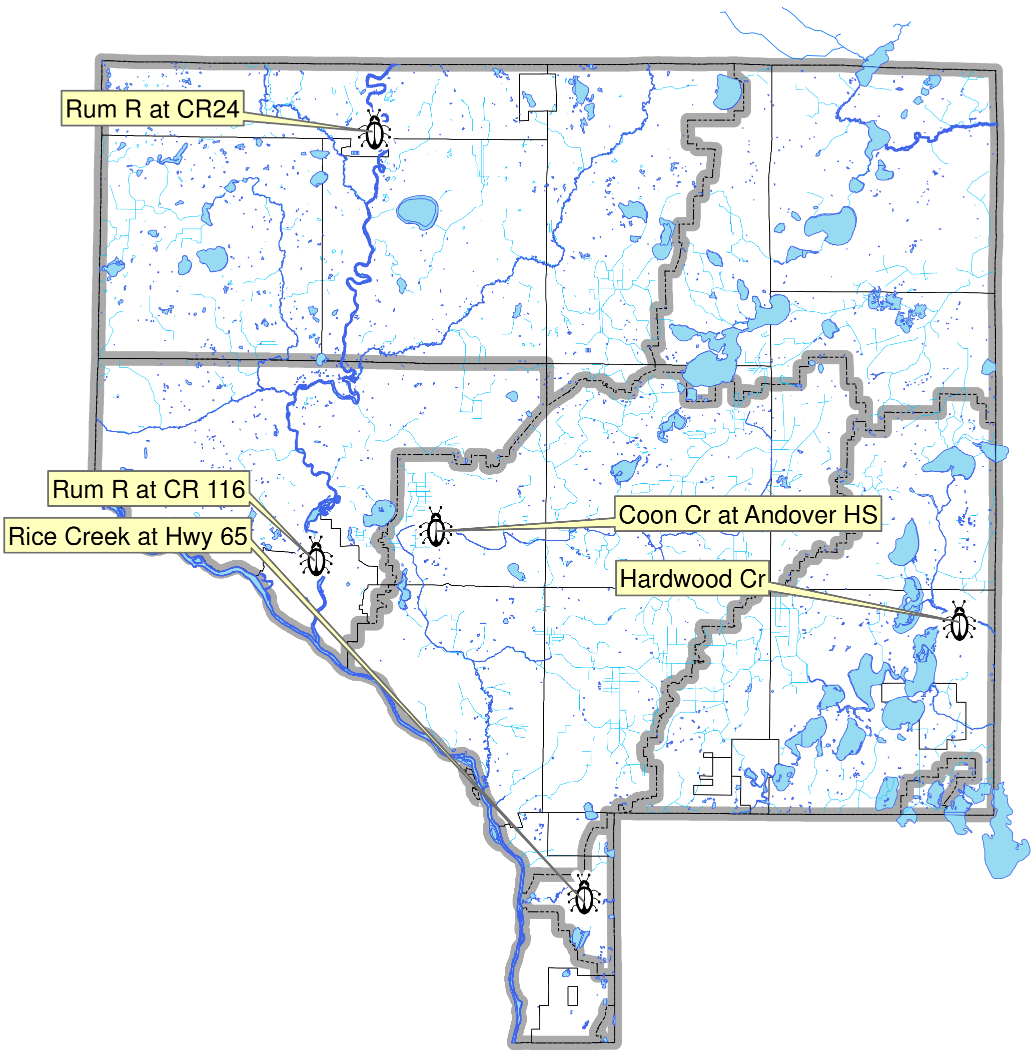
Stream Water Quality – Biological Monitoring

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.

2014 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.

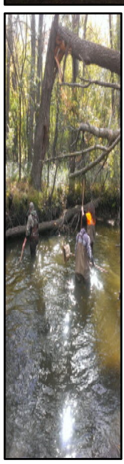
% Dominant Family: This measures the percentage of individuals in the sample that are in the sample's most abundant family. A high percentage is usually bad because it indicates low evenness (one or a few families dominate, and all others are rare).

Sites

In 2014, high school classes, with ACD staff supervision, sampled Five sites for benthic macroinvertebrates.

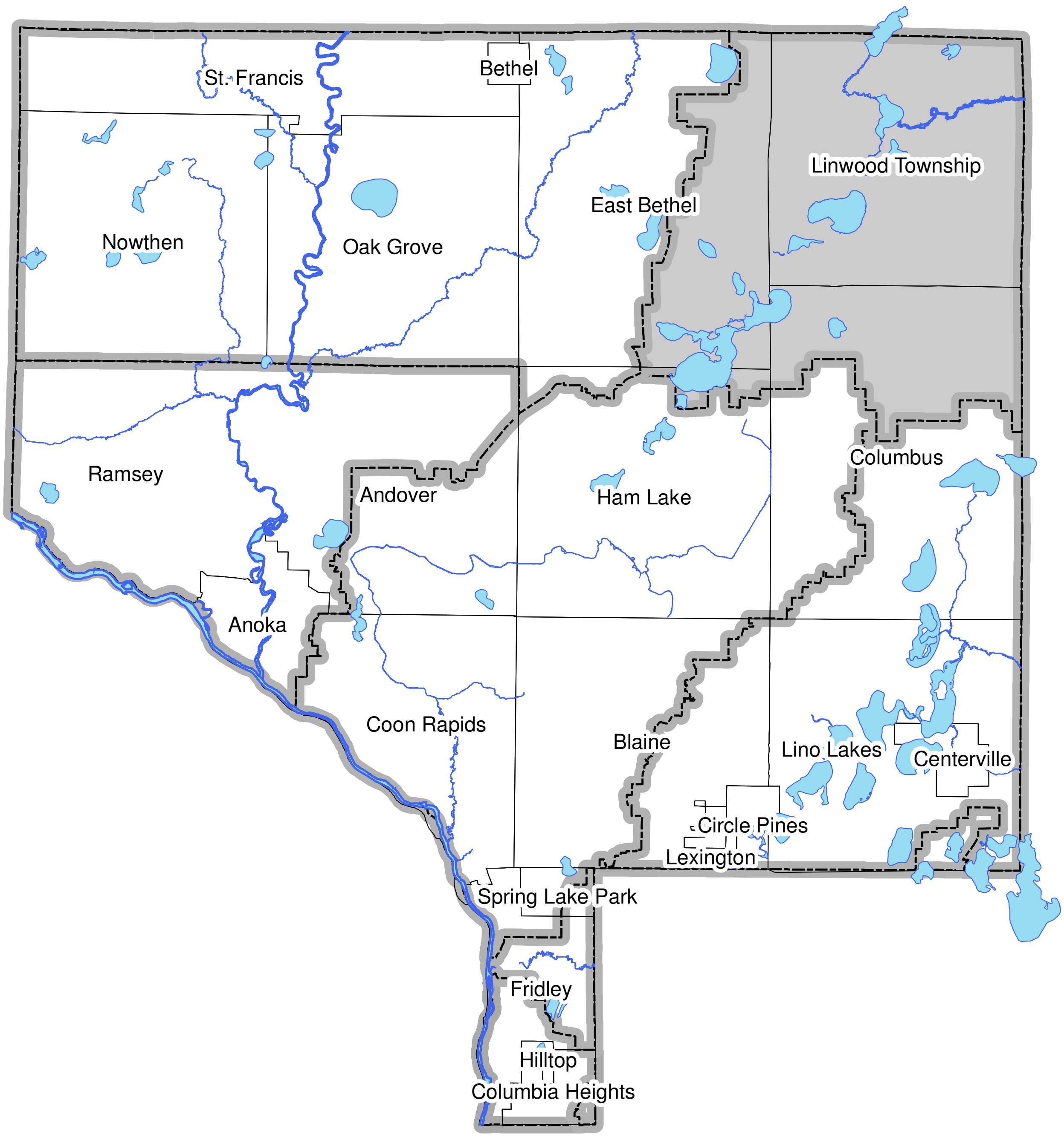
2014 Biomonitoring Sites and Corresponding Monitoring Groups

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



Excerpt from the
2014 Anoka Water Almanac

Chapter 2: Sunrise River Watershed



Prepared by the Anoka Conservation District

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
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Water Quality Grant Fund	SRWMO, ACD	2-46
Coon Lake Area Stormwater Retrofit Assessment	SRWMO, ACD	2-47
Carp Barriers Installation	SRWMO, ACD, Martin Lakers Assoc, DNR, Linwood Twp, et al	2-51
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On-call Administrative Services	SRWMO, ACD	2-59
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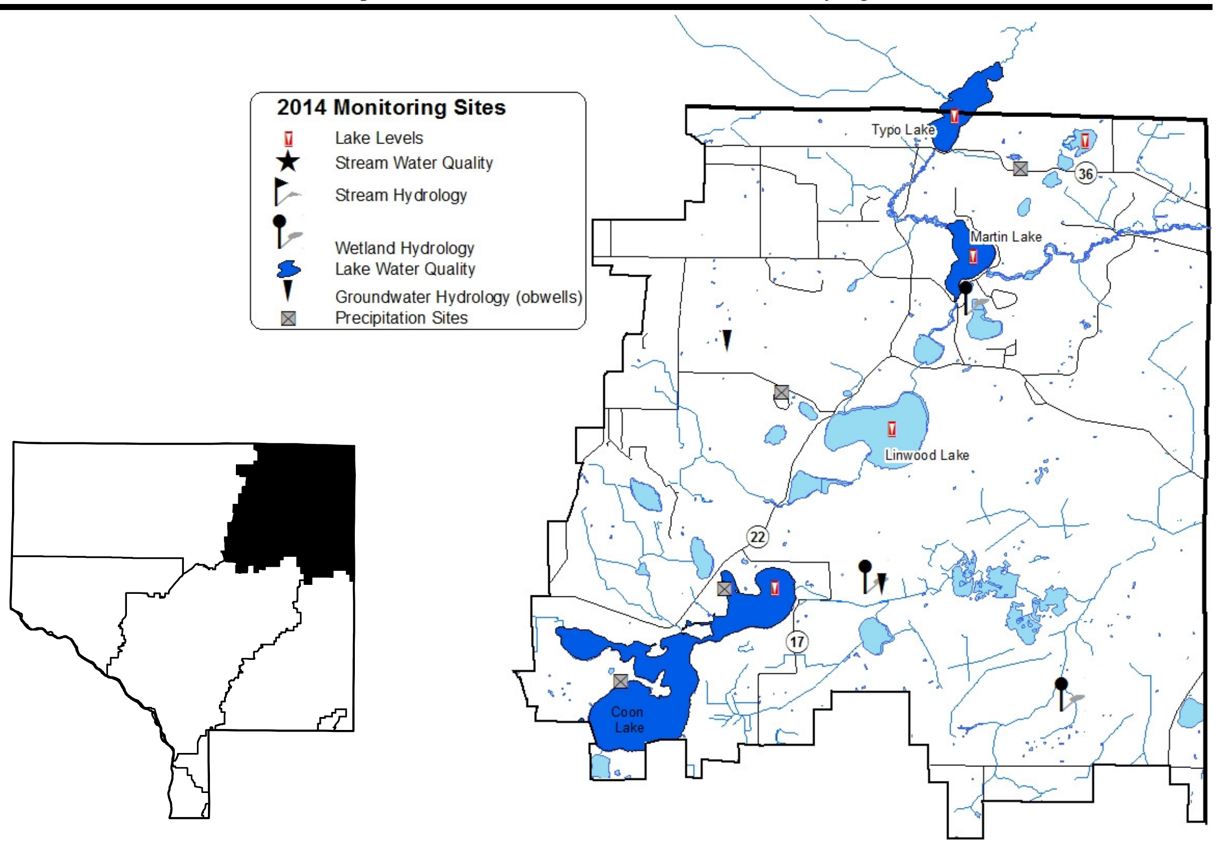
Groundwater Hydrology (obwells)	ACD, MNDNR	See Chapter 1
Precipitation	ACD, volunteers	See Chapter 1

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).

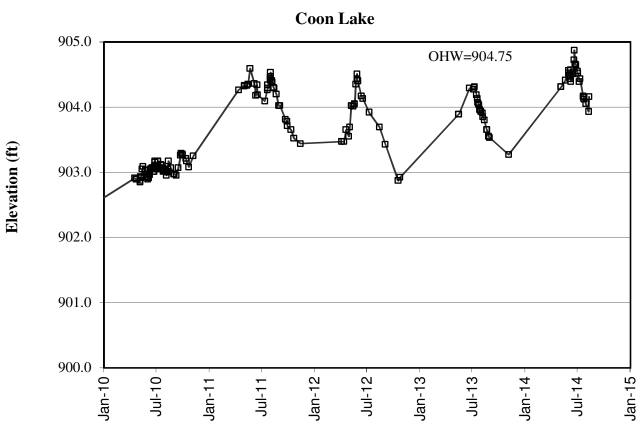
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

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

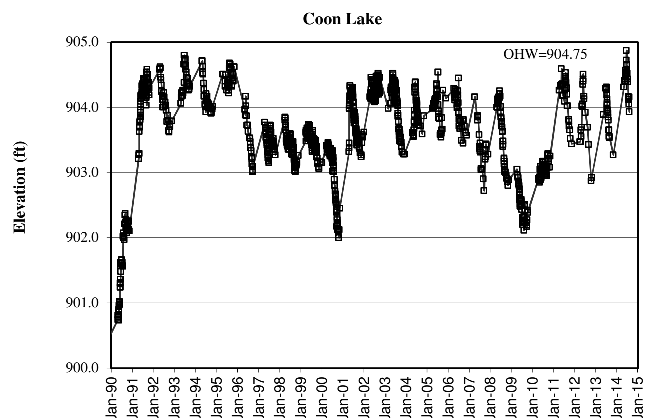
Results: Lake levels were measured by volunteers throughout the 2014 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. Lakes had sharply increasing water levels in spring and early summer 2014 when very heavy rainfall totals occurred. Rainfall tapered off later in the year and lake levels fell accordingly.

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.

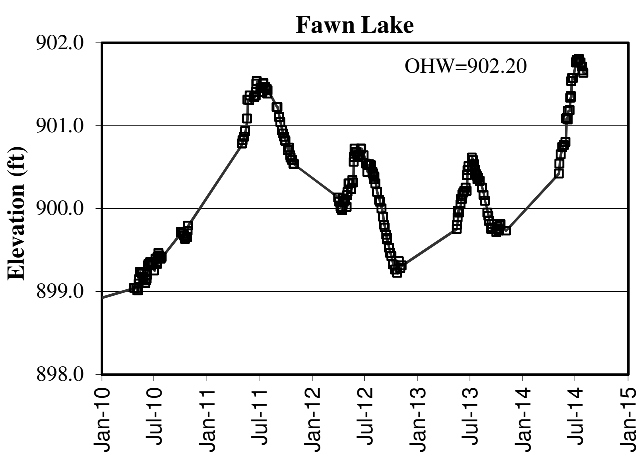
Coon Lake Levels – last 5 years



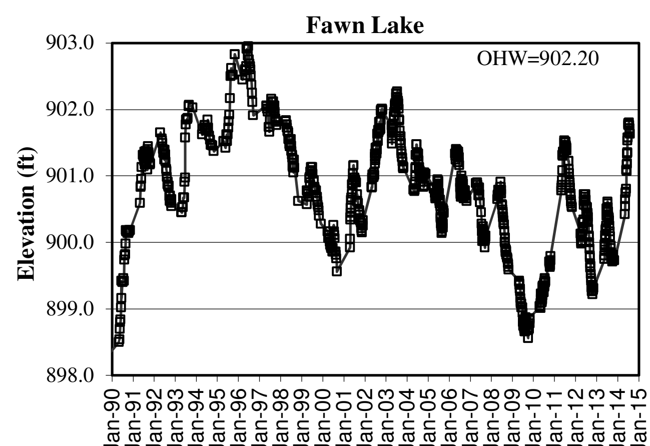
Coon Lake Levels – last 25 years



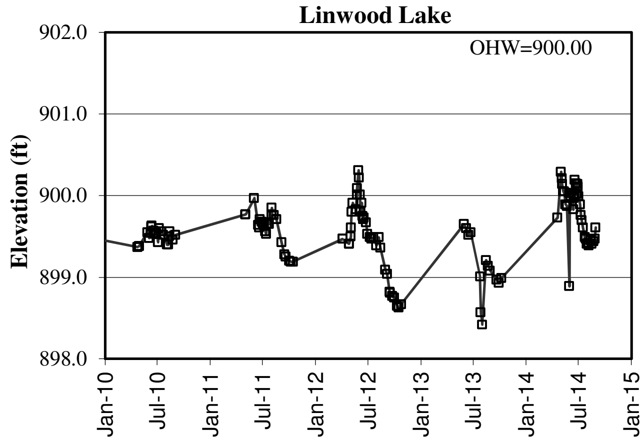
Fawn Lake Levels – last 5 years



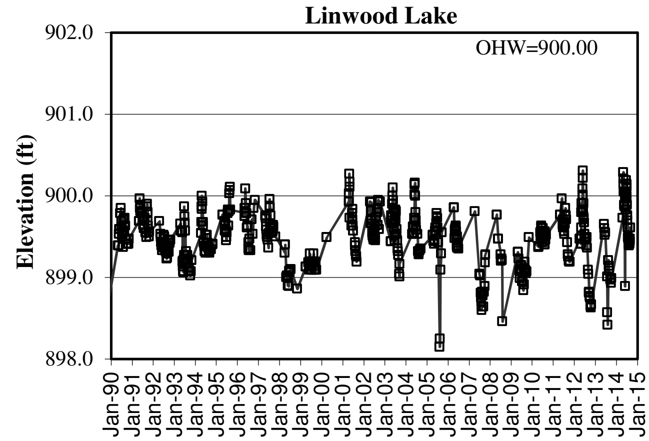
Fawn Lake Levels – last 25 years



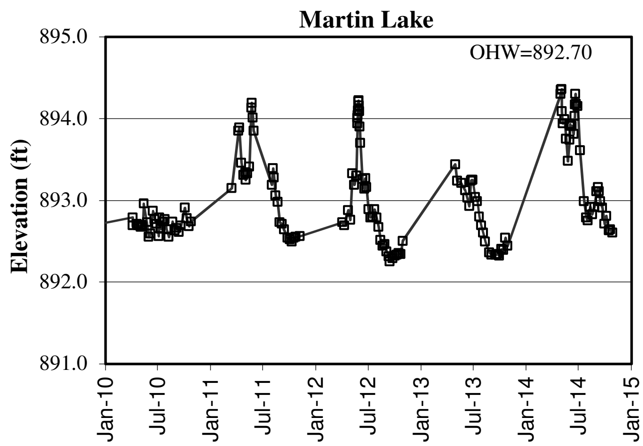
Linwood Lake Levels – last 5 years



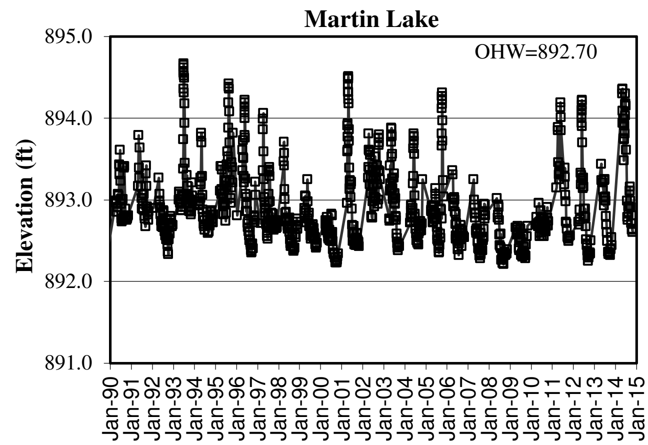
Linwood Lake Levels – last 25 years



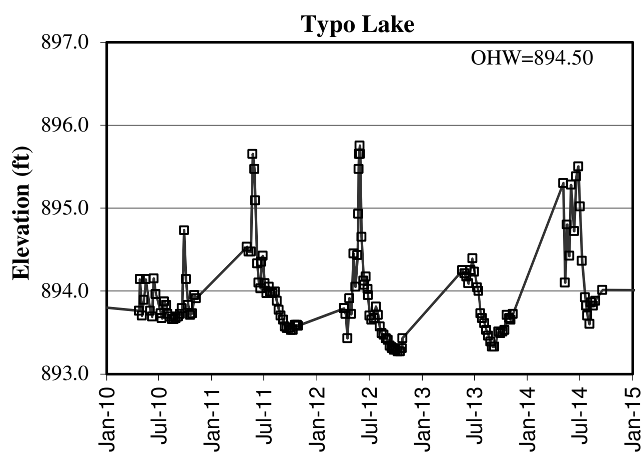
Martin Lake Levels – last 5 years



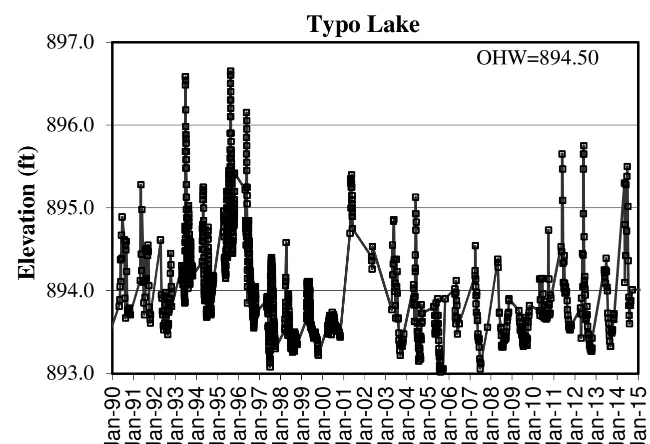
Martin Lake Levels – last 25 years



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

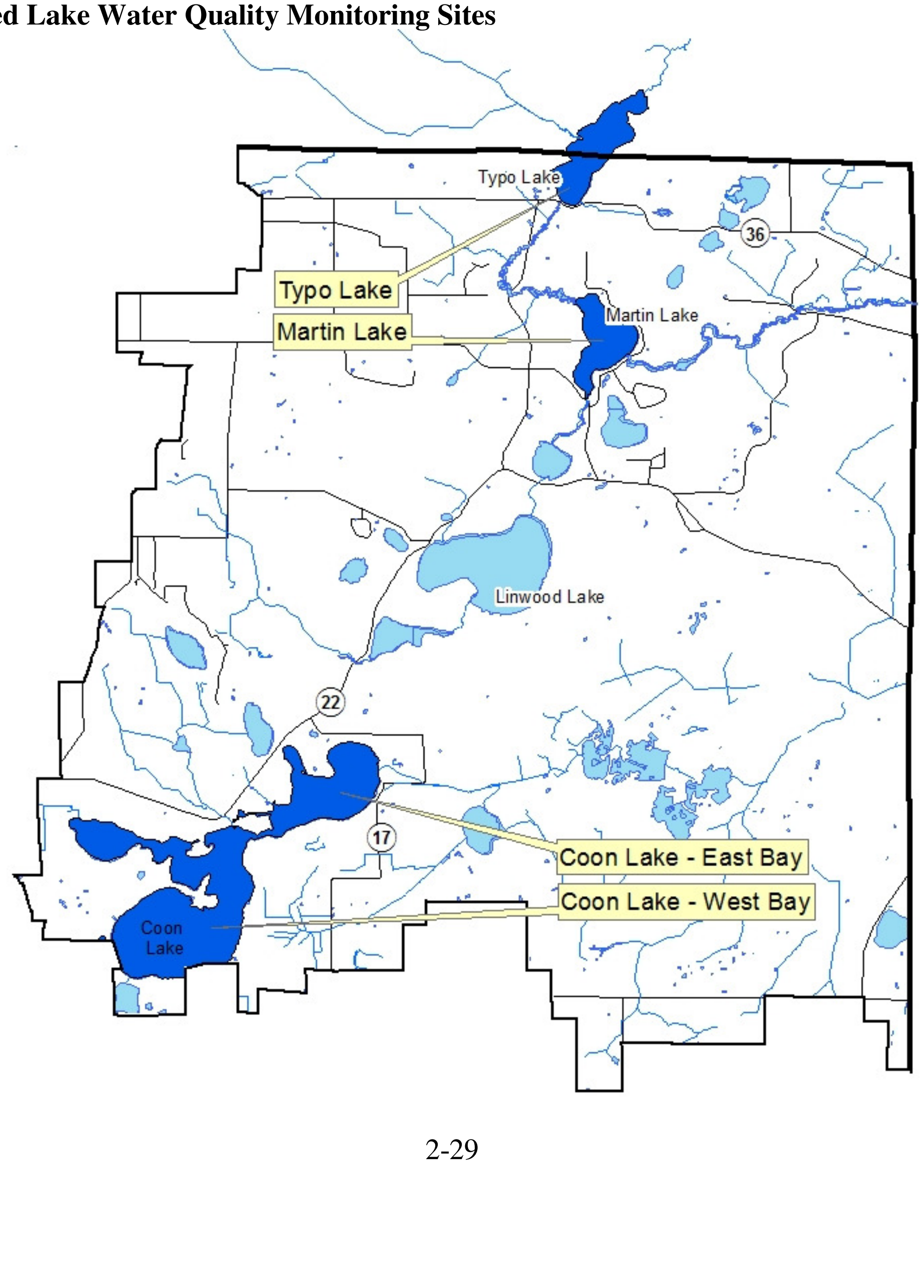
Coon Lake West Bay

Martin Lake

Typo 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.

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

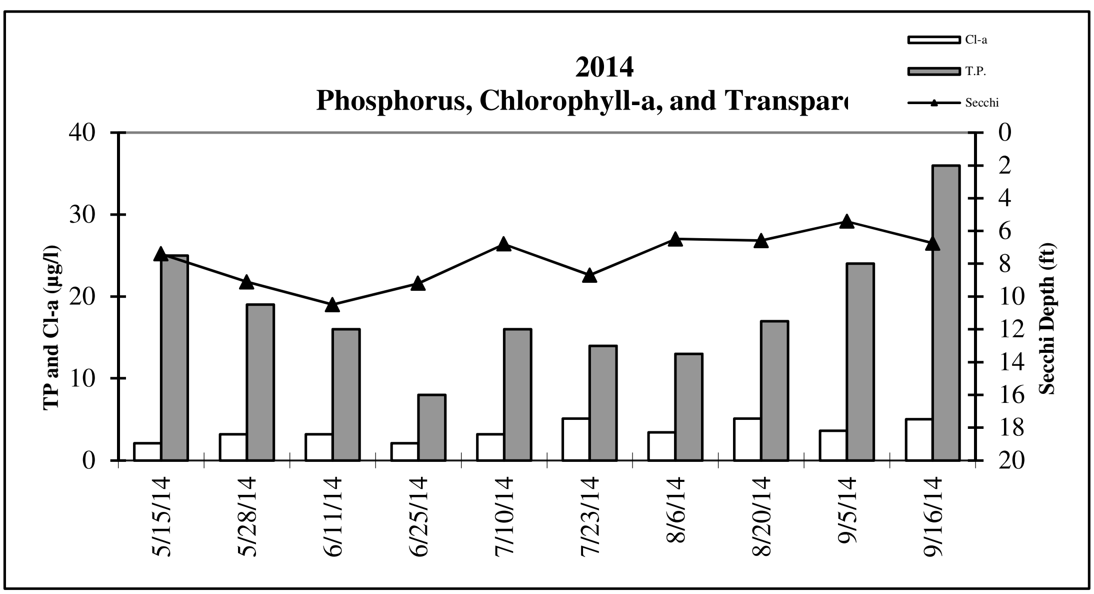
Coon Lake is located in east central Anoka County and is the county's largest lake. Coon Lake has a surface area of 1498 acres and a maximum depth of 27 feet (9 m). Public access is available at three locations with boat ramps, including one park with a swimming beach. The lake is used extensively by 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) and West Bay (aka southwest or south bay) of Coon Lake in 2014. The 2010-14 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, 2012 and 2014; data from other years do not lend themselves well to direct comparisons because monitoring regimes were likely different.

2014 Results – East Bay

In 2014 the East Bay was monitored every 2 weeks. The water quality is better than average for this region of the state (NCHF Ecoregion), receiving an A grade. Average values of important water quality parameters included 18.8 µg/L for total phosphorus, 3.6 µg/L chlorophyll-a, and Secchi transparency of 7.7 feet. Both Chlorophyll-a and phosphorous levels were the lowest of all monitored years. In addition, both have seen a drop in each of the last 5 years. Similarly, transparency results were the second deepest observed in all monitored years and had 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.

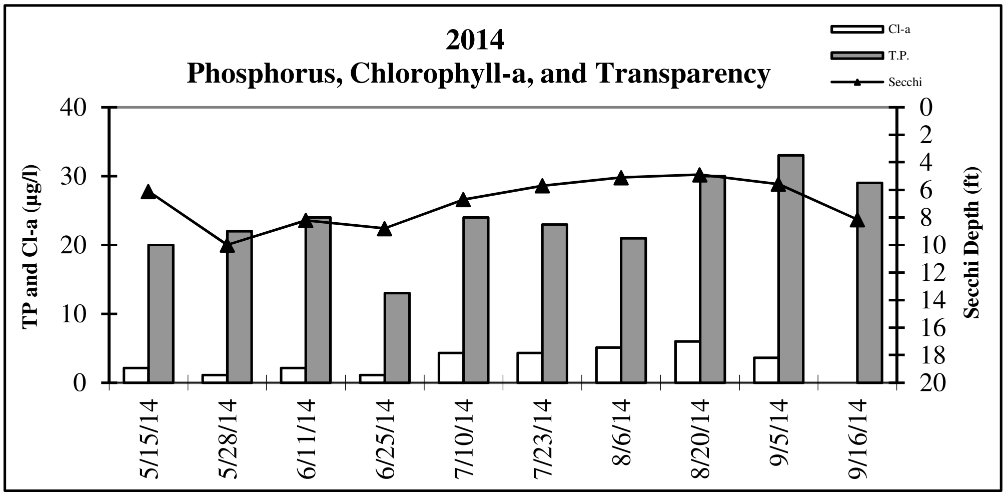
2014 Water Quality Results – East Bay



2014 Results – West Bay

In 2014 the West Bay had average water quality for this region of the state (NCHF Ecoregion), receiving a B letter grade. Average values of water quality parameters included 23.9 µg/L for total phosphorus, 3.3 µg/L chlorophyll-a, and Secchi transparency of 6.9 feet. Chlorophyll-a and phosphorus levels were the lowest of all monitored years. Despite only receiving a B grade, Secchi transparency results were the deepest observed in over 10 years and the second deepest of all monitored years.

2014 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. In both 2012 and 2014, water quality in the two bays was more similar. The East Bay typically had lower phosphorus readings, though the average differed by only 5.1 µg/L. Chlorophyll-a readings were more frequently lower in the West bay but the average reading only differed by 0.3 µg/L. Secchi transparency was consistently deeper in the East Bay but the average reading differed by 0.77 ft.

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>

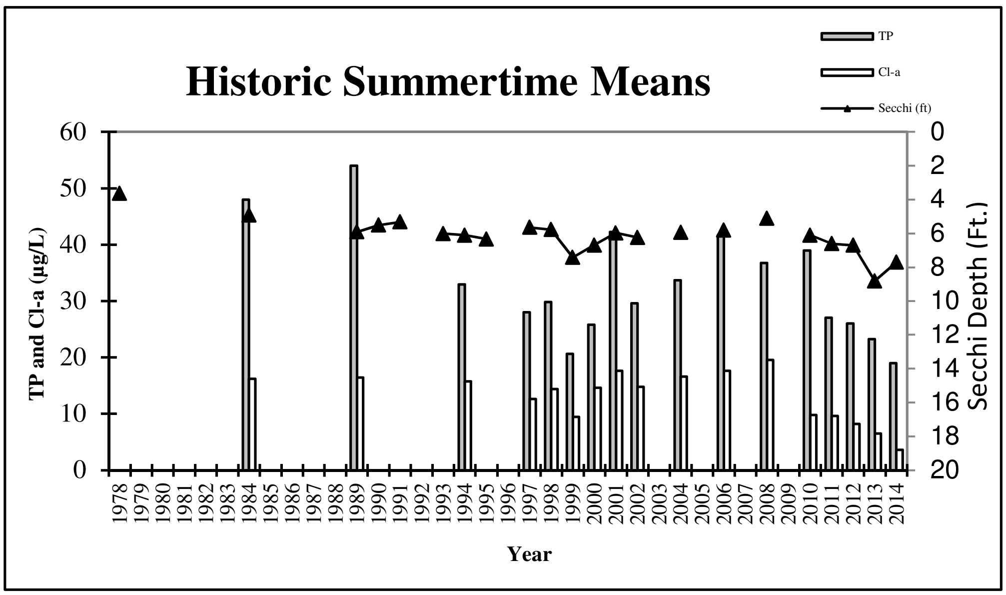
In the East Bay twenty one years of water quality data have been collected since 1978. During the most recent 13 years that were monitored (since 1996), the data collected included total phosphorus, chlorophyll-a, and Secchi transparency. For most of the other eight years (all pre-1997) only Secchi transparency 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.

When we examined those years with total phosphorus, chlorophyll-a, and Secchi transparency, excluding the years with only Secchi transparency data an improving water quality trend does exist. The analysis was a repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth ($F_{2,14}$=4.37, p=0.03). This is our preferred approach because it examines all three parameters simultaneously.

We also examined variables TP, Cl-a, and Secchi depth across all years of existing data using a one-way ANOVA. Including all years, a significant trend of improving TP ($F_{1,16}$=7.12, p=0.02) , Cl-a ($F_{1,16}$=7.13, p=0.02), and transparency ($F_{1,20}$=11.30, p=0.0033) is found.. In summary, it appears that water quality improvements 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

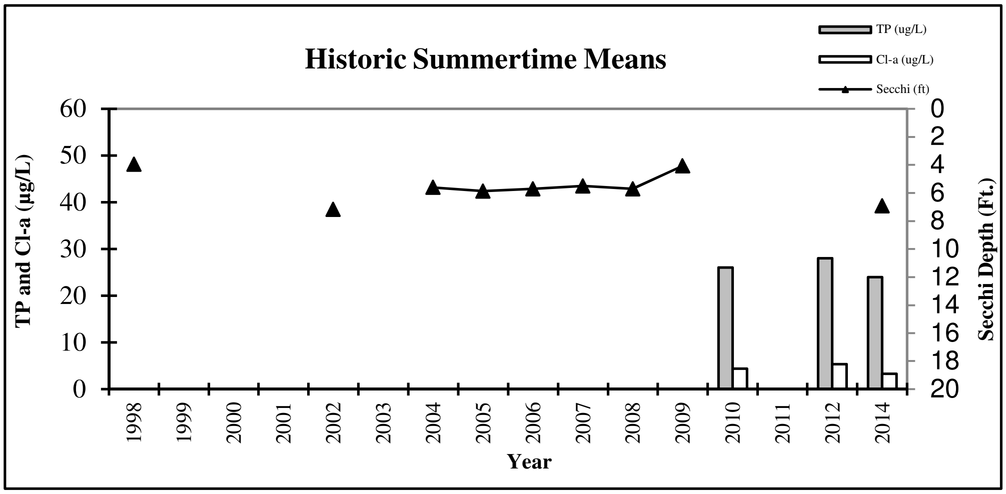


West Bay Trend Analysis

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 2014 the average secchi was 6.93 feet. For eight monitored years in 1998-2009, seven of those years had average secchi of <6 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 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 4 year consecutive decline in phosphorous levels. Phosphorous levels dropped to 27 µg/L in 2011, again to 26 µg/L in 2012, again to 23.2 µg/L (second lowest on record) in 2013, and in 2014 hit an all-time low of 18.8 µg/L. 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).

2014 Coon Lake East Bay Water Quality Data

Coon Lake East Bay			5/15/2014	5/28/2014	6/11/2014	6/25/2014	7/10/2014	7/23/2014	8/6/2014	8/20/2014	9/5/2014	9/16/2014			
2014 Water Quality Data			10:15	10:55	9:50	10:30	10:20	10:30	10:15	13:20	11:00	10:55			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.41	8.3	8.61	8.62	8.63	8.84	9.15	9.28	8.10	8.92	8.69	8.10	9.28
Conductivity	mS/cm	0.01	0.213	0.21	0.205	0.203	0.202	0.212	0.221	0.217	0.239	0.217	0.214	0.202	0.239
Turbidity	NTU	1	2.9	0.4	0.8	5.3	3.6	4.4	2	2	14	8	4	0	14
D.O.	mg/L	0.01	11.86	10.22	9.96	9.6	8.68	7.83	8.88	9.10	7.17	9.70	9.30	7.17	11.86
D.O.	%	1	112%	104%	114%	106%	105%	97%	111%	114%	85%	103%	105%	85%	114%
Temp.	°C	0.1	12	20	22	24	24	25	25.1	24.6	22.0	16.9	21.5	11.9	25.1
Temp.	°F	0.1	53.4	68.2	71.9	74.6	75.1	77.2	77.2	76.3	71.6	62.3	70.8	53.4	77.2
Salinity	%	0.01	0.1	0.1	0.1	0.1	0.1	0.1	0.11	0.11	0.11	0.10	0.10	0.10	0.11
Cl-a	ug/L	0.5	2.1	3.2	3.2	2.1	3.2	5.1	3.4	5.1	3.6	5.0	3.6	2.1	5.1
T.P.	mg/L	0.010	0.025	0.019	0.016	0.008	0.016	0.014	0.013	0.017	0.024	0.036	0.019	0.008	0.170
T.P.	ug/L	10	25	19	16	8	16	14	13.0	17.0	24.0	36.0	19.0	8.0	170.0
Secchi	ft	0.1	7.4	9.11	10.5	9.2	6.8	8.7	6.5	6.6	5.4	6.8	7.7	5.4	10.5
Secchi	m	0.1	2.26	2.78	3.20	2.80	2.07	2.65	2.0	2.0	1.7	2.1	2.3	1.7	3.2
Physical			1.0	1.0	2.0	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.2	1.0	2.0
Recreational			1.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.1	1.0	2.0

*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	ACD
Year	1978	1984	1989	1990	1991	1993	1994	1995	1997	1998	1999	2000	2001	2002	2004	2006	2008	2010	2011	2012	2013	2014
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	19.0
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	3.6
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	2.35
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	7.7

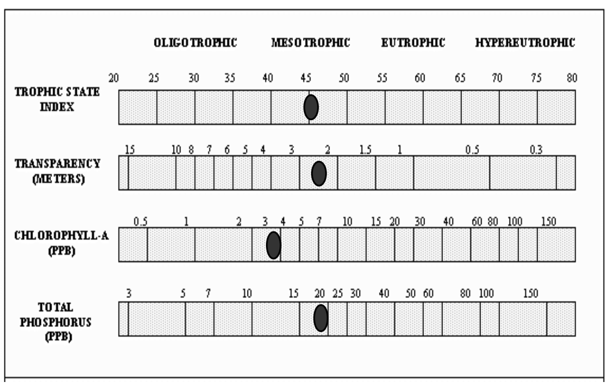
Carlsons trophic state indices

TSIP		60	62				55		52	53	48	51	58	53	55	58	56	57	52	51	49	47
TSIC		58	58				58		55	57	53	57	59	57	58	59	60	53	53	51	49	43
TSIS	58	54	52	53	53	51	51	51	52	52	48	50	51	51	51	52	54	51	50	49	46	48
TSI		57	57				54		53	54	50	53	56	54	55	56	57	54	51	51	48	46

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	2014
TP		C	C				C		B	B	A	B	C	B	C	C	C	C	B	B	B+	A
Cl-a		B	B				B		B	B	A	B	B	B	B	B	B	A	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	B
Overall	**D**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**B**	**B**	**A**	**B**	**C**	**B**	**C**	**C**	**C**	**B-**	**B**	**B**	**B+**	**A**

Carlson's Trophic State Index



2014 Coon Lake West Bay

Water Quality Data

Coon Lake West Bay
2014 Water Quality Data

	Units	R.L.*	5/15/2014 10:00 Results	5/28/2014 10:20 Results	6/11/2014 9:30 Results	6/25/2014 9:55 Results	7/10/2014 9:50 Results	7/23/2014 9:50 Results	8/6/2014 9:45 Results	8/20/2014 12:50 Results	9/5/2014 10:35 Results	9/16/2014 10:30 Results	Average	Min	Max
pH		0.1	8.21	8.13	8.40	8.45	8.48	8.33	8.60	8.63	8.28	8.84	8.44	8.13	8.84
Conductivity	mS/cm	0.01	0.198	0.199	0.192	0.185	0.184	0.190	0.197	0.201	0.211	0.198	0.196	0.184	0.211
Turbidity	FNRU	1	1.90	0.10	1.60	7.20	5.40	10.70	12.30	3.50	13.70	4.00	6	0	14
D.O.	mg/l	0.01	11.22	11.31	9.27	9.35	7.90	6.89	7.54	8.14	8.34	10.20	9.02	6.89	11.31
D.O.	%	1	106%	96%	106%	98%	95%	185%	94%	101%	95%	105%	108%	94%	185%
Temp.	°C	0.1	12.1	20.7	22.0	24.0	23.5	24.9	25.1	24.6	21.4	15.3	21.4	12.1	25.1
Temp.	°F	0.1	53.8	69.3	71.7	75.1	74.2	76.8	77.1	76.3	70.5	59.5	70.4	53.8	77.1
Salinity	%	0.01	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.09	0.09	0.09	0.10
Cl-a	ug/L	0.5	2.1	1.1	2.1	1.1	4.3	4.3	5.1	6.0	3.6	<1.0	3.3	<1.0	6.0
T.P.	mg/l	0.010	0.020	0.022	0.024	0.013	0.024	0.023	0.021	0.030	0.033	0.029	0.024	0.013	0.033
T.P.	ug/l	10	20	22	24	13	24	23	21	30	33	29	24	13	33
Secchi	ft		6.1	10.0	8.2	8.8	6.7	5.7	5.1	4.9	5.6	8.2	6.93	4.9	10.0
Secchi	m		1.9	3.0	2.5	2.7	2.0	1.7	1.6	1.5	1.7	2.5	2.11	1.5	3.0
Physical			1	1	2	1	1	1	1	1	1	2	1.2	1.0	2.0
Recreational			1	1	1	1	1	1	1	1	1	1	1.0	1.0	1.0

*reporting limit

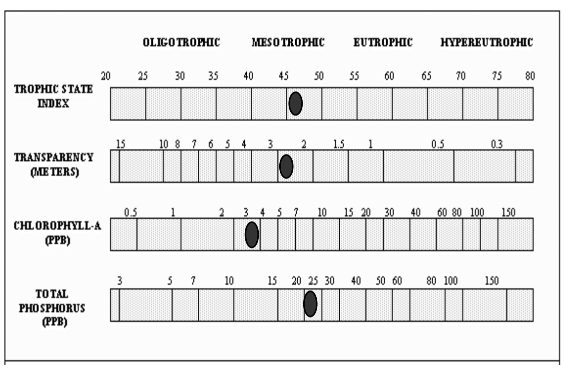
Coon Lake West Bay Historical Summertime Mean Values

Agency	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1998	2002	2004	2005	2006	2007	2008	2009	2010	2012	2014
TP									26.0	28.0	24.0
Cl-a									4.4	5.4	3.3
Secchi (m)	1.21	2.19	1.71	1.79	1.74	1.68	1.74	1.24			2.1
Secchi (ft)	3.97	7.18	5.61	5.87	5.71	5.51	5.71	4.07			6.9
Carlson's Trophic State Index											
TSIP									51	52	50
TSIC									45	47	42
TSIS	57	49	52	52	52	53	52	57			49
TSI									48	50	47

Coon Lake West Bay Water Quality Report Card

Year	1998	1999	2001	2003	2004	2006	2007	2009	2010	2012	2014
TP (µg/L)									B	B	B
Cl-a (µg/L)									A	A	A
Secchi (m)	C	C	C	C	C	C	C	C			C
Overall									**A-**	**A-**	**B**

Carlson's Trophic State Index



Typo Lake

Linwood Township, Lake ID # 03-0009

Background

Typo Lake is located in the northeast portion of Anoka County and the southeast portion of Isanti County. It has a surface area of 290 acres and maximum depth of 6 feet (1.82 m), though most of the lake is about 3 feet deep. The lake has a mucky, loose, and unconsolidated bottom in some areas, while other areas have a sandy bottom. Public access is at the south end of the lake along Fawn Lake Drive. The lake is used very little for fishing or recreational boating because of the shallow depth and extremely poor water quality. The lake's shoreline is mostly undeveloped, with only 21 homes within 300 feet of the lakeshore. The lake's watershed of 11,520 acres is 3% residential, 33% agricultural, 28% wetlands, with the remainder being forested or grassland. Typo Lake is on the Minnesota Pollution Control Agency's (MPCA) list of impaired waters for excess nutrients.

2014 Results

In 2014 Typo Lake had extremely poor water quality compared to other lakes in this region (NCHF Ecoregion), receiving an overall D- letter grade. While the overall grade is still poor, it is the best grade received in all years monitored. In addition, some of the most important parameters were the best they have ever been observed. In the worst two years of results, total phosphorus averaged 340 (2007) and 353 µg/L(2009), respectively. Total phosphorus in 2014 averaged 182 µg/L, which while still very high, but is the lowest observed since 1997. Chlorophyll-a levels were lower in 2014 (42.8 µg/L) than in any other year in monitored history. In both 2007 and 2009 a bright white Secchi disk could be seen only 5-6 inches below the surface, on average. There was a slight improvement in 2012 to 9-10 inches and a larger improvement in 2014 to 21-22 inches. The reason for the especially poor conditions in 2007 and 2009 seems to be drought-induced low water levels. To that same sentiment, it is reasonable to believe that the improvements observed in 2014 may be a result of above average rainfall.

Trend Analysis

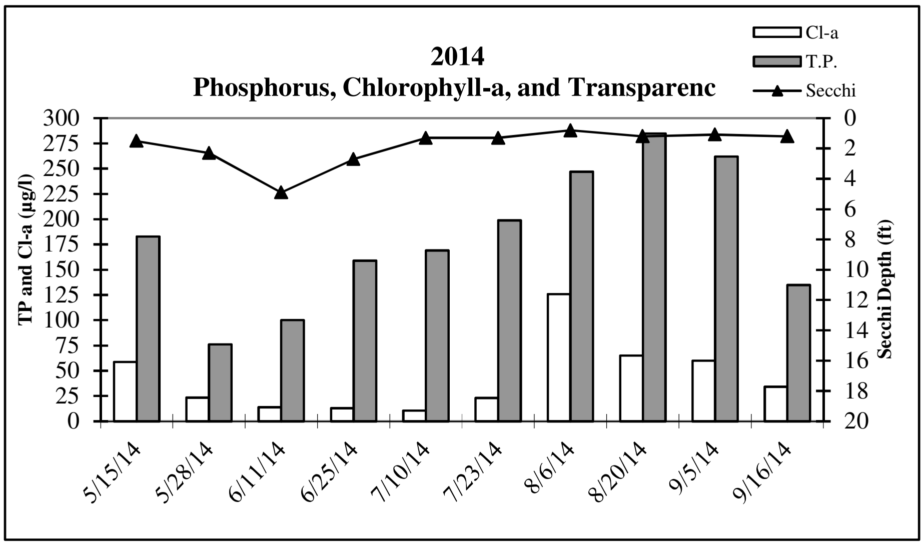
Fourteen years of water quality monitoring have been conducted by the Minnesota Pollution Control Agency (1993, '94, and '95) and the Anoka Conservation District (1997-2001, '03, '05, '07, '09, '12, '14). Water quality has significantly deteriorated from 1993 to 2014 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2,11}=4.84$, $p=0.03$). Though, tested individually (one-way ANOVAs on the individual response variables) TP, Cl-a, and Secchi depth show no significant change. The trend toward poorer phosphorus and transparency continue to appear to be strong despite the fact that in 2012 and 2014 these parameters were slightly better than the previous years monitored.

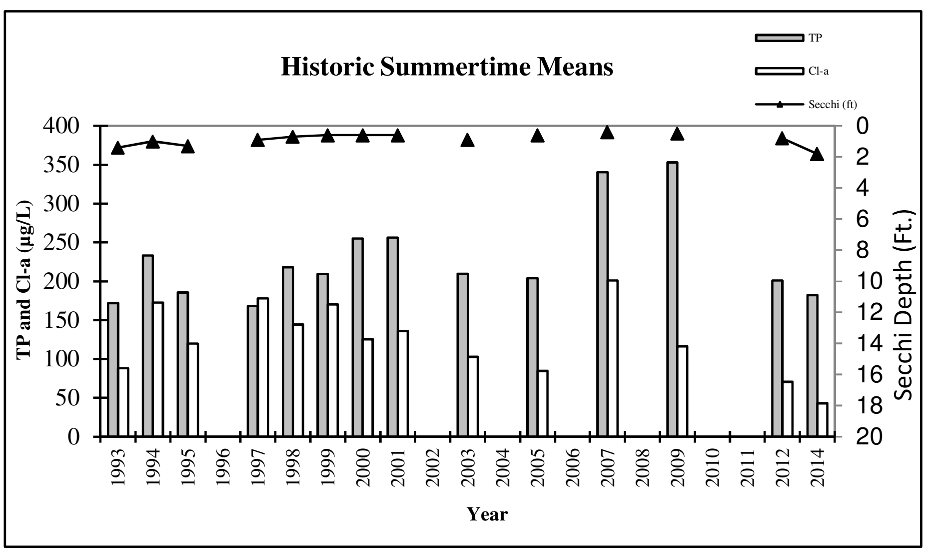
Discussion

Typo Lake, along with Martin Lake downstream, were the subject of TMDL study by the Anoka Conservation District which was approved by the State and EPA in 2012. This study documented the source of nutrients to the lake, the degree to which each is impacting the lake, and put forward lake rehabilitation strategies. Some factors impacting water quality on Typo Lake include rough fish, high phosphorus inputs from a ditched wetland west of the lake, and lake sediments. A carp barrier project between Martin and Typo lakes has been approved and funded. The first barrier was installed in 2014 with contractors set to install the final three in 2015.

Typo Lake Water Quality Results

Typo Lake		Date	5/15/2014	5/28/2014	6/11/2014	6/25/2014	7/10/2014	7/23/2014	8/6/2014	8/20/2014	9/5/2014	9/16/2014			
2014 Water Quality Data		Time	12:00	12:15	11:15	11:50	11:40	11:30	11:25	14:35	12:40	12:40			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	9.01	8.47	8.22	7.71	7.80	7.74	8.35	8.17	8.79	9.31	8.36	7.71	9.31
Conductivity	mS/cm	0.01	0.197	0.251	0.258	0.273	0.299	0.337	0.363	0.337	0.328	0.299	0.294	0.197	0.363
Turbidity	FNRU	1	62.30	21.70	8.70	18.30	48.20	103.00	12.10	89.80	88.40	38.60	49	9	103
D.O.	mg/l	0.01	16.65	8.66	10.64	3.90	2.82	2.54	5.33	5.74	9.18	11.85	7.73	2.54	16.65
D.O.	%	1	132%	96%	123%	46%	34%	31%	65%	65%	102%	121%	82%	31%	132%
Temp.	°C	0.1	12.5	21.1	22.8	22.0	22.7	24.7	24.0	23.7	20.1	15.1	20.87	12.53	24.71
Temp.	°F	0.1	54.6	70.0	73.0	71.5	72.9	76.5	75.3	23.7	68.1	59.1	69.6	23.7	76.5
Salinity	%	0.01	0.09	0.12	0.12	0.13	0.15	0.16	0.18	0.16	0.16	0.14	0.1	0.1	0.2
Cl-a	ug/l	0.5	58.7	23.5	13.9	12.8	10.7	23.1	126.0	65.2	59.8	34.2	42.8	10.7	126.0
T.P.	mg/l	0.010	0.183	0.076	0.100	0.159	0.169	0.199	0.247	0.285	0.262	0.135	0.182	0.076	0.285
T.P.	ug/l	10	183	76	100	159	169	199	247	285	262	135	182	76	285
Secchi	ft	0.1	1.5	2.3	4.9	2.7	1.3	1.3	0.8	1.2	1.1	1.2	1.8	0.8	4.9
Secchi	m	0.1	0.5	0.7	1.5	0.8	0.4	0.4	0.2	0.4	0.3	0.4	0.6	0.2	1.5
Physical			1.0	2.0	2.0	2.0	2.00	3.00	3.0	3.0	2.0	2.0	2.2	1.0	3.0
Recreational			1.0	2.0	1.0	2.0	2.00	3.00	3.0	3.0	1.0	3.0	2.1	1.0	3.0





Typo Lake Historic Summertime Mean Values

Agency	CLMP	CLMP	MPCA	MPCA	MPCA	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1974	1975	1993	1994	1995	1997	1998	1999	2000	2001	2003	2005	2007	2009	2012	2014
TP			172.0	233.0	185.6	168.0	225.7	202.1	254.9	256.0	209.8	204	340.5	353.0	201.0	182.0
Cl-a			88.1	172.8	119.6	177.8	134.7	67.5	125.3	136.0	102.5	84.7	200.9	116.2	70.7	42.8
Secchi (m)	0.23	0.27	0.43	0.29	0.38	0.27	0.21	0.25	0.18	0.19	0.3	0.2	0.1	0.1	0.2	0.6
Secchi (ft)	0.2	0.3	1.4	1.0	1.3	0.9	0.7	0.8	0.6	0.6	0.9	0.6	0.4	0.5	0.8	1.8

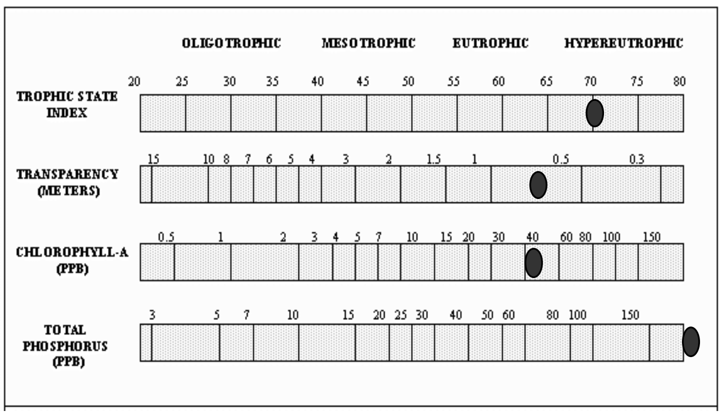
Carlson's Tropic State Indices

TSIP			78	83	79	78	82	81	83	82	81	81	88	89	81	79
TSIC			75	81	78	82	79	72	74	77	76	74	83	77	72	68
TSIS	81	79	72	78	74	79	82	80	86	85	77	83	93	93	83	67
TSI			75	81	77	79	81	78	81	81	78	79	88	86	79	71

Typo Lake Water Quality Report Card

Year	1974	1975	1993	1994	1995	1997	1998	1999	2000	2001	2003	2005	2007	2009	2012	2014
TP			F	F	F	F	F	F	F	F	F	F	F	F	F	F
Cl-a			F	F	F	F	F	D	F	F	F	F	F	F	D	C
Secchi	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Overall			**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**D-**

Carlson's Trophic State Index



Martin Lake

Linwood Township, Lake ID # 02-0034

Background

Martin Lake is located in northeast Anoka County. It has a surface area of 223 acres and maximum depth of 20 ft. Public access is available on the southern end of the lake. The lake is used moderately by recreational boaters and fishers, and would likely be used more if water quality improved. Martin Lake is almost entirely surrounded by private residences. The 5402 acre watershed is 18% developed; the remainder is vacant, agricultural, or wetlands. The non-native, invasive plant curly-leaf pondweed occurs in Martin Lake, but not at nuisance levels. Martin is on the Minnesota Pollution Control Agency's (MPCA) list of impaired waters for excess nutrients.

2014 Results

In 2014 Martin Lake had poor water quality compared to other lakes in the North Central Hardwood Forest Ecoregion (NCHF), receiving a C letter grade. This eutrophic lake has chronically high total phosphorus and chlorophyll-a. In 2014 total phosphorus averaged 91.0 µg/L, slightly below the lake's historical average of 92.1 µg/L but still well above the impairment threshold of 60 µg/L. Chlorophyll-a was the lowest observed in the lakes monitored history at 15.5 µg/L. Average Secchi transparency was only 3.4 feet in 2014 but slightly better than the historical average. ACD staff's subjective perceptions of the lake were that "high" algae made the lake less than desirable for swimming from July through September.

Trend Analysis

Thirteen years of water quality data have been collected by the Minnesota Pollution Control Agency (1983), Metropolitan Council (1998, 2008), and ACD (1997, 1999-2001, 2003, 2005, 2007, 2009, 2012, 2014). Citizens monitored Secchi transparency 17 other years. Anecdotal notes from DNR fisheries data indicate poor water quality back to at least 1954. A water quality change from 1983 to 2014 is detectable with statistical tests (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2,10}$=7.96, p=<0.01). However, further examination of the data reveals that no water quality parameter alone has changed significantly, and the direction of their changes is mixed. If the oldest year of data (1983) is excluded, there is no longer a statistically significant trend. Because the statistical trend is dependent upon one year's data and the direction of change is mixed among the parameters, the statistical trend can be largely discounted. No true trend likely exists.

Discussion

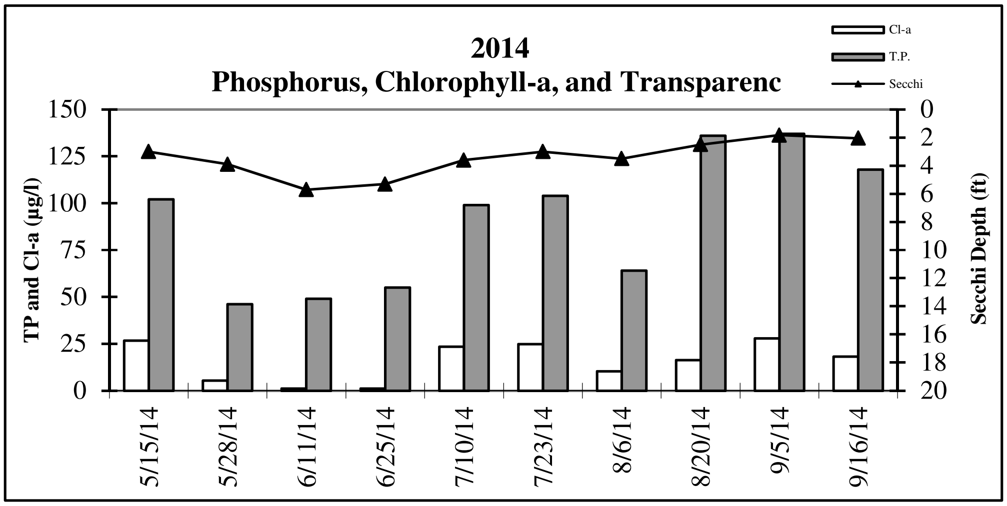
Martin Lake, along with Typo Lake upstream, were the subject of an TMDL study by the Anoka Conservation District that was approved by the State and EPA in 2012. This study documented the source of nutrients to the lake, the degree to which each is impacting the lake, and put forward lake rehabilitation strategies. Water from Typo Lake and internal loading (carp, septic systems, sediments, etc) are two of the largest negative impacts on Martin Lake water quality. A carp barrier project between Martin and Typo lakes has been approved and funded. The first barrier was installed in 2014 with contractors set to install the final two in 2015.

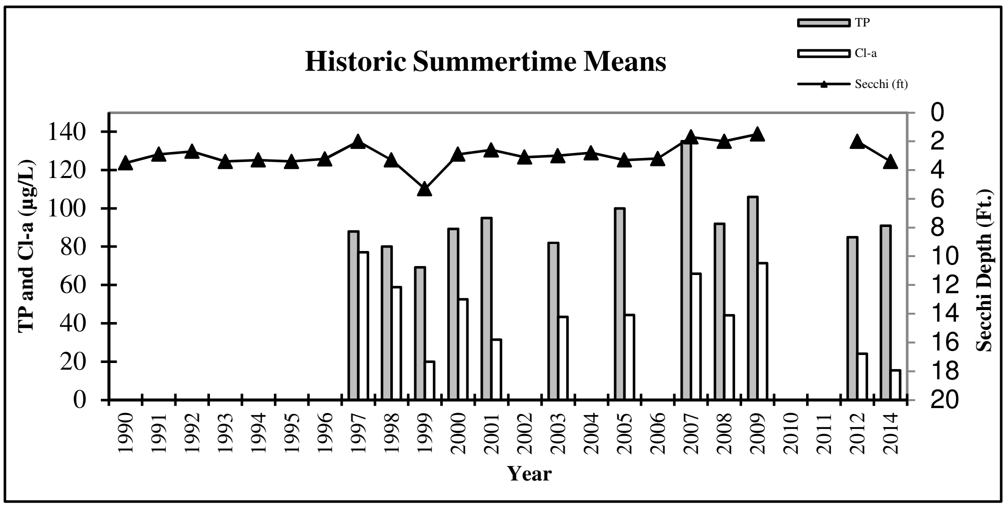
2014 Martin Lake Water Quality Data

Martin Lake			5/15/2014	5/28/2014	6/11/2014	6/25/2014	7/10/2014	7/23/2014	8/6/2014	8/20/2014	9/5/2014	9/16/2014			
2014 Water Quality Data			11:30	11:40	10:45	11:30	11:10	10:55	11:00	14:10	13:10	12:00			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.15	8.57	7.82	7.73	7.87	8.81	9.19	9.21	8.76	8.80	8.49	7.73	9.21
Conductivity	mS/cm	0.01	0.240	0.248	0.262	0.269	0.279	0.299	0.327	0.335	0.353	0.320	0.293	0.240	0.353
Turbidity	NTU	1	18.70	6.70	0.60	7.30	12.70	33.20	14.20	31.00	52.00	32.30	20.87	0.60	52.00
D.O.	mg/L	0.01	13.53	10.58	7.20	4.59	4.35	10.39	10.62	10.18	8.66	10.57	9.07	4.35	13.53
D.O.	%	1	117%	117%	83%	55%	52%	130%	131%	126%	100%	110%	102%	52%	131%
Temp.	°C	0.1	12.4	20.8	22.0	22.9	23.3	25.5	24.8	24.0	21.6	16.3	21.4	12.4	25.5
Temp.	°F	0.1	54.2	69.5	71.5	73.2	74.0	78.0	76.6	75.2	70.9	61.4	70.4	54.2	78.0
Salinity	%	0.01	0.11	0.12	0.13	0.13	0.13	0.14	0.16	0.16	0.17	0.15	0.14	0.11	0.17
Cl-a	ug/L	0.5	26.7	5.3	1.1	1.1	23.5	24.8	10.3	16.2	27.8	18.2	15.5	1.1	27.8
T.P.	mg/L	0.010	0.102	0.046	0.049	0.055	0.099	0.104	0.064	0.136	0.137	0.118	0.091	0.046	0.137
T.P.	ug/L	10	102	46	49	55	99	104	64	136	137	118	91	46	137
Secchi	ft	0.1	3.0	3.9	5.7	5.3	3.6	3.0	3.5	2.5	1.8	2.1	3.4	1.8	5.7
Secchi	m	0.1	0.9	1.2	1.7	1.6	1.1	0.9	1.1	0.8	0.6	0.6	1.0	0.6	1.7
Physical			1.0	2.0	2.0	1.0	1.0	3.0	3.0	4.0	3.0	3.0	2.3	1.0	4.0
Recreational			1.0	2.0	1.0	2.0	2.0	4.0	3.0	3.0	1.0	3.0	2.2	1.0	4.0

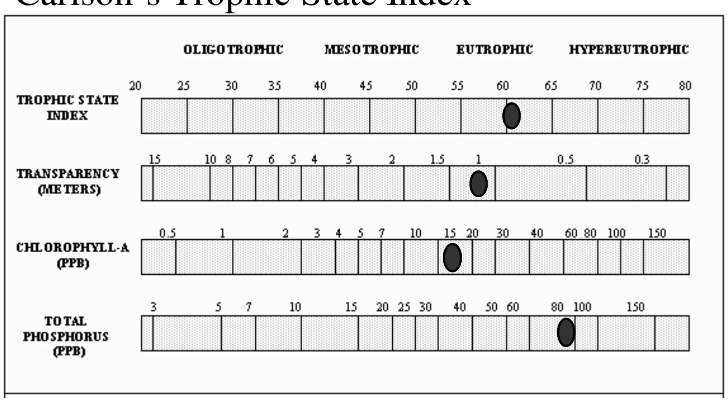
*reporting limit

Martin Lake Water Quality Results





Carlson's Trophic State Index



Martin Lake Summertime Annual Mean

Agency	CLMP	ACD	MC	ACD	ACD	ACD	CLMP	ACD	CLMP	ACD	ACD	ACD	CAMP	CAMP	ACD	ACD
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2014
TP		88.0	80.0	61.7	89.4	95.4		81.9		100.0		135.0	92.0	106.0	85.0	91.0
Cl-a		77.0	58.8	18.0	52.5	31.4		43.3		44.3		65.8	44.1	71.4	24.1	15.5
Secchi (m)	1.0	0.6	1.0	1.8	0.9	0.8	0.9	0.9	0.9	1.0	1.0	0.5	0.6	0.4	0.6	1.0
Secchi (ft)	3.2	2.0	3.3	5.3	2.9	2.6	3.1	3.0	2.8	3.3	3.2	1.7	2.0	1.5	2.0	3.4

Carlson's Tropic State Indices

TSIP		69	67	64	68	69		68		71		75	69	71	68	69
TSIC		73	71	59	67	63		68		68		72	68	73	62	58
TSIS	60	67	60	52	63	65	65	62	62	60	60	70	67	73	67	60
TSI		70	66	58	66	66		66		66		72	68	72	66	62

Martin Lake Water Quality Report Card

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2014
TP		D	D	C	D	D		D		D		D	D	D	D	D
Cl-a		D	D	B	C	C		C		C		D	C	D	C	B
Secchi	D	F	D	C	D	D	D	D	D	D	D	F	F	F	F	D
Overall		**D**	**D**	**C**	**D**	**D**		**D**		**D**		**D**	**D**	**D**	**D**	**C**

WETLAND HYDROLOGY

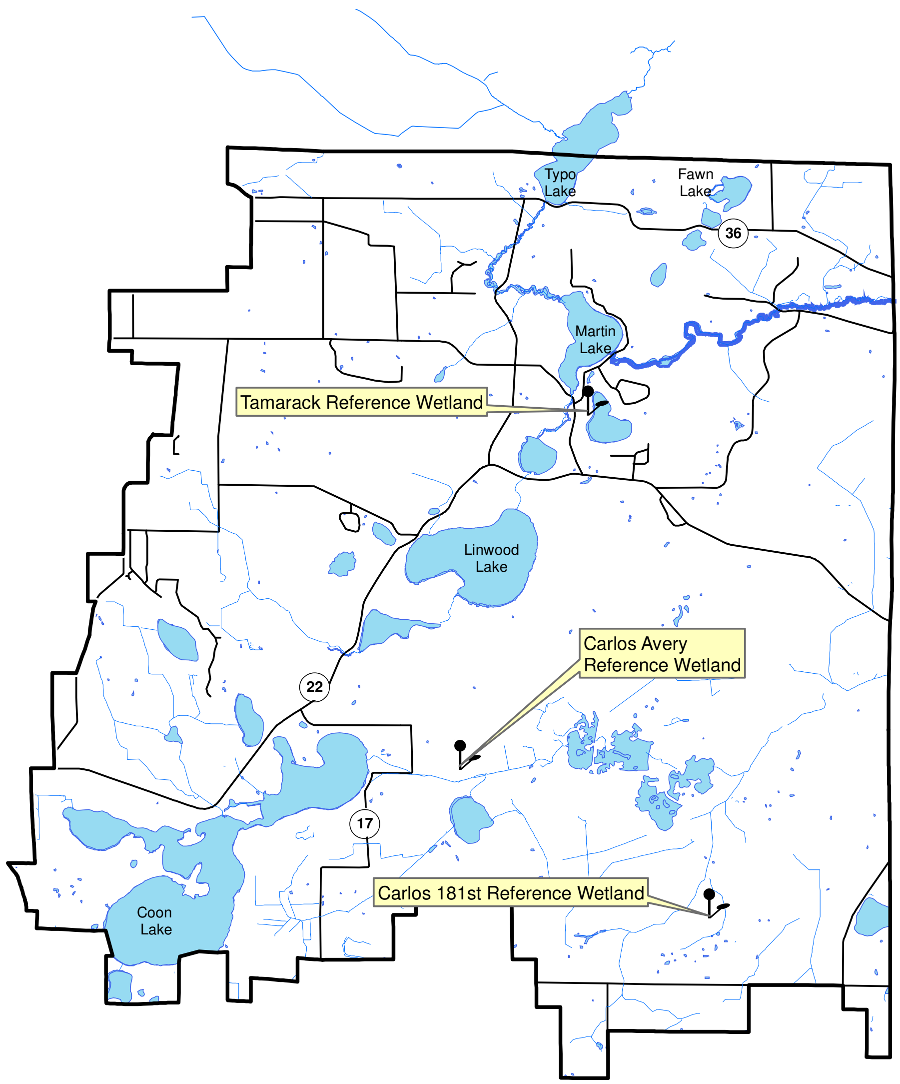
Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 18 wetland hydrology monitoring stations.

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.

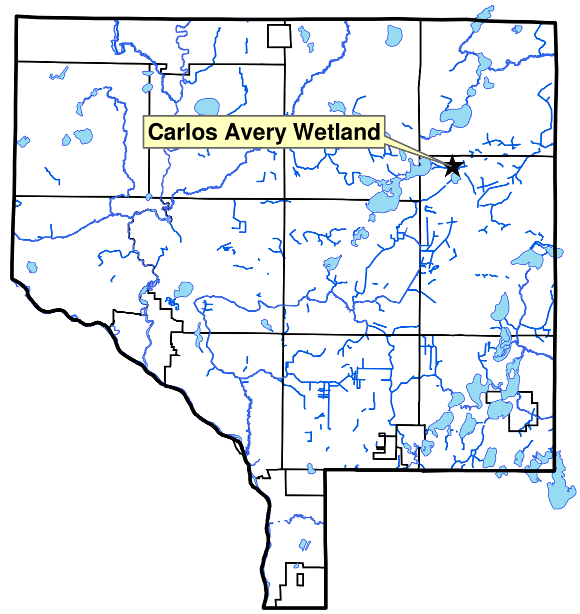
Sunrise Watershed Wetland Hydrology Monitoring Sites



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

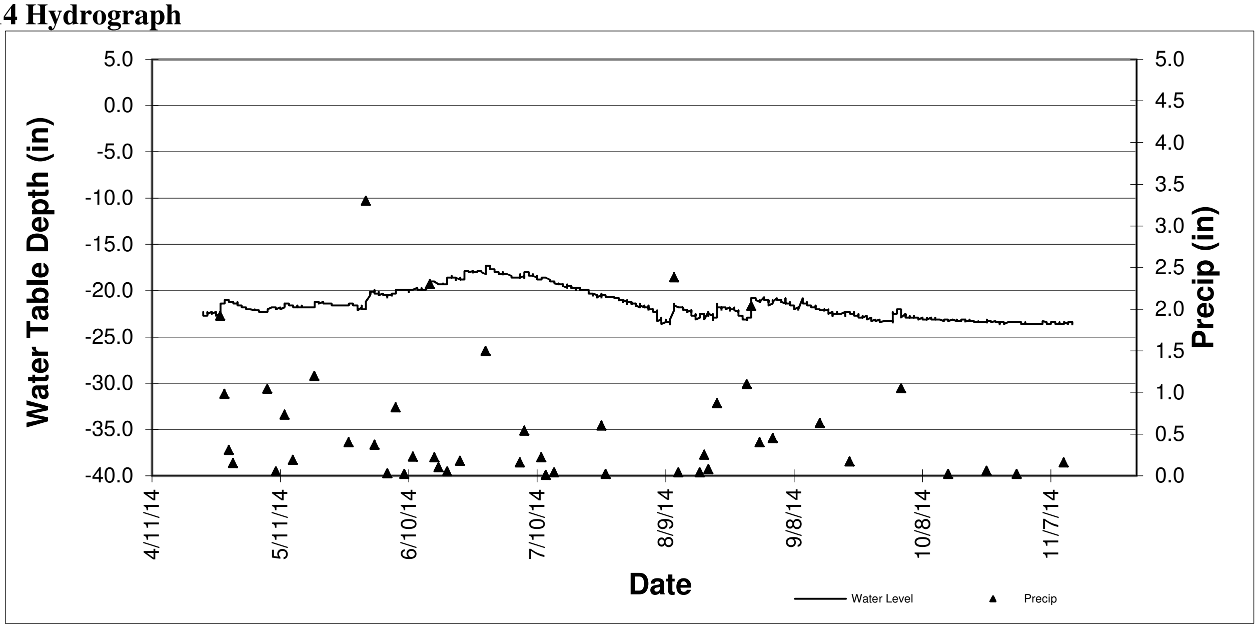
Surrounding Soils: Lino loamy fine sand

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.

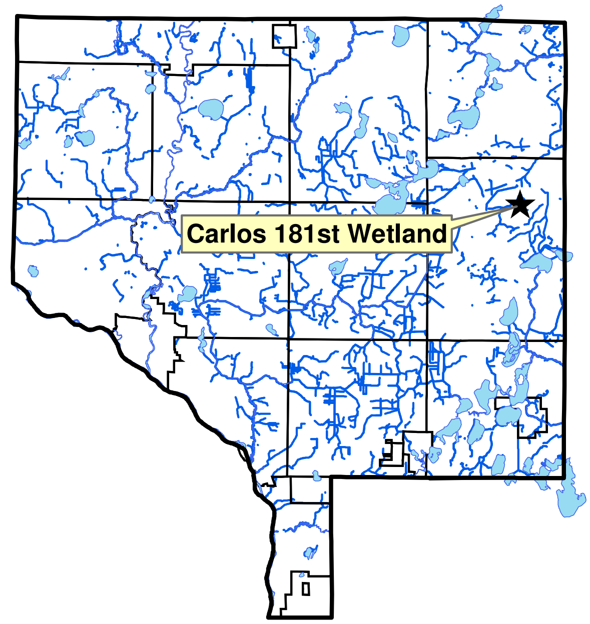
2014 Hydrograph



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	-

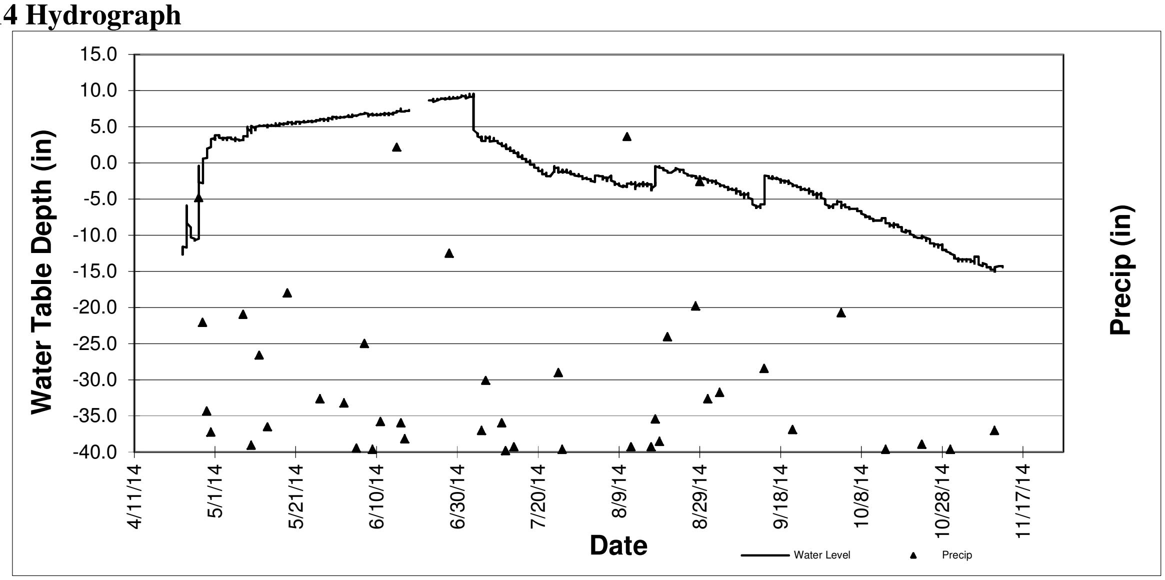
Surrounding Soils: Soderville fine sand

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.

2014 Hydrograph

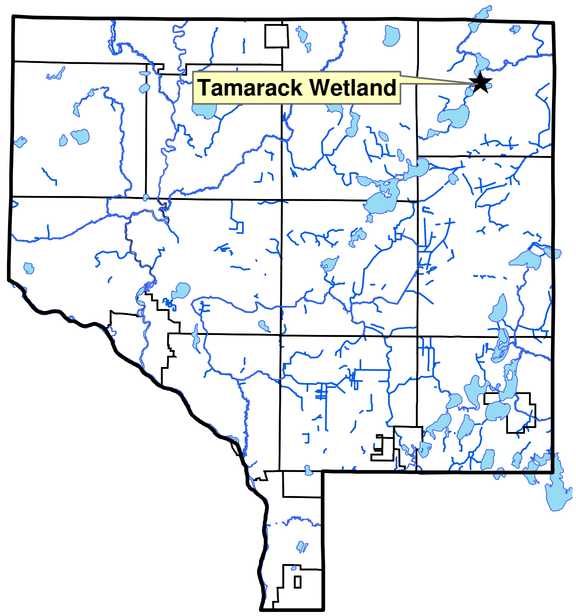


Well depths were 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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	-

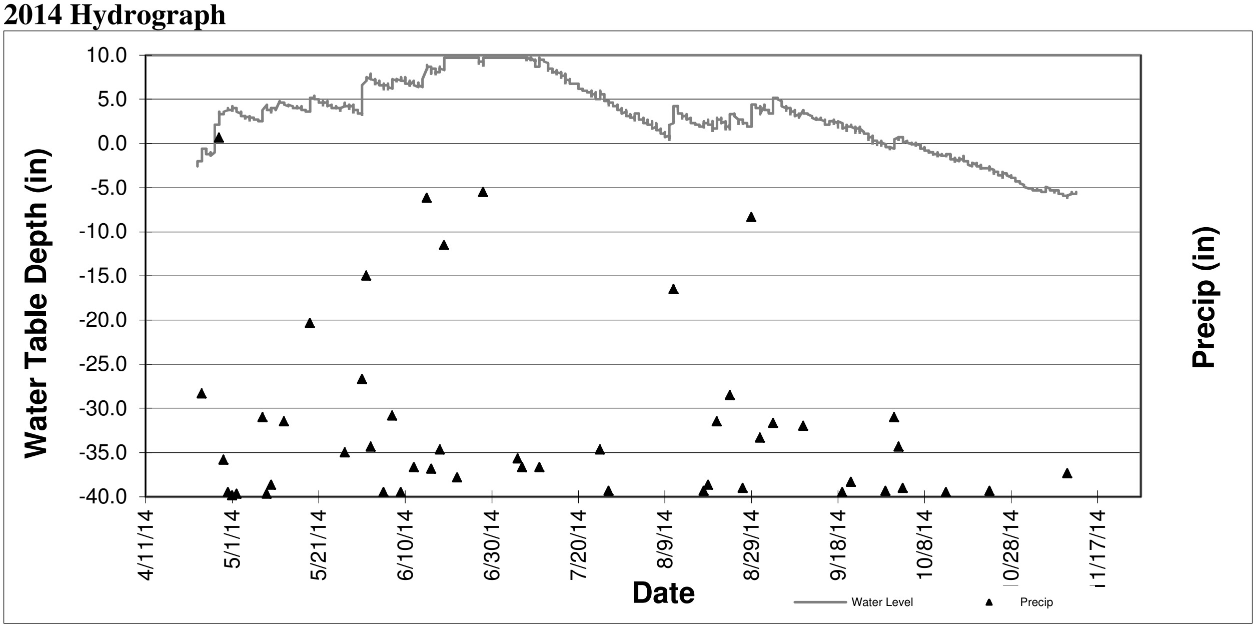
Surrounding Soils: Sartell fine sand

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.

2014 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: Projects reported in the year they are installed. No projects were installed in 2014.

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
2014 SRWMO Contribution	+	$2,000.00
Fund Balance		**$7,848.74**

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.

This stormwater analysis focuses on "stormwater retrofitting" and ranking projects on cost effectiveness. Stormwater retrofitting refers to adding stormwater treatment to an already built-up area, where little open land exists. This process is investigative and creative. Stormwater retrofitting success is sometimes improperly judged by the number of projects installed or by comparing costs alone. Those approaches neglect to consider how much pollution is removed per dollar spent. In this stormwater analysis we estimated both costs and pollutant reductions and used them to calculate cost effectiveness of each possible project.

Areas that drain to Coon Lake were delineated using available GIS watershed information, maps of stormwater conveyance features (where available), and advanced GIS terrain analysis technologies. Those areas were then divided into 7 smaller stormwater drainage areas, or catchments. For each catchment, modeling of stormwater volume and pollutants was completed using water quality software for urban (WinSLAMM) and rural agrarian (SWAT) landscapes. Base (without any stormwater treatment) and existing (with present day stormwater treatment) conditions were modeled. In total, under existing conditions the subwatershed contributes an estimated 2,455 acre feet (ac-ft) of runoff, 809 pounds of phosphorus, and 81 tons of suspended solids each year.

Potential stormwater retrofits identified during this analysis were modeled to estimate reductions in volume, total phosphorus (TP), and total suspended solids (TSS). Finally, cost estimates were developed for each retrofit project, including up to 30 years of operations and maintenance. Projects were ranked by cost effectiveness with respect to their reduction of TP.

A variety of stormwater retrofit approaches were identified. They include:

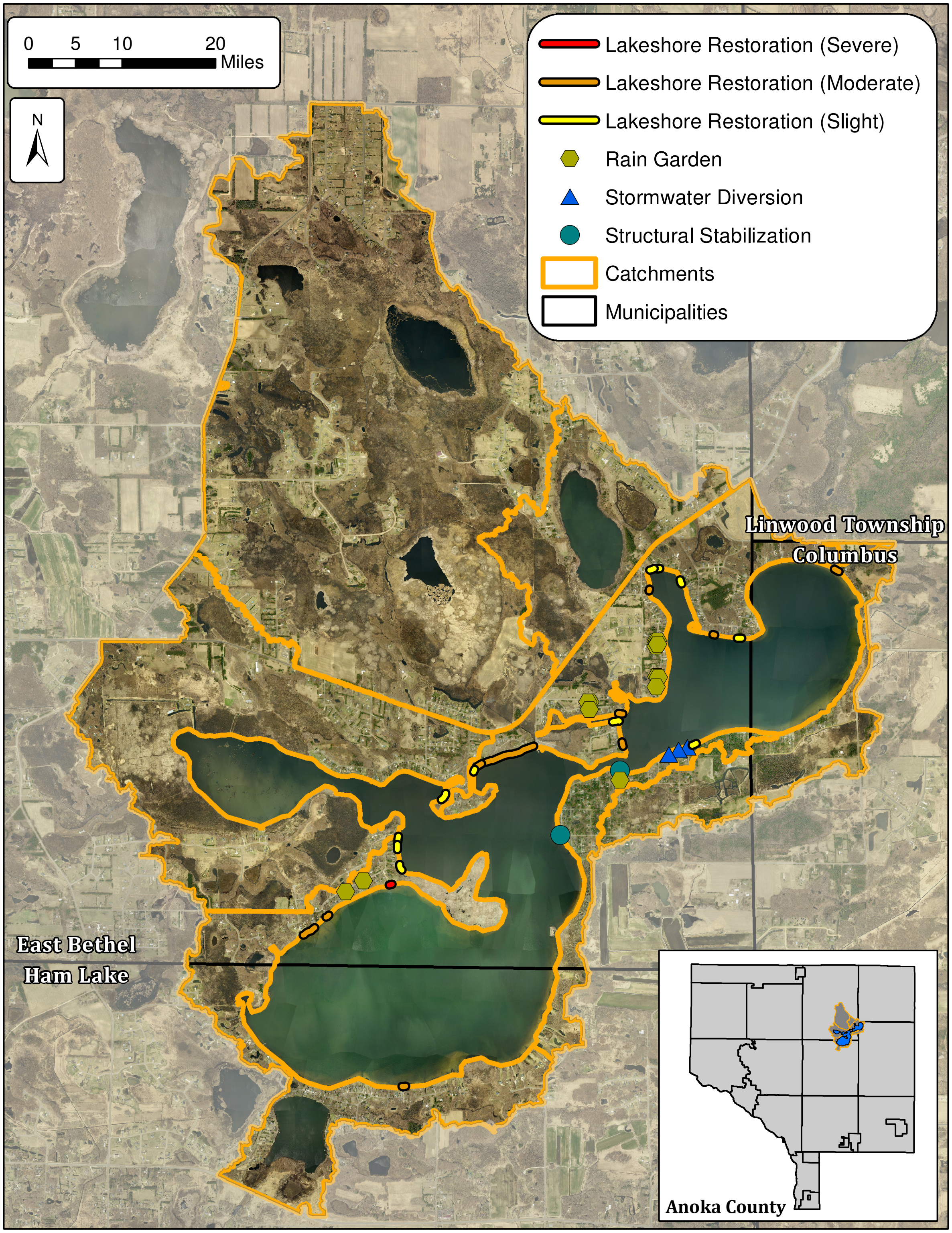
- Maintenance of, or alterations to, existing stormwater treatment practices,
- Residential curb-cut rain gardens,
- Lakeshore restorations,
- Stabilization of erosion sites, and
- Stormwater redirection.

This report provides conceptual sketches or photos of recommended stormwater retrofitting projects. The intent is to provide an understanding of the approach. If a project is selected, site-specific designs must be prepared. In addition, many of the proposed retrofits will require engineered plan sets if selected. This typically occurs after committed partnerships are formed to install the project. Committed partnerships must include willing landowners when installed on private property.

The tables on the next pages summarize 30 potential projects organized from most cost effective to least, based on cost per pound of TP removed. If all of these practices were installed, pollutant loading to Coon Lake could be reduced by 25.3 lbs of TP and 12.8 tons of TSS. The 25.3 lbs-TP reduction could potentially reduce algal growth in the lake by 6.3 tons (assuming 1 lb phosphorus = 500 lbs algae). Reported treatment levels are dependent upon optimal site selection and sizing. More detail about each project can be found in the Catchment Profile pages of this report. Projects that were deemed unfeasible due to prohibitive size, number, or were too expensive to justify installation are not included in this report.

Installing all of these projects is unlikely due to funding limitations and landowner interest. Instead, it is recommended that projects be installed in order of cost effectiveness (pounds of pollution reduced per dollar spent). Other factors, including a project's educational value, visibility, construction timing, total cost, or non-target pollutant reduction also affect project installation decisions and will need to be weighed by resource managers when selecting projects to pursue.

EXAMPLE OF PROPOSED STORMWATER RETROFITS IN THE COON LAKE SUBWATERSHED



Summary of preferred stormwater retrofit opportunities ranked by cost-effectiveness with respect to total phosphorus (TP) reduction. TSS and volume reductions are also shown. For more information on each project refer to the catchment profile pages in this report.

Project Rank	Retrofit Type (refer to catchment profile pages for additional detail)	Catchment	Projects Identified	TP Reduction (lb/yr)	TSS Reduction (lb/yr)	Volume Reduction (ac-ft/yr)	Probable Project Cost (2014 Dollars)	Estimated Annual Operations & Maintenance (2014 Dollars)	Estimated cost/ lb-TP/year (30-year)
1	Lakeshore Restoration LR-87	CL-5	1	2.6	3,683	0.1	$14,180	$122	$232
2	Lakeshore Restoration LR-28	CL-4	1	1.0	1,440	0.1	$8,105	$81	$351
3	Lakeshore Restoration LR-63	CL-4	1	1.2	1,542	0.2	$15,155	$222	$606
4	Lakeshore Restoration LR-39	CL-4	1	0.7	941	0.1	$10,555	$78	$614
5	Lakeshore Restoration LR-50	CL-4	1	0.8	941	0.1	$11,780	$155	$684
6	Lakeshore Restoration LR-95	CL-5	1	1.9	2,204	0.4	$29,705	$513	$791
7	Lakeshore Restoration LR-103	CL-5	1	0.6	774	0.1	$11,330	$146	$872
8	Lakeshore Restoration LR-61	CL-4	1	0.9	1,093	0.1	$14,625	$176	$887
9	Residential Rain Gardens	CL-4	1, 2, 4	0.6-1.9	190-592	0.4-1.4	$10,110-$34,600	$225-$900	$936-$1,081
10	King Road Stormwater Diversion	CL-6	1	0.9	290	0.7	$14,490	$365	$942
11	Laurel Road Stormwater Diversion	CL-6	1	0.9	295	0.7	$14,490	$365	$942
12	Lakeshore Restoration LR-62	CL-4	1	3.1	3,831	0.5	$64,055	$900	$979
13	Lakeshore Restoration LR-19	CL-7	1	0.6	762	0.1	$13,130	$182	$1,032
14	Maple Road Stormwater Diversion	CL-6	1	0.8	240	0.6	$14,490	$365	$1,060
15	Forest Road Boat Launch Structural Stablization	CL-6	1	0.4	550	0.0	$10,925	$75	$1,098

* Pollution reduction benefits and costs cannot be summed with other projects in the same catchment because they are alternative options for treating the same source area.

For a full report please contact the Anoka Conservation District

Carp Barriers Installation

Description: 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: In 2014 the SRWMO installed one carp barrier in the Martin and Typo Lake system with the approved financing and planning for three additional barriers to be installed in 2015.

During and completed installation of first barrier.

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.

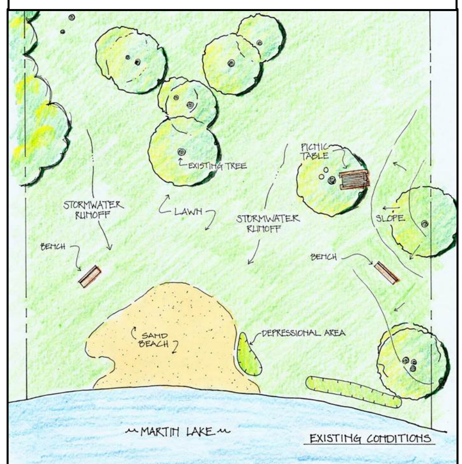
Results:

SRWMO 2014 press release, which was published in member city newsletters:

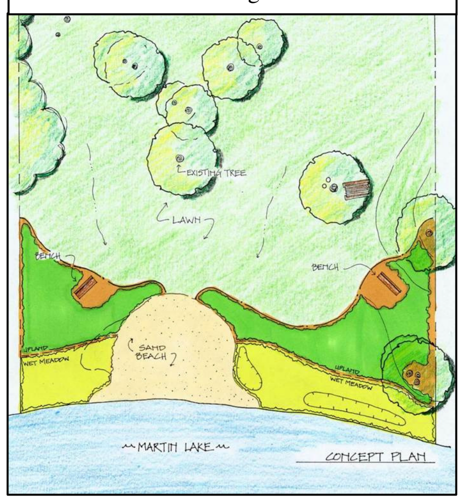
Lessons in Landscaping: The Water's Edge

When Jean and Mike Bury purchased a home on Coon Lake in 1975, their 105 feet of shoreline had a few trees. The rest was turf grass. "We spent a multitude of hours mowing to the water's edge, removing the weeds and raking the sand," explained Jean. In the years since, they've turned that blank canvas into art that seems to be equally appreciated by fellow lakeshore owners, Coon Lake visitors, and local wildlife like frogs, ducks and fish.

Typical mowed lakeshore



Lakeshore with native gardens.



"In the 90's we read an article in the Star Tribune about the City of Minneapolis park system implementing several projects around the lakes and creeks, restoring them with natural vegetation and the environmental benefits in doing so," recalls Jean. "We set a goal to naturalize 80 feet of our shoreline and leave 25 feet sandy for our dock and recreation space."

The Bury's created outdoor rooms of landscaping, carpeted with turf grass but framed by warm natural areas. Their gardens have clear limits and are tidy around the edges. Farther from the edges, the gardens have a more natural appearance with tall, fountain-like grasses and colorful wildflowers. Particularly at the lakeshore, there are an abundance of native plants. Planting in groupings and curving borders ensure it is much more attractive than a simple strip along the lakeshore.

Also on Coon Lake, fellow gardener Michelle Rogers has been meeting the challenges of lakeshore landscaping with her own creative flair. In 2006 her lakeshore was turf grass too, with a two foot wide strip left unmowed at the water's edge. It stood in contrast to her flower-lined driveway that burst with color and character.

"We put together a plan to restore our lakeshore," said Rogers. "We picked a palate of mostly native plants that were adapted for either the wetter soils near the water or the drier areas higher in the yard. These are the plants to which wildlife is most adapted. We even added some logs half in the water, half out. We get tons of turtles sunning on them."

Rogers created a more formal look around the edges using flagstone borders. A path leads to the dock.

Both homeowners say a big part of the plan was to help Coon Lake. The shoreline is important for water quality, wildlife and fish. Native plants, unlike turf, help on all fronts.

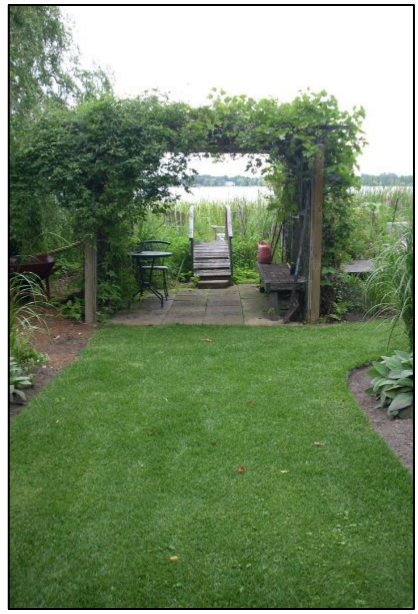
Native plants grow densely to create a filter, or buffer, for any runoff before it reaches the lake. They also have deep root systems that hold the soil, protecting it from wave action. Before their shoreline restoration, the Bury's had experienced shoreline erosion.

"One downside of turf grass is that its root system is only about 2 inches deep," says Jamie Schurbon, Water Resource Specialist at the Anoka Conservation District. "If it's all you've got at the water's edge, the bank is susceptible to erosion and undercutting. No one wants to watch their lakeshore wash away. And we don't want that sediment in the lake. Many native plants have root systems that grow more than five feet deep."

Some of the Roger's plantings were actually in the water, with plants like three-stem bulrush that are good fish habitat. "As any fisherman knows, aquatic plants are key fish habitat," notes Schurbon.

The Bury's took a different approach for plants in the water. "We allowed some cattail in and through the years other native plant species like arrowhead started to grow in the water," adds Jean Bury. They were still able to maintain ample area for the dock and other active use.

Fish aren't the only wildlife. "Many of the plants attract butterflies and dragonflies. We put up bluebird, wood duck and martin houses, which are inhabited most years. We feel we have a science lab on our shoreline for our grandchildren, as we watch tadpoles develop, and explore all the wonders of the ecosystem a natural site offers, said Bury."



"I see lots of butterflies, bees, green herons, hummingbirds and other wildlife," says Rogers. "One typical evening my husband and I were sitting on the dock and watched a muskrat quietly nibble off mountain mint shoots, stack them neatly, and then swim away with them."

This harmonious scene is a far cry from the frustrating, endless battle that many lakeshore homeowners wage against muskrats who dig burrows that damage lawns and create uneven turf for their mower. When you aren't mowing at the water's edge, muskrat activity is no big deal.

Bury also notes another benefit of naturalizing the shoreline: fewer geese. "Geese are uncomfortable in and around taller vegetation because it makes it more difficult for them to see approaching predators, and does not give them a clear line of sight to the water," informs Schurbon.

Perhaps the most important selling point for native gardens that these homeowners can tout is that it looks great. "The textures of the naturalization project and other plantings reward us with year round visual interest," says Bury. "We frequently have neighbors, garden clubs and boats pulling up to our dock in the summer to view the gardens. We always inform people that it does not have to be as grand of scale as we designed ours; a smaller buffer zone on their shoreline still benefits the lake and wildlife greatly." Rogers agrees, "It's spreading."

Locally, the Sunrise River Watershed Management Organization offers grants to partially pay for these projects that benefit the lake. Applications are accepted through the Anoka Conservation District, which also provides free on-site consultations and can guide homeowners through the design and budgeting process.

For more information, the "Blue Thumb – Planting for Clean Water" program is a good resource. Their website includes an interactive native plant selector tool. Input your sunlight conditions, moisture, color and even level of care to produce a custom list.

Landowners should note that permits are required from the DNR for any project below the ordinary high water mark, which is the highest level the water has been for a sufficient period of time to leave evidence on the landscape. It is often higher than most homeowners expect.

The Anoka Conservation District can be reached at 763-434-2030.

Evening view over Coon Lake at the Bury residence.

Lakeshore restoration at the Rogers Residence, Coon Lake.

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 2014.

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 2014 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 2014 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, wetland Protection was chosen.

Limited space in city newsletters was recognized as an issue. A poem was written and submitted to catch the reader's attention and best utilize the limited space available. It was provided to member cities for their city newsletters in June.

<u>Mosquito Retaliation</u>
I hate mosquitoes
With all of my heart
Buzzing and biting
Living, sucking darts
Squished ones are left on me
As bloody body art
An omen to others
To quickly depart

But yet they persist
I must give them credit
We've drained half their wetlands
If that's a hint, they don't get it
They mount up on wings
With sick humor and wit
And bite me in places
I hate to admit

They're settling the score
Retaliation – here's why
For the wetlands we've mowed, filled
Or drained completely dry
They're enlisting their friends
Like the loathsome black fly
And signing up birds
To drop bombs from the sky

Surrender - I'll never!
Mosquitoes deserve no respect
But wetlands are worthy
And useful to protect
They clean the water for free
That often we've wrecked
Are home to more good critters
Than you'd ever suspect
So please don't dig, drain or fill them
As the law does expect

This is a message from the Sunrise River Watershed Management Organization.
www.SRWMO.org
Wetlands are critical habitat for desirable wildlife, filter water before it gets to our lakes and rivers, and help prevent flooding.
Please respect the laws that prohibit filling, draining, or excavating in them. Unmowed buffers at the edge of wetlands are especially valuable.

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.

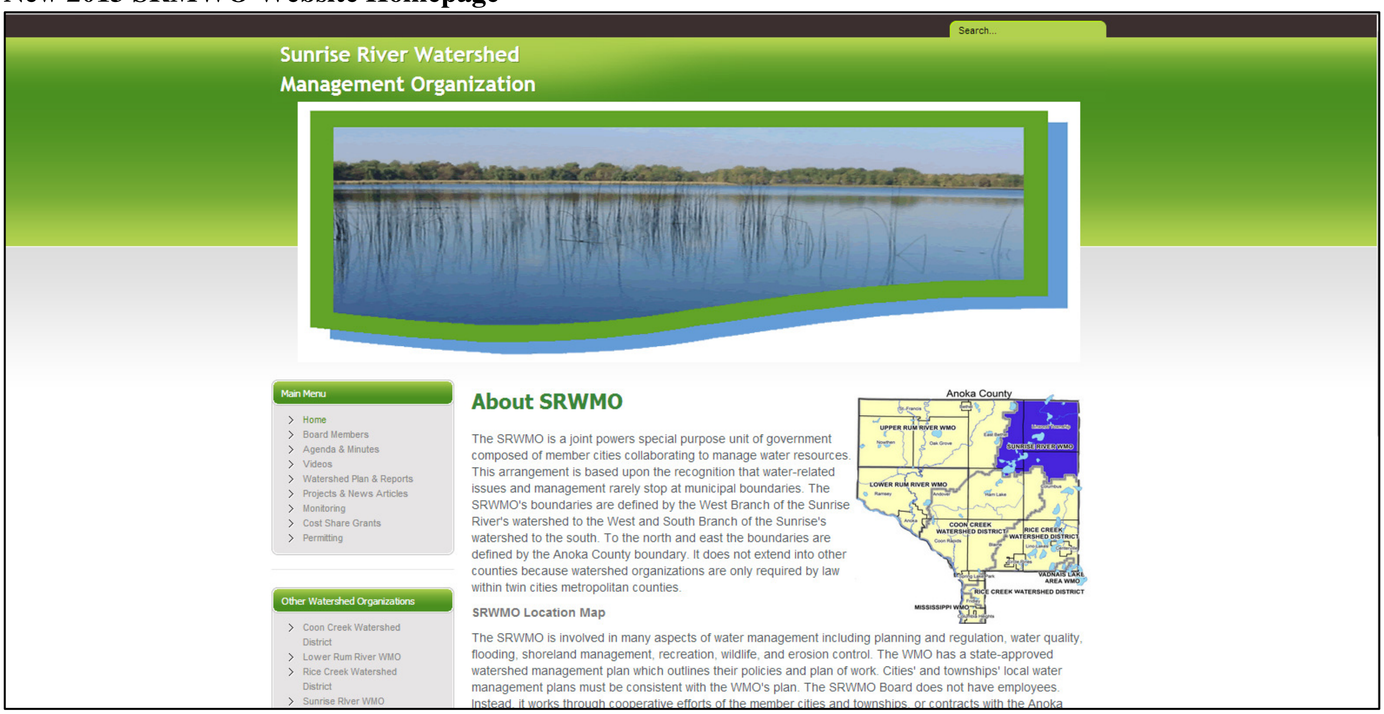
Location: www.SRWMO.org

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:

BWSR Clean Water Fund Grant Application

$73,824 grant request
$18,456 match
Outcome of application will be known January 30, 2015.

Title: Ditch 20 Wetland Restoration Feasibility Study to Benefit Downstream Water Quality

Abstract

This feasibility study will produce strategies for wetland restoration and ditch hydrology changes that improve water quality in Typo and Martin Lakes, the Sunrise River and St. Croix River. Our focus is County Ditch 20 (aka Data Cr), which drains >500 acres of wetland. 1849 land surveys show the area as "tamarack swamp." But by 1938 there were no trees, active haying and a network of ditches. Downstream waterbodies were declining. Recently, TMDL studies have found that these ditched wetlands export large amounts of phosphorus and solids.

This project is unique because it targets a pollutant source that is often overlooked but common – ditched wetlands. The Ditch 20 subwatershed has seemingly benign land uses. Yet during storms its phosphorus concentrations were 70% higher than that of neighboring Ditch 13 which is mostly agricultural. As a result, the local watershed plan and TMDLs noted this as a key area for pollutant reduction.

Mechanisms of phosphorus export from ditch 20 were studied over 6 years. Multiple mechanisms are at work, including aerobic decomposition of peat soils, periodic re-wetting, effective drainage of soil water and bank sloughing. These mechanisms can be managed through lateral ditch blocks, water level manipulation, settling basins or other measures.

A feasibility study is needed before construction. We'll use surveying, terrain analysis and hydrologic/hydraulic modeling to evaluate the scope and effects of potential projects. We'll involve landowners early. We'll evaluate the cost/benefit ratio of each project by consolidating primary literature knowledge and applying it, because pollutant models or calculators are not available for this type of project. Finally, we'll prepare designs.

We anticipate designed projects can be installed within 1-3 years after study completion. The watershed management organization plans to budget sufficient funds to match installation grants.

SRWMO 2013 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).

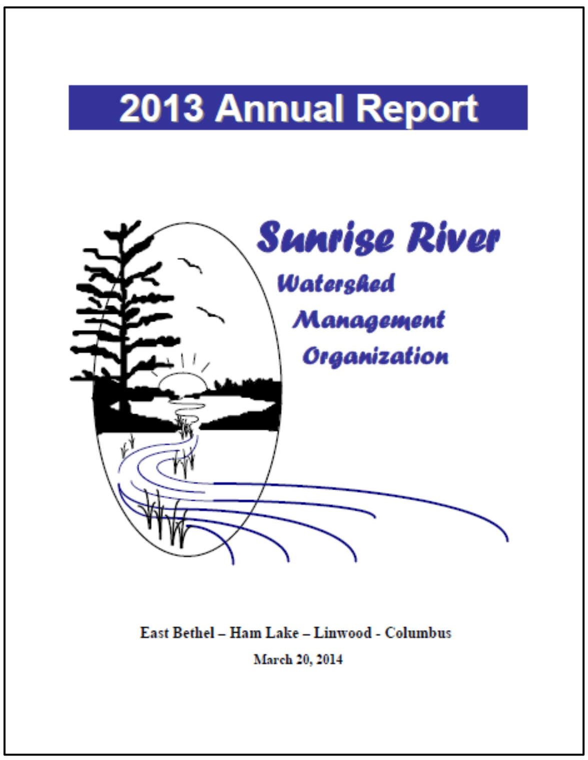
The SRWMO must also submit an annual financial report to the State Auditor. They accept unaudited financial reports for financial districts with annual revenues less than $185,000.

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 2013 Sunrise River WMO Annual Report. ACD drafted the report and a cover letter. After SRWMO Board review the final draft was forwarded to BWSR in spring of 2014. 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.

Cover



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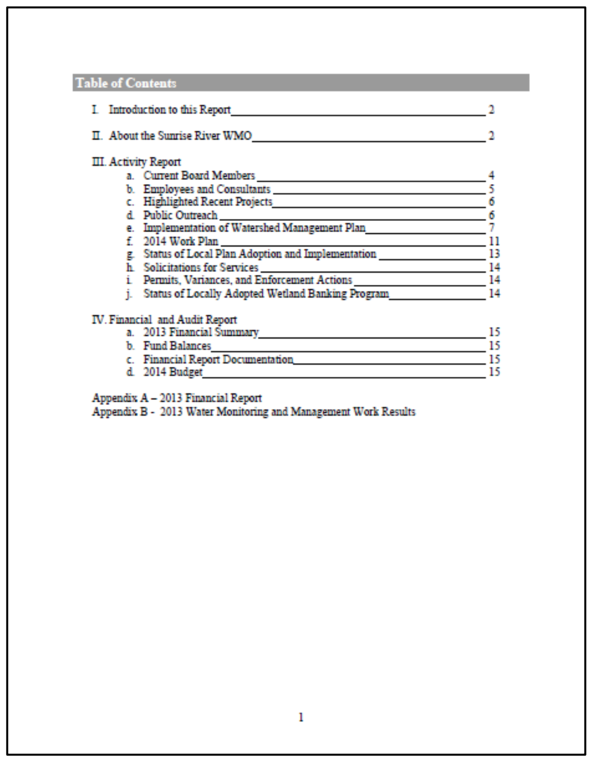
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On-call Administrative Services

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 agreement.

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

Results: In 2014 a total of 24.0 hours of administrative assistance have occurred as of December 31.

The following tasks were accomplished:

- 2015 budget preparation and related questions from cities.
- 2016 draft budget preparation.
- Occasional inquiries from contractors and developers about any SRWMO permitting requirements.
- SRWMO Blue Thumb annual reporting.
- Advise the board regarding proposed revisions to MN Rules 8410 and assist in preparing an official WMO comment.
- Provide Linwood Twp with content for their website about the SRWMO, per their request.
- Notices to reschedule August mtg.
- Prepare agenda, packet, minutes for Sept meeting in the recording secretary's absence.

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

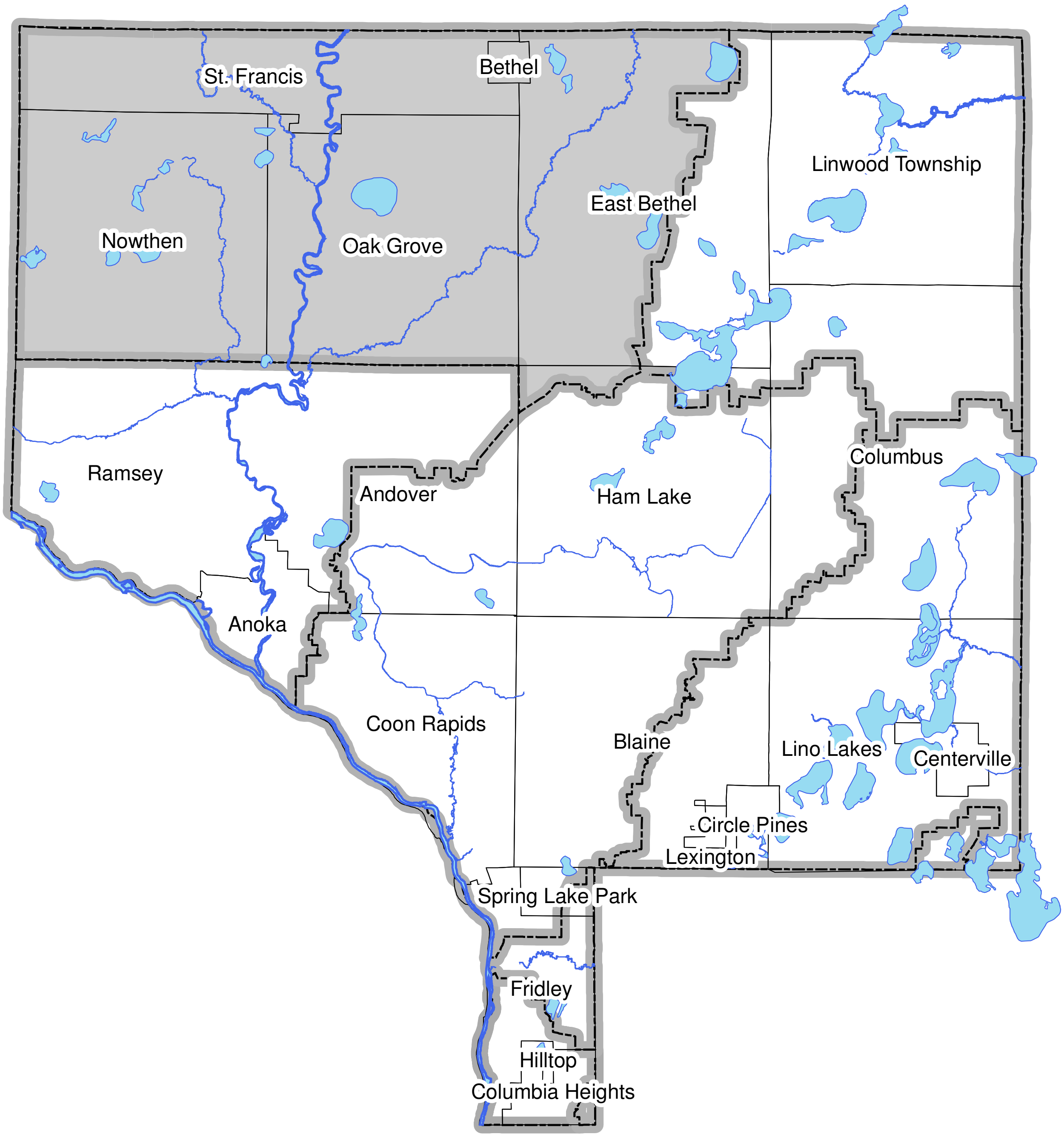
Sunrise River Watershed	WMO Asst (no charge)	Volunteer Precipitation	Reference Wetlands	DNR Observation Wells	Lake Levels	Lake Water Quality	WMO Admin	WMO Grant Search	SRWMO Outreach/Promo	Website Management	Martin/Typo Carp Bariers	Buckthorn Clean Sweep	Coon Lake Retrofits - CWF	Sunrise River WRAPP	Coon Lake Retrofit Analysis	Total
Revenues																
SRWMO	0	0	1725	0	1250	6400	2850	1000	1157	480	0	0	0	0	6944	21806
State	0	0	0	240	0	0	0	0	0	0	73803	1434	0	0	0	75476
Anoka Conservation District	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anoka Co. General Services	586	0	0	154	0	0	0	112	0	0	9164	1475	7574	0	4104	23170
County Ag Preserves	0	0	0	0	0	646	0	0	0	0	0	0	0	0	0	646
Regional/Local	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	2500	0	0	1238	0	3738
BWSR Cons Delivery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BWSR Cost Share TA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Local Water Planning	0	395	241	0	0	0	455	355	0	14	0	0	0	0	0	1460
TOTAL	586	395	1966	394	1250	7046	3305	1467	1157	494	85467	2909	7574	1238	11048	126295
Expenses-																
Capital Outlay/Equip	13	9	42	9	24	116	53	32	11	9	245	63	166	27	243	1060
Personnel Salaries/Benefits	505	341	1633	339	956	4548	2064	1264	422	337	9588	2468	6520	1066	9517	41567
Overhead	34	23	110	23	64	306	139	85	28	23	644	166	438	72	639	2793
Employee Training	4	2	12	2	7	33	15	9	3	2	70	18	47	8	69	302
Vehicle/Mileage	9	6	29	6	17	81	37	22	7	6	170	44	116	19	169	738
Rent	22	15	71	15	41	196	89	55	18	15	414	107	282	46	411	1796
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Program Supplies	0	0	59	0	4	1767	0	0	0	0	74336	43	5	0	0	76214
McKay Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	586	395	1956	394	1113	7046	2396	1467	489	391	85467	2909	7574	1238	11048	124470

Recommendations

- **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.
- **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.

Excerpt from the
2014 Anoka Water Almanac

Chapter 3: Upper Rum River Watershed



Prepared by the Anoka Conservation District

CHAPTER 3:
UPPER RUM RIVER WATERSHED

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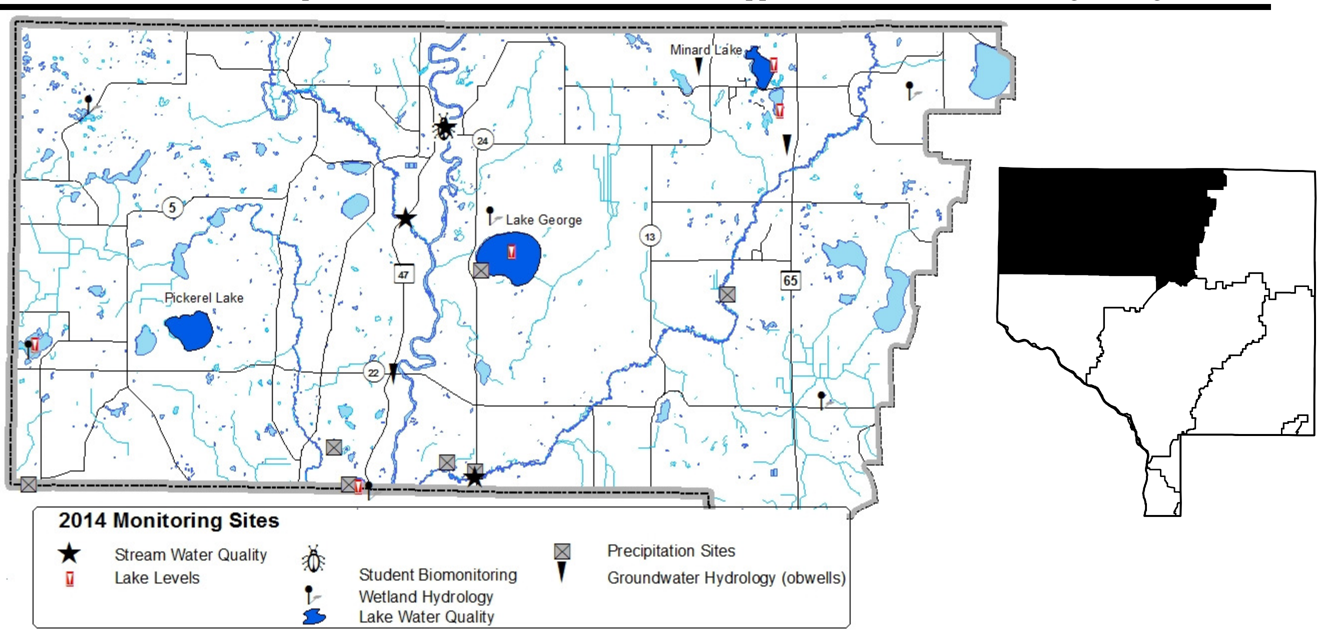
ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District,
LRRWMO = Lower Rum River Watershed Mgmt. Org, MC = Metropolitan Council
MNDNR = Minnesota Dept. of Natural Resources, URRWMO = Upper Rum River Watershed Mgmt. Org



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

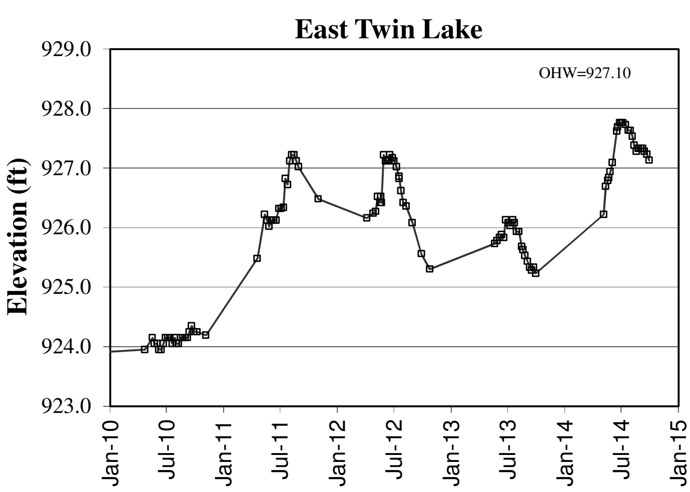
Results: Lake levels were measured by volunteers throughout the 2014 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. Lakes had sharply increasing water levels in spring and early summer 2014 when well above average rainfall occurred. Little rainfall 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.

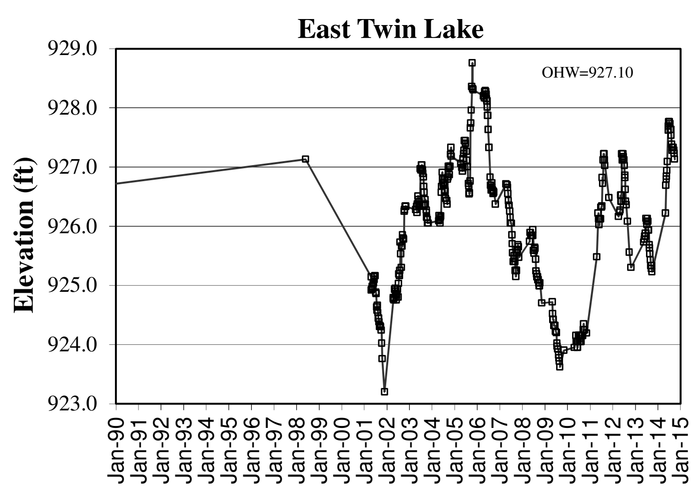
2011 and 2012 were the first years for monitoring Coopers and Minard Lakes. In recent years, there had been complaints about disproportionately low water in Coopers Lake and questions about why Minard Lake did not seem to have this problem. Indeed, both lakes have had similar maximum water levels in 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.

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.

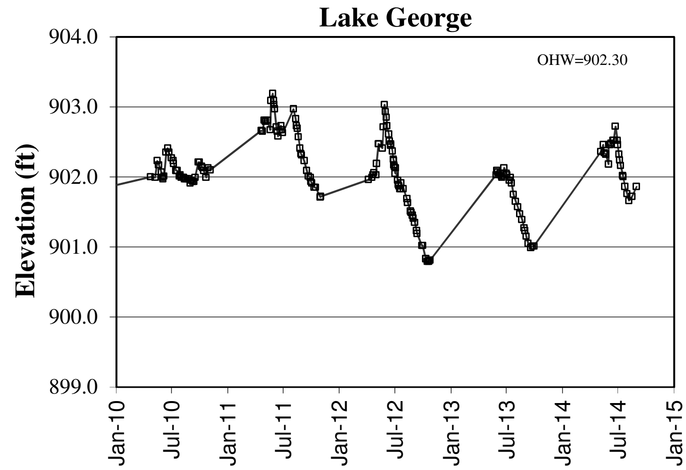
East Twin Lake Levels – last 5 years



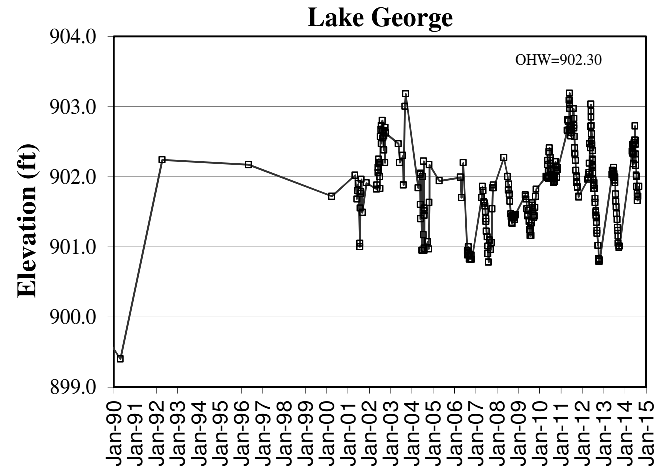
East Twin Lake Levels – last 25 years



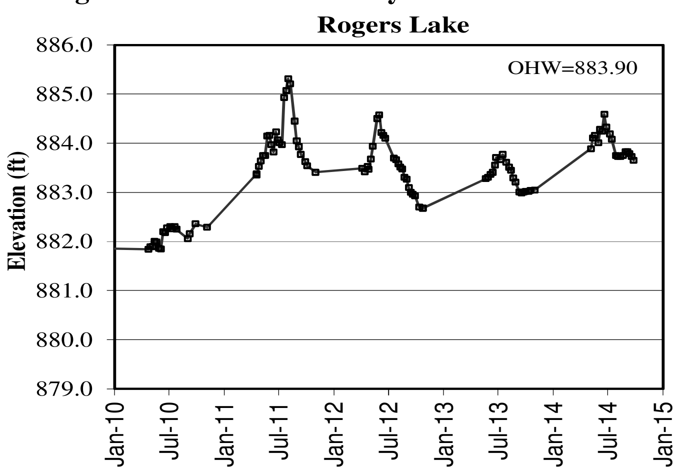
Lake George Levels – last 5 years



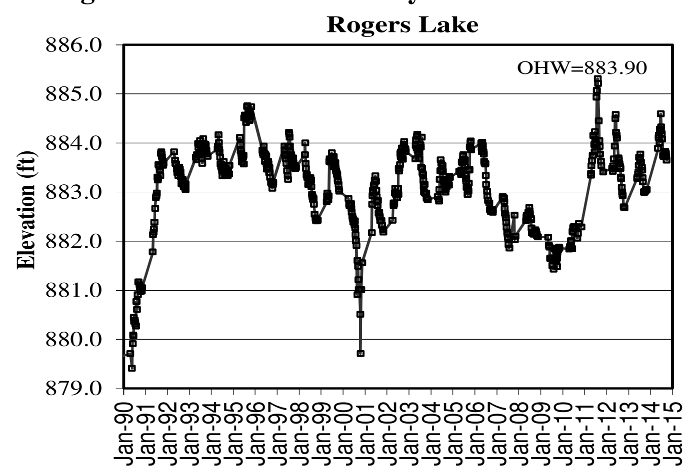
Lake George Levels – last 25 years



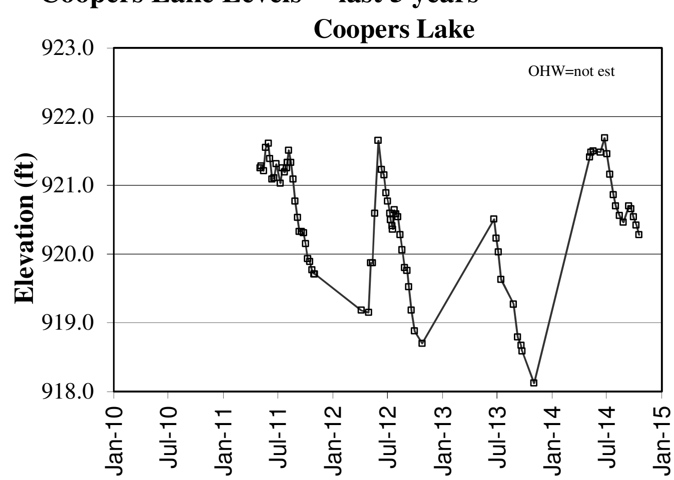
Rogers Lake Levels – last 5 years



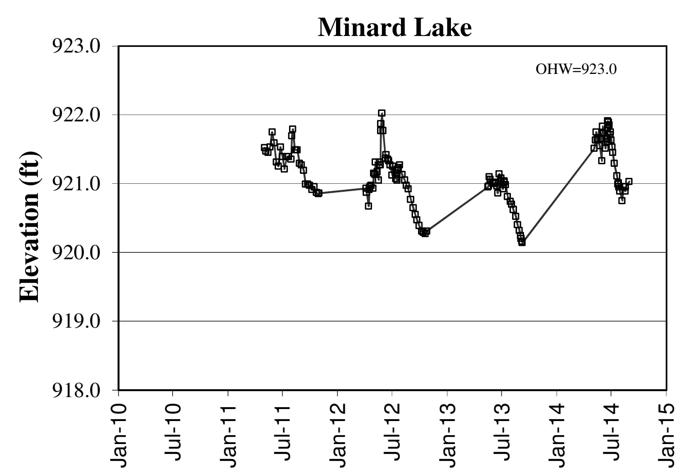
Rogers Lake Levels – last 25 years



Coopers Lake Levels – last 5 years



Minard Lake Levels – last 5 years



Lake Water Quality

Description: May through September at least once-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.

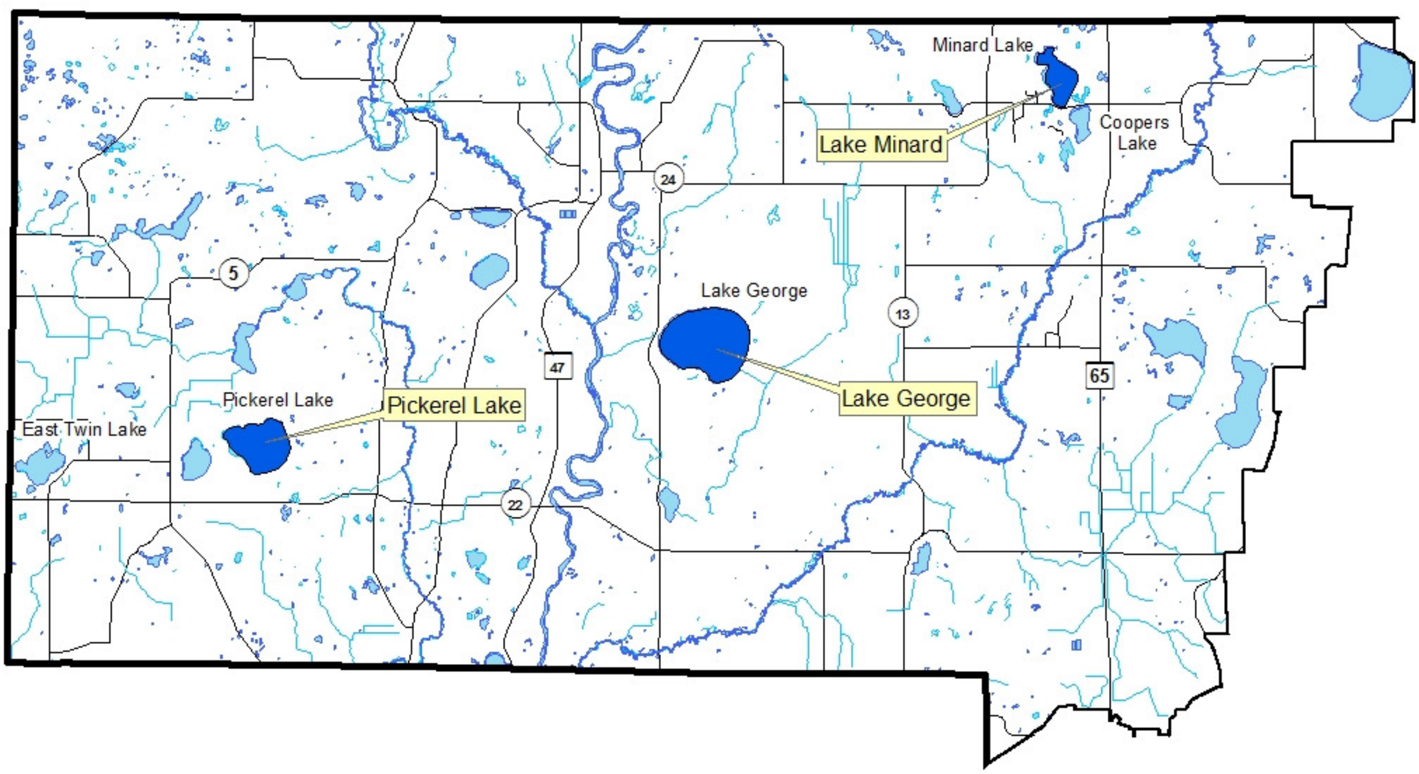
Locations: Lake George

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



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.

2014 Results

In 2014 Lake George had good water quality for this region of the state (NCHF Ecoregion), receiving an overall B grade. The lake is mesotrophic. Total phosphorus averaged 25.5 ug/L, lower from the previous year. Secchi transparency was over 15 feet in late-May, but dropped to as low as 3.1 feet in late July. Average Secchi transparency was 7.4 feet, the second poorest observed. Chlorophyll-a averaged 6.4 mg/L, which is below the average of all years monitored. Total Phosphorous, Chlorophyll-a, and transparency were poorest in July.

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, 2011,2013 and 2014). Water quality as a whole has not significantly changed from 1980 to 2014 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,14}$= 0.76, p=0.49). However, when analyzed individually Secchi Transparency indicates a significant decrease (one-way ANOVA $F_{1,15}$= 6.18, p=0.03)

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.

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 was 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. In 2013 water quality monitoring showed a dramatic rise in phosphorus shortly after curly leaf pondweed treatment and it was suspected that the herbicide treatment may have caused the phosphorus increase. In The 2014 water quality data was collected immediately before and after herbicide treatment to determine if this was the case. In

2014, no upward spike of phosphorus occurred after herbicide treatment, however the water quality results were similar 2013.

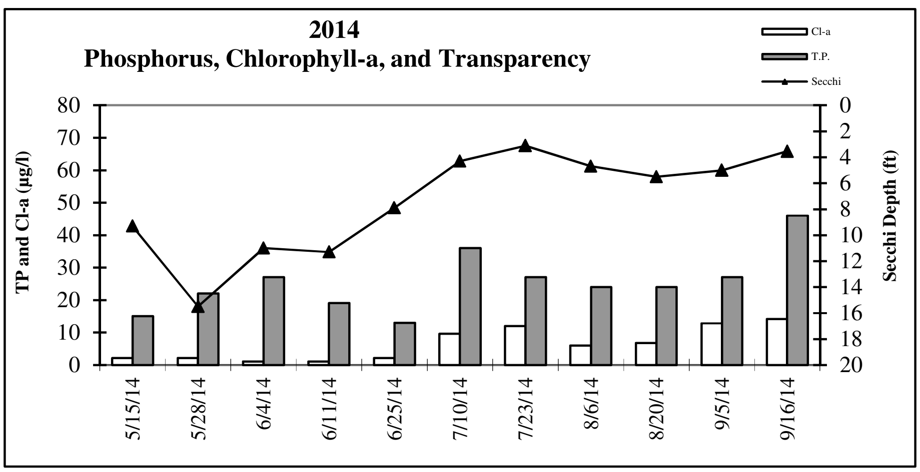
In 2014 the invasive plants were mapped out earlier in the season to allow for earlier treatment. While immediate impacts were not observed in 2014 future monitoring and continued modified herbicide treatments may provide insight. The lake improvement district, DNR, and Anoka Conservation District are continuing to mold 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, observing water introduced through the lake's inlets, and treating curly leaf pondweed earlier to minimize water quality impacts that are more likely when water is warmer.

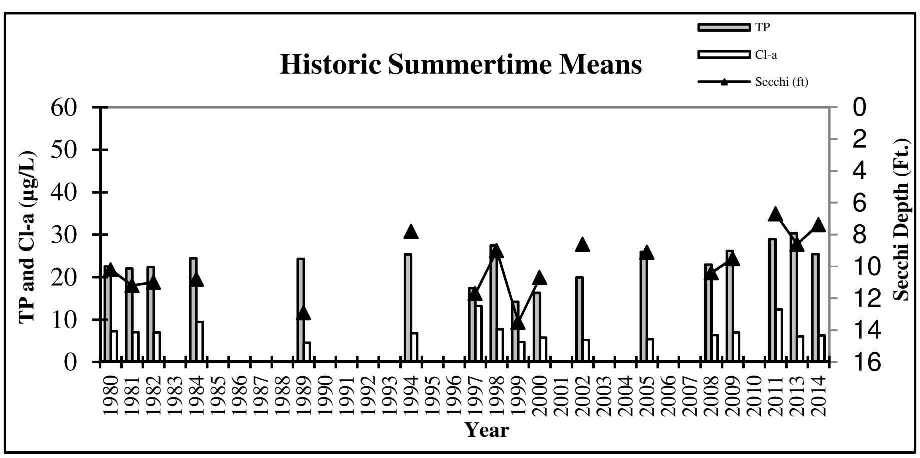
2014 Lake George Water Quality Data

Lake George			5/15/2014	5/28/2014	6/4/2014	6/11/2014	6/25/2014	7/10/2014	7/23/2014	8/6/2014	8/20/2014	9/5/2014	9/16/2014			
2014 Water Quality Data			13:15	13:15	13:45	12:45	12:45	13:00	12:30	13:15	15:30	13:50	13:25			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.4	8.38	8.39	8.57	8.54	8.92	9.14	9.52	9.48	8.66	8.77	8.80	8.38	9.52
Conductivity	mS/cm	0.01	0.226	0.221	0.213	0.214	0.211	0.211	0.222	0.233	0.232	0.254	0.234	0.22	0.211	0.254
Turbidity	NTU	1.00	1.30	0.00	0.00	0.80	8.80	7.50	19.10	6.60	3.50	12.20	11.50	6.48	0.00	19.10
D.O.	mg/L	0.01	12.17	9.41	8.48	9.44	8.54	9.36	8.58	10.03	9.69	8.56	9.83	9.46	8.48	12.17
D.O.	%	1	115.9%	105.2%	100.6%	109.7%	103.4%	115.6%	107.0%	125.5%	122.2%	98.1%	103.8%	110%	98%	126%
Temp.	°C	0.1	12	20	22	22	24	25	25	25	25	22	17	21.78	11.9	25.4
Temp.	°F	0.1	53.3	68.5	72.2	72.3	74.8	76.2	77.7	77.6	77.3	71.0	62.3	71.21	53.3	77.7
Salinity	%	0.01	0.11	0.11	0.1	0.1	0.1	0.1	0.11	0.11	0.11	0.12	0.11	0.11	0.10	0.12
Cl-a	ug/L	0.5	2.1	2.1	1.1	1.1	2.1	9.6	12	6	6.8	12.8	14.2	6.35	1.1	14.2
T.P.	mg/L	0.010	0.015	0.022	0.027	0.019	0.013	0.036	0.027	0.024	0.024	0.027	0.046	0.03	0.013	0.046
T.P.	ug/L	10	15	22	27	19	13	36	27	24	24	27	46	25.45	13	46
Secchi	ft	0.1	9.3	15.5	11	11.3	7.9	4.3	3.11	4.7	5.5	5	3.55	7.38	3.1	15.5
Secchi	m	0.03	2.83	4.72	3.35	3.44	2.41	1.31	0.95	1.43	1.68	1.52	1.08	2.25	0.9	4.7
Physical			1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.18	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	1.00	1.0	1.0

*reporting limit

		2014 Median
pH		8.80
Conductivity	mS/cm	0.225
Turbidity	FNRU	6.00
D.O.	mg/l	9.46
D.O.	%	110.00%
Temp.	°C	21.80
Temp.	°F	71.20
Salinity	%	0.11
Cl-a	ug/L	6.40
T.P.	mg/l	0.03
T.P.	ug/l	25.50
Secchi	ft	7.40
Secchi	m	2.20





Lake George Summertime Annual Means

Agency	MC	MC	MC	MC	MC	MC	ACD	MC	ACD	ACD	ACD	ACD	ACD	MC	MC	ACD	ACD
Year	1980	1981	1982	1984	1989	1994	1997	1998	1999	2000	2002	2005	2008	2009	2011	2013	2014
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	25.5
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	6.4
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	2.2
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	7.4

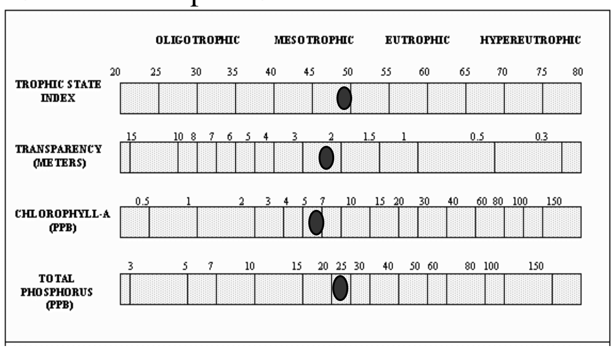
Carlson's Tropic State Indices

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

Lake George Water Quality Report Card

Year	80	81	82	84	89	94	97	98	99	2000	2002	2005	2008	2009	2011	2013	2014
TP	A	A	A	B	B	B	A	B	A	A	A	B	B+	B	B	B	B
Cl-a	A	A	A	A	A	A	B	A	A	A	A	A	A	A	B	A	A
Secchi	A	A	A	A	A	B	A	B	A	B	B	B	A	B	C	B	B
Overall	**A**	**A**	**A**	**A**	**A**	**B**	**A**	**B**	**A**	**A**	**A**	**B**	**A**	**B**	**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 sampling. The watershed is mostly undeveloped or vacant, with some residential areas on the East side of the watershed.

In 2013 and 2014 this lake was monitored by the Anoka Conservation District as part of the MPCA's Rum River Watershed Restoration and Protection Project (WRAP).

2014 Results

In 2014, the overall water quality grade for Minard Lake was a B grade. The limited data available indicates that the lake is mesotrophic. In 2014 the average surface total phosphorus (TP) concentration was 38 µg/l (maximum of 62 µg/l and a minimum of 24 µg/l) receiving a B grade. The average Chlorophyll-a (Cl-a) concentration was 2.3 µg/l (maximum of 3.2 µg/l and a minimum of 1.1 µg/l) receiving an A grade. Vegetation prevented accurate Secchi transparency readings.

Trend Analysis

Insufficient historical data available to conduct any trend analysis. Aside from 2013 and 2014, the only available data are Secchi transparency readings from 1990, 1991, and 2008. Those readings are similar to 2013 and 2014.

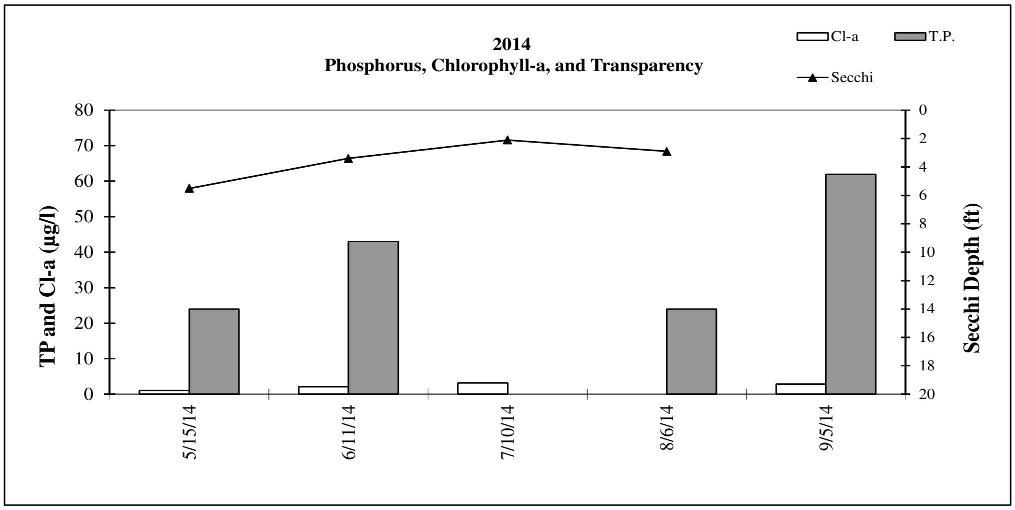
Discussion

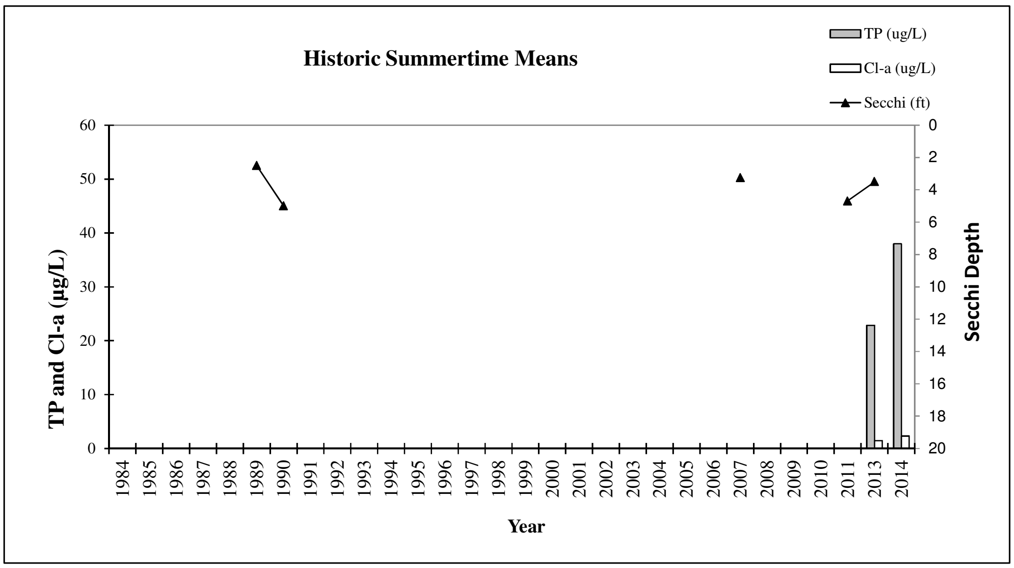
During each sampling event, the recreational suitability and physical conditions were evaluated. These rankings are based on the subjective perception of ACD staff regarding the appearance of the lake. The physical condition of the lake was consistently perceived as having an abundance of aquatic vegetation.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

2014 Minard Lake Water Quality Data

Lake Minard	Units	R.L.*	5/15/2014 12:30 Results	6/11/2014 11:50 Results	7/10/2014 13:20 Results	8/6/2014 12:35 Results	9/5/2014 13:10 Results	Average	Min	Max
pH		0.1	8.13	8.11	7.87	9.66	7.59	8.272	7.59	9.66
Conductivity	mS/cm	0.01	0.159	0.167	0.172	0.18	0.203	0.1762	0.159	0.203
Turbidity	NTU	1	2	2.9	7.1	1.4	6.8	4.04	1.4	7
D.O.	mg/L	0.01	11.26	9.22	1.21	9.94	6.8	7.686	1.21	11.26
D.O.	%	1	105.2%	109.0%	12.7%	123.1%	77.0%	85.4%	12.7%	123%
Temp.	°C	0.1	12	23	23	24	20	21	12	24.4
Temp.	°F	0.1	53.9	73.7	73.9	76.0	68.6	69.2	53.9	76.0
Salinity	%	0.01	0.08	0.08	0.09	0.09	0.1	0.088	0.08	0.10
Cl-a	ug/L	0.5	1.1	2.1	3.2	<1	2.8	2.3	1.1	3.2
T.P.	mg/L	0.010	0.024	0.043		0.024	0.062	0.03825	0.024	0.062
T.P.	ug/L	10	24	43		24	62	38.25	24	62.0
Secchi	ft	0.1	5.5	3.4	2.11	2.9	> 3	3.4775	2.11	5.5
Secchi	m	0.1	1.68	1.04	0.64	0.88		1.06	0.64	1.68
Physical			1.0	1.0	1.0	2.0	1.0	1.2	1.0	2.0
Recreational			1.0	1.0	1.0	4.0	1.0	1.6	1.0	4.0

*reporting limit





Lake Minard Summertime Historic Mean

Agency	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1998	1999	2000	2002	2004	2007	2008	2010	2013	2014
TP (µg/L)									22.8	38.0
Cl-a (µg/L)									1.5	2.3
Secchi (m)							1.0		1.4	1.1
Secchi (ft)							3.2		4.7	3.5

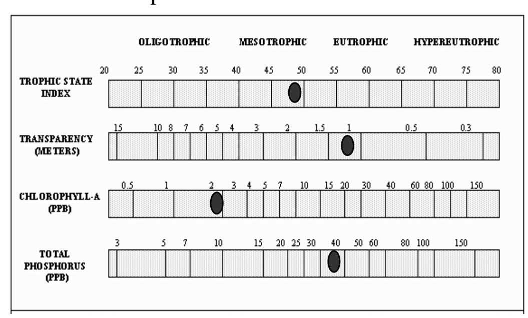
Carlson's Tropic State Indices

Year	1998	1999	2000	2003	2005	2007	2008	2010	2013	2014
TSIP									49	57
TSIC									34	39
TSIS							60		55	59
TSI							60		42	48

Lake Minard Water Quality Report Card

Year	1998	1999	2000	2003	2005	2007	2008	2010	2013	2014
TP (µg/L)									A	C
Cl-a (µg/L)									A	A
Secchi (m)									n/a	n/a
Overall									**A**	**B**

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 and 2014 this lake was monitored by the Anoka Conservation District as part of the MPCA's Rum River Watershed Restoration and Protection Project (WRAP).

2014 Results

In 2014, Pickerel Lake had above average water quality, receiving an A grade. The average surface total phosphorus (TP) concentration was 16 µg/l (maximum of 30 µg/l and a minimum of 12 µg/l) receiving an A grade. TP was below the historical average and the lowest monitored since 2010. The average Chlorophyll-a (Cl-a) concentration was 1.8 µg/l (maximum of 3.2 µg/l and a minimum of 1.1 µg/l) falling well below the historical average and receiving an A grade. The average Secchi transparency measurement was 4.9 feet (maximum of 5.6 ft. and a minimum of 3.8 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).

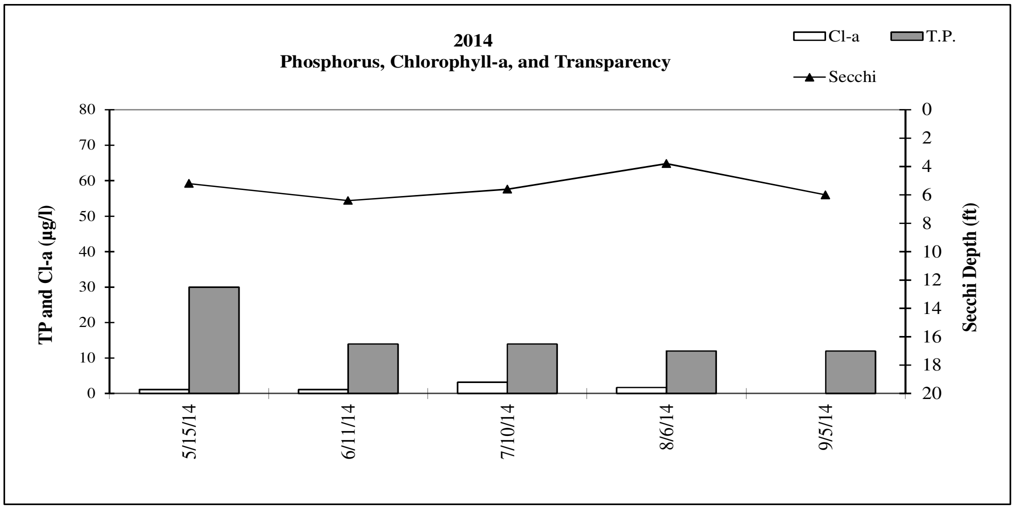
Discussion

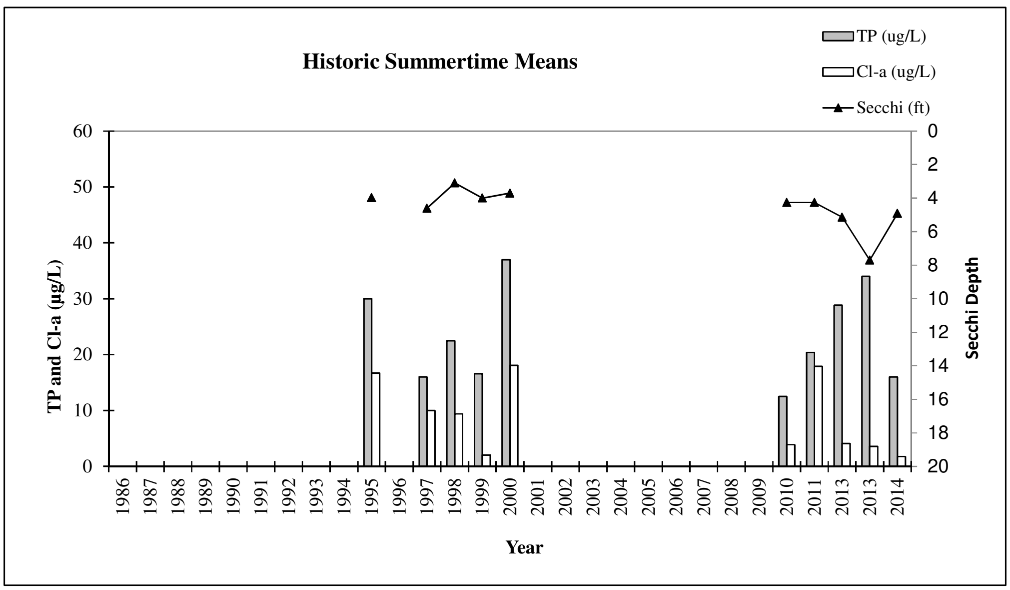
In 2014 the physical condition of the lake was consistently perceived as beautiful with occasional aesthetic issues. In terms of recreational suitability, Pickerel Lake is limited due to the abundance of rooted aquatic vegetation. This is to be expected in a healthy shallow lake, and is not problematic.

2014 Pickerel Lake Water Quality Data

Pickerel Lake	Units	R.L.*	5/15/2014 13:50 Results	6/11/2014 13:30 Results	7/10/2014 14:10 Results	8/6/2014 13:45 Results	9/5/2014 14:35 Results	Average	Min	Max
pH		0.1	8.35	8.79	9.21	9.24	8.57	8.83	8.35	9.24
Conductivity	mS/cm	0.01	0.235	0.207	0.185	0.197	0.238	0.212	0.185	0.238
Turbidity	NTU	1	2	0.1	3.2	1.4	2.7	2	0	3
D.O.	mg/L	0.01	12.38	10.73	10.8	8.76	8.95	10.32	8.76	12.38
D.O.	%	1	1.135	1.261	1.344	1.111	1.02	1.17	1.02	1.344
Temp.	°C	0.1	12	23	25	26	21	21.4	12.3	25.6
Temp.	°F	0.1	54.1	74.1	76.6	78.0	69.4	70.4	32.0	78.0
Salinity	%	0.01	0.11	0.1	0.09	0.1	0.11	0.10	0.09	0.11
Cl-a	ug/L	0.5	1.1	1.1	3.2	1.7	<1	1.8	1.1	3.2
T.P.	mg/L	0.010	0.03	0.014	0.014	0.012	0.012	0.016	0.012	0.030
T.P.	ug/L	10	30	14	14	12	12	16.4	0.0	30.0
Secchi	ft	0.1	5.2	>6.4	5.6	3.8	>6.0	4.9	3.8	5.6
Secchi	m	0.1	1.58		1.71	1.16		1.48		
Physical			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Recreational			1.0	1.0	1.0	3.0	1.0	1.4	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	ACD
Year	1980	1995	1997	1998	1999	2000	2010	2011	2013	2014
TP (µg/L)	32.5	30.0	16.0	22.5	16.6	37.0	12.5	20.4	28.8	16.0
Cl-a (µg/L)	19.5	16.7	10.0	9.4	2.1	18.1	3.9	17.9	4.1	1.8
Secchi (m)	0.9	1.2	1.4	0.9	1.2	1.1	1.3	1.3	1.6	1.5
Secchi (ft)	2.8	4.0	4.6	3.1	4.0	3.7	4.3	4.3	5.1	4.9

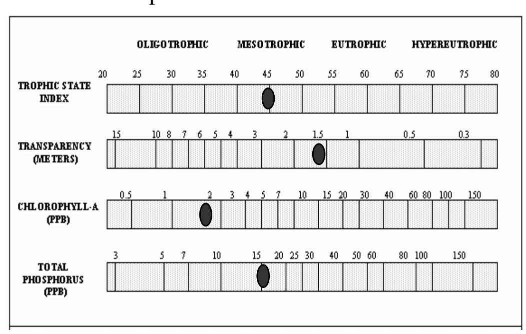
Carlson's Tropic State Indices

Year	1980	1995	1997	1998	1999	2000	2010	2011	2013	2014
TSIP	54	53	44	49	45	56	41	48	53	44
TSIC	60	58	53	53	38	59	44	59	45	36
TSIS	62	57	55	61	57	58	56	56	54	54
TSI	59	56	51	54	47	58	47	54	49	45

Lake Pickerel Water Quality Report Card

Year	1980	1995	1997	1998	1999	2000	2010	2011	2013	2014
TP (µg/L)	C	B	A	A	B	C	A	A	B	A
Cl-a (µg/L)	B	B	A	A	B	B	A	B	A	A
Secchi (m)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	C
Overall	**C**	**B**	**A**	**A**	**B**	**C**	**A**	**B+**	**B+**	**A**

Carlson's Trophic State Index



Aquatic Invasive Vegetation Mapping

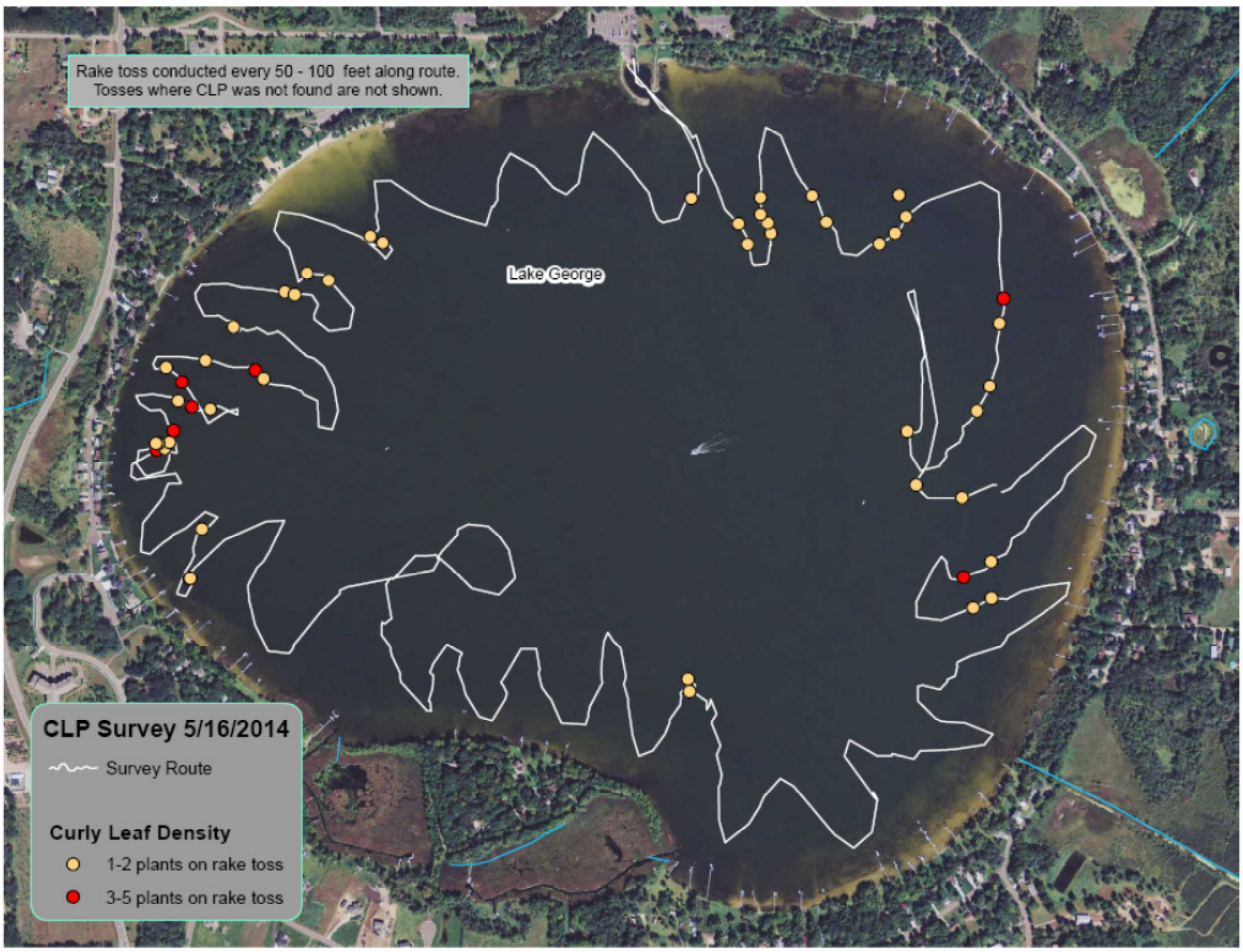
Description: The Anoka Conservation District (ACD) was contracted through the Lake George Lake Improvement District (LID) to conduct an aquatic invasive vegetation delineation.

Purpose: To map out the presence of Curly Leaf Pondweed (CLP) and Eurasian Water Milfoil (EWM) earlier in the season. This would allow for sooner chemical treatment with the goal of eliminating the bounce in nutrients following treatment seen in years past.

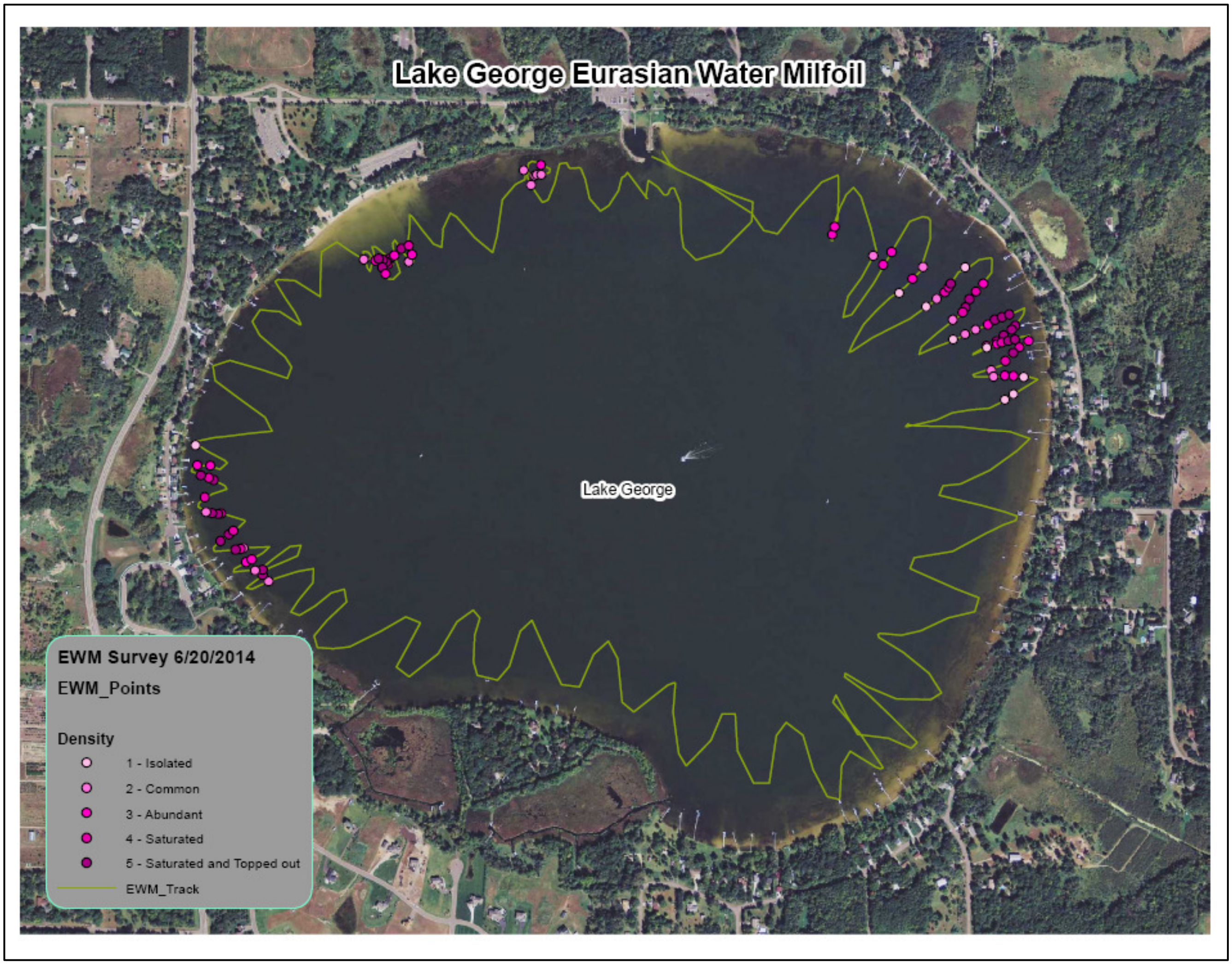
Locations: Lake George

Results: Maps are presented on the following pages. These maps were reviewed by the MNDNR and herbicide treatments occurred in areas with the most invasive plants.

2014 Lake George Curly Leaf Pondweed (CLP) Survey



2014 Lake George Eurasian Water Milfoil (EWM) Survey



Stream Water Quality - Chemical Monitoring

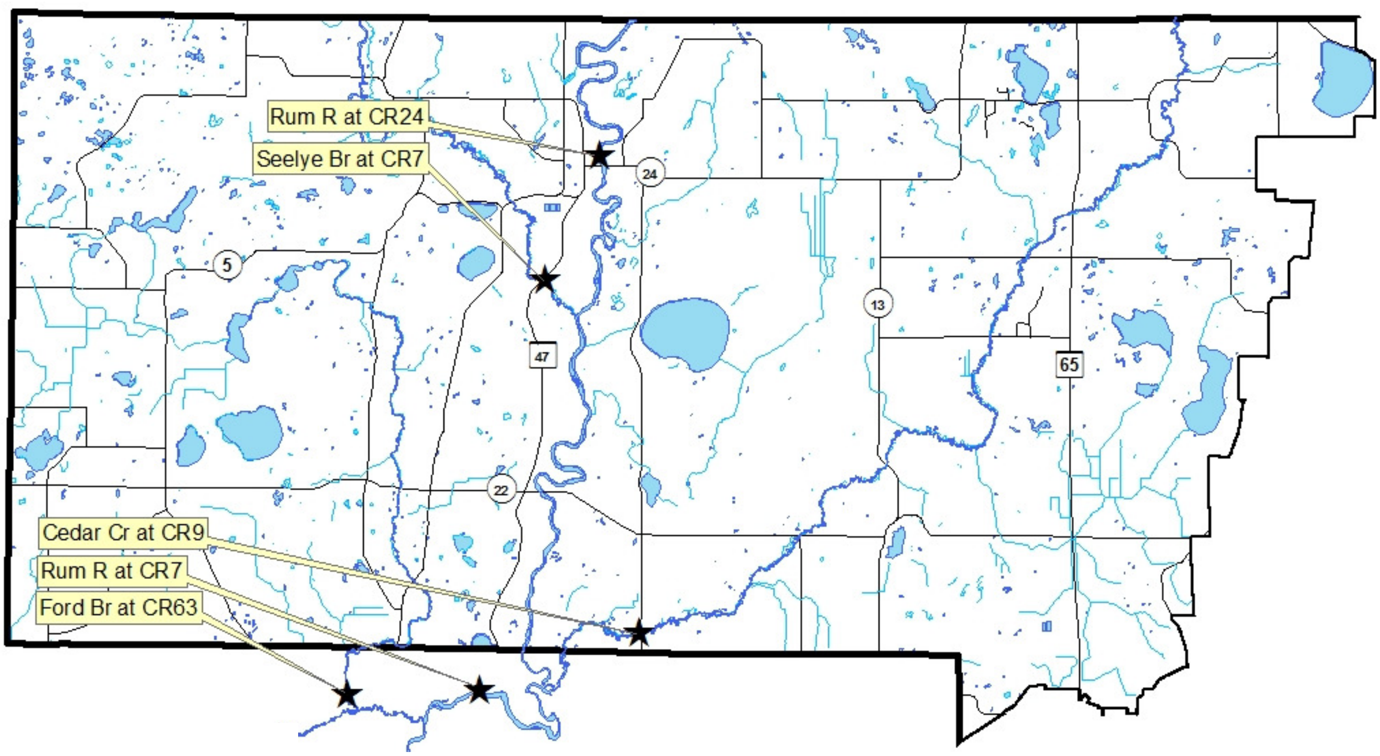
Description: The Anoka Conservation District (ACD) is conducting stream monitoring in 2014 and 2015 in addition to Surface Water Assessment Grant (SWAG) monitoring for the MPCA. Monitoring events are scheduled May through September for of the following parameters: total suspended solids, e. coli, total phosphorus, Secchi tube transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

Purpose: To detect water quality trends and problems, and diagnose the source as well as provide an initial assessment of water quality to be used in the completion of the Rum River Watershed Restoration and Protection Plan (WRAPP).

Locations:
Rum River at Co Rd 24
Rum River at Co Rd 7
Seeyle Brook at Co Rd 7
Cedar Creek at Co Rd 9
Ford Brook at Co Rd 63

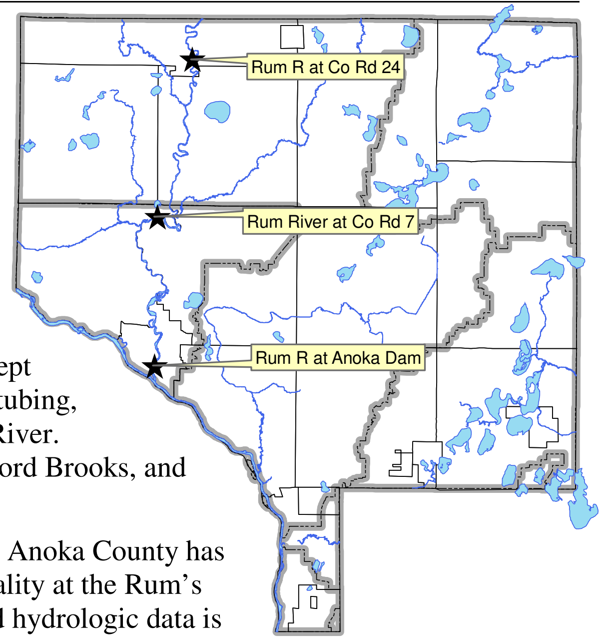
Results: Results are presented on the following pages.

Upper Rum River Watershed and SWAG Stream Water Quality Monitoring Sites



RUM RIVER

Rum River at Co. Rd. 24 (Bridge St), St. Francis	STORET SiteID = S000-066
Rum River at Co. Rd. 7 (Roanoke St), Ramsey	STORET SiteID = S004-026
Rum River at Anoka Dam, Anoka	STORET SiteID = S003-183



Years Monitored

At Co. Rd. 24 –	2004, 2009, 2010, 2011, 2014
At Co. Rd. 7 –	2004, 2009, 2010, 2011, 2014
At Anoka Dam –	1996-2011 by the Met Council WOMP program

Background

The Rum River is regarded as one of Anoka County's highest quality and most valuable water resources. It is designated as a state scenic and recreational river throughout Anoka County, except south of the county fairgrounds in Anoka. It is used for boating, tubing, and fishing. Much of western Anoka County drains to the Rum River. Subwatersheds that drain to the Rum include Seelye, Trott, and Ford Brooks, and Cedar Creek.

The extent to which water quality improves or is degraded within Anoka County has been unclear. The Metropolitan Council has monitored water quality at the Rum's outlet to the Mississippi River since 1996. This water quality and hydrologic data is well suited for evaluating the river's water quality just before it joins the Mississippi River. Monitoring elsewhere has been sporadic and sparse. Water quality changes might be expected from upstream to downstream because land use changes dramatically from rural residential in the upstream areas of Anoka County to suburban in the downstream areas.

Methods

In 2004, 2009, 2010, 2011 and 2014 monitoring was conducted to determine if Rum River water quality changes in Anoka County, and if so, generally where changes occur. The data is reported together for a more comprehensive analysis of the river from upstream to downstream.

In 2014 the river was monitored during both storm and baseflow conditions by grab samples. Four water quality samples will be taken each year 2014 and 2015; 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. 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. During every sampling the water level (stage) was recorded. The monitoring station at the Anoka Dam includes automated equipment that continuously tracks water levels and calculates flows. Water level and flow data for other sites was obtained from the US Geological Survey, who maintains a hydrological monitoring site at Viking Boulevard.

The purpose of this report is to make an upstream to downstream comparison of Rum River water quality. It includes only parameters tested in 2014. It does not include additional parameters tested at the Anoka Dam or additional monitoring events at that site. For that information, see Metropolitan Council reports at http://www.metrocouncil.org/Environment/RiversLakes. All other raw data can be obtained from the Anoka

Conservation District and is also available through the Minnesota Pollution Control Agency's EQuIS database, which is available through their website.

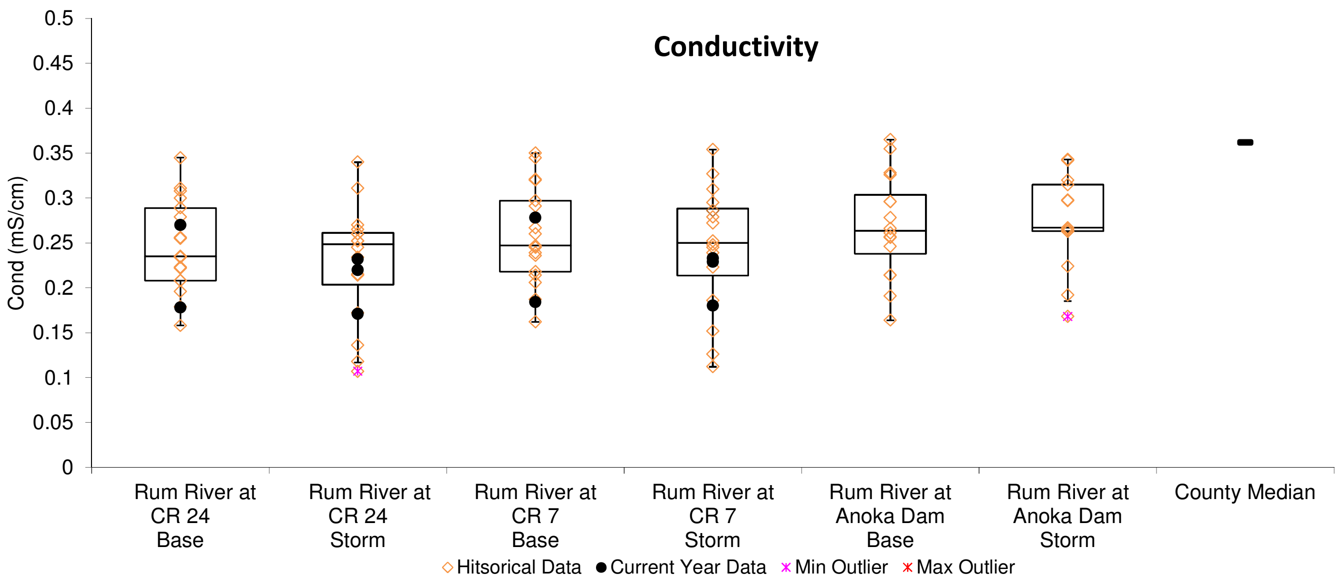
Results and Discussion

On the following pages data are presented and discussed for each parameter. Management recommendations will be included in the 2015 report at the conclusion of this monitoring project. The Rum River is an exceptional waterbody, and its protection and improvement should be a high priority.

Conductivity

Conductivity and chlorides are measures of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial 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 were not sampled in 2014 and thus not displayed below. Historical chloride data can be obtained from the Anoka Conservation District and is also available through the Minnesota Pollution Control Agency's EQuIS database, which is available through their website. These pollutants are of greatest concern because of the effect they can have on the stream's biological community. They can also be of concern because the Rum River is upstream from the Twin Cities drinking water intakes on the Mississippi River.

Conductivity during baseflow and storm conditions 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).



Conductivity is acceptably low in the Rum River, but increases downstream (see figures above) and during baseflow. Median conductivity from upstream to downstream of the sites monitored in 2014 was 0.220 mS/cm and 0.269 mS/cm, respectively. This is lower than the median for 34 Anoka County streams of 0.362 mS/cm. The 2014 maximum observed conductivity in the Rum River was 0.278 mS/cm.

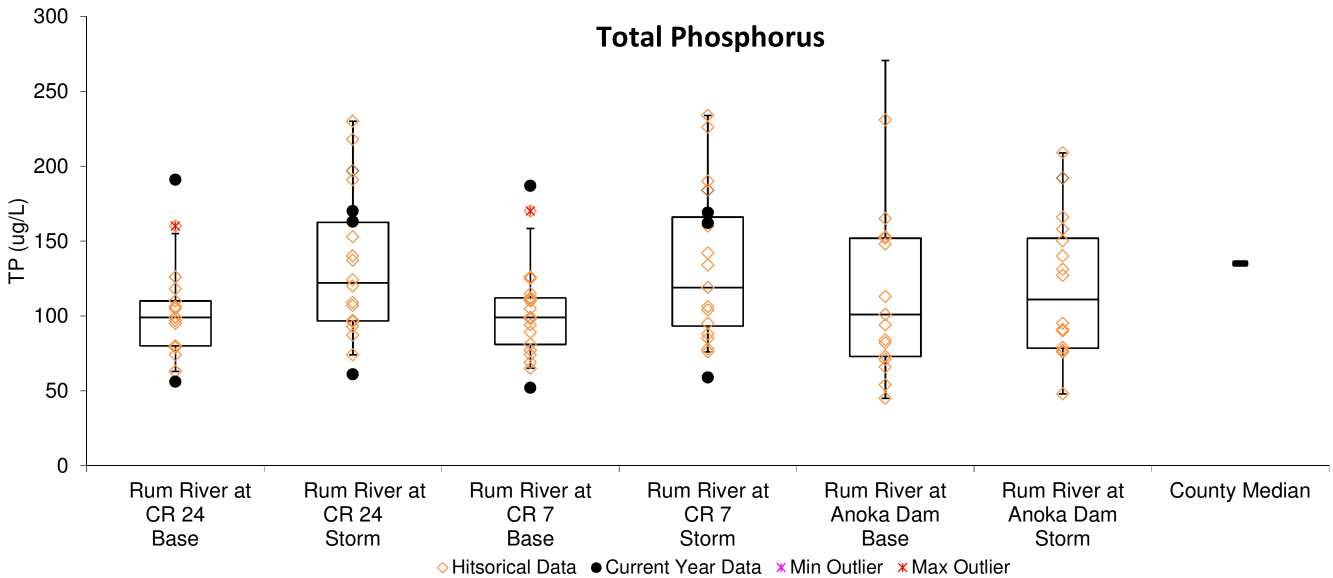
Conductivity was lowest at all sites during storms, suggesting that stormwater runoff contains fewer dissolved pollutants than the surficial water table that feeds the river during baseflow. High baseflow conductivity has been observed in most other nearby streams too, studied extensively, and the largest cause has been found to be road salts that have infiltrated into the shallow aquifer. Geologic materials also contribute, but to a lesser degree.

Conductivity increased from upstream to downstream. During baseflow this increase from upstream to downstream reflects greater road densities and deicing salt application. During storms, the higher conductivity downstream is reflective of greater stormwater runoff and pollutants associated with the more densely developed lower watershed.

Total Phosphorus

Total phosphorus in the Rum River is acceptably low and is similar to the median for all other monitored 34 Anoka County streams (see figure below). Though 2014 did find some of the highest and lowest readings ever observed. This nutrient is one of the most common pollutants in our region, and can be associated with urban runoff, agricultural runoff, wastewater, and many other sources. The median phosphorus concentration at the two monitored sites was 163 and 162 ug/L. These upstream-to-downstream differences are negligible and there is no trend of increasing phosphorus downstream. All sites occasionally experience phosphorus concentrations higher than the median for Anoka County streams of 135 ug/L. In 2014 the highest observed total phosphorus readings were during one particular baseflow event, including the maximums at each site of 191 and 187 ug/L (upstream to downstream). In all, phosphorus in the Rum River is at acceptable levels but should continue to be an area of pollution control effort as the area urbanizes.

Total phosphorus during baseflow and storm conditions Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Turbidity and Total Suspended Solids (TSS)

Turbidity and total suspended solids (TSS) are two different measurements of solid material suspended in the water. Turbidity is measured by refraction of a light beam passed through a water sample. It is most sensitive to large particles. Total suspended solids is measured by filtering solids from a water sample and weighing the filtered material. The amount of suspended material is important because it affects transparency and aquatic life, and because many other pollutants are attached to particles. Many stormwater treatment practices such as street sweeping, sumps, and stormwater settling ponds target sediment and attached pollutants. In 2014 Suspended solids in the Rum River were low.

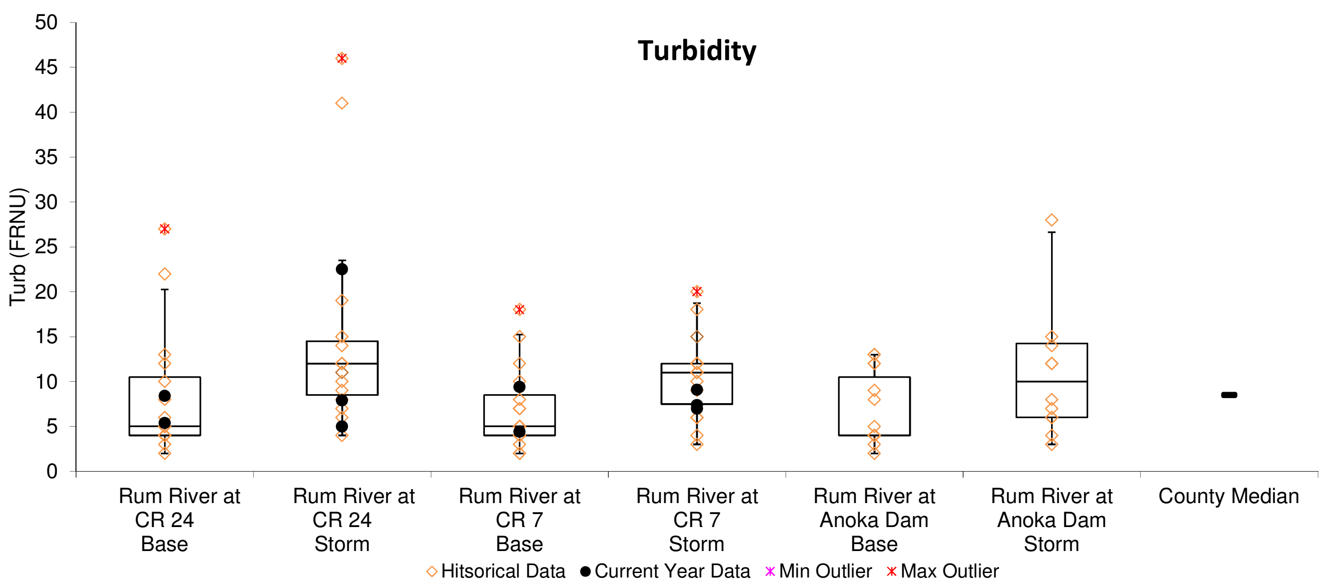
It is important to note the suspended solids can come from sources within and outside of the river channel. Sources on land include soil erosion, road sanding, and others. Riverbank erosion and movement of the river bottom also contributes to suspended solids. A moderate amount of this "bed load" is natural and expected.

In the Rum River, turbidity was low with only slight increases during storms and a very slight decrease at downstream monitoring sites (see figure below). The median turbidity at each site was 7.9, and 7 FNRU (upstream to downstream), which is similar to the median for Anoka County streams of 8 FNRU. Turbidity was elevated on a few occasions, especially during storms. In 2014 the maximum observed was 22.5 FNRU during an early season monitoring event.

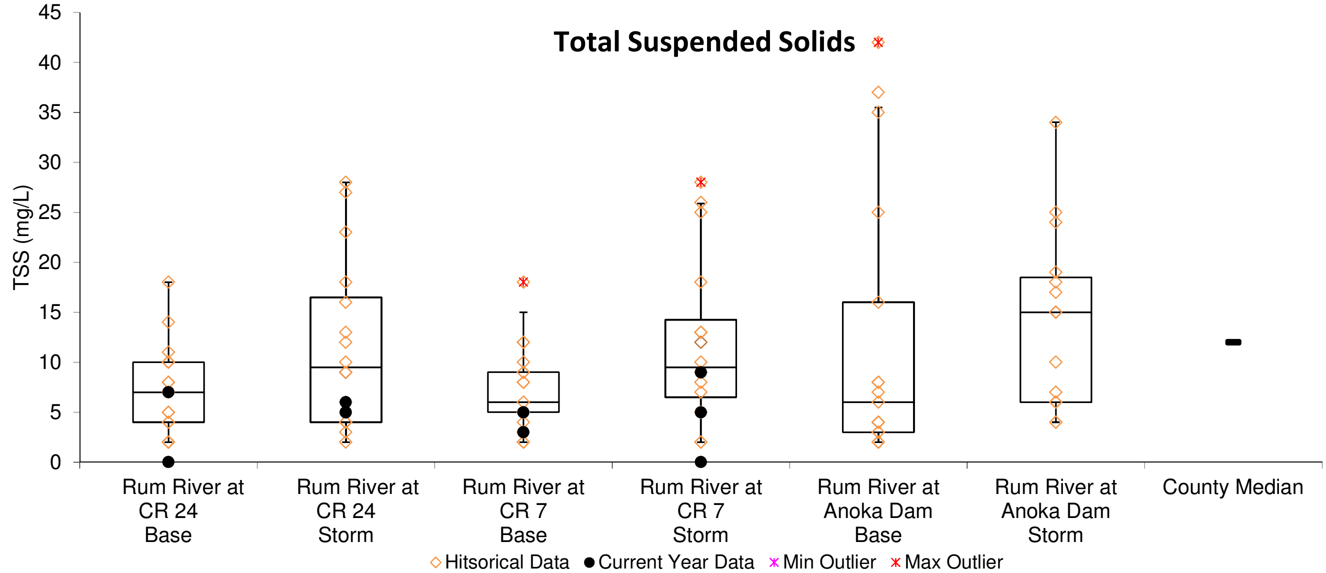
Rigorous stormwater treatment should occur as the Rum River watershed develops, or the collective pollution caused by many small developments will seriously impact the river. Bringing stormwater treatment up to date in older developments is also important.

Differences between TSS and turbidity lend insight into the nature of any problems. TSS showed increases at the downstream monitoring site, while turbidity did not. Turbidity is most sensitive to large particles. Therefore, the downstream increases are likely due to smaller particles. Other pollutants, such as phosphorus and metals, are most highly correlated with smaller particles. These other pollutants can "hitch a ride" on smaller particles because of their greater surface area and, in the case of certain soils, ionic charge. Furthermore, small particles stay suspended in the water column and therefore are more likely to be transported by stream flows and are more difficult to remove with stormwater practices like settling ponds.

Turbidity during baseflow and storm conditions Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



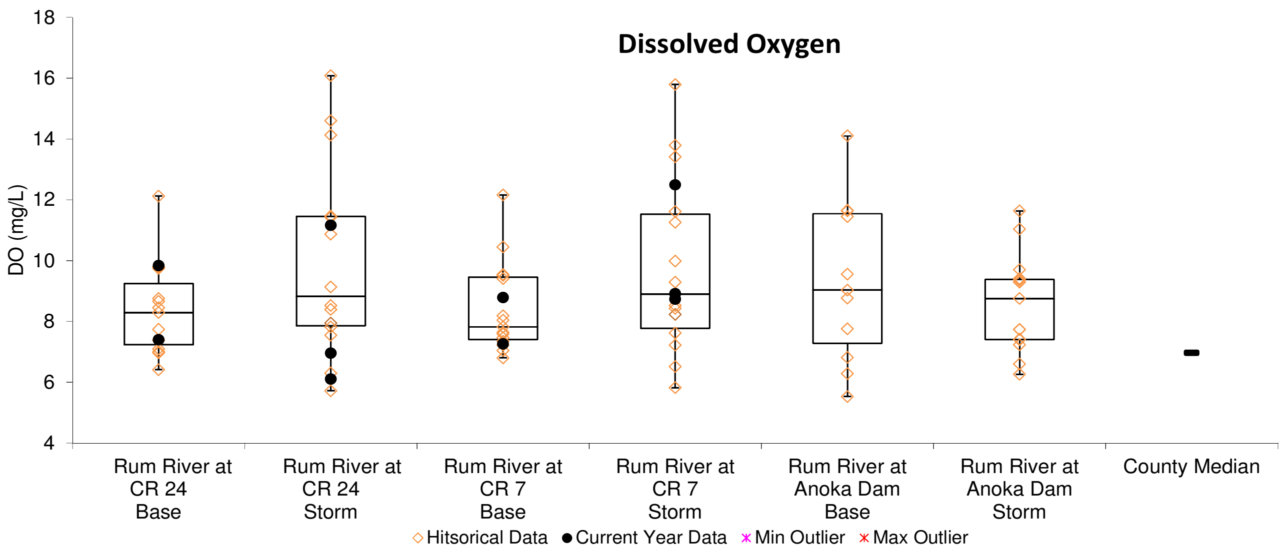
Total suspended solids during baseflow and storm conditions Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Dissolved Oxygen

Dissolved oxygen is necessary for aquatic life, including fish. Organic pollution consumes oxygen when it decomposes. If oxygen levels fall below 4 mg/L aquatic life begins to suffer. In the Rum River dissolved oxygen was always above 5.5 mg/L at all monitoring sites.

Dissolved oxygen during baseflow and storm conditions Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

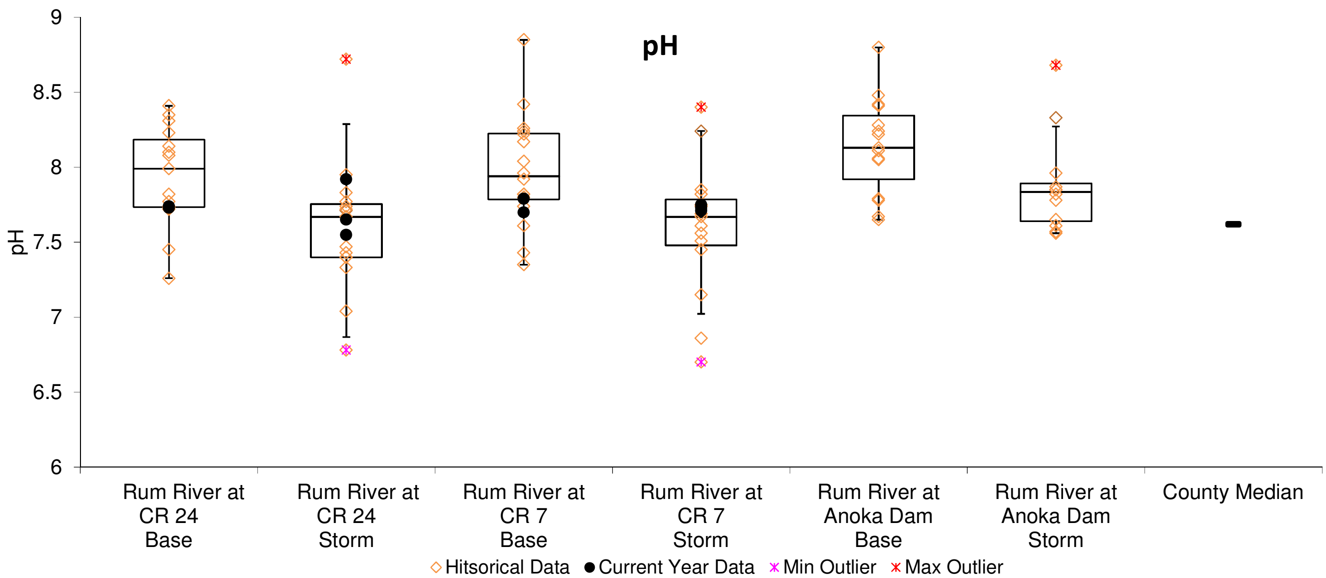


pH

pH refers to the acidity of the water. The Minnesota Pollution Control Agency's water quality standard is for pH to be between 6.5 and 8.5. The Rum River is regularly within this range (see figure below).

It is interesting to note that pH is lower during storms than during baseflow. This is because the pH of rain is typically lower (more acidic). While acid rain is a longstanding problem, its affect on this aquatic system is small.

pH during baseflow and storm conditions Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

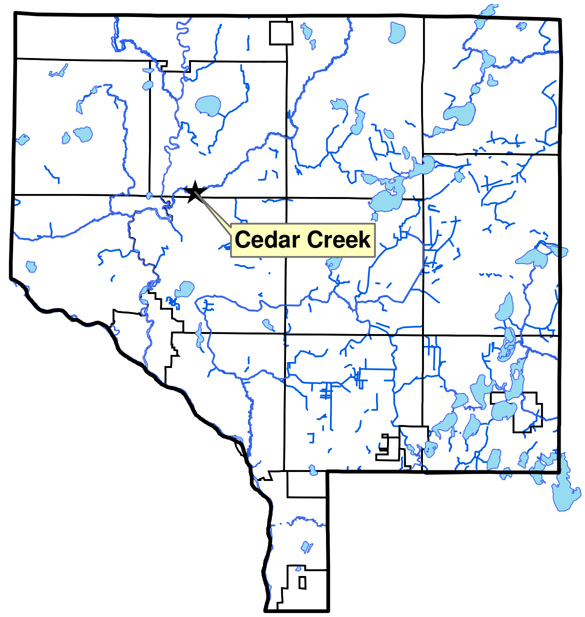


Summary and Recommendations

The Rum River's water quality is very good. It does show a slight increase in suspended solids and conductivitydownstream. Protection of the Rum River should be a high priority for local officials. Large population increases are expected for the Rum River's watershed within Anoka County and have the potential to degrade water quality unless carefully sited and managed. Development pressure is likely to be especially high near the river because of its scenic and natural qualities.

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 2014. 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 0.352 mS/cm Maximum of 0.485 mS/cm and a minimum of 0.247 mS/cm). Chlorides were last sampled in 2013 where they 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 118.4 ug/l (maximum of 181 ug/l and a minimum of 43 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 3.5 mg/l (maximum of 5 mg/l and a minimum of <2 mg/l). Turbidity averaged 9.24 NTU (maximum of 19.7 NTU and a minimum of 2 NTU).
- pH and dissolved oxygen were with the range considered normal and healthy for streams in this area. However, on two sampling occasions DO fell below the 5.0 mg/l. While these sampling events did fall below the daily average standard, they did not exceed the daily minimum. pH averaged 7.71 (maximum of 8.11 and a minimum of 7.45). DO averaged 6.82 mg/l (maximum of 10.44 mg/l and a minimum of 4.77 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.

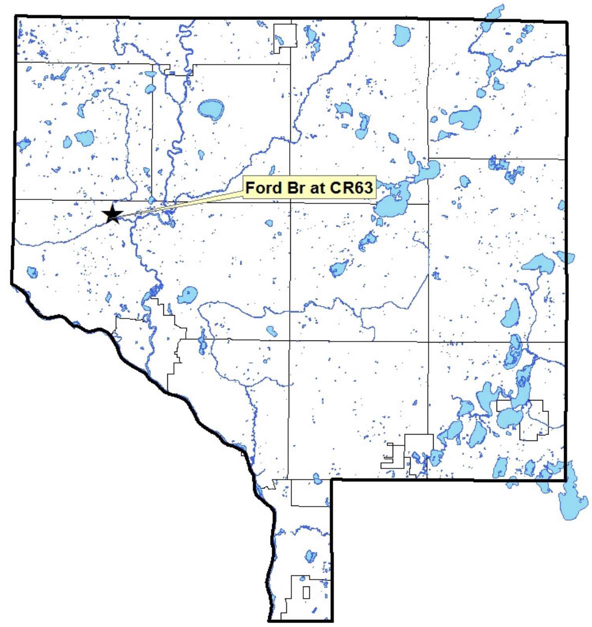
Grey Columns indicate events with E.coli samples only.

Cedar Creek at CR 9			4/28/2014	5/9/2014	6/2/2014	6/16/2014	7/2/2014	7/21/2014	8/5/2014	8/26/2014			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.58	7.60	7.46	7.45	7.45	7.97	8.05	8.11	7.71	7.45	8.11
Conductivity	mS/cm	0.01	0.247	0.280	0.258	0.262	0.350	0.427	0.505	0.485	0.352	0.247	0.505
Turbidity	NTU	1	6.0	2.5	14.2	2.0	2.1	19.7	12.0	15.9	9.30	2.00	19.70
D.O.	mg/L	0.01	10.44	4.77	5.07	4.81	6.25	6.86	7.93	8.41	6.82	4.77	10.44
D.O.	%	1	83.8	43.2	37.6	38.6	59.2	81.9	88.6	91.2	65.5	37.6	91.2
Temp.	°C	0.1	4.86	11.88	20.02	18.00	19.22	22.44	18.90	18.16	16.7	4.9	22.4
Salinity	%	0.01	0.11	0.13	0.12	0.13	0.17	0.21	0.24	0.23	0.17	0.11	0.24
T.P.	ug/L	10	60	43	178	130	181				118	43	181
TSS	mg/L	2	2	<2	4	3	5				3.5	2.0	5.0
Secchi-tube	cm		>100	>100	>100	>100	>100	67	>100	79	>90	67	>100
E coli	MPN				308.0	261.0	26.0	291.0	<1	308.0	238.8	26.0	308.0
Appearance					1B	1B	1B	2	1B	2			
Recreational					2	2	2	2	2	2	2	2	2

*reporting limit

FORD BROOK

At CR 63, Oak Grove



Background

Ford Brook originates at Goose Lake in north-western Anoka County and flows south. Ford Brook is a tributary to the Rum River. In north-western Anoka County it flows through the relatively undisturbed community of Nowthen before joining Trott Brook just prior to the Rum River.

Ford Brook is one of the smaller streams in Anoka County. The watershed is moderately developed with scattered single family homes, but continues to grow.

Results and Discussion

This report includes data from 2014. 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, in Ford Brook was average when compared to similar Anoka County streams. Conductivity averaged 0.299 mS/cm (maximum of 0.394 mS/cm and a minimum of 0.128 mS/cm).
- Phosphorous averaged over the proposed MPCA water quality standard of 100 ug/l. If the proposed standard is approved, Ford Brook often exceeds the limit, even during baseflow periods. Phosphorous results in Ford Brook averaged 120.2 ug/l (maximum of 176 ug/l and a minimum of 54 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 8.80 mg/l (maximum of 19 mg/l and a minimum of 3 mg/l). Turbidity averaged 15.86 NTU (maximum of 50.0 NTU and a minimum of 4.1 NTU). Water flow during the 50.0 NTU reading was extremely fast and turbulent due to abnormal rainfall.
- pH and dissolved oxygen were with the range considered normal and healthy for streams in this area. pH averaged 7.64 (maximum of 7.71 and a minimum of 7.58). DO averaged 9.58 mg/l (maximum of 14.73 mg/l and a minimum of 6.19 mg/l).

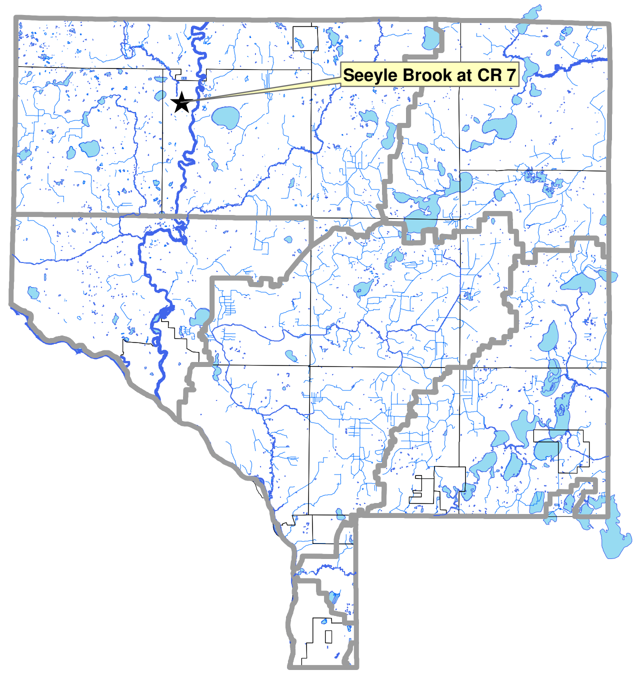
For a significant number of the results below there are no current state standards. However, this data will be used as a baseline for future assessments of the watershed.

FordBrook at CR63			4/28/2014	5/9/2014	6/2/2014	6/16/2014	7/2/2014			
	Units	R.L.*	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.7	7.71	7.58	7.6	7.6	7.64	7.58	7.71
Conductivity	mS/cm	0.01	0.314	0.128	0.344	0.316	0.394	0.299	0.128	0.394
Turbidity	NTU	1	50.0	4.1	10.4	8.0	7.0	15.90	4.10	50.00
D.O.	mg/L	0.01	12.29	7.35	14.73	7.33	6.19	9.58	6.19	14.73
D.O.	%	1	97.7	70.8	75	71	69.8	76.9	69.8	97.7
Temp.	°C	0.1	4.7	11.6	20.5	18.5	19.8	15.0	4.7	20.5
Salinity	%	0.01	0.14	0.03	0.16	0.15	0.19	0.13	0.03	0.19
T.P.	ug/L	10	98	54	176	121	152	120	54	176
TSS	mg/L	2	19	4	10.0	3	8	8.8	3.0	19.0
Secchi-tube	cm		43	>100	83	97	92	>100	43	97
E coli	MPN				93.0	161.6	224.7	159.8	93.0	224.7
Appearance					1B	2	3			
Recreational					2	2	2	2	2	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 2014. 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. Conductivity averaged 0.375 mS/cm (maximum of 0.580 mS/cm and a minimum of 0.223 mS/cm).
- 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 111 ug/l (maximum of 199 ug/l and a minimum of 40 ug/l).
- Suspended solids and turbidity both stayed below the state standards throughout the season. Suspended solids averaged 3.7 mg/l (maximum of 5.0 mg/l and a minimum of 2.0 mg/l). Turbidity averaged 4.46 NTU's (maximum of 8.50 NTU's and a minimum of 2.0 NTU's)
- pH and dissolved oxygen averaged within the range considered normal and healthy for streams in this area. pH averaged 7.79 (maximum of 8.10 and a minimum of 7.52). DO averaged 8.86 mg/l (maximum of 14.23 mg/l and a minimum of 5.95 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			4/28/2014	5/9/2014	6/2/2014	6/16/2014	7/2/2014	7/21/2014	8/5/2014	8/26/2014			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.73	7.7	7.55	7.52	7.61	8.02	8.1	8.06	7.79	7.52	8.10
Conductivity	mS/cm	0.01	0.231	0.26	0.223	0.314	0.403	0.477	0.58	0.515	0.375	0.223	0.580
Turbidity	NTU	1	2.3	2.0	7.9	4.0	5.9	8.5	2.0	3.1	4.46	2.00	8.50
D.O.	mg/L	0.01	12.65	8.34	5.95	14.23	6.36	6.85	8.42	8.08	8.86	5.95	14.23
D.O.	%	1	90.3	63.5	69.4	77.9	69.3	81	90.2	86.9	78.6	63.5	90.3
Temp.	°C	0.1	5.0	11.7	21.0	17.8	18.8	22.1	18.1	17.9	16.6	5.0	22.1
Salinity	%	0.01	0.11	0.12	0.11	0.15	0.20	0.23	0.28	0.25	0.18	0.11	0.28
T.P.	ug/L	10	40	41	151	126	199				111	40	199
TSS	mg/L	2	<2	<2	4.0	2	5				3.7	2.0	5.0
Secchi-tube	cm		>100	>100	>100	>100	87	89	>100	>100	>100	87	89
E coli	MPN				93.0	161.6	224.7	86.7	488.4	127.4	197.0	86.7	488.4
Appearance					1B	2	3	2	1B	1B			
Recreational					2	2	2	2	2	2	2	2	2

*reporting limit

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 2014

Monitored Since

2000

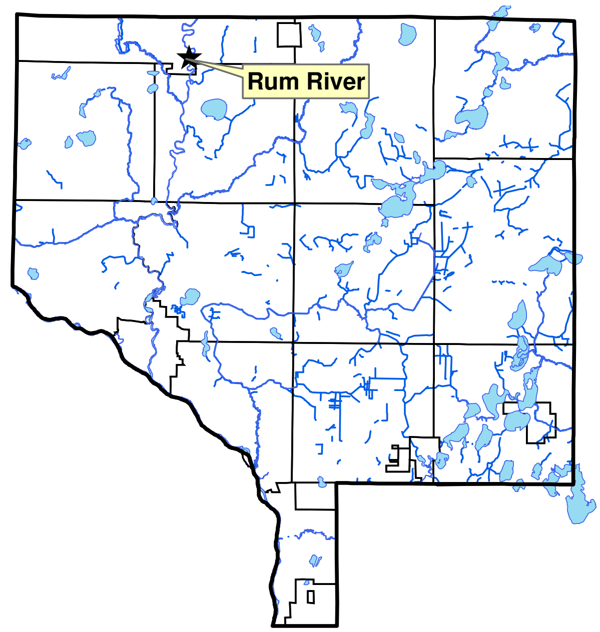
Student Involvement

35 students in 2014, approximately 1,323 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.

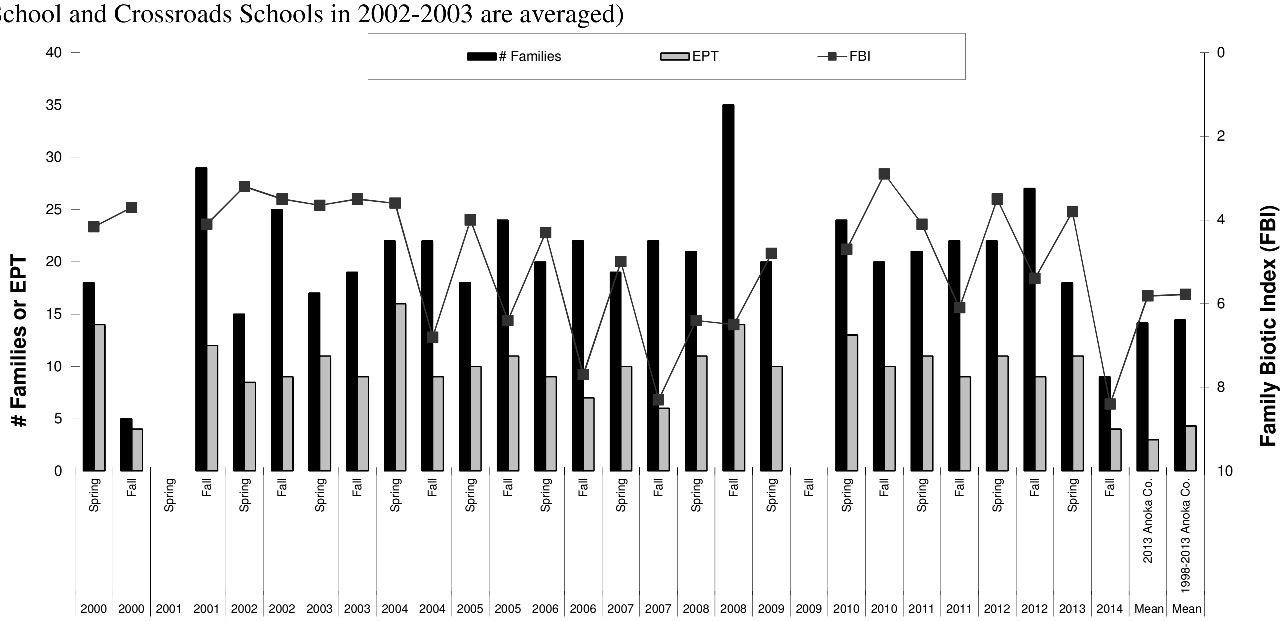
The sampling site is in Rum River North County Park. This site is typical of the Rum in northern Anoka County, having a rocky bottom with numerous pool and riffle areas.



Results

St. Francis High School classes monitored the Rum River in fall 2014, with Anoka Conservation District (ACD) oversight. Biological data for 2014 appears to be an anomaly when compared with the historical data. Results were far worse than have been observed in over a decade. In fall 2014, 9 families were found which is the lowest ever observed. The number of EPT families were still 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	2014	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	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	8.4	5.8	5.8
# Families	21	35	20	Sample	24	20	21	22	22	27	18	9	14.2	14.5
EPT	11	14	10		13	10	11	9	11	9	11	4	3.0	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	24-Oct		
Sampled By	SFHS	SFHS	SFHS	SFHS	SFHS	ACD	ACD	SFHS	SFHS	SFHS	SFHS	SFHS		
Sampling Method	MH	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	219		
# Replicates	2	4	2		3	1	1	2	2	1	2	1		
Dominant Family	Corixidae	Corixidae	Corixidae		Nemouridae	Leptophlebiidae	baetidae	hydrophilidae	hydropsy	veliidae	Baetiscida	Corixidae		
% Dominant Family	57.5	61.4	24.3		28.1	39.4	66.3	21.4	36.6	13.8	34.7	86.3		
% Ephemeroptera	11.9	17.9	18.7		23.9	51.1	81.3	3.6	43.2	34.2	54.1	3.7		
% Trichoptera	5.9	6.9	20.2		10.8	6.2	6.0	4.3	41.1	4.2	6.3	0.5		
% Plecoptera	17.1	2.1	27.7		32.8	26.6	3.8	9.7	5.2	11.1	30.3	2.3		

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

Historically, both chemical and biological monitoring indicate the good quality of this river. 2014 observed the worst biomonitoring results for this site in recent history. The lack of families found as well as the dominant family making up such a high percentage were the key factors in the poor Family Biotic Index observed in 2014. . 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. This season did see higher than average water flow which could have flushed some critters out. Additionally, this is the latest into the season we have monitored this location and temperature could have played a factor. Both may have contributed to the poorer than average results. While there does not appear to be any trend, this location should continue to be observed closely.

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

- Enforce scenic river law building and clear cutting setbacks .
- Retrofit stormwater conveyance systems to provide better water quality treatment, especially in St. Francis and Anoka where older areas have little or no stormwater treatment.
- Education programs to encourage actions by residents that will benefit the river's health.
- Continue water quality monitoring programs.

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

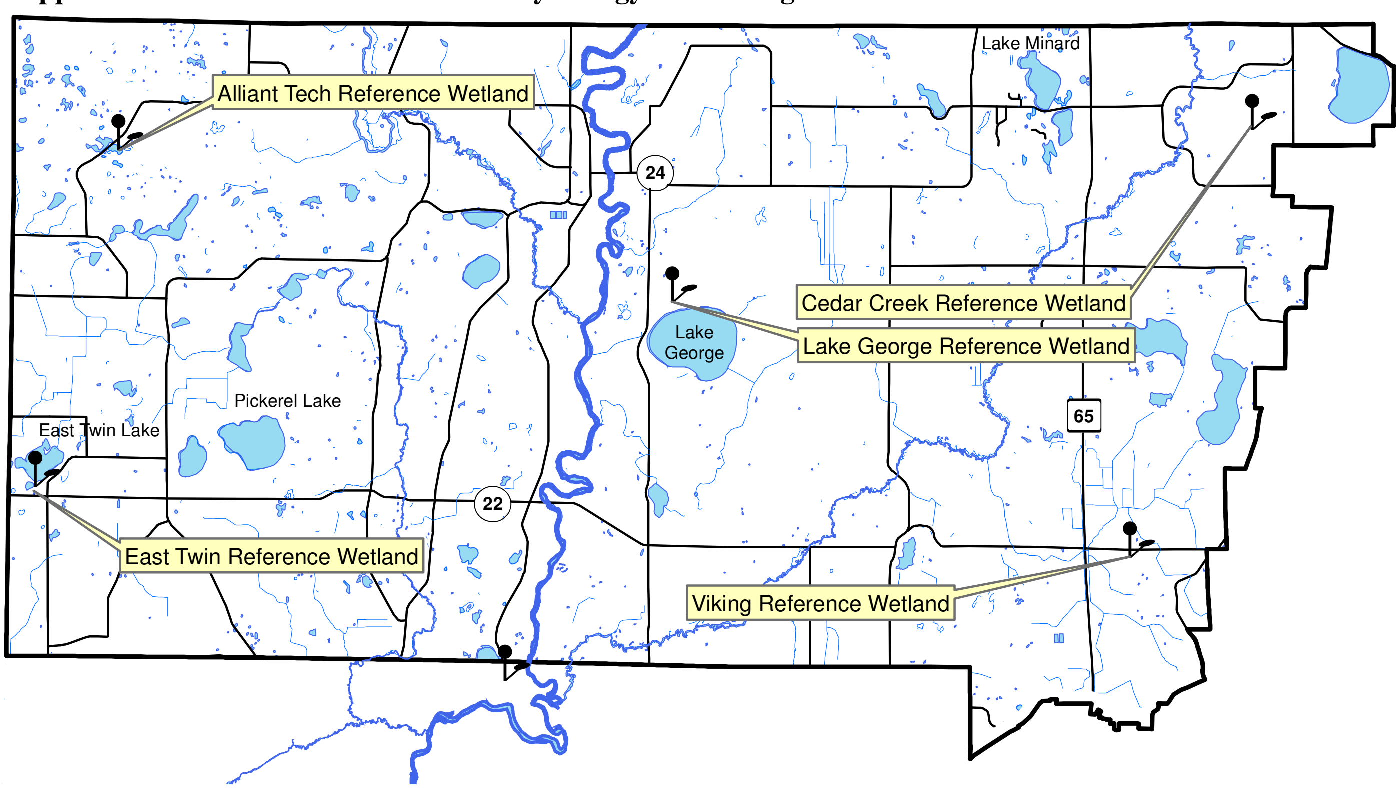
East Twin Reference Wetland, East Twin Township Park, Nowthen

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.

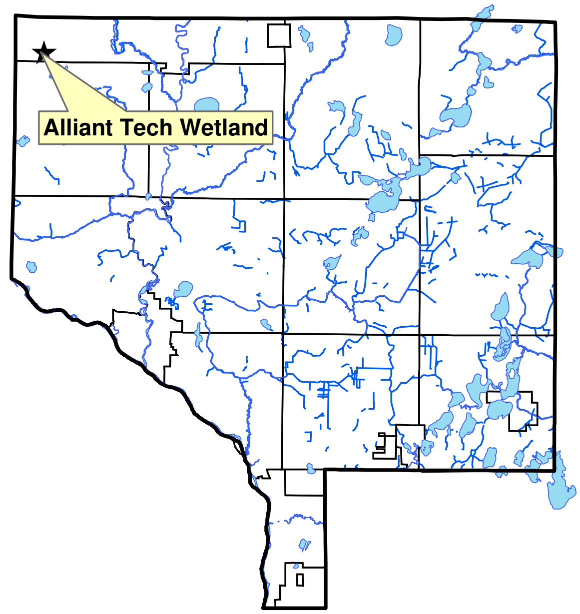
Upper Rum River Watershed Wetland Hydrology Monitoring Sites



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	-

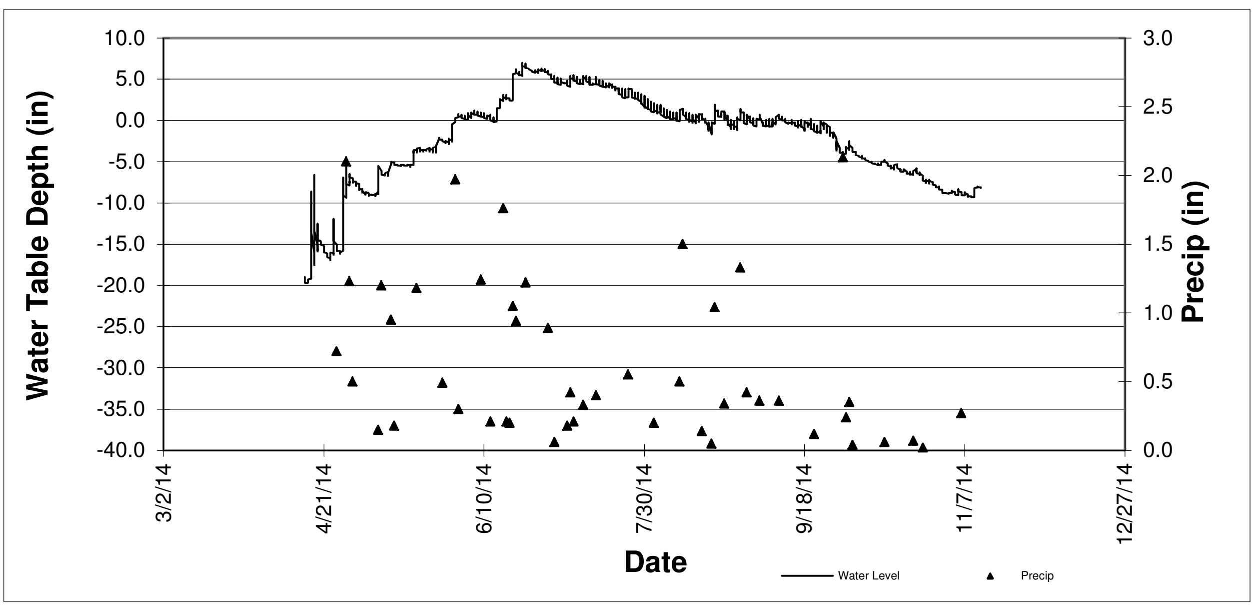
Surrounding Soils: Emmert

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.

2014 Hydrograph

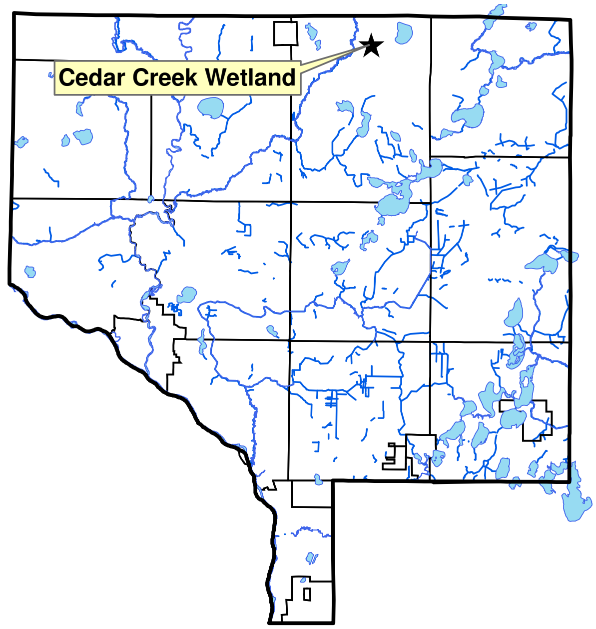


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

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

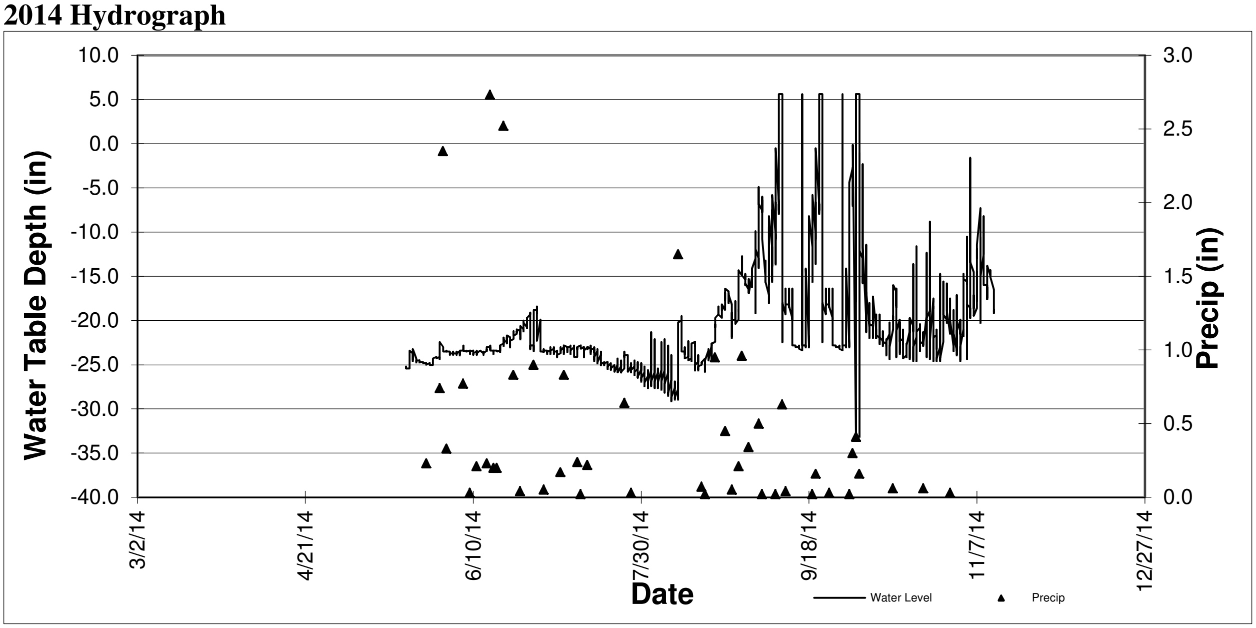
Soils at Well Location: not yet available

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.

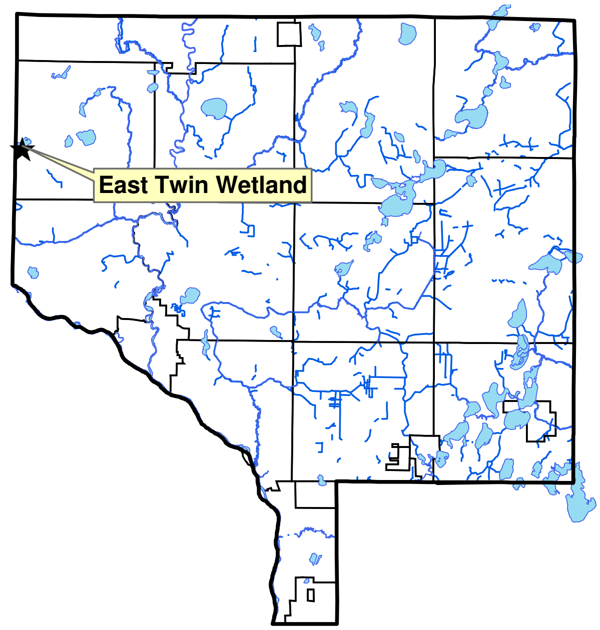
2014 Hydrograph



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.

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	-

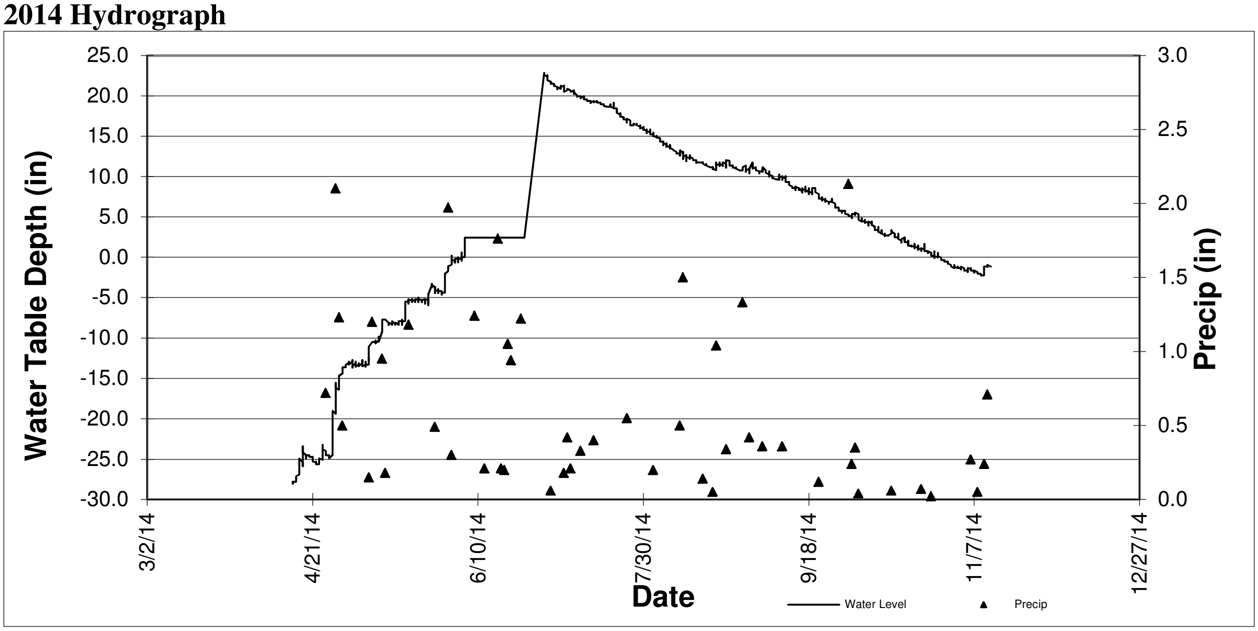
Surrounding Soils: Lake Beach, Growton and Heyder fine sandy loams

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.

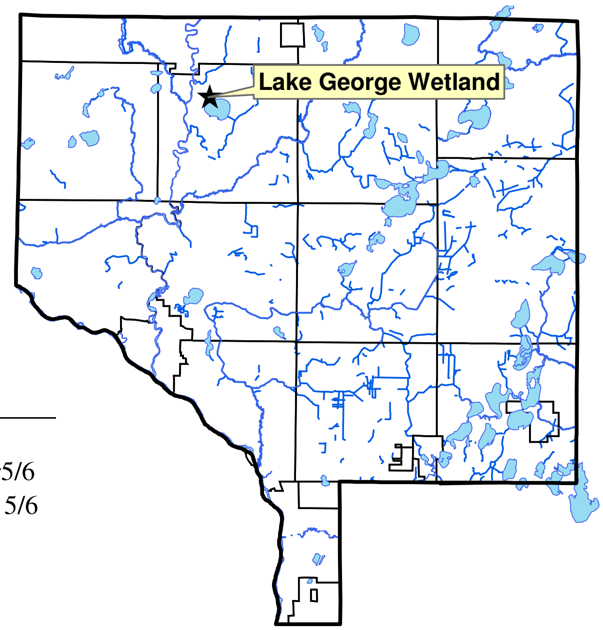
2014 Hydrograph



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

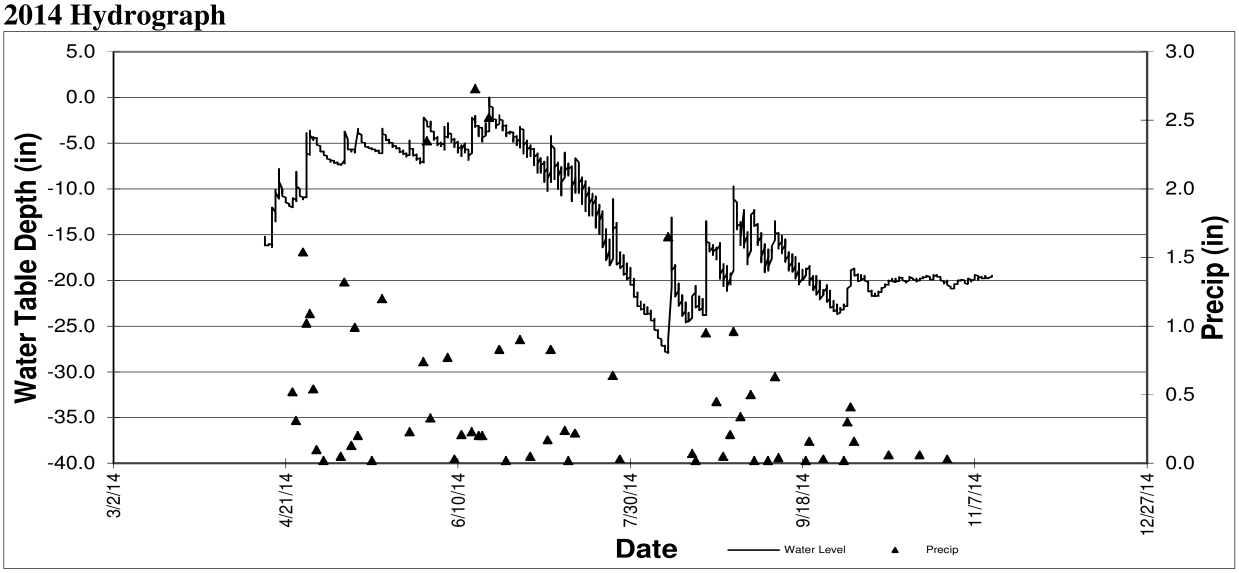
Surrounding Soils: Lino loamy fine sand and Zimmerman fine sand

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.

2014 Hydrograph

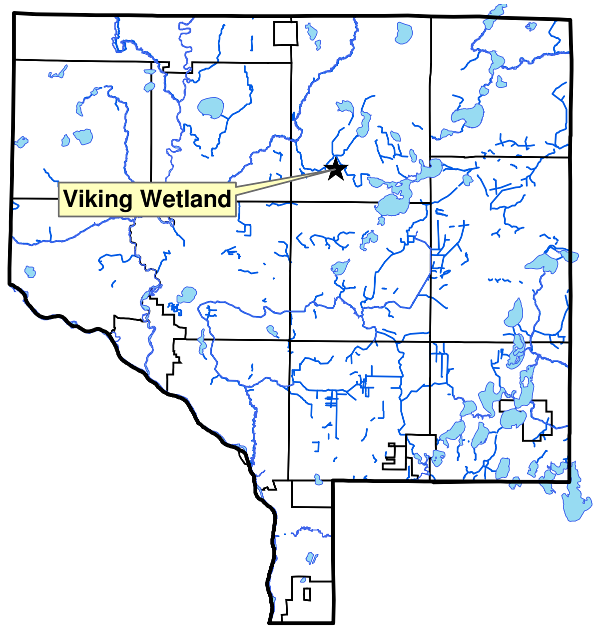


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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

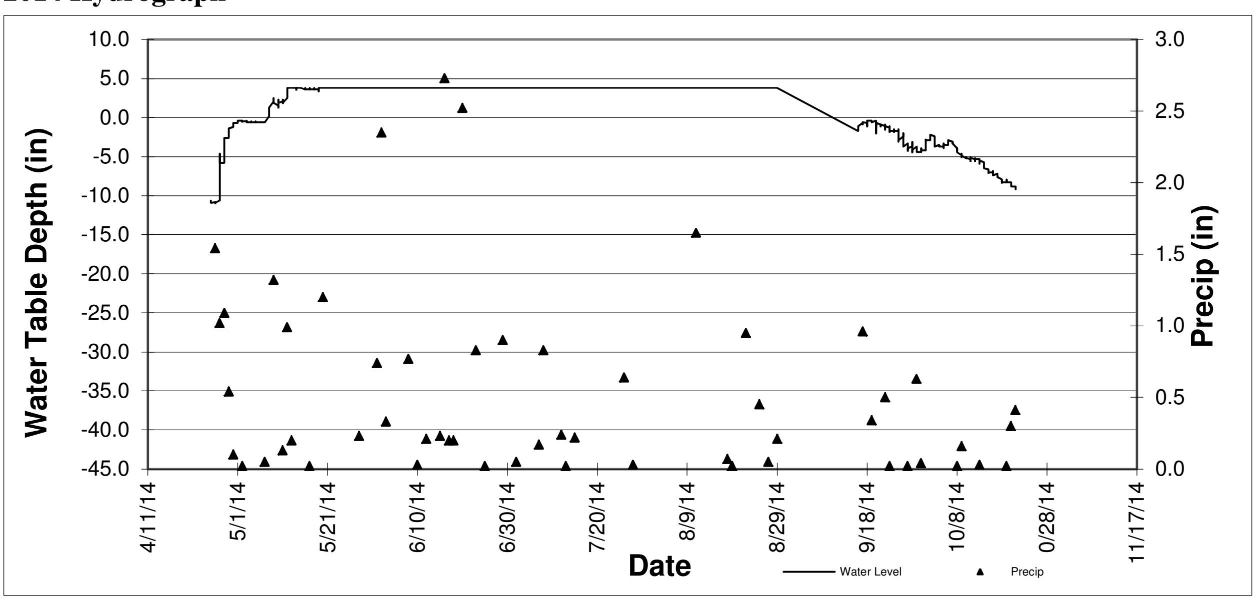
Surrounding Soils: Zimmerman fine sand

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).

2014 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.

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	-	$1,059.69
2013 Correction	+	$ 0.48
Fund Balance		**$ 1598.67**

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.

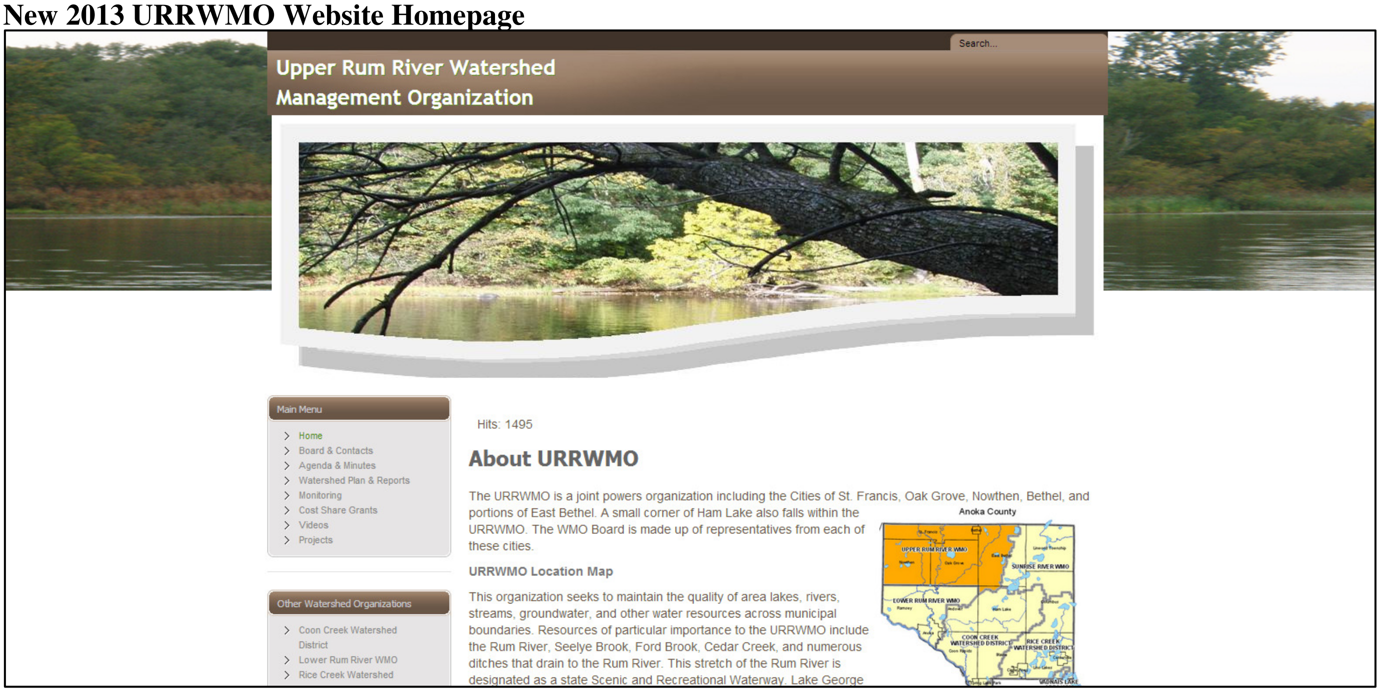
Location: www.URRWMO.org

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 as well as receive input.

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 requesting public input regarding Rum River Watershed Restoration and Protection Project (WRAPP) as well as providing a background of the project.

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 posted to the URRWMO Website, sent to each member community, as well as to the Independent School District 15 publication, "The Courier."

2014 URRWMO Newsletter Article

Public Input Sought on Rum River Watershed Management

An effort is underway to protect and improve water quality in the almost one million acre Rum River watershed. The Rum River Watershed Restoration and Protection Project (WRAP) will create a management plan for the entire watershed, including each lake, stream and the river. Public input is being sought through an online survey.

The survey allows respondents to tell managers what issues are important for them, suspected sources of problems and preferred management. It can also address how to keep good quality waterbodies in good condition. Comments can pertain to lakes, wetlands, streams or the Rum River itself. The survey takes about 10 minutes to complete. It is posted at www.URRWMO.org.

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.

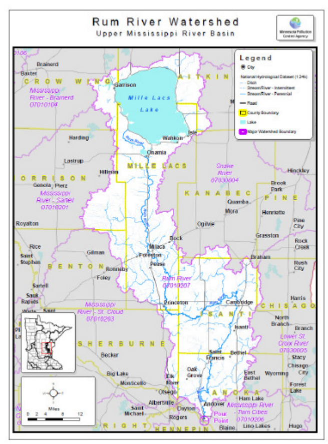
The Rum River WRAP project began in 2013 and will be completed in 2016. It will include:

- 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 for waterbodies not meeting state water quality standards (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 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" or call Jamie Schurbon at the Anoka Conservation District at 763-434-2030 ext. 12.



URRWMO 2013 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.

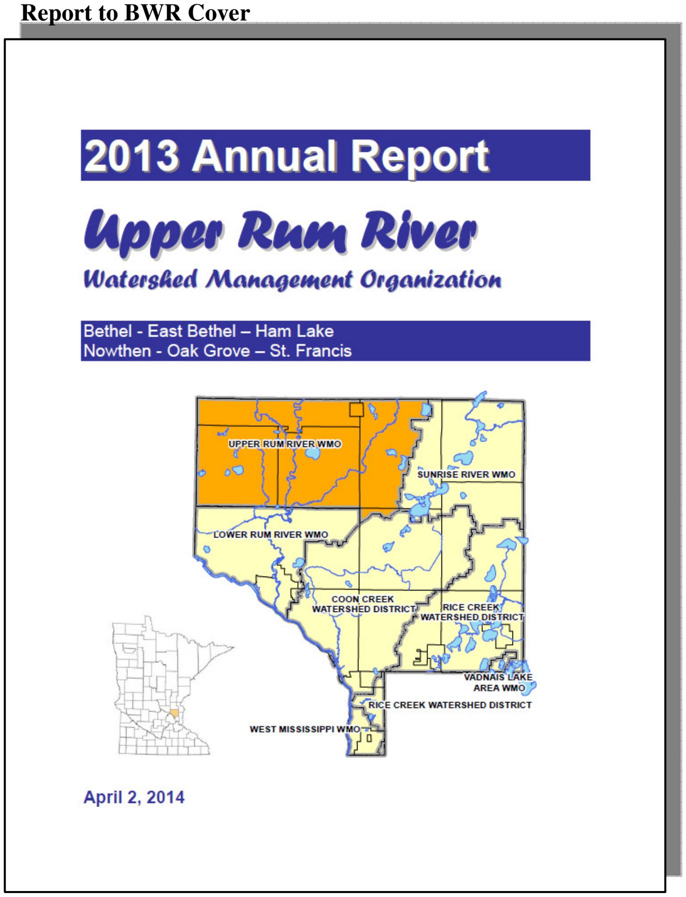
Locations: Watershed-wide

Results: The Anoka Conservation District assisted the URRWMO with preparation of a 2013 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 2014. The report to BWSR and financial report are available on the URRWMO website.

Report to BWR Cover



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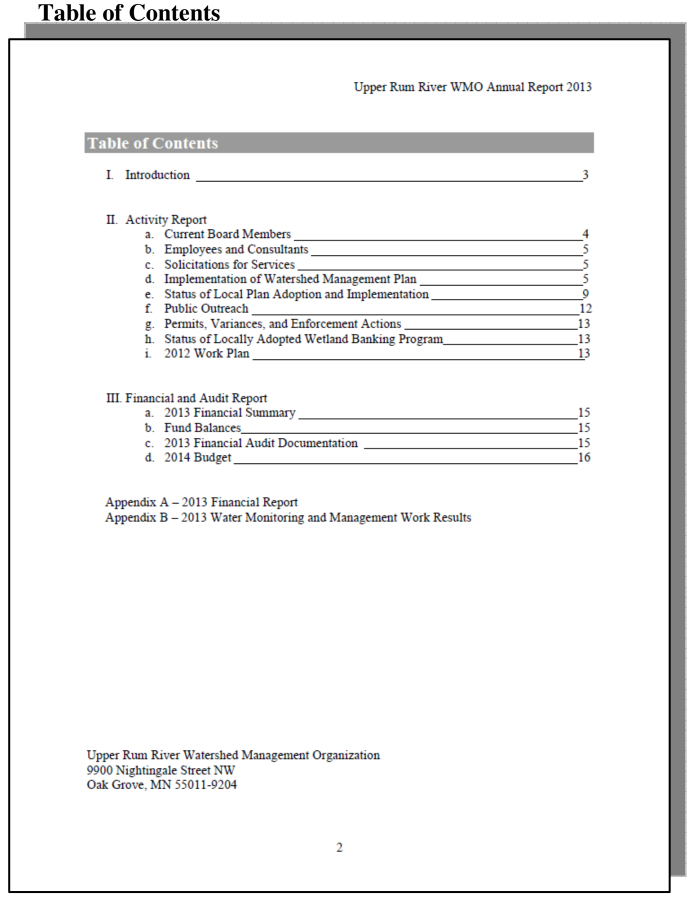

Upper Rum River WMO Annual Report 2013

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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

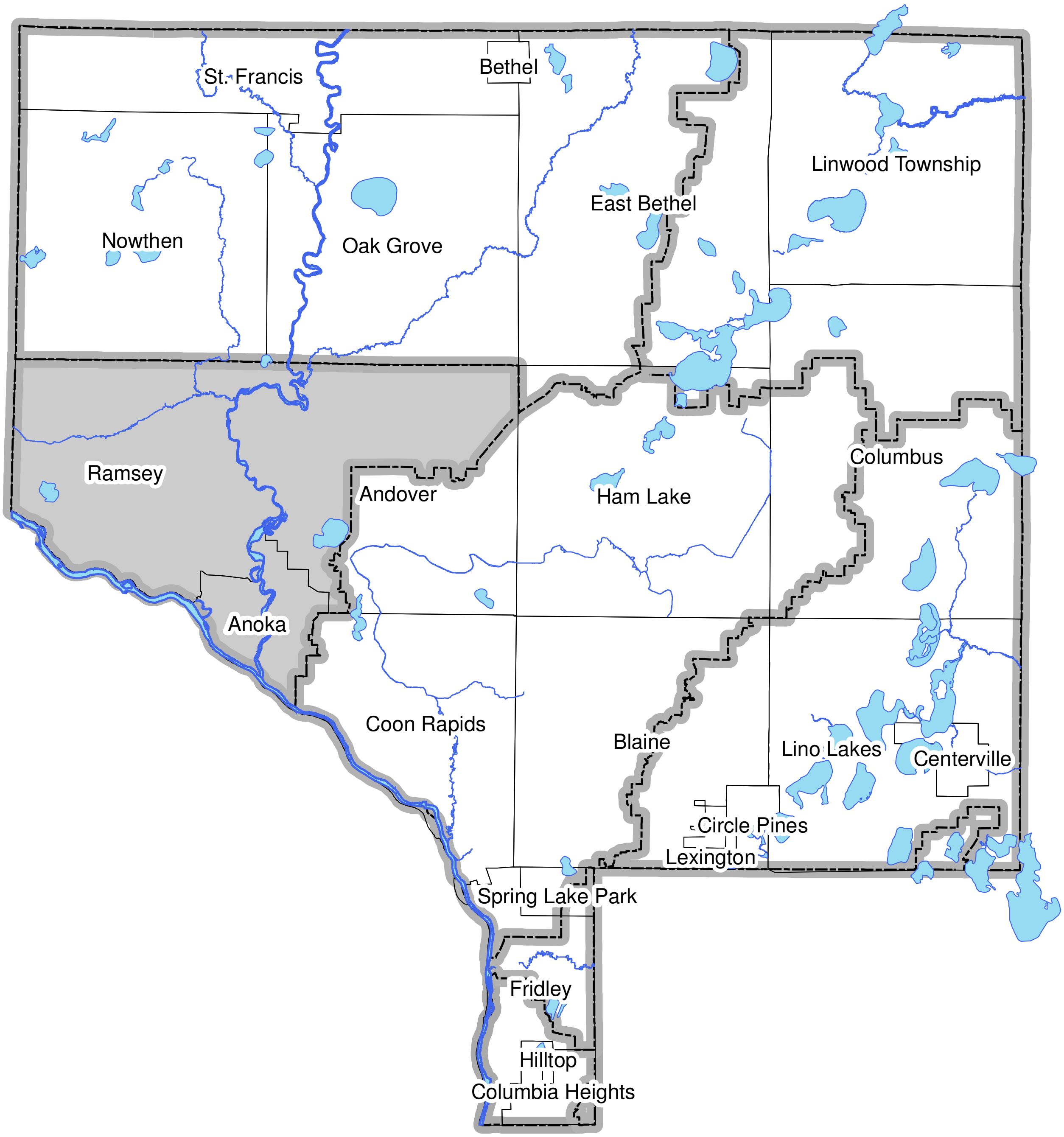
Upper Rum River Watershed	WMO Asst (no charge)	Volunteer Precipitation	Reference Wetlands	DNR Observation Wells	Lake Levels	Lake WQ - SWAG	Stream Water Quality	Watershed Outlet Monitoring	Student Biomonitoring	URRWMO Admin	URRWMO Outreach/Promo	Website Management	Rum River Stabilization	Rum River WRAPP	Lake George CLP Mapping	Cost Share - Local/State	Total
Revenues																	
URRWMO	0	0	1725	0	1000	0	4050	0	825	1365	500	480	0	0	0	1060	11005
State	0	0	0	360	0	3395	4473	0	0	0	0	0	0	16480	0	0	24707
Anoka Conservation District	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anoka Co. General Services	586	0	0	230	0	293	0	0	0	0	0	0	90	0	1393	0	2593
County Ag Preserves	0	0	0	0	0	0	0	0	39	0	0	0	0	0	0	1	40
Regional/Local	0	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	0	0	0
BWSR Cons Delivery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BWSR Cost Share TA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Local Water Planning	0	593	1602	0	0	0	0	287	0	455	0	14	0	0	0	0	2950
TOTAL	586	593	3327	590	1000	3688	8523	1007	864	1820	500	494	90	16480	1393	1060	42015
Expenses-																	
Capital Outlay/Equip	13	13	69	13	19	69	137	22	18	38	5	9	2	118	31	0	578
Personnel Salaries/Benefits	505	511	2722	509	765	2720	5390	867	708	1494	214	337	78	4642	1200	0	22661
Overhead	34	34	183	34	51	183	362	58	48	100	14	23	5	312	81	0	1523
Employee Training	4	4	20	4	6	20	39	6	5	11	2	2	1	34	9	0	165
Vehicle/Mileage	9	9	48	9	14	48	96	15	13	27	4	6	1	82	21	0	402
Rent	22	22	118	22	33	118	233	37	31	65	9	15	3	201	52	0	979
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1060	1060
Program Supplies	0	0	99	0	3	530	1217	0	42	0	0	0	0	11090	0	0	12981
McKay Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	586	593	3259	590	891	3688	7474	1007	864	1734	249	391	90	16480	1393	1060	40350

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.
- **Develop a plan to diagnose declining water quality in Lake George..** This effort might be paired with the Rum River WRAPP project.
- **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.
- **Participate with county and DNR efforts to upgrade the water control structure in 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.

Excerpt from the
2014 Anoka Water Almanac

Chapter 4: Lower Rum River Watershed



Prepared by the Anoka Conservation District

CHAPTER 4:
LOWER RUM RIVER WATERSHED

Task	Partners	Page
Lake Levels	LRRWMO, ACD, volunteers, MN DNR	4-105
Lake WQ	LRRWMO, ACD	4-107
Stream Water Quality – Chemical	MPCA, ACD	4-111
Stream Water Quality – Biological	LRRWMO, ACD, ACAP, Anoka High School	4-118
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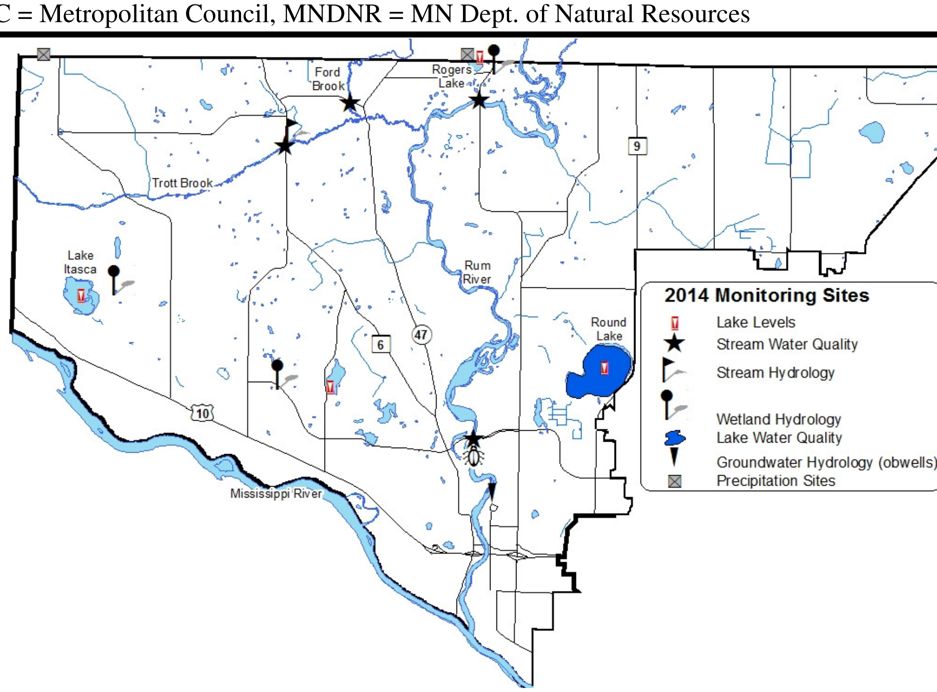
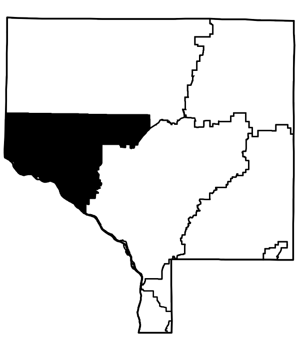
Public Education - Web Video	LRRWMO, ACD	4-129
Review Member Community Local Water Plans	LRRWMO, ACD	4-129
LRRWMO Website	LRRWMO, ACD	4-130
Financial Summary		4-131
Recommendations		4-131
Groundwater Hydrology (obwells)	ACD, MNDNR	Chapter 1
Precipitation	ACD, volunteers	Chapter 1 Chapter 1
		Chapter 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).

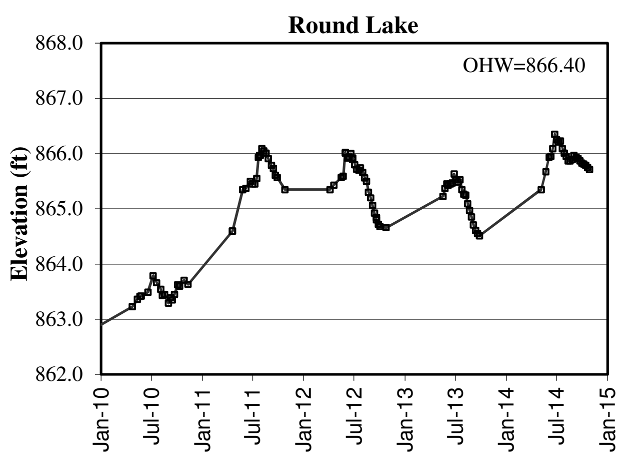
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

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

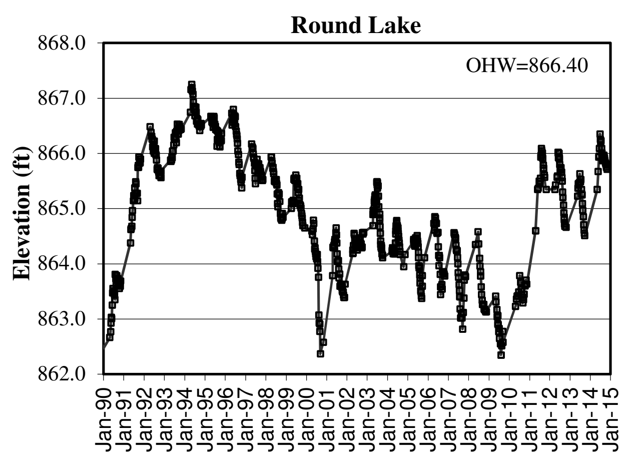
Results: Lake levels were measured by volunteers throughout the 2014 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. Lakes had sharply increasing water levels in spring and early summer 2014 when very heavy rainfall totals occurred. Rainfall tapered off later in the year and lake levels fell accordingly.

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.

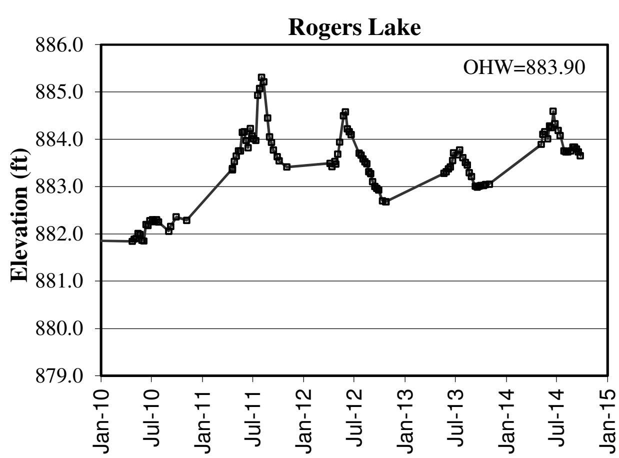
Round Lake Levels – last 5 years



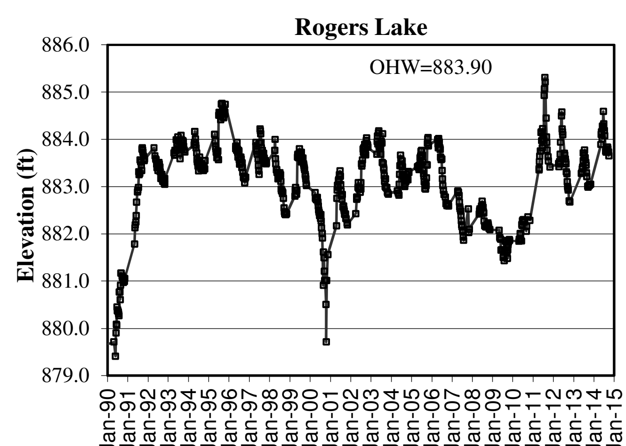
Round Lake Levels – last 25 years



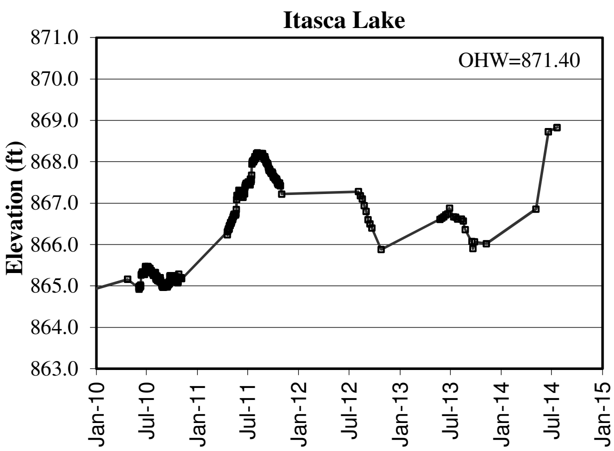
Rogers Lake Levels – last 5 years



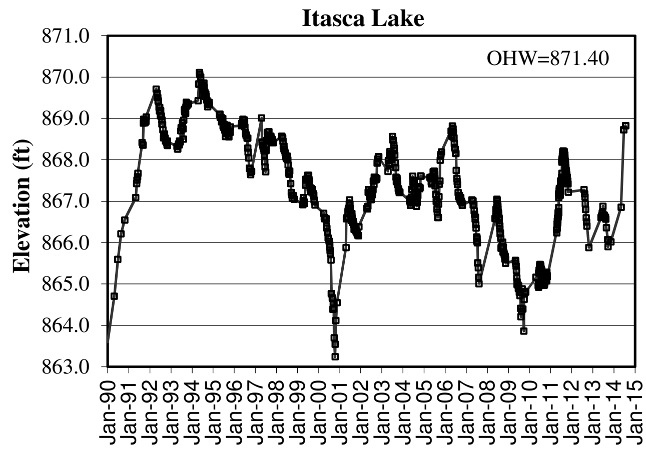
Rogers Lake Levels – last 25 years



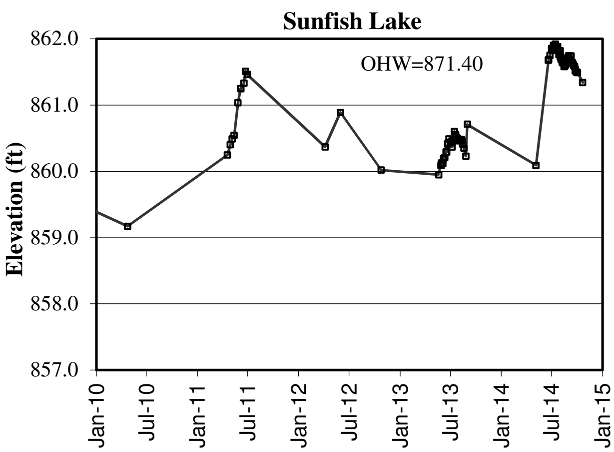
Itasca Lake Levels – last 5 years



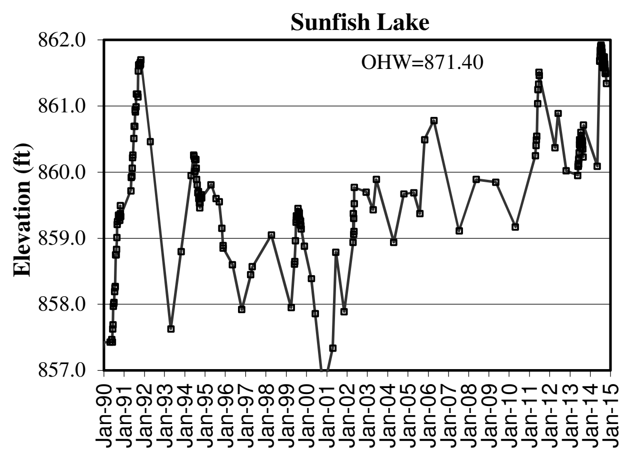
Itasca Lake Levels – last 25 years



Sunfish/Grass Lake Levels – last 5 years



Sunfish/Grass Lake Levels – last 25 years



Lake Water Quality

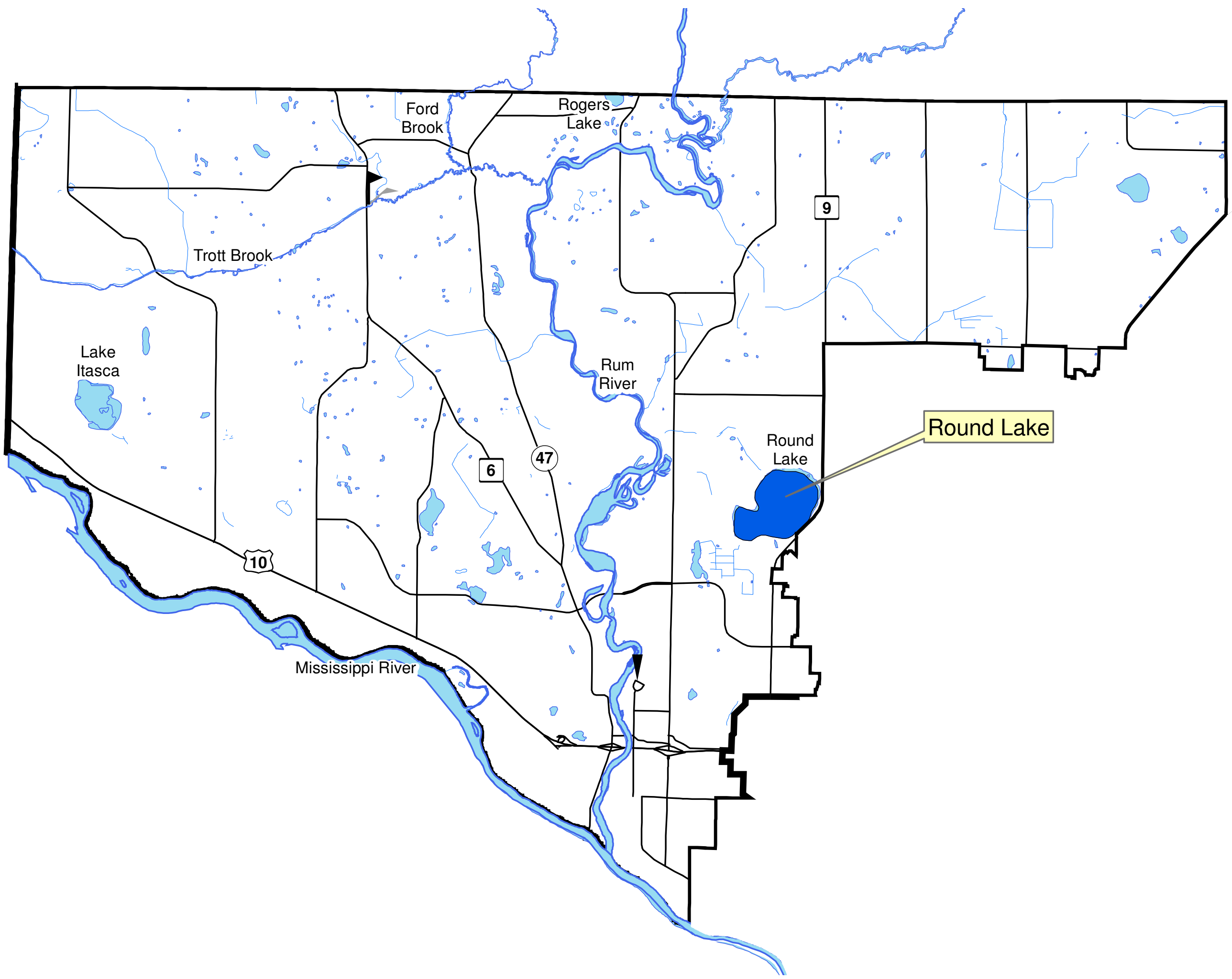
Description: May through September every-other-week monitoring of the following parameters: total phosphorus, chlorophyll-a, secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

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

Locations: Round 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.

Lower Rum River Watershed Lake Water Quality Monitoring Sites



Round Lake
City of Andover, Lake ID # 03-0089

Background

Round Lake is located in southwest Anoka County. It has a surface area of 220 acres and maximum depth of 19 feet, though the majority of the lake is less than 4 feet deep. The lake is surrounded by cattails and has submerged vegetation interspersed throughout the basin. This lake has a small watershed, with a watershed to surface area ratio of less than 10:1. Public access is from a dirt ramp on the lake's southeast side. Almost no boating and mostly wintertime fishing occurs. Wildlife, especially waterfowl, usage of the lake is relatively high.

2014 Results

In 2014 Round Lake's water quality was very good compared with other lakes in this region (NCHF Ecoregion) receiving an overall A letter grade. The average of total phosphorus (15.0 ug/L) and chlorophyll *a* (1.8 ug/L) were the lowest on record. Secchi transparency was 10.2 feet, which is the second best ever observed. It's important to note that the true Secchi transparency average was deeper than 10.2 feet, one reading was not used in this average since clarity exceeded the maximum depth of the lake.

Phosphorus and algae were fairly consistent without indication of any seasonal fluctuation. Additionally, results were very low. This could be the product of abnormally high rainfall early in the season, which resulted in higher than average lake water levels throughout the entire season.

Trend Analysis

Ten years of water quality monitoring have been conducted by the Anoka Conservation District (1998-2000, 2003, 2005, 2007, and 2009-2010, 2012, 2014), which is a marginal number of years for a powerful statistical test of trend analysis. In 2010, the results of the analysis indicated a significant trend of declining water quality across the years studied (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,5} = 9.6065$, $p = 0.0194$). When the analysis is run to include the exceptional water quality observed in 2012 and 2014 no significant water quality changes are apparent ($F_{2,7} = 0.41$, $p = 0.68$).

Discussion

2014 was the second consecutive monitoring year which observed good water quality for Round Lake. There was growing concern about a trend toward poorer water quality. Phosphorus and chlorophyll-a had increased substantially in each of four monitored years from 2005-2009, and 2010 was similar to 2009. These were years of low lake levels. There was speculation that in-lake sources of nutrients, driven by sediment mixing, were a source of phosphorus. During low water there is more wind mixing because of shallow water depths, and in these years there was also a conspicuous reduction of chara (a plant-like algae) carpeting the bottom. In both 2012 and 2014 water levels recovered substantially and water quality was dramatically improved. It does seem that low water levels in Round Lake lead to poorer water quality. Additional monitoring in the future can help verify.

Since at least the 1980's there have been complaints about low water in Round Lake. The lake has few surface water in-flows, so groundwater is important to lake hydrology. There have been concerns that local surficial groundwater levels, and hence the lake, are negatively impacted by a variety of causes including irrigation, residential groundwater use, stormwater management, road embankments, and others. Each has been studied by groups including the MN DNR, Anoka Conservation District, Watershed Organizations, and City. None have been found to cause lower-than-expected lake levels. But there is evidence that Round Lake levels do behave differently from other nearby lakes. Moreover, studies by the Metropolitan Council and others have found regional surficial water tables are being drawn down by groundwater pumping thorughout the metro. Several lakes, including Round and Bunker Lakes are believed to be victims of this groundwater overuse.

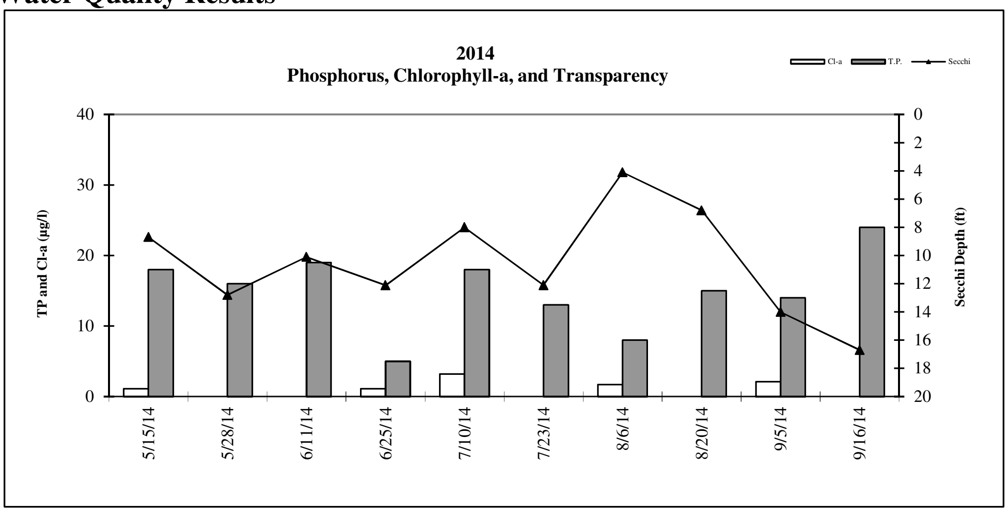
Conservation of groundwater must become a regional and local priority, least there will be negative impacts on lakes. In fact many negative impacts are already being documented. At Round Lake, where water quality appears linked to water levels, this issue is very important.

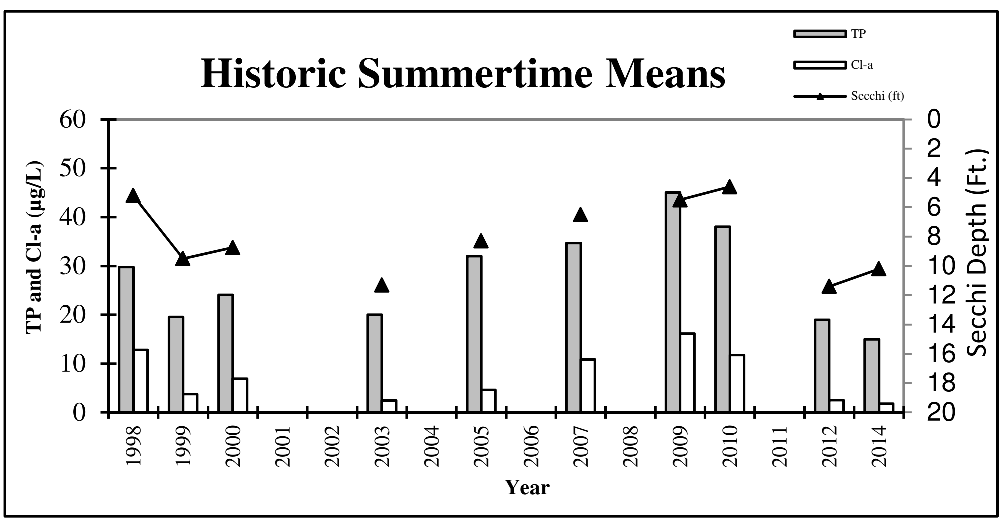
2014 Round Lake Water Quality Data

Round Lake 2014 Water Quality Data	Units	R.L.*	5/15/2014 14:15 Results	5/28/2014 13:58 Results	6/11/2014 14:10 Results	6/25/2014 13:30 Results	7/10/2014 15:00 Results	7/23/2014 13:15 Results	8/6/2014 14:15 Results	8/20/2014 15:55 Results	9/5/2014 15:10 Results	9/16/2014 14:15 Results	Average	Min	Max
pH		0.1	8.32	8.02	8.4	8.63	8.7	8.86	9.34	8.46	8.34	8.99	8.61	8.02	9.34
Conductivity	mS/cm	0.01	0.327	0.331	0.324	0.289	0.299	0.311	0.305	0.350	0.376	0.334	0.325	0.289	0.376
Turbidity	NTU	1	1.4	0	0.2	3.1	0.9	7.7	0	0	0	0.8	1	0	8
D.O.	mg/L	0.01	12.19	8.44	10.31	9.24	8.87	8.33	10.07	8.36	8.74	11.65	9.62	8.33	12.19
D.O.	%	1	114%	95%	123%	113%	102%	106%	129%	108%	102%	121%	111%	95%	129%
Temp.	°C	0.1	13	23	23	25	26	26	26.0	26.4	21.2	16	22.5	12.5	26.5
Temp.	°F	0.1	54.5	72.8	74.1	76.1	78.0	79.7	78.8	79.4	70.1	61.0	72.4	54.5	79.7
Salinity	%	0.01	0.16	0.16	0.16	0.14	0.15	0.15	0.15	0.17	0.18	0.16	0.16	0.14	0.18
Cl-a	ug/L	0.5	1.1	<1	<1	1.1	3.2	<1	1.7	<1	2.1	<1	1.8	1.1	3.2
T.P.	mg/L	0.010	0.018	0.016	0.019	0.005	0.018	0.013	0.008	0.015	0.014	0.024	0.015	0.005	0.024
T.P.	ug/L	10	18	16	19	5	18	13	8.0	15.0	14.0	24	15.0	5.0	24.0
Secchi	ft	0.1	8.7	12.8	10.1	12.11	8	12.1	4.1	6.8	>14"	16.7	10.2	4.1	16.7
Secchi	m	0.1	2.65	3.90	3.08	3.69	2.44	3.69	1.2	2.1	>4.3	5.09	3.1	1.2	5.1
Physical			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
Recreational			1.0	1.0	1.0	1.0	1.0	1.0	3.0	1.0	1.0	1.0	1.2	1.0	3.0

*reporting limit

Round Lake Water Quality Results





Round Lake Historic Summertime Mean Values

Agency	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1998	1999	2000	2003	2005	2007	2009	2010	2012	2014
TP	29.8	19.6	24.1	20.0	32.0	34.7	45.0	38.0	19.0	15.0
Cl-a	12.8	3.7	6.9	2.4	4.6	10.9	16.2	11.8	2.5	1.8
Secchi (n	1.60	2.90	2.67	3.40	2.50	2.00	1.70	1.40	3.50	3.10
Secchi (f	5.2	9.5	8.8	11.3	8.3	6.5	5.5	4.6	11.4	10.2

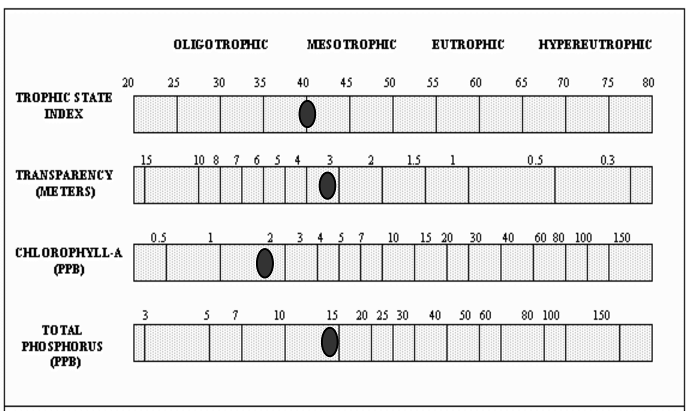
Carlsons trophic state indices

TSIP	53	47	50	47	54	55	59	57	47	43
TSIC	56	44	49	39	46	54	58	55	40	36
TSIS	53	45	46	42	47	50	52	55	42	44
TSI	54	45	48	43	49	53	56	56	43	41

Round Lake Water Quality Report Card

Year	1998	1999	2000	2003	2005	2007	2009	2010	2012	2014
TP	B	A	B	A	B	C	C	C	A	A
Cl-a	B	A	A	A	A	B+	B	B	A	A
Secchi	C	B	B	A	B	C	C	C	A-	A
Overall	**B**	**A**	**B**	**A**	**B**	**C**	**C**	**C**	**A**	**A**

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.

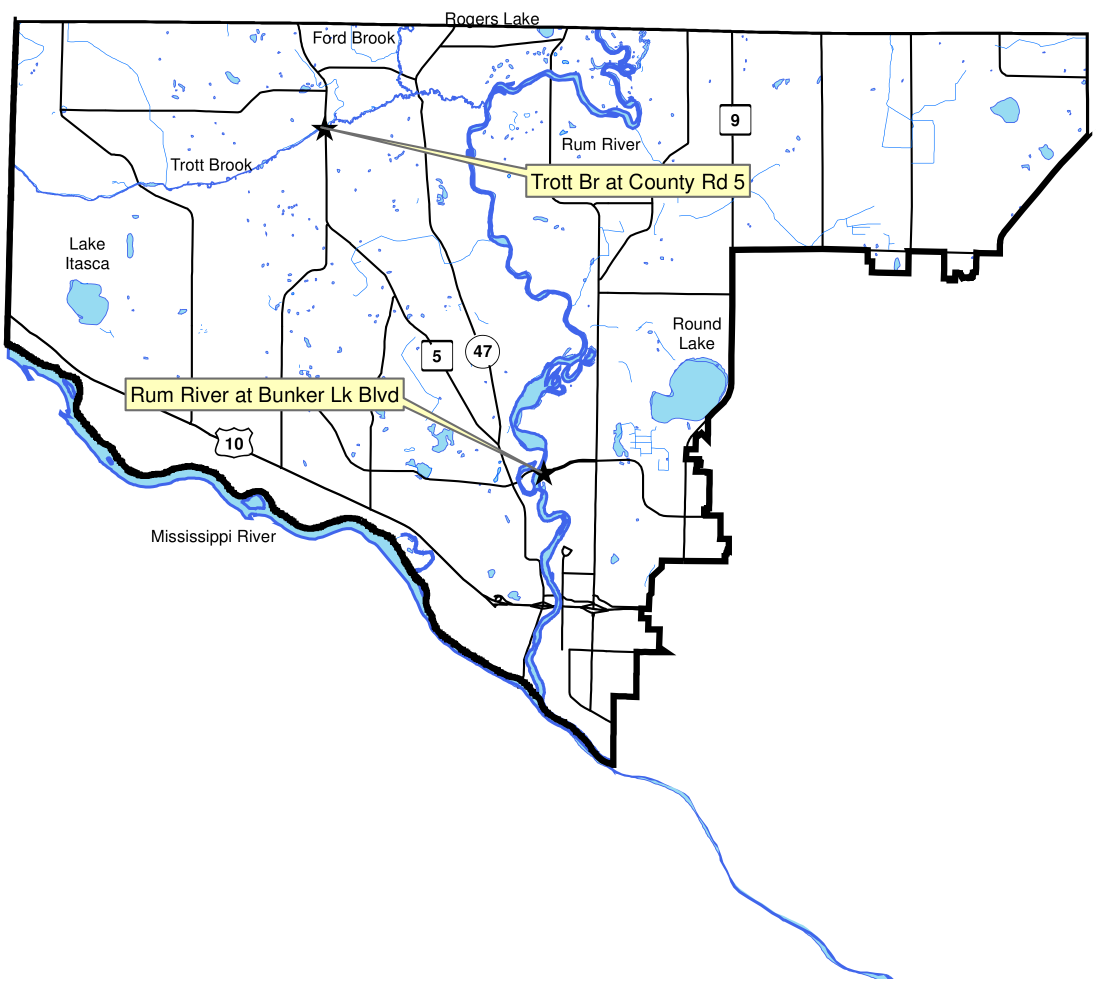
Purpose: To provide an initial assessment of water quality to be used in the completion of the Rum River Watershed Restoration and Protection Plan (WRAPP).

Locations: Trott Brook at County Road 5

Rum River at Bunker Lake Blvd

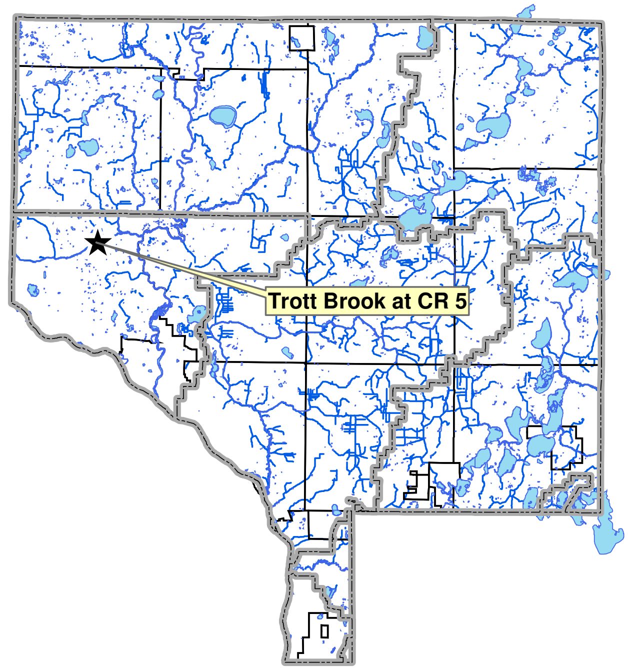
Results: Results are presented on the following pages.

2014 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, 2014

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 2014. 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, in Trott Brook was similar to other Anoka County streams. Conductivity averaged 0.482 mS/cm Maximum of 0.595 mS/cm and a minimum of 0.320 mS/cm).
- 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 111 ug/l (maximum of 150 ug/l and a minimum of 78 ug/l).
- Turbidity stayed below the state standards each sampling event. Turbidity averaged 4.2 NTU (maximum of 10.2 NTU and a minimum of 0.00 NTU).
- pH was within the range considered normal and healthy for streams in this area. pH averaged 7.61 (maximum of 7.88 and a minimum of 7.35).
- 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 2014 Trott Brook 1 of the 6 DO measurements was below 5 mg/L and all measurements averaged 5.29 mg/l (maximum of 6.38 mg/l and a minimum of 3.69 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.

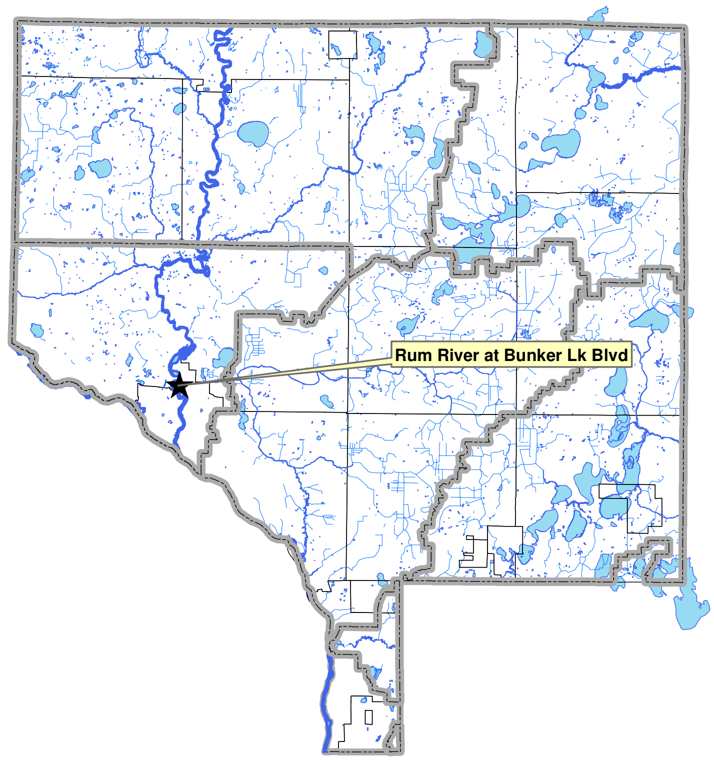
Trott Brook Water Quality Monitoring Results for 2014.

Grey column indicates date with E.coli duplicate.

Trott Brook at CR 5			6/2/2014	6/16/2014	7/2/2014	7/2/2014	7/21/2014	8/5/2014	8/26/2014			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.35	7.41	7.58		7.81	7.63	7.88	7.61	7.35	7.88
Conductivity	mS/cm	0.01	0.357	0.32	0.512		0.531	0.576	0.595	0.482	0.320	0.595
Turbidity	NTU	1	10.2	5.4	7.0		1.8	0.0	0.6	4.2	0.0	10.2
D.O.	mg/L	0.01	4.21	3.69	6.19		6.01	6.38	5.27	5.29	3.69	6.38
D.O.	%	1	36.2	35.4	69.8		70.9	69.3	56.4	56.3	35.4	70.9
Temp.	°C	0.1	20.0	18.3	19.8		22.0	18.7	17.6	19.4	17.6	22.0
Salinity	%	0.01	0.17	0.15	0.19		0.26	0.27	0.29	0.22	0.15	0.29
T.P.	ug/L	10	150	112	114		99		78	111	78	150
Chl-a	ug/L		3.2	1.1	<1		<1		2.6	2.3	<1	3.2
Ortho-P	mg/L		0.036	0.034	0.033		0.032		0.033	0.034	0.032	0.036
Secchi-tube	cm		>100	>100	92		>100	>100	>100	>100	92	>100
Nitrogen, Ammonia	mg/L		<0.16	<0.16	<0.16		<0.16		<0.16	<0.16	0.00	0.15
TKN	mg/L		2.1	1.5	1.2		1.4		1.2	1.48	1.20	2.10
Nitrate plus Nitrite	mg/L		<0.2	<0.2	0.38		0.26		0.36	0.33	0.26	0.38
BOD	mg/L		<2	<2	<2		<2		<2	<2.00	0.00	1.99
E coli	MPN		135	186	35.0	31.0	51.0	36.0	58.0	76.0	31.0	186.0
Appearance			3	3	1A		1A	1A	1A			
Recreational			2	2	2		2	2	3	2	2	3

RUM RIVER

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



Years Monitored

Rum River at Bunker L Blvd 2013, 2014

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 2014. 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.

- Dissolved constituents, as measured by conductivity, in the Rum River were low when compared to Anoka County streams. Conductivity averaged 0.293 mS/cm Maximum of 0.338 mS/cm and a minimum of 0.240 mS/cm).
- Phosphorous 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 139 ug/l (maximum of 188 ug/l and a minimum of 73 ug/l).
- Turbidity was below the state standards each sampling event and averaged well below the standards. Turbidity averaged 8.35 NTU (maximum of 11.30 NTU and a minimum of 5.90 NTU).
- pH and dissolved oxygen were with the range considered normal and healthy for streams in this area. pH averaged 7.98 (maximum of 8.40and a minimum of 7.63). DO averaged 9.03 mg/l (maximum of 15.50 mg/l and a minimum of 7.36 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.

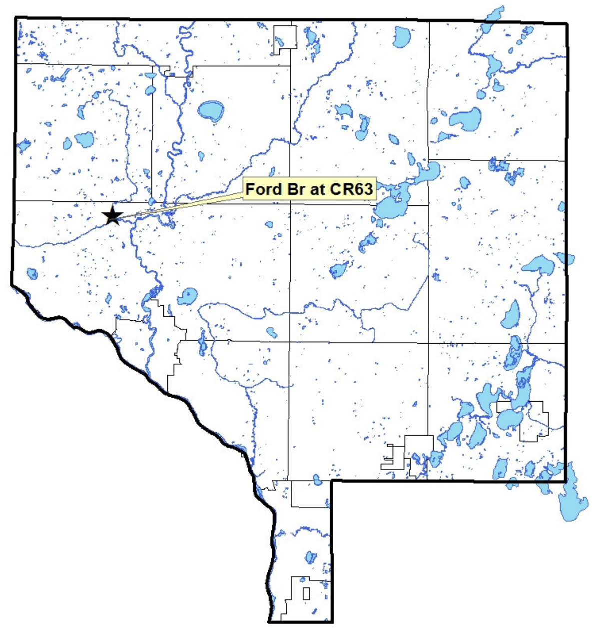
Rum River Water Quality Monitoring Results for 2014.

Grey column indicates date with QA/QC duplicates.

Rum River at Bunker Lk Boulevard	Units	R.L.*	6/2/2014 Results	6/16/2014 Results	7/2/2014 Results	7/2/2014 Results	7/21/2014 Results	8/5/2014 Results	8/26/2014 Results	Average	Min	Max
pH		0.1	7.63	7.63	7.77		8.11	8.4	8.33	7.98	7.63	8.40
Conductivity	mS/cm	0.01	0.240	0.247	0.296		0.306	0.331	0.338	0.293	0.240	0.338
Turbidity	NTU	1	8.4	5.9	9.8		11.3	6.3	8.4	8.35	5.90	11.30
D.O.	mg/L	0.01	15.5	7.36	7.50		7.44	8.07	8.30	9.03	7.36	15.50
D.O.	%	1	80.7	73.6	86.5		90.2	93.5	96.6	86.9	73.6	96.6
Temp.	°C	0.1	21.2	18.8	21.1		23.8	22.8	21.7	21.6	18.8	23.8
Salinity	%	0.01	0.11	0.12	0.14		0.15	0.16	0.16	0.14	0.11	0.16
T.P.	ug/L	10	162	165	183	188	113	73	90	139	73	188
Chl-a	ug/L		2.1	<1	2	1.1	1.7	3.4	2.6	2.2	1.1	3.4
Secchi-tube	cm		81	>100	83		91	>100	>100		81	>100
TKN	mg/L		1.2	1.1	1.2	1.4	1.5	0.8	1.2	1.20	0.80	1.50
Nitrate plus Nitrite	mg/L		0.2	0.22	0.23	0.25	0.3	0.24	0.39	0.26	0.20	0.39
E coli	MPN		172	46	28.0	31.0	50.0	50.0	77.0	64.9	28.0	172.0
Appearance			1	1	1		1	1	1	1	1	1
Recreational			3	3	3		2	3	2	3	2	3

FORD BROOK

At CR 63, Oak Grove



Background

Ford Brook originates at Goose Lake in north-western Anoka County and flows south. Ford Brook is a tributary to the Rum River. In north-western Anoka County it flows through the relatively undisturbed community of Nowthen before joining Trott Brook just prior to the Rum River.

Ford Brook is one of the smaller streams in Anoka County. The watershed is moderately developed with scattered single family homes, but continues to grow.

Results and Discussion

This report includes data from 2014. 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, in Ford Brook was average when compared to similar Anoka County streams. Conductivity averaged 0.299 mS/cm (maximum of 0.394 mS/cm and a minimum of 0.128 mS/cm).
- Phosphorous averaged over the proposed MPCA water quality standard of 100 ug/l. If the proposed standard is approved, Ford Brook often exceeds the limit, even during baseflow periods. Phosphorous results in Ford Brook averaged 120.2 ug/l (maximum of 176 ug/l and a minimum of 54 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 8.80 mg/l (maximum of 19 mg/l and a minimum of 3 mg/l). Turbidity averaged 15.86 NTU (maximum of 50.0 NTU and a minimum of 4.1 NTU). Water flow during the 50.0 NTU reading was extremely fast and turbulent due to abnormal rainfall.
- pH and dissolved oxygen were with the range considered normal and healthy for streams in this area. pH averaged 7.64 (maximum of 7.71 and a minimum of 7.58). DO averaged 9.58 mg/l (maximum of 14.73 mg/l and a minimum of 6.19 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.

FordBrook at CR63			4/28/2014	5/9/2014	6/2/2014	6/16/2014	7/2/2014			
	Units	R.L.*	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.7	7.71	7.58	7.6	7.6	7.64	7.58	7.71
Conductivity	mS/cm	0.01	0.314	0.128	0.344	0.316	0.394	0.299	0.128	0.394
Turbidity	NTU	1	50.0	4.1	10.4	8.0	7.0	15.90	4.10	50.00
D.O.	mg/L	0.01	12.29	7.35	14.73	7.33	6.19	9.58	6.19	14.73
D.O.	%	1	97.7	70.8	75	71	69.8	76.9	69.8	97.7
Temp.	°C	0.1	4.7	11.6	20.5	18.5	19.8	15.0	4.7	20.5
Salinity	%	0.01	0.14	0.03	0.16	0.15	0.19	0.13	0.03	0.19
T.P.	ug/L	10	98	54	176	121	152	120	54	176
TSS	mg/L	2	19	4	10.0	3	8	8.8	3.0	19.0
Secchi-tube	cm		43	>100	83	97	92	>100	43	97
E coli	MPN				93.0	161.6	224.7	159.8	93.0	224.7
Appearance					1B	2	3			
Recreational					2	2	2	2	2	2

*reporting limit

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.

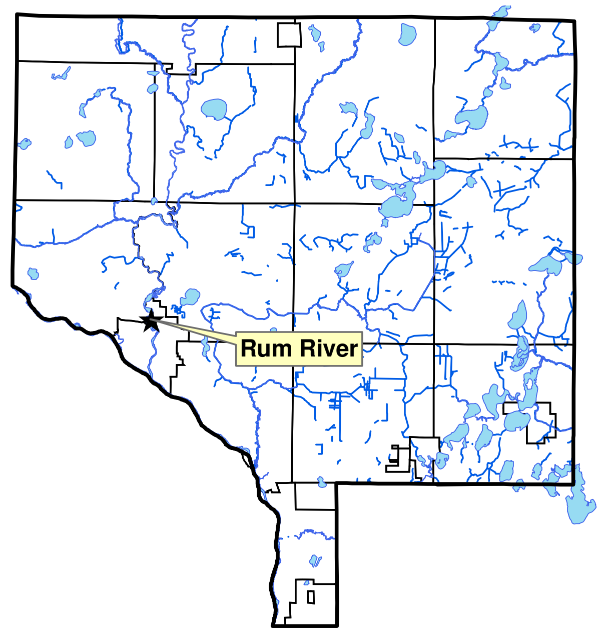
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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 2014

Monitored Since

2001

Student Involvement

128 students in 2014, approximately 738 since 2001

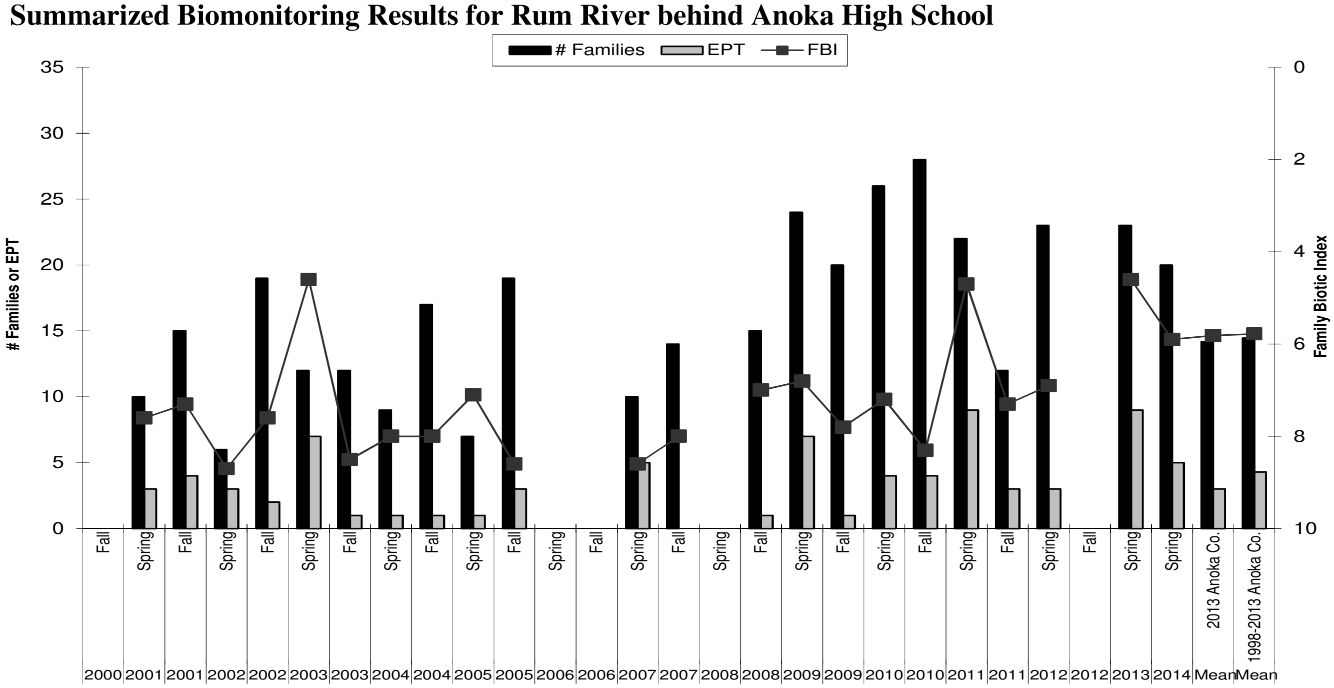
Background

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 2014 with Anoka Conservation District (ACD) oversight. The results for spring 2014 were similar to previous years. More families, 20 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 (5) and the FBI score (5.9) were the best in Anoka County and 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	2014	Mean	Mean
Season	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Spring**	**Spring**	**2014 Anoka Co.**	**1998-2014 Anoka Co.**
FBI	6.80	7.80	7.20	8.30	4.70	7.30	6.90	4.60	5.90	5.8	5.8
# Families	24	20	26	28	22	12	23	23	20	13.2	14.6
EPT	7	1	4	4	9	3	3	9	5	3.0	4.3
Date	8-May	28-Sep	18-May	7-Oct	10-Jun	5-Oct	8-May	14-May	20-May		
sampling by	AHS	AHS	AHS	AHS	ACD	ACD	AHS	AHS	AHS		
sampling method	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # individuals	880	585	443	816	604	188	502	357	350		
# replicates	1	2	1	1	1	1	2	4	4		
Dominant Family	Siphlonuridae	Hyalellidae	Gastropoda	Hyalellidae	baetidae	hyalellidae	silphonuridae	Perlodidae	Siphlonuridae		
% Dominant Family	40.7	39.1	31.8	34.1	57.5	63.3	37.8	42.1	33.4		
% Ephemeroptera	48.2	0.9	8.1	0.9	59.3	11.2	44.9	19.4	57.8		
% Trichoptera	0.1	0	0	0.2	1	0	1.2	0.2	0.1		
% Plecoptera	2.6	0	0.5	0	3.8	0.5	0	42.6	0.5		

Supplemental Stream Chemistry Readings

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

Parameter	5/18/2010	10/7/2010	6/10/2011	10/5/2011	5/8/2012	5/13/2013	5/20/2014
pH	7.24	7.22	7.84	7.98	8.10	7.69	8
Conductivity (mS/cm)	0.207	0.399	0.296	0.296	0.205	0.181	0.237
Turbidity (NTU)	7	7	18	10	7	5	14.2
Dissolved Oxygen (mg/L)	6.93	na	6.85	7.91	7.87	10.00	13.05
Salinity (%)	0	0.01	0.01	0.01	0.00	0.00	0.11
Temperature (°C)	14.8	12.2	20.7	15.3	15.7	13.0	13.5

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. In 2014 sampling returned to the backwater area, however extreme water levels likely altered its normal functions.

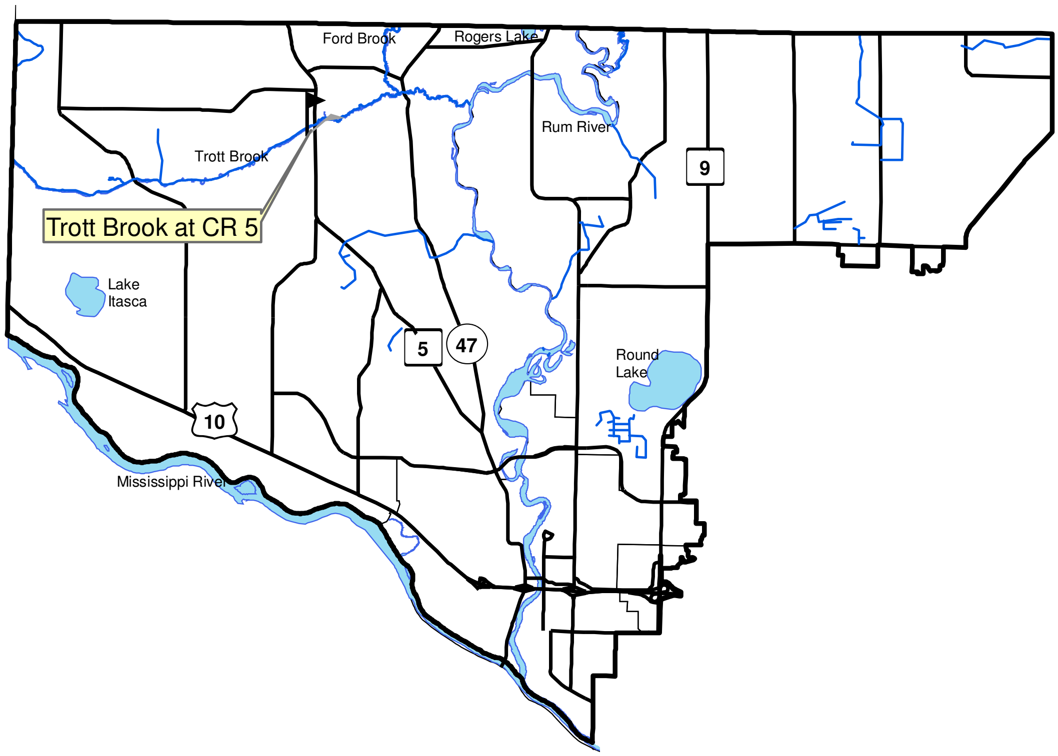
Stream Hydrology

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.

Locations: Trott Brook at County Road 5

Lower Rum River Watershed Stream Hydrology Monitoring Sites

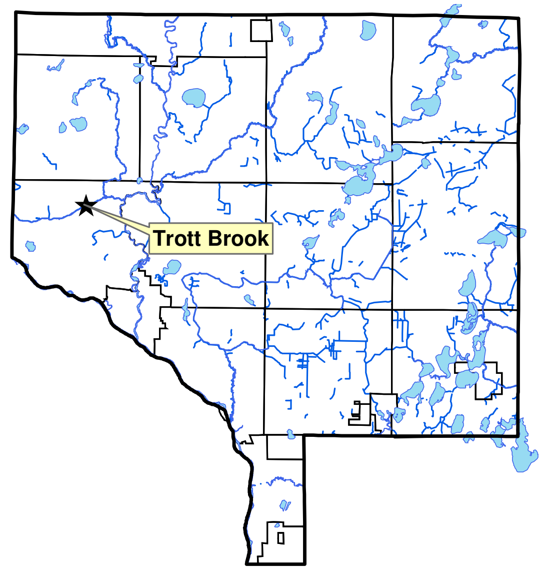


TROTT BROOK

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

Notes

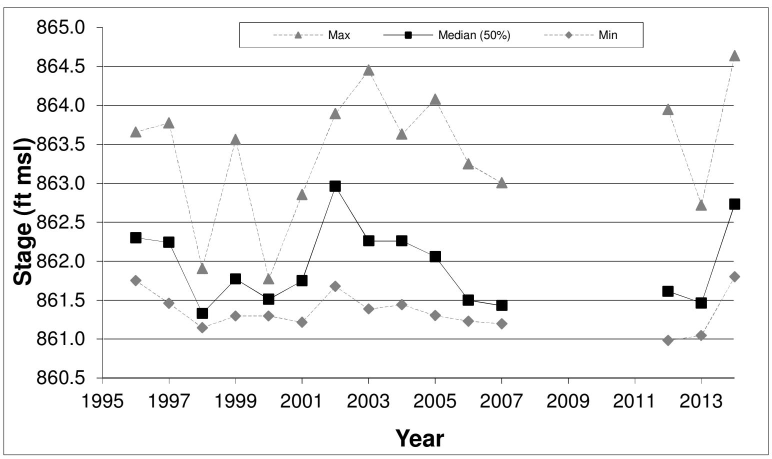
Trott Brook is a medium-sized creek that flows south through Sherburne County, paralleling the Anoka-Sherburne County boundary before turning east through the City of Ramsey where outlets to the Rum River. Overall, the watershed is rural or suburban residential, and areas within the watershed are undergoing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



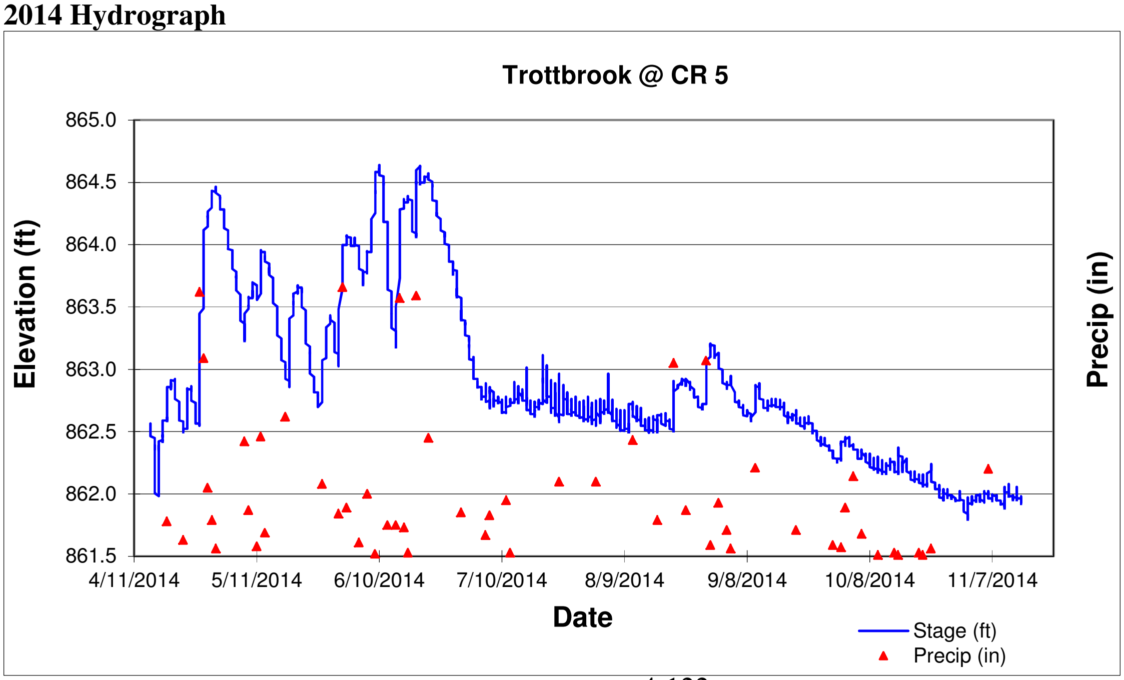
A rating curve for this site was developed in 2013:

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

Summary of All Monitored Years



2014 Hydrograph



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.

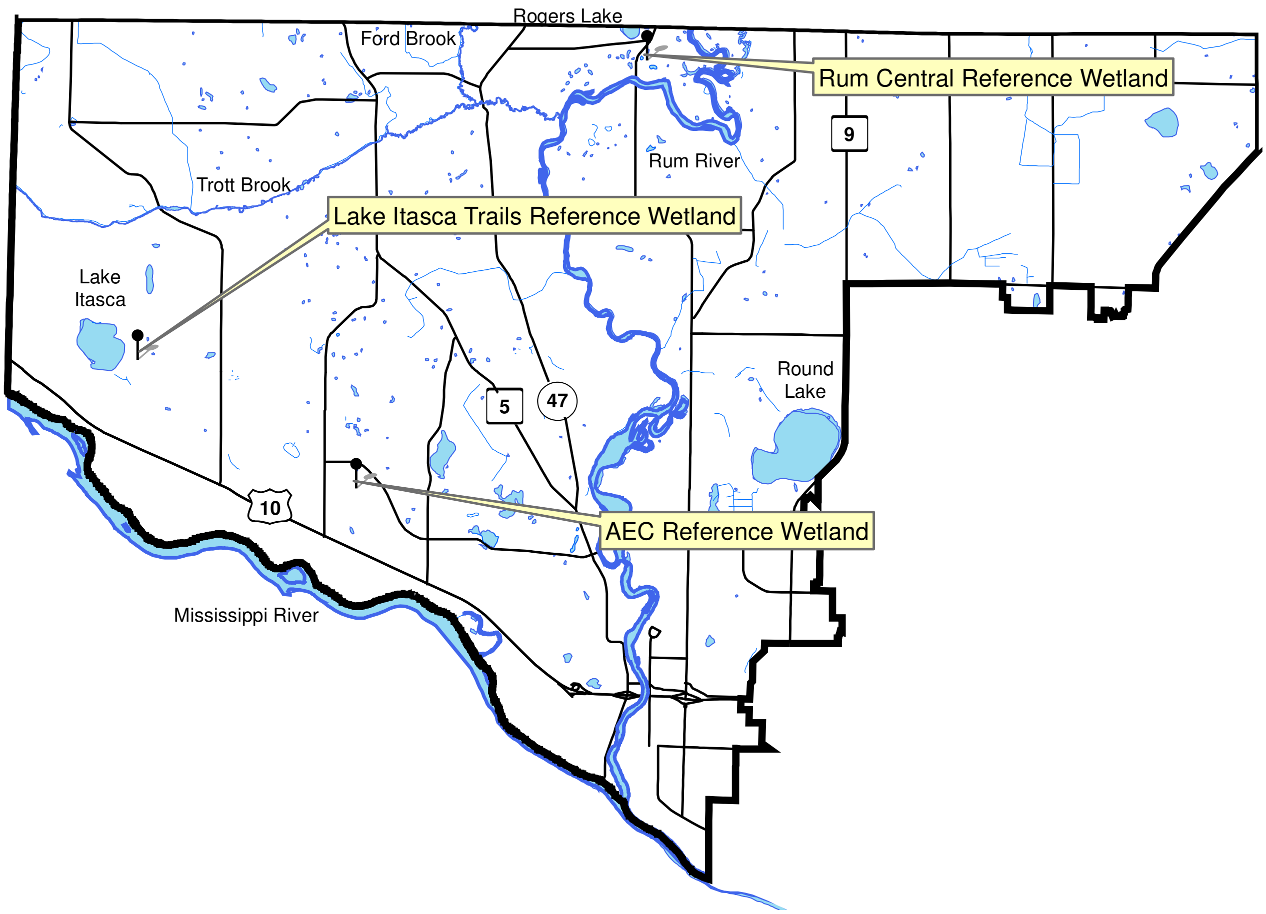
Locations: AEC Reference Wetland, Connexus Energy Property on Bunker Lake Blvd, Ramsey

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

Lake Itasca Trail Reference Wetland, Lake Itasca Park, Ramsey

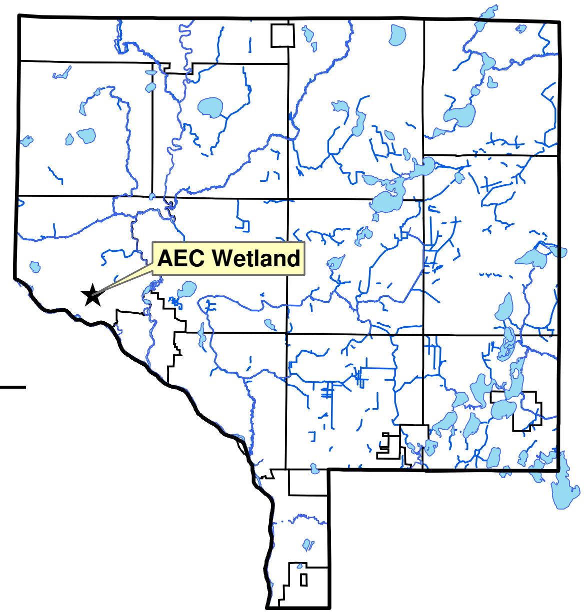
Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

Lower Rum River Watershed Wetland Hydrology Monitoring Sites



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	-

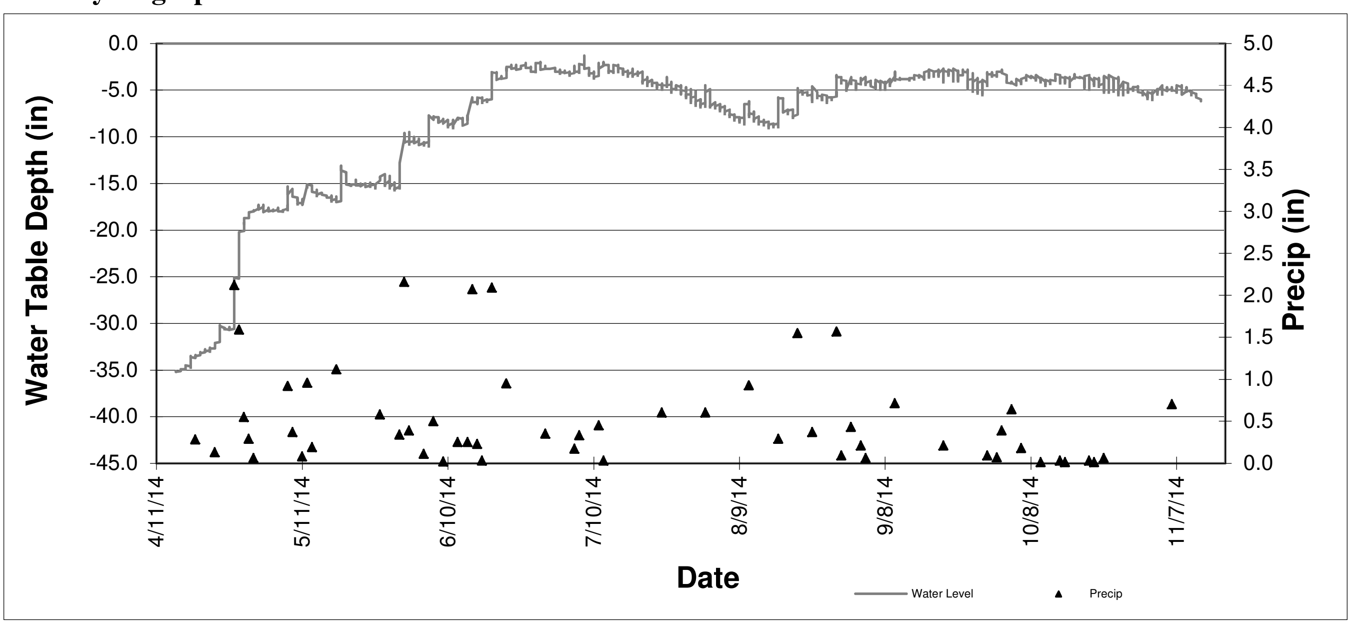
Surrounding Soils: Hubbard coarse sand

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.

2014 Hydrograph

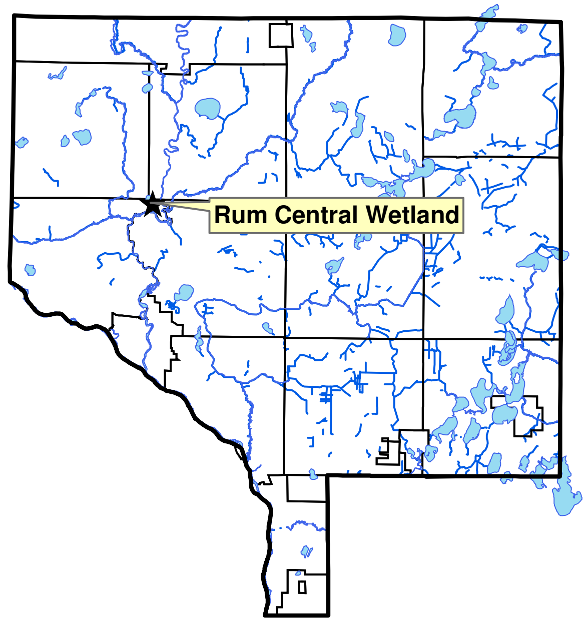


Well depth was 42 inches, so a reading of –42 indicates water levels were at an unknown depth greater than or equal to 42 inches.

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	-

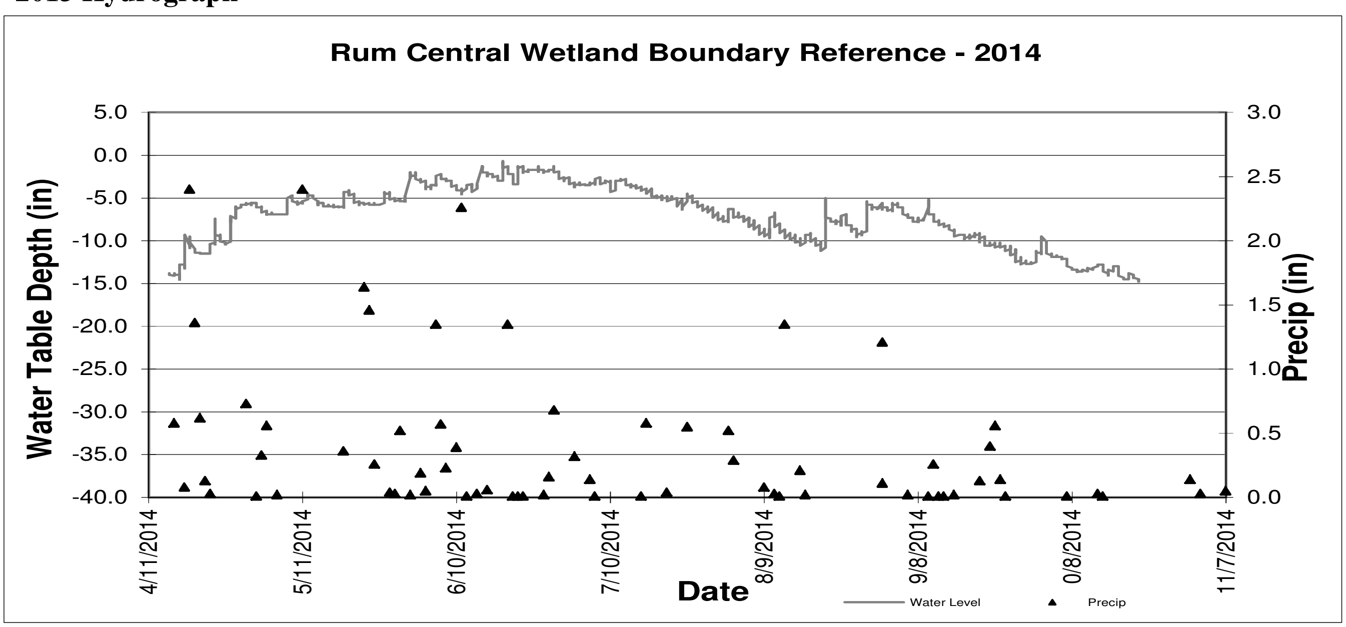
Surrounding Soils: Zimmerman fine sand

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

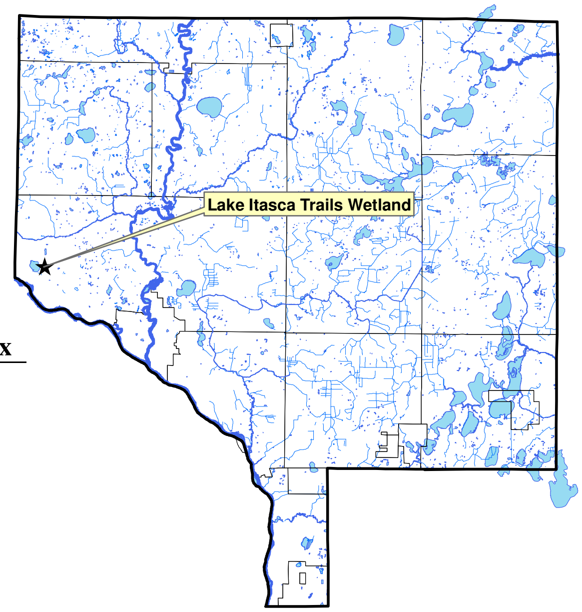


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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	-

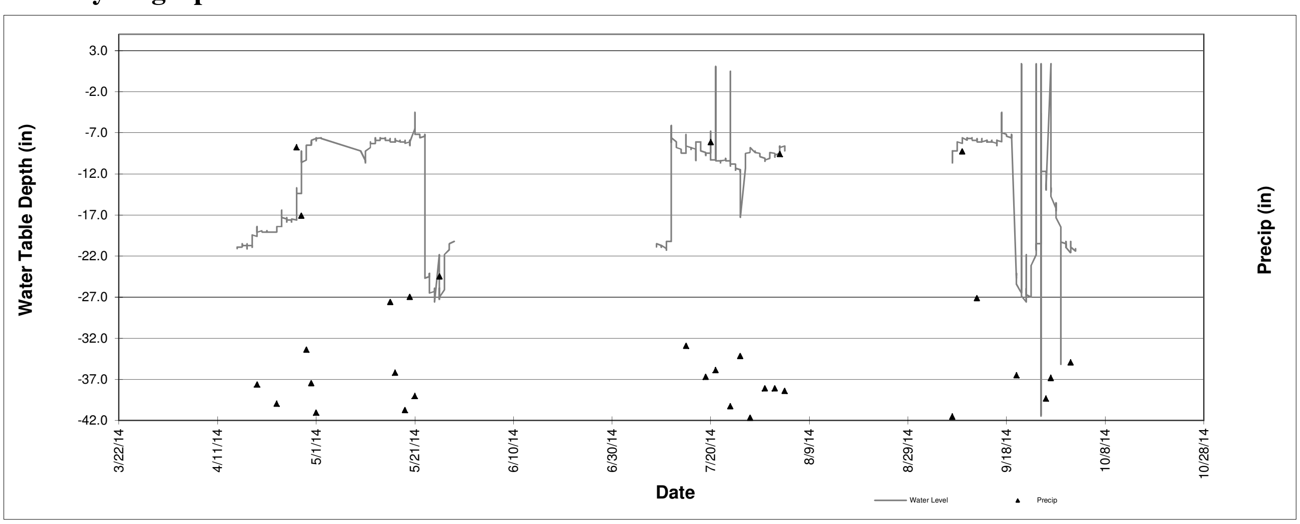
Surrounding Soils: Hubbard coarse sand

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.

2014 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. Equipment deployed at this site experienced a multitude of malfunctions. Data should be interpreted accordingly.

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 reported in the year they are installed. No projects were installed in 2014.

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
2014 LRRWMO Contribution	+	$2,050.00
Fund Balance		**$2,050.00**

Newsletters

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.

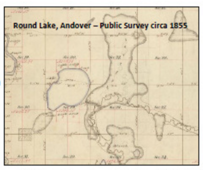
Location: Watershed-wide

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.

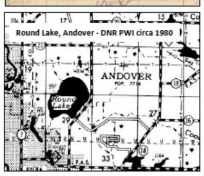
Both newsletters focused on public education regarding wetlands. The articles included information on recognizing wetlands as well as their values and benefits. Brief explanations of wetland regulations and penalties for rule violations were included in both articles. Directives on how to acquire additional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

A Brief History of Wetland Policy in Minnesota

1850's survey maps show the general locations of expansive "pre-settlement" wetlands that may have covered as much as 40% of Anoka County. At the turn of the 20th Century, state policy treated these wetlands as undesirable wastelands. This resulted in large-scale ditching efforts that contributed to the drainage of as much as 50% of Anoka County's pre-settlement wetlands.



Following the droughts of the 1930s, however, large-scale drainage efforts were generally abandoned in Anoka County, and Minnesota policy began to shift toward the conservation of surface waters that were considered to have public value. In 1973, shortly after the passage of the federal Clean Water Act, Minnesota expanded it's definition of public waters to include large, deep wetlands. These wetlands were mapped in the early-1980s as part of the Minnesota Public Water Inventory. PWI wetlands continue to be managed by the DNR today.



Since Minnesota public waters only protect large, deep wetlands, Minnesota passed the Wetland Conservation Act of 1991 (WCA) to establish protection for all of Minnesota's wetlands that were not included in the PWI. To ensure a "no net loss" of wetland values, WCA requires people to off-set approved unavoidable wetland impacts through wetland mitigation, or by purchasing credits from a local wetland mitigation bank.

WCA is administered through Local Government Units (LGUs), which includes the Lower Rum River Watershed Management Organization and Coon Creek Watershed District. If you have a project that may impact a wetland, contact your LGU to identify any necessary approvals.

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

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

An Ode to Anoka County Wetland Policy - The Dr. Seuss Version

Wasteland, wasteland the surveyors said.
It's 1858, Minnesota settlers are on their way.
We need some land that's dry.

Ditch, ditch all wetlands, the state of Minnesota did say.
It's 1900, swamps, bogs, and marshes? What a waste,
We want progress today.

Clank, clank when the machines.
Cutting deep channels in strait lines.
It's the early 1900s, It's still too wet here!
Drain and straighten everything,
We're nearly halfway there!

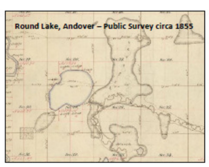
Stop, stop! Cease all the ditching, we have better things to do.
It's the 1930s, we're out of money, and oh the land so dry.

Wasteland, wasteland? Does surface water have value?
Perhaps we shouldn't drain them all.
It's the 1940s, we'll save the biggest and the deepest.
We'll call them Minnesota public waters.

Wetlands, wetlands. We didn't realize.
Habitat? Flood Storage? Water Quality? They have public value too.
It's the 1970s, let's map them and protect the wet areas.
We'll call them public water wetlands.

Wait, wait! We haven't protected them all?
It's 1991, let's save all wetlands.
We'll pass the Wetland Conservation Act because they provide us public service.

Drain, fill, excavate. We're still impacting wetlands.
Will you help protect them too?
It's 2014, your chance to make history.
What are you going to do?



Wetland drainage circa 1900

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

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

What is the Wetland Conservation Act?

Or, What is a WMO?

Metropolitan Surface Water Act of 1982

1973 Wild and Scenic River Act of MN

HTTP://BWSR.STATE.MN.US/PLANNING/WD-WMO_OVERVIEW.HTML

The Rum River was added to Minnesota's Wild & Scenic Rivers Program in 1978. The designated stretch extends along Mille Lacs, Sherburne, Isanti and Anoka counties.

In the Minnesota, more than 50 percent of streams have been ditched or straightened.

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.

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.

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.

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.

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

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.

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.

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 2014 the review of Anoka's local water plan has been completed. No other plans have yet been received.

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 web videos about water conservation, correcting riverbank erosion, as well as wetland regulation and post them on the LRRWMO website.

Purpose: To provide education to the public about aquifer sustainability and water use, streambank erosion problems and solutions, as well as wetland regulation and protection.

Location: Watershed-wide

Results: The web video about water conservation was completed in March of 2014 and can be viewed through the LRRWMO website. Scripts have been written and video footage has been collected for the assembly of the Riverbank Erosion and Wetland Regulation videos. The videos will be completed and posted to the LRRWMO (*LRRWMO.org*) website by March 31 of 2015.

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.

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.

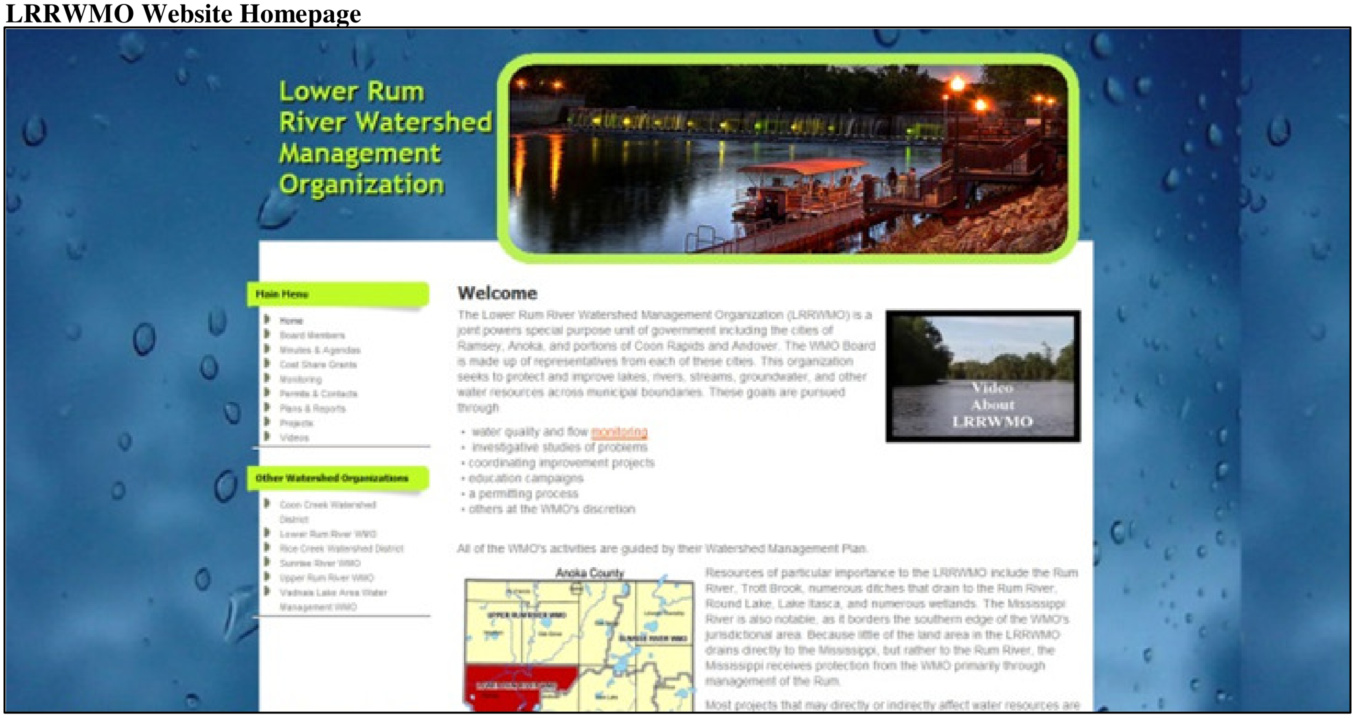
Location: LRRWMO.org

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.

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

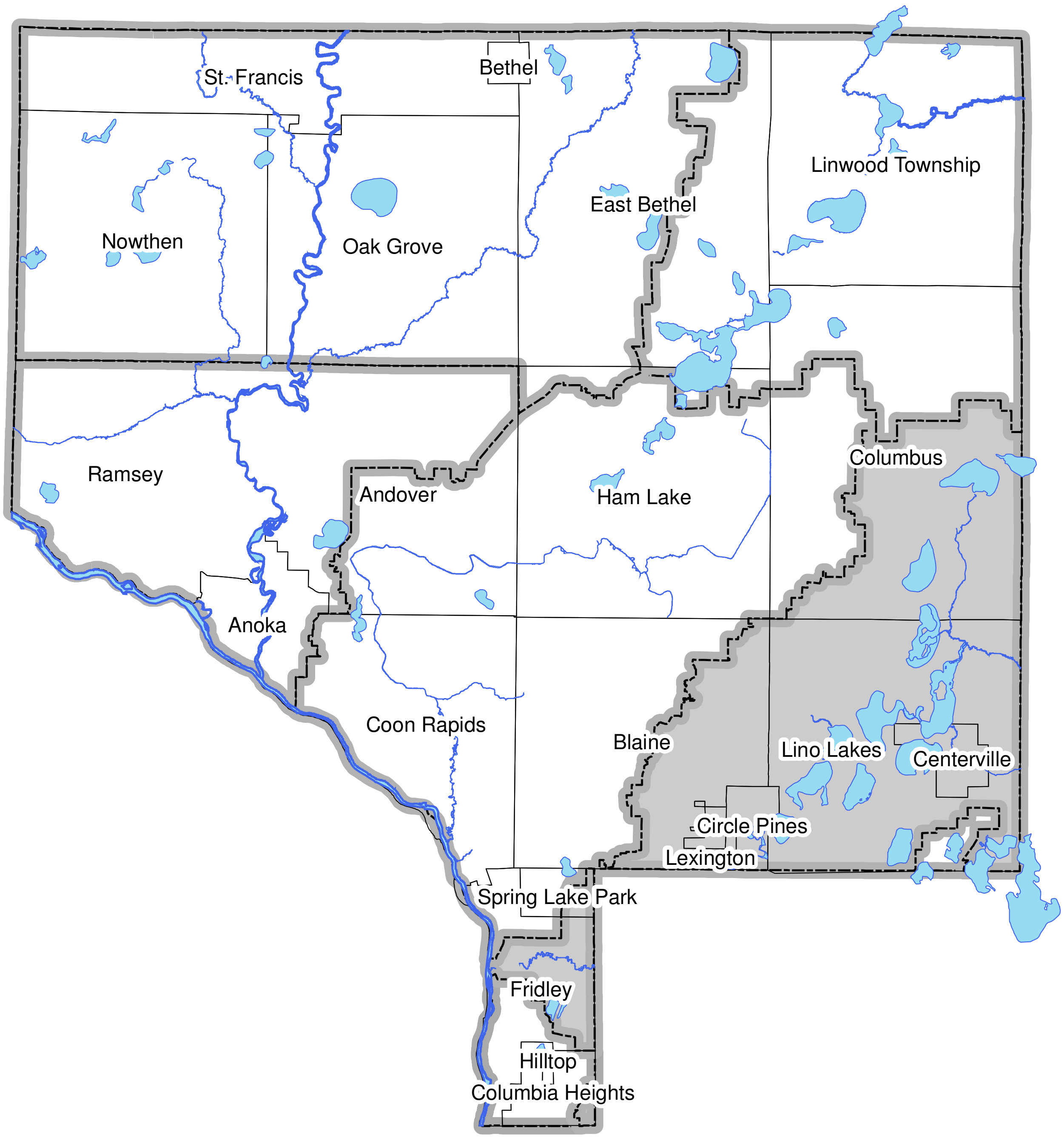
Lower Rum River Watershed	WMO Asst (no charge)	BMP Maintainance	Volunteer Precipitation	Reference Wetlands	DNR Observation Wells	Lake Levels	Lake Water Quality	Stream Levels	Stream Water Quality	Watershed Outlet Monitoring	Student Biomonitoring	LRRWMO Admin	LRRWMO Outreach/Promo	Website Management	Anoka Nat. Pres. Restoration	Rum River WRAPP	Cost Share - Local/State	Total
Revenues																		
LRRWMO	0	0	0	1725	0	800	1300	600	0	0	825	850	8440	440	0	0	1431	16411
State	0	0	0	0	120	0	0	0	4473	0	0	0	0	0	29066	16480	0	50138
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	586	0	0	0	77	0	0	0	0	0	0	0	0	0	8071	0	384	9117
County Ag Preserves	0	0	0	0	0	0	461	0	0	0	39	0	0	0	0	0	5746	6246
Regional/Local	0	0	0	0	0	0	0	0	0	720	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	1336	0	0	1336
BWSR Cons Delivery	0	3302	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3302
BWSR Cost Share TA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Local Water Planning	0	0	99	241	0	0	0	0	0	287	0	471	0	14	0	0	0	1111
TOTAL	586	3302	99	1966	197	800	1761	600	4473	1007	864	1321	8440	454	38473	16480	7561	88383
Expenses-																		
Capital Outlay/Equip	13	70	2	42	4	19	29	13	90	22	18	29	101	9	393	118	0	972
Personnel Salaries/Benefits	505	2744	85	1633	170	765	1137	499	3542	867	708	1138	3957	337	15393	4642	0	38122
Overhead	34	184	6	110	11	51	76	34	238	58	48	76	266	23	1034	312	0	2562
Employee Training	4	20	1	12	1	6	8	4	26	6	5	8	29	2	112	34	0	277
Vehicle/Mileage	9	49	2	29	3	14	20	9	63	15	13	20	70	6	273	82	0	677
Rent	22	119	4	71	7	33	49	22	153	37	31	49	171	15	665	201	0	1647
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7561	7561
Program Supplies	0	117	0	59	0	3	442	10	362	0	42	0	677	0	20602	11090	0	33404
McKay Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	586	3302	99	1956	197	891	1761	590	4473	1007	864	1321	5270	391	38473	16480	7561	85221

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.** Diagnostic monitoring is complete and will be reviewed by MPCA. Local review is advised.
- **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. A grant is secured by ACD and will be used in communities providing 25% match.
- **Implement water conservation measures** throughout the watershed and promote it metro-wide. Depletion of surficial water is a concern.
- **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.
- **Remind LRRWMO Cities that local water plans must be updated**.

Excerpt from the 2014 Anoka Water Almanac

Chapter 5: Rice Creek Watershed

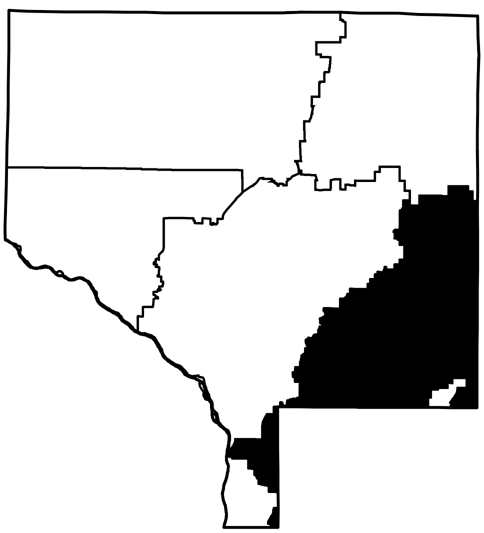


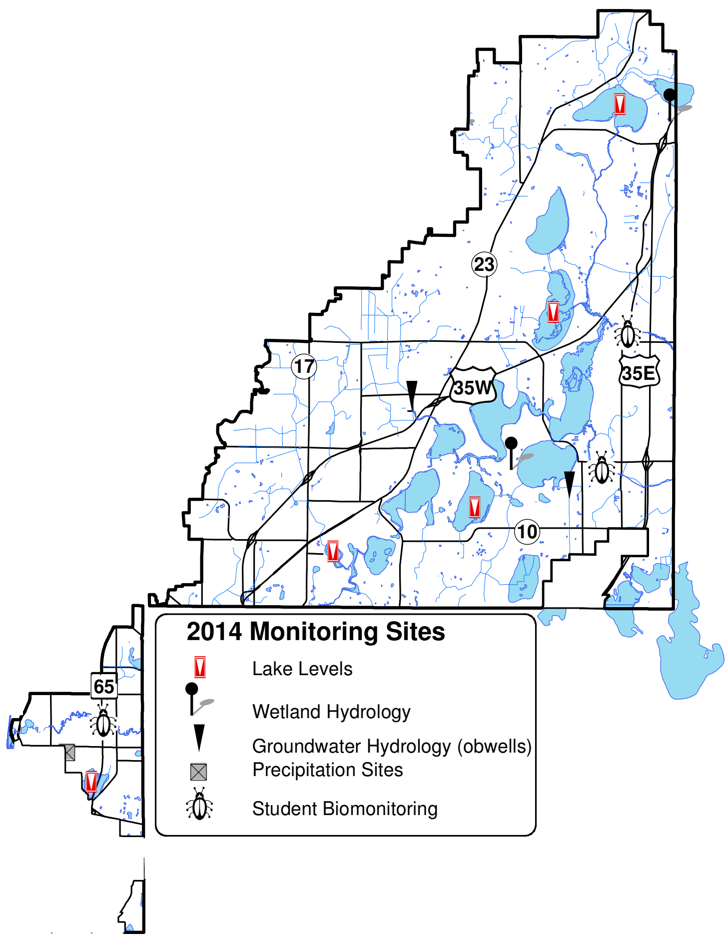
Prepared by the Anoka Conservation District

CHAPTER 5: RICE CREEK WATERSHED

Task	Partners	Page
Lake Levels	RCWD, ACD	5-133
Wetland Hydrology	RCWD, ACD	5-135
Stream Water Quality – Biological	RCWD, ACD, ACAP, Forest Lake Area Learning Center, Totino Grace HS	5-138
Water Quality Grant Administration	RCWD, ACD	5-143
Financial Summary		5-144
Recommendations		5-145
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.

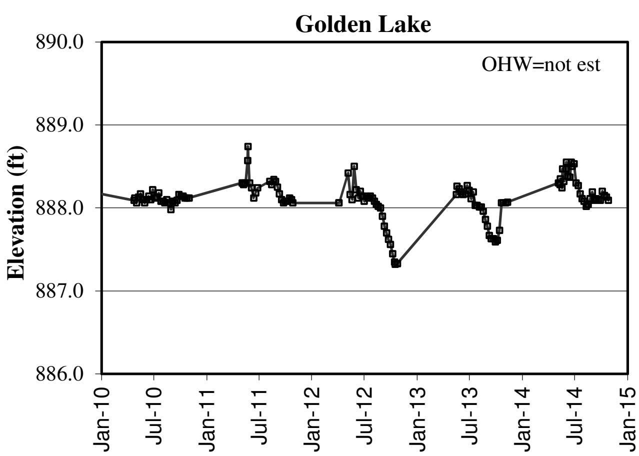
Locations: Golden Lake, Howard Lake, Moore Lake, Reshanau Lake, and Rondeau Lake

Results: Lake levels were measured by volunteers throughout the 2014 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 2014 when heavy rainfall totals occurred. Rainfall tapered off later in the year and lake levels fell accordingly.

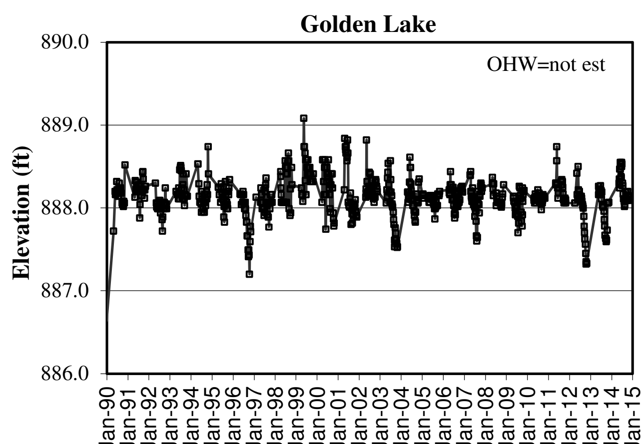
2014 was unlike most recent years. Water levels remained at manageable levels throughout the season. In 2013 and 2012, all lakes in the Rice Creek Watershed within Anoka County displayed at or near record low levels. Most notably, Rondeau Lake set another new record low water level (884.63) on both September 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.

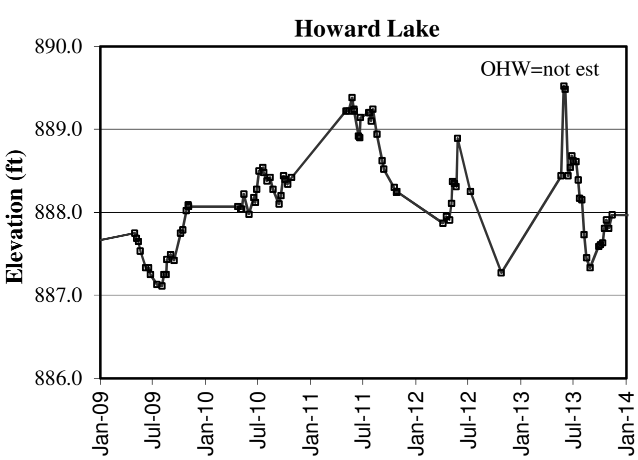
Golden Lake Levels 2010-2014



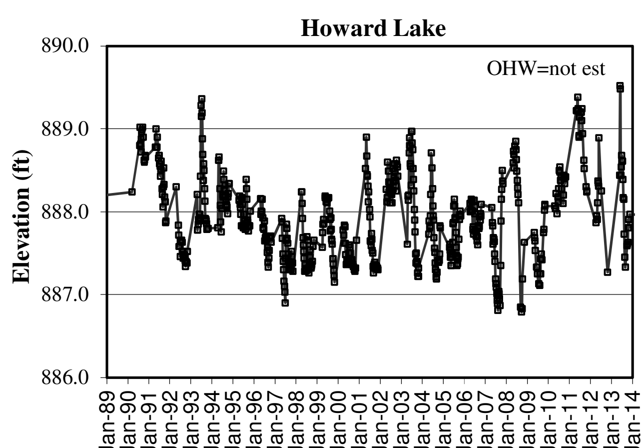
Golden Lake Levels 1990-2014



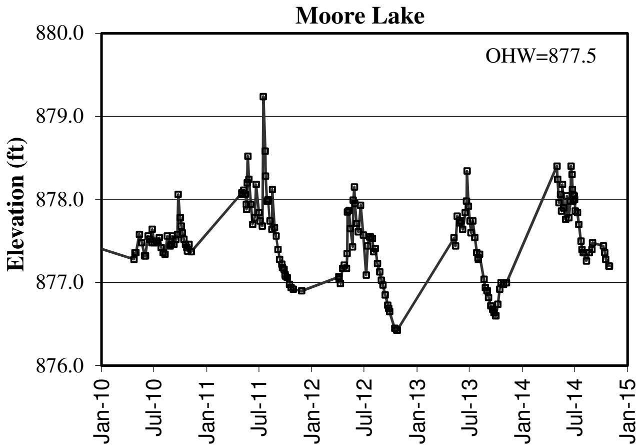
Howard Lake Levels 2010-2013



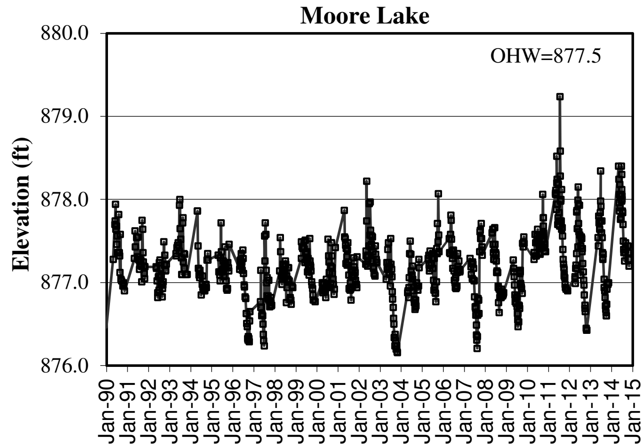
Howard Lake Levels 1990-2013



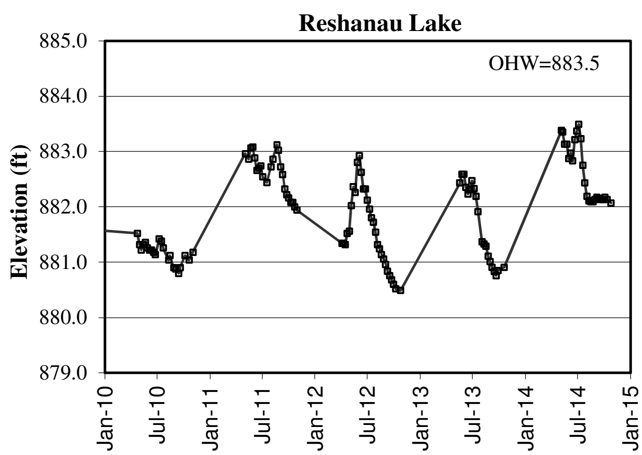
Moore Lake Levels 2010-2014



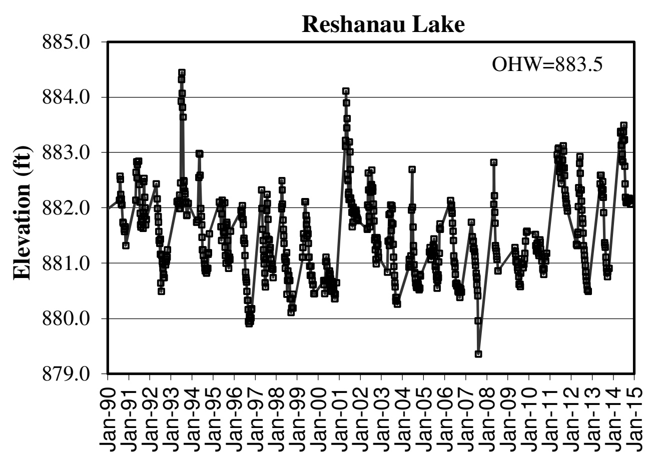
Moore Lake Levels 1990-2014



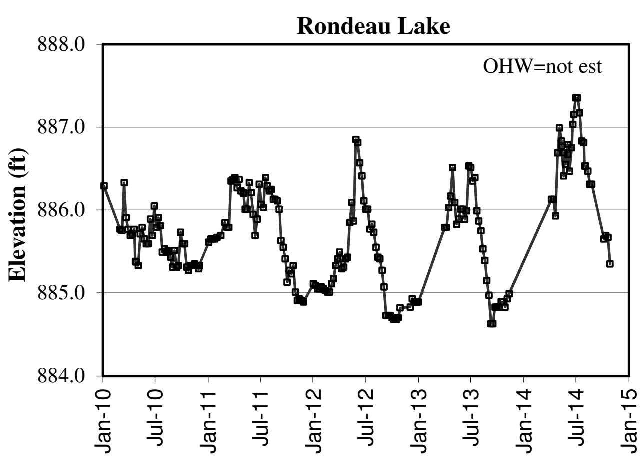
Reshanau Lake Levels 2010-2014



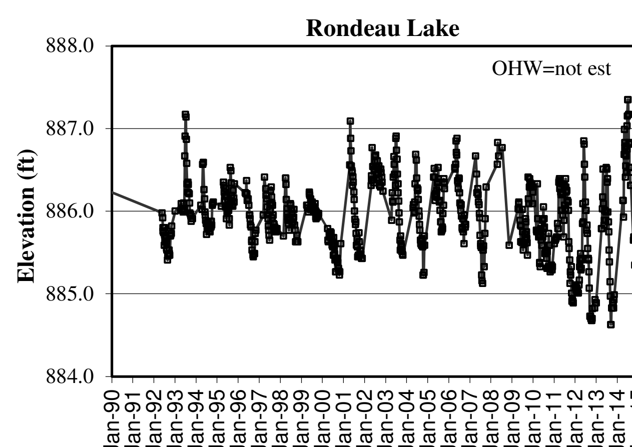
Reshanau Lake Levels 1990-2014



Rondeau Lake Levels 2010-2014



Rondeau Lake Levels 1990-2014



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.

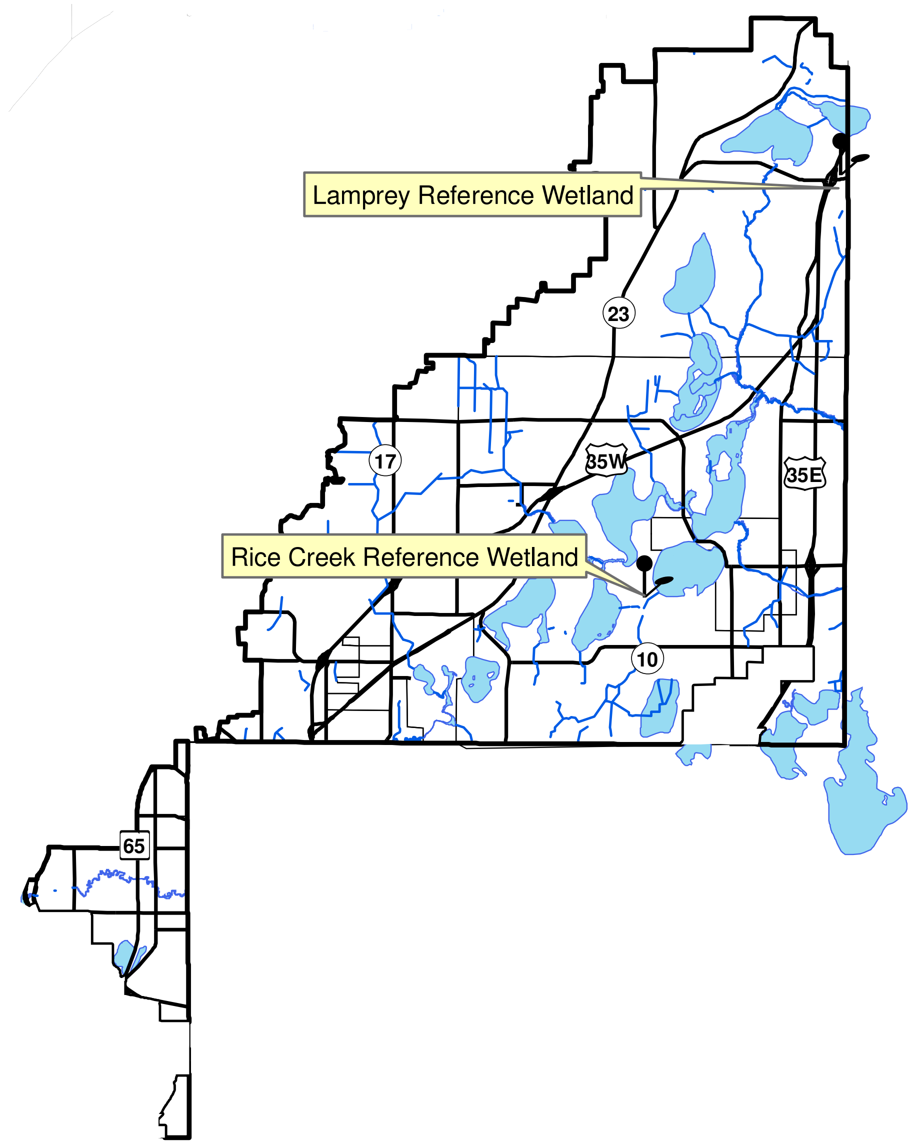
Purpose: To provide an understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

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.

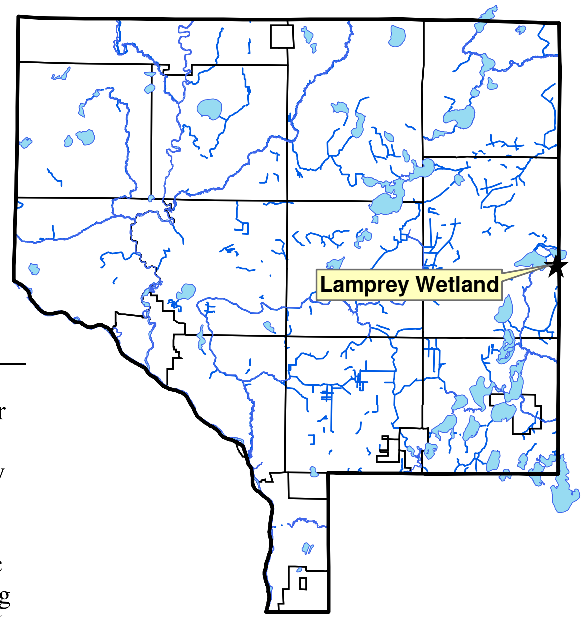
Rice Creek Watershed Wetland Hydrology Monitoring Sites



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

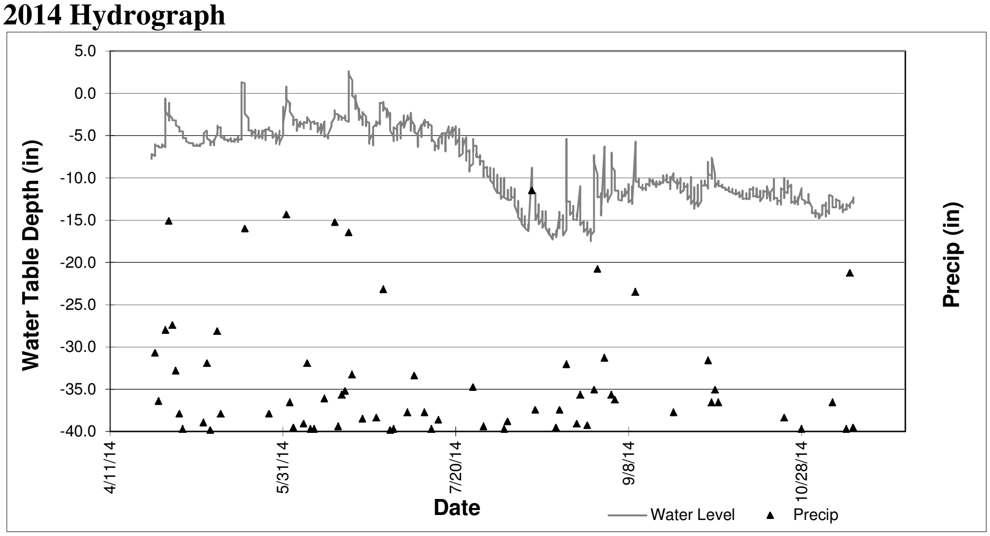
Surrounding Soils: Braham loamy fine sand

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.

2014 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

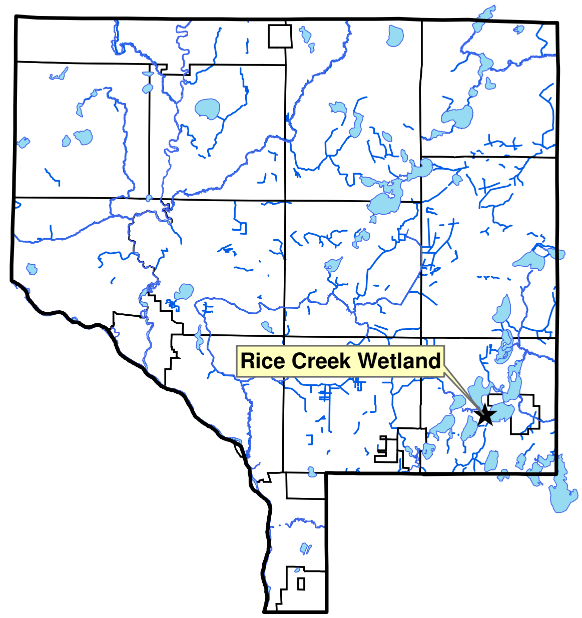
Wetland Size: ~0.5 acres

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



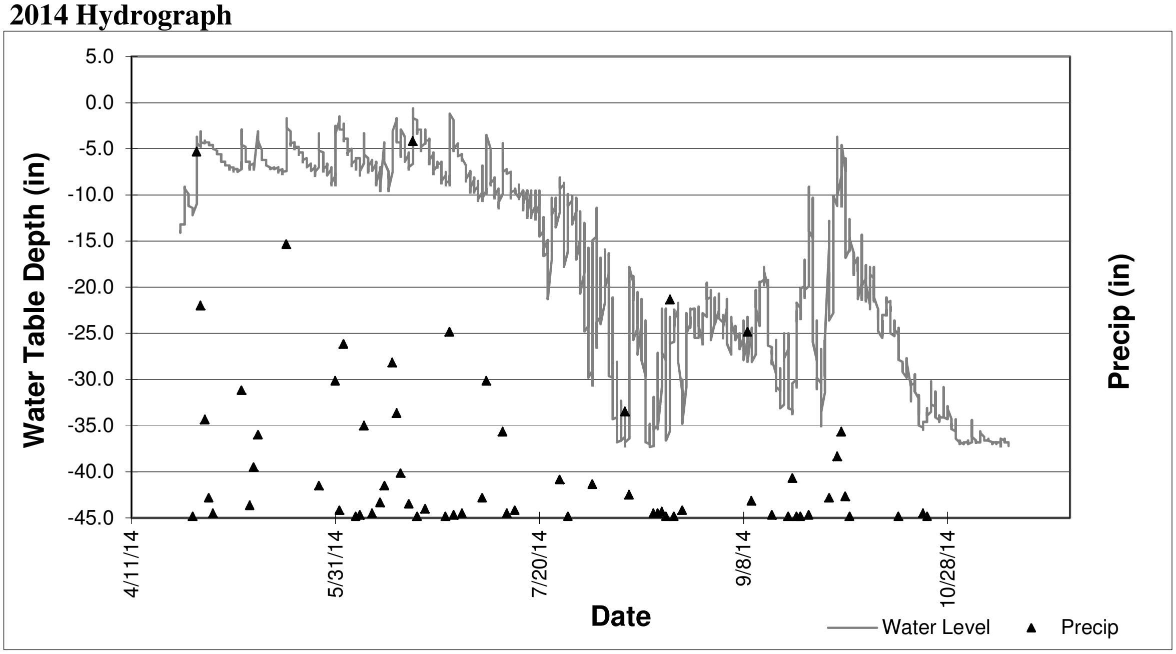
Surrounding Soils: Nessel fine sandy loam and Blomford loamy fine sand

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.

2014 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: 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.

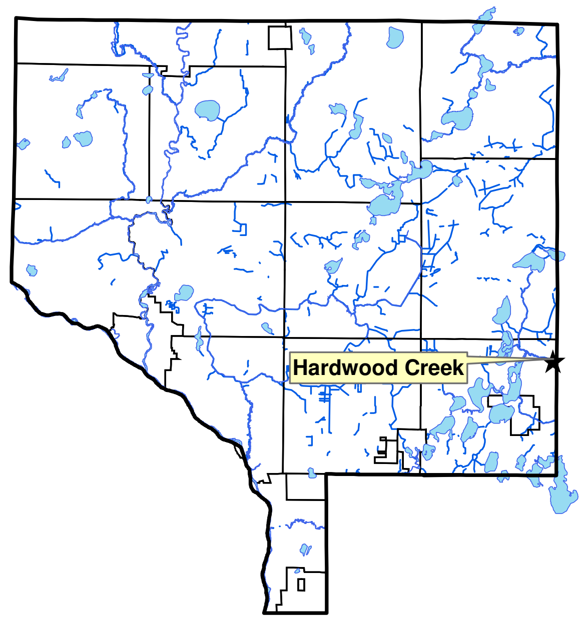
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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.

HARDWOOD CREEK

see list of monitoring locations below



Last Monitored

By Forest Lake Area Learning Center in fall of 2014

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

8 students in 2014, approximately 242 since 2001

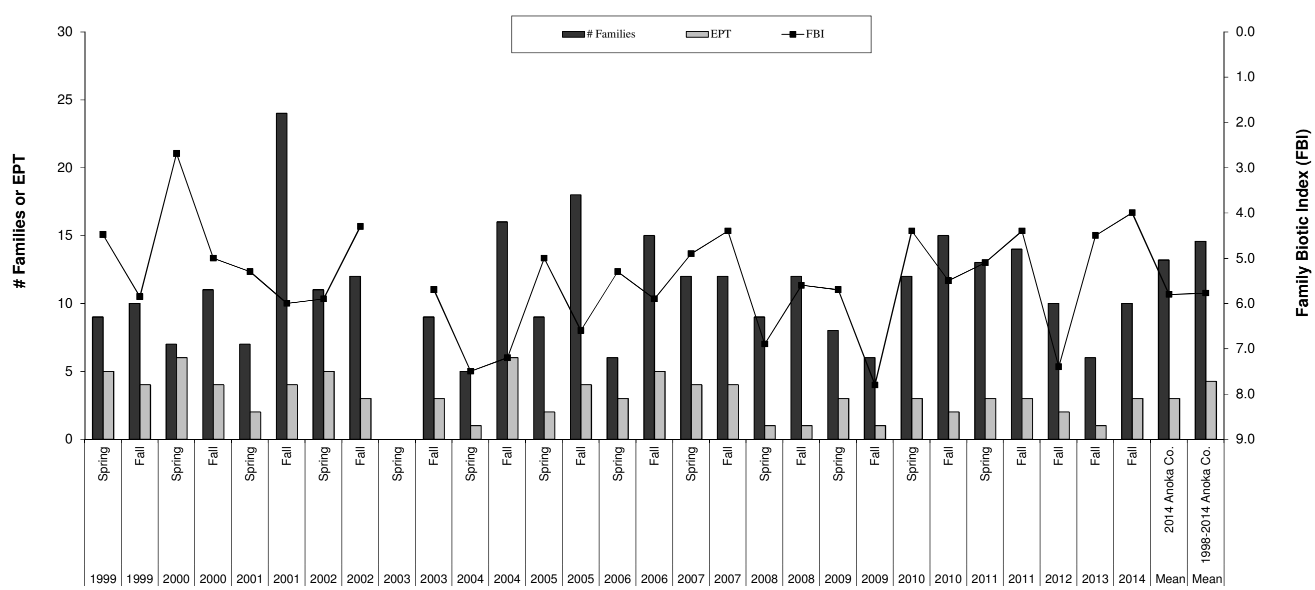
Background

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 2009-14 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 2014, 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 slight rebound in both was observed in 2014. A rebound in the FBI was observed in 2013 and again in 2014. 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	2009	2009	2010	2010	2011	2011	2012	2013	2014	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Fall	Fall	Fall	2014 Anoka Co.	1998-2014 Anoka Co.
FBI	5.70	7.80	4.40	5.50	5.1	4.4	7.4	4.5	4.0	5.8	5.8
# Families	8	6	12	15	13	14	10	6	10	13.2	14.6
EPT	3	1	3	2	3	3	2	1	3	3.0	4.3
Date	19-May	8-Oct	5-May	14-Oct	11-May	5-Oct	11-Oct	10-Oct	10-Oct		
Sampled By	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	400	391	290	110	237	190	83	87	359		
# Replicates	1	1	1	1	1	1	1	1	1		
Dominant Family	Simuliidae	Corixidae	Baetidae	Gammaridae	Gammaridae	Gammarida	Hyalellidae	Gammaridae	Gammaridae		
% Dominant Family	67.3	74.7	68.6	51.8	50.2	62.6	73	87.4	97.2		
% Ephemeroptera	19.5	0.3	69	9.1	2.5	16.3	12	3.4	0.8		
% Trichoptera	0.8	0	1.4	0	0.4	1.1	0	0	0.3		
% Plecoptera	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.

RICE CREEK

at Hwy 65, Locke Park, Fridley

Last Monitored

By Totino Grace High School in fall 2014

Monitored Since

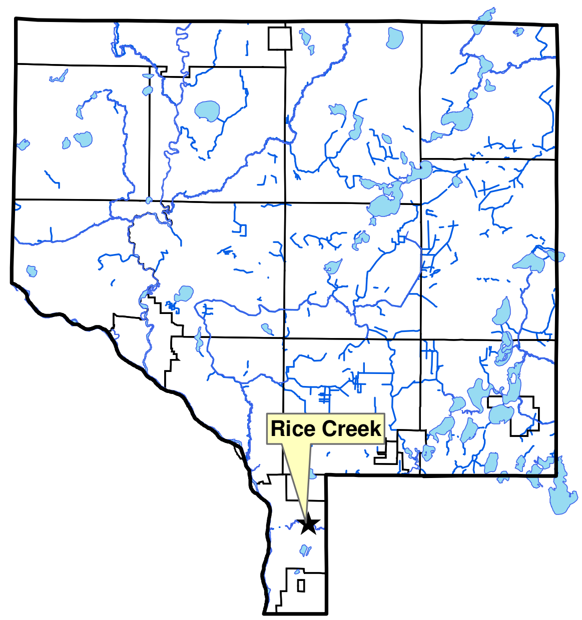
1999

Student Involvement

78 students in 2014, approximately 998 since 2001

Background

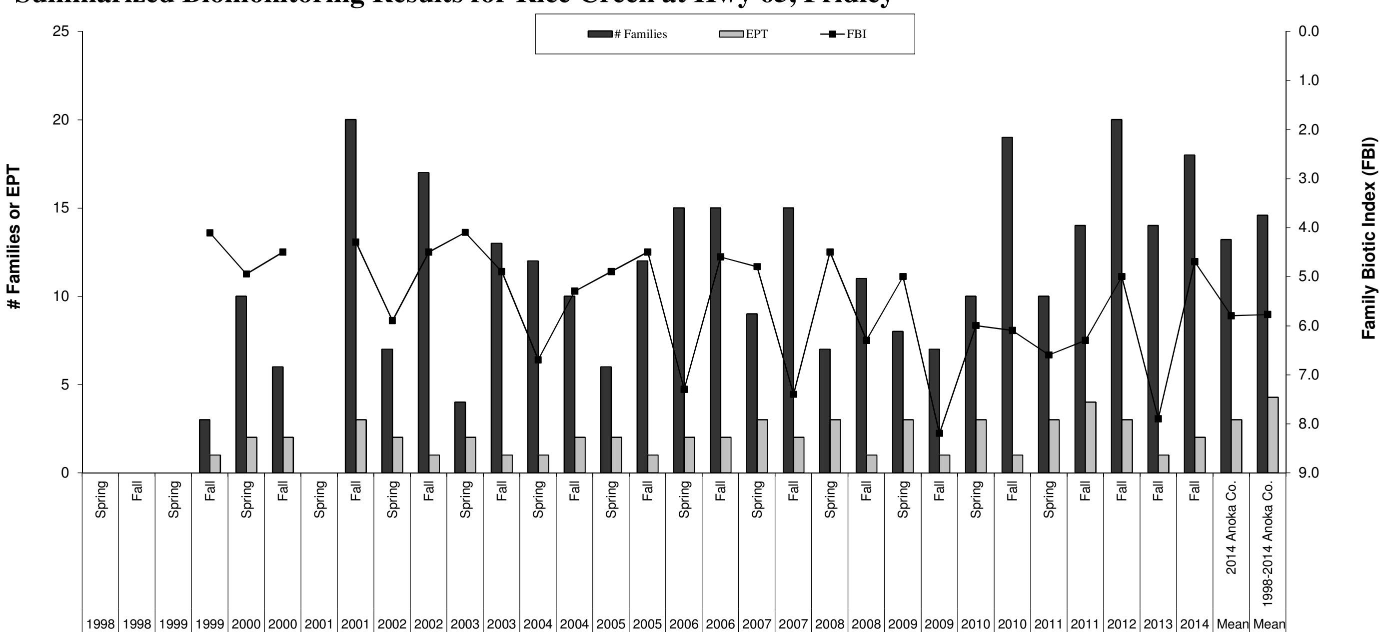
Rice Creek originates from Howard Lake in east-central Anoka County and flows south and west through the Rice Creek Chain of Lakes and eventually to the Mississippi River. Sampling is conducted in Locke Park, which encompasses a large portion of the stream's riparian zone in Fridley. This site is wooded. 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 2014, 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, or above the average for Anoka County streams on several occasions (fall 2010, 2011, 2012, 2013 and 2014), 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. In addition to being the dominant species found in Rice Creek during 2014 monitoring, Hydropsychidae made up 99.8% of all EPT specimen found.

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	2009	2009	2010	2010	2011	2011	2012	2013	2014	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Fall	Fall	Fall	2014 Anoka Co.	1998-2014 Anoka Co.
FBI	5.0	8.2	6	6.1	6.6	6.3	5	7.9	4.7	5.8	5.8
# Families	8	7	10	19	10	14	20	14	18	13.2	14.6
EPT	3	1	3	1	3	4	3	1	2	3.0	4.3
Date	11-May	8-Oct	14-May	13-Oct	31-May	7-Oct	5-Oct				
Sampled By	ACD	TGHS	ACD	TGHS	ACD	TGHS	TGHS	TGHS	TGHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH		
# Individuals	148	111	154	132	126	215	248	107	670.5		
# Replicates	1	1	1	1	1	1	2	2	2		
Dominant Family	Baetidae	Corixidae	Chironomidae	Hydropsychidae	Chironomidae	Simulidae	Philopotamidae	Corixidae	Hydropsychidae		
% Dominant Family	50.0	74.8	29.2	31.1	39.7	23.3	38.0	38.0	76.7		
% Ephemeroptera	50.7	0.0	23.4	0.0	15.9	12.1	10.9	0.0	0.1		
% Trichoptera	6.8	9.0	3.2	31.1	0.8	14.0	43.1	6.4	76.7		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

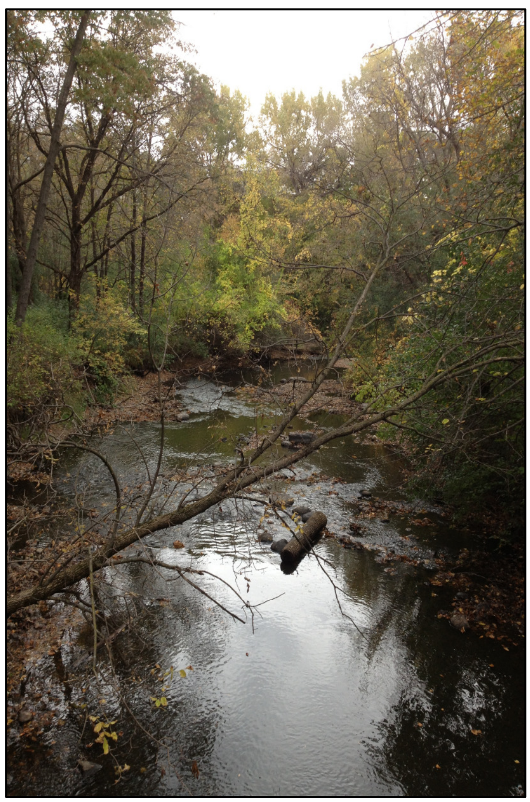
Data presented from the most recent five years. Contact the ACD to request archived data.

Parameter	10/10/2008	5/11/2009	10/8/2009	5/14/2010	10/13/2010	5/31/2011	10/7/2011	10/5/2012	10/16/2014
pH	7.73	8.23	4.76	7.85	7.92	7.62	8.02	8.17	8.62
Conductivity (mS/cm)	0.639	0.624	0.638	0.545	0.535	0.504	0.364	0.460	0.363
Turbidity (NTU)	13	16	18	13	15	0	6	na	15.6
Dissolved Oxygen (mg/L)	9.01	12.29	10.74	12.64	na	7.94	7.34	7.82	10.06
Salinity (%)	0.02	0.02	0.02	0.02	0.02	na	0.01	0.01	0.34
Temperature (°C)	12.9	14.5	11.2	12.8	16.5	19.6	17.1	9.6	11.23

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 2014 ACD provided technical/design assistance valued at $16,174.25 and was reimbursed $14,093.75 through the Rice Creek Watershed District.

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
<u>Services</u>			
Cost-Share Service Agreement			
Administrative Hours (Specialist)	20	$73	$1,460.00
TA & Design Hours (Specialist)	55	$73	$4,015.00
TA & Design Hours (Technician)	5	$63	$315.00
TA & Design Hours (Manager)	26	$85	$2,210.00
Total			**$8,000.00**
Additional Services			
RL-13 Rain Garden Monitoring and Repair (Manager)	6	$85	$1,020.00
RL-13 Rain Garden Monitoring and Repair (Seasonal)	26	$52	$1,352.00
RL-13 Rain Garden Monitoring and Repair (Technician)	40.25	$63	$2,535.75.00
Total			**$4,907.75**
Locke 23 Service Agreement			
Locke 23 Rain Garden Assistance (Seasonal)	6	$52	$312.00
Locke 23 Rain Garden Assistance (Technician)	1	$63	$63.00
Locke 23 Rain Garden Assistance (Specialist)	10.5	$73	$766.50
Locke 23 Rain Garden Assistance (Manager)	25	$85	$2,125.00
Locke 23 Rain Garden Assistance (ACD In Kind)			-$2,080.50
Total			**$1,186.00**
Total Value of Services Provided			**$14,093.75**

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

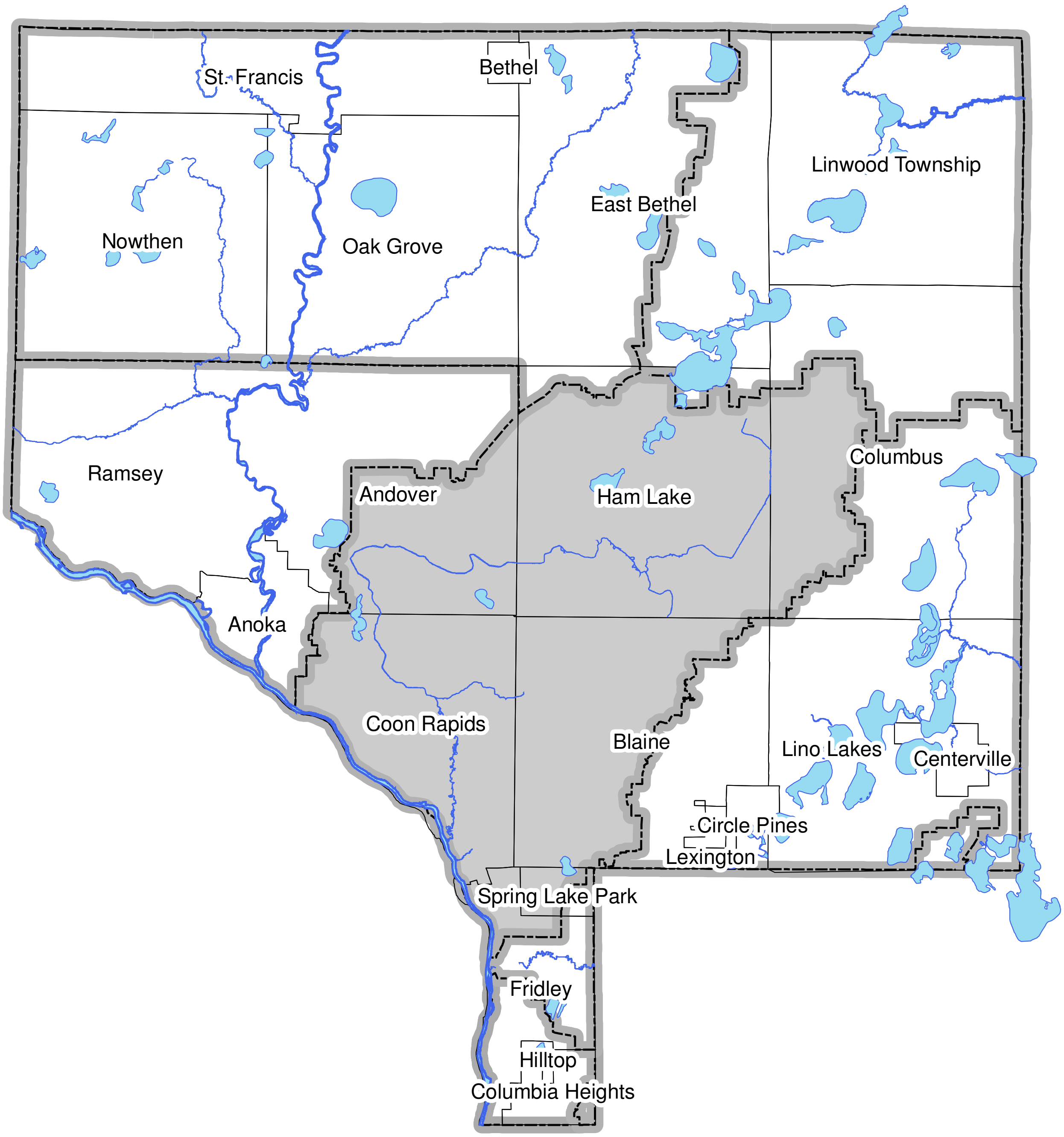
Rice Creek Watershed	WMO Asst (no charge)	BMP Maintainance	Volunteer Precipitation	Reference Wetlands	DNR Observation Wells	Lake Levels	Student Biomonitoring	Landowner Cost Share and Tech Assist	Golden Lake IESF - CWF	Total
Revenues										
RCWD	0	4908	0	1150	0	1250	2475	9707	4119	23609
State	0	0	0	0	240	0	0	0	7785	8025
Anoka Conservation District	0	0	0	0	0	0	0	0	0	0
Anoka Co. General Services	586	0	0	0	154	0	0	0	0	740
County Ag Preserves	0	0	0	0	0	0	0	0	0	0
Regional/Local	0	0	0	0	0	0	0	0	0	0
Other Service Fees	0	0	0	0	0	0	0	0	0	0
BWSR Cons Delivery	0	45	0	0	0	0	0	0	0	45
BWSR Cost Share TA	0	0	0	0	0	0	0	0	0	0
Local Water Planning	0	0	99	161	0	0	0	0	0	259
TOTAL	586	4953	99	1311	394	1250	2475	9707	11904	32679
Expenses-										
Capital Outlay/Equip	13	105	2	28	9	24	36	182	90	489
Personnel Salaries/Benefits	505	4115	85	1089	339	956	1416	7132	3548	19185
Overhead	34	277	6	73	23	64	95	479	238	1289
Employee Training	4	30	1	8	2	7	10	52	26	140
Vehicle/Mileage	9	73	2	19	6	17	25	127	63	341
Rent	22	178	4	47	15	41	61	308	153	829
Program Participants	0	0	0	0	0	0	0	0	0	0
Program Supplies	0	176	0	40	0	4	85	270	7785	8358
McKay Expenses	0	0	0	0	0	0	0	0	0	0
TOTAL	586	4953	99	1304	394	1113	1728	8549	11904	30630

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.

Excerpt from the
2014 Anoka Water Almanac

Chapter 6: Coon Creek Watershed



Prepared by the Anoka Conservation District

CHAPTER 6:
COON CREEK WATERSHED

Task	Partners	Page
Precipitation	CCWD, ACD, volunteers	6-147
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Lake Levels	CCWD, ACD, volunteers	6-151
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Stormwater Retrofit Analysis – Woodcrest and Sand Creeks	CCWD, ACD	6-281
Financial Summary		6-283
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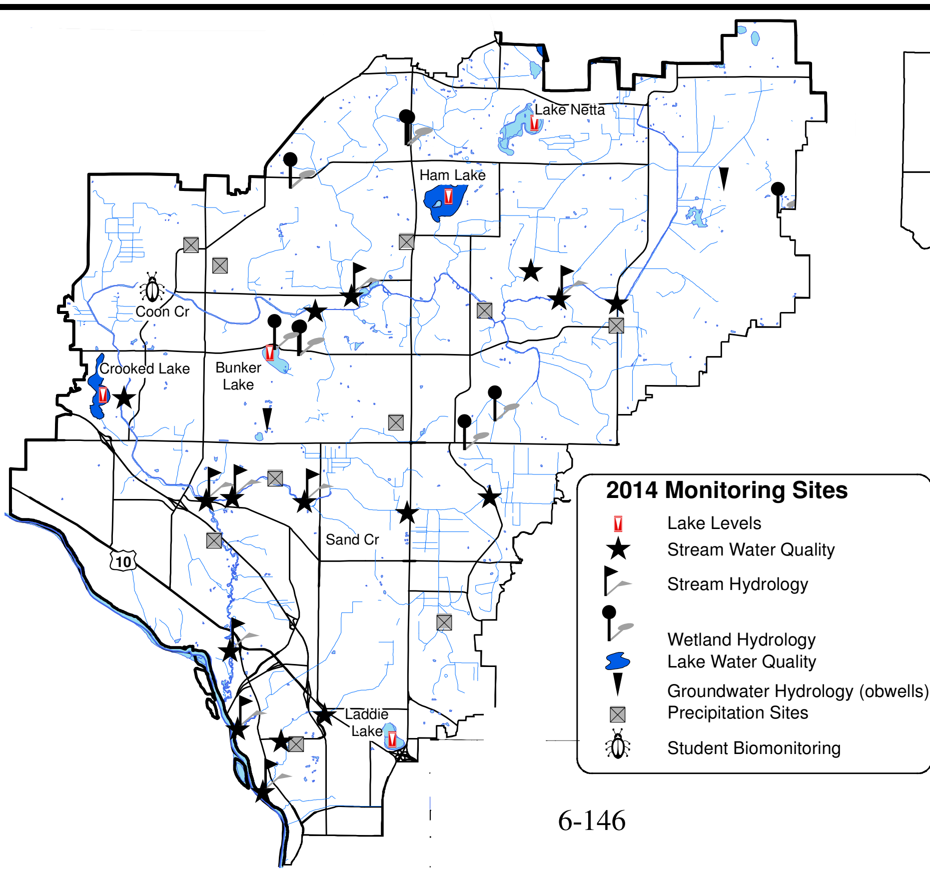
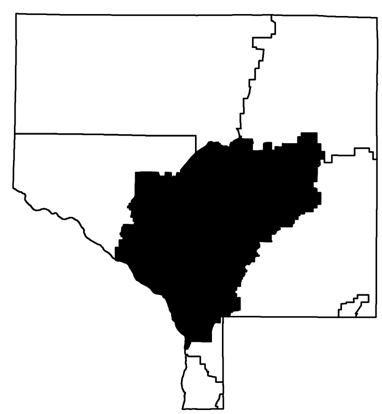
Groundwater Hydrology (obwells)	ACD, MNDNR	see Chapter 1

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.

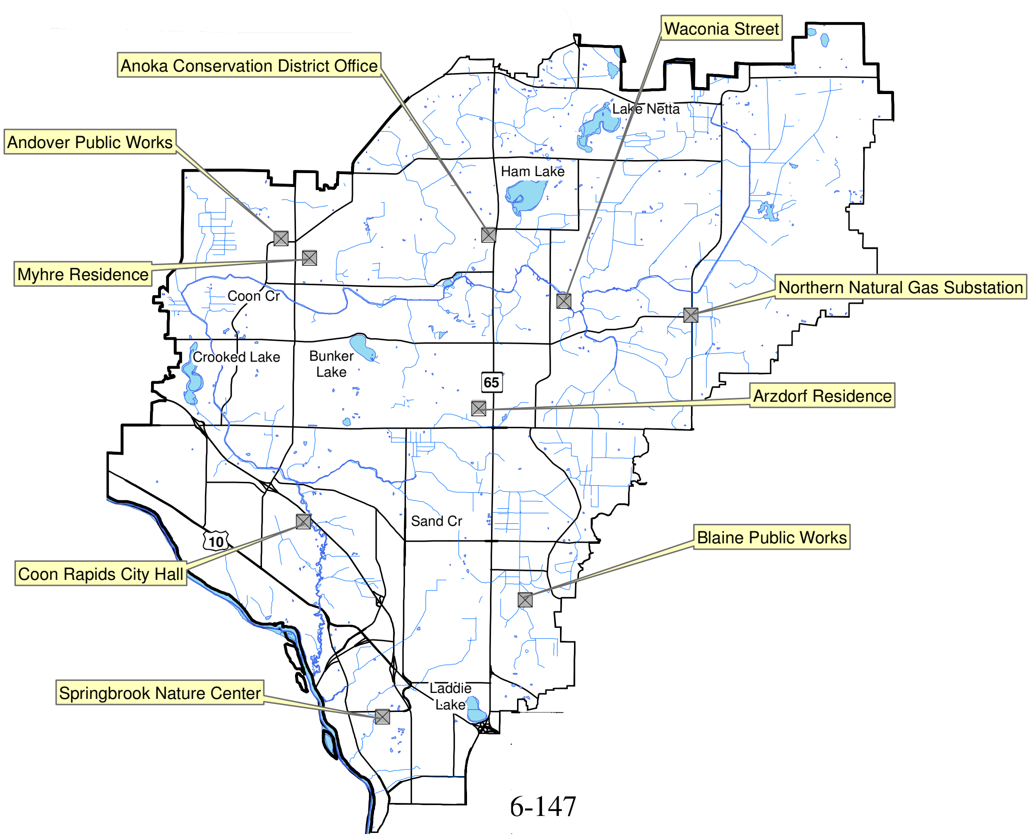
Locations:

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

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.

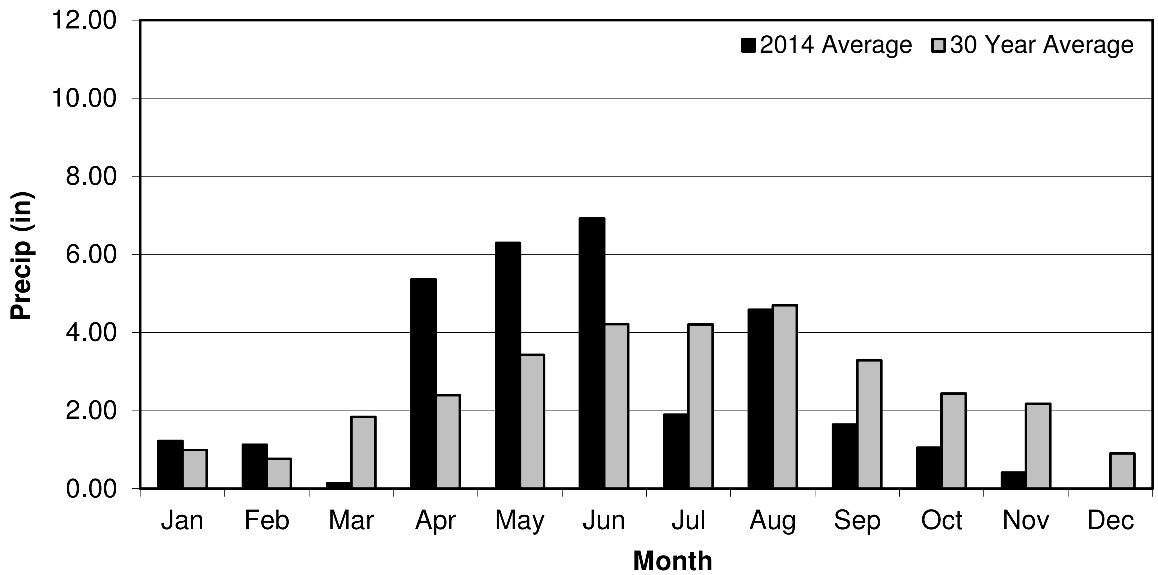
Coon Creek Watershed 2014 Precipitation Monitoring Sites



Coon Creek Watershed 2014 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			0.00	0.00	8.41	2.70	1.97	6.56	1.65	0.99	0.33		22.61	21.29
Blaine Public Works	Blaine			0.00	4.55	4.69	7.98	1.96	2.65	1.78	1.16	0.22		24.99	19.06
Coon Rapids City Hall	Coon Rapids			0.00	6.31	7.20	8.33	2.58	5.26	2.02	1.10	0.33		33.13	25.39
Anoka Cons. District office	Ham Lake			0.00	6.03	6.57	9.49	2.08	6.11	1.82	1.04	0.00		33.14	26.07
Waconia St.	Ham Lake			0.00	6.09	5.67	0.07	0.00	0.00	0.30	1.20	0.31		13.64	6.04
Northern Nat. Gas substation	Ham Lake			0.00	5.68	6.08	8.84	1.96	5.58	1.34	1.13	0.22		30.83	23.80
Springbrook Nature Center	Fridley			0.00	6.20	5.31	4.93	2.85	4.41	2.26	0.77	0.32		27.05	19.76
Cylinder rain gauges (read daily)															
N. Myhre	Andover	1.23	1.13	0.92	6.96	4.48	11.69	1.72	5.45	1.86	0.95	1.58		35.61	25.20
J. Arzdorf	Blaine			0.30	6.45	8.22	8.26	1.98	5.23	1.78	1.21			33.43	25.47
2014 Average	County-wide	1.23	1.13	0.14	5.36	6.29	6.92	1.90	4.58	1.65	1.06	0.41		30.68	21.34
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) 2014 storm analyses and 2) long term precipitation trend analysis.

1.) **2014 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:

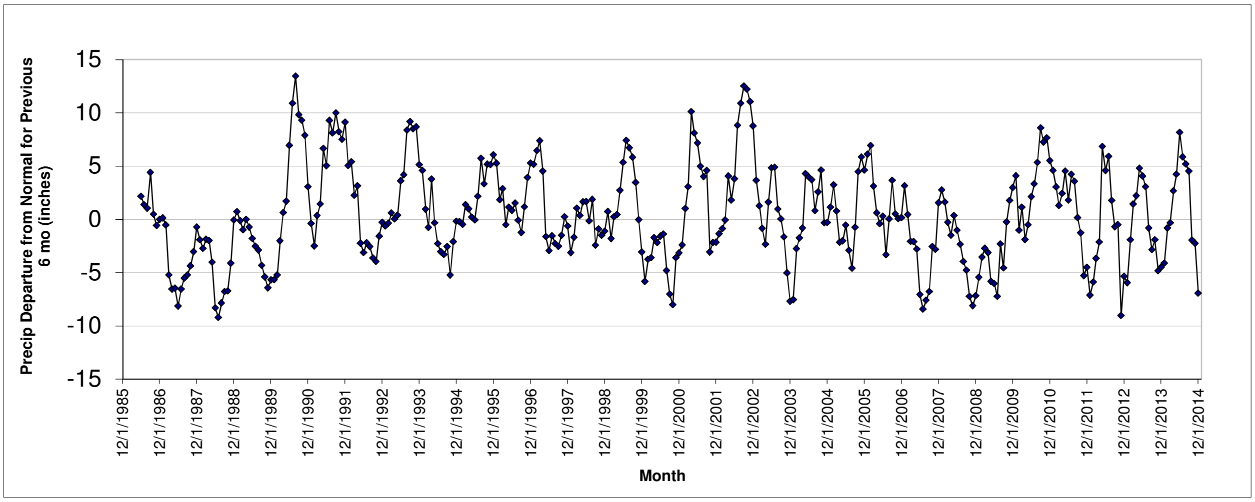
1.) **2014 Storm Analyses:** The results of these analyses were delivered to the Coon Creek Watershed District in digital form and are not reported here due to complexity and lengthiness.

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

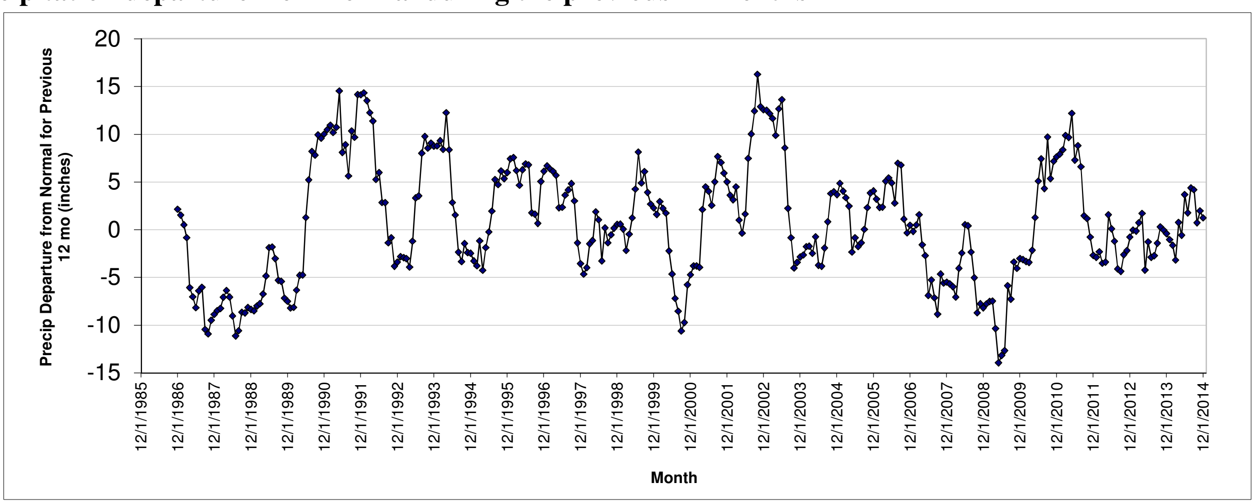
Long Term Precipitation Trends

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.

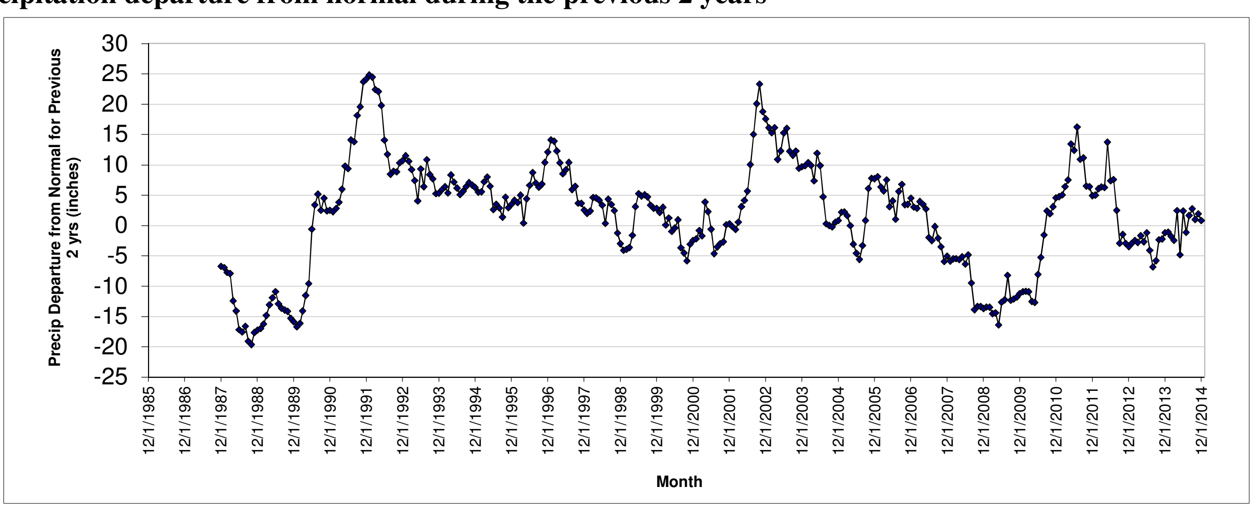
Precipitation departure from normal during the previous 6 months



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:

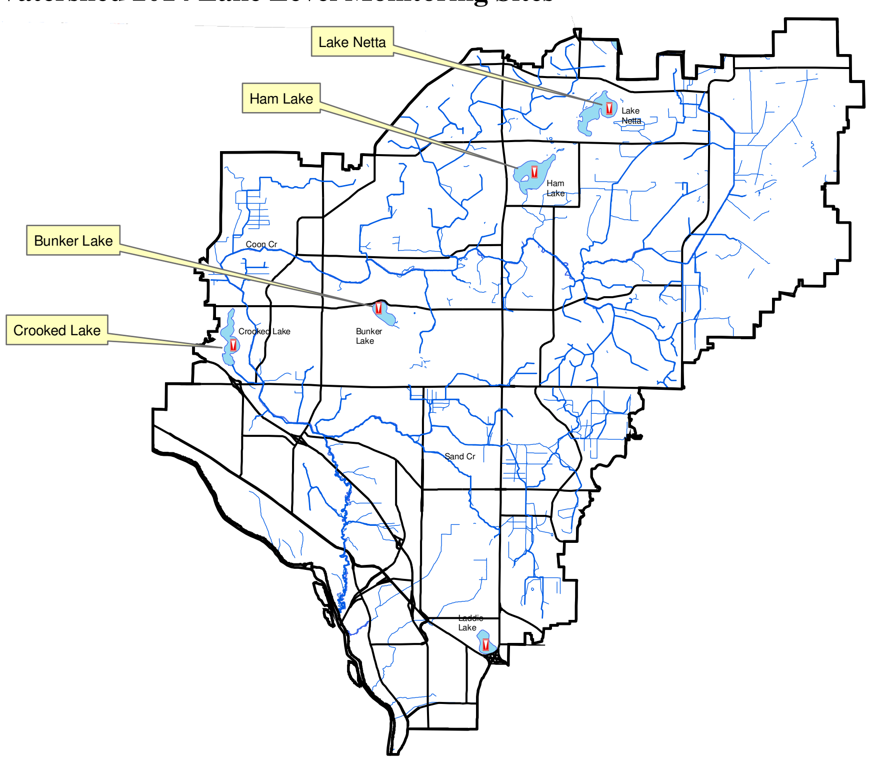
Site	City
Bunker Lake	Andover
Crooked Lake	Andover/Coon Rapids
Ham Lake	Ham Lake
Lake Netta	Ham Lake
Laddie Lake	Blaine

Results: Lake levels were measured by volunteers 45 times at Crooked Lake, 61 times at Ham Lake, 27 times at Lake Netta, and 38 at Laddie Lake. The level in Bunker Lake was monitored using an electronic gauge, which resulted in 206 days of measurements generated by averaging six readings from each day.

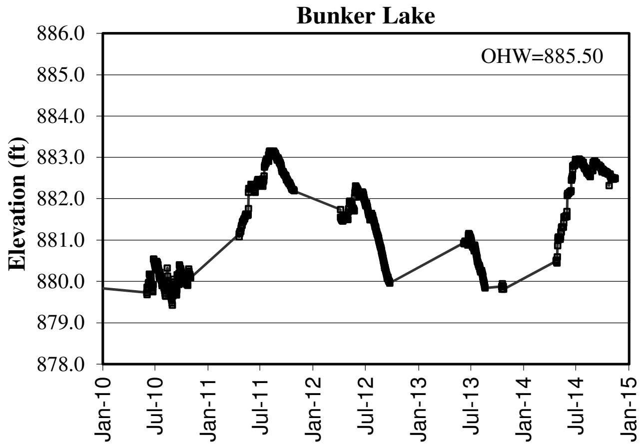
Coon Creek Watershed lake levels during 2014 exhibited a higher than average trend than in previous years. Following spring and early summer increases due to abnormally high precipitation, lake levels then dropped steadily throughout the remainder of the year. The levels of Ham Lake even managed to reach a record high of (897.53).

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.

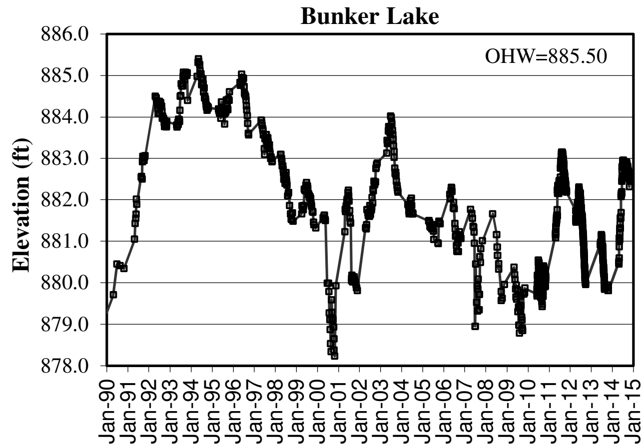
Coon Creek Watershed 2014 Lake Level Monitoring Sites



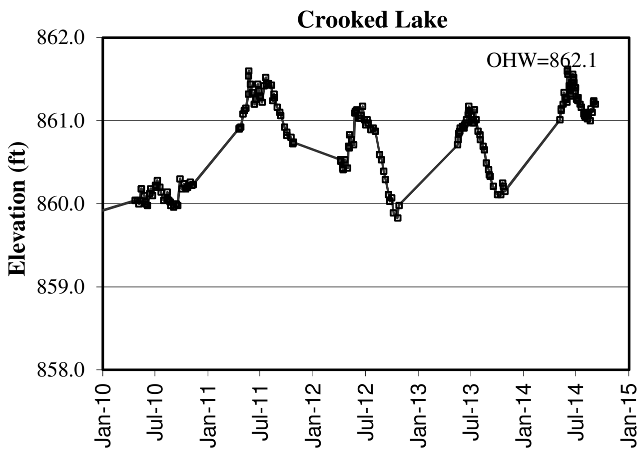
Bunker Lake Levels 2010-2014



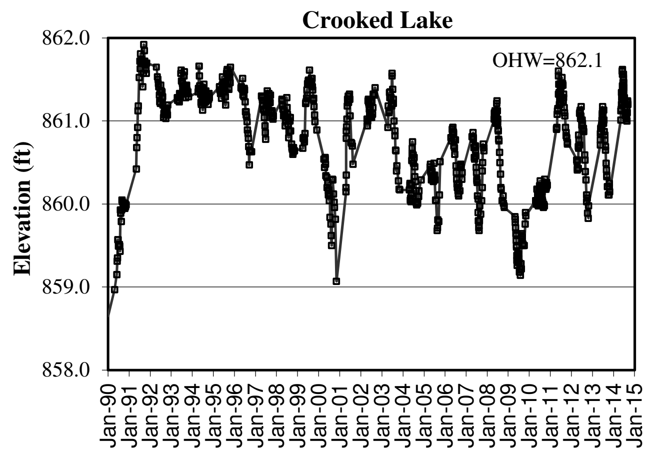
Bunker Lake Levels 1990-2014



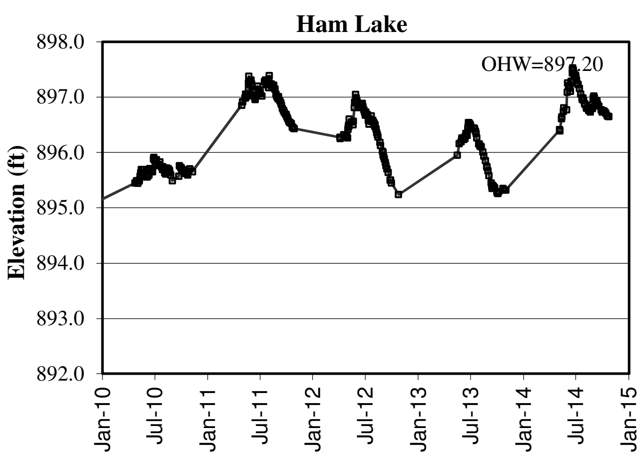
Crooked Lake Levels 2010-2014



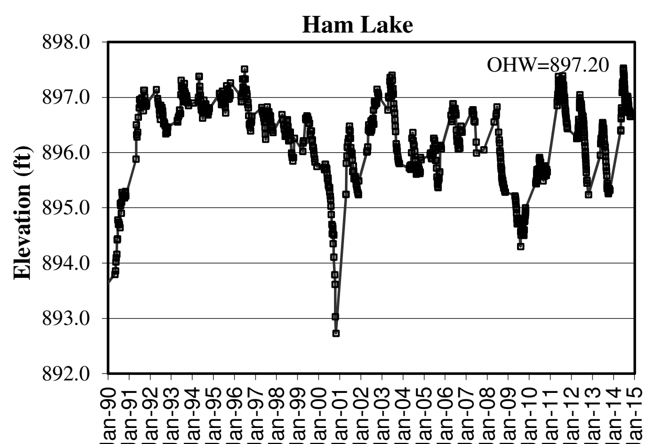
Crooked Lake Levels 1990-2014



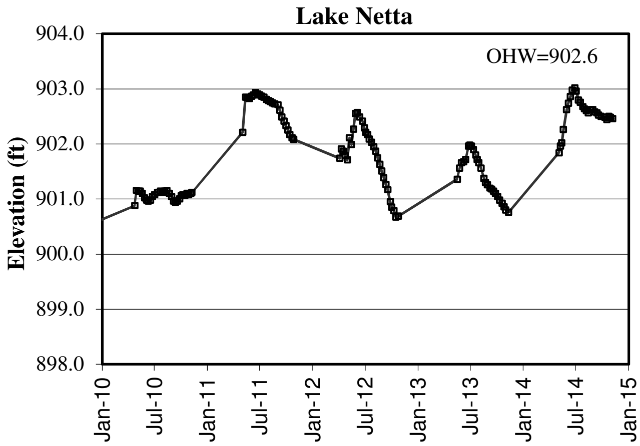
Ham Lake Levels 2010-2014



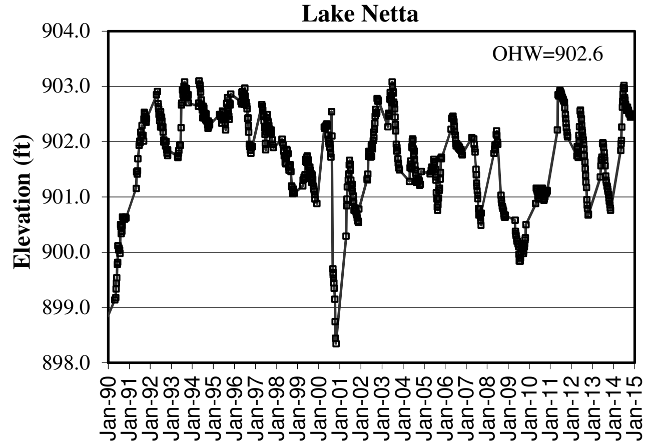
Ham Lake Levels 1990-2014



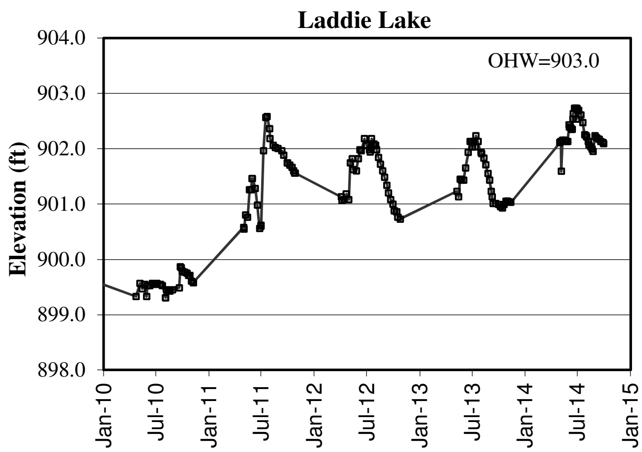
Lake Netta Levels 2010-2014



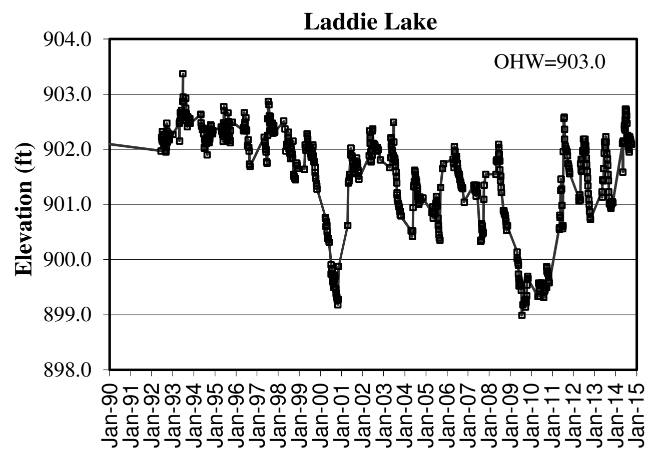
Lake Netta Levels 1990-2014



Laddie Levels 2010-2014



Laddie Levels 1990-2014



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

Lake	Year	Average	Min	Max
Bunker	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
	2014	882.40	880.45	882.96
Crooked	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
	2014	861.28	861.00	861.62
Ham	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
	2014	896.97	896.39	897.53

Lake	Year	Average	Min	Max
Netta	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
	2014	902.56	901.84	903.02
Laddie	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
	2014	902.30	901.59	902.73

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.

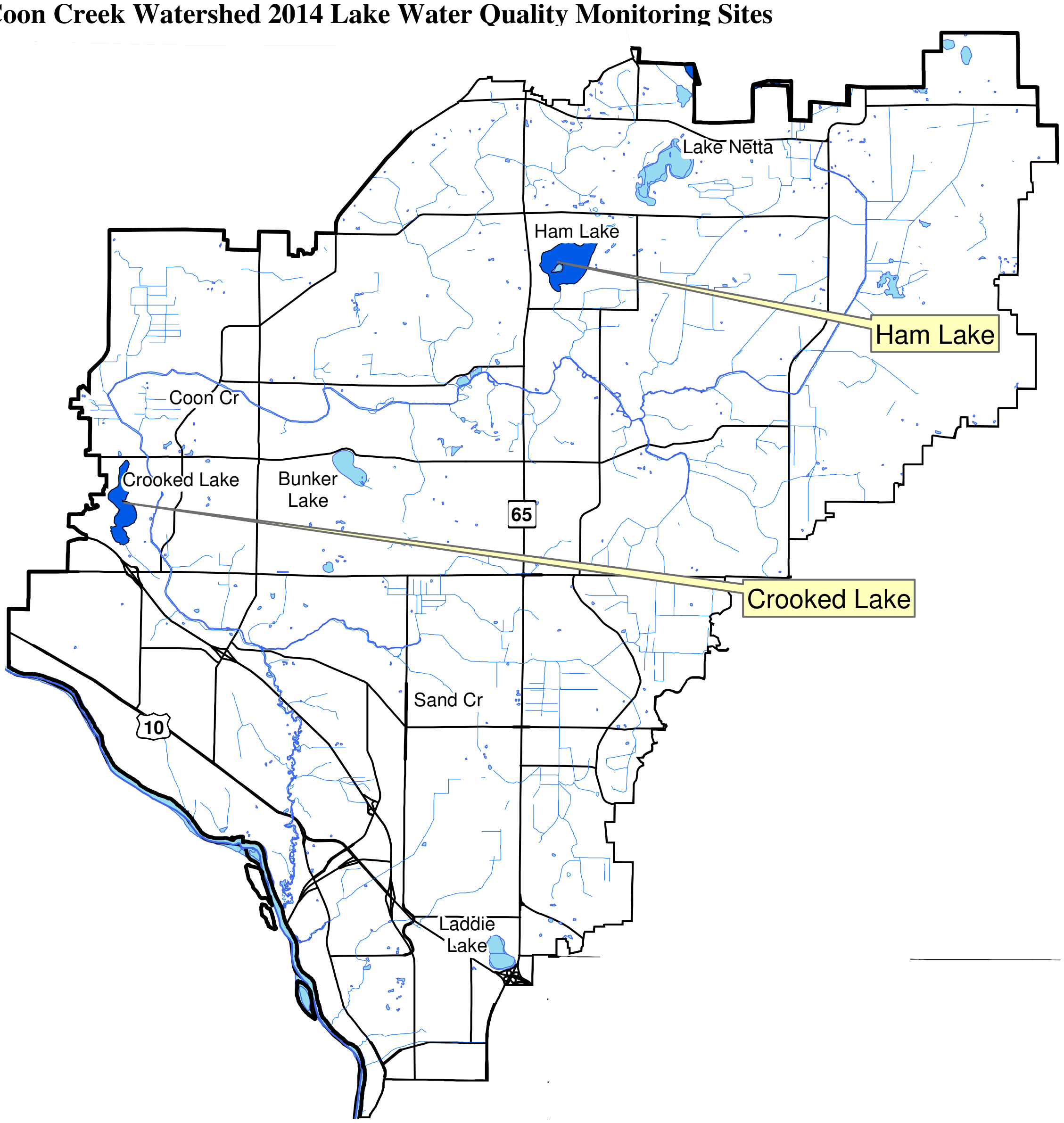
Purpose: To detect water quality trends and diagnose the cause of changes.

Locations:

Site	City
Ham Lake	Ham Lake
Crooked Lake	Andover/Coon Rapids

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 2014 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.

2014 Results

Ham Lake water quality received a slightly above-average rating for this region of the state (NCHF Ecoregion) in 2014, receiving an A letter grade. The average of total phosphorus results was among the lowest of all years monitored at 19.6 ug/L. A drop in phosphorus has been observed in each of the last three monitored years. Chlorophyll-a, a measure of algal growth, was the lowest of all monitored years averaging <1.9 mg/L. This is the second monitoring year in a row which has set the all-time record low for Chl-a and a drop has been observed in each of the last three monitored years. Transparency was similar, recording the third 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 2014 than in previous years, this may be in part due to the extreme weather observed during its peak growing season as well as competition from Eurasian Water Milfoil.

Trend Analysis

Seventeen 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 2014). 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, $F_{2,14} = 2.94$, $p = 0.09$). We also examined variables TP, Cl-a, and Secchi depth across all years of existing data using a one-way ANOVA. Including all years, a significant trend of improving Cl-a ($F_{1,16}=6.19$, p=0.03) is found.

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. 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 organized a lake association and raised funds to begin management of the invasives. The first treatments occurred in 2014, but an aggressive management plan had to be altered due to the presence of both invasives being down in 2014. The effect of the two invasive species on water quality beyond recreational hindrance is unknown.

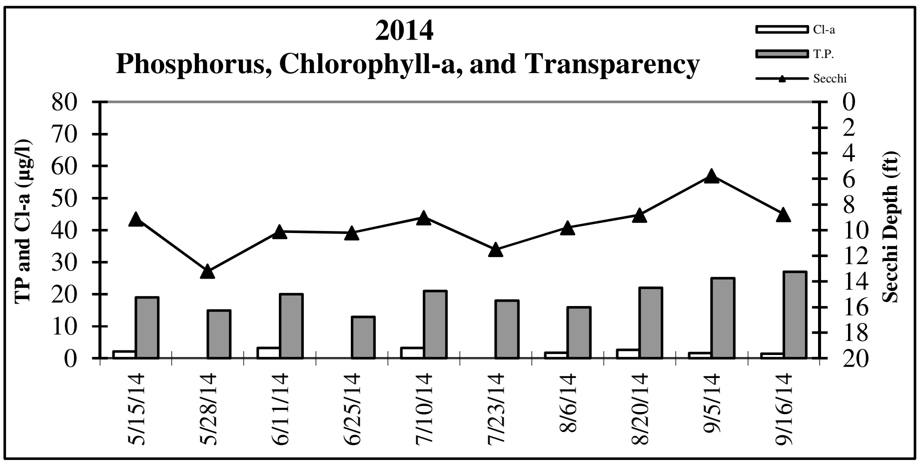
2014 Ham Lake Water Quality Data

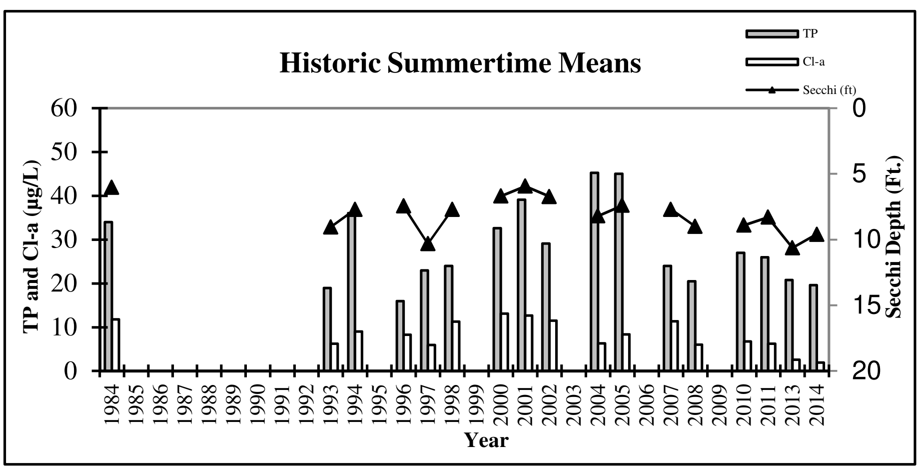
Ham Lake
2014 Water Quality Data

	Units	R.L.*	5/15/2014 Results	5/28/2014 Results	6/11/2014 Results	6/25/2014 Results	7/10/2014 Results	7/23/2014 Results	8/6/2014 Results	8/20/2014 Results	9/5/2014 Results	9/16/2014 Results	Average	Min	Max
pH		0.1	8.32	8	8.44	8.81	8.79	8.79	8.57	8.09	7.78	8.19	8.38	7.78	8.81
Conductivity	mS/cm	0.01	0.319	0.327	0.314	0.301	0.296	0.304	0.321	0.331	0.374	0.35	0.324	0.296	0.374
Turbidity	NTU	1.00	0.90	0.00	0.00	1.00	2.40	3.20	0.00	0.10	1.10	2.70	1.14	0.00	3.20
D.O.	mg/L	0.01	10.67	8.37	9.6	9.34	8.51	8.26	8.24	6.8	5.35	7.97	8.31	5.35	10.67
D.O.	%	1	102%	91%	111%	114%	103%	102%	102%	84%	63%	84%	96%	63%	114%
Temp.	°C	0.1	13	21	22	24	24	25	25	24	22	16	21.6	12.7	25.0
Temp.	°F	0.1	54.9	69.5	72.0	75.2	75.0	77.0	76.7	75.7	71.6	61.5	70.9	54.9	77.0
Salinity	%	0.01	0.15	0.16	0.15	0.14	0.14	0.15	0.15	0.16	0.18	0.17	0.16	0.14	0.18
Cl-a	ug/L	0.5	2.1	<1	3.2	<1	3.2	<1	1.7	2.6	1.6	1.4	<1.9	<1.0	3.2
T.P.	mg/L	0.010	0.019	0.015	0.02	0.013	0.021	0.018	0.016	0.022	0.025	0.027	0.020	0.013	0.027
T.P.	ug/L	10	19	15	20	13	21	18	16	22	25	27	20	13	27
Secchi	ft	0.1	9.11	13.2	10.1	10.2	9	11.5	9.8	8.8	5.75	8.75	9.6	5.8	13.2
Secchi	m	0.1	2.78	4.02	3.08	3.11	2.74	3.51	2.99	2.68	1.75	2.67	2.9	1.8	4.0
Physical			1.0	1.0	2.0	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.2	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

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	ACD	ACD
Year	84	93	94	96	97	98	2000	2001	2002	2004	2005	2007	2008	2010	2011	2013	2014
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	19.6
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	<1.9
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	2.9
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	9.6

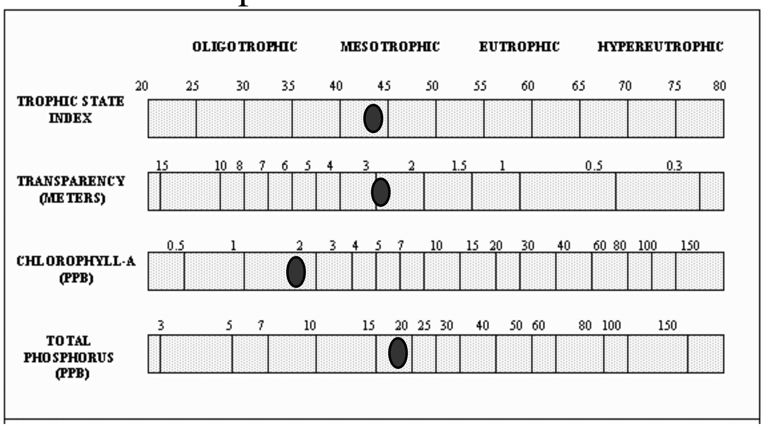
Carlson's Tropic State Indices

TSIP	55	47	56	44	49	50	54	57	53	59	59	50	48	52	51	48	47
TSIC	55	49	52	51	48	54	56	56	55	49	52	55	48	49	49	40	37
TSIS	51	45	48	48	43	48	50	51	50	47	49	48	45	46	47	43	45
TSI	54	47	52	48	47	51	53	55	52	52	53	51	47	49	49	44	43

Ham Lake Water Quality Report Card

Year	84	93	94	96	97	98	2000	2001	2002	2004	2005	2007	2008	2010	2011	2013	2014
TP	C	A	C	A	A	B	C	C	B	C	C	B	A	B	B	A	A
Cl-a	B	A	A	A	A	B	B	B	B	A	A	B	A	A	A	A	A
Secchi	C	B	B	B	A	B	C	C	C	B	B	B	B	B	B	A	B
Overall	**C**	**A**	**B**	**A**	**A**	**B**	**C**	**C**	**B**	**B**	**B**	**B**	**A**	**B**	**B**	**A**	**A**

Carlson's Trophic State Index



Crooked Lake

CITIES OF ANDOVER AND COON RAPIDS, LAKE ID # 02-0084

Background

Crooked Lake is located half in the City of Andover and half in Coon Rapids. It has a surface area of 117.5 acres with a maximum depth of 26 feet (7.9 m). Public access is from two locations, at a boat launch off Bunker Lake Boulevard and at a City of Coon Rapids park on the east side of the lake where a fishing pier is located. The lake is used extensively by recreational boaters and fishers. The 236 acre watershed is developed and primarily comprised of residential land use.

In 1990 Eurasian Water Milfoil (EWM) was discovered in the lake. In 1992 a whole-lake treatment with fluridone was conducted that eradicated nearly all aquatic vegetation. EWM was discovered again in 1996. In 2002 the DNR implemented a low dose of fluridone, which reduced the EWM while having a lesser impact on other vegetation. Spot treatments using triclopyr or 2, 4-D have been conducted since 2010, with 11.5 acres being treated in 2012. EWM is still at nuisance levels in some areas, and may be expanding or becoming denser. In other areas the similar-looking, native, northern milfoil is present. The exotic, invasive plant curly leaf pondweed is also present, but rarely to nuisance levels.

2014 Results

In 2014 Crooked Lake had above-average water quality for this region of the state (NCHF Ecoregion). Water quality in Crooked Lake received an overall A grade in 2014, which is a substantial improvement over the B grade received in 12 of the previous 15 years. This improvement was driven by a decrease in TP to the lake's lowest summertime average observed (22 µg/L). In addition, chlorophyll–a concentrations averaged 3.9 µg/L, which is lower than the previous record set in 2012. Although average Secchi transparency decreased by 0.4 feet relative to 2012, it was still good with an average of 8.6 feet. This is in contrast to water clarity that rarely averaged near 4 feet before 1996.

Trend Analysis

Seventeen years of water quality data have been collected between 1983 and 2014, with eight additional years of transparency measurements by citizens. Water quality has significantly improved from 1983 to 2014 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,15} = 42$, $p < 0.001$). The most dramatic improvements in water quality occurred between 1989 and 1994. However, if only data after 1993 are examined a statistically significant trend of improvement is still found (same analysis, $F_{2,12} = 13.73$, $p = 0.0008$). Examining the trend during this period for each parameter (one-way ANOVA graphs on following page) we find no change in phosphorus, but a trend toward lower chlorophyll-a and greater transparency.

Discussion

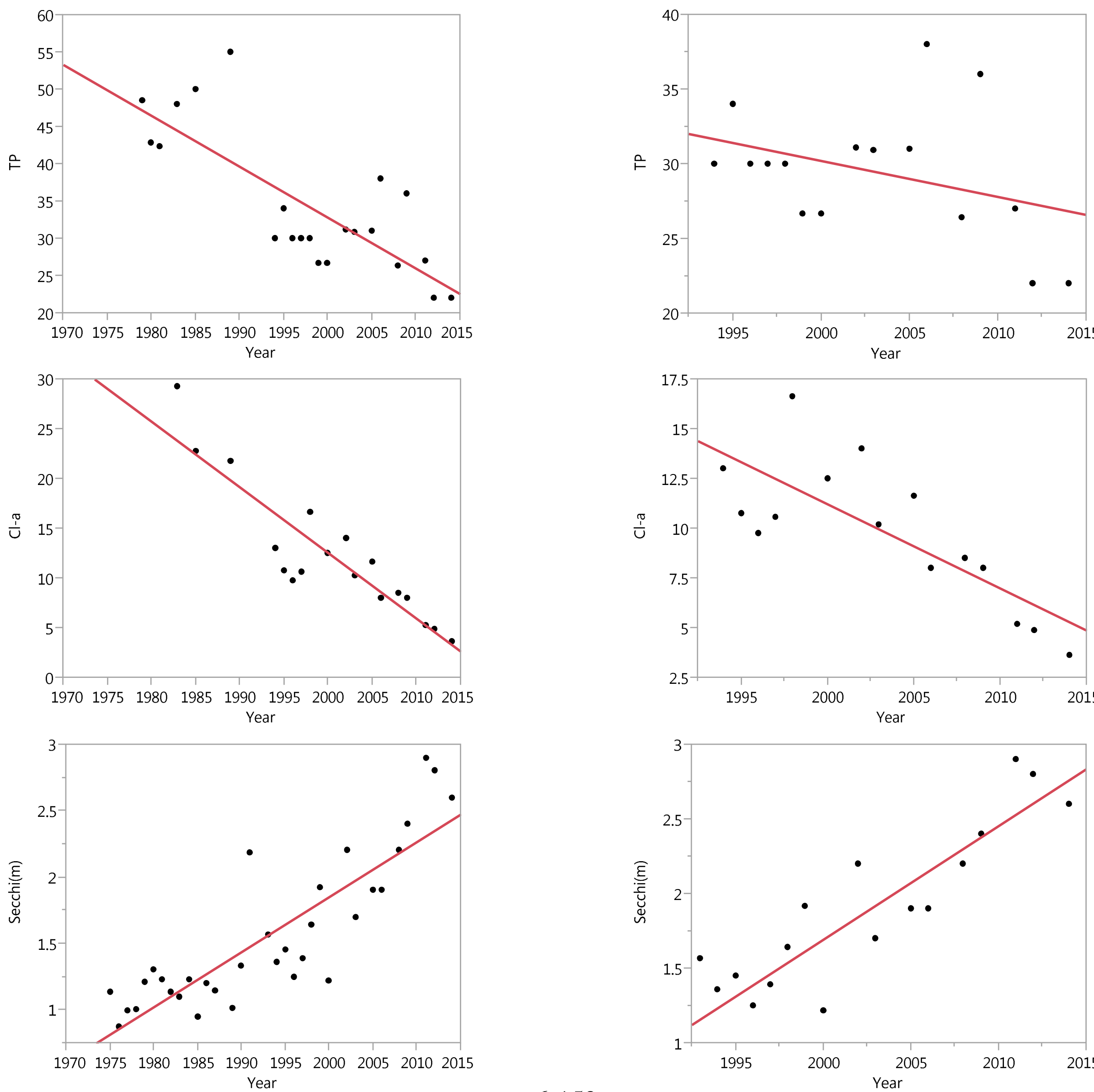
Water quality in Crooked Lake is remarkably good considering its urbanized watershed and intensely manicured shorelines. Noticeable improvements in water quality occurred in both 2012 and 2014. The cause of this trend is unknown, but it may be linked to the submerged plant community sequestering nutrients and out-competing algae. Continued efforts to improve stormwater draining to the lake and implement shoreline restorations are encouraged. Invasive aquatic plants continue to be a challenge in Crooked Lake, and EWM seems to be persisting as the primary nuisance, despite continued herbicide treatments. Native plants like the native northern milfoil and coontail are present in some areas, and could heighten resident frustrations about abundant plants hampering recreation. Caution is urged when managing non-native plants to avoid impacting native plants and water quality. The 2009 lake management plan provides direction for protecting water quality and managing plants.

2014 Crooked Lake Water Quality Data

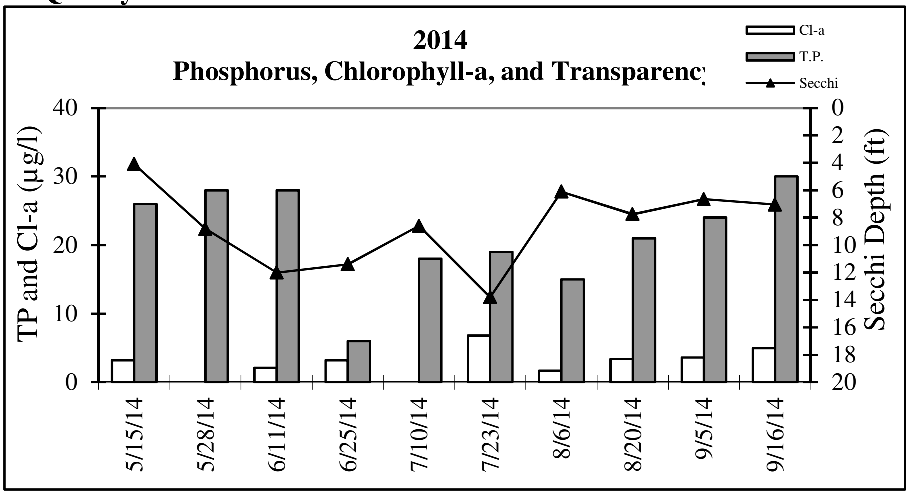
Crooked Lake 2014 Water Quality Data			5/15/2014	5/28/2014	6/11/2014	6/25/2014	7/10/2014	7/23/2014	8/6/2014	8/20/2014	9/5/2014	9/16/2014			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Average	Min	Max	Results	Average	Min	Max
pH		0.1	8.75	8.48	8.7	8.65	8.67	8.53	8.79	8.80	8.48	8.67	8.65	8.48	8.80
Conductivity	mS/cm	0.01	0.53	0.522	0.504	0.49	0.495	0.527	0.553	0.551	0.593	0.544	0.531	0.490	0.593
Turbidity	NTU	1	7.8	0.1	0.3	6.1	2.8	0.6	2	0	5	4.4	3	0	8
D.O.	mg/L	0.01	14.01	8.39	11.09	8.87	9.55	8.04	9.48	9.10	7.72	9.23	9.55	7.72	14.01
D.O.	%	1	128%	99%	130%	110%	111%	100%	120%	112%	92%	100%	110%	92%	130%
Temp.	°C	0.1	12	22	23	25	25	26	26.0	25.7	22.5	18	22.5	12.4	26.0
Temp.	°F	0.1	54.4	71.7	73.1	76.6	77.6	78.5	78.9	78.3	72.5	64.3	72.6	54.4	78.9
Salinity	%	0.01	0.25	0.25	0.24	0.23	0.24	0.258	0.27	0.27	0.29	0.26	0.26	0.23	0.29
Cl-a	ug/L	0.5	3.2	<1	2.1	3.2	<1	6.8	1.7	3.4	3.6	5	3.6	1.7	6.8
T.P.	mg/L	0.010	0.026	0.028	0.028	0.006	0.018	0.019	0.015	0.021	0.024	0.03	0.022	0.006	0.030
T.P.	ug/L	10	26	28	28	6	18	19	15.0	21.0	24.0	30	21.5	6.0	30.0
Secchi	ft	0.1	4.1	8.82	12	11.4	8.6	13.8	6.1	7.8	6.7	7.05	8.6	4.1	13.8
Secchi	m	0.1	1.25	2.69	3.66	3.47	2.62	4.21	1.9	2.4	2.0	2.15	2.6	1.2	4.2
Physical			1.0	1.0	2.0	1.0	1.0	1.0	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

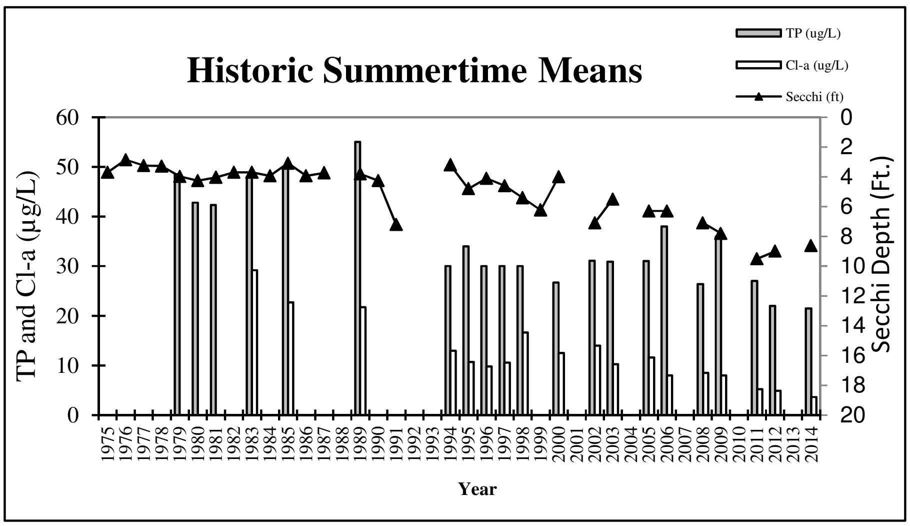
*reporting limit

Crooked Lake Water Quality Changes for Each Parameter, All Years (left column) and 1994 – 2014 (right column).



Crooked Lake Water Quality Results





Crooked Lake Historical Summertime Mean Values

Agency	CAMP	CAMP	CAMP	CAMP	CAMP	CAMP	CAMP	CAMP	MC	CAMP	MC	CAMP	CAMP	MC	CAMP	CAMP
Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1989	1990	1991
TP					48.5	42.8	42.3		48.0		50.0			55.0		
Cl-a									29.2		22.7			21.7		
Secchi (m)	1.1	0.9	1.0	1.0	1.2	1.3	1.2	1.1	1.1	1.2	1.0	1.2	1.1	1.0	1.3	2.2
Secchi (ft)	3.7	2.9	3.2	3.3	4.0	4.3	4.0	3.7	3.7	3.9	3.1	3.9	3.7	3.8	4.3	7.2

Carlson's Tropic State Indices

TSIP					60	58	58		60		61			62		
TSIC									64		61			61		
TSIS	58	62	60	60	57	56	57	58	58	57	61	57	58	60	56	49
TSI									61		61			61		

Crooked Lake Water Quality Report Card

Year	75	76	77	78	79	80	81	82	83	84	85	86	87	89	90	91
TP									C		C			C		
Cl-a									C		C			C		
Secchi	C	D	D	D	C	C	C	D	D		D	C	D	D	C	C
Overall									**C**		**C**			**C**		

Crooked Historic Summertime Mean Values

Agency	MC	MC	MC	MC	MC	CAMP	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD		
Year	1994	1995	1996	1997	1998	1999	2000	2002	2003	2005	2006	2008	2009	2011	2012	2014
TP	30.0	34.0	30.0	30.0	30.0		26.7	31.1	30.9	31.0	38.0	26.4	36.0	27.0	22.0	22.0
Cl-a	13.0	10.7	9.8	10.6	16.7		12.5	14.0	10.2	11.6	8.0	8.5	8.0	5.2	4.9	3.6
Secchi (m)	1.36	1.45	1.25	1.39	1.64	1.90	1.22	2.20	1.70	1.93	1.90	2.20	2.40	2.90	2.80	2.60
Secchi (ft)	3.2	4.8	4.1	4.6	5.4	6.2	4.0	7.1	5.5	6.3	6.3	7.1	7.8	9.5	9.0	8.6

Carlsons trophic state indices

TSIP	53	55	53	53	53		52	54	54	54	57	51	56	52	49	49
TSIC	56	54	53	54	58		55	56	53	55	51	52	51	47	46	43
TSIS	56	55	57	55	53	51	57	49	52	51	51	49	47	45	45	46
TSI	55	55	54	54	55		55	53	53	53	53	51	51	48	47	46

Crooked Lake Water Quality Report Card

Year	94	95	96	97	98	99	2000	2002	2003	2005	2006	2008	2009	2011	2012	2014
TP	B	C	B	B	B		B	B	B	B	C	B	C	B	A	A
Cl-a	B	B	A	B	B		B	B	B	B	A	A	A	A	A	A
Secchi	C	C	C	C	C	C	C	C	C	C	C	B-	B	B	B	B
Overall	**B**	**C**	**B**	**B**	**B**		**B**	**B**	**B**	**B**	**B-**	**B**	**B**	**B**	**A**	**A**

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.

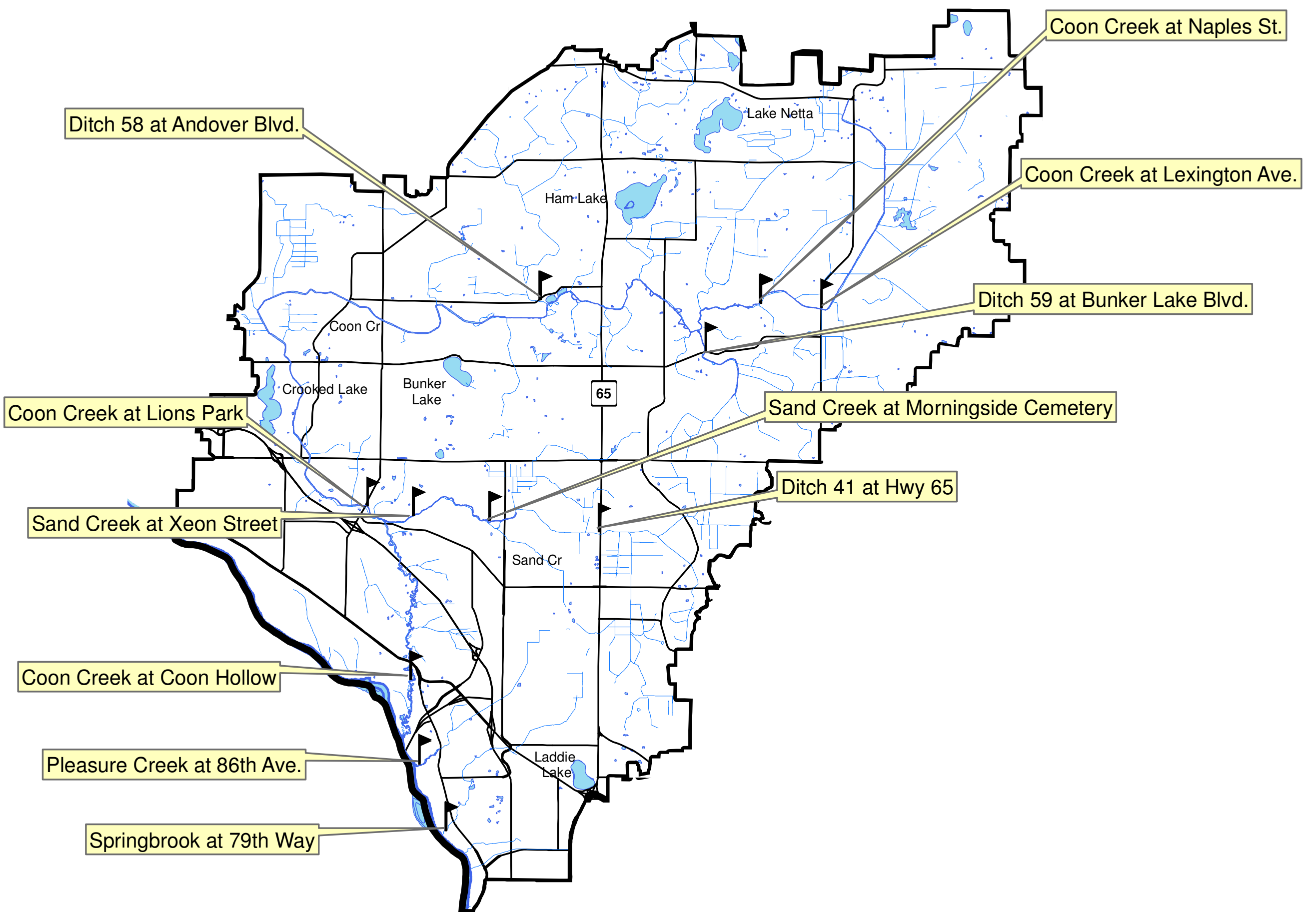
Locations:

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

Stream	Location	City
Ditch 41	Highway 65	Blaine
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.

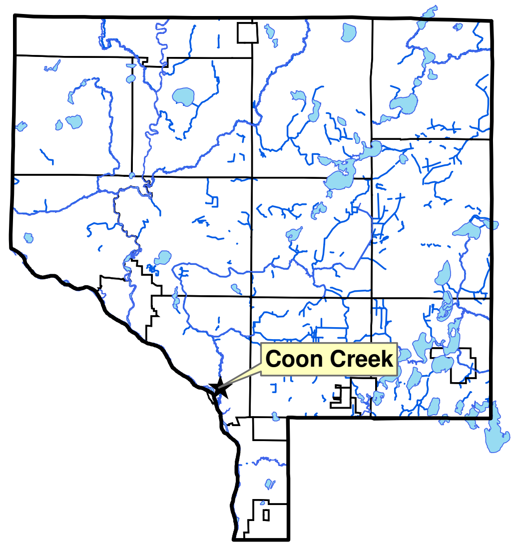
Coon Creek Watershed 2014 Stream Hydrology and Rating Curves Monitoring Sites



COON CREEK

at Coon Creek Hollow, Vale Street, Coon Rapids

Notes



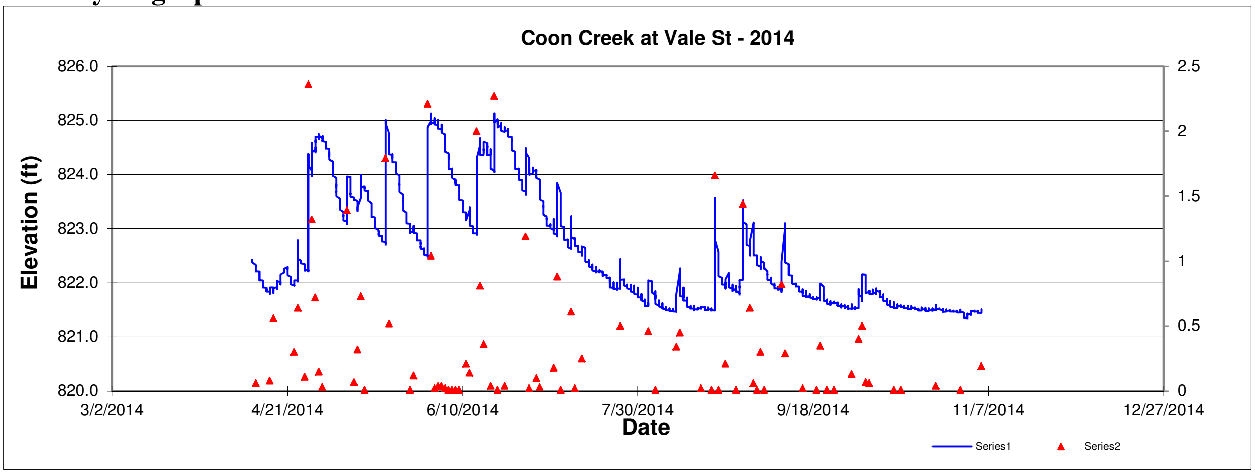
Coon Creek is a major drainage through central Anoka County. This monitoring location is the closest to the outlet to the Mississippi River that is accessible and does not have backwater effects from the Mississippi during high water. Land use in the upstream watershed ranges from rural residential upstream 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 2014 Coon Creek water levels spanned a range of 3.78 feet (see hydrograph on next page). Over a span of 6 hours in late-June 2014, 2.27 inches of rain resulted in the maximum observed stream level (825.13 feet), while below average rainfall from August to October resulted in little water level fluctuation and the lowest stream level of the year (<821.35).

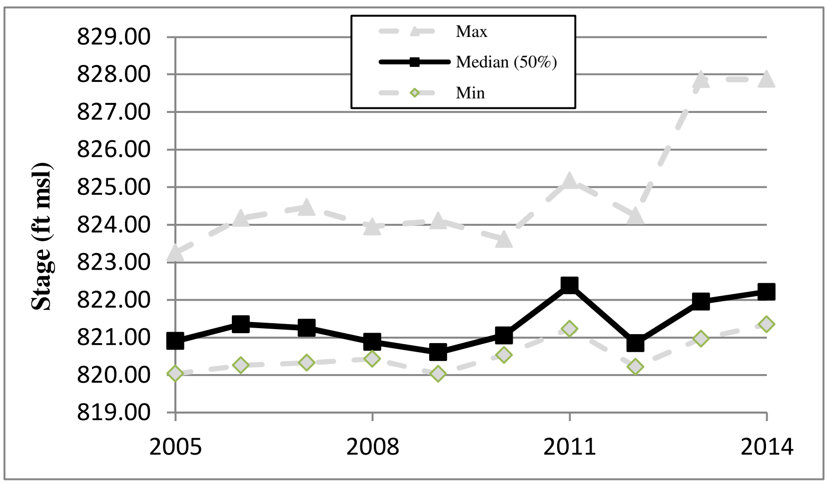
Coon Creek has flashy responses to storms, as displayed in the hydrograph on the next page. Water levels rise quickly in response to precipitation, but return to baseflow conditions more slowly. The quick, intense response to rainfall is runoff from the urbanized downstream watershed near the monitoring 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 2006-2014 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 2.21-inch storm on May 31, 2014 creek levels rose 2 feet in a two hour period.

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.

2014 Hydrograph



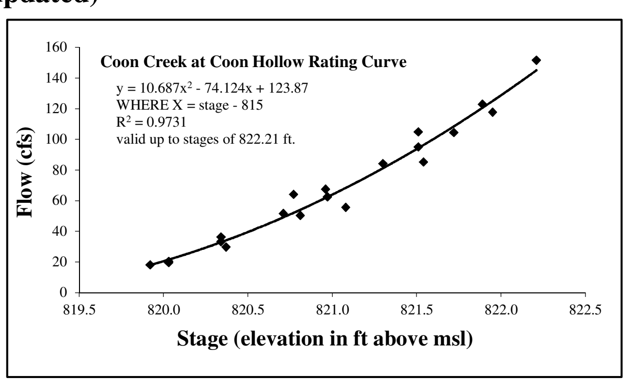
Summary of All Monitored Years



Summary of All Monitored Years

Percentiles	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Min	820.04	820.26	820.33	820.43	820.03	820.54	821.23	820.22	820.97	821.35
2.5%	820.06	820.42	820.40	820.52	820.12	820.64	821.27	820.28	820.99	821.47
10.0%	820.19	820.53	820.53	820.57	820.20	820.73	821.31	820.33	821.00	821.51
25.0%	820.57	820.78	820.73	820.63	820.35	820.85	821.83	820.45	821.20	821.67
Median (50%)	820.91	821.35	821.25	820.88	820.61	821.05	822.38	820.85	821.95	822.15
75.0%	821.26	821.78	821.88	821.78	820.93	821.32	822.99	821.28	827.87	823.33
90.0%	821.77	822.27	822.63	822.26	821.31	821.68	823.70	821.89	827.87	824.38
97.5%	822.92	822.76	823.21	822.79	822.05	822.33	824.56	823.60	827.87	824.87
Max	823.26	824.18	824.47	823.96	824.11	823.62	825.18	824.25	827.87	825.13

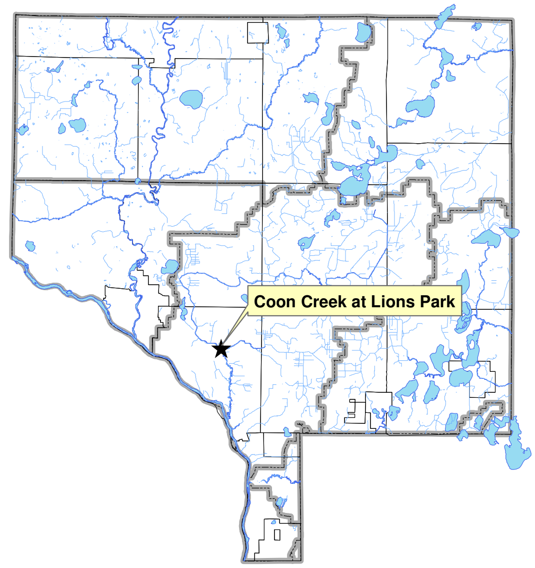
Rating Curve (2010 - updated)



COON CREEK

at Lions Park, Hanson Blvd., Coon Rapids

Notes

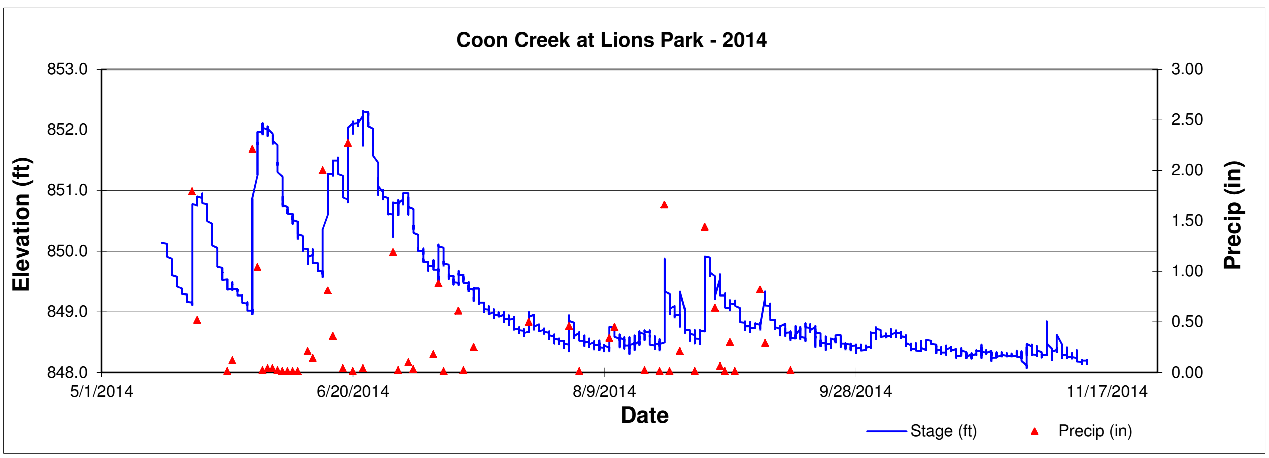


Coon Creek is a major drainage through central Anoka County. This monitoring location is within Lions Park in Coon Rapids, just downstream of the intersection of Coon Creek with Hanson Blvd. Land use in the upstream watershed ranges from rural residential to highly urbanized. The creek is approximately 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 2.21" precipitation event on June 1st Coon Creek at Lions Park stream level rose 1.32ft in 4 hours.

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

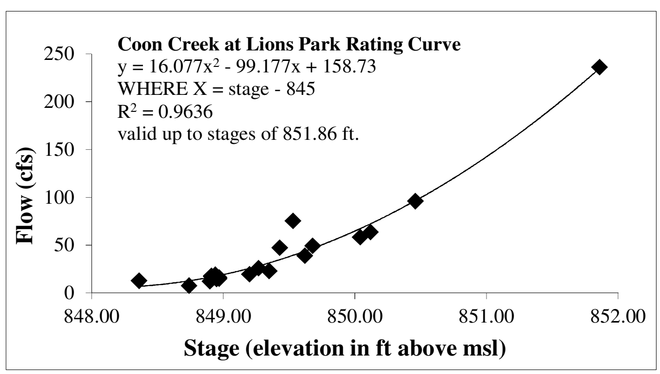
2014 Hydrograph



Summary of All Monitored Years

Percentiles	2012	2013	2014
Min	848.87	849.43	848.08
2.5%	848.91	849.54	848.25
10.0%	848.96	849.60	848.33
25.0%	849.11	849.73	848.46
Median (50%)	849.51	850.15	848.75
75.0%	849.78	850.51	849.67
90.0%	850.31	850.78	850.90
97.5%	851.94	851.33	852.02
Max	852.35	852.87	852.31

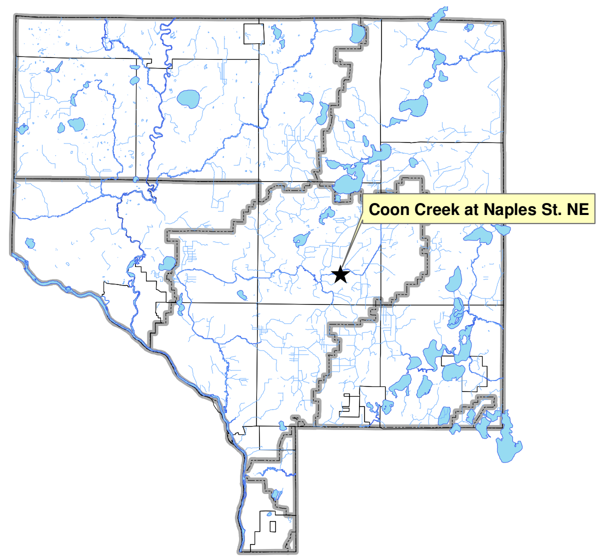
Rating Curve (2013)



COON CREEK

at Naples St. NE, Ham Lake

Notes

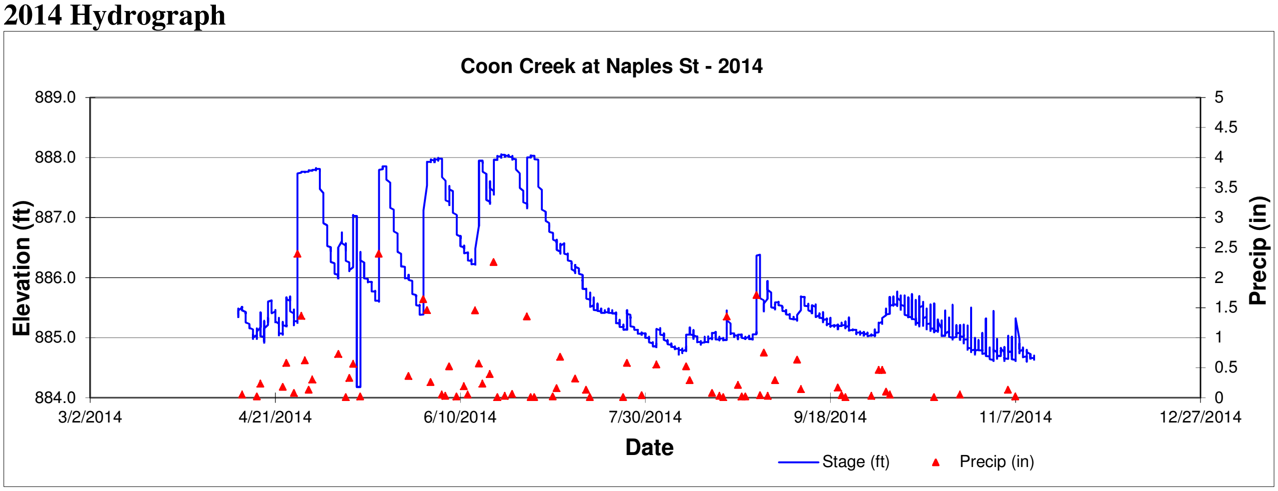


Coon Creek is a major drainage through central Anoka County. This monitoring location is just upstream of the intersection of Coon Creek with Naples St. NE and is the most upstream sampling site of the entire Coon Creek system. Land use in the upstream watershed is comprised of rural residential and 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 May 31 when the stage rose 2.13ft in 12 hours in reaction to a 1.64" 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.

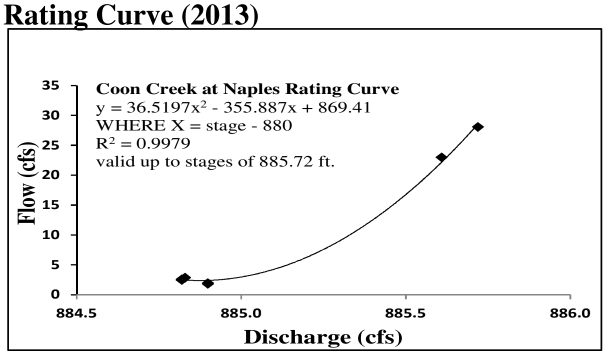
2014 Hydrograph



Summary of All Monitored Years

Percentiles	2012	2013	2014
Min	884.61	884.24	884.18
2.5%	884.71	884.41	884.69
10.0%	884.81	884.46	884.88
25.0%	884.89	884.55	885.06
Median (50%)	885.01	884.97	885.42
75.0%	885.49	885.42	886.38
90.0%	885.89	885.84	887.76
97.5%	887.78	886.22	888.01
Max	888.09	886.78	888.06

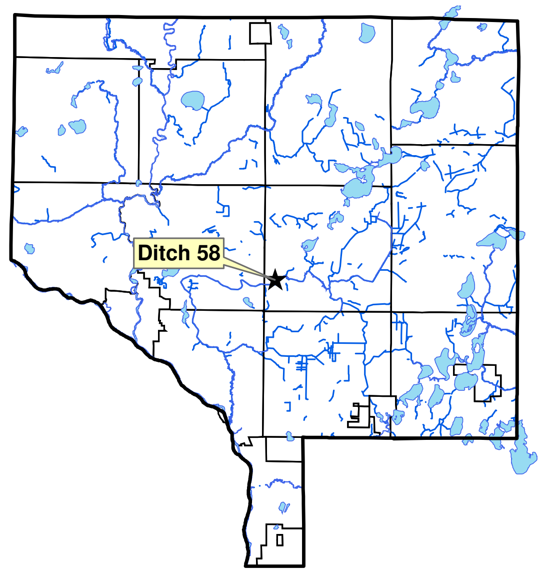
Rating Curve (2013)



DITCH 58

at Andover Boulevard, Ham Lake

Notes

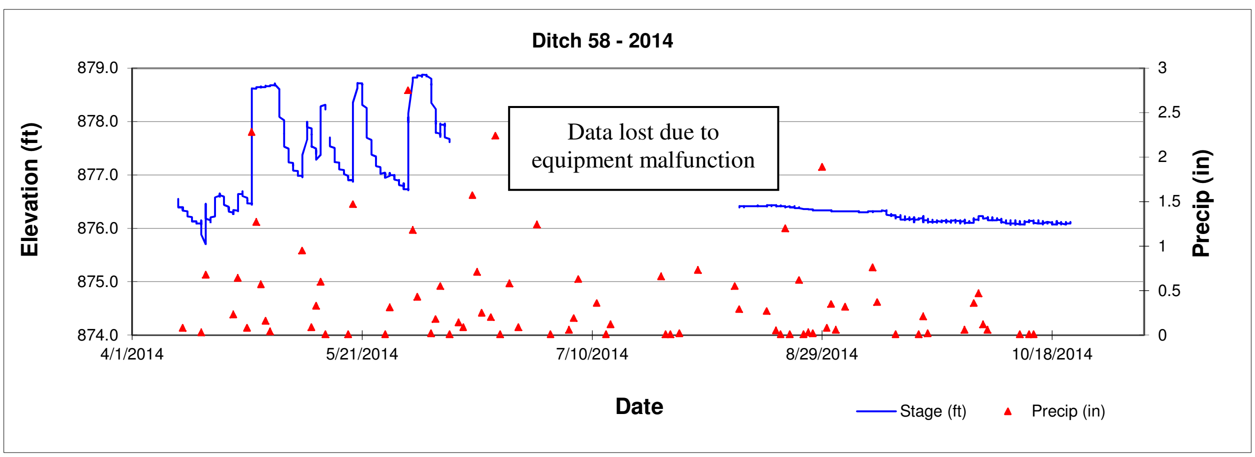


Ditch 58 is a tributary to Coon Creek. Upstream of the monitoring site are 20 miles of ditch, including many small tributaries. Its light bulb-shaped watershed is roughly delimited by Lake Netta to the northeast, Crosstown Boulevard to the northwest and southwest, and highway 65 to the southeast. Watershed 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.

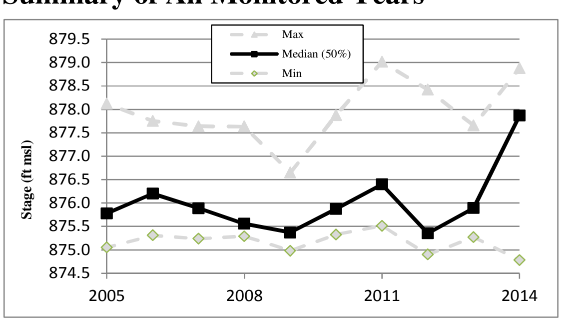
Ditch 58 water levels fluctuated in 2014 similar to 2011 and 2012. These years were unique due to the increased frequency of larger rainfall events. Water levels spanned a range of 4.10 feet which was 2.38 feet more than 2013, but similar to 2011 & 2012. Ditch 58 remains flashy during rain events. Of 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. In 2014 during a 2.28 inch rain event the water level rose 2.08 feet over a 14 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.

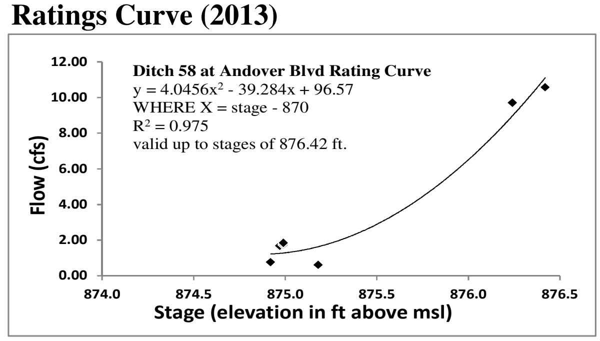
2014 Hydrograph



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	2014
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	874.78
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	876.09
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	876.14
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	876.32
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	877.87
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	878.27
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	878.27
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	878.69
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	878.88

SAND CREEK

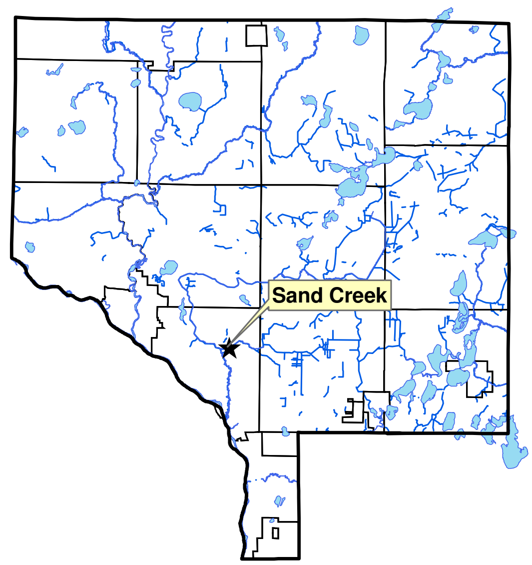
at Xeon Street, Coon Rapids

Notes

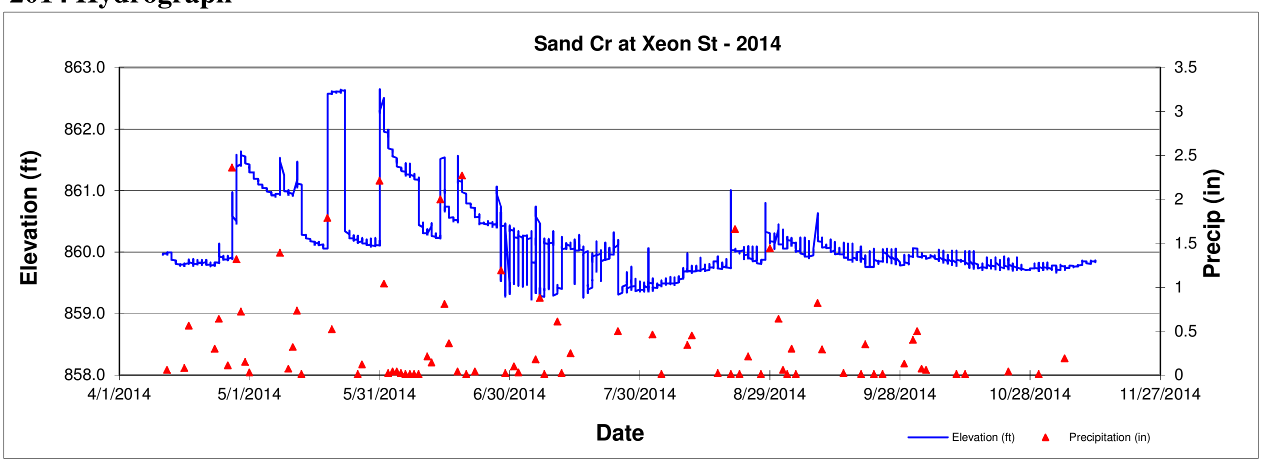
Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. The stream is about 15 feet wide and 3 feet deep at the monitoring site during baseflow.

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. 2014 water levels reacted similarly, rising 1.79 feet over a 4 hour span in response to a 1.79 inch rain event on May 19.

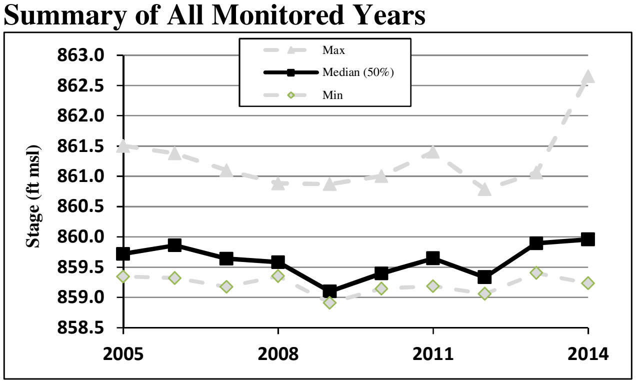
Additional measurements were conducted in 2013 to refine the rating curve and are presented below.



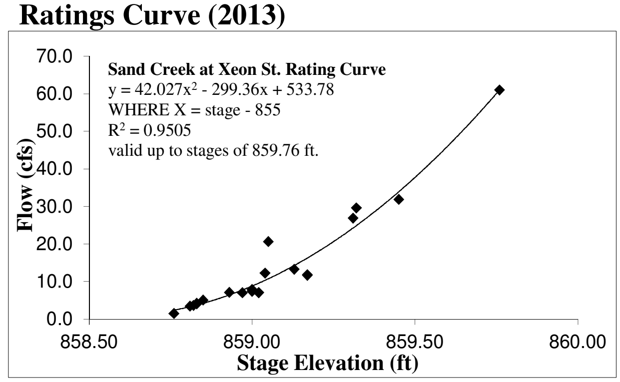
2014 Hydrograph



Summary of All Monitored Years



Ratings Curve (2013)



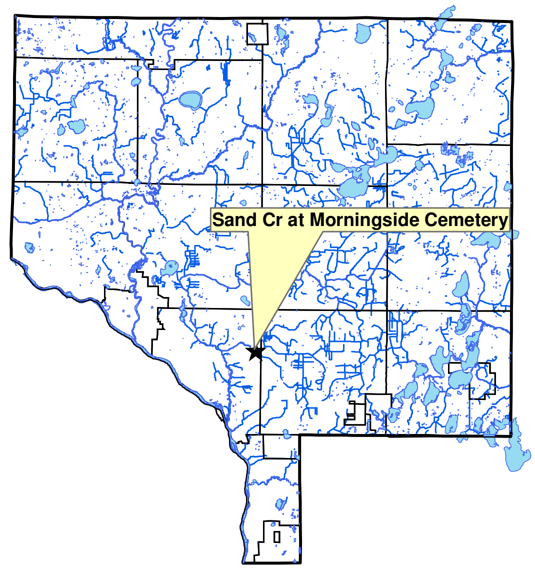
Summary of All Monitored Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
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	859.23
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	859.42
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	859.69
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	859.79
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	859.98
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	860.41
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	861.38
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	862.05
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	862.65

SAND CREEK

at Morningside Cemetery, Coon Rapids

Notes



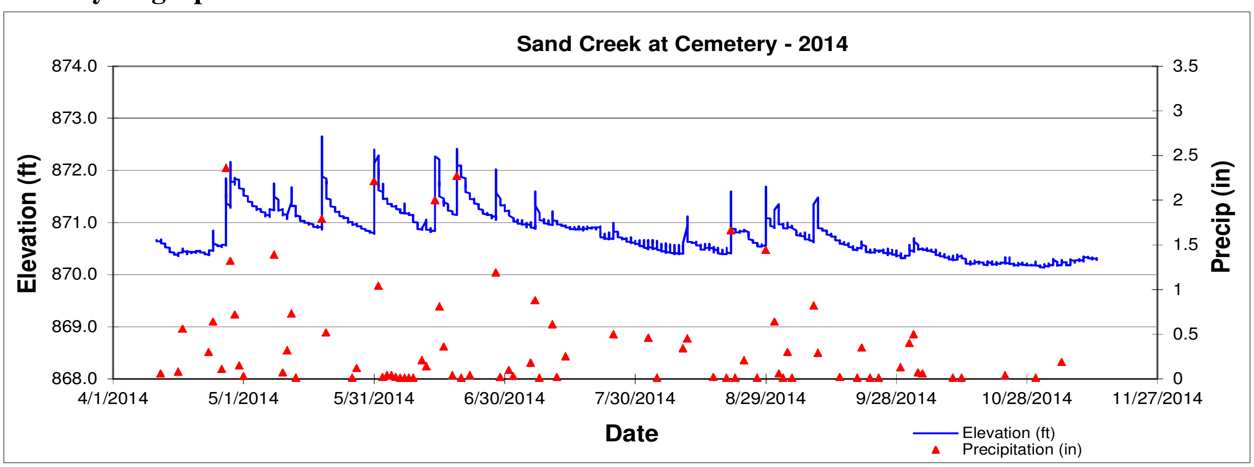
Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. The stream is approximately 8 feet wide and 3 feet deep at the monitoring site during baseflow.

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.

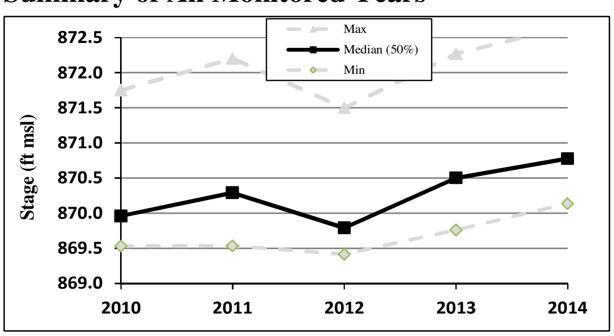
Interestingly, creek levels often rise at this site more than downstream at Xeon Street following rainstorms. It is likely that flow volumes are similar or less at the cemetery, but because the channel is narrow the vertical rise in water levels is greater.

No rating curve exists at this site.

2014 Hydrograph



Summary of All Monitored Years

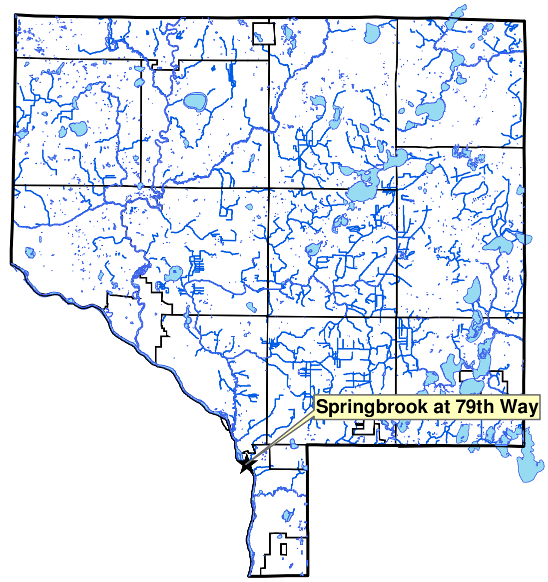


Percentiles	2010	2011	2012	2013	2014
Min	869.53	869.53	869.42	869.76	870.14
2.5%	869.61	869.59	869.44	869.99	870.19
10.0%	869.70	869.67	869.47	870.09	870.25
25.0%	869.79	870.03	869.59	870.19	870.44
Median (50%)	869.96	870.29	869.79	870.50	870.73
75.0%	869.96	870.53	870.09	870.74	871.06
90.0%	870.29	870.86	870.38	871.23	871.35
97.5%	870.60	871.17	870.82	871.56	871.79
Max	871.75	872.20	871.50	872.27	872.65

SPRINGBROOK

at 79th Way, Fridley

Notes

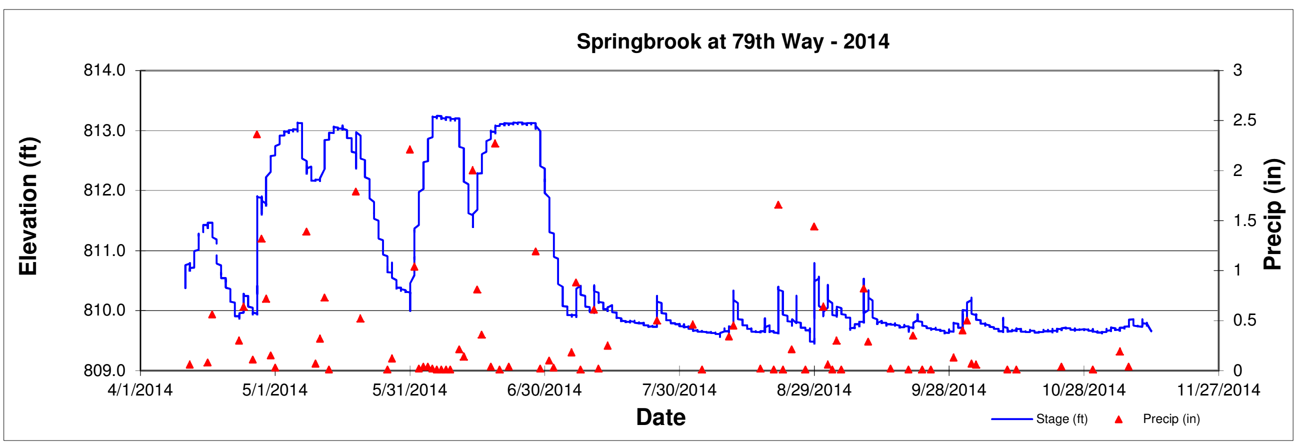


Springbrook is a small waterway draining an urbanized and highly modified subwatershed. The watershed includes portions of the Cities of Blaine, Coon Rapids, Spring Lake Park and Fridley. Several tributaries, or stormwater systems contributing to the creek, join at the Springbrook Nature Center Impoundment. 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 2012-2014 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.

2014 Hydrograph



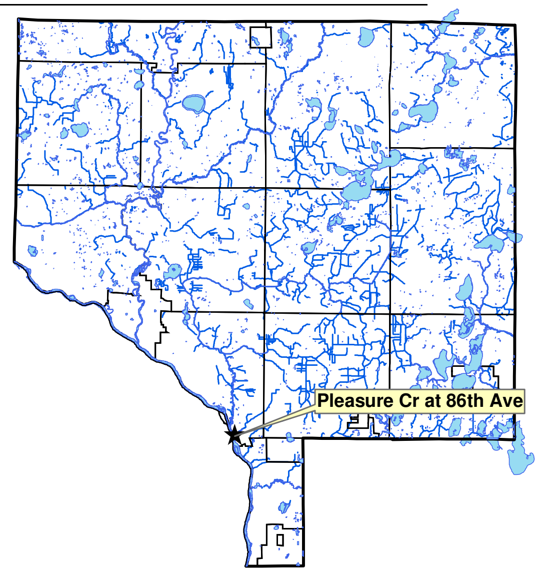
Summary of All Monitored Years

Percentiles	2012	2013	2014
Min	809.62	809.47	809.46
2.5%	809.65	809.54	809.63
10.0%	809.69	809.60	809.66
25.0%	809.76	809.67	809.72
Median (50%)	809.97	809.84	809.93
75.0%	810.29	810.08	811.62
90.0%	811.24	810.71	812.99
97.5%	812.87	812.17	813.18
Max	813.43	812.76	813.25

PLEASURE CREEK

at 86th Ave, Fridley

Notes

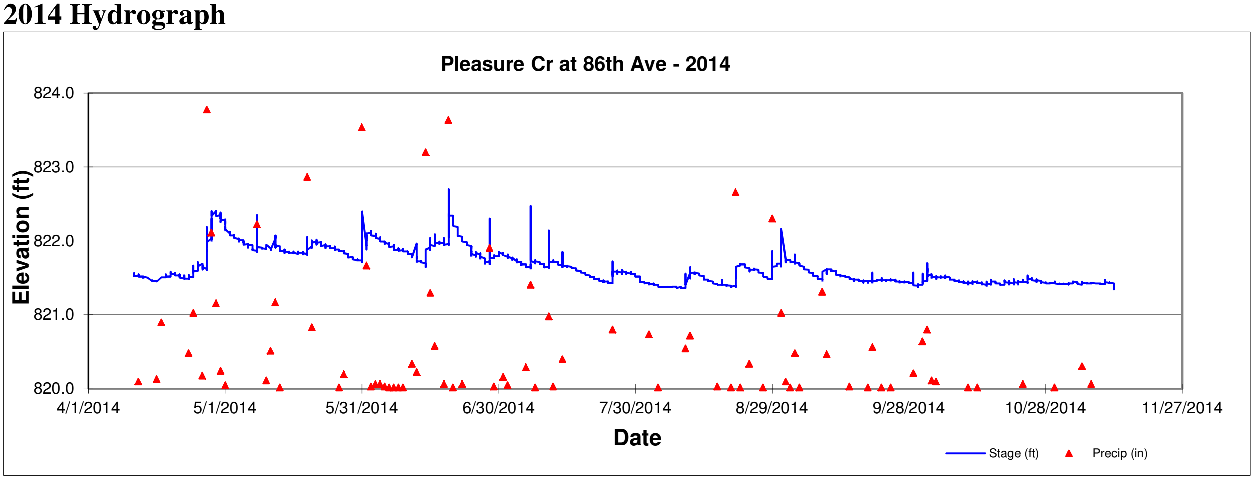


Pleasure Creek flows through the southwestern portion of Blaine and southern Coon Rapids. The watershed is urbanized. The creek is about 8-10 feet wide and 0.5 to 1 foot deep during baseflow. It flows through an interconnected network of stormwater ponds in the upper part of the watershed.

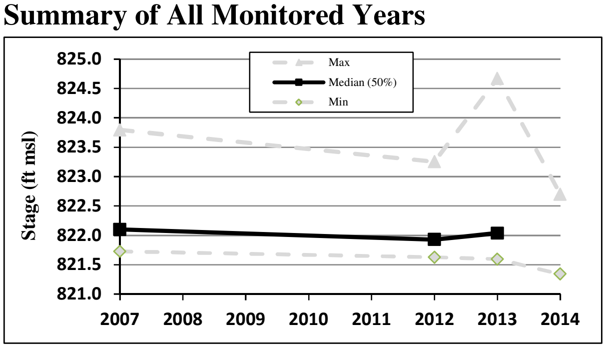
Variations in the water level at Pleasure Creek are seldom more than one foot. As an example, during a 1.21 inch storm on April 15, 2012 Pleasure Creek rose 0.52 feet in two hours, and then retreated 0.40 feet in the following two hours. A 2.27 inch storm in 2014 reacted similarly rising 0.75 feet in the first two hours and had retreated 0.64 in the following two hours. 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.

2014 Hydrograph

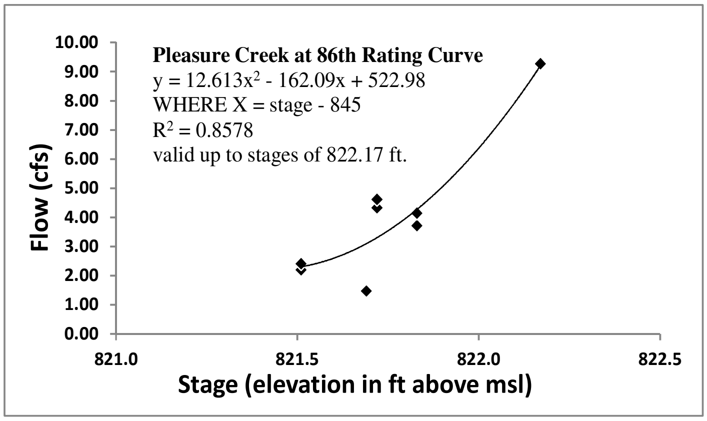


Summary of All Monitored Years



Percentiles	2007	2012	2013	2014
Min	821.73	821.63	821.60	821.34
2.5%	821.77	821.69	821.63	821.38
10.0%	821.84	821.77	821.73	821.42
25.0%	821.95	821.80	821.78	821.45
Median (50%)	822.10	821.93	822.04	821.57
75.0%	822.32	822.04	824.67	821.82
90.0%	822.49	822.19	824.67	821.98
97.5%	822.63	822.33	824.67	822.19
Max	823.79	823.25	824.67	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.

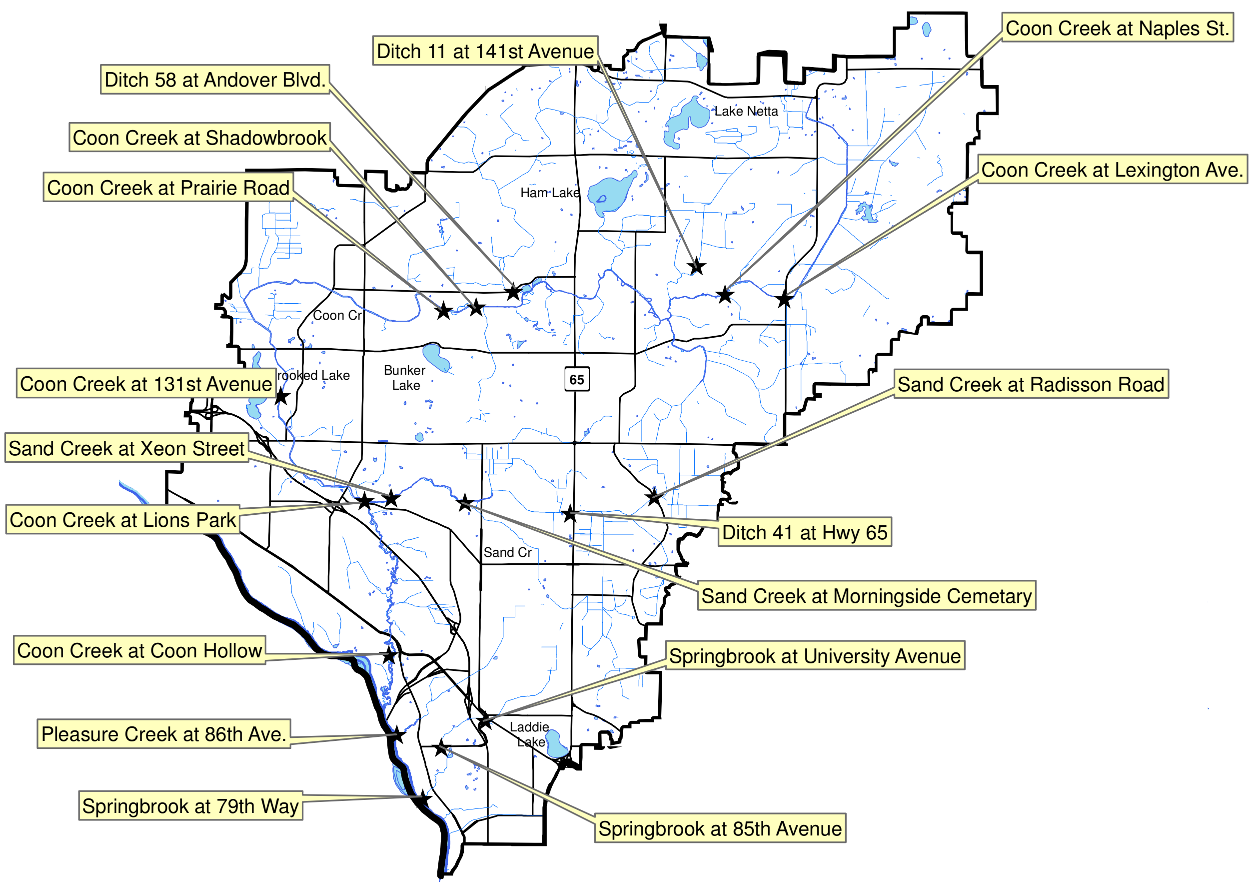
Locations:

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	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 2014 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 2014 are included.

	Springbrook Cr	Pleasure Cr	Sand Cr	Coon Cr	Median for Anoka Co Streams	State Water Quality Standard
Conductivity (mS/cm)	0.821	0.845	0.729	0.509	0.362	none
Chlorides (mg/L)	159	125	67	40	17	860 - acute 230 - chronic
Turbidity (NTU)	3.75	12.5	7.65	14.9	8.5	None*
Total Suspended Solids (mg/L)	5	9	6	11	12	30*
Total Phosphorus (ug/L)	109	73.0	61.0	124	135	100*
Dissolve Oxygen (mg/L)	8.11	8.33	8.12	8.16	6.97	5
pH	7.91	7.99	7.78	7.75	7.62	6.5-8.5

*Proposed new state water quality standards.

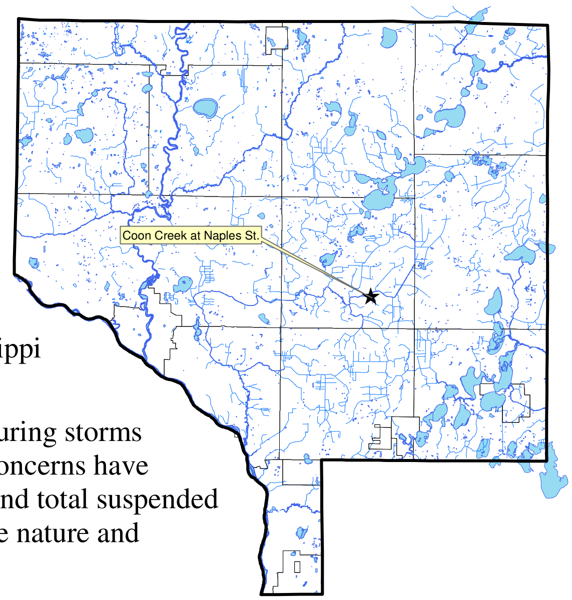
Hydrolab Continuous Stream Water Quality Monitoring

COON CREEK

Coon Creek at Naples St., Ham Lake STORET SiteID = S003-993

Years Monitored

Coon Creek at Naples Street 2014



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 Naples Street was chosen for monitoring because it is the second furthest upstream site, and an easily accessible site on Coon Creek. This site has been used for past monitoring efforts.

Coon Creek at Naples 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-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 Northern Natural Gas, which is approximately 1.2 miles southeast 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 0.47 to 1.43 inches. The wide distribution is helpful in discerning the creek's response to different storms.

2014 was the first year of Hydrolab monitoring at this location, only 2014 individual storm results are presented in this report. The individual storm results for other locations of Coon Creek not presented in this report 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.

Turbidity

- A brief turbidity spike is observed during or immediately following rainfall. This is likely due to the flush of stormwater from upstream farm fields as well as the couple of developments nearby. Turbidity retreats to much lower levels within a few days.
- 2014 turbidity results were inconsistent for Coon Creek at Naples St. due to equipment malfunction.
- Because turbidity does not closely follow stream stage, bed load is not the primary driver of high turbidity.

Specific Conductance

- 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.

Dissolved Oxygen

- The observed dissolved oxygen concentrations in Coon Creek were well below the healthy, desirable range.
- Dissolved oxygen stayed below 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 rises as well, but stay low overall.
- Dissolved oxygen consistently drops overnight, indicating diel-cycling hypoxia. This is likely caused by excess nutrients fueling algae which release large amounts of oxygen through photosynthesis during the day, but respire and draw in oxygen at night. This results in large swings from day to night.

Temperature

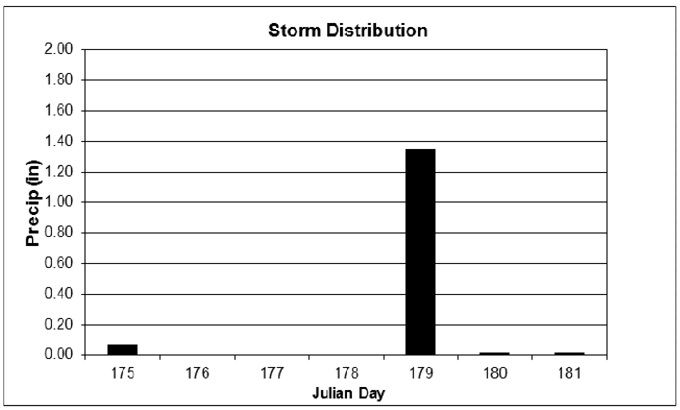
- Water temperature is generally not considered a concern in Coon Creek because there are no trout or other temperature sensitive resources.
- Cycles of day warming and night cooling are apparent in the data.

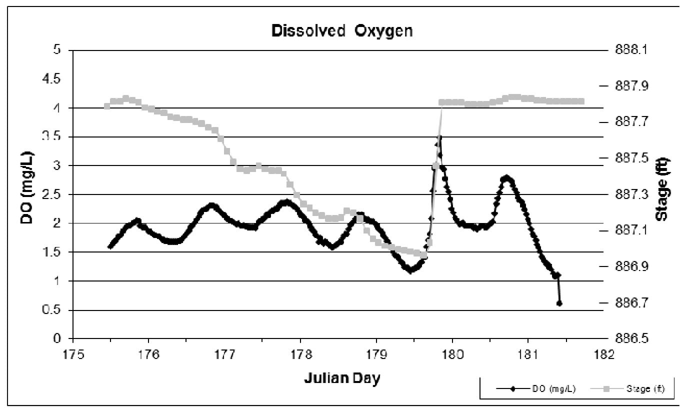
pH

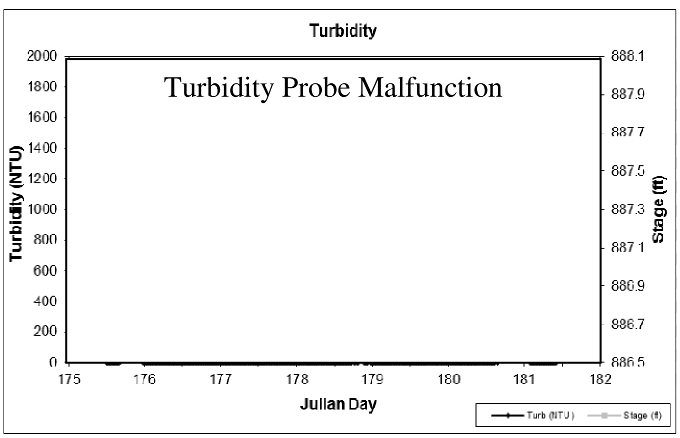
- pH is inversely related to water level in Coon Creek. When water level rises, pH declines. This is because rainwater has a lower pH than that of local shallow groundwater.
- pH stayed within the desired range of 6.5 to 8.5 that is specified in state water quality standards.

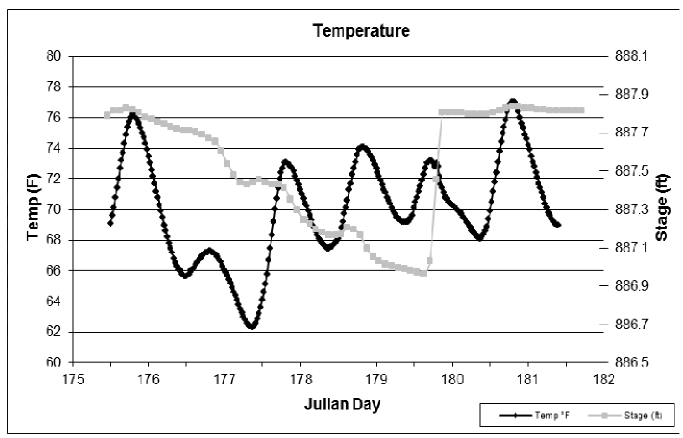
Hydrolab Continuous Monitoring
Storm 1 - 2014

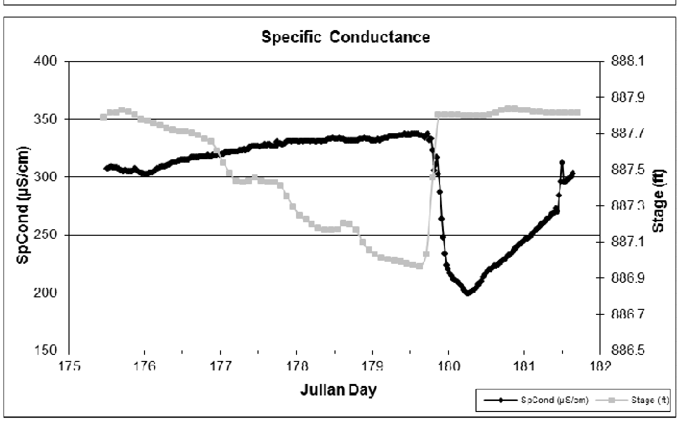
Coon Creek at Naples Street
<u>Storm Summary:</u>
Dates: 24 June 2014 (day 175) to 60 June 2014 (day 181)
Precipitation: 1.43 inches

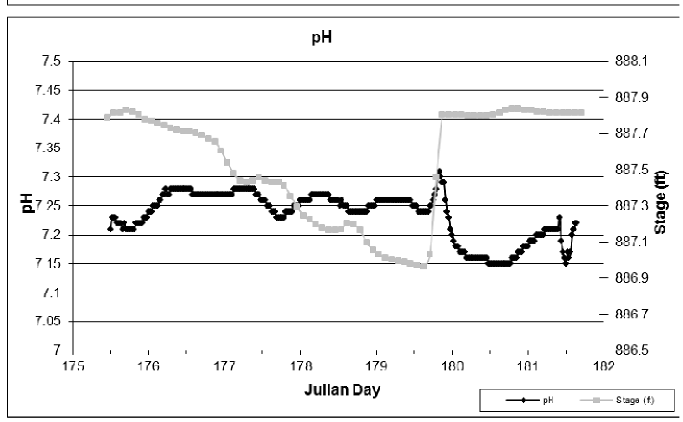












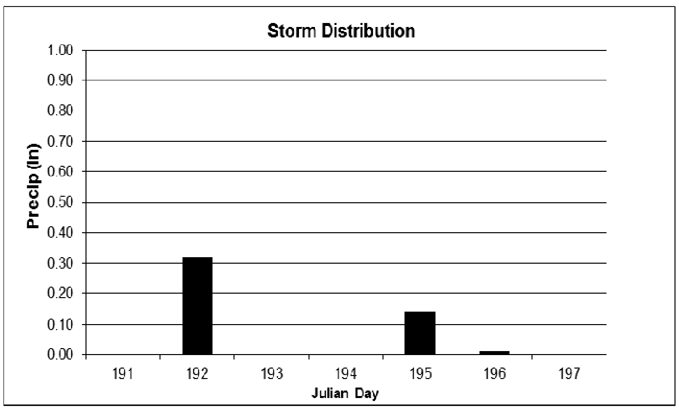
Hydrolab Continuous Monitoring
Storm 2 - 2014

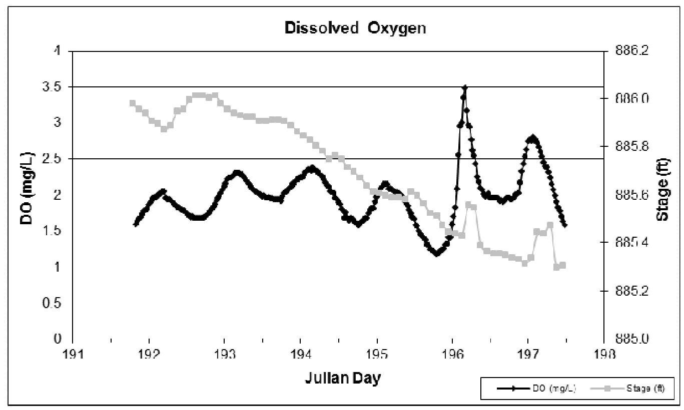
Coon Creek at Naples Street

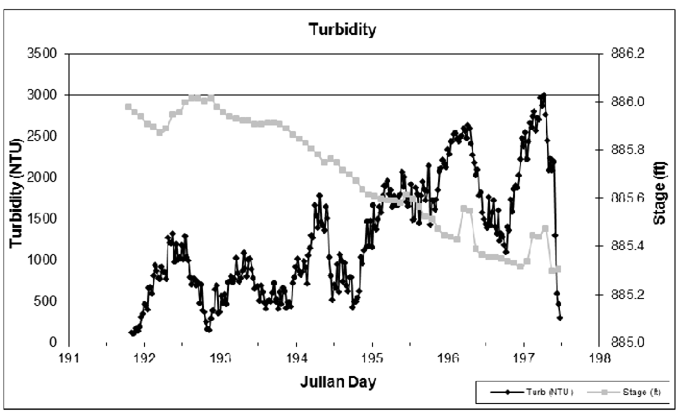
<u>Storm Summary:</u>

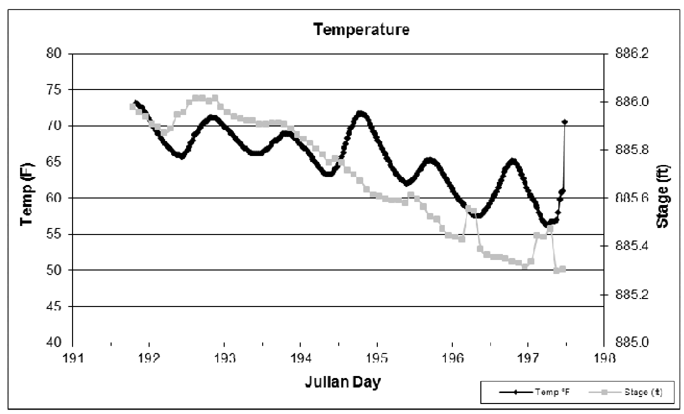
Dates: 10 July 2014 (day 191) to 16 July 2014 (day 197)

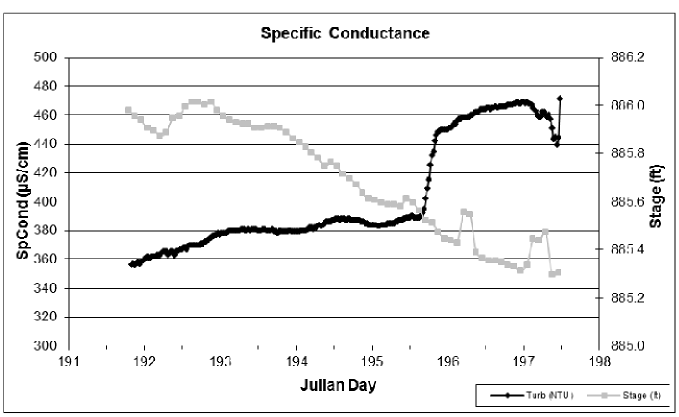
Precipitation: 0.47 inches

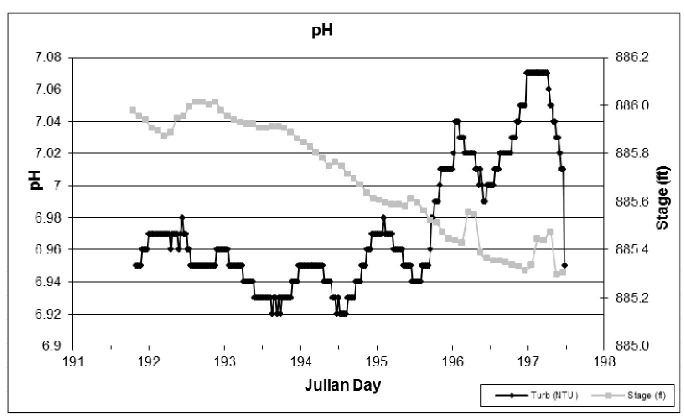












Hydrolab Continuous Stream Water Quality Monitoring

COON CREEK

Coon Creek at Lexington Ave., Ham Lake STORET SiteID = S003-993

Years Monitored

Coon Creek at Lexington Avenue 2014

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 Lexington Avenue was chosen for monitoring because it is the farthest upstream easily accessible site on Coon Creek. This site has been used for past monitoring efforts.

Coon Creek at Lexington Avenue 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 at a nearby site 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. Coon Creek at Lexington Avenue did not have 2014 stage readings. Stage data from the nearest site was used (Naples). It would be preferable to present flow, and a rating curve does exist, however stage was not collected at this site so 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 Northern Natural Gas, which is approximately 0.4 miles south 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

Similar storm sizes were analyzed. Rainfall during the monitored time periods stayed below 0.60 inches. The distribution is helpful in confirming the creek's response to mild storms.

The discussion below incorporates results from all years of Hydrolab monitoring, but only 2014 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.

Turbidity

- A brief turbidity spike is observed during or immediately following rainfall. This is likely due to the flush of stormwater from upstream farm fields and wetlands. Turbidity retreats to much lower levels within a few hours.
- 2014 turbidity results were inconsistent for Coon Creek at Lexington due to equipment malfunction.
- Because turbidity does not closely follow stream stage, bed load is not the primary driver of high turbidity.

Specific Conductance

- 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.

Dissolved Oxygen

- The observed dissolved oxygen concentrations in Coon Creek fluctuated in and out of the healthy, desirable range.
- Dissolved oxygen fell below 5 mg/L, the state water quality standard often, though not due to storms.
- When stream levels rise, dissolved oxygen rises quickly, but quickly returns to its diurnal pattern.
- Dissolved oxygen consistently drops overnight, indicating diel-cycling hypoxia. This is likely caused by excess nutrients fueling algae which release large amounts of oxygen through photosynthesis during the day, but respire and draw in oxygen at night. This results in large swings from day to night.

Temperature

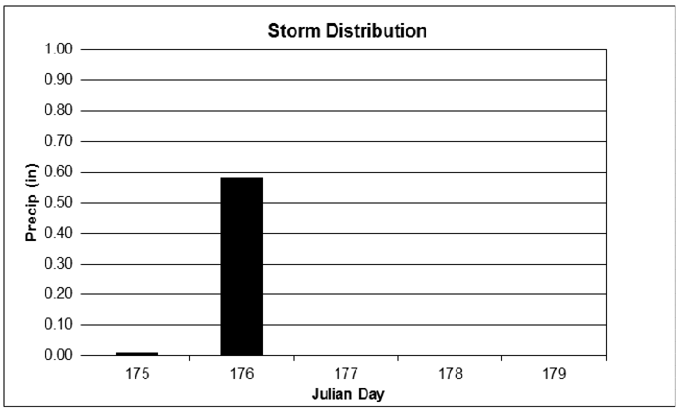
- Water temperature is generally not considered a concern in Coon Creek because there are no trout or other temperature sensitive resources.
- Cycles of day warming and night cooling are apparent in the data.

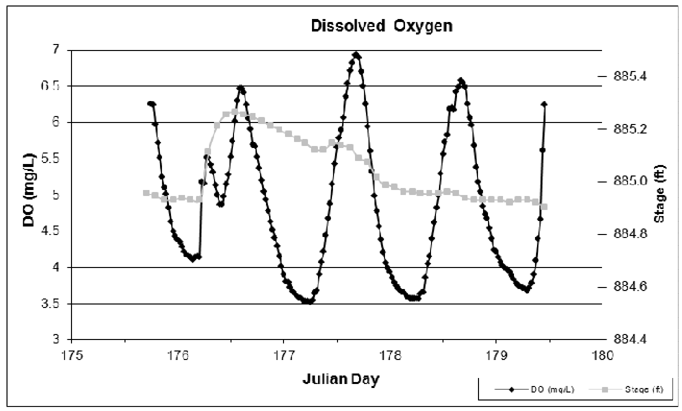
pH

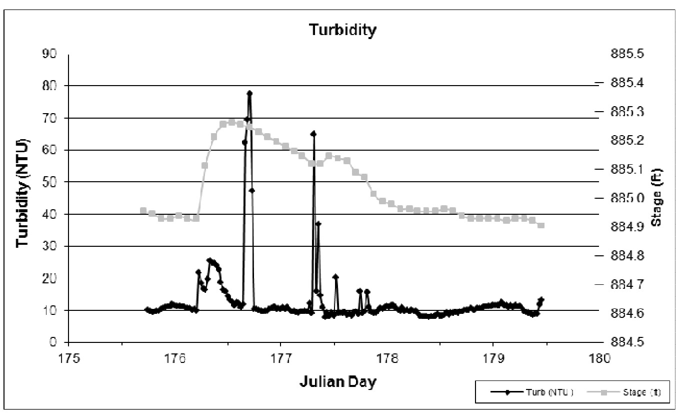
- pH is inversely related to water level in Coon Creek. When water level rises, pH declines. This is because rainwater has a lower pH than that of local shallow groundwater.
- pH stayed within the desired range of 6.5 to 8.5 that is specified in state water quality standards.
- pH fluctuates diurnally indicating that photosynthesis and respiration of excessive aquatic plants is likely the driving force in poor dissolved oxygen levels.

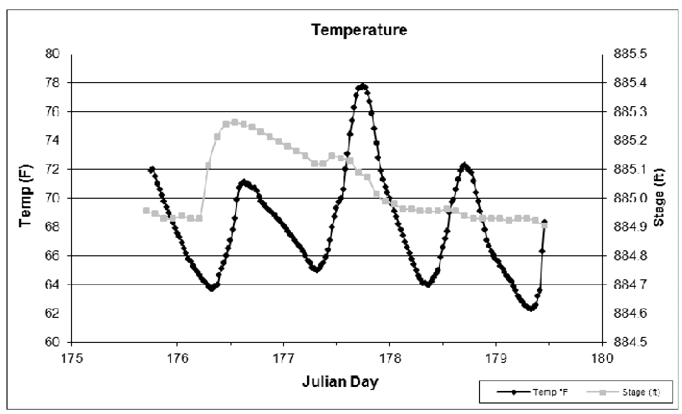
Hydrolab Continuous Monitoring
Storm 1 - 2014

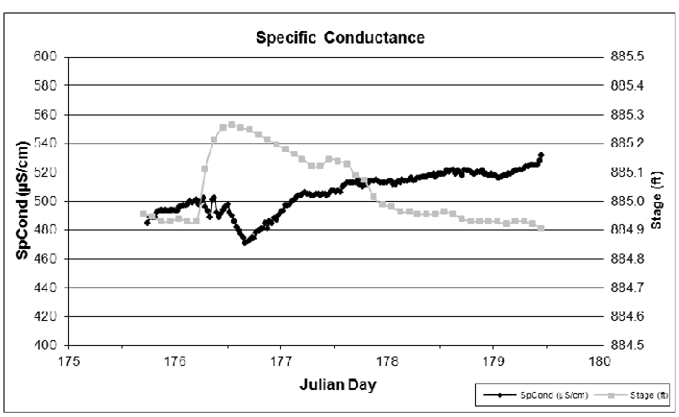
Coon Creek at Lexington Avenue
<u>Storm Summary:</u>
Dates: 24 July 2014 (day 175) to 28 July 2014 (day 179)
Precipitation: 0.59 inches

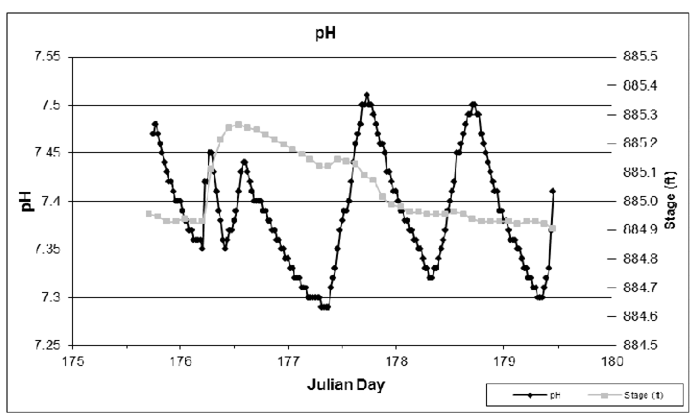












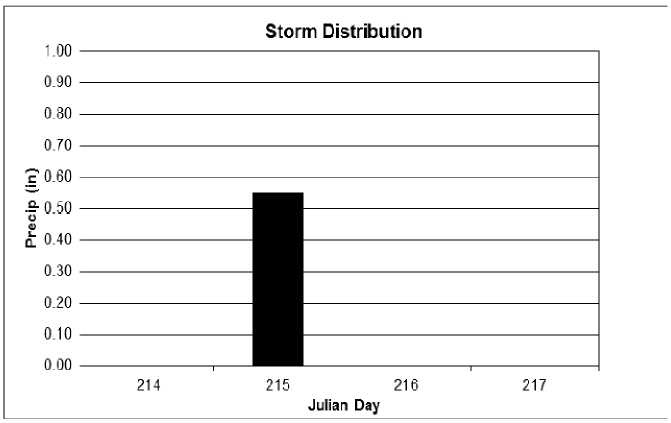
Hydrolab Continuous Monitoring
Storm 2 - 2014

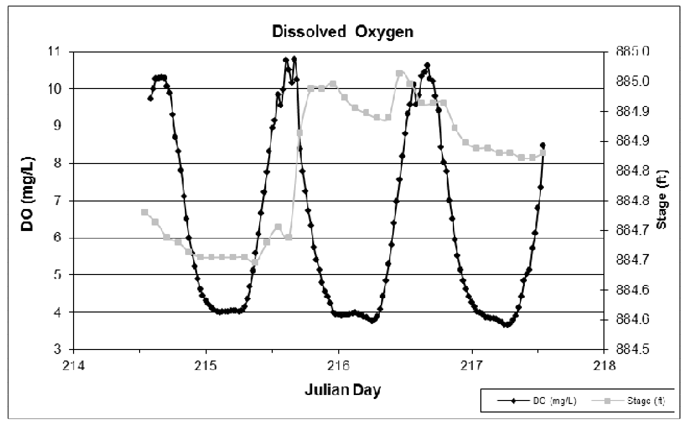
Coon Creek at Lexington Avenue

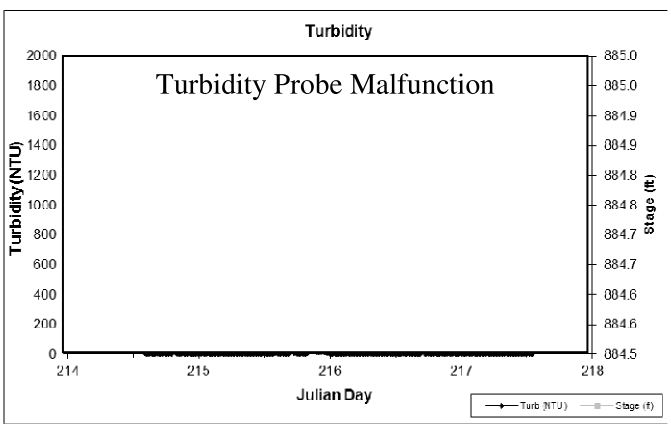
<u>Storm Summary:</u>

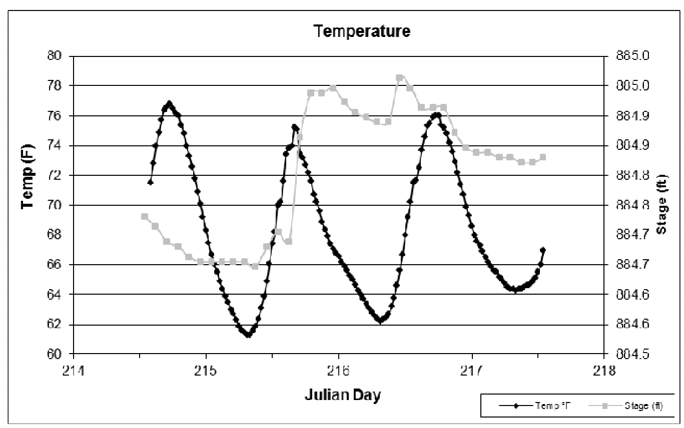
Dates: 1 August 2014 (day 214) to 4 August 2014 (day 217)

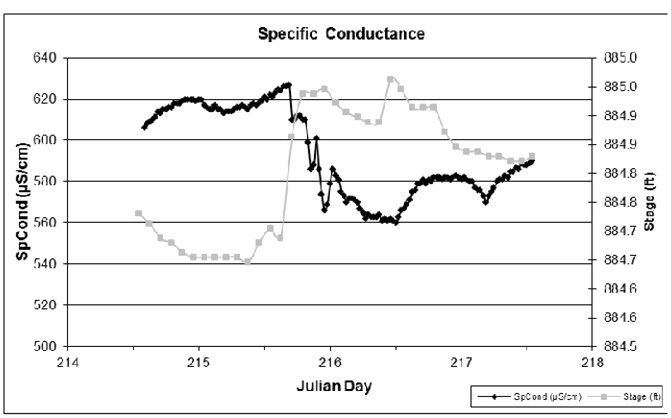
Precipitation: 0.55 inches

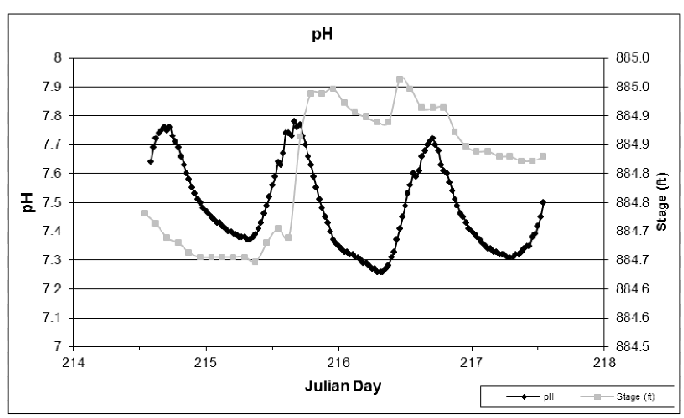












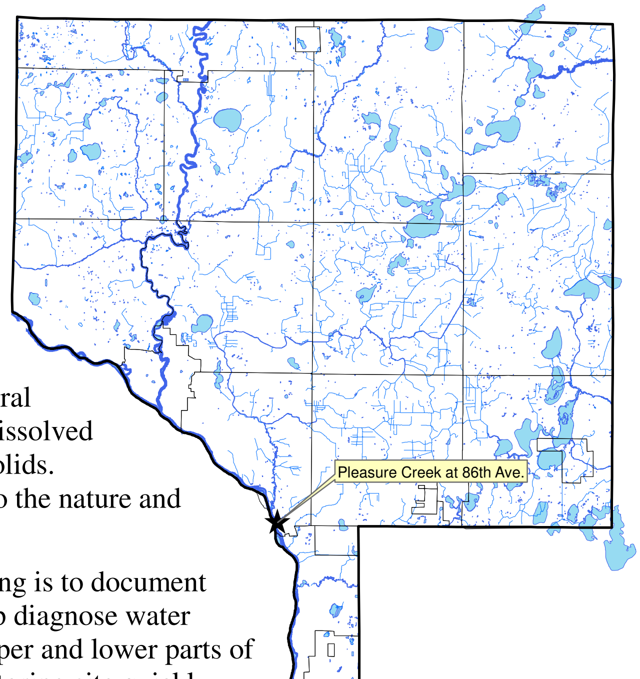
Hydrolab Continuous Stream Water Quality Monitoring

PLEASURE CREEK

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

Years Monitored

Pleasure Creek at 86th Avenue 2013, 2014



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.

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.

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

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 Springbrook Nature Center, which is approximately 2 miles northeast 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 0.14 to 4.59 inches. The wide distribution is helpful in discerning the creek's response to different events.

The discussion below incorporates results from 2014 Hydrolab monitoring. 2014 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 900+ 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.
- When stream levels rise, dissolved oxygen often drops, but not to critically low levels.

Temperature

- 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.

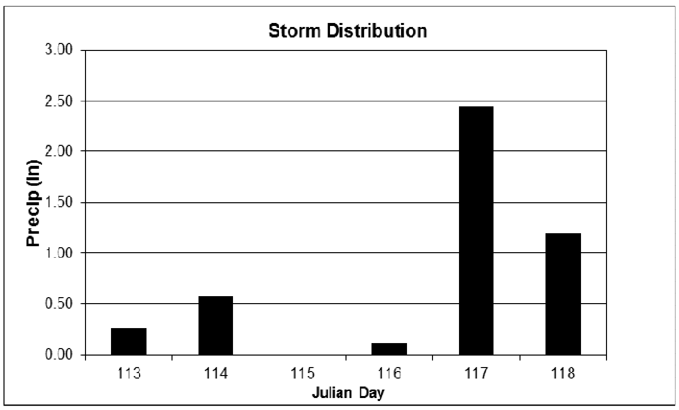
Hydrolab Continuous Monitoring
Storm 1 - 2014

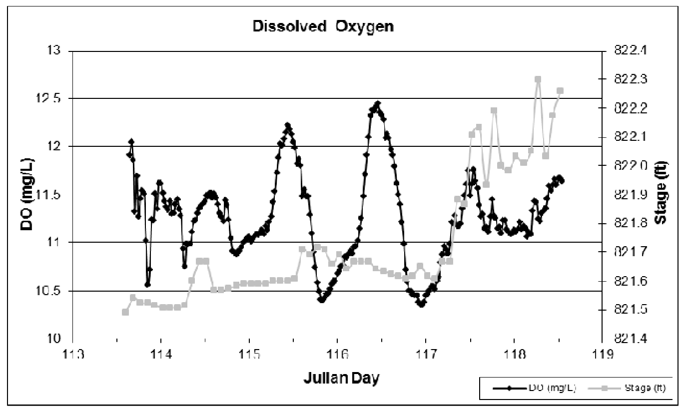
Pleasure Creek at 86th Ave

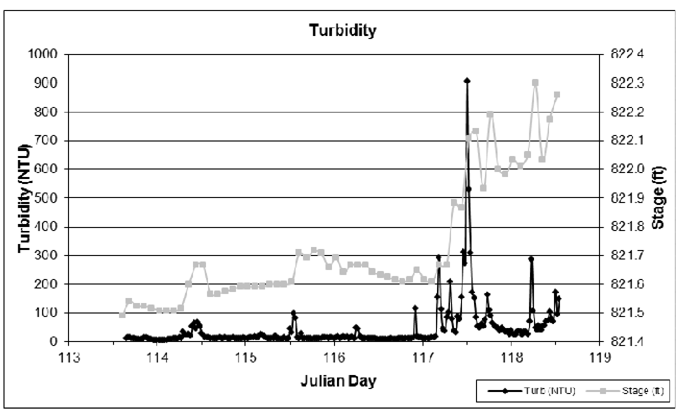
<u>Storm Summary:</u>

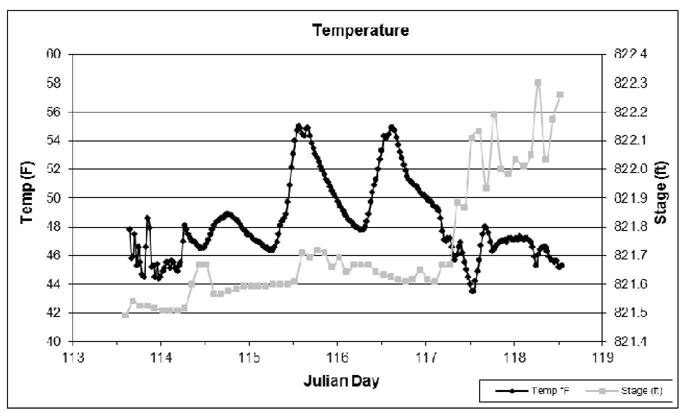
Dates: 23 April 2014 (day 113) to 28 April 2014 (day 118)

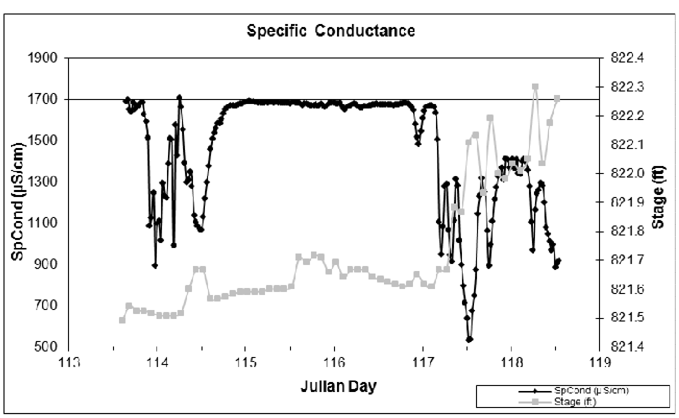
Precipitation: 4.59 inches plus snowmelt

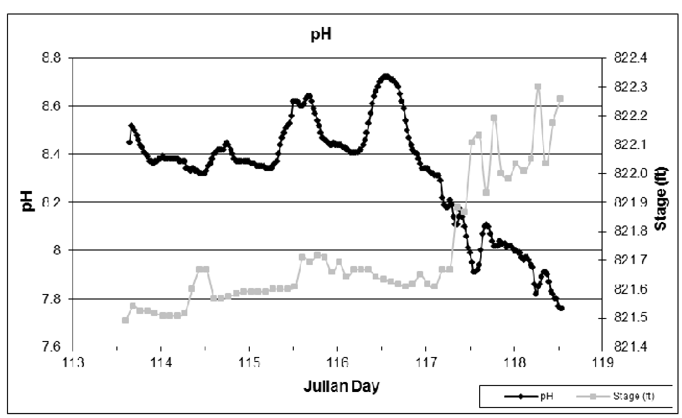






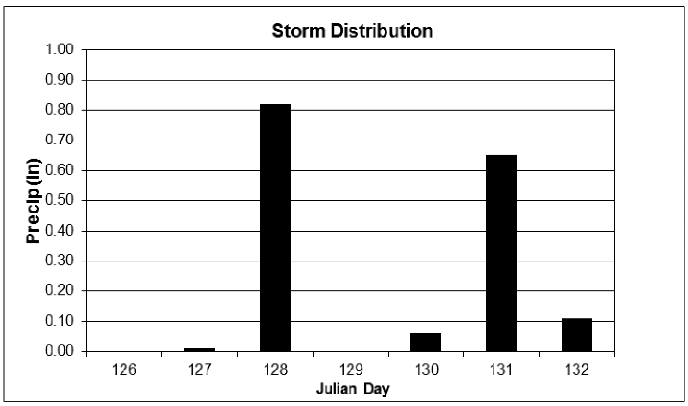


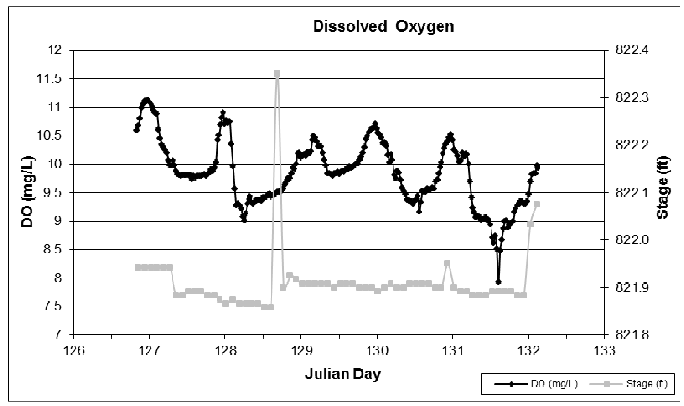


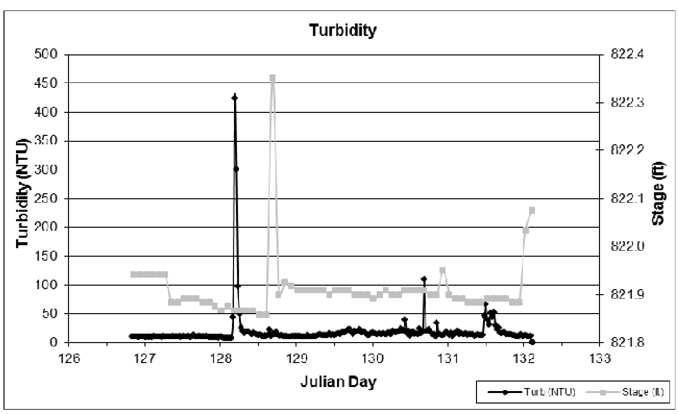


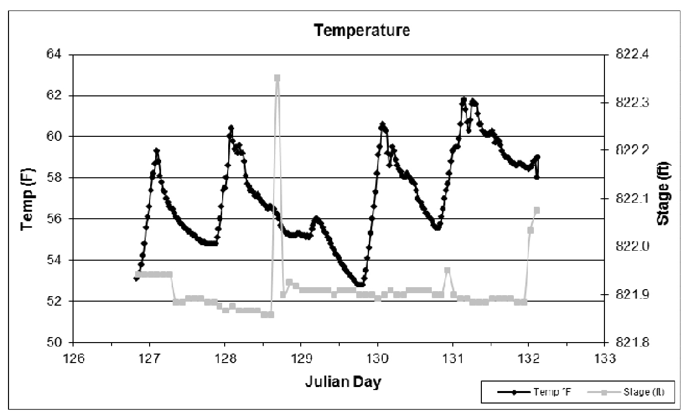
Hydrolab Continuous Monitoring
Storm 2 - 2014

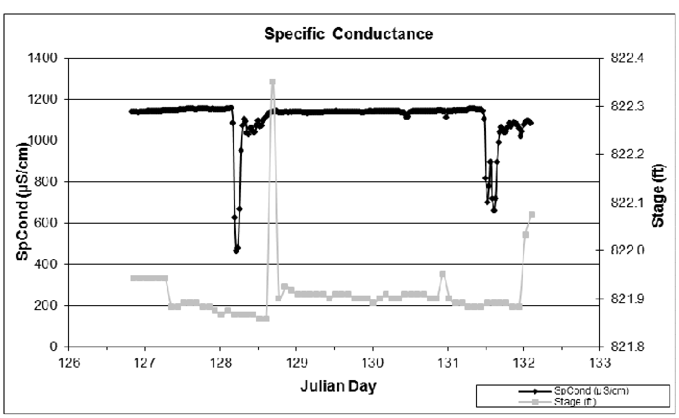
Pleasure Creek at 86th Ave
Storm Summary:
Dates: 6 May 2014 (day 126) to 12 May 2014 (day 132)
Precipitation: 1.65 inches

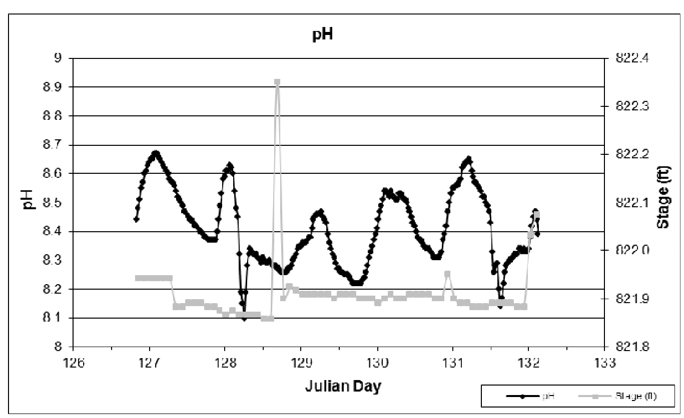












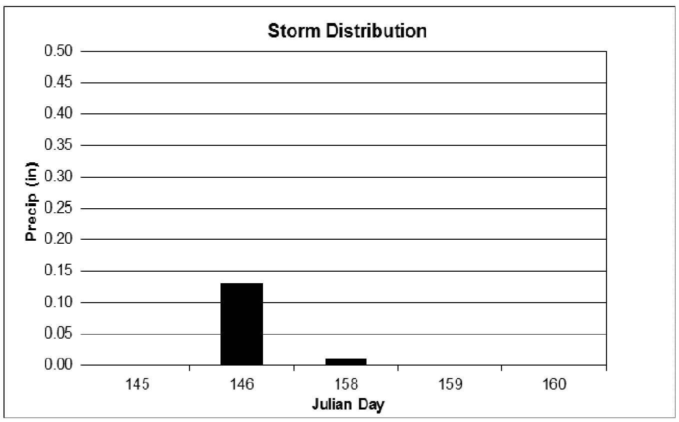
Hydrolab Continuous Monitoring
Storm 3 - 2014

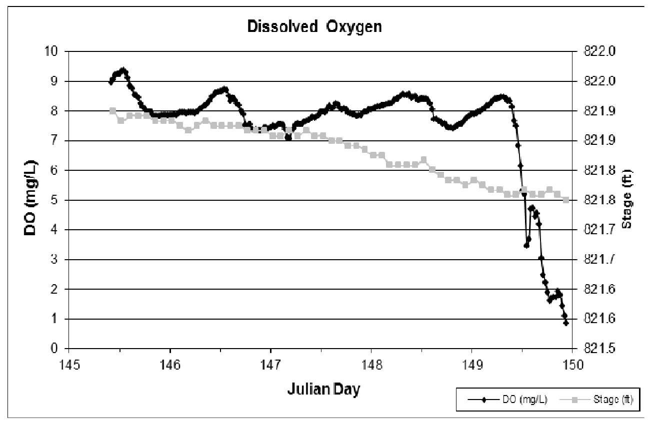
Pleasure Creek at 86th Ave

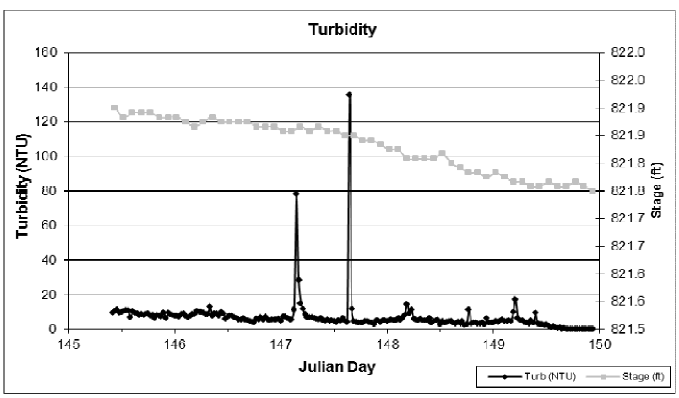
Storm Summary:

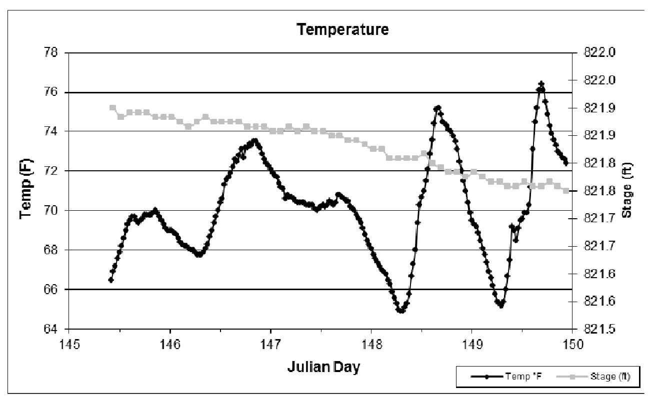
Dates: 25 May 2014 (day 145) to 29 May 2014 (day 149)

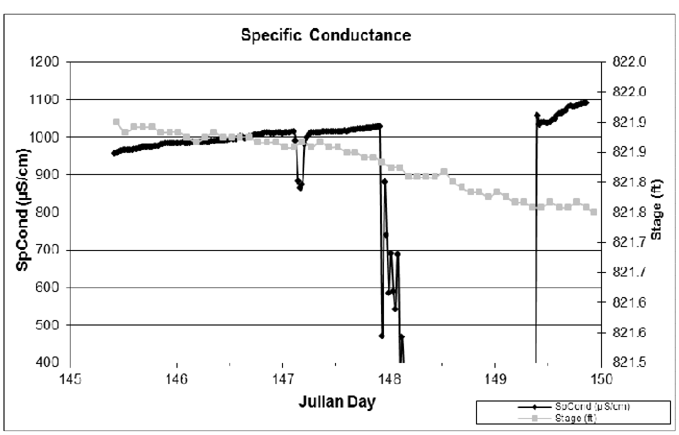
Precipitation: 0.14 inches

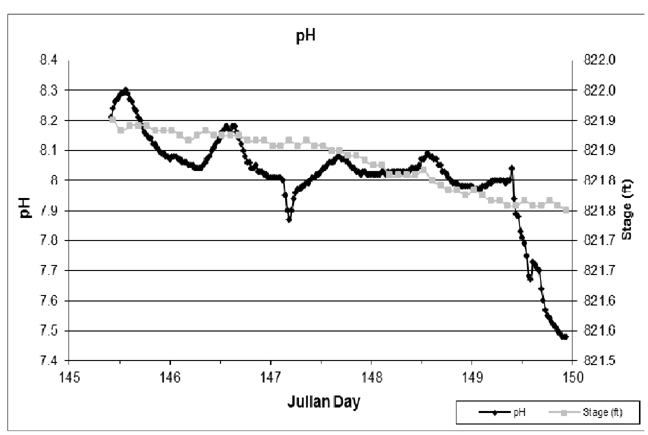












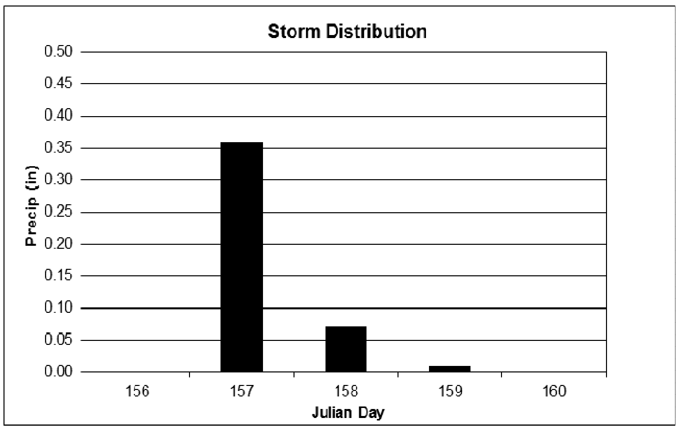
Hydrolab Continuous Monitoring
Storm 4 - 2014

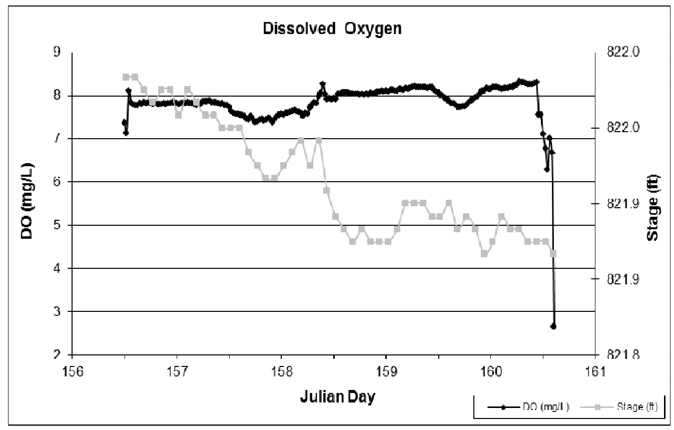
Pleasure Creek at 86th Ave

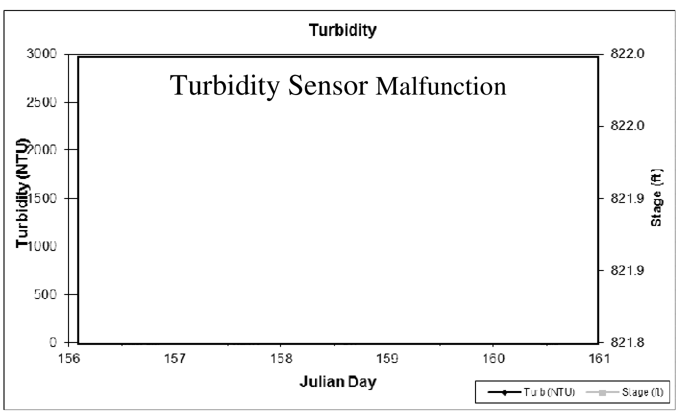
Storm Summary:

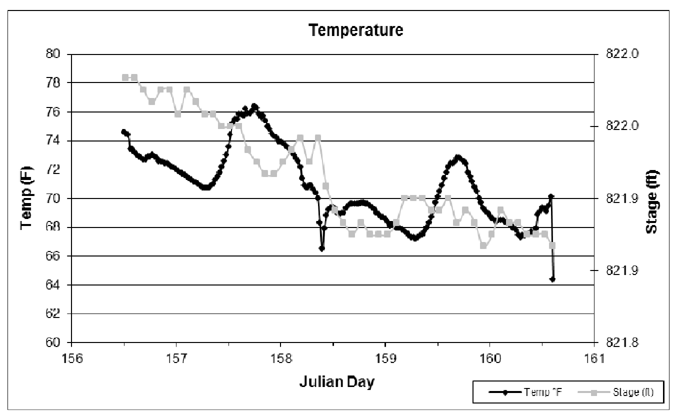
Dates: 5 June 2014 (day 156) to 9 June 2014 (day 160)

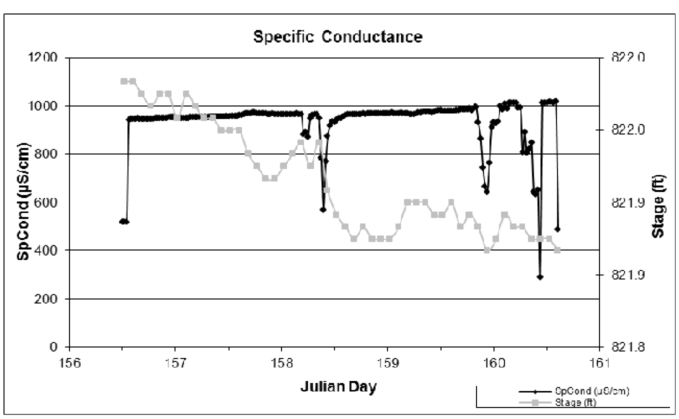
Precipitation: 0.44 inches

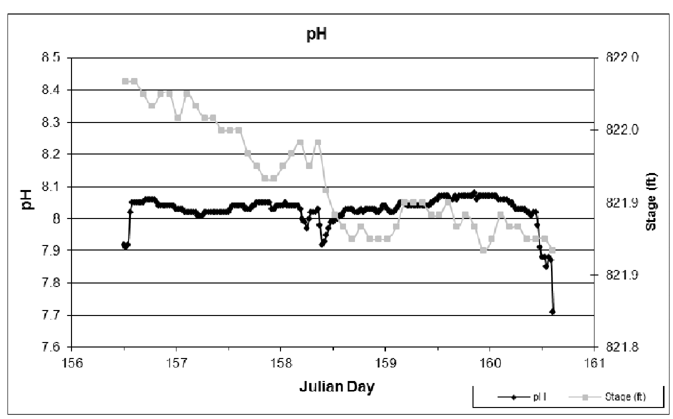






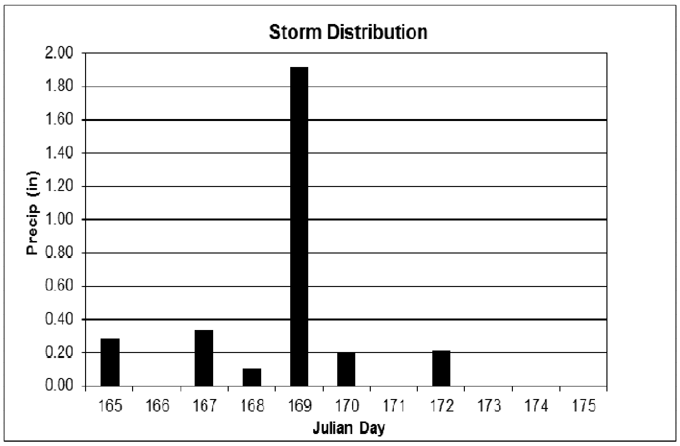


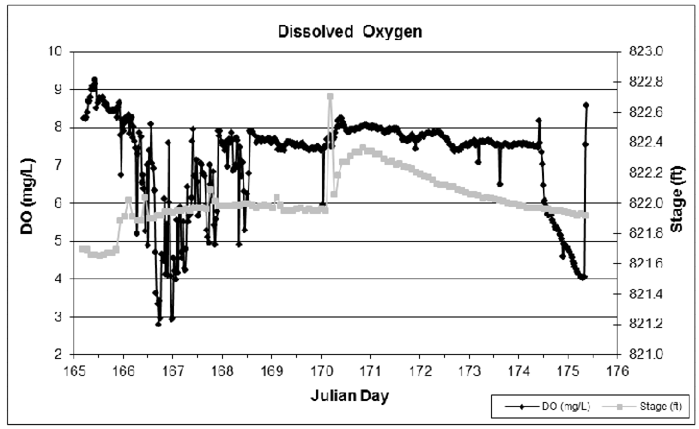


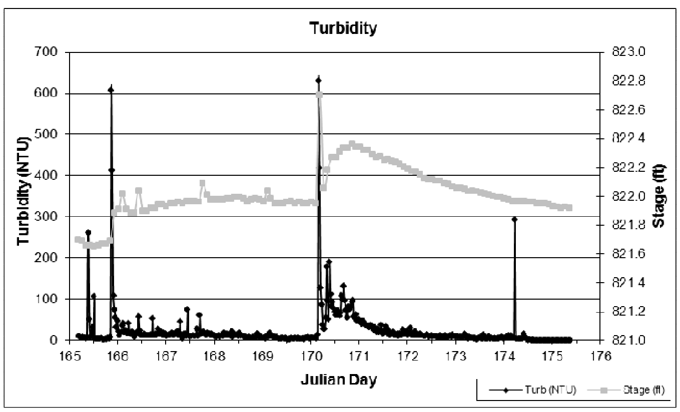


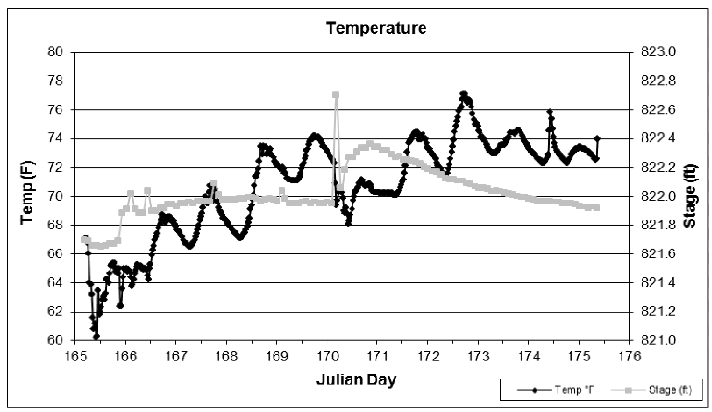
Hydrolab Continuous Monitoring
Storm 5 - 2014

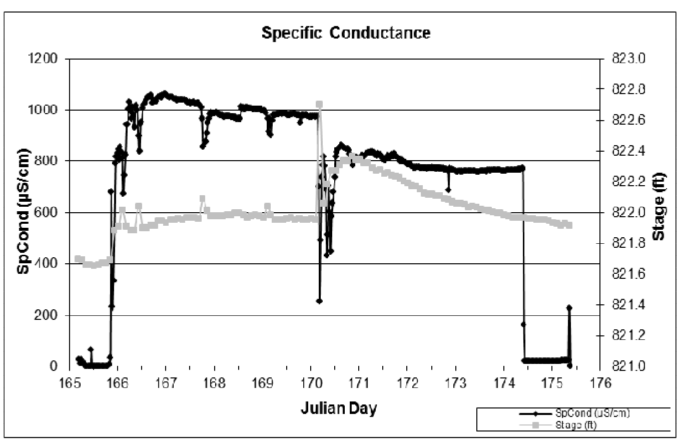
Pleasure Creek at 86th Ave
<u>Storm Summary:</u>
Dates: 14 June 2014 (day 165) to 24 July 2014 (day 175)
Precipitation: 3.03 inches

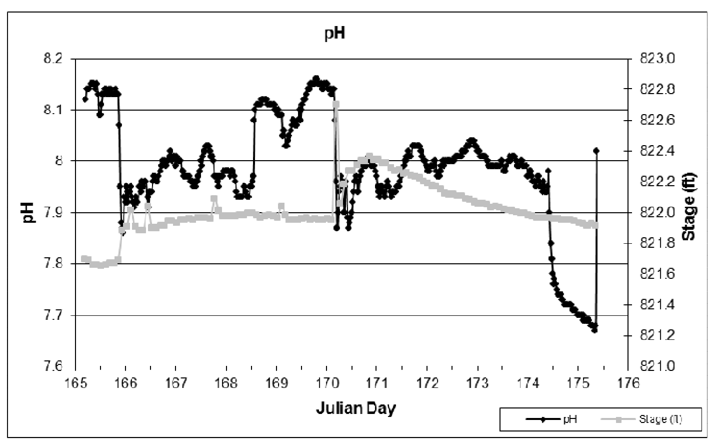












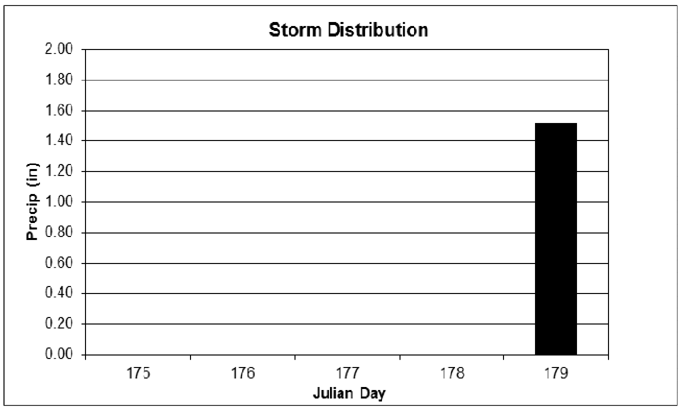
Hydrolab Continuous Monitoring
Storm 6 - 2014

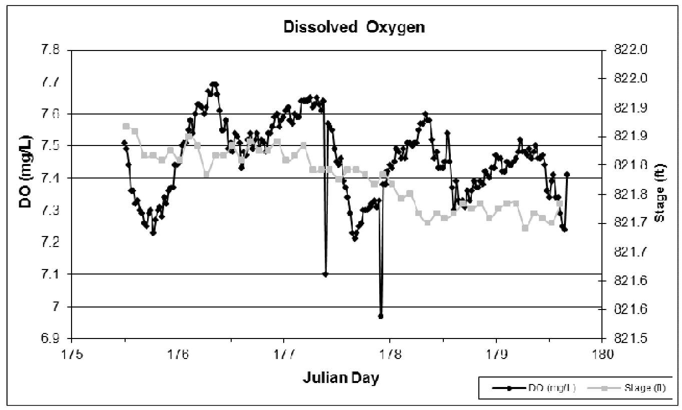
Pleasure Creek at 86th Ave

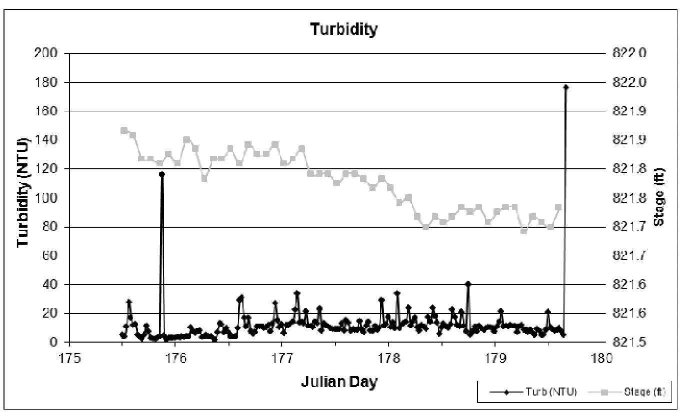
<u>Storm Summary:</u>

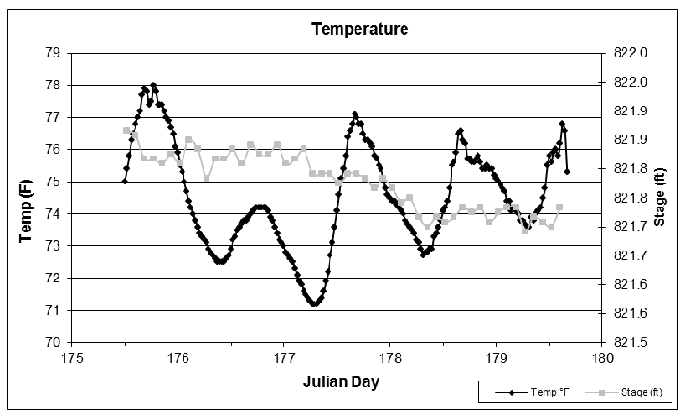
Dates: 24 June 2014 (day 175) to 28 June 2014 (day 179)

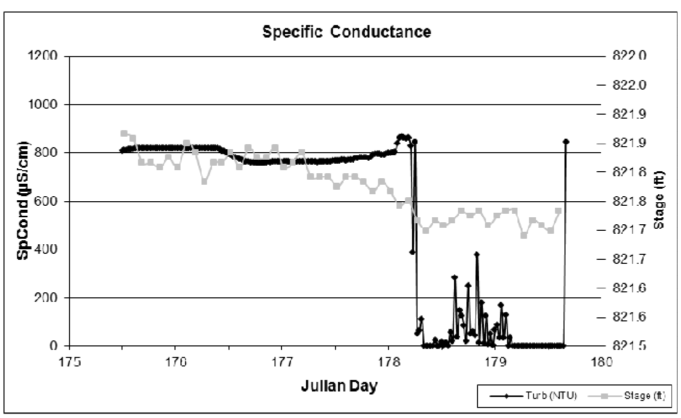
Precipitation: 1.52 inches

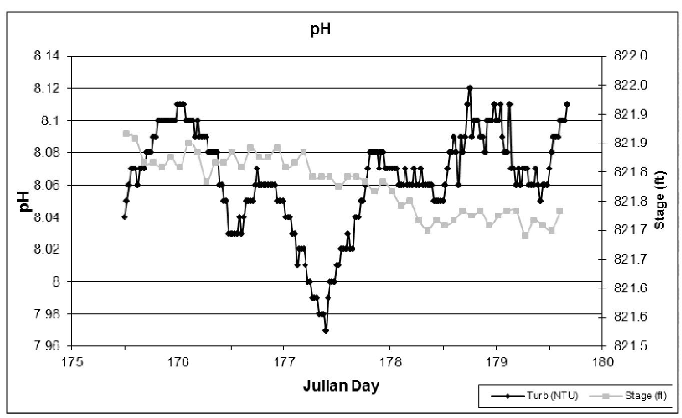








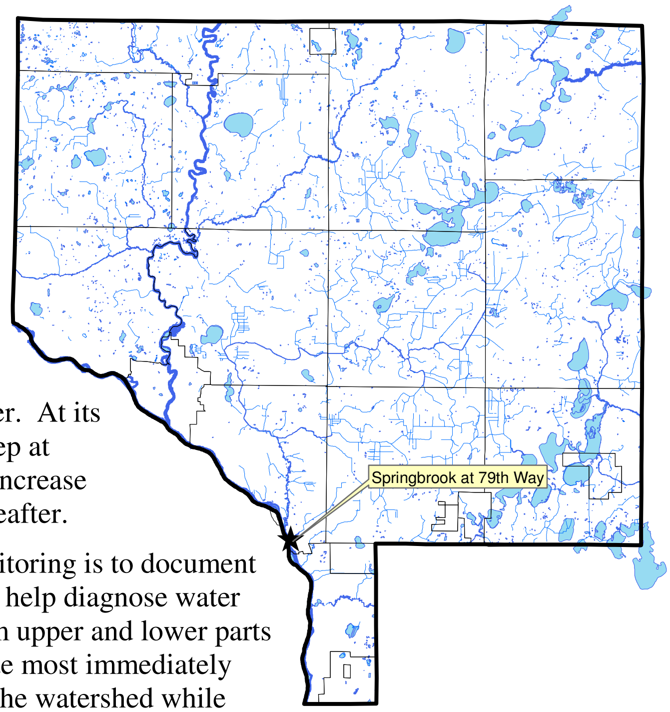




Hydrolab Continuous Stream Water Quality Monitoring

SPRINGBROOK

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



Years Monitored

Springbrook at 79th Way 2013, 2014

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 the Springbrook Nature Center, 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 0.27 to 1.90 inches. The wide distribution is helpful in discerning the creek's response to different events.

The discussion below incorporates results from 2014 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 90+ 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 stayed well within the healthy, desirable range.
- Dissolved oxygen rarely 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 to critically low levels.

Temperature

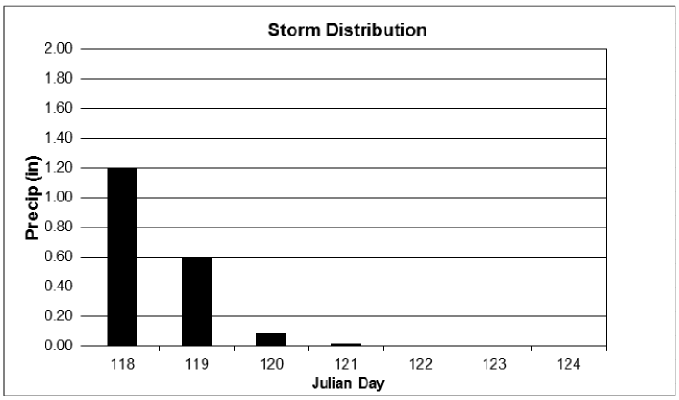
- Water temperature is generally not considered a concern in Springbrook Creek because there is no trout or other temperature sensitive resource.
- Cycles of day warming and night cooling are apparent in the data.

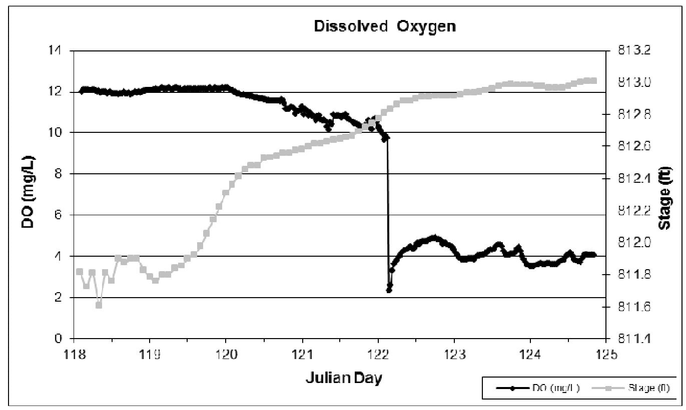
pH

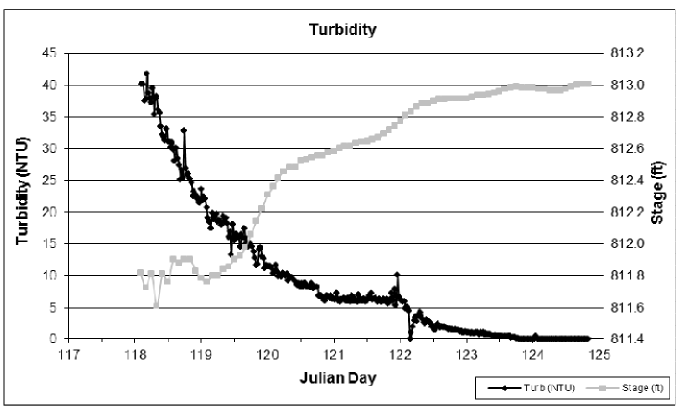
- pH is inversely related to water level in Springbrook Creek. When water level rises, pH declines. This is because rainwater has a lower pH than that of local shallow groundwater.
- pH was in the desired range of 6.5 to 8.5 that is specified in state water quality standards.

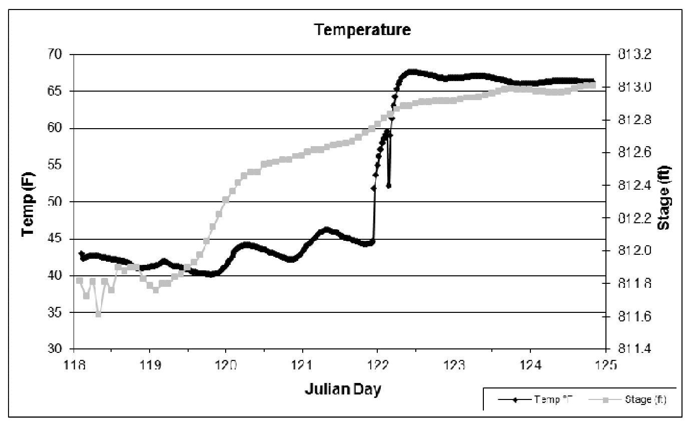
Hydrolab Continuous Monitoring
Storm 1 - 2014

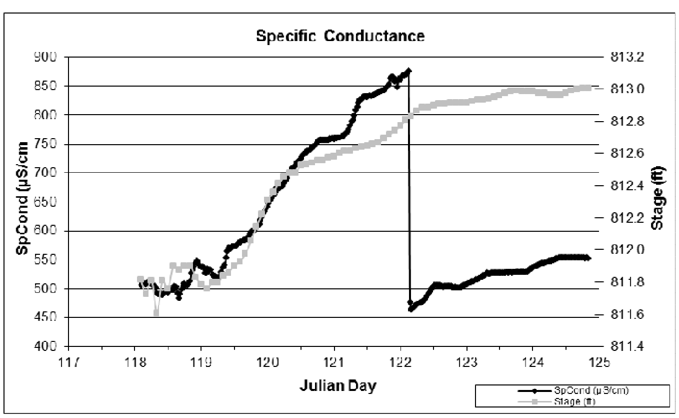
Springbrook at 79th Way
<u>Storm Summary:</u>
Dates: 28 April 2014 (day 118) to 4 May 2014 (day 124)
Precipitation: 1.90 inches

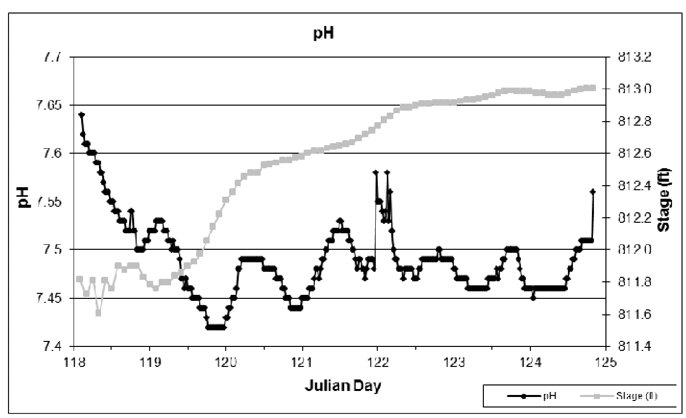






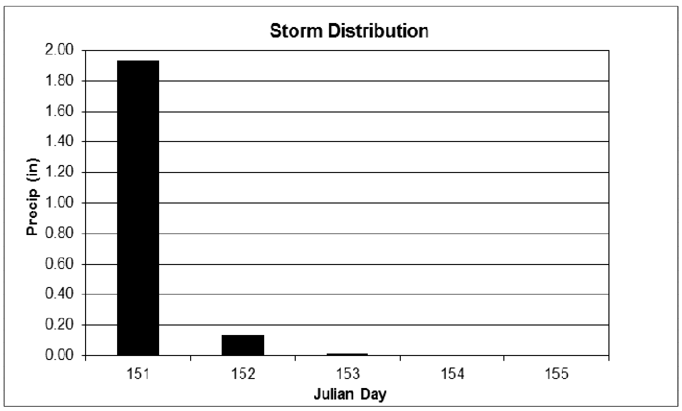


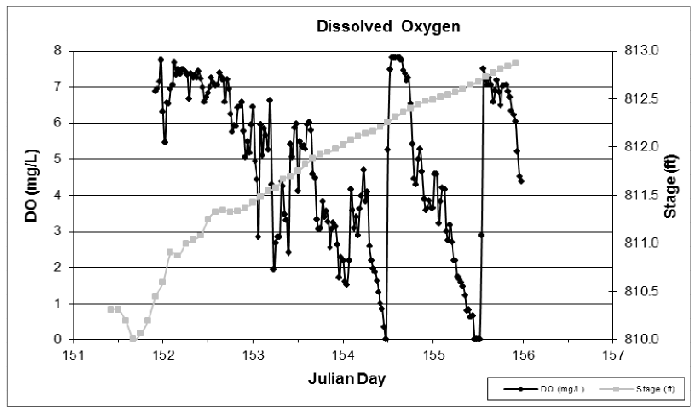


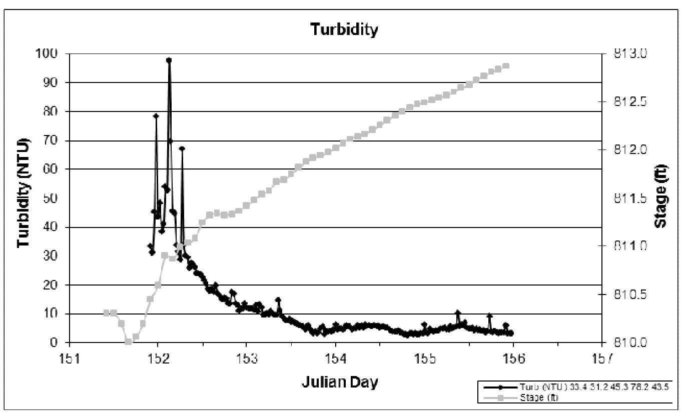


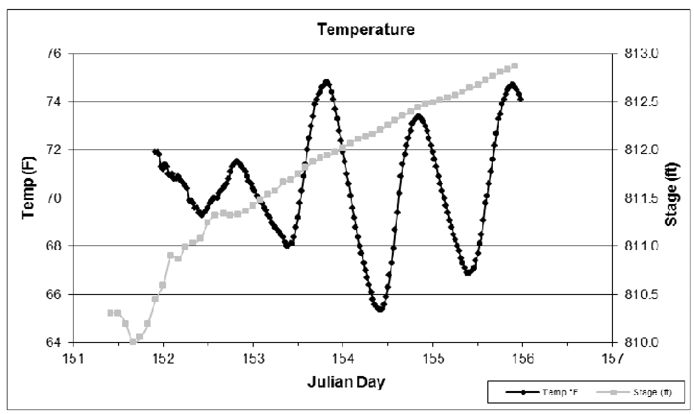
Hydrolab Continuous Monitoring
Storm 2 - 2014

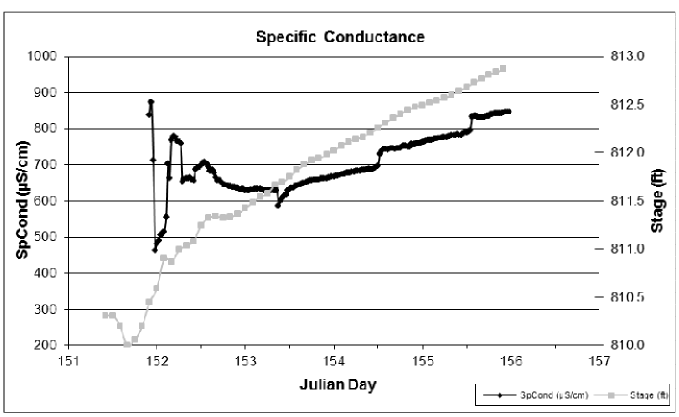
Springbrook at 79th Way
<u>Storm Summary:</u>
Dates: 31 May 2014 (day 151) to 4 June 2014 (day 155)
Precipitation: 2.07 inches

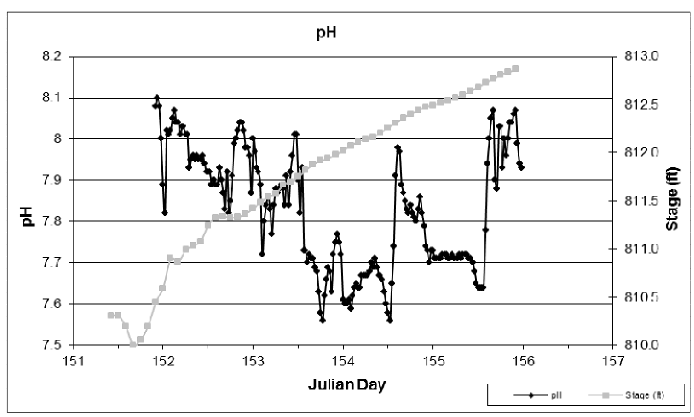






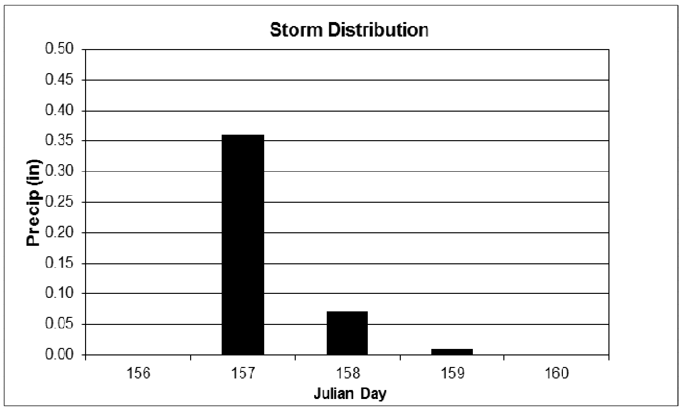


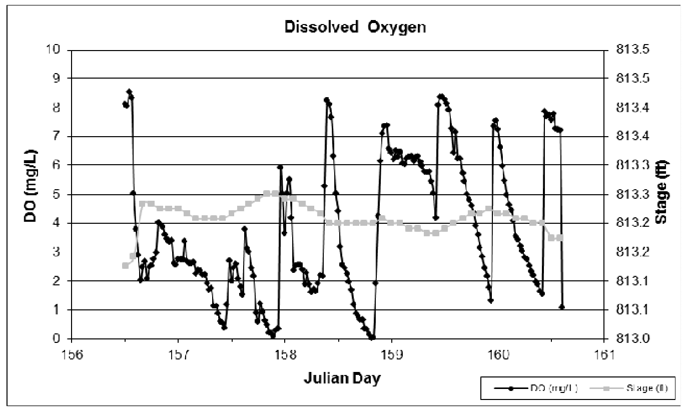


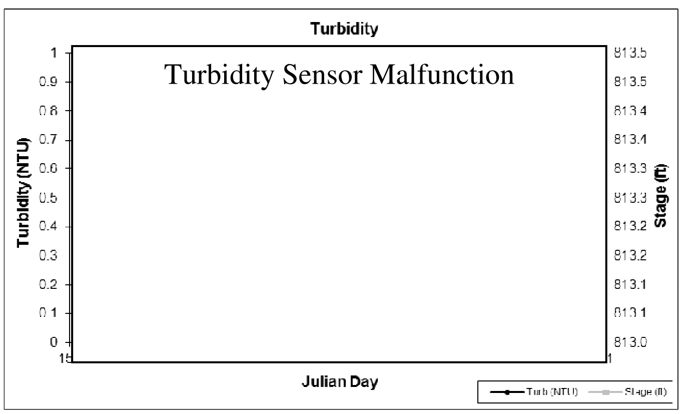


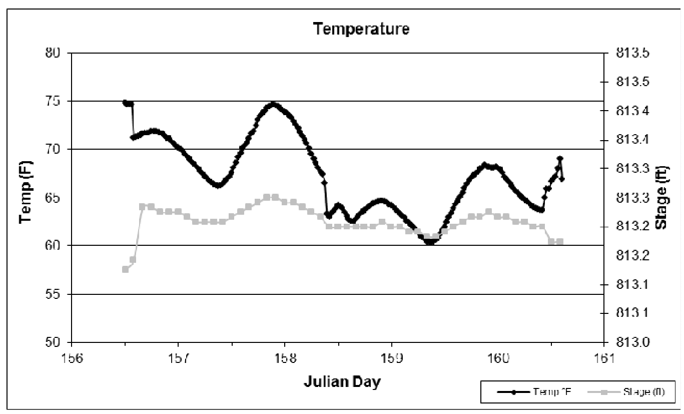
Hydrolab Continuous Monitoring
Storm 3 - 2014

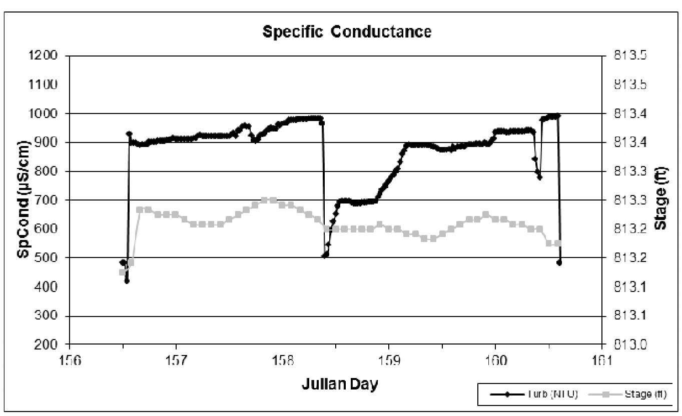
Springbrook at 79th Way
<u>Storm Summary:</u>
Dates: 5 June 2014 (day 156) to 9 June 2014 (day 160)
Precipitation: 0.44 inches

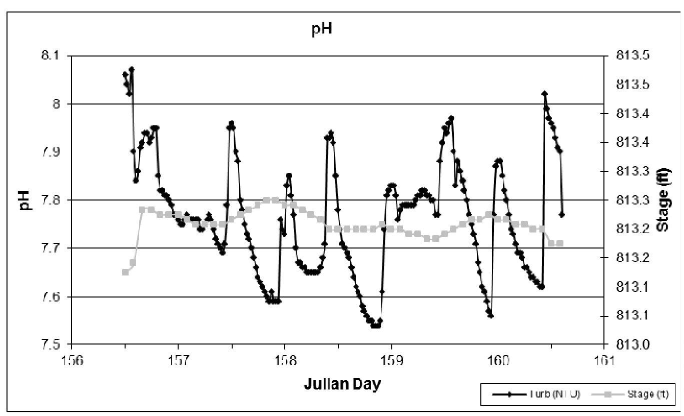






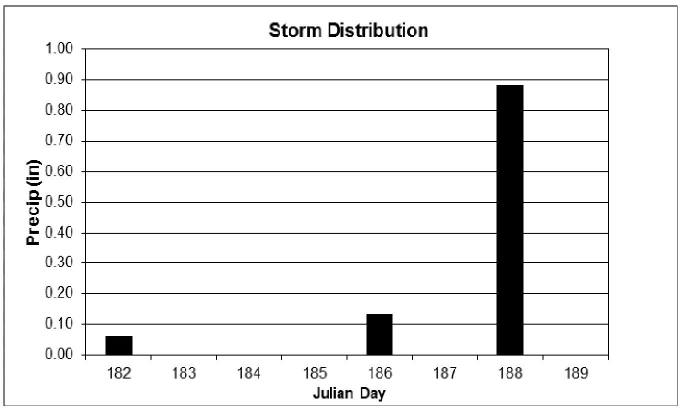


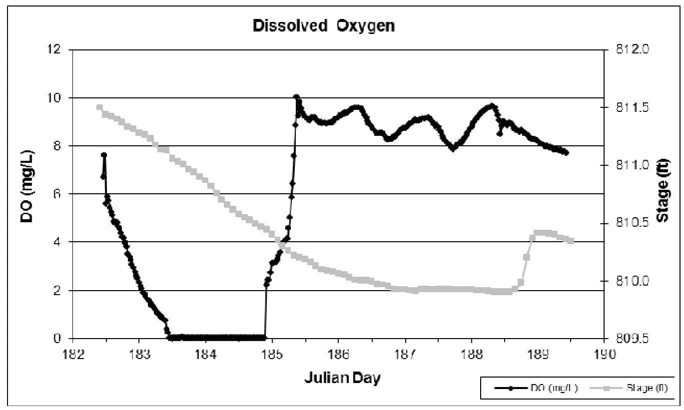


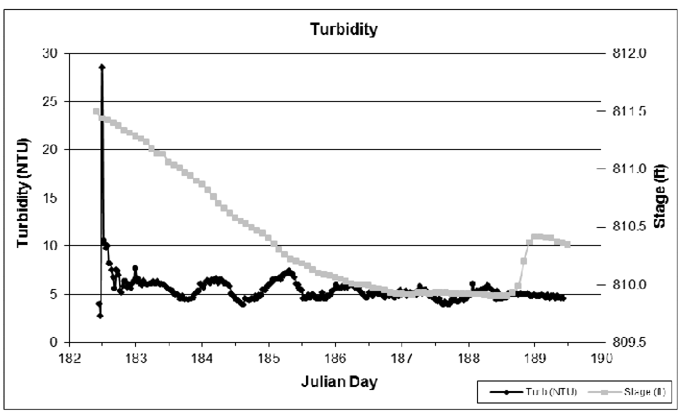


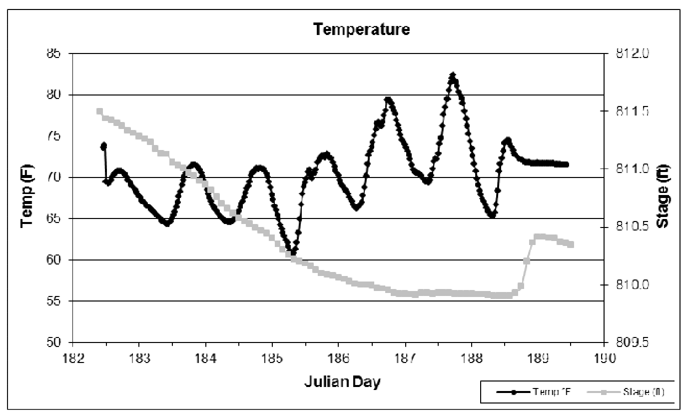
Hydrolab Continuous Monitoring
Storm 4 - 2014

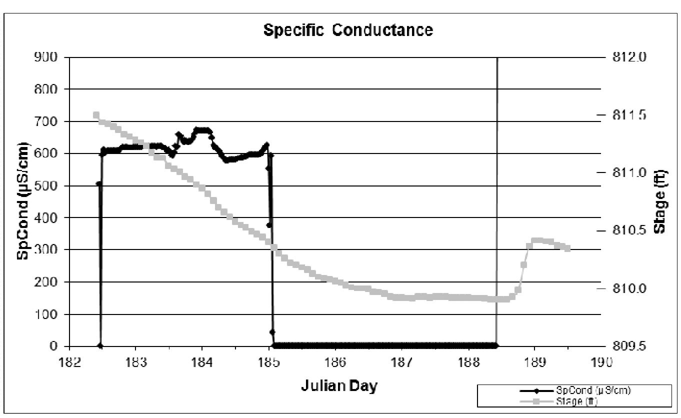
Springbrook at 79th Way
Storm Summary:
Dates: 1 July 2014 (day 182) to 8 July 2014 (day 189)
Precipitation: 1.07 inches

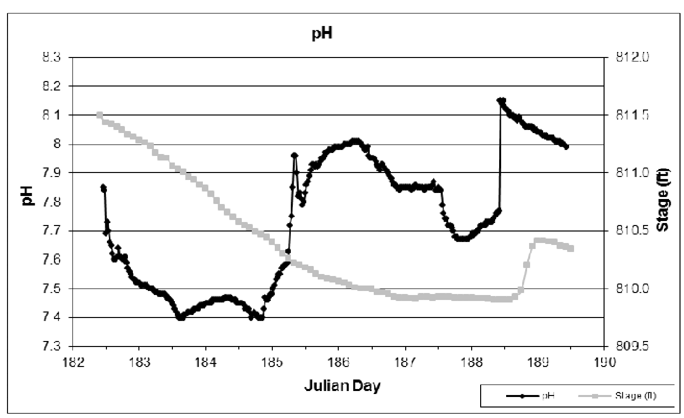












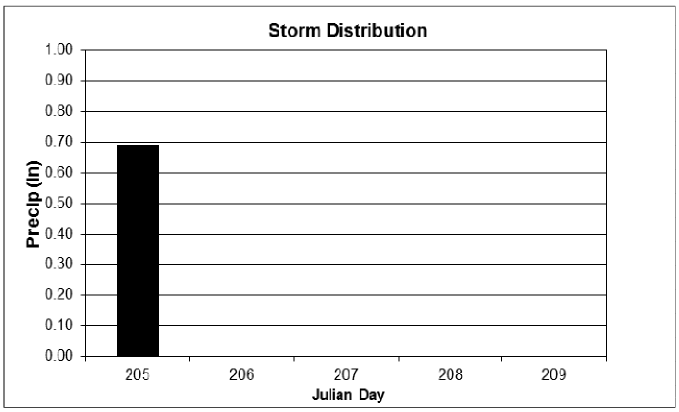
Hydrolab Continuous Monitoring
Storm 5 - 2014

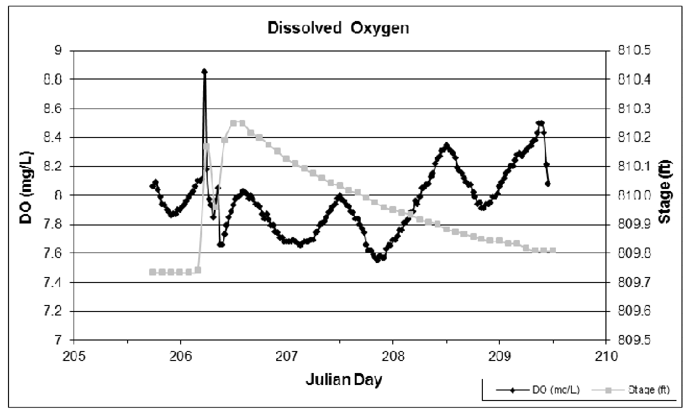
Springbrook at 79th Way

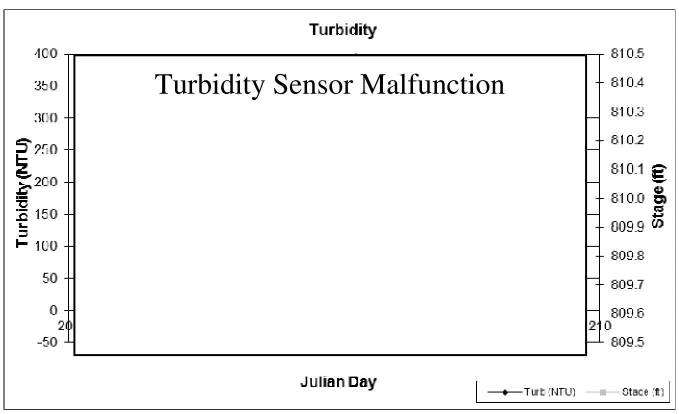
<u>Storm Summary:</u>

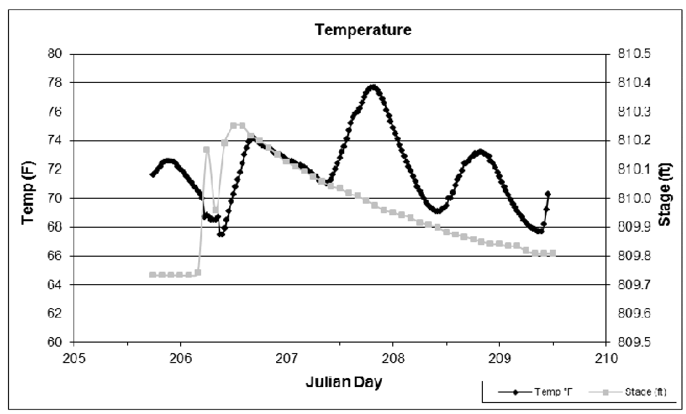
Dates: 24 July 2014 (day 205) to 28 July 2014 (day 208)

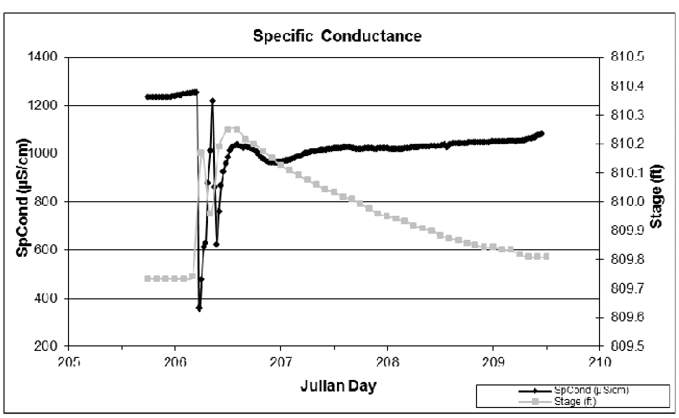
Precipitation: 0.69 inches

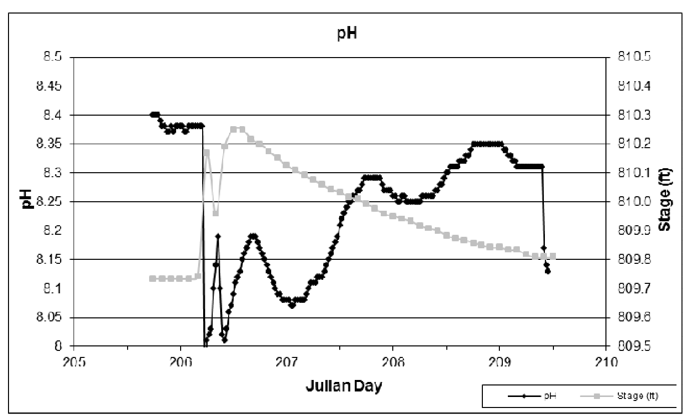






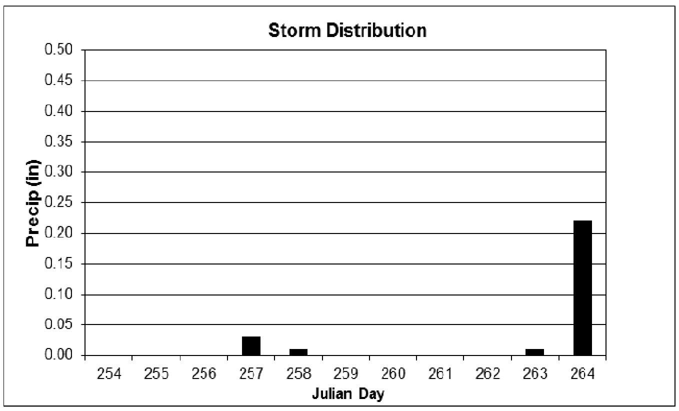


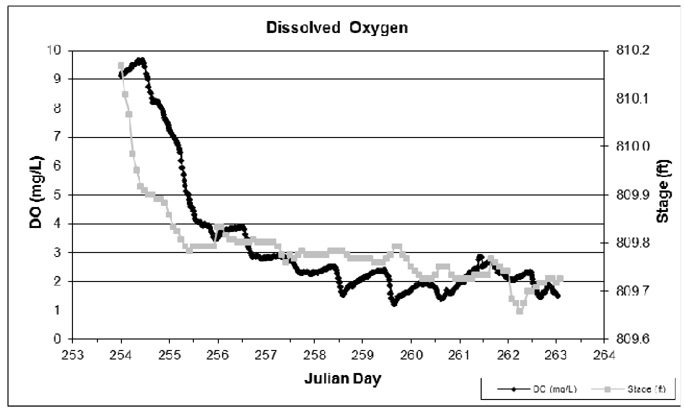


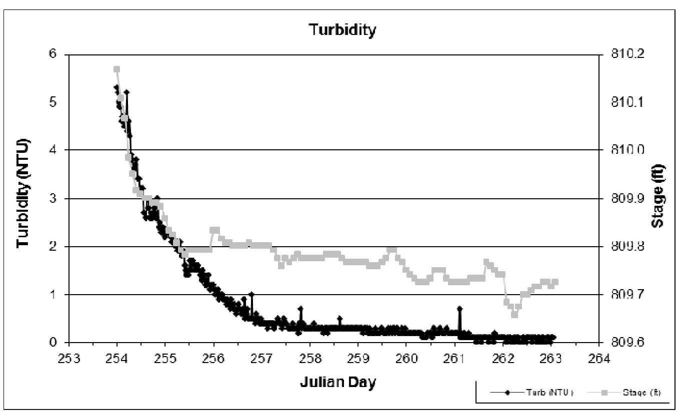


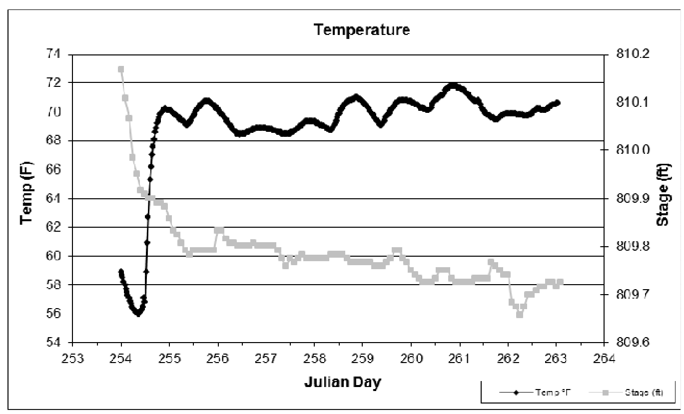
Hydrolab Continuous Monitoring
Storm 6 - 2014

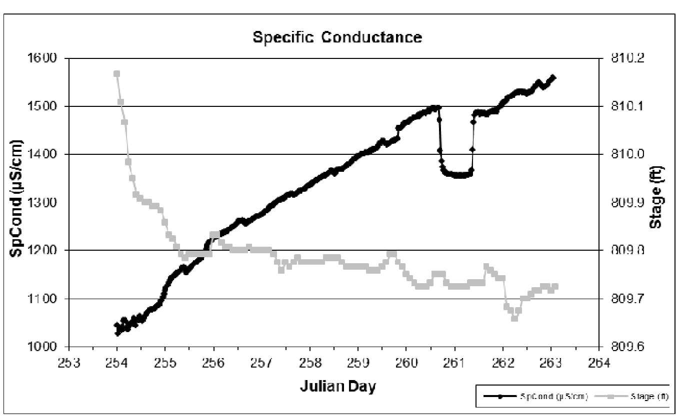
Springbrook at 79th Way
<u>Storm Summary:</u>
Dates: 9 September 2014 (day 254) to 20 September 2014 (day 263)
Precipitation: 0.27 inches

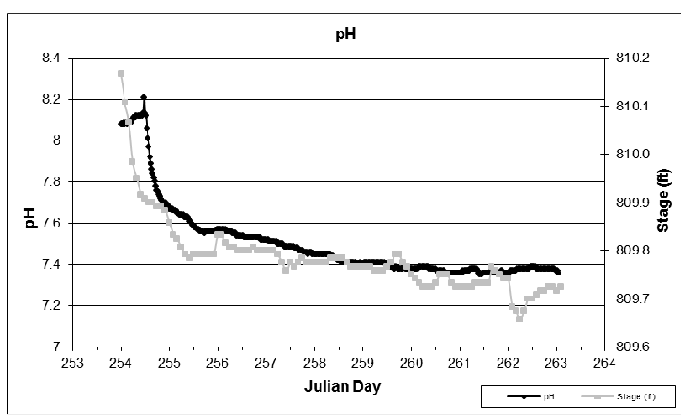












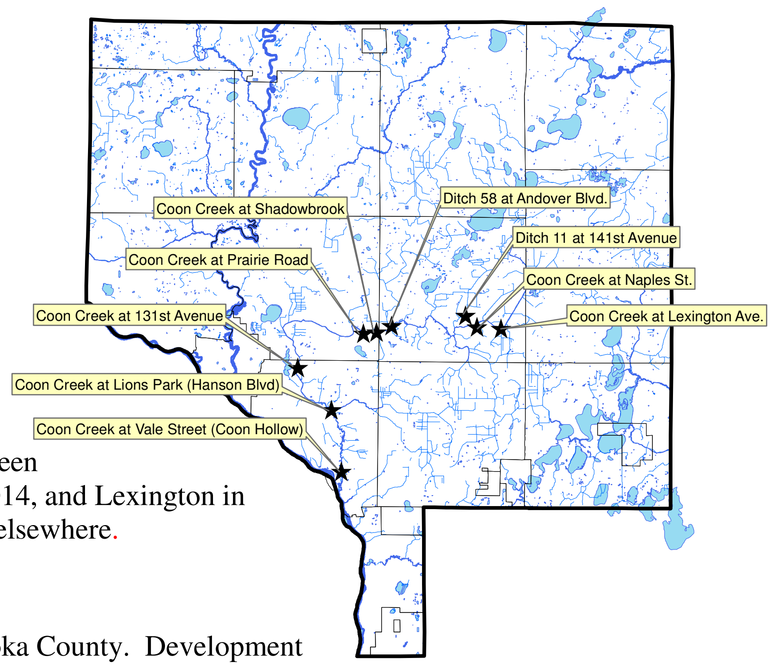
COON CREEK

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	2013-2014
Ditch 11 at 149st Ave	2013-2014
Coon Cr at Naples St	2012-2014
Ditch 58 at Andover Blvd	2013-2014
Coon Cr at Shadowbrook Townhomes	2007-2014
Coon Cr at Prairie Rd	2013
Coon Cr at 131st Ave	2010-2014
Coon Cr at Lions Park (Hanson Blvd)	2007-2014
Coon Cr at Vale St	2005-2014

Additional, intermittent data available at some other sites



Note that continuous water quality monitoring has been conducted at Vale Street in 2011-2013, Naples in 2014, and Lexington in 2014 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:

- <u>Dissolved pollutants</u>, 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.

- <u>Phosphorus</u> 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 approximately 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.

- <u>Suspended solids and turbidity</u> 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.

- <u>pH and dissolved oxygen</u> 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 0.461 mS/cm compared to the countywide median of 0.362 mS/cm.

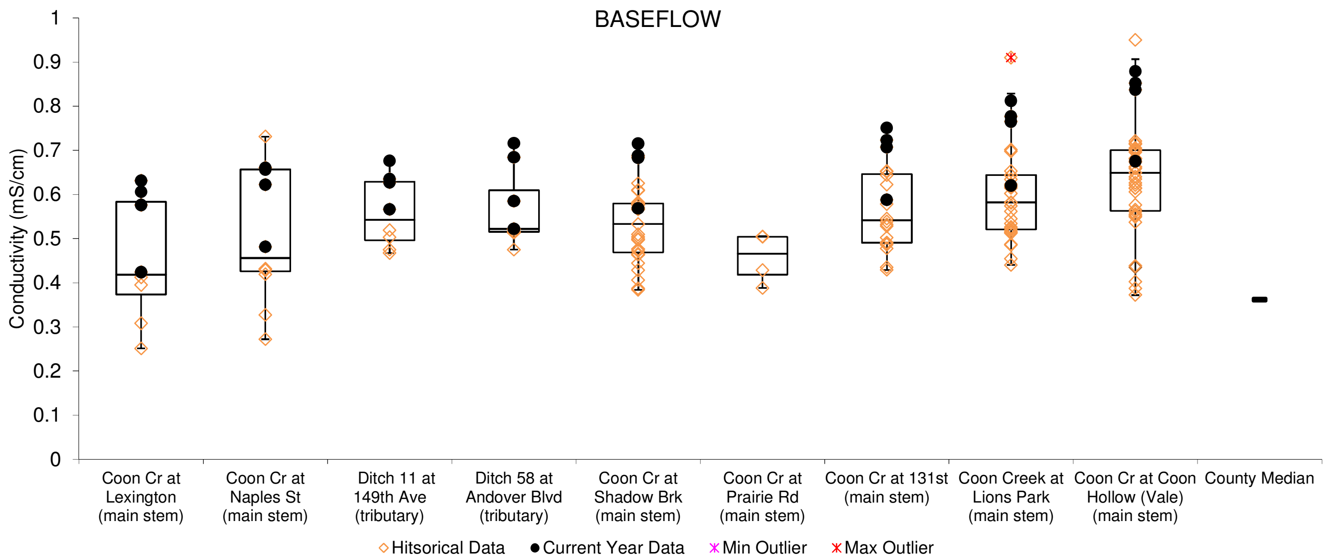
Dissolved pollutants were higher in downstream reaches of Coon Creek, where there is more impervious area (see figures below). Median conductivity increased gradually from upstream (0.3515 mS/cm) to downstream (0.635 mS/cm) during baseflow. Storm data show moderate to no difference between up and downstream conductivity and range from 0.3785 to 0.493 mS/cm.

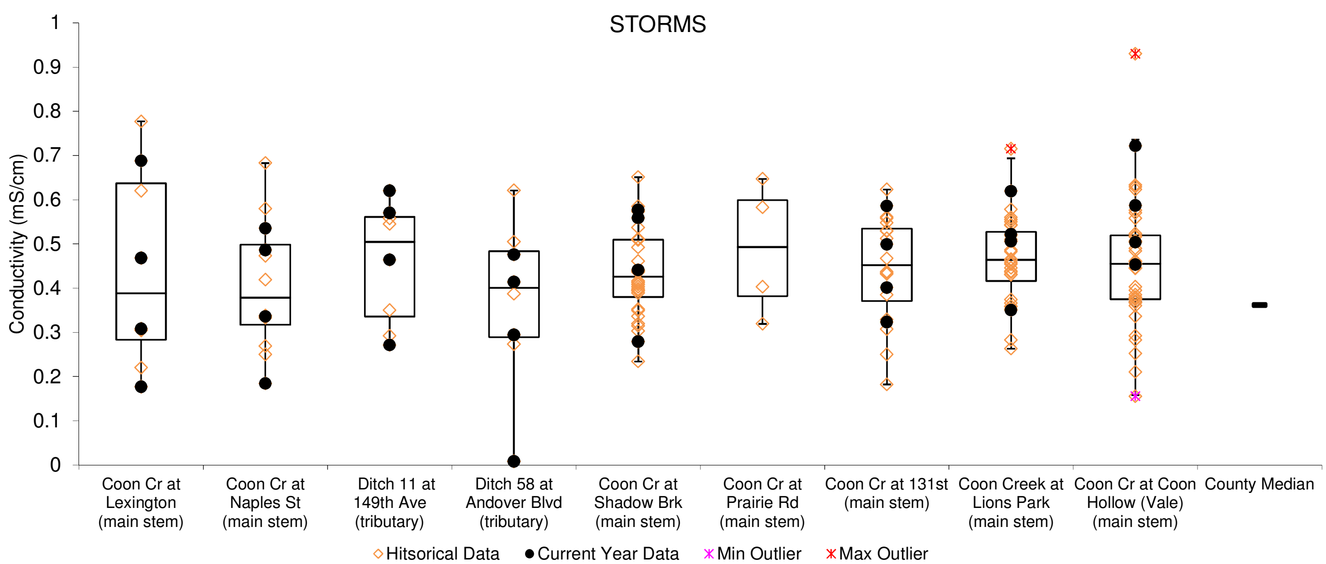
This lends some insight into the pollutant sources. If dissolved pollutants were only elevated during storms, stormwater runoff would be suspected as the primary contributor. If dissolved pollutants were highest during baseflow, pollution of the shallow groundwater which feeds the stream during baseflow 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 2014. Chlorides not monitored in 2013 or 2014.

	Conductivity (mS/cm)	**Chlorides (mg/L)**	**State Standard**	**N**
Baseflow	0.649	62	Conductivity – none	39
Storms	0.455	40	Chlorides 860 mg/L acute, 230 mg/L chronic	40
All	0.555	52		79
Occasions > state standard				0

Conductivity at Coon Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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. Total phosphorus in Coon Creek was consistently low during baseflow conditions and increased substantially 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 2014, eight Coon Creek watershed sites were monitored (two are tributaries).

Baseflow TP was low. During baseflow the nine monitoring sites had median TP of 76, 69, 119.5, 114, 79.5, 129.5, 107 and 83 ug/L, respectively, from upstream to downstream. All were 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 16 of 40 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, 59, 139, 139, 122, 117, 160, 132, 101, and 129 ug/L. By contrast, the standard deviations during baseflow were 39, 31, 71, 89, 49, 46, 80, 46, and 39 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 81.5, 112, 208, 134, 171, 149.5, 179, 171, and 177 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 three of 40 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 2014 – 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 119.5 and 114 ug/L, respectively. Median TP during storms were 208 and 134 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.

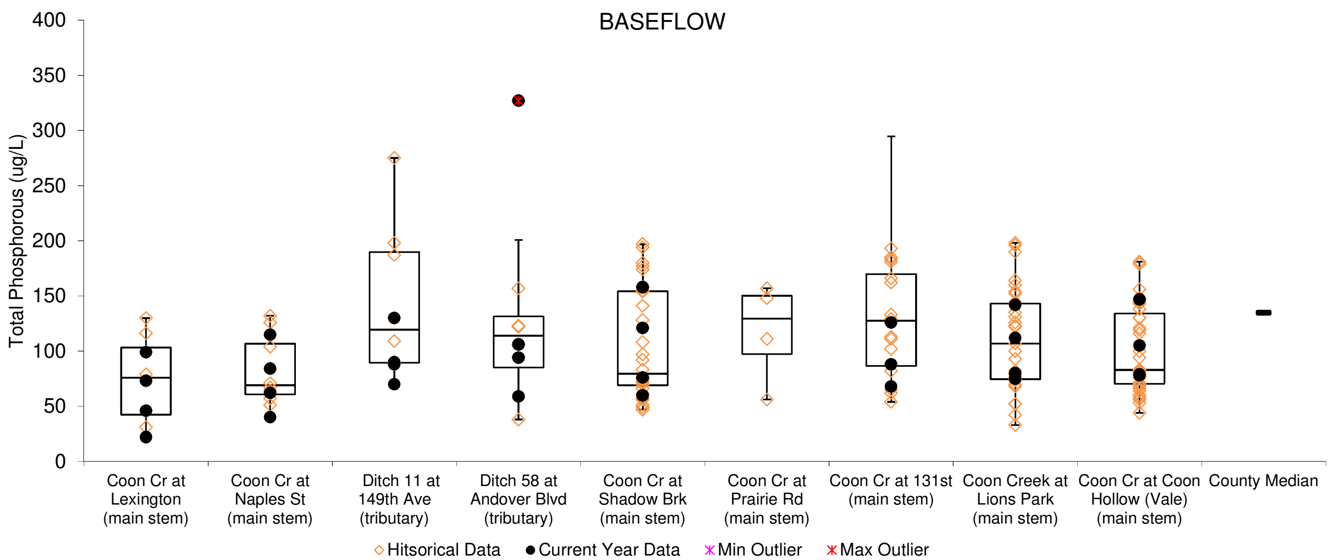
Phosphorus reduction needs to occur throughout the watershed. The highest priority should be addressing phosphorus from urban stormwater runoff in the lower portion of the watershed. This is the area with the highest TP. Also, this is the area with the highest levels of other pollutants, such as total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

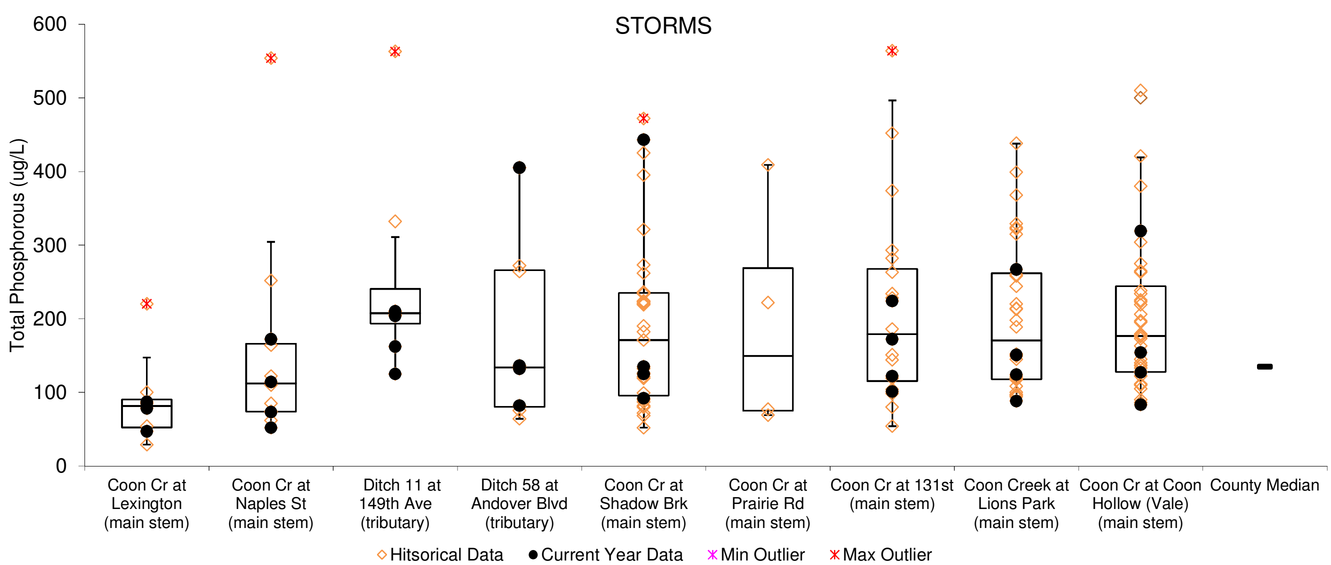
Median total phosphorus in Coon Creek. Data is from Vale St for all years through 2014.

	Total Phosphorus (ug/L)	State Standard*	N
Baseflow	83	100	39
Storms	177		40
All	130		79
Occasions > state standard			48 (37 storms, 16 baseflow)

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

Total Phosphorus at Coon Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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.

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 sometimes 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 6.3, 9.65, 1.65, 7.8, 9.5, 9.15, 14.1, 11 and 12 NTU, respectively. This is similar to the countywide median of 8 NTU. Six of 40 (15%) baseflow measurements at Vale Street are greater than MPCA's present water quality standard of 25 NTU. Median TSS during baseflow from upstream to downstream was 3.5, 5.5, 6, 6, 8, 4.5, 7, 11, and 9 mg/L, respectively. This is lower than the median for streams county-wide of 12 mg/L. At Vale, the furthest downstream reach, only 1 of 40 (2.5%) of baseflow 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 8.5, 11, 9, 7, 13, 30.5, 19, 21 and 35 mg/L from upstream to downstream. Median storm turbidity was 15.25, 23.7, 12.4, 20.45, 15, 15, 34.5, 29.5, and 31.45 NTU 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.

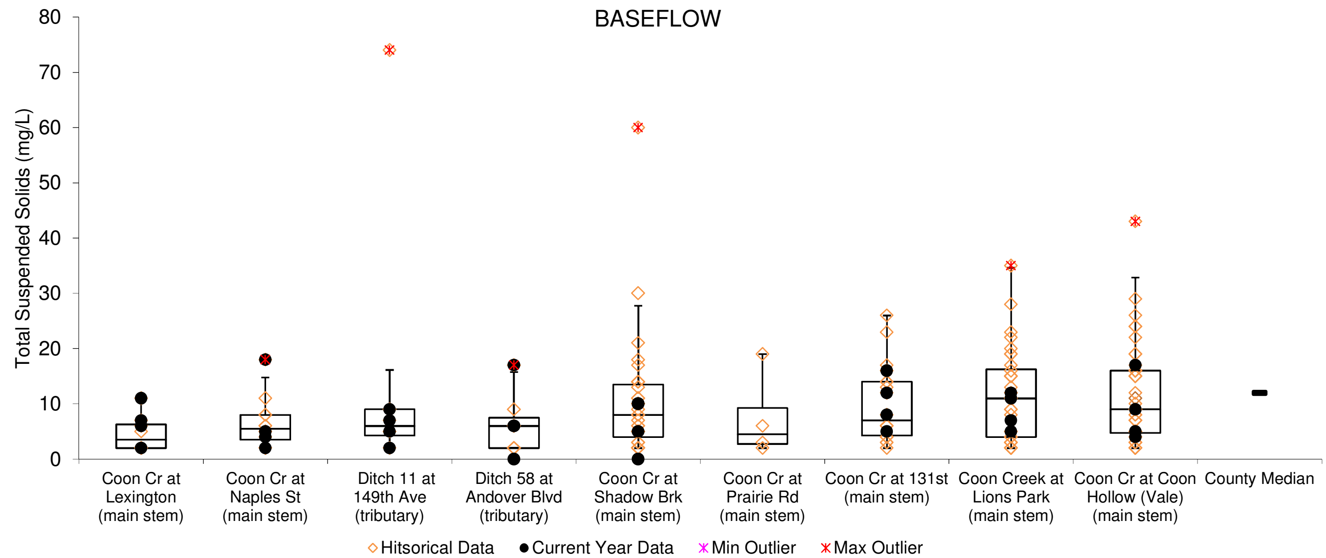
Research should be done to determine the extent to which bed load transport of sediment is contributing to high turbidity and TSS. Presently, it appears that it has the potential to be important. High suspended solids in the upper watershed, where land uses are rural residential and sod fields is surprising, 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.

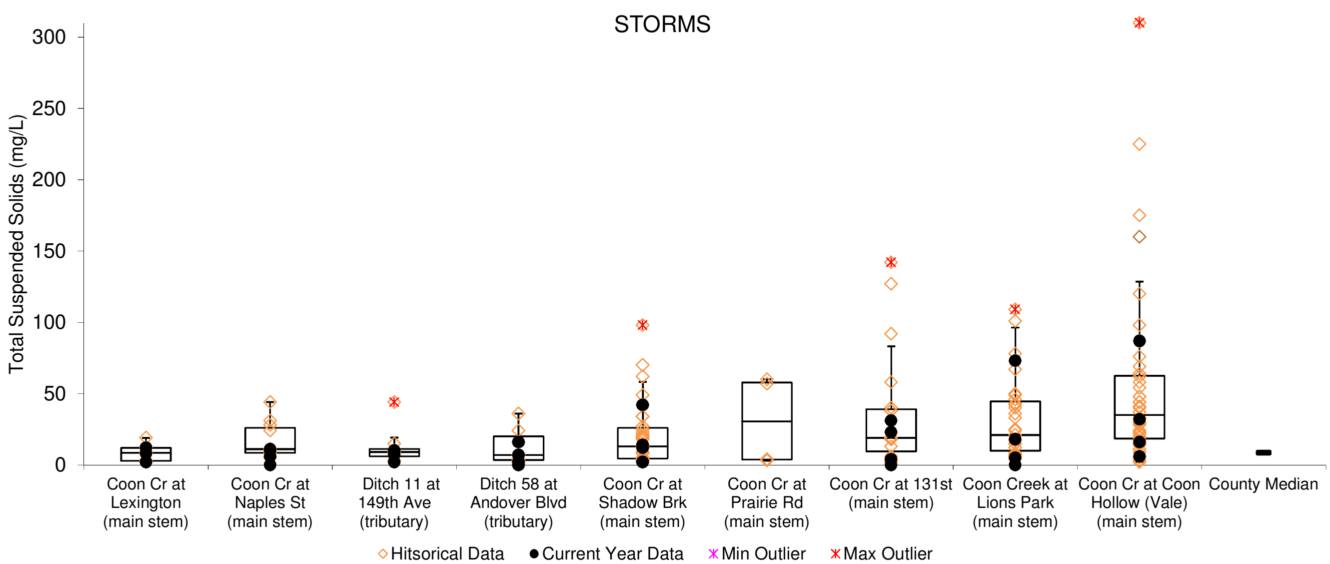
Median turbidity and suspended solids in Coon Creek. Data is from Vale St for all years through 2014.

	Turbidity (NTU)	Total Suspended Solids (mg/L)	State Standard*	N
Baseflow	12.0	9.0	30 mg/L TSS	40
Storms	31.5	35.0		40
All	20.0	16.5		80
Occasions > new state TSS standard				23

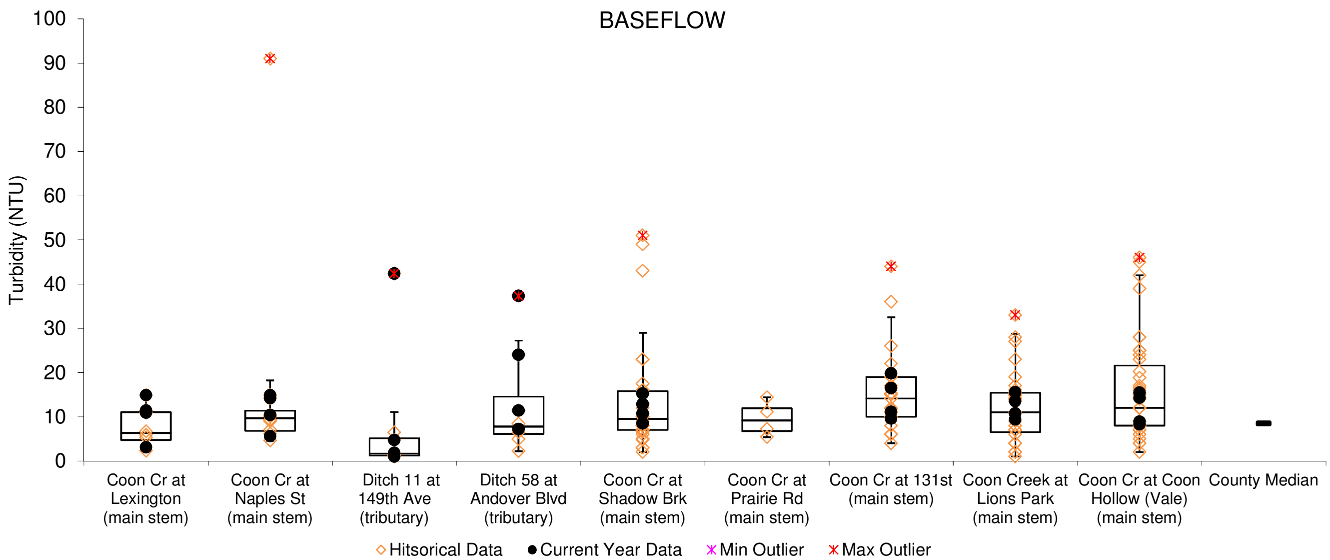
*New state standards are under development. The standard listed is the likely new threshold.

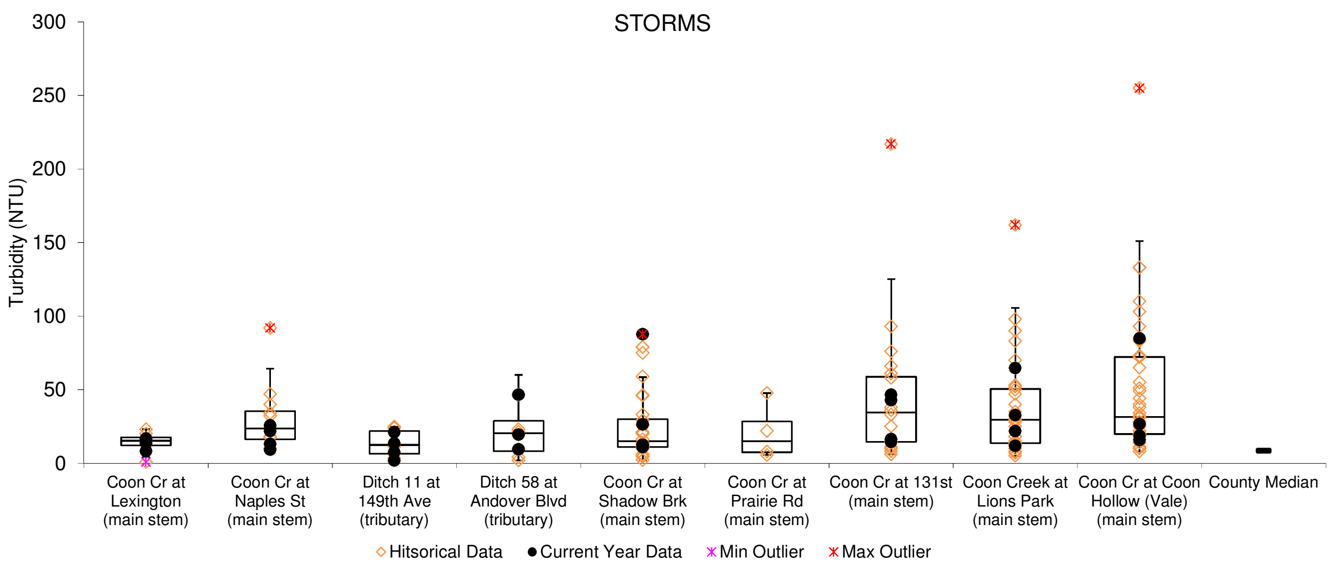
Total Suspended Solids at Coon Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Turbidity at Coon Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





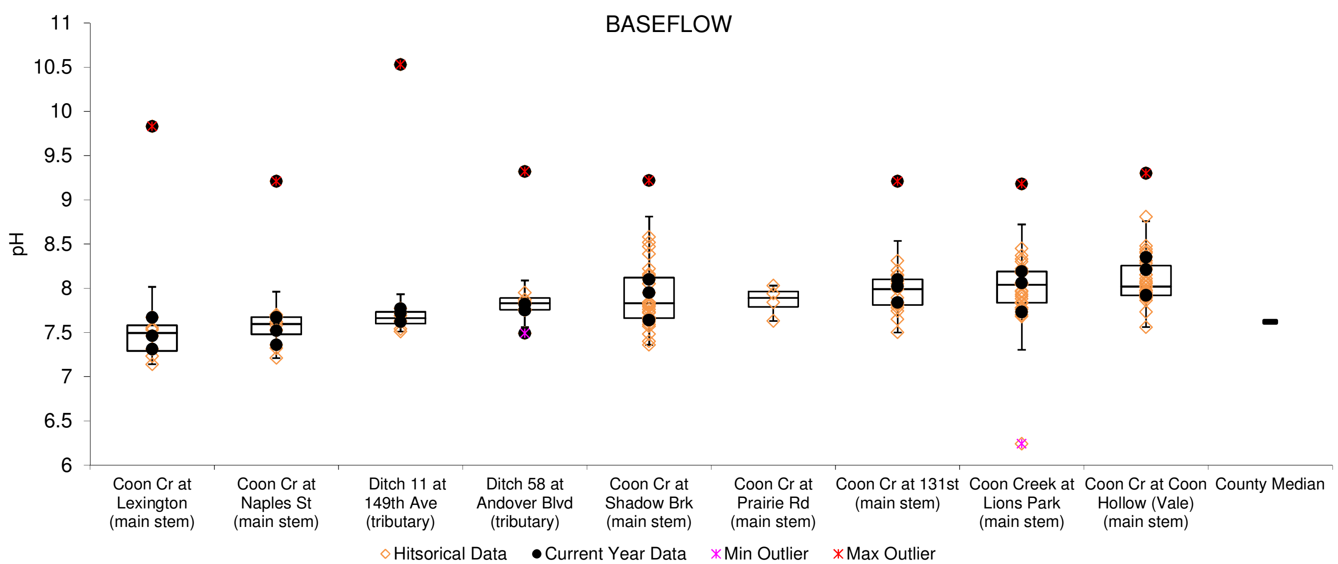
pH

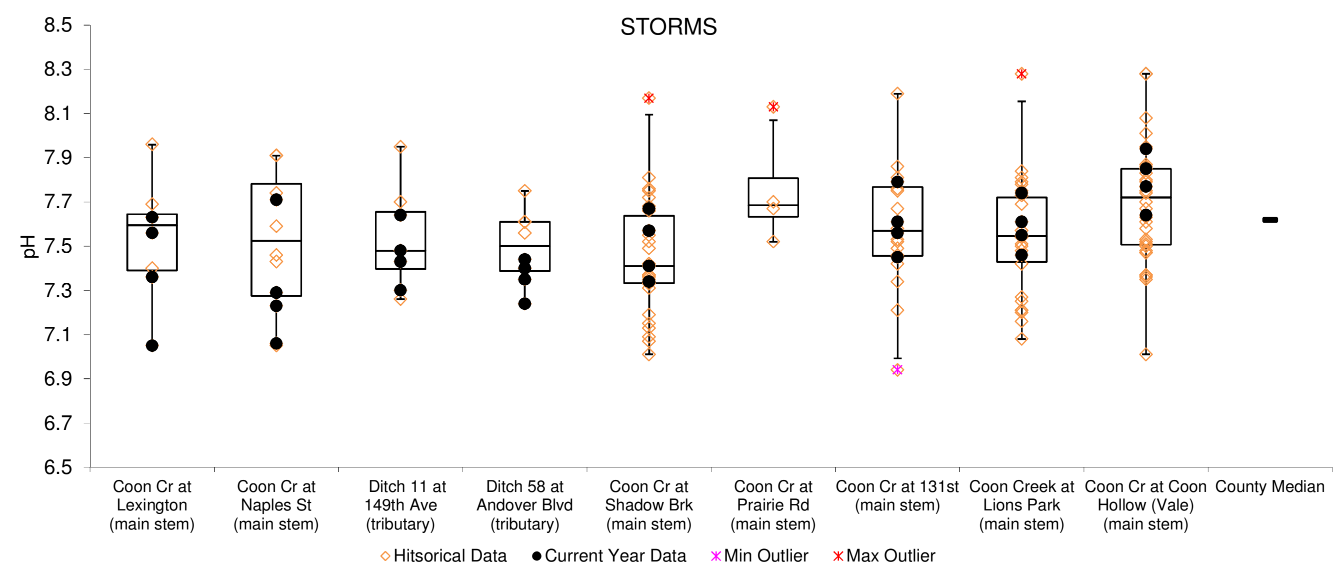
pH was within the expected range at all sites, with rare exceptions. pH is expected to be between 6.5 and 8.5 according to MPCA water quality standards. While occasional readings outside of this range did occur, they were not large departures that generate concerns. pH was notably lower during all storm 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 2014.

	pH	State Standard	N
Baseflow	8.02	6.5-8.5	36
Storms	7.72		39
All	7.91		75
Occasions outside state standard			12, all sites

pH at Coon Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





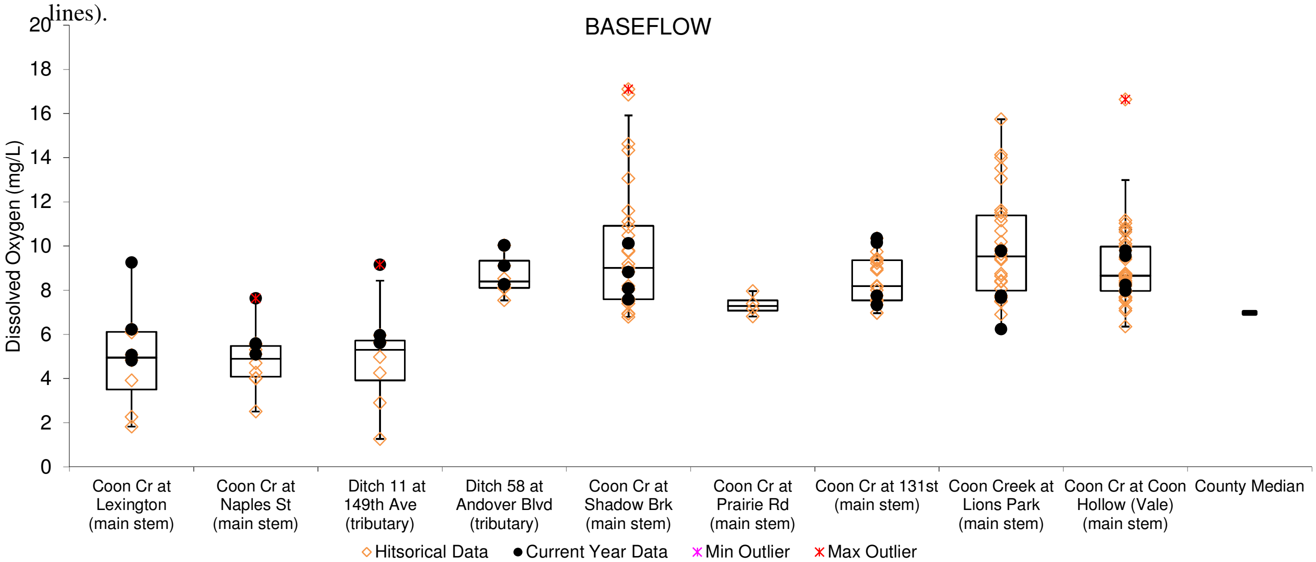
Dissolved Oxygen

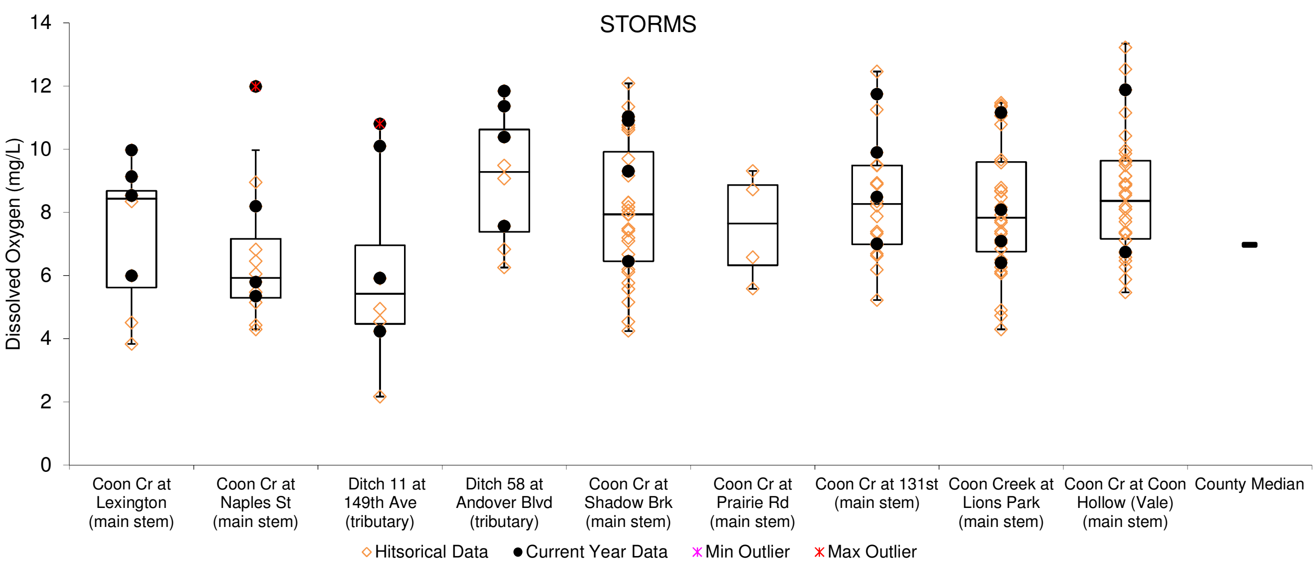
Dissolved oxygen was similar at all sites and adequate for most aquatic live (i.e. >5 mg/L). On one occasion it dropped below 5 mg/L at Lexington Avenue, and once at the Ditch 11 tributary to Coon Creek. The other sites had no instances of dissolved oxygen below 5 mg/L. In sum, any dissolved oxygen problems 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 2014.

	Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	8.66	5 mg/L daily minimum	36
Storms	8.36		38
All	8.61		74
Occasions <5 mg/L			3 at Lions Park, 2 at Shadowbrook Townhomes, 7 at Naples St, 6 at Lexington, 8 at Ditch 11 tributary

Dissolved oxygen at Coon Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 most probable number per 100 milliliters of water (MPN) or if the geometric mean of five samples taken within 30 days is greater than 126 MPN.

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 exceedance. 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 34, 49, (64, 62 tributaries), 93, 113, 135.5, 169, and 247 MPN, respectively. Though the frequency requirements were not met, bacteria levels during baseflow generally were below the 126 MPN state water quality standard in the upper watershed but routinely exceeded it in the lower watershed.

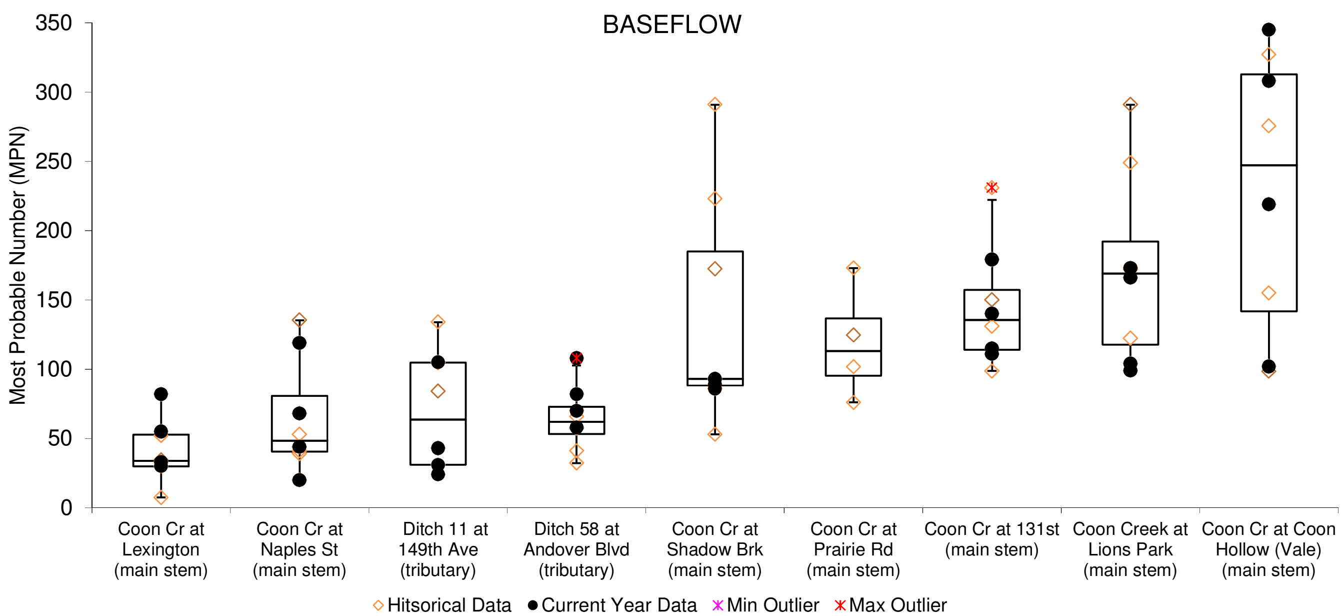
During storms E. coli was significantly higher and variable (notice the difference in Y axis scales in the graphs below). Median E. coli during storms from upstream to downstream were 232, 360, (216, 317 tributaries), 344, 796, 438, 560, and 668 MPN, respectively. A large part of this variability might be explained by the intensity of the storm, phenology of the storm and when during the storm the sampling was done.

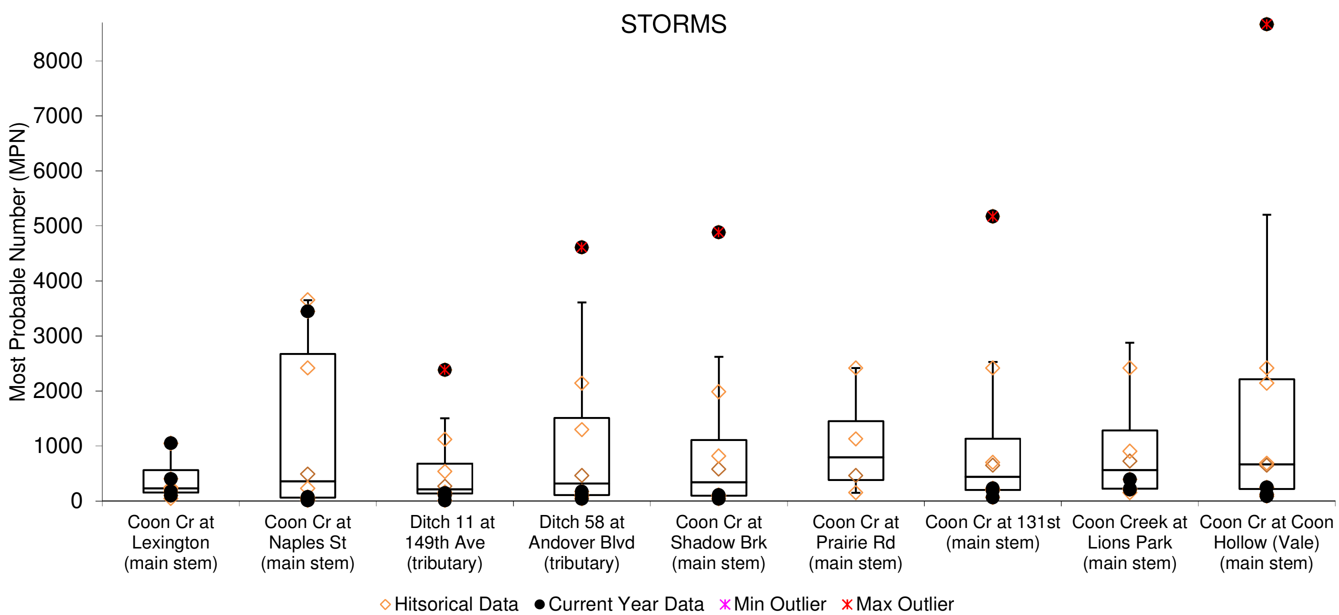
Though the frequency requirements were not met, bacteria levels during storms grossly exceed the 126 MPN state water quality standard on most occasions (75% of samples taken). Coon Creek clearly exceeded the standard of 10% of monitoring events in a month above 1260 MPN. It is notable, however, that two storm events accounted for 81% of the samples that exceeded the 1260 MPN standard.

Median E. *coli* in Coon Creek. Data is from All Sites from 2013-2014.

	E. *coli* (MPN)	State Standard	N
Baseflow	99	Monthly Geometric Mean >126	68
Storms	399		68
All	149		136
Occasions >126 MPN		Monthly 10% average >1260	22 baseflow, 33 storm
Occasions >1260 MPN			0 baseflow, 17 storm

E. *coli* at Coon Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



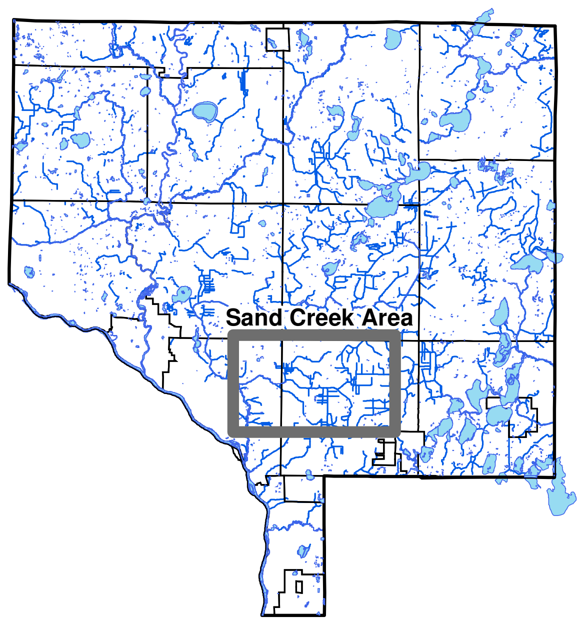


SAND CREEK SYSTEM

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 2010-2014
Sand Cr (Ditch 41) at Highway 65 2009-2014
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 2010-2014
Sand Cr at Xeon Street 2007-2014



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.

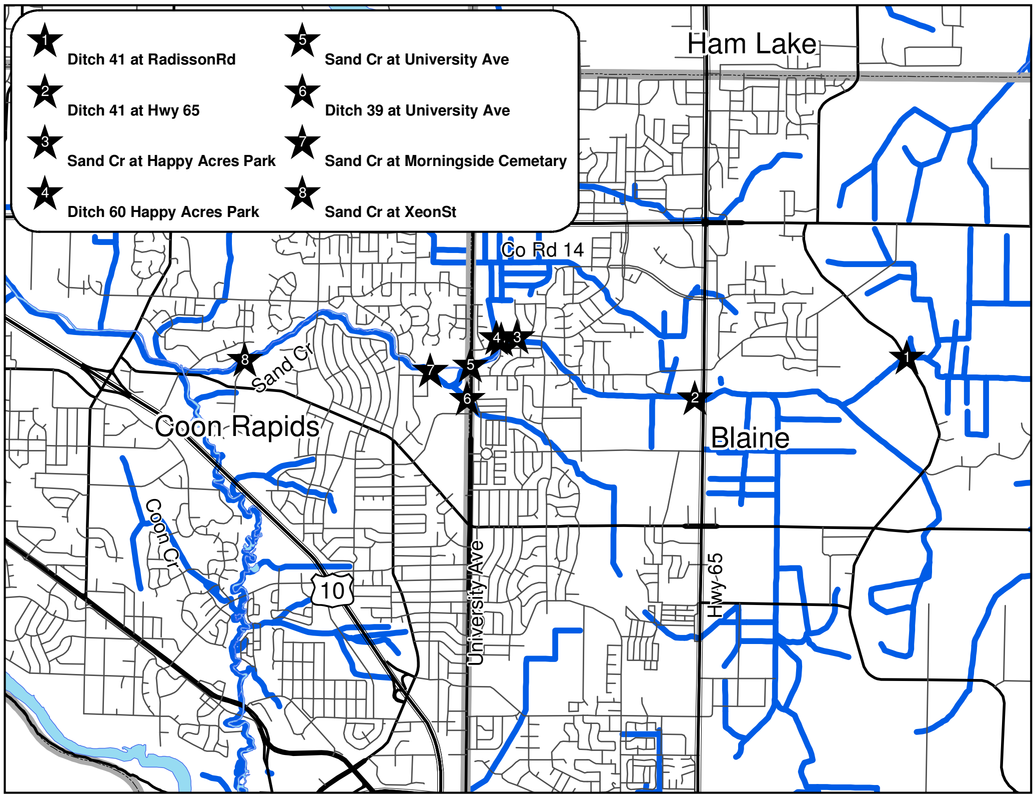
Methods

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 2014.

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.

  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 (0.723 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.

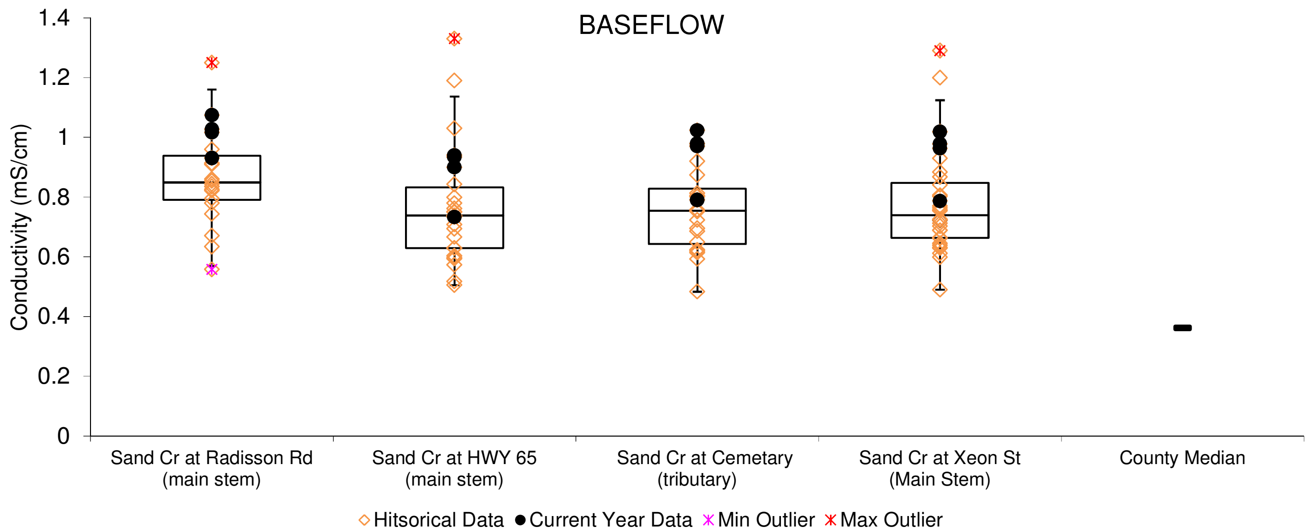
Dissolved pollutants were slightly lower during storms than during baseflow (see figures below). Dissolved pollutants can easily infiltrate into the shallow groundwater that feeds streams during baseflow. If this has occurred, dissolved pollutants will be high during baseflow. If road runoff was the primary dissolved pollutant source, then readings would be highest during storms. The median conductivity from all Sand Creek sites during baseflow was higher than during storms (0.723 vs 0.681 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.

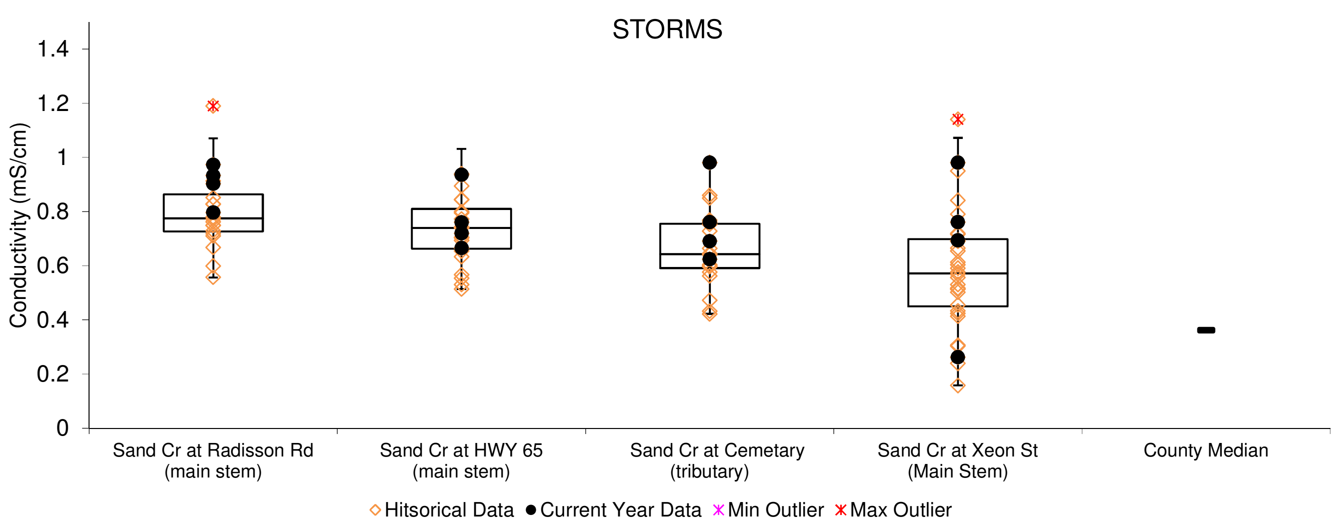
Sand Creek degrades Coon Creek with dissolved pollutants. Both creeks were monitored just before they join. Across all years monitored, Sand Creek's median conductivity was 24% higher than Coon Creek (0.688 vs 0.555 mS/cm). Sand Creek's median chlorides were 42% higher than Coon Creek (74 vs 52 mg/L).

Median conductivity and chlorides in Sand Creek. Data is from Xeon St for all years through 2014.

	Conductivity (mS/cm)	Chlorides (mg/L)	State Standard	N
Baseflow	0.740	75	Conductivity – none Chlorides 860 mg/L acute, 230 mg/L chronic	32
Storms	0.572	63		32
All	0.688	72		64
Occasions > state standard				0

Conductivity at Sand Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 (58 ug/L) and storms (61 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 (13 0f 18) 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.

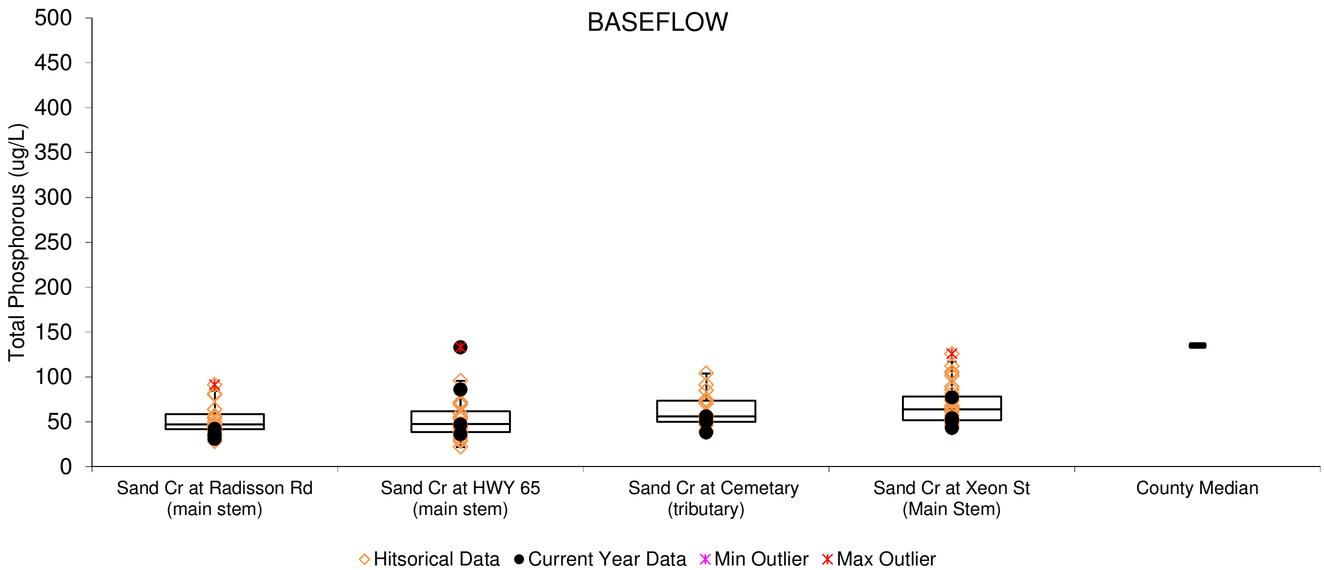
Sand Creek TP is lower than Coon Creek. In Coon Creek, just before the confluence with Sand Creek, the median TP is 126 ug/L. The median in Sand Creek at this same junction is 79 ug/L.

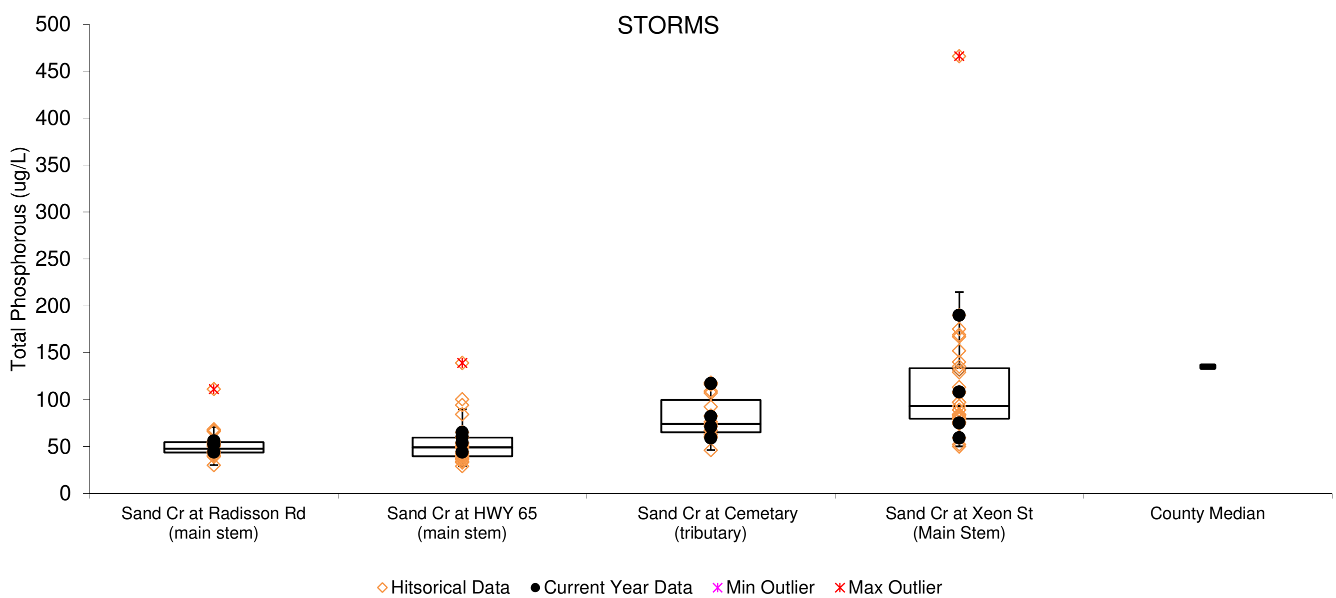
Median total phosphorus in Sand Creek. Data is from Xeon St for all years through 2014.

	Total Phosphorus (ug/L)	State Standard*	N
Baseflow	64	100	32
Storms	93		31
All	79		63
Occasions > state standard			13 during storms, 5 baseflow

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

Total phosphorus at Sand Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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.

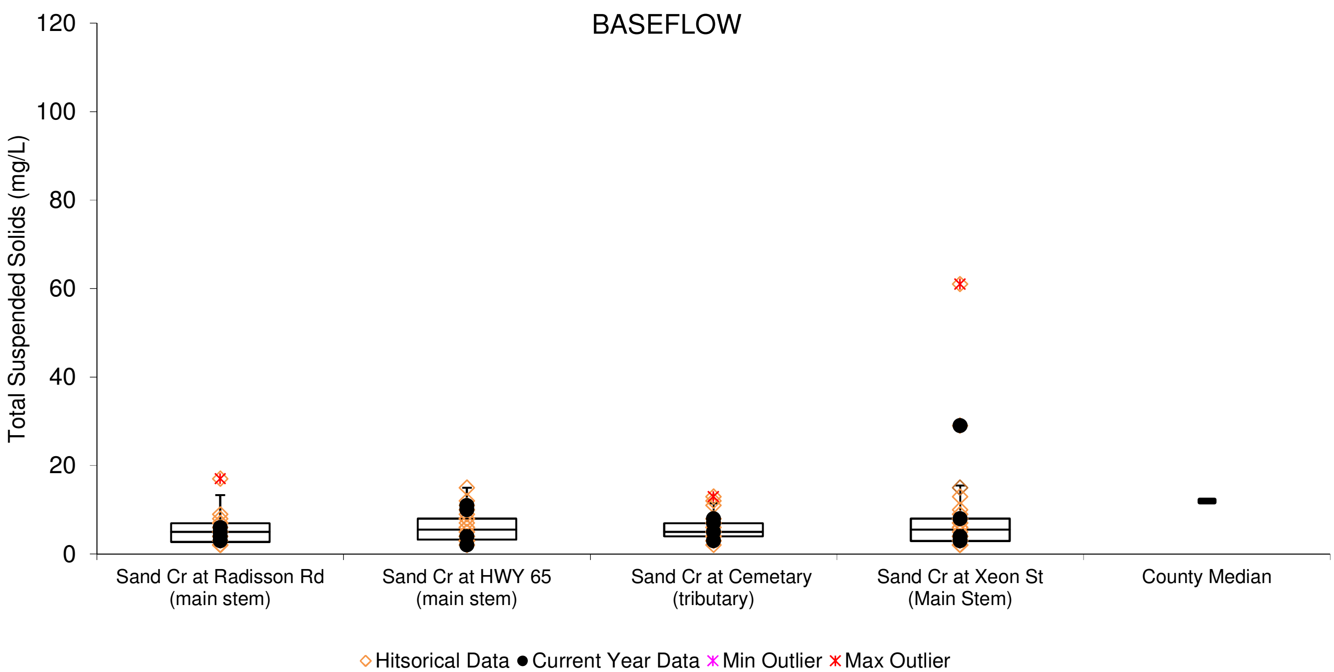
Because it is so close to water quality standards, and because it flows into Coon Creek which has high suspended solids, efforts should be made to lower these pollutants in Sand Creek. The Coon Creek Watershed District is already installing projects toward this end. Projects in the lower watershed are 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 2014.

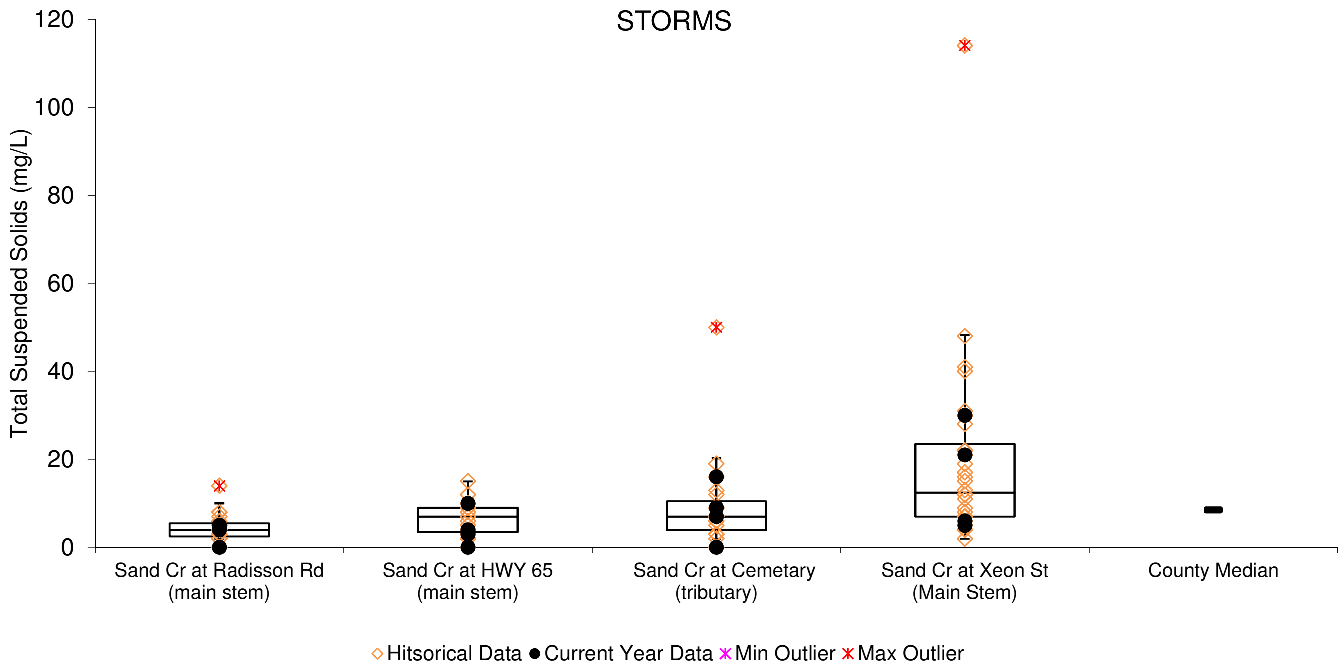
	Turbidity (FNRU)	Total Suspended Solids (mg/L)	State Standard*	N
Baseflow	5.0	5.5	30 mg/L TSS	32
Storms	12.0	12.5		32
All	8.0	7.5		64
Occasions > new state TSS standard				5 during storms, 1 baseflow

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

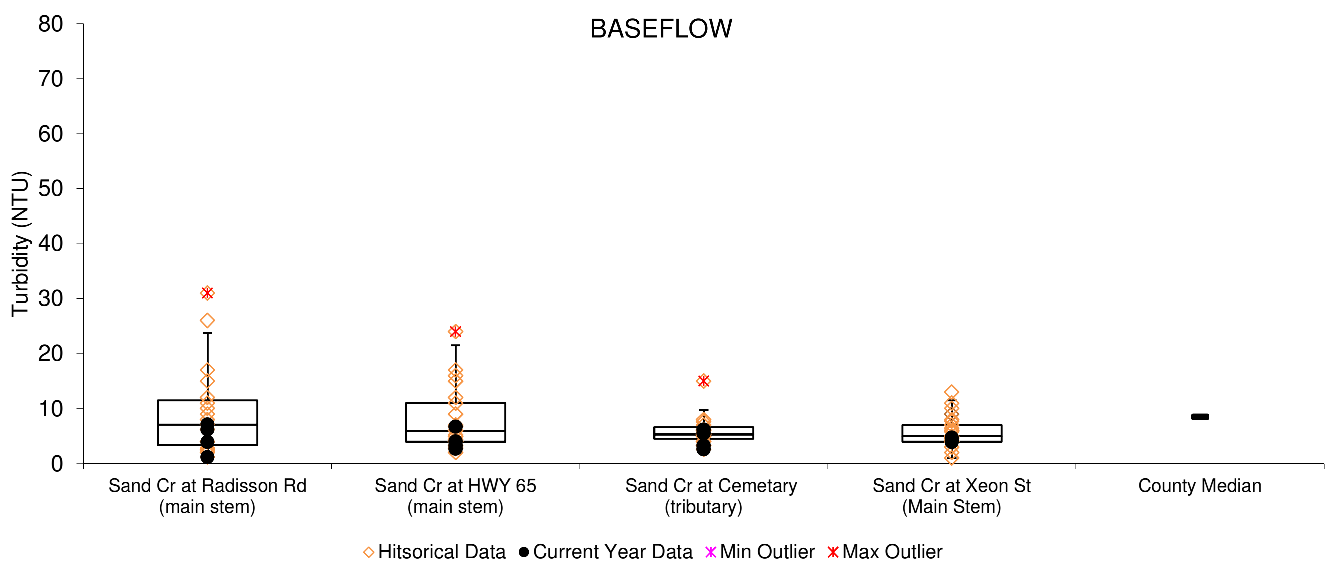
Total suspended solids at Sand Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



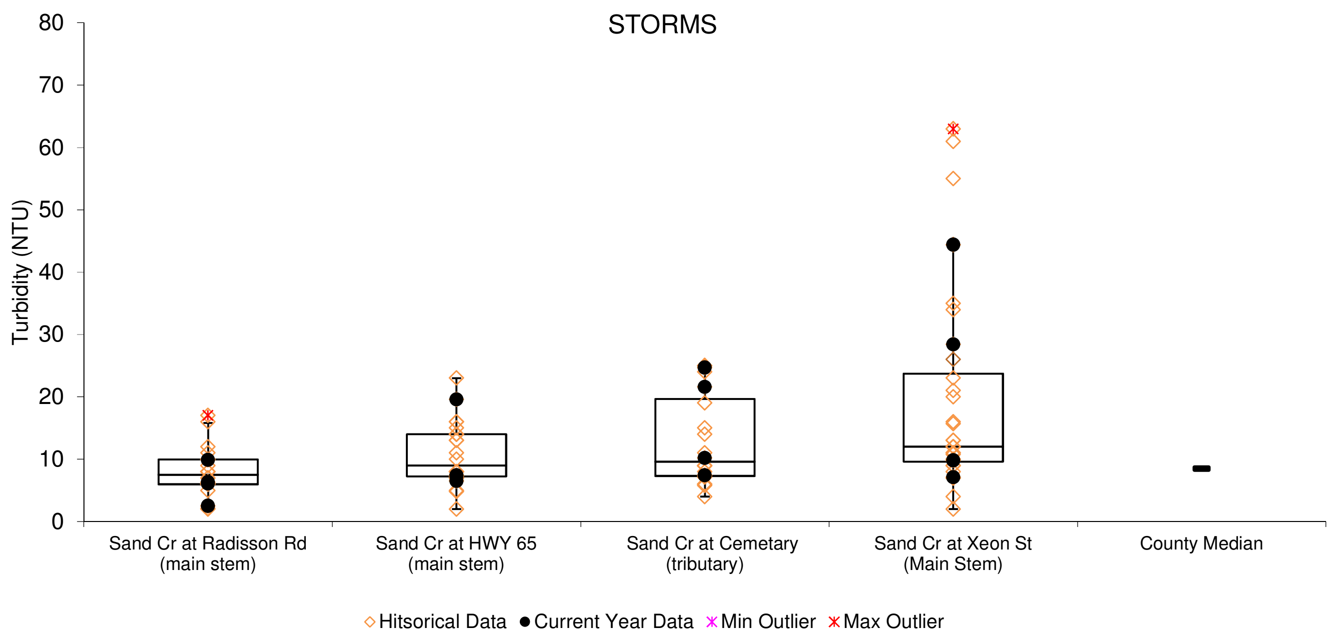
Total suspended solids at Sand Creek continued…



Turbidity at Sand Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Turbidity at Sand Creek continued…



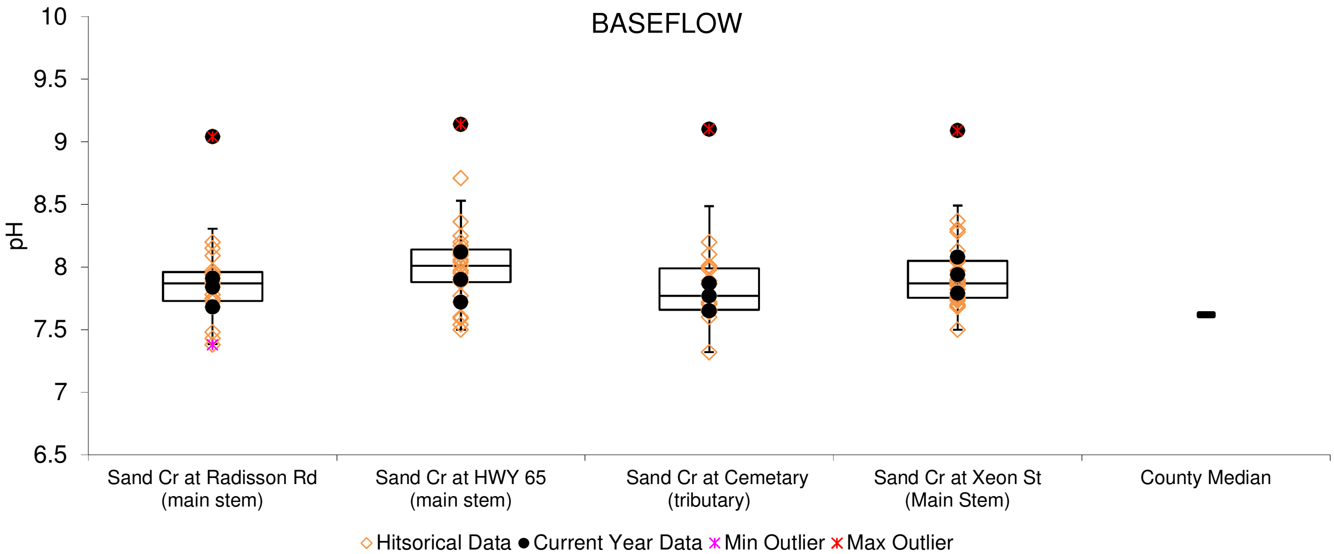
pH

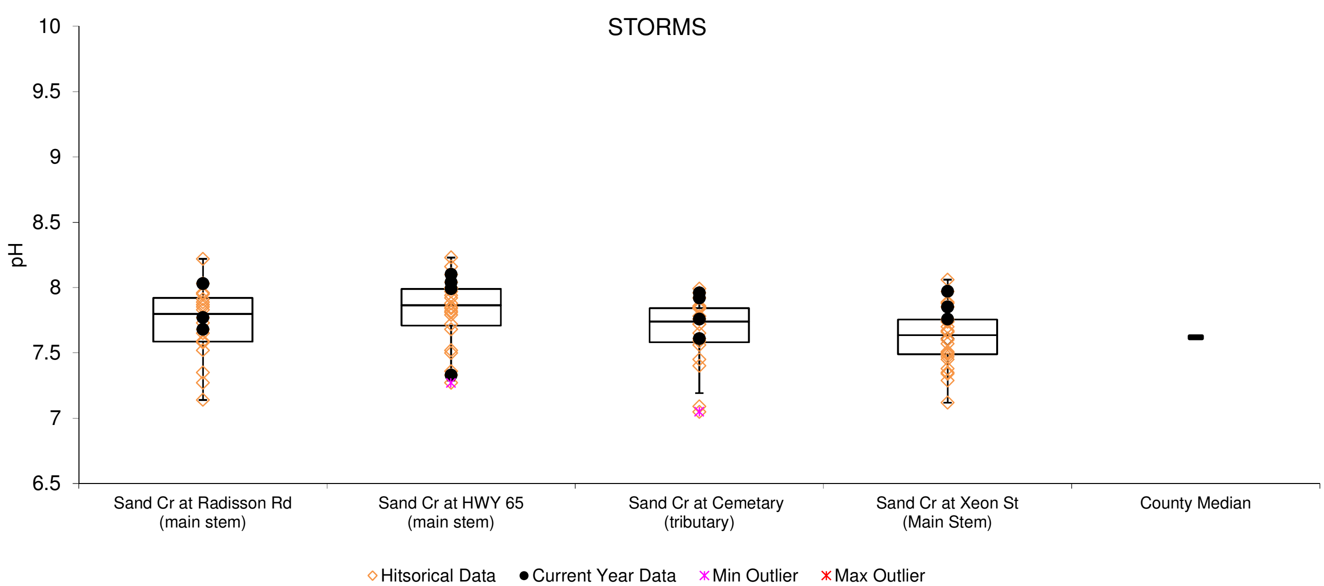
Sand Creek pH was within the expected range at all sites and during all conditions (see figures below), ranging from 7.05 to 9.14. The median was 7.76. The Minnesota Pollution Control Agency water quality standards set an expectation for pH between 6.5 and 8.5. At all sites pH was lower during storms because rainwater has a lower pH.

Median pH in Sand Creek. Data is from Xeon St for all years through 2014.

	pH	State Standard	N
Baseflow	7.87	6.5-8.5	31
Storms	7.64		30
All	7.76		61
Occasions outside state standard			2

pH at Sand Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Dissolved Oxygen

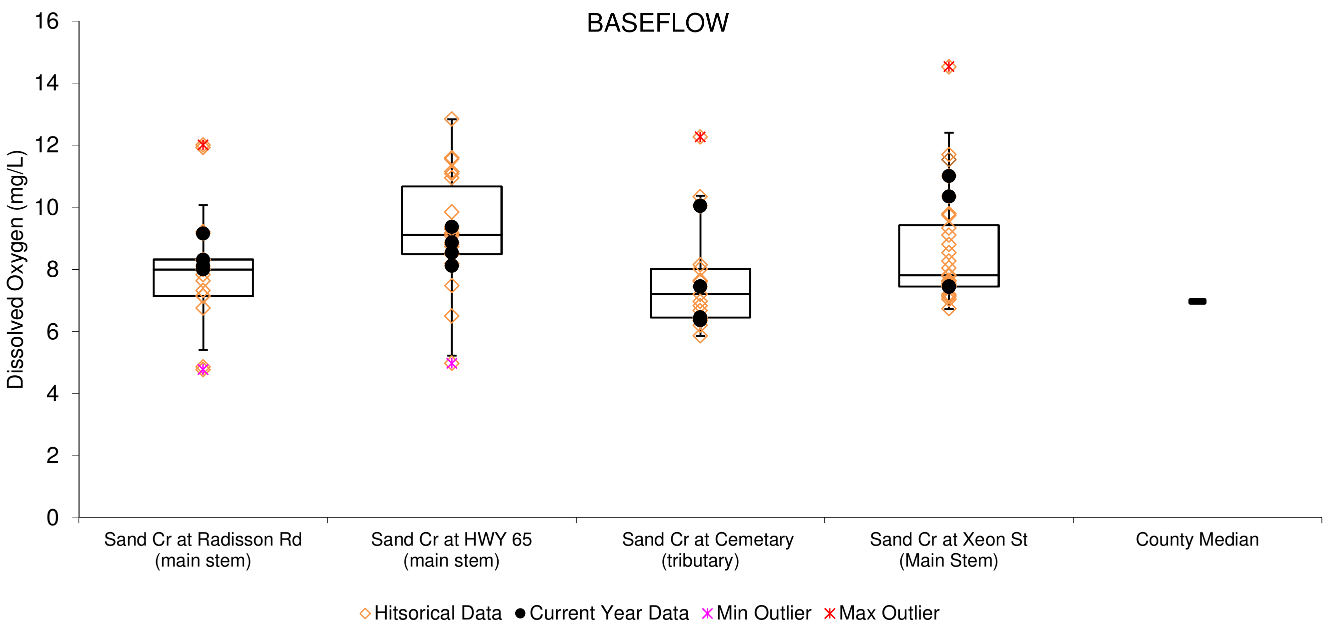
Dissovled oxygen (DO) essential for aquatic life. Fish, invertebrates, and other aquatic life suffer if DO is below 5 mg/L. Low DO can be a symptom of organic pollution, the decomposition of which reduces oxygen.

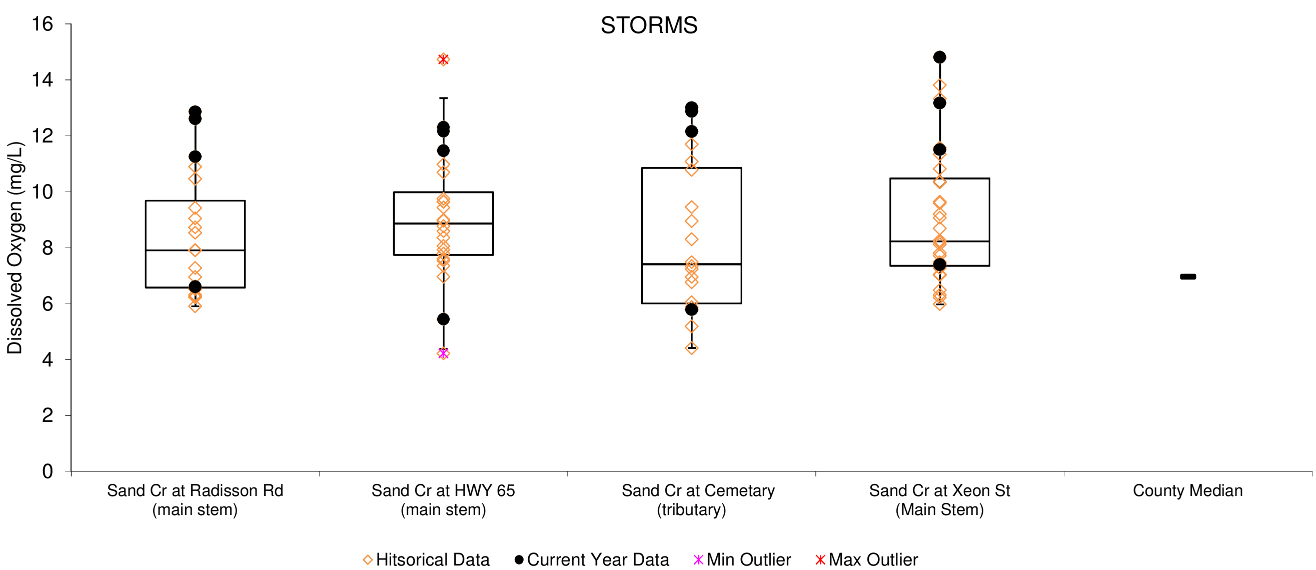
Dissolved oxygen in Sand Creek was within the acceptable level (>5 mg/L) on 97.3% of the site visits (see table figure below). On five occasions it dropped below 5 mg/L. Two were during storms and three during baseflow, suggesting the issue is not flow-dependent. Overall, we do not have concerns about dissolved oxygen levels in Sand Creek.

Median dissolved oxygen in Sand Creek. Data is from Xeon St for all years through 2014.

	Dissolved Oxygen (mg/L)	**State Standard**	**N**
Baseflow	7.81	5 mg/L daily minimum	28
Storms	8.23		32
All	8.09		60
Occasions <5 mg/L			0 at Xeon St., 5 at other sites

Dissolved Oxygen at Sand Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating 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 most probable number per 100 milliliters of water (MPN) or if the geometric mean of five samples taken within 30 days is greater than 126 MPN.

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 exceedance. We can, however, perform other examination of the data.

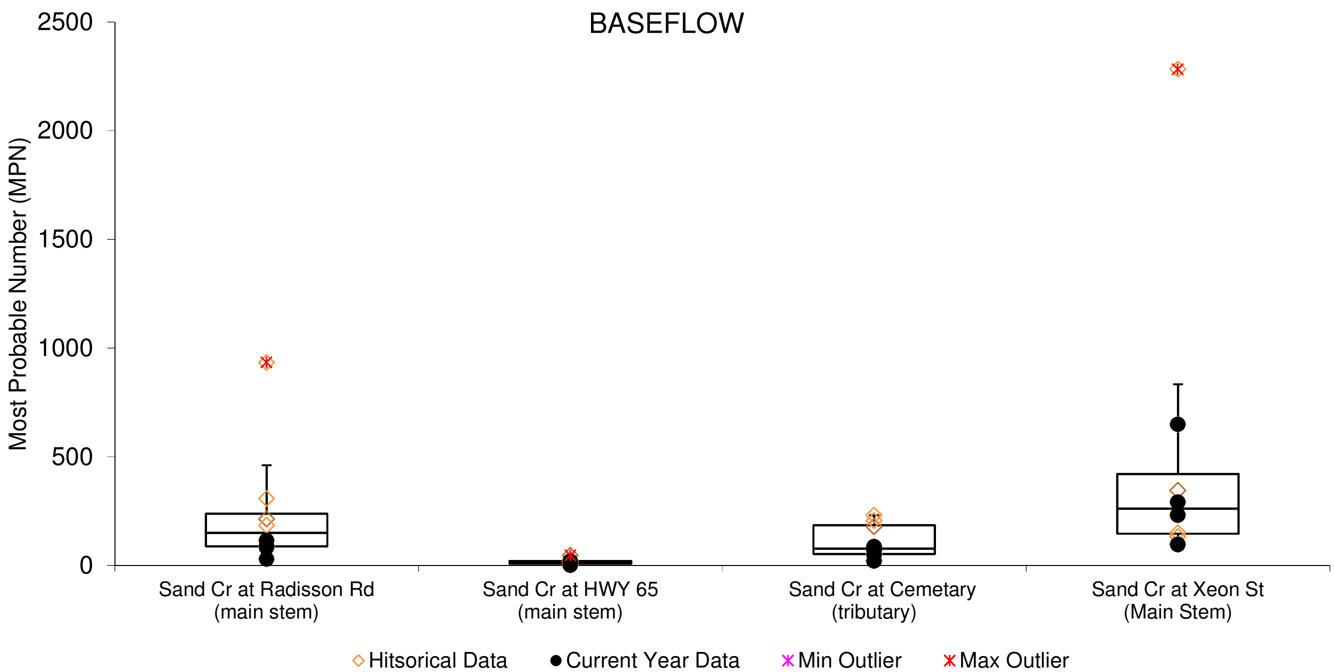
2014 E. coli results were much less than 2013. During baseflow E. *coli* was moderate and showed slight upstream to downstream increase after highway 65. Median E. *coli* during baseflow from upstream to downstream were 87, 8.5, 59.5, and 261 MPN, respectively. Other than the furthest downstream site E. coli during baseflow generally did not exceed 126 MPN on a regular basis.

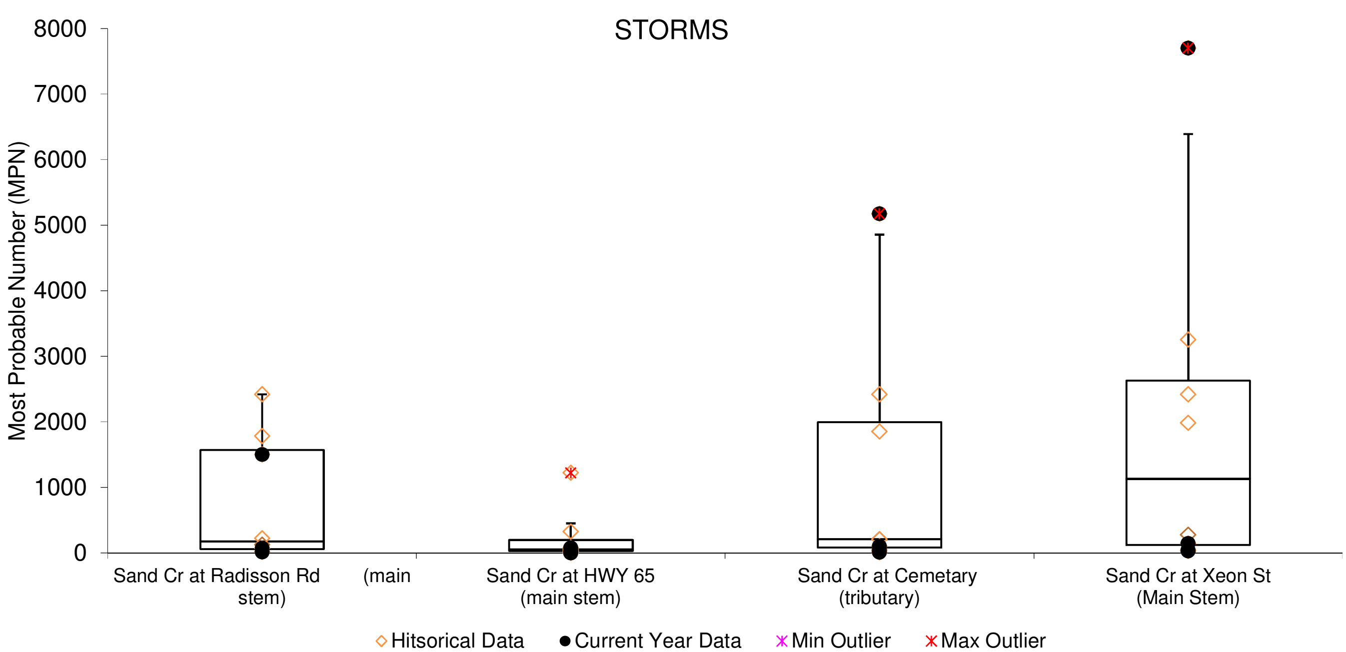
During storms E. coli was significantly higher and more variable, and there was modest increase from upstream to downstream after Highway 65. Median E. coli during storms from upstream to downstream were 47, 22.5, 1030, and 2203 MPN, respectively. E. coli levels during storms grossly exceed the 126 MPN on most occasions (88% of samples taken).

Median E. *coli* in Sand Creek. Data is from All Sites for 2014.

	E. *coli* (MPN)	**State Standard**	**N**
Baseflow	94	Monthly Geometric Mean >126	32
Storms	210		32
All	127		64
Occasions >126 MPN **Occasions >1260 MPN**		Monthly 10% average >1260	14 baseflow, 18 storm 1 baseflow, 11 storm

E. *coli* at Sand Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating lines).





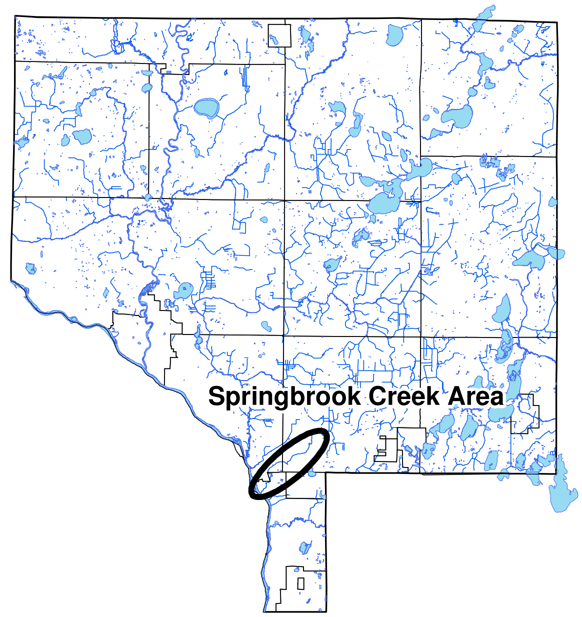
SPRINGBROOK CREEK

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 2013-2014
Springbrook at 85th Avenue 2013-2014
Springbrook at 79th Way 2012-2014

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 in all events but one. pH rose above the 8.5 unit limit at all monitoring sites during one baseflow event in 2014.

- 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 more than two times greater than the median for all Anoka County streams (0.852 mS/cm compared to 0.362 mS/cm). Conductivity was high both during storms (median 0.689 mS/cm) and baseflow (median 0.891 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.

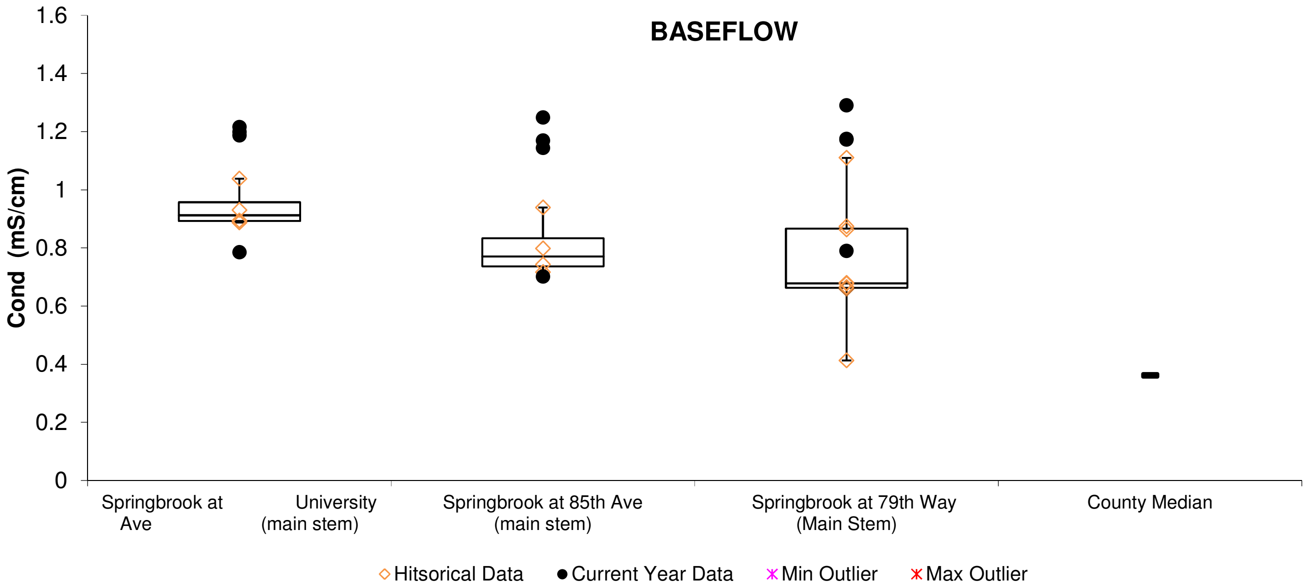
Springbrook's high dissolved pollutants are likely from stormwater runoff, with road deicing salts as one, but not the only, contributor. Greater road densities and a long history of road salting contribute to high chlorides. Chlorides are persistent in the environment; not effectively broken down by 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.

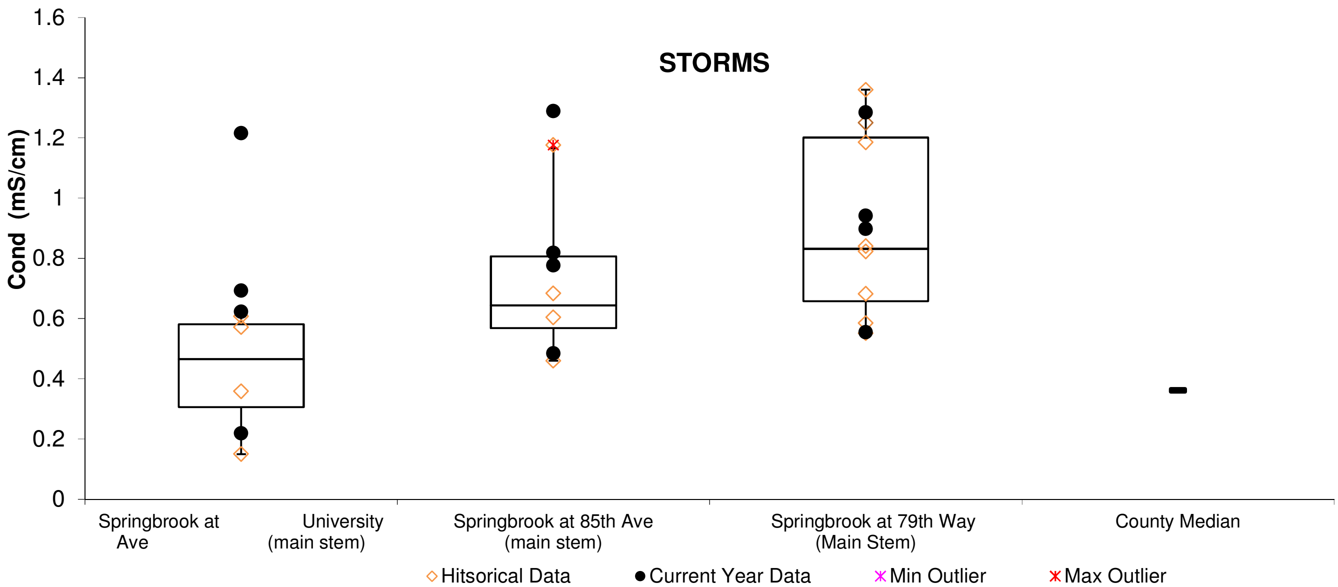
Dissolved pollutants are especially difficult to manage once in the environment. They are not removed by stormwater settling ponds. Infiltration practices can provide some treatment through biological processes in the soil, but also risk contaminating groundwater. The first approach to dissolved pollutant 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 2014.

<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>0.827</td><td>129</td><td rowspan="3">Conductivity – none
Chlorides 860 mg/L acute, 230 mg/L chronic</td><td>12</td></tr>
<tr><td>Storms</td><td>0.869</td><td>216</td><td>12</td></tr>
<tr><td>All</td><td>0.852</td><td>159</td><td>24</td></tr>
</table>

Conductivity at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 (0.110 mg/L) and storms (0.108 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.

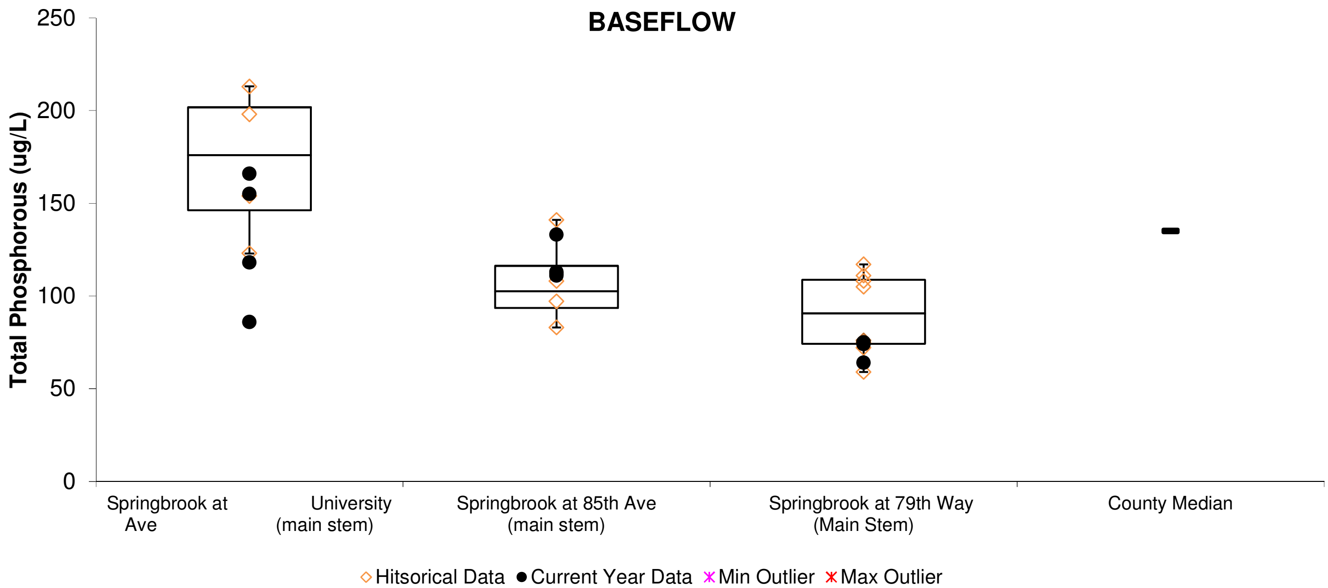
The MN Pollution Control Agency is likely to adopt 0.100 mg/L as a new phosphorus standard for streams. Based on data collected to date, Springbrook would probably violate this standard and then be designated as "impaired."

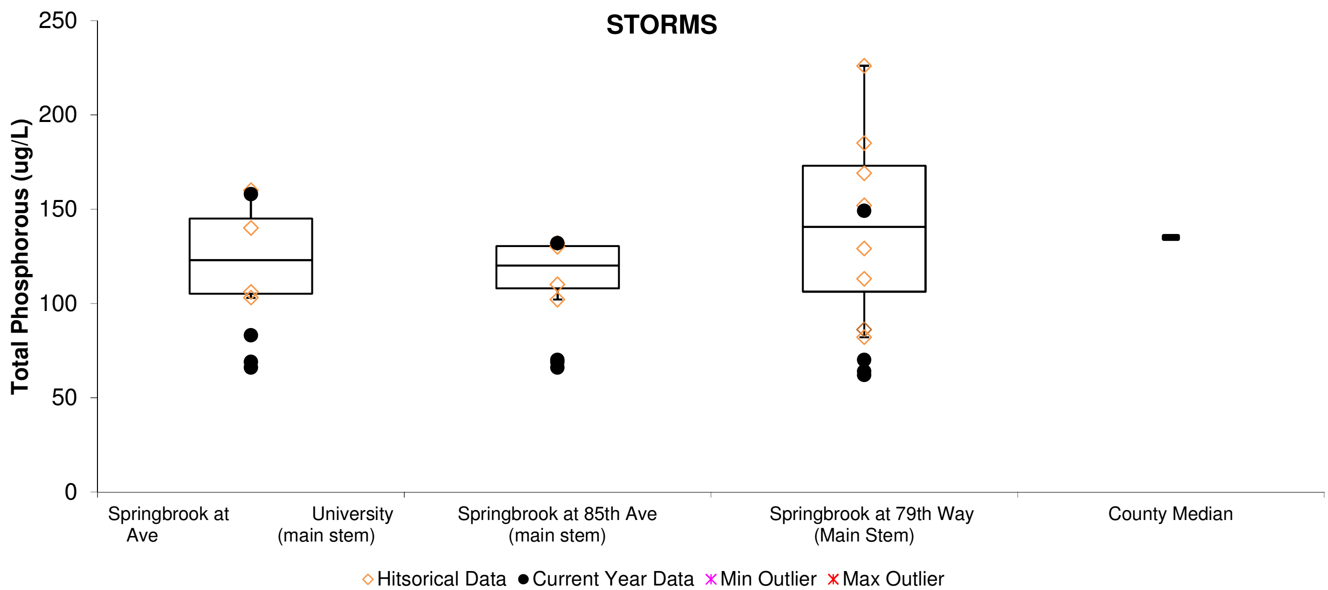
Median total phosphorus in Springbrook Creek. Data is from 79th Way for all years through 2014.

	Total Phosphorus (ug/L)	State Standard*	N
Baseflow	75	100	12
Storms	121		12
All	85		24
Occasions > state standard			11 (7 during storms)

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

Total phosphorus at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 60.3 NTU. During baseflow turbidity has not exceeded 7. TSS during baseflow never exceeded 11 and averaged less than 5. Overall, these levels are within the desirable range for streams in this area.

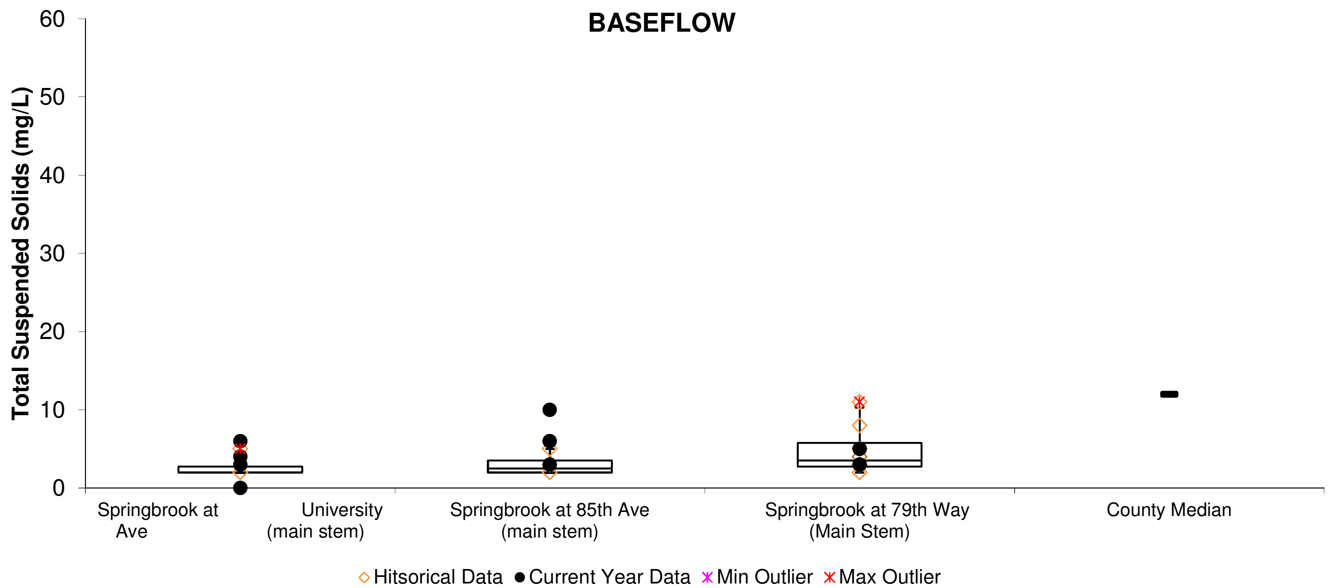
The MN Pollution Control Agency is in the process of modifying the state water quality standard in this region. The new standard will likely be 30 mg/L TSS, with no turbidity standard. Only one of thirty two samples exceeded this standard. 20 samples will be needed for the MPCA to determine if water quality standards for suspended solids are being met.

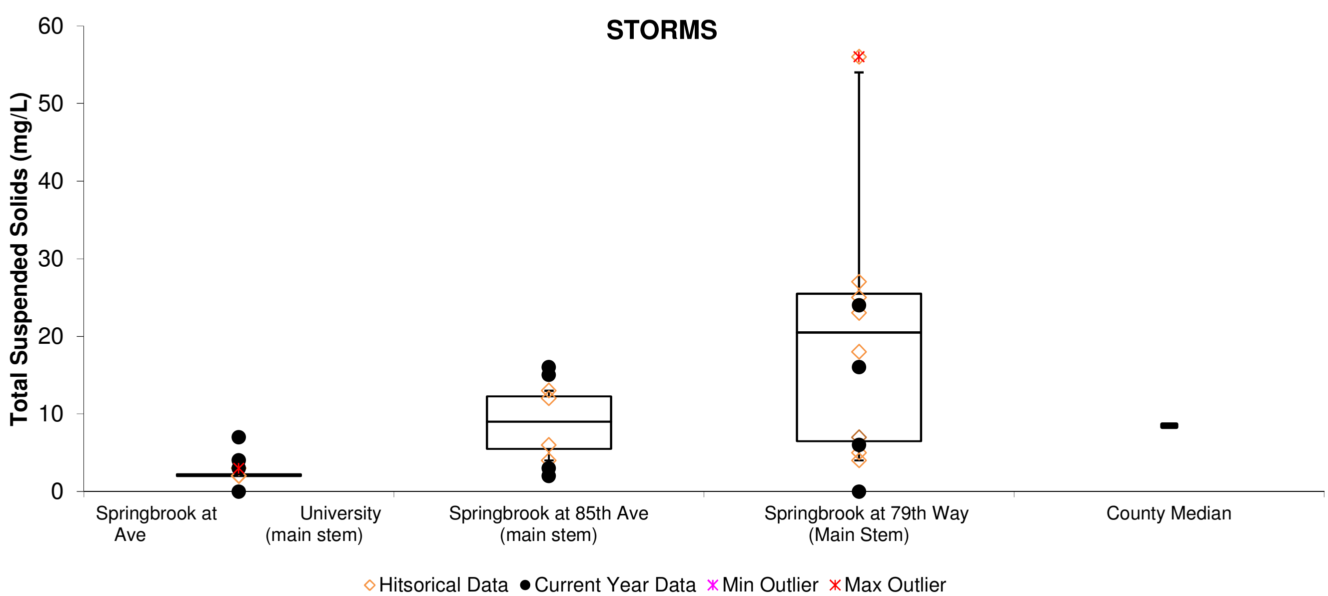
Median turbidity and suspended solids in Springbrook Creek. Data is from 79th Way for all years through 2014.

	Turbidity (FNRU)	**Total Suspended Solids (mg/L)**	**State Standard***	**N**
Baseflow	1.75	3.5	30 mg/L TSS	12
Storms	13.95	18		12
All	4.3	5		24
Occasions > new state TSS standard				1

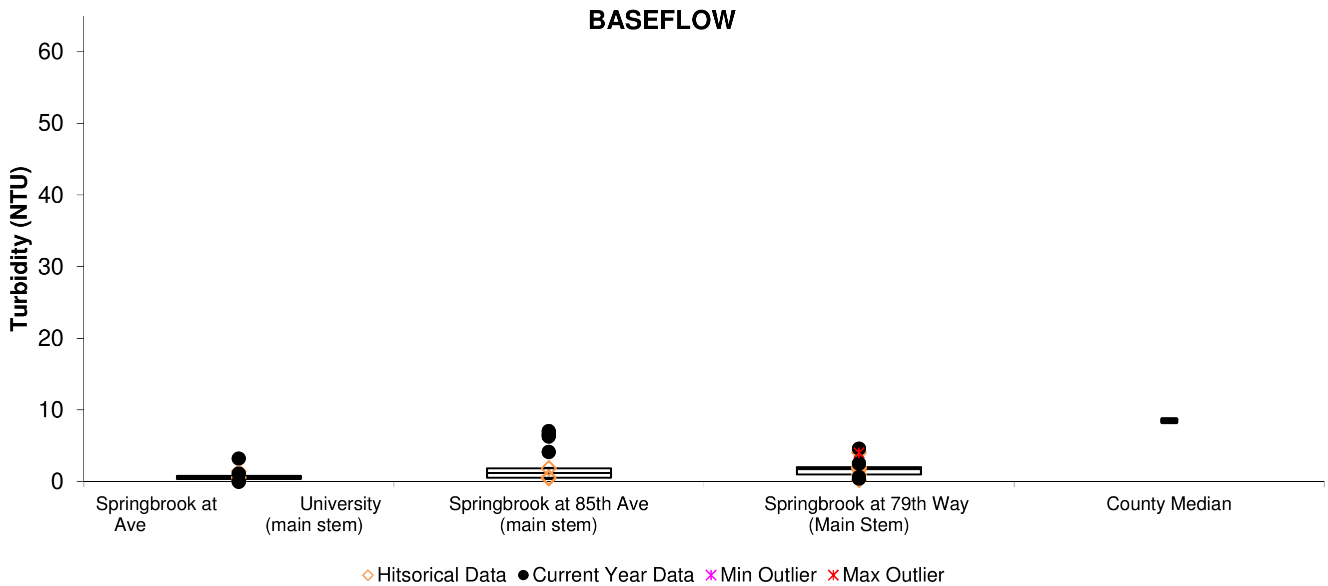
*New state standards are under development. The standard listed is the likely new threshold.

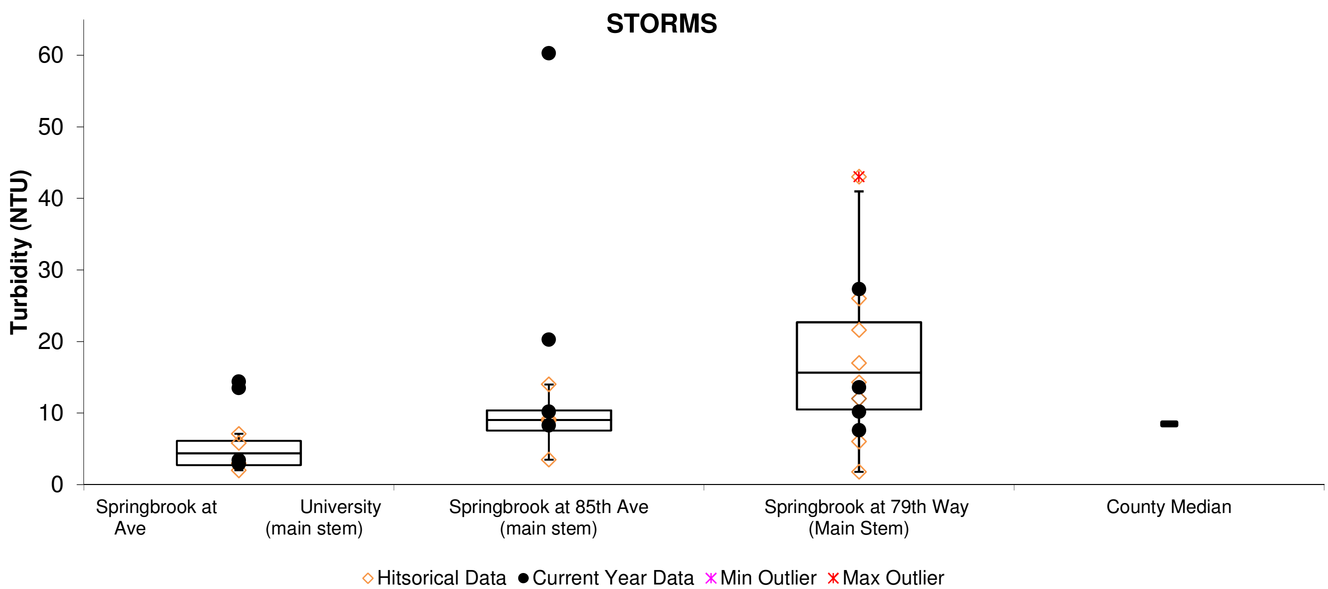
Total suspended solids at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Turbidity at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





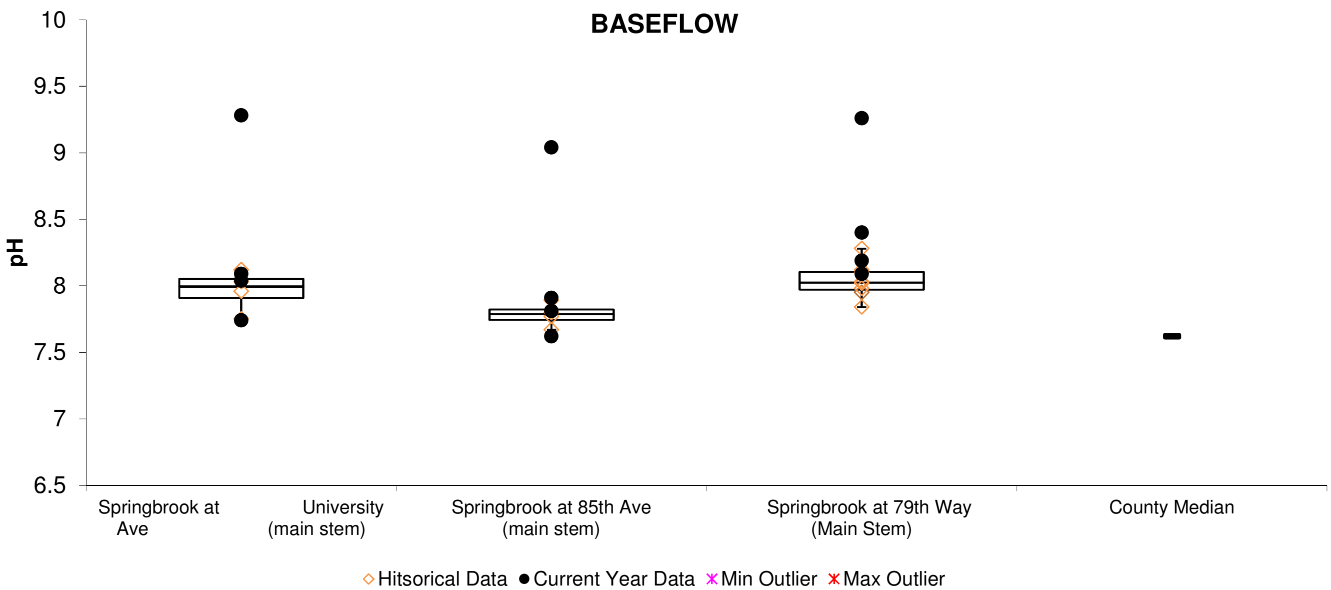
pH

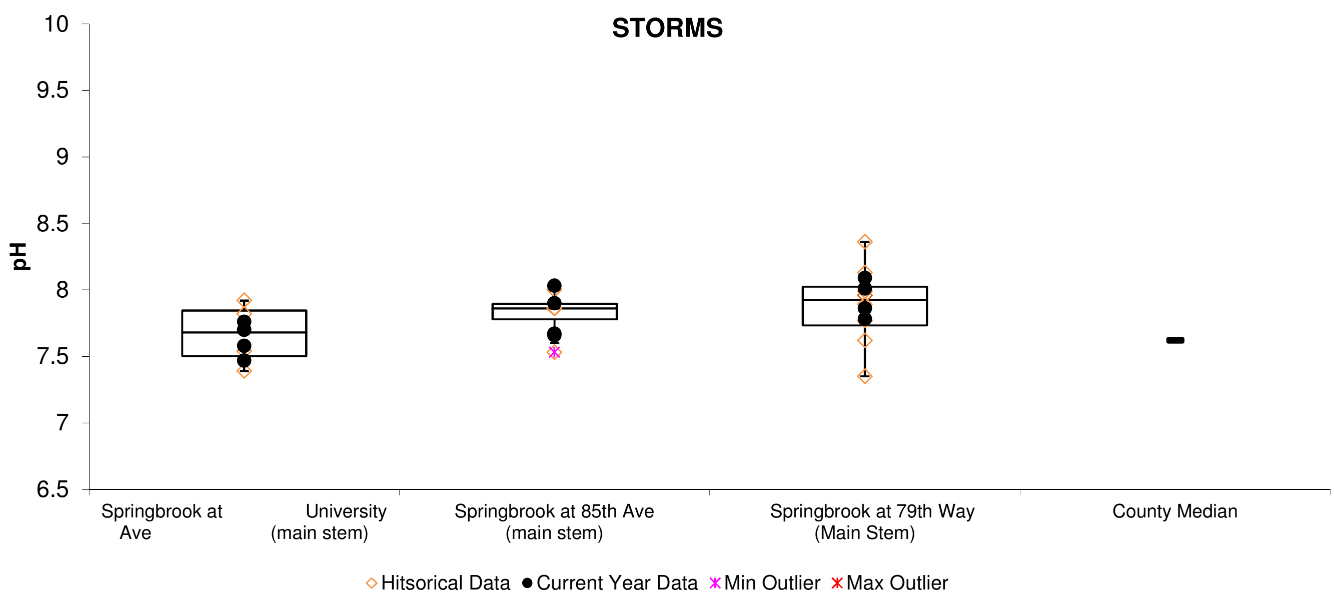
Springbrook Creek pH has been within the expected range at all sites and all conditions for each sampling event until 2014. On one baseflow sampling event in September of 2014 all three sites monitored exceeded the 8.5 standard for pH. All measurements collected for Springbrook pH has ranged from 7.35 to 9.28. 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 2014.

	pH	State Standard	N
Baseflow	8.10	6.5-8.5	12
Storms	7.93		12
All	8.02		24
Occasions outside state standard			1

pH at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





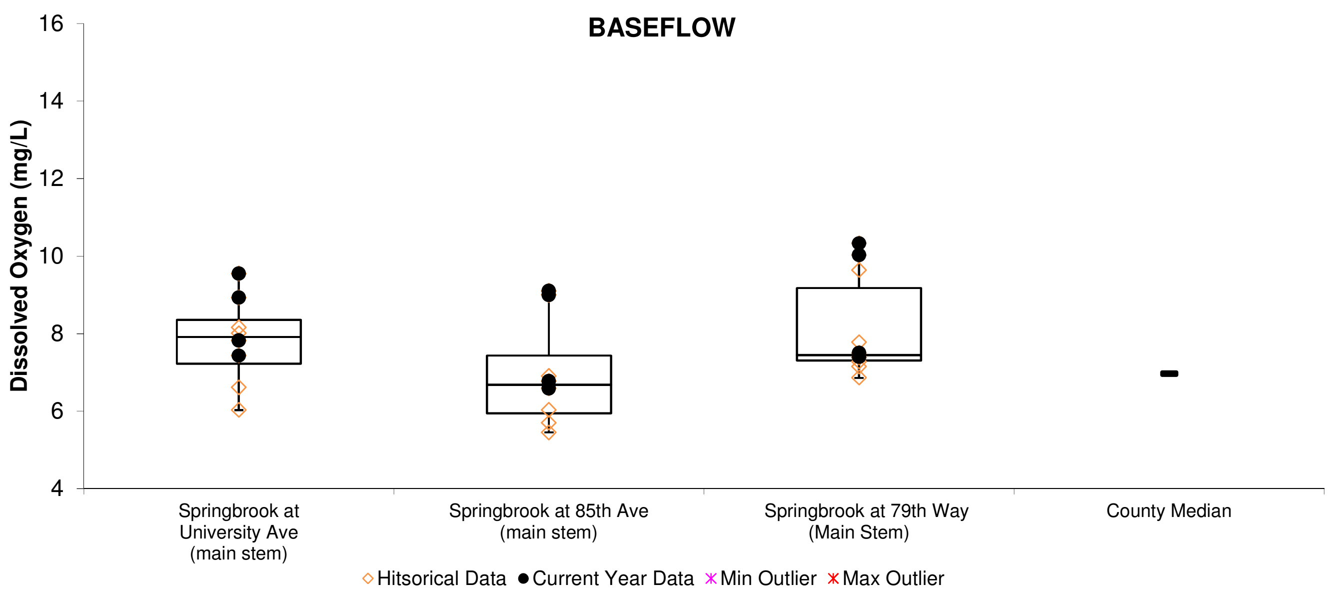
Dissolved Oxygen

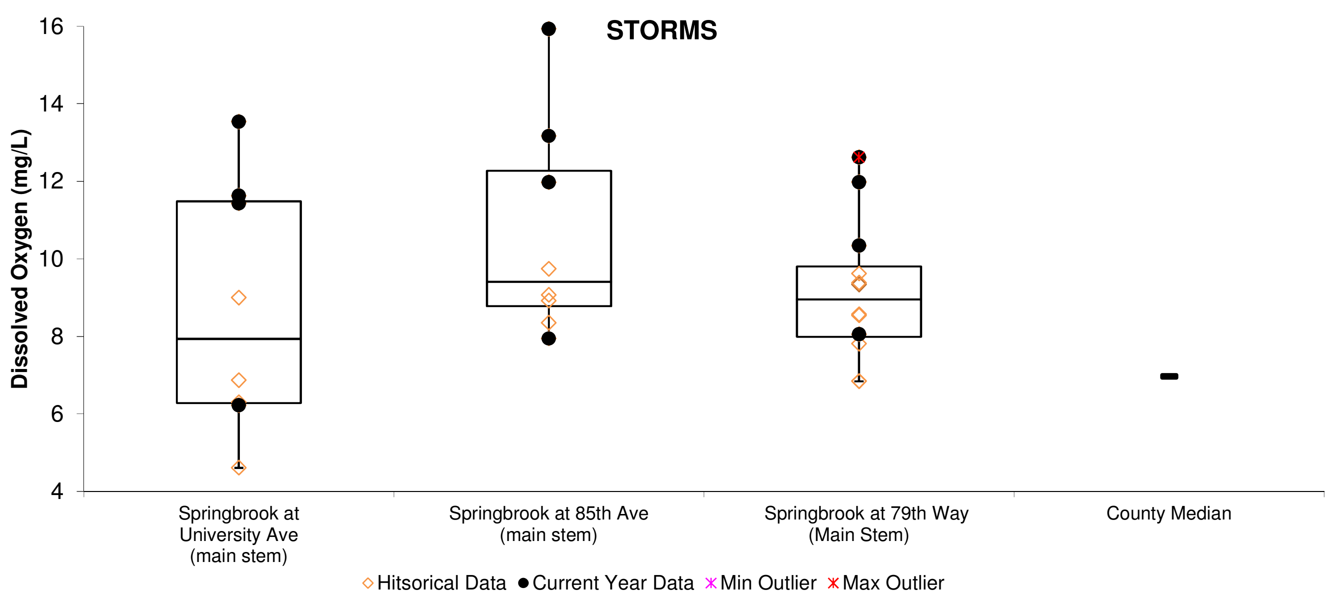
Dissovled oxygen (DO) essential for aquatic life. Fish, invertebrates, and other aquatic life suffer if DO is below 5 mg/L. Low DO can be a symptom of organic pollution, the decomposition of which reduces oxygen. Dissolved oxygen in Springbrook Creek was within the acceptable level (>5 mg/L) during all 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 2014.

	Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	7.45	5 mg/L daily minimum	12
Storms	8.96		12
All	8.30		24
Occasions <5 mg/L			0

Dissolved Oxygen at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 most probable number per 100 milliliters of water (MPN) or if the geometric mean of five samples taken within 30 days is greater than 126 MPN.

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 exceedance. 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 116.5, 107, and 135 MPN, respectively. E. coli during baseflow exceeded 126 MPN in 58% of samples taken.

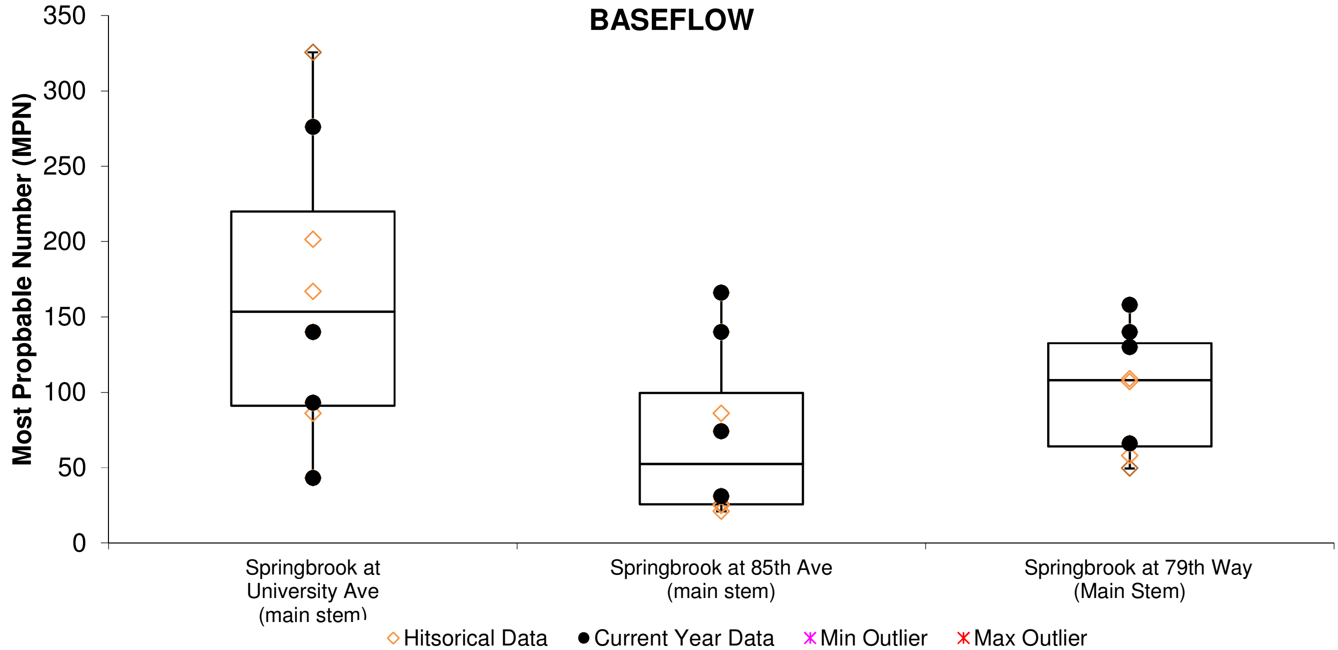
During baseflow the upstream-most at University Avenue had the second highest E. coli. It appears that the ponds and wetlands between University Ave and 85th Ave sites may be providing baseflow treatment.

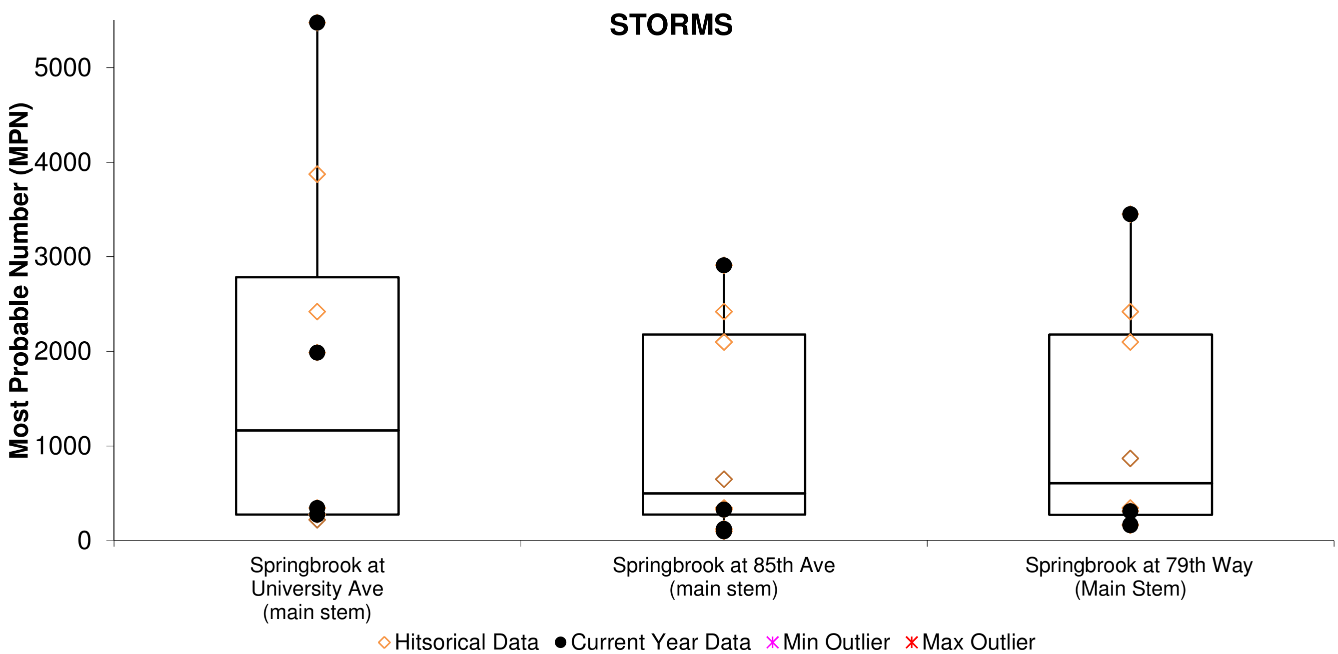
During storms E. coli was significantly higher (note the difference in scale on below charts), and there was very slight increase from upstream to downstream. Median E. coli during storms from upstream to downstream were 1348, 1373, and 1482 MPN, respectively. 63% of storm samples exceeded 126 MPN/100ml. All of the events that surpassed the 1260 MPN limit occurred during storms (50% of all storm samples).

Median E. *coli* in Springbrook Creek. Data is from All Sites through 2014.

	E. *coli* (MPN)	**State Standard**	**N**
Baseflow	100	Monthly Geometric Mean >126	24
Storms	497		24
All	168		48
Occasions >126 MPN		Monthly 10% average >1260	10 baseflow, 22 storm
Occasions >1260 MPN			0 baseflow, 10 storm

E. *coli* at Springbrook. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



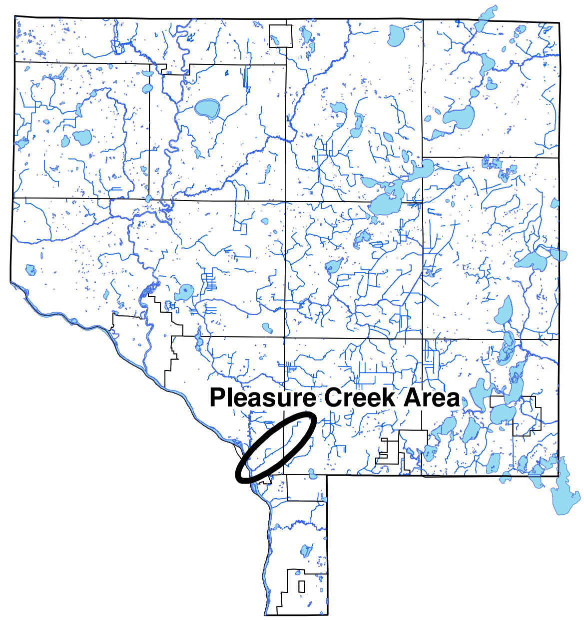


PLEASURE CREEK

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, 2014 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.

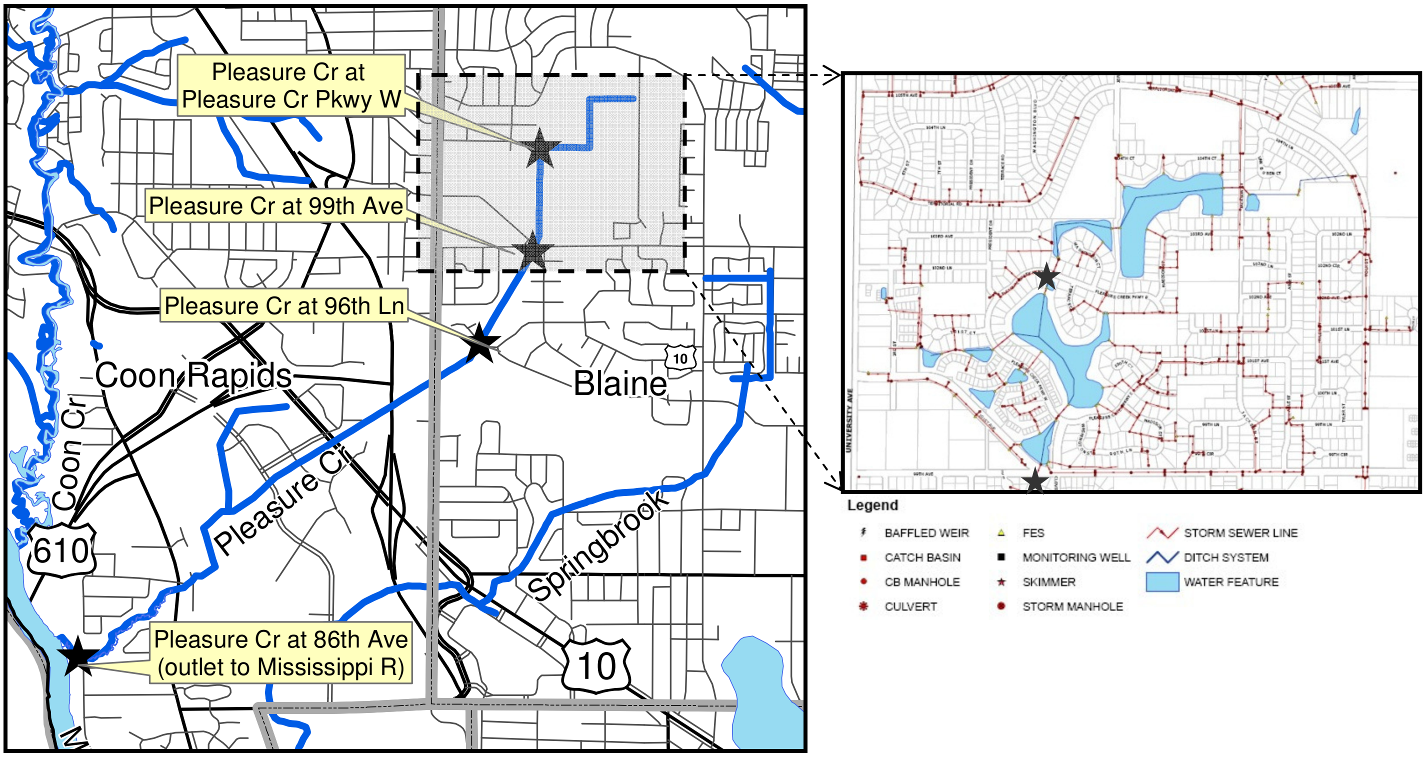
Methods

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 2014.

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:

- <u>Dissolved pollutants</u>, 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.

- <u>Phosphorus</u> 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 may 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. 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. Median baseflow conductivity at the 86th Ave site was 0.796 mS/cm. 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 are likely to be highest. Chlorides were not monitored 2014.

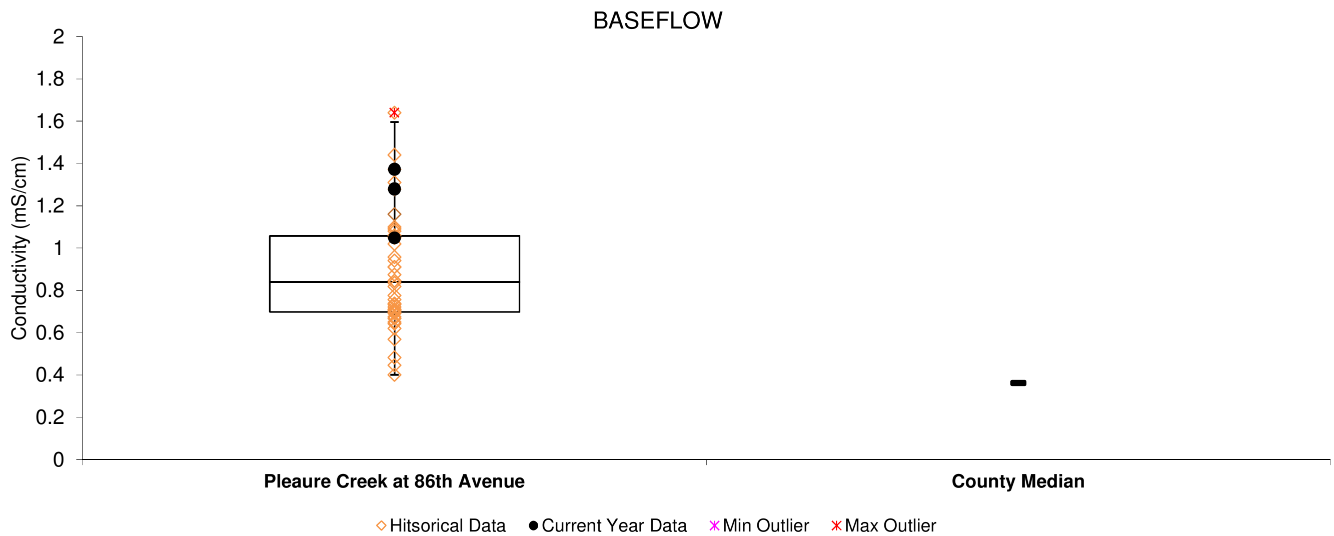
Both conductivity and chlorides where slightly higher during storms than baseflow. Median conductivity was 0.812 mS/cm during storms and 0.796 mS/cm during baseflow. Median chlorides were 178 mg/L during storms and 147 mg/L during baseflow. This result suggests that dissolved pollutants are high in the 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.

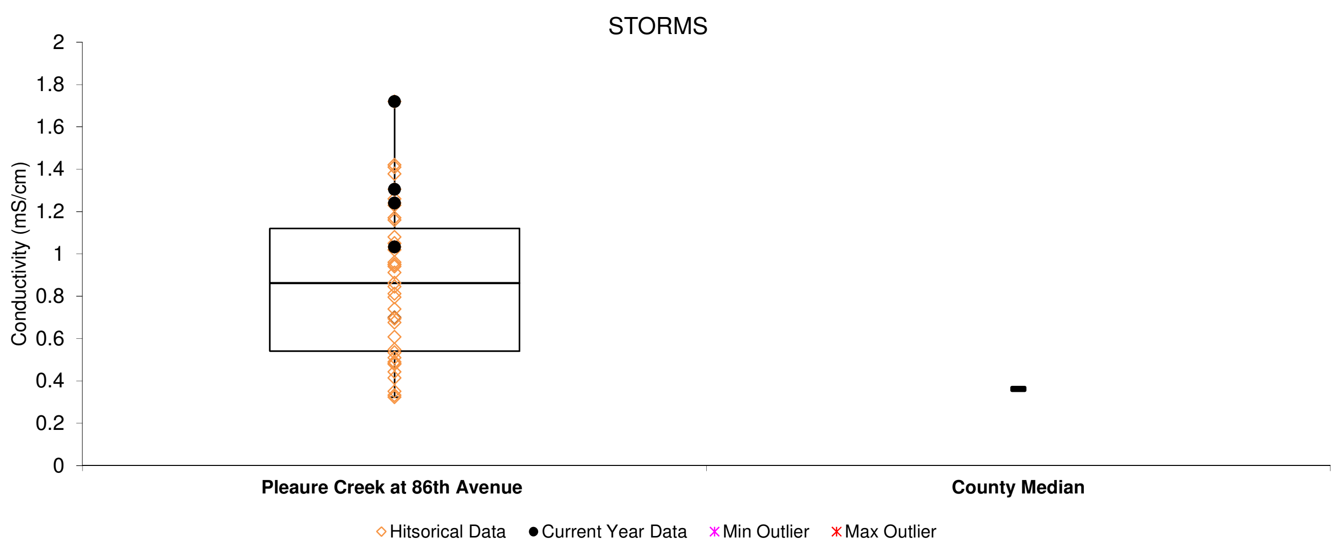
Dissolved pollutants are especially difficult to manage once in the environment. They are not removed by stormwater settling ponds. Infiltration practices can provide some treatment through biological processes in the soil, but also risk contaminating groundwater. The first approach to dissolved pollutant 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 2014.

	Conductivity (mS/cm)	Chlorides (mg/L)	State Standard	N
Baseflow	0.840	147	Conductivity – none Chlorides 860 mg/L acute, 230 mg/L chronic	42
Storms	0.862	178		39
All	0.845	159		81

Conductivity at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 Ave NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Medain	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	0.4	0.796	1.64
Storm	0.323	0.545	0.694	0.443	0.529	1.26	0.414	0.507	0.795	0.343	0.812	1.42
All Events	0.323	0.643	0.707	0.4	0.509	1.26	0.414	0.697	0.795	0.343	0.812	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.

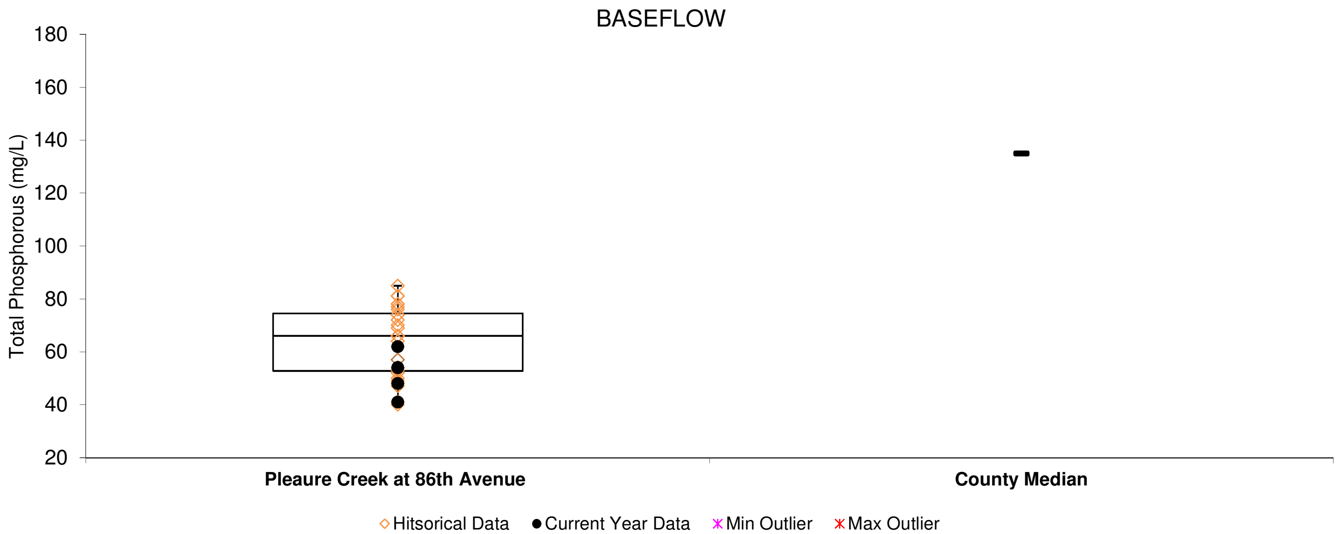
The MN Pollution Control Agency is likely to adopt 100 ug/L as a new phosphorus standard for streams. Based on data collected to date, Pleasure Creek would probably fall within this standard during baseflow and storms.

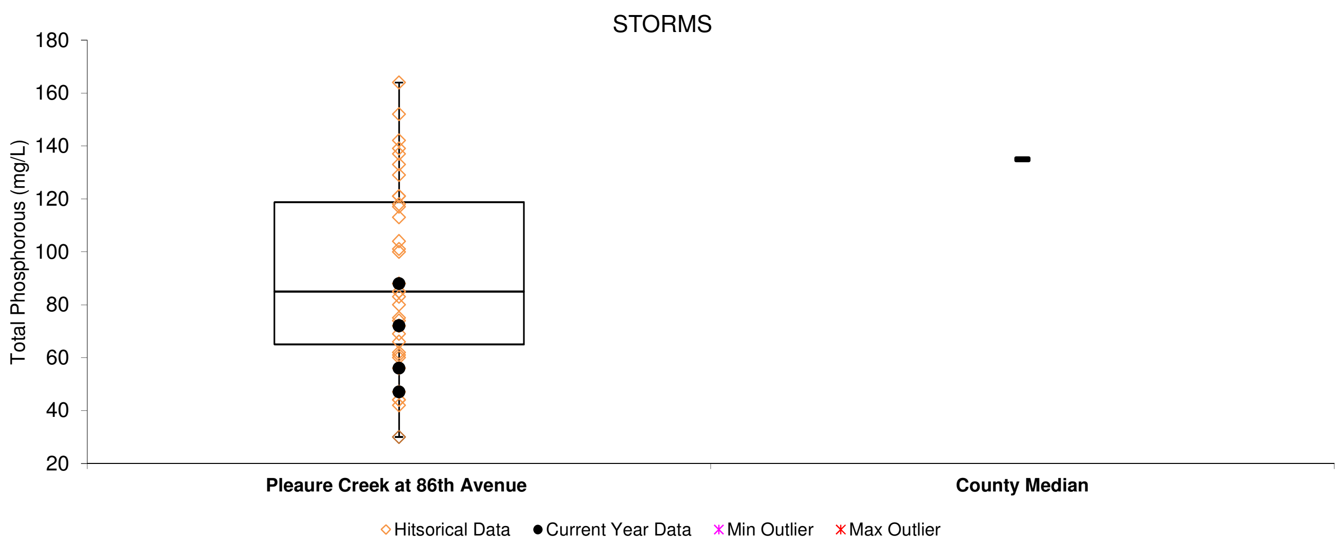
Median TP in Pleasure Creek. Data is from the 86th Avenue site and all years through 2014.

	Total Phosphorus (ug/L)	State Standard*	N
Baseflow	66	100	28
Storms	85		36
All	73		64
Occasions > state standard			14, all during storms

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

Total phosphorus at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 Ave NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Medain	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Baseflow	74	76	78	52	66.5	81	66	73	81	40	67.5	85
Storm	85	127	152	44	61.5	118	44	80	104	30	86.5	164
All Events	74	117	152	44	61.5	118	44	74.5	104	30	74.5	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 higher during storms. The low turbidity and TSS is probably reflective of the effectiveness of large stormwater ponds just upstream of East River Road and the headwaters.

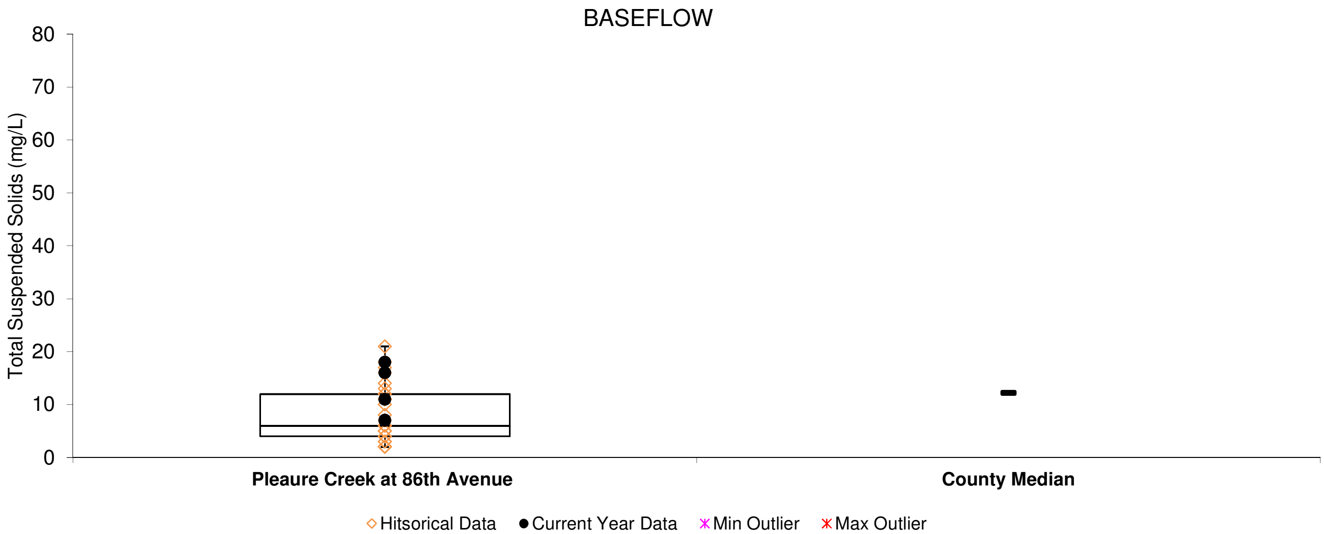
The MN Pollution Control Agency is in the process of modifying the state water quality standard in this region. The new standard will likely be 30 mg/L TSS, with no turbidity standard. At the outfall to the Mississippi River Pleasure Creek will likely exceed this standard during storms and be considered 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.

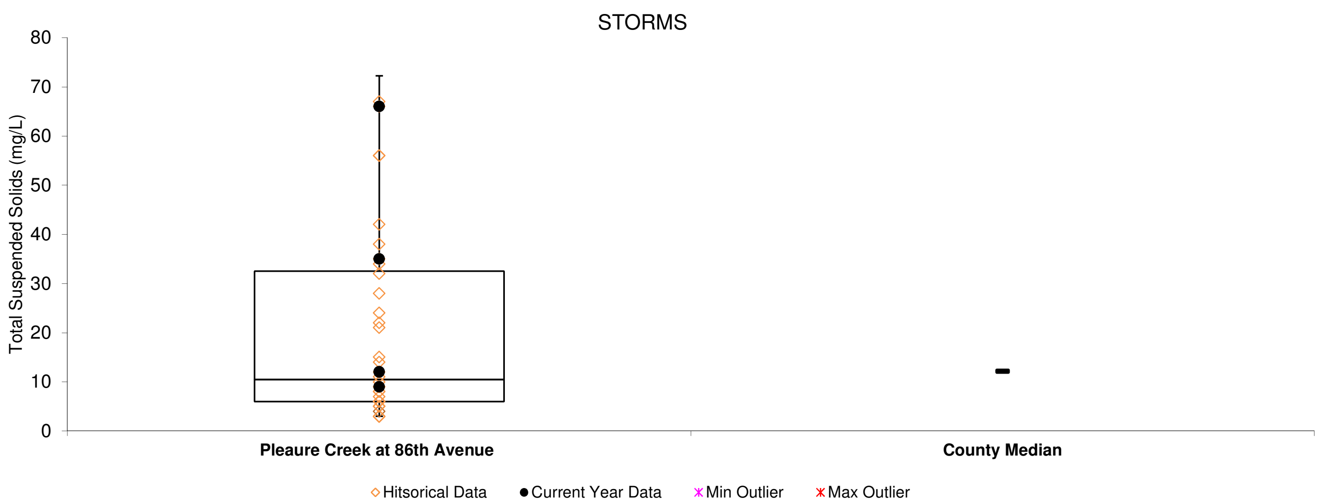
Median turbidity and suspended solids in Pleasure Creek. Data is from the 86th Avenue site and all years through 2014.

	Turbidity (FNRU)	Total Suspended Solids (mg/L)	State Standard*	N
Baseflow	8	6	30 mg/L TSS	28
Storms	18	10.5		36
All	12.5	9		64
Occasions > new state TSS standard				10, all during storms

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

Total suspended solids at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

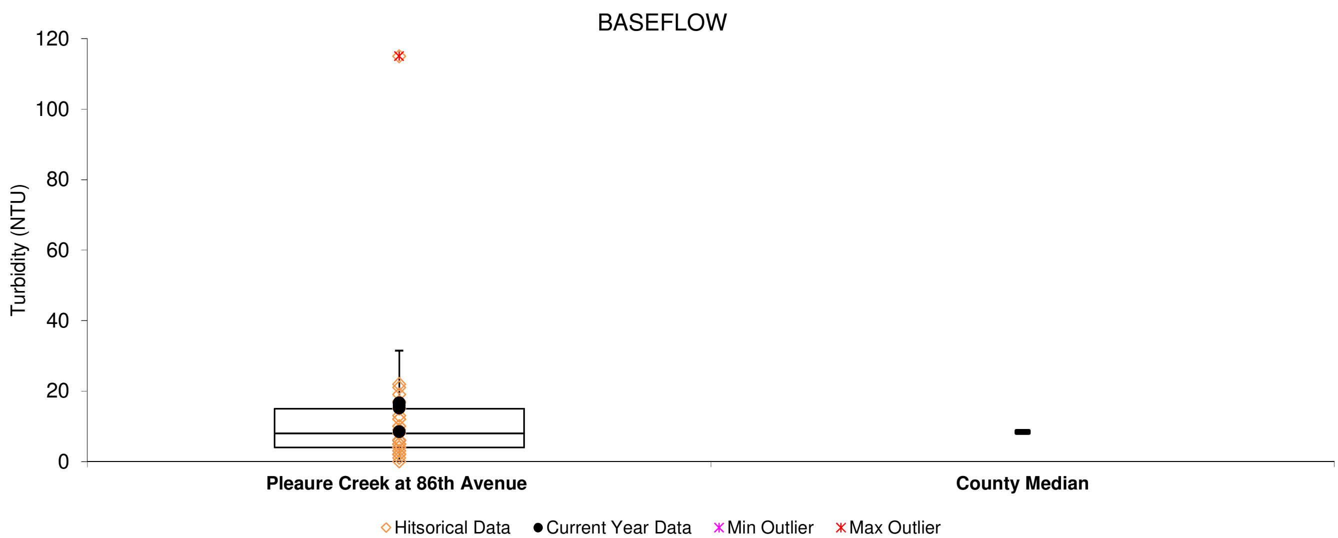


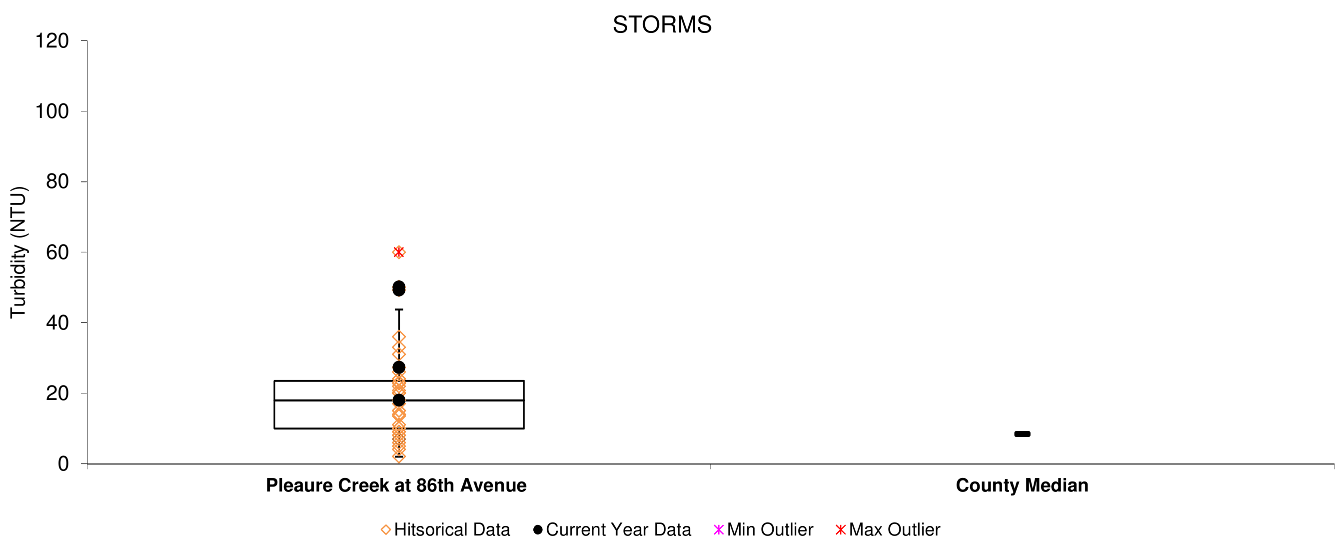


Total Suspended Solids: All Sites, all years in mg/L

	Pleasure Creek at Pleasure Cr Pkwy			Pleasure Creek at 99th Ave NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Medain	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	3	9.5	81
All Events	6	9	22	2	4	10	2	4	8	2	8	81

Turbidity at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 NTU

	Pleasure Creek at Pleasure Cr Pkwy			Pleasure Creek at 99th Ave NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Medain	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Baseflow	2	12	17	2	4	8	0	2	10	0	6.2	115
Storm	8	14	60	3	12.5	20	5	8.5	20	2	17	60
All Events	2	14	60	2	8	20	0	5	20	0	11.1	115

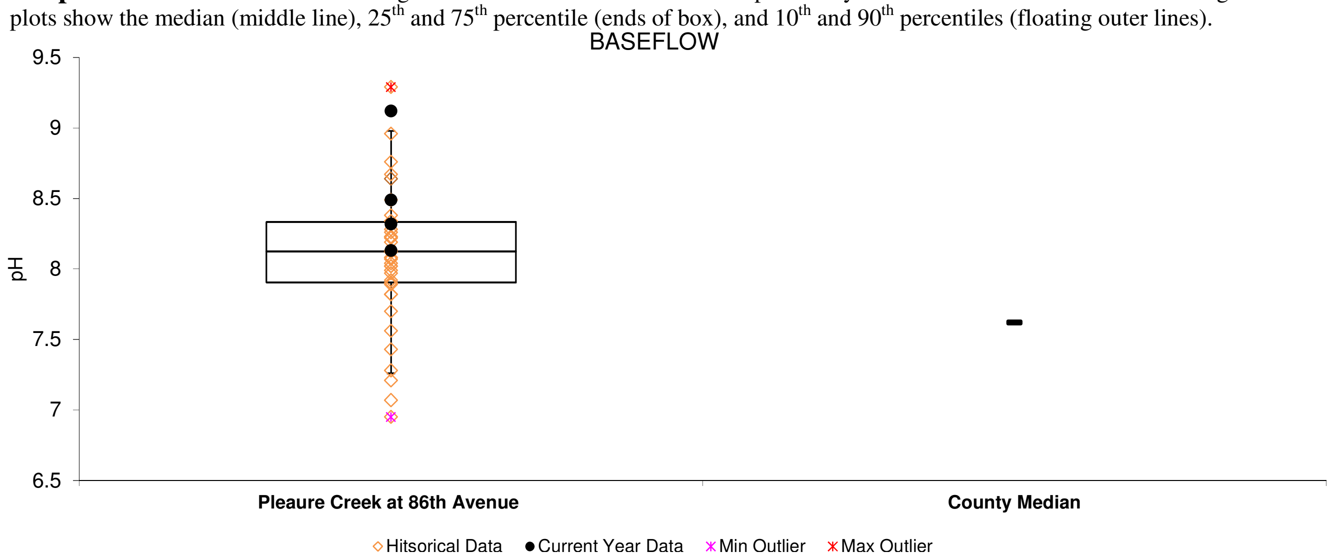
pH

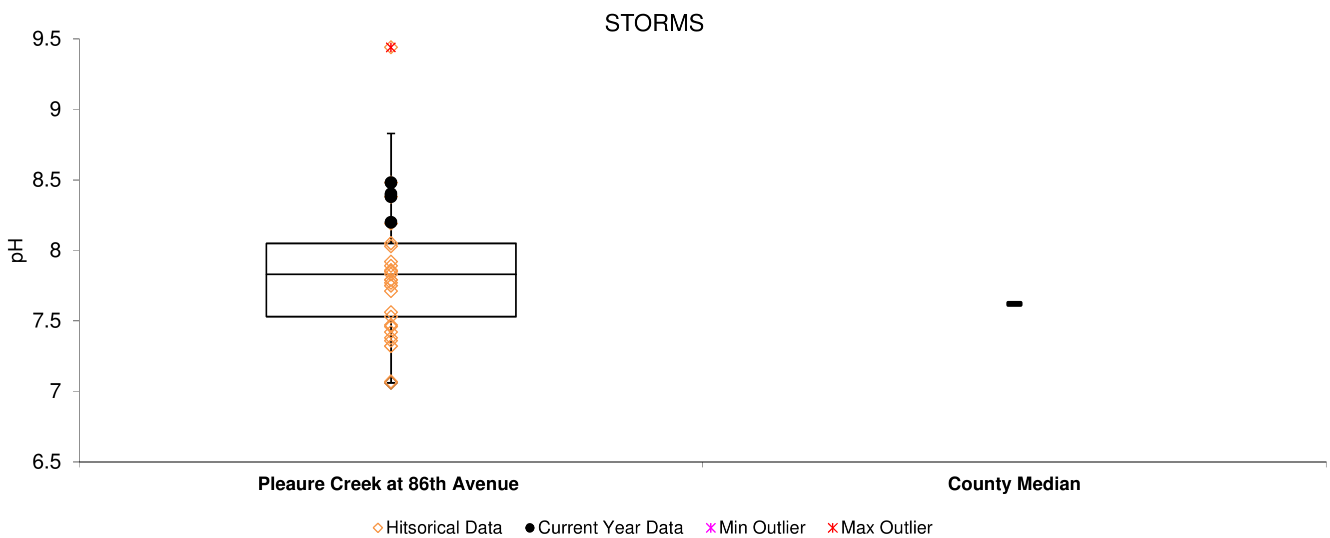
Pleasure Creek pH was generally within the expected range during all conditions (see figures below). Only one out of 8 samples was >8.5. The median for baseflow was 7.89 and the median for storms was 7.79. The Minnesota Pollution Control Agency water quality standards set an expectation for pH between 6.5 and 8.5.

Median pH in Pleasure Creek. Data is from the 86th Avenue site and all years through 2014.

	pH	State Standard	N
Baseflow	8.13	6.5-8.5	42
Storms	7.83		37
All	7.99		79
Occasions outside state standard			7

pH at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 Ave NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Medain	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	6.95	8.08	9.29
Storm	7.32	7.64	7.85	7.32	7.66	8.03	7.07	7.46	7.71	7.06	7.79	9.44
All Events	7.32	7.7	7.92	7.32	7.89	8.96	6.95	7.28	7.71	6.95	7.92	9.44

Dissolved Oxygen

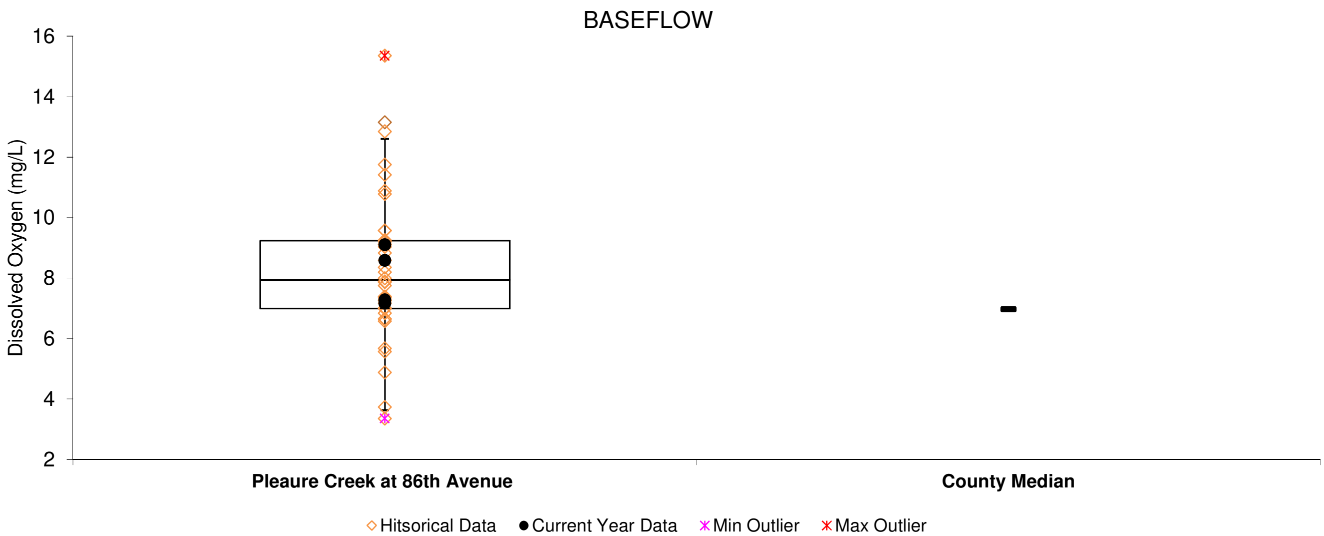
Dissovled oxygen (DO) essential for aquatic life. Fish, invertebrates, and other aquatic life suffer if DO is below 5 mg/L. Low DO can be a symptom of organic pollution, the decomposition of which reduces oxygen.

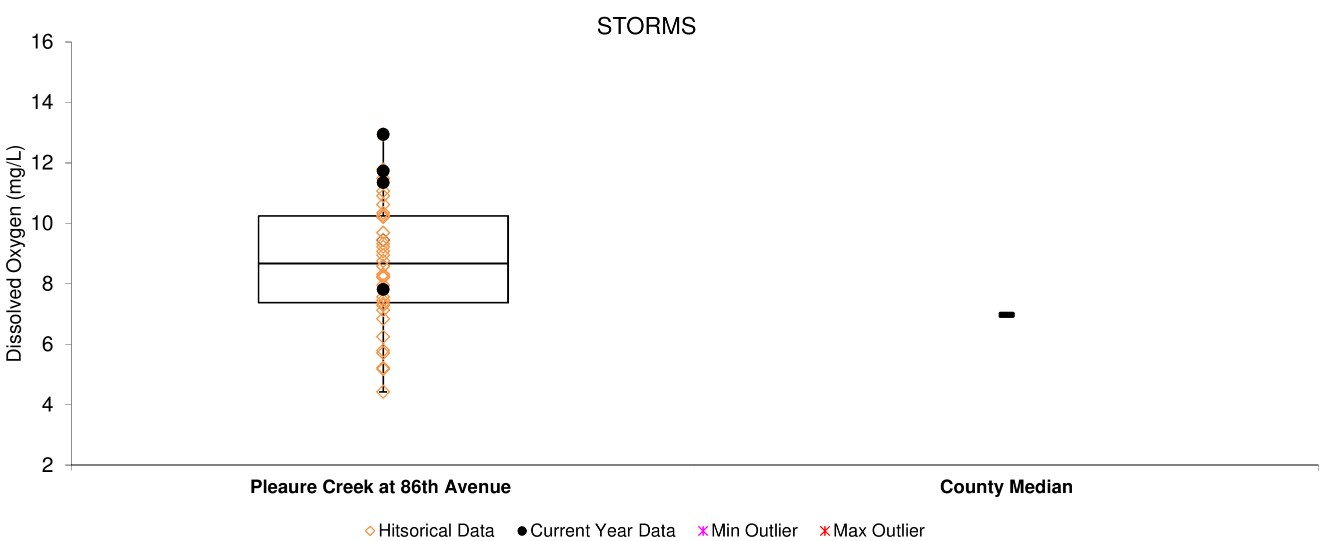
Dissolved oxygen in Pleasure Creek was within the acceptable level (>5 mg/L; see table and figure below). No instances of DO <5mg/L were observed at 86th Avenue. The fact that one-third of measurements had low dissolved oxygen at the farthest upstream monitoring site is not particularly concerning because 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 2014.

	Dissolved Oxygen (mg/L)	**State Standard**	**N**
Baseflow	7.94	5 mg/L daily minimum	38
Storms	8.67		38
All	8.33		76
Occasions <5 mg/L			0*

Dissolved Oxygen at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 Ave NE			Pleasure Creek at 96th Ln			Pleasure Creek at 86th Ave		
	Min	Medain	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	3.35	7.96	15.35
Storm	4.42	6.31	11.49	5.17	7.37	10.62	6.24	9.75	11.78	4.42	8.58	11.78
All Events	3.35	5.78	11.49	5.17	7.28	12.85	4.87	8.59	11.78	3.35	8.28	15.35

E. coli Bacteria

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 most probable number per 100 milliliters of water (MPN) or if the geometric mean of five samples taken within 30 days is greater than 126 MPN. 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 MPN/100mL (261, 1986, and two samples exceeded the test limits of 2420 MPN/100mL). In 2006, five samples taken between 5/24 and 6/21 had a geometric mean of 318 MPN/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 MPN/100mL. If we conservatively replace those readings with 2420 MPN/100mL, then geometric mean is 934 MPN/100mL. It appears the creek at 86th Avenue exceeds state standards.

Data collected in 2014 was generally higher than 2013 and more matched previous year's results. Both the baseflow median (261 MPN/100mL) and the storm event median (98 MPN/100mL) were higher than 2013 observations. All of the baseflow monitoring and 63% of total events exceeded 126 MPN/100mL. Only one storm event exceeded 126 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 345.3 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 decreased to 252.3 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 (99th 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.

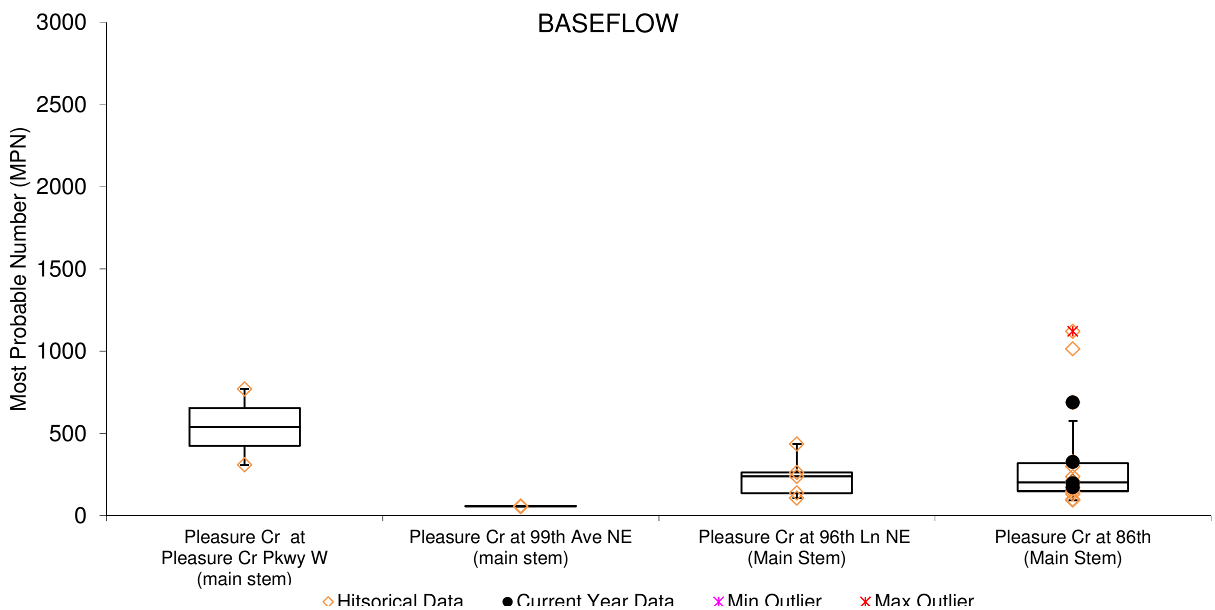
E. coli levels during storms at 99th Avenue were much more variable, similar to what was found in the ponds. While one storm sample had desirably low E. coli (104 MPN/100mL), others were high (248, 435, 727, 727, and 1986 MPN/100mL). This indicates some bacteria pass through the ponds, or are flushed from them, during storms. E. coli levels were not correlated with precipitation totals or stream water level.

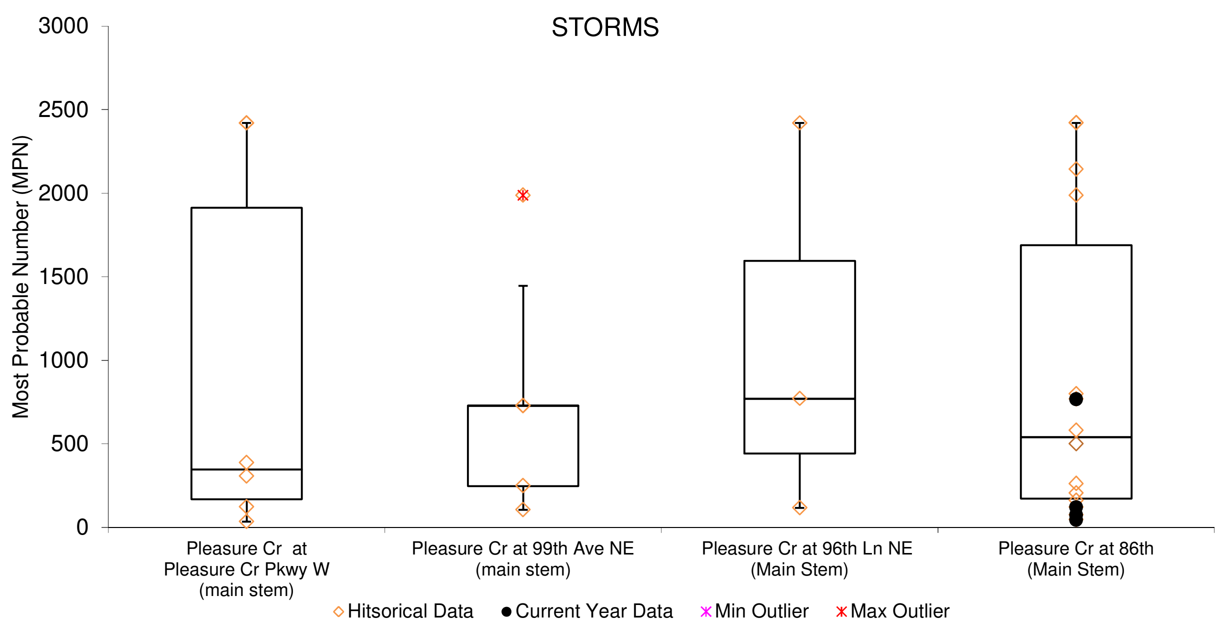
There is some evidence that E. coli is not associated with nutrient-rich sources such as wastewater. Phosphorus in Pleasure Creek is low, especially for an urban stream (see phosphorus section of this report). If wastewater or other nutrient rich sources were significant, phosphorus would be higher.

Median E. *coli* in Pleasure Creek. Data is from Outlet to Mississippi site only, all data through 2014.

	E. *coli* (MPN)	State Standard	N
Baseflow	203	Monthly Geometric Mean >126	14
Storms	540		14
All	249		28
Occasions >126 MPN		Monthly 10% average >1260	12 baseflow, 11 storm
Occasions >1260 MPN			0 baseflow, 4 storm

E. *coli* at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2014 readings. 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 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.

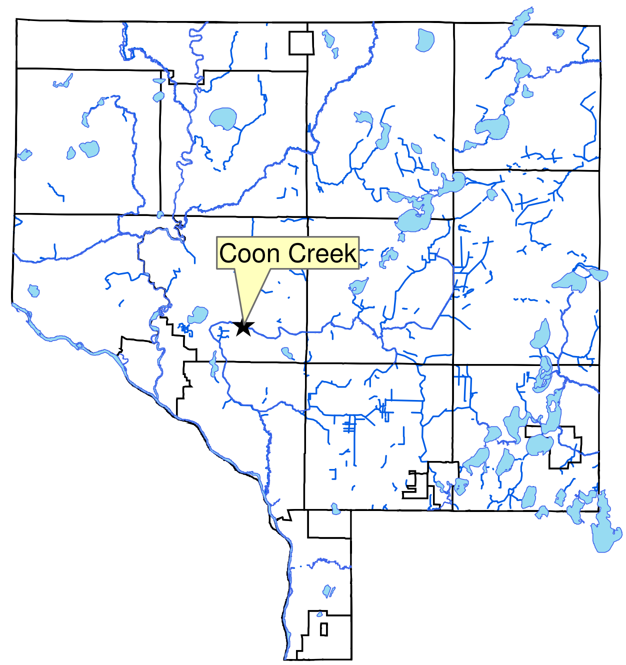
Family Biotic Index (FBI) — An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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 2014

Monitored Since

Fall 2003

Student Involvement

35 students in 2014, approximately 1,188 since 2003

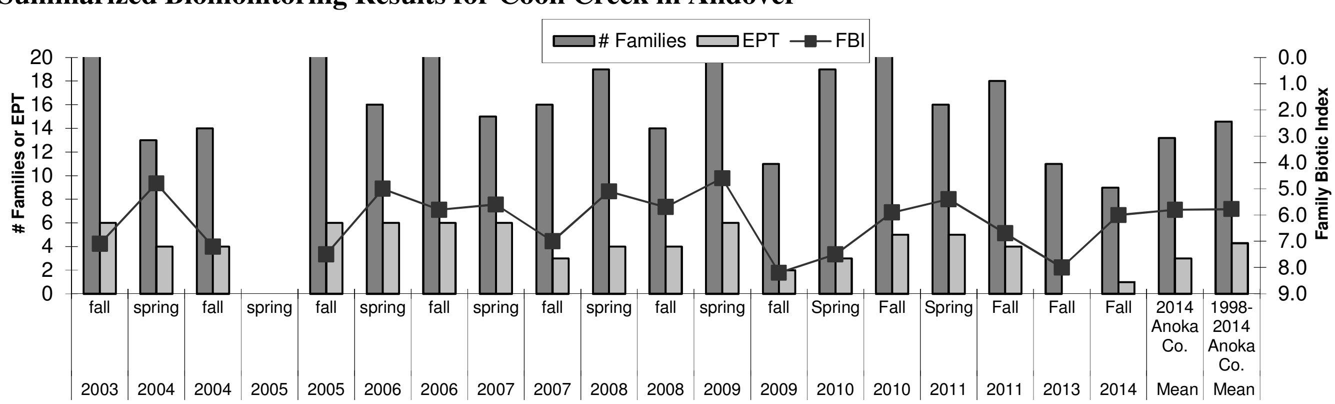
Background

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 2014. 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 2014, fall samples produced invertebrate indices lower than the average for streams in Anoka County.

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	2009	2009	2010	2010	2011	2011	2013	2014	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Fall	Fall	2014 Anoka Co.	1998-2014 Anoka Co.
FBI	4.60	8.20	7.5	5.9	5.4	6.7	8.0	6.0	5.8	5.8
# Families	21	11	19	27	16	18	11	9	13.2	14.6
EPT	6	2	3	5	5	4	0	1	3.0	4.3
Date	15-May	29-Sep	13-Apr	5-Oct	10-Jun	23-Sep	28-Oct	3-Oct		
Sampled By	AHS	AHS	AHS	AHS	ACD	AHS	AHS	AHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	679	203	207	446	165	154	64.5	198		
# Replicates	1	1	1	1	1	1	6	1		
Dominant Family	Baetidae	Corixidae	Corixidae	Calopterygidae	Baetidae	Belostomatidae	Corixidae	Corixidae		
% Dominant Family	68.9	51.2	45.4	28.7	24.2	27.9	48.1	37.9		
% Ephemeroptera	70.3	1.5	0.5	14.1	28.5	10.4	0.0	0.0		
% Trichoptera	3.2	2.0	1.9	2.0	9.7	9.1	0.0	0.0		
% Plecoptera	0.0	0.0	0.0	0.0	9.7	0.0	0.0	0.0		

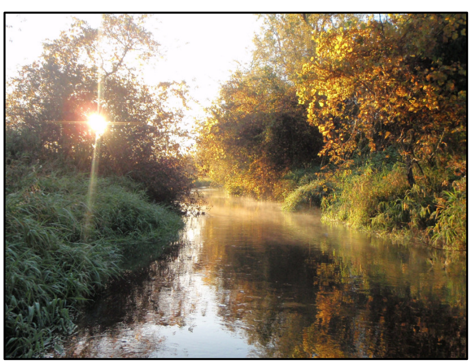
Supplemental Stream Chemistry Readings

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

Parameter	5/30/2008	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

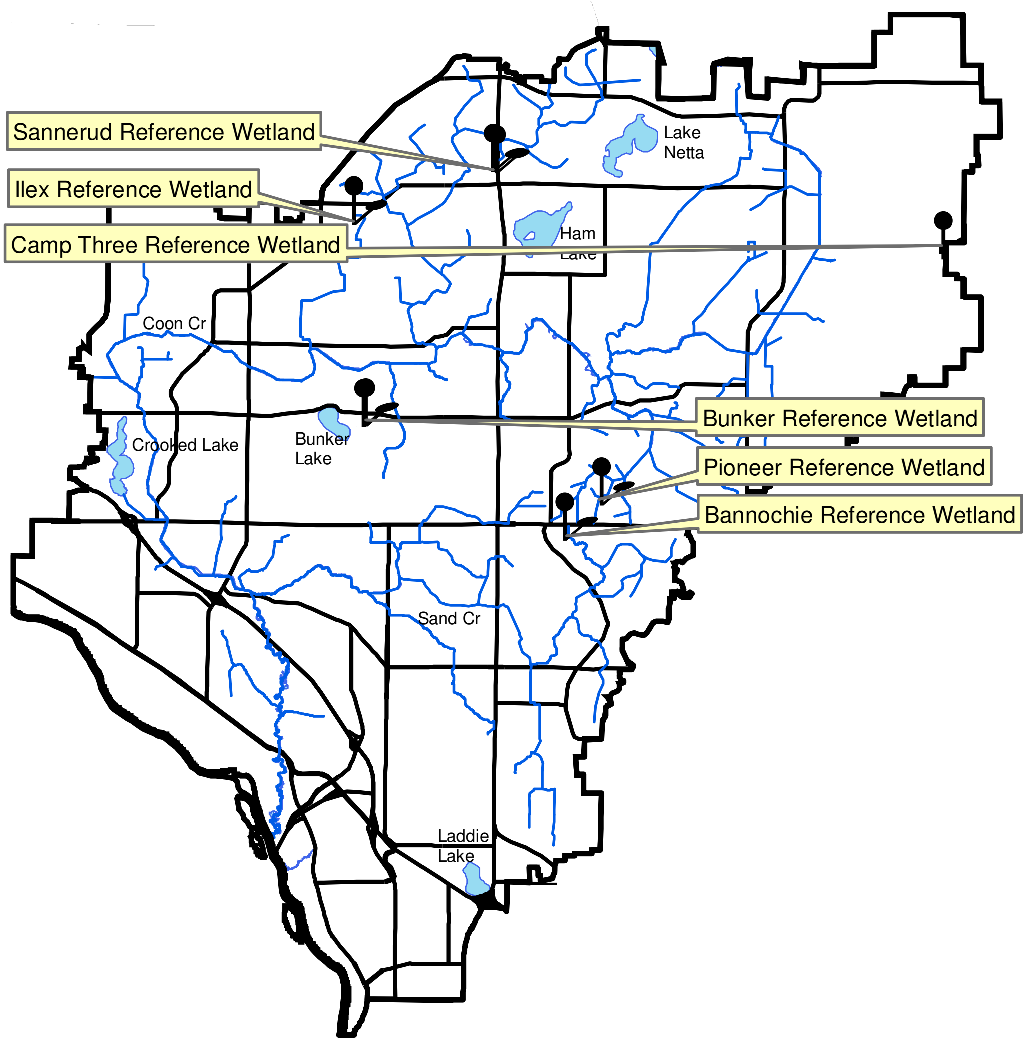
Ilex Wetland, City Park at Ilex St and 159th Ave, Andover
(middle and edge of Ilex Wetland are monitored)

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.

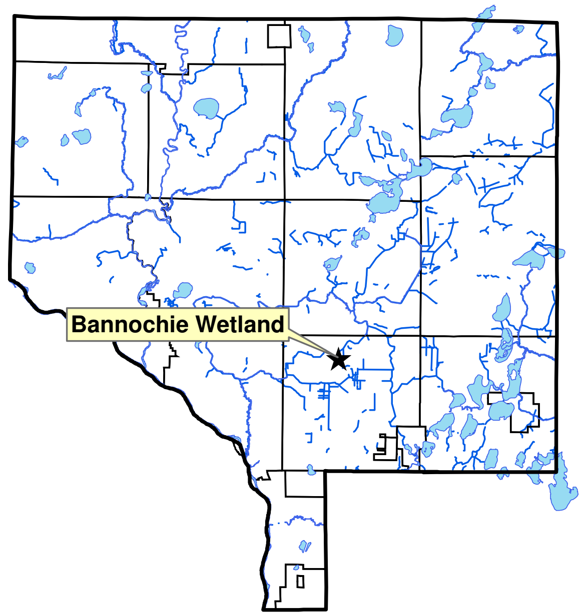
Coon Creek Watershed 2014 Wetland Hydrology Monitoring Sites



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	-

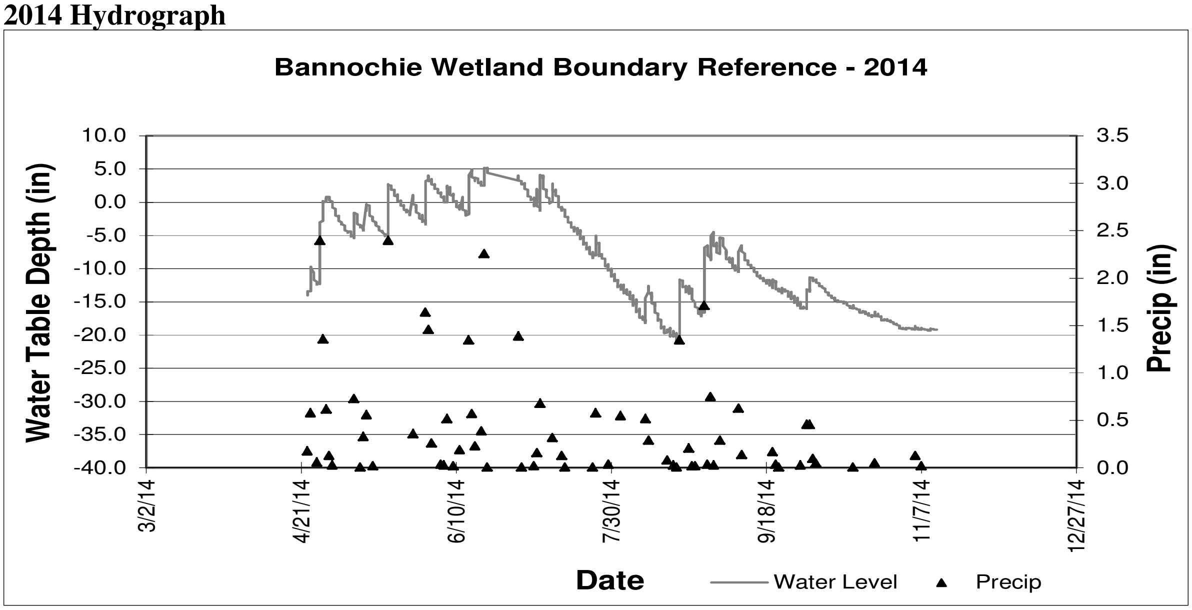
Surrounding Soils: Rifle and some Zimmerman fine sand

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.

2014 Hydrograph

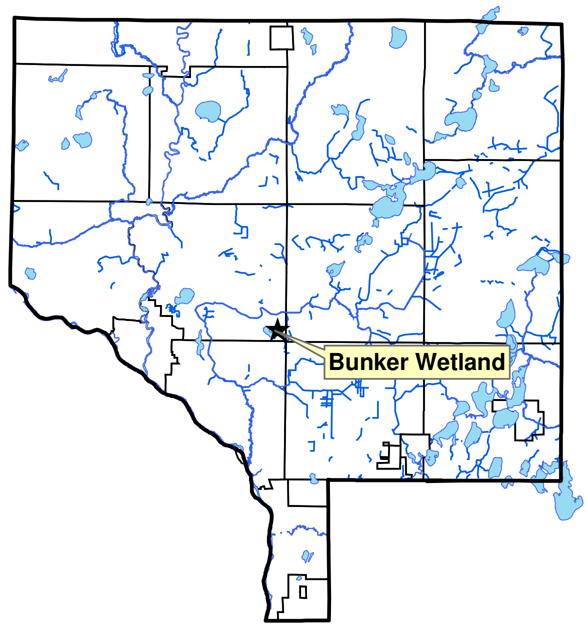


Well depth was 39 inches, so a reading of –39 or less indicates water levels were at an unknown depth greater than or equal to 39 inches.

Wetland Hydrology Monitoring

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	-

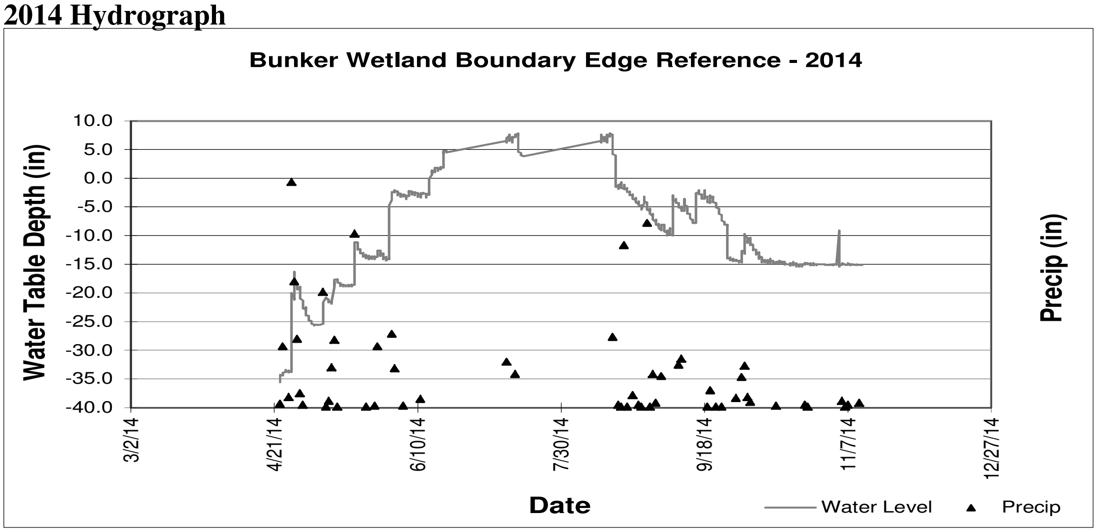
Surrounding Soils: Zimmerman fine sand

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.

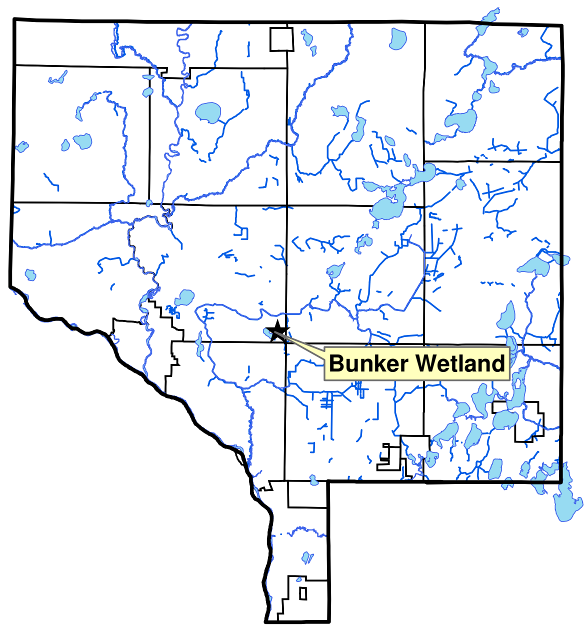
2014 Hydrograph



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.

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	-

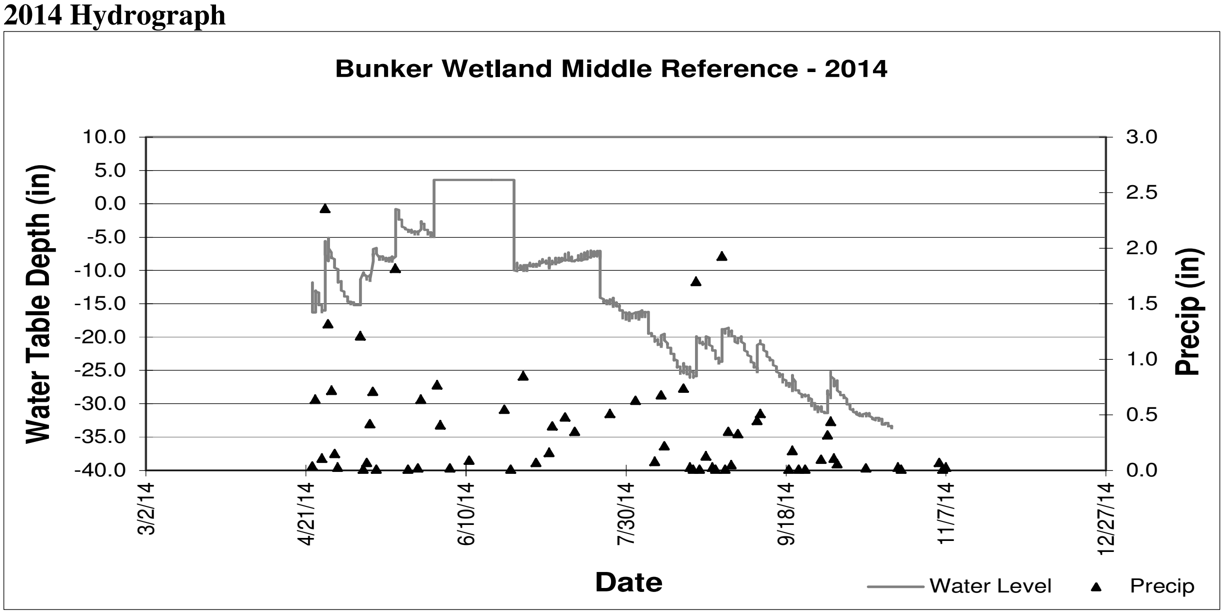
Surrounding Soils: Zimmerman fine sand

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.

2014 Hydrograph

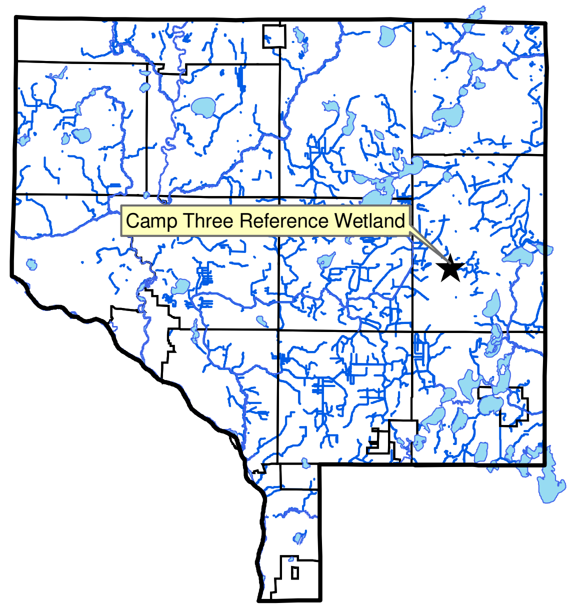


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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

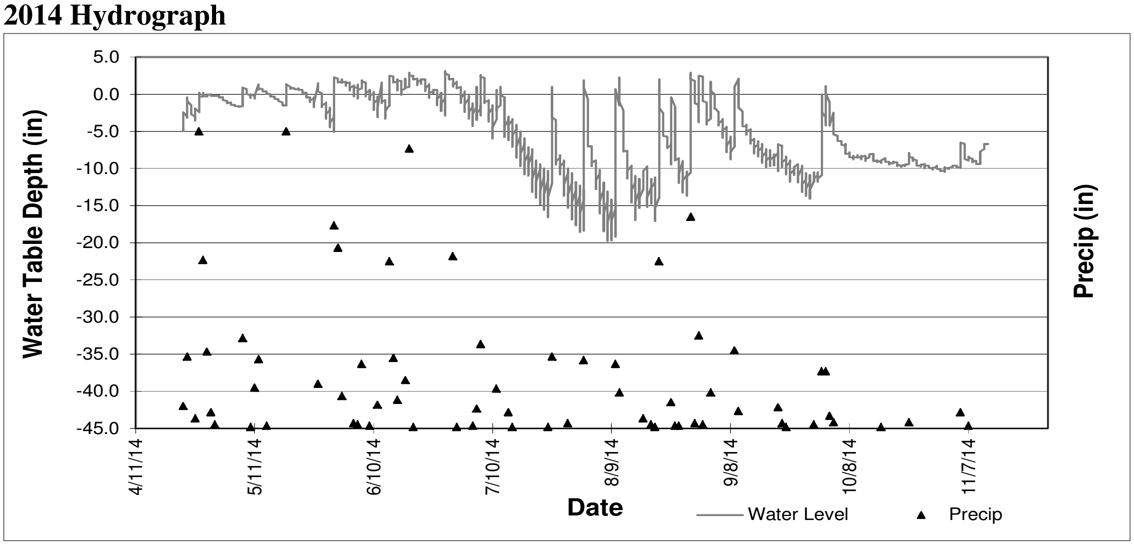
Surrounding Soils: Zimmerman Fine Sand

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.

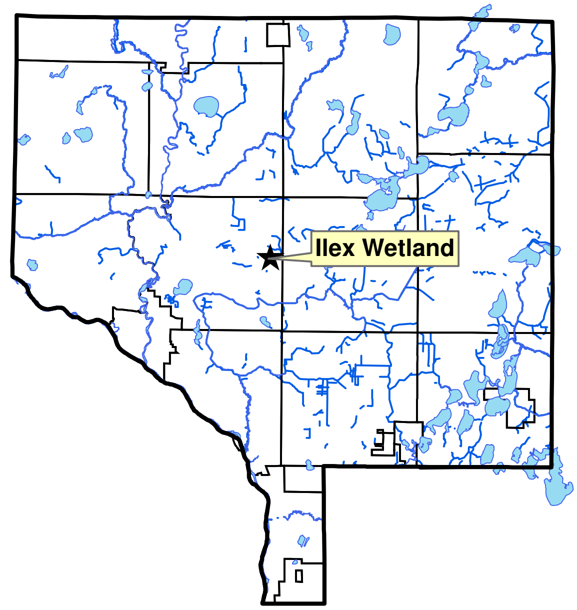
2014 Hydrograph



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	-

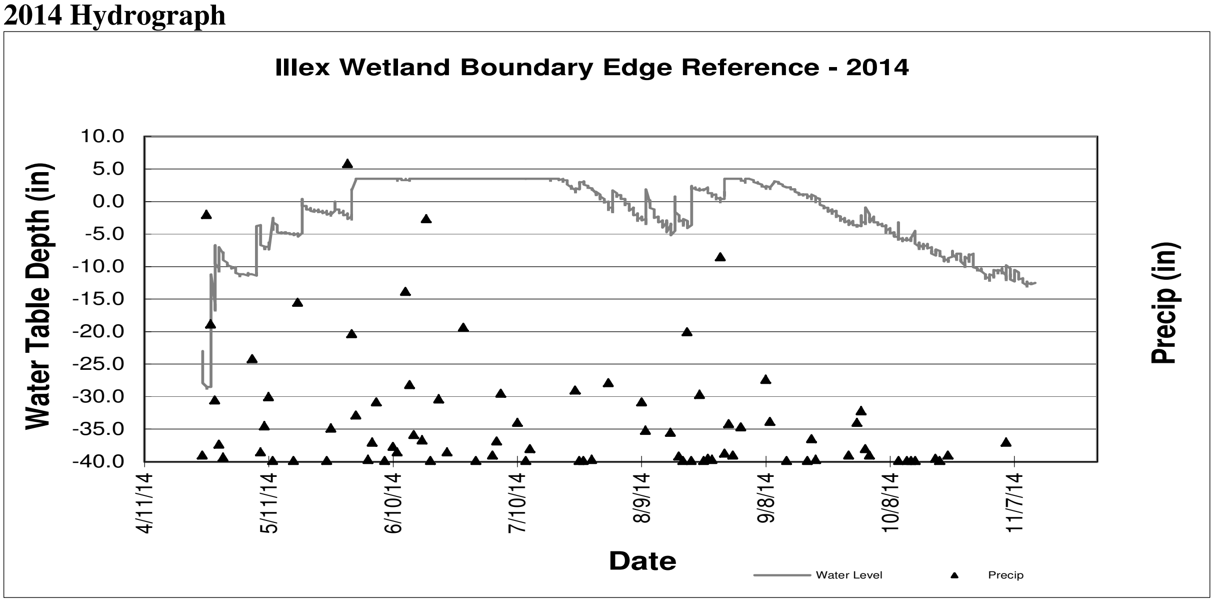
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

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.

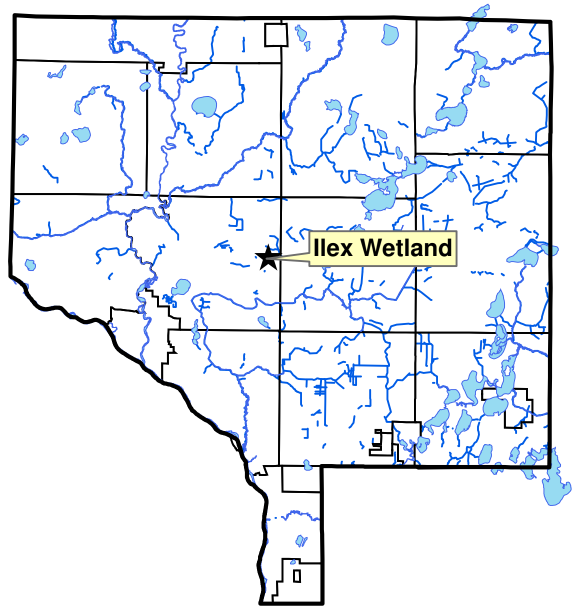
2014 Hydrograph



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 - 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	-

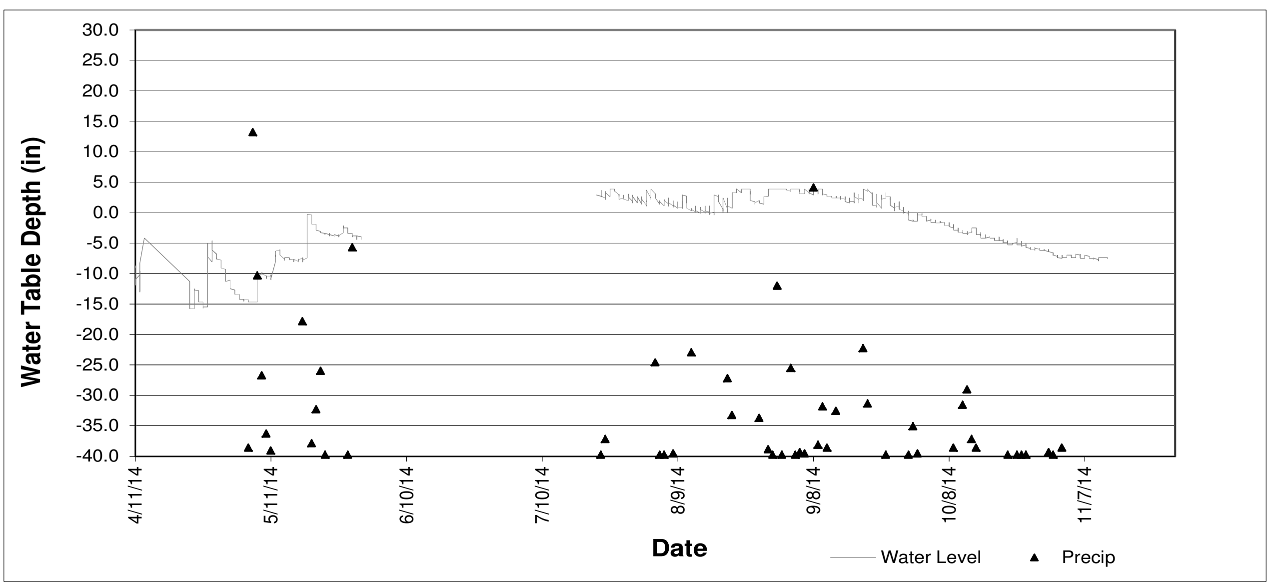
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

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.

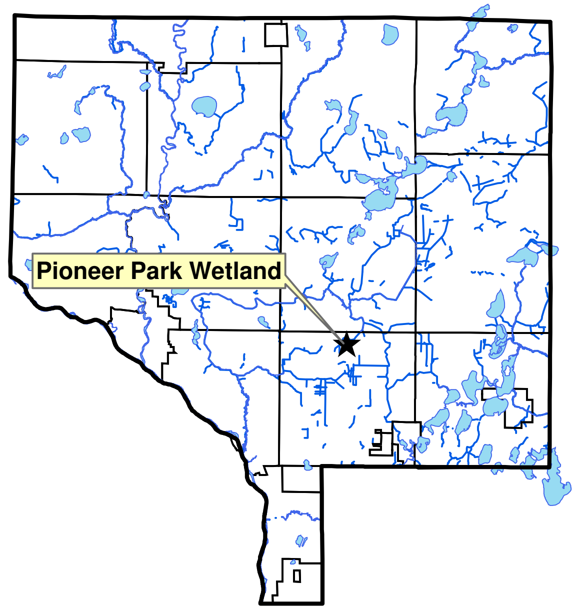
2014 Hydrograph



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.

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	-

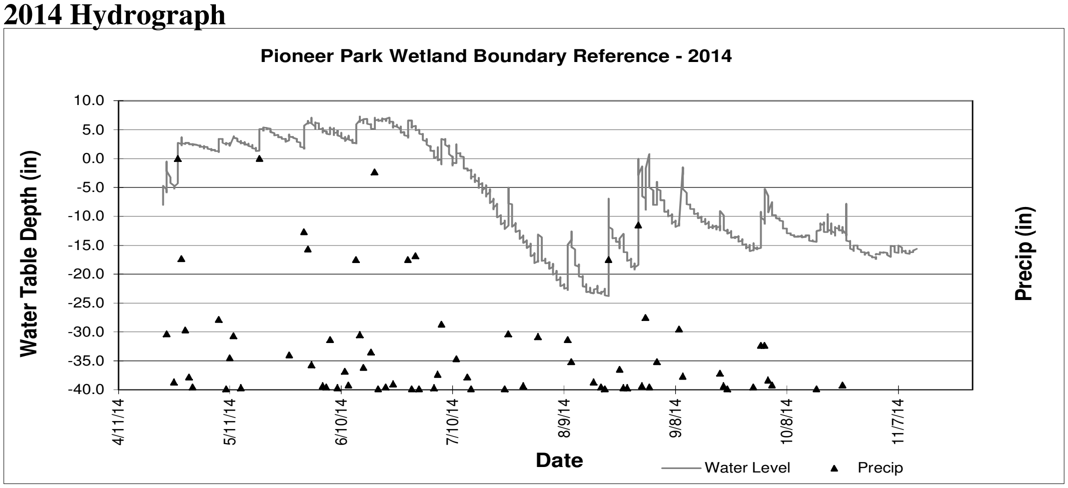
Surrounding Soils: Rifle and loamy wet sand.

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)

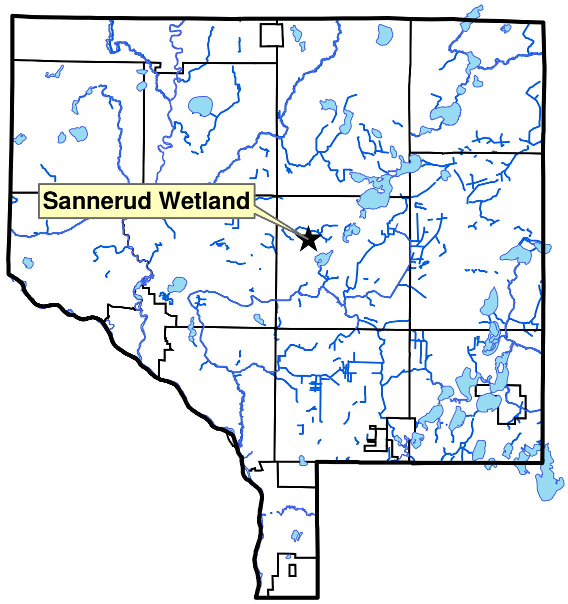
2014 Hydrograph



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

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	-

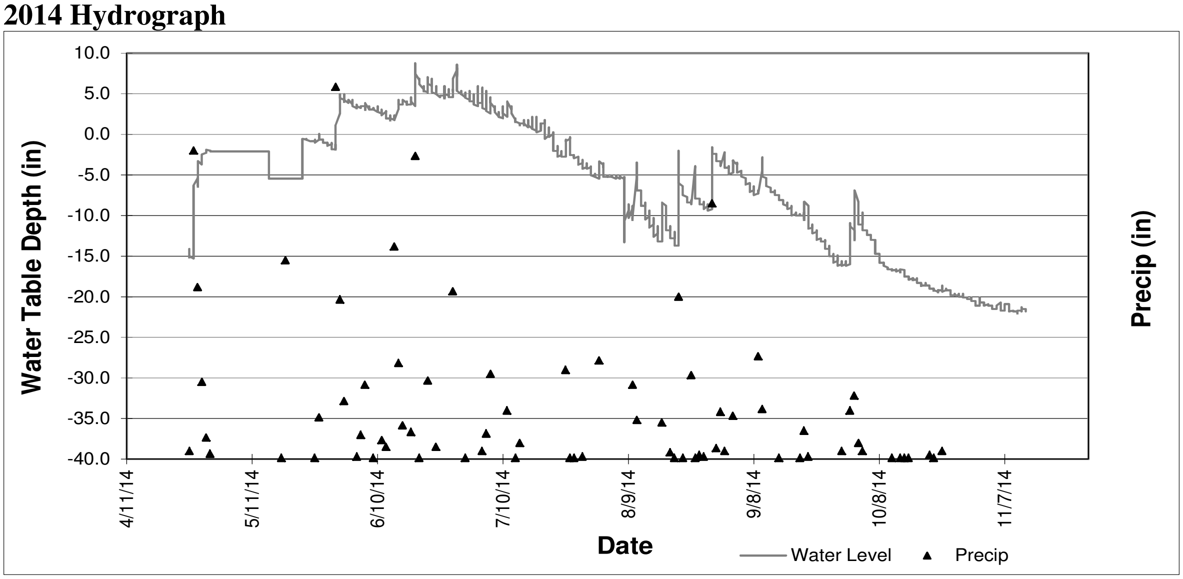
Surrounding Soils: Zimmerman and Lino.

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.

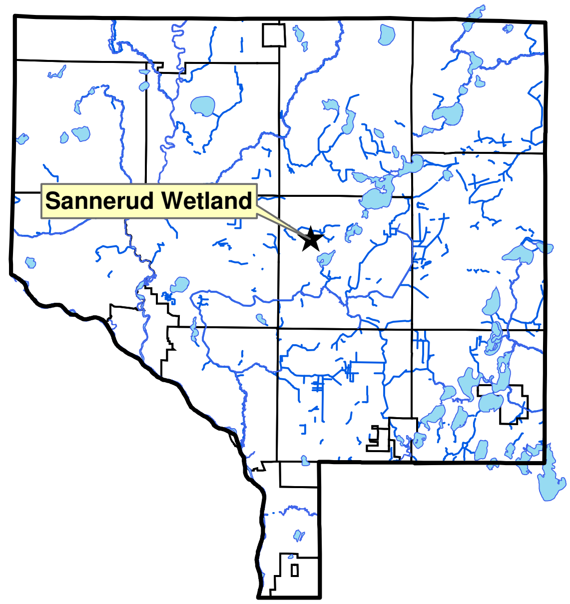
2014 Hydrograph



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	-

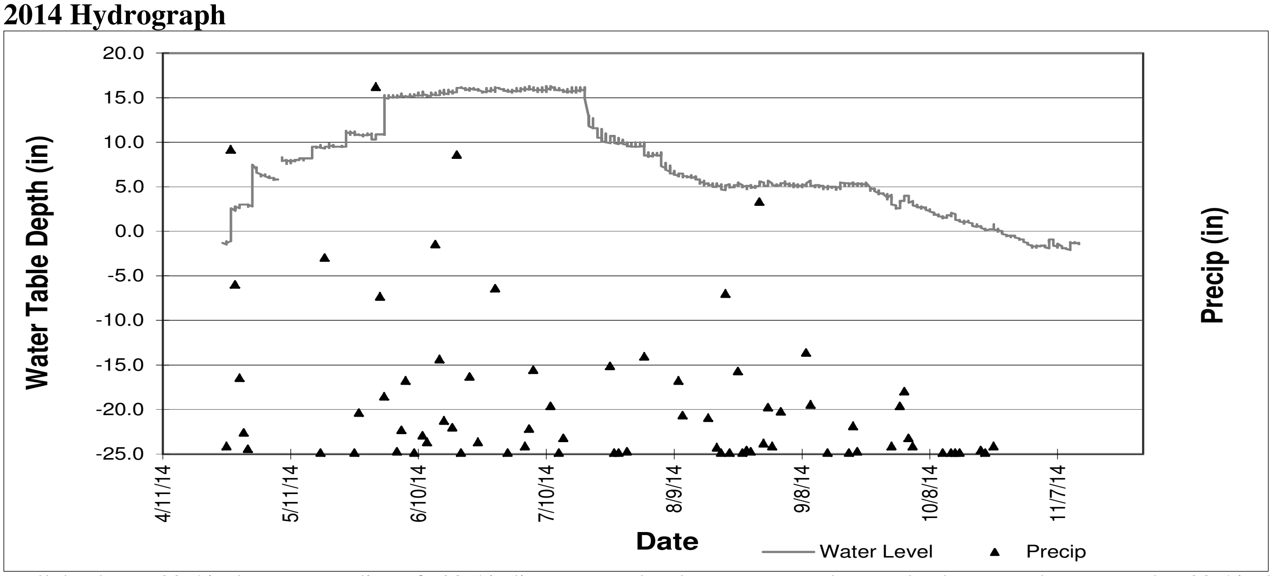
Surrounding Soils: Zimmerman and Lino.

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.

2014 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

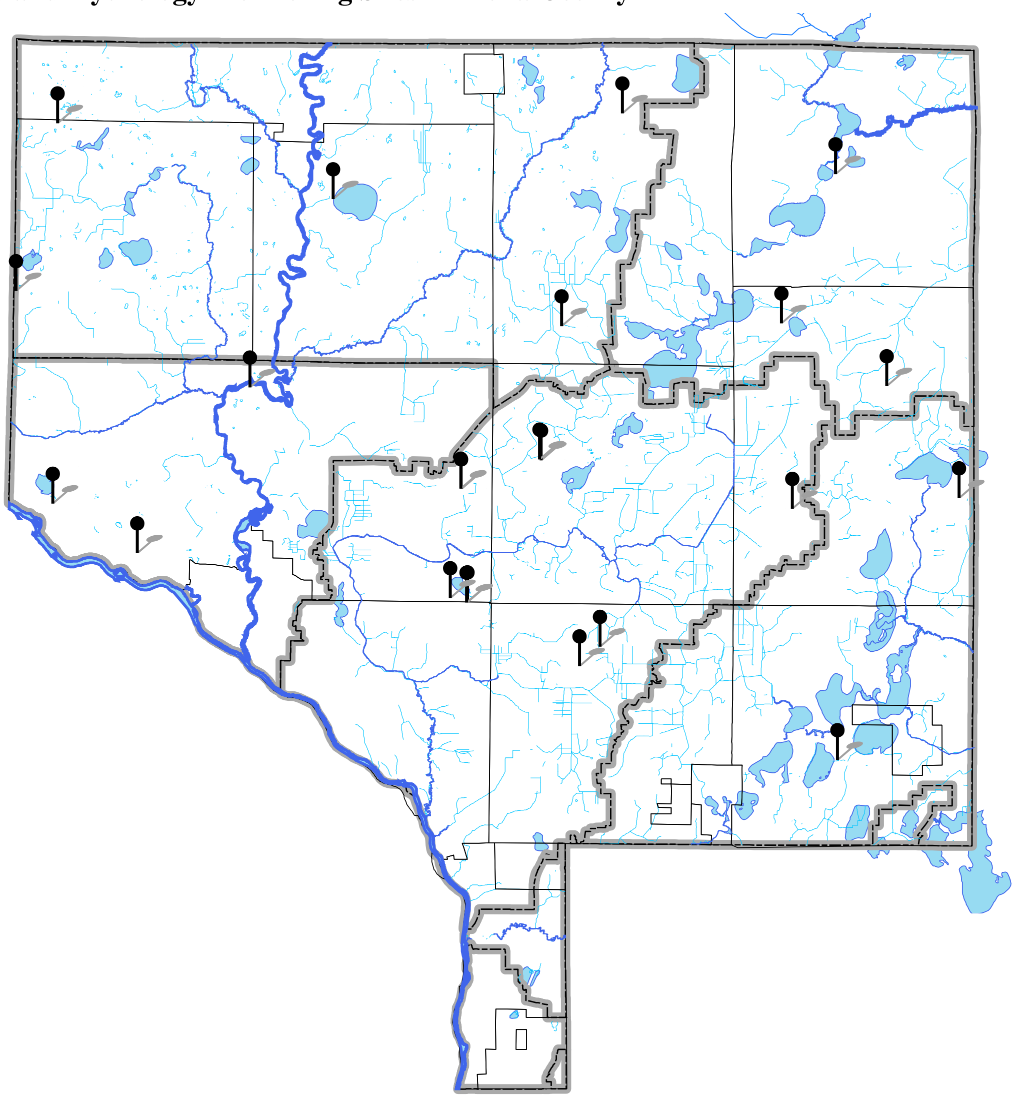
Description: This section includes analyses of wetland hydrology data of 23 reference wetland sites collected at 19 locations. Shallow groundwater levels at the edge of these wetlands are recorded every four hours. Many have been monitored since 1996. These analyses summarize this enormous multi-year, 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.

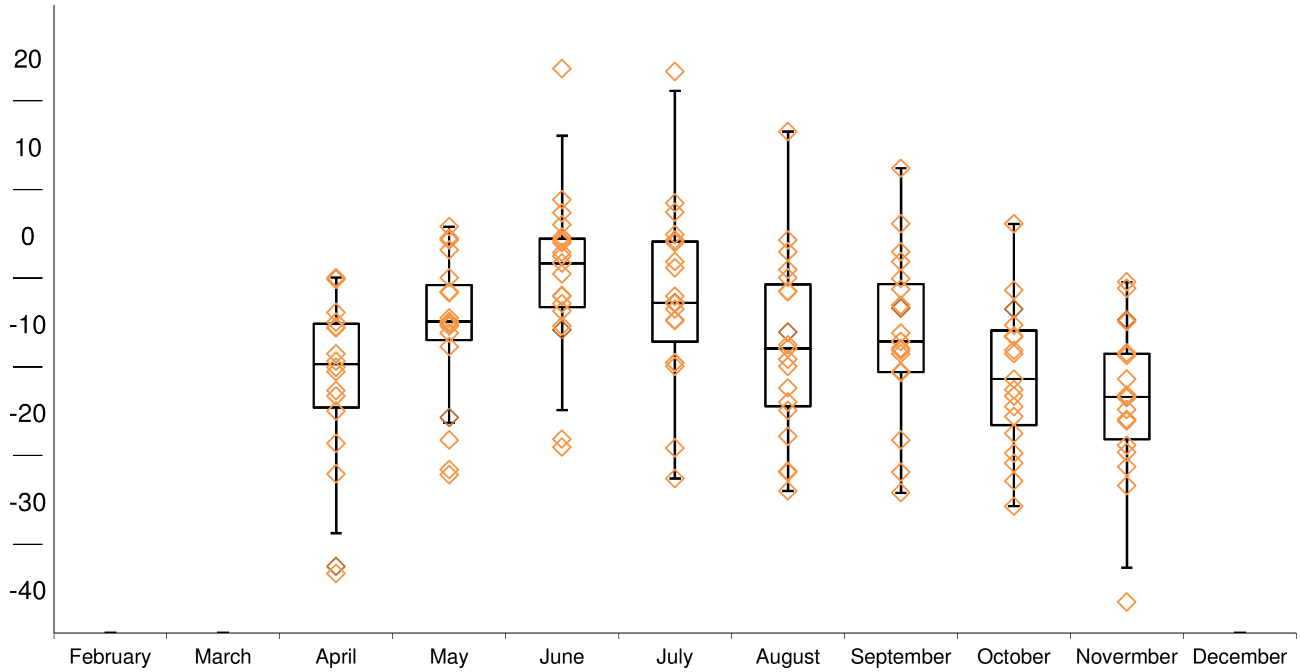
Locations: All 23 reference wetland hydrology monitoring sites in Anoka County.

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



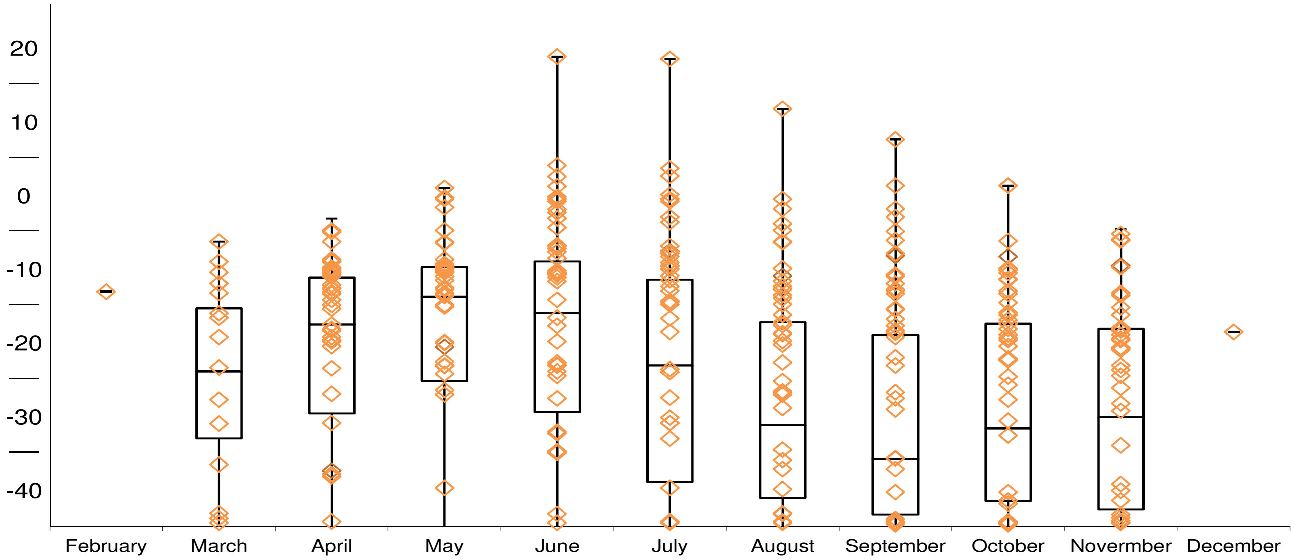
2014 Reference Wetland Water Levels Summary: Each marker represents the median depth to the water table at the edge of one reference wetland for a given month in 2014. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal 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	Min	10%	25%	Median	75%	90%	Max
4	-33.5	-27.1	-18.0	-10.1	-5.5	-0.6	-0.4
5	-24.7	-19.2	-8.1	-5.4	-1.2	3.8	5.3
6	-23.4	-10.2	-3.9	1.6	3.7	5.9	8.3
7	-23.9	-12.1	-7.6	-3.2	3.7	7.1	19.2
8	-24.2	-22.4	-16.7	-8.3	-1.2	2.8	11.8
9	-24.4	-19.2	-11.1	-8.3	-2.6	1.6	8.6
10	-25.9	-21.6	-18.9	-12.9	-7.0	-3.5	2.3
11	-36.6	-22.1	-18.4	-14.5	-9.8	-5.2	-1.5

1996-2014 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 2014. 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	Min	10%	25%	Median	75%	90%	Max
2	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
3	-41.6	-39.1	-28.3	-19.3	-10.8	-6.4	-1.9
4	-41.6	-34.3	-25.3	-13.5	-7.0	-4.1	1.2
5	-41.6	-33.2	-21.6	-10.1	-5.6	-2.1	5.3
6	-42.0	-38.4	-25.5	-12.1	-5.2	-0.5	8.3
7	-42.2	-39.7	-34.8	-19.5	-8.5	-2.5	19.2
8	-43.0	-40.4	-36.9	-28.4	-14.7	-5.6	13.9
9	-43.0	-40.9	-38.7	-32.4	-18.7	-6.6	8.6
10	-43.1	-40.4	-37.3	-28.7	-13.9	-6.3	2.4
11	-43.8	-40.8	-38.6	-29.2	-14.9	-8.0	-0.2
12	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0

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 10th, 25th, 50th, 75th, and 90th 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.

Woodcrest Creek and Sand Creek Rain Garden Promotion and Design

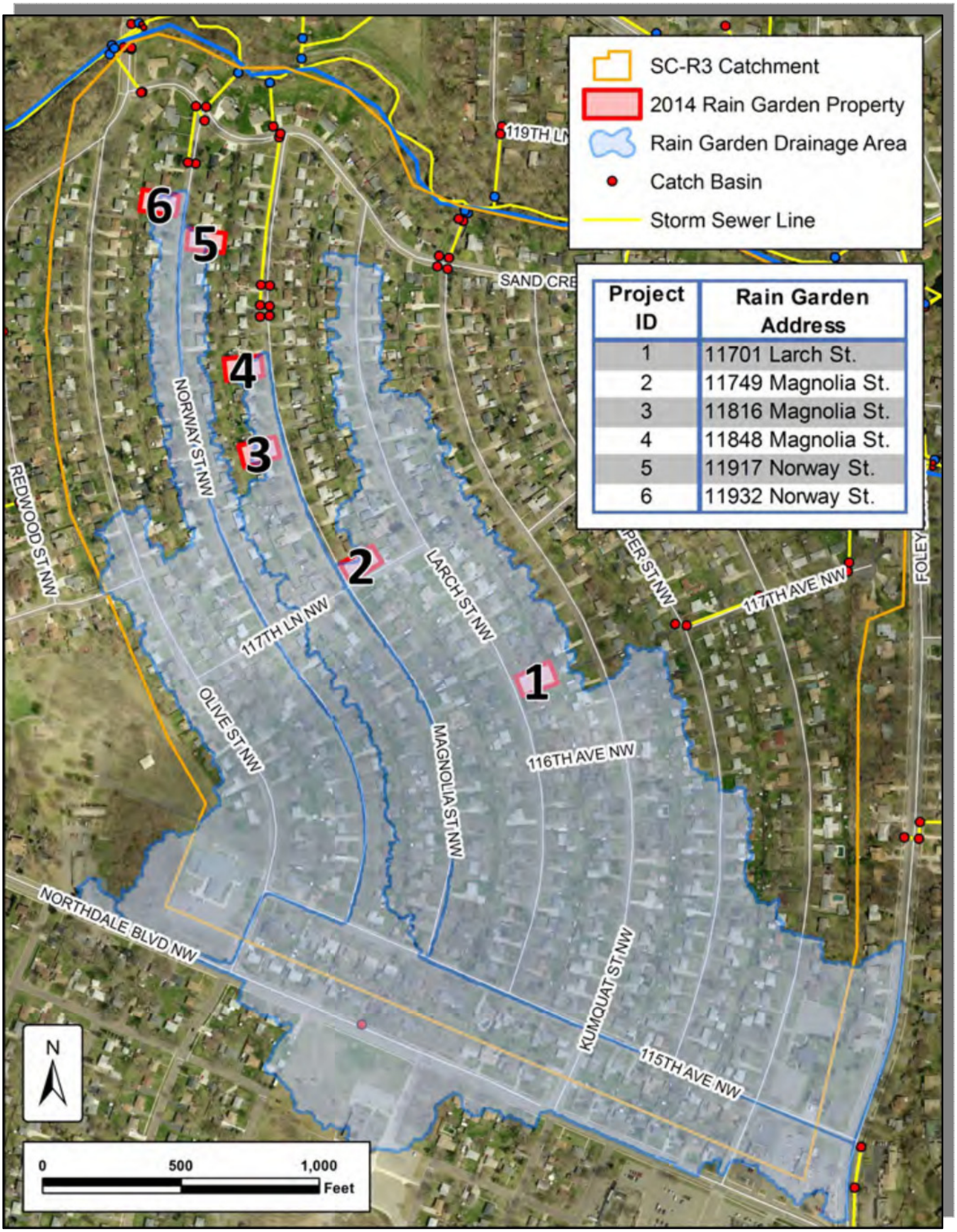
Description: The Coon Creek Watershed District (CCWD) contracted with ACD to manage the promotion, design, and construction oversight of a rain garden project in the WC-8 and SC-R3 catchments of the Woodcrest Creek and Sand Creek subwatersheds.

Purpose: To improve stormwater quality and reduce the volume of runoff generated within the WC-8 and SC-R3 catchments. All stormwater runoff from these catchments previously discharged directly into the stormwater system without receiving treatment. This contributes to the degradation of Woodcrest Creek, Sand Creek, and ultimately Coon Creek.

Results: ACD staff targeted priority properties in the residential neighborhoods located within the catchments 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 five rain gardens throughout the WC-8 catchment and six rain gardens throughtout the SC-R3 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, the five rain gardens of the WC-8 catchment reduce stormwater runoff volumes into Woodcrest Creek by 3.1 acre-ft/yr, total suspended solids by 1,117 lbs/yr, and total phosphorus by 3.7 lbs/yr. The six rain gardens of the SC-R3 catchment reduce stormwater runoff volumes into Sand Creek by 7.2 acre-ft/yr, total suspended solids by 2,725 lbs/yr, and total phosphorus by 8.4 lbs/yr.

Sites of five rain gardens installed in the WC-8 catchment of the Woodcrest Creek subwatershed in 2014.

Sites of six rain gardens installed in the SC-R3 catchment of the Sand Creek subwatershed in 2014.



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

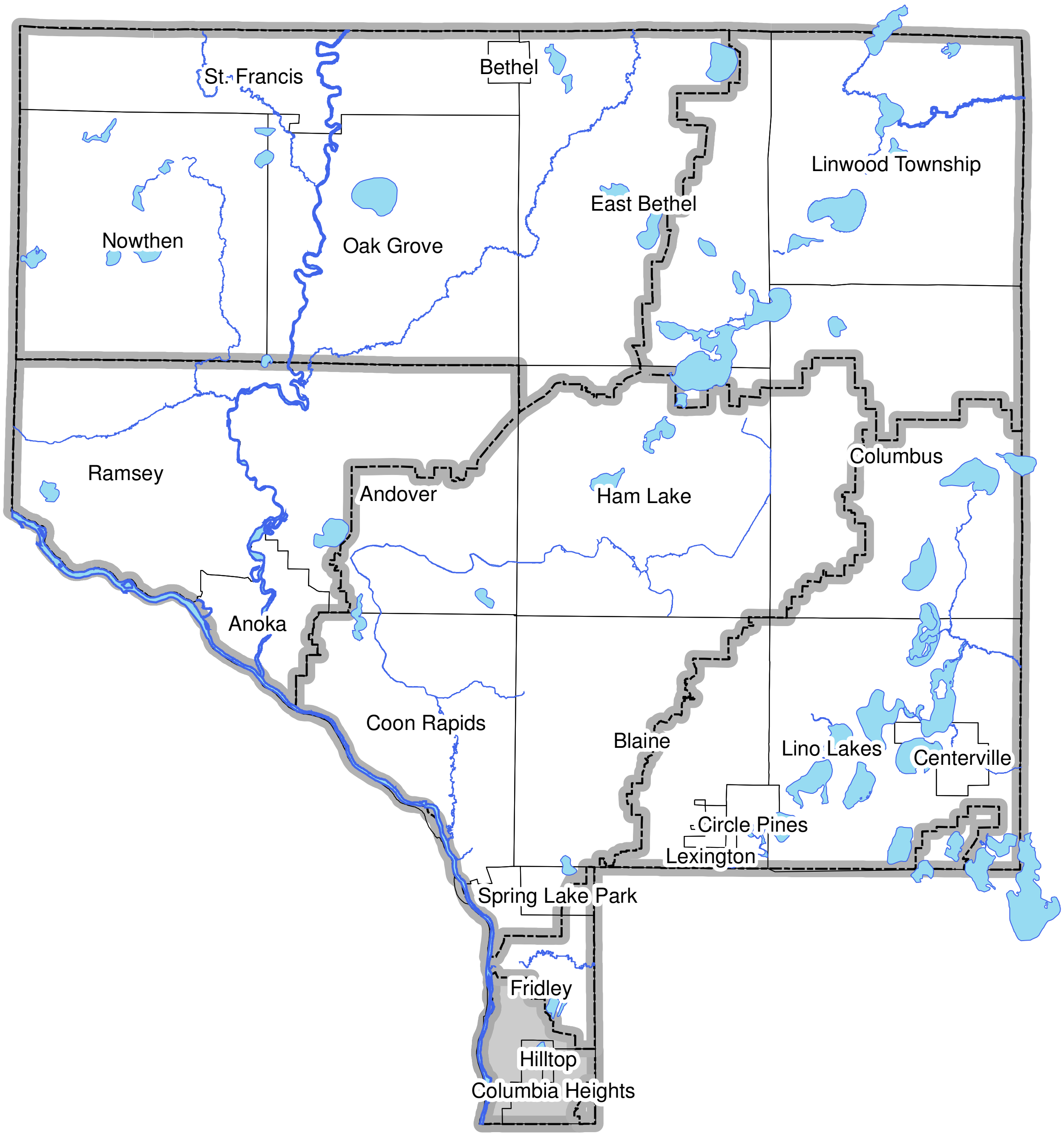
Coon Creek Watershed	WMO Asst (no charge)	Volunteer Precipitation	CCWD Precip	Reference Wetlands	DNR Observation Wells	Lake Levels	Lake Water Quality	Stream Levels	Stream Water Quality	CCWD Hydrolab & Bacteria	Student Biomonitoring	Oak Glen Creek Stabilization	Woodcrest Rain Garden Planting	WC-8 Retrofit Promo/Installs	SC-R3 Retrofit Promo/Installs	SC-R5 Retrofit Promo/Installs	Oak Glen Creek Pond/IESF CWF	Coon Creek WRAPP	Pleasure Cr SRA	Springbrook SRA	Stoneybrook SRA	Sand Creek-R5 SRA	Ditch 54 (Coon Cr) SRA	Total
Revenues																								
CCWD	0	0	5047	4447	0	1000	3637	4800	22400	9520	0	0	0	16352	19856	6560	0	6223	7242	10278	5139	1270	0	123771
State	0	0	0	0	240	0	0	0	0	0	0	327406	0	0	0	0	0	0	0	0	0	0	0	327646
Anoka Conservation District	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anoka Co. General Services	586	0	0	0	154	0	0	0	0	0	0	1449	717	0	0	0	302	0	2463	428	600	0	2760	9458
County Ag Preserves	0	0	0	0	0	0	0	0	0	0	1728	0	0	0	0	0	0	0	0	0	0	0	0	1728
Regional/Local	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3600	0	0	3600
Other Service Fees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	803	0	0	0	0	0	0	803
BWSR Cons Delivery	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BWSR Cost Share TA	0	0	0	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	198	528	561	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1287
TOTAL	586	198	5575	5008	394	1000	3637	4800	22400	9520	1728	328855	717	16352	19856	6560	1105	6223	9705	10706	9339	1270	2760	468293
Expenses-																								
Capital Outlay/Equip	13	4	122	107	9	19	58	102	302	112	36	177	16	262	302	96	24	101	213	235	205	4	61	2580
Personnel Salaries/Benefits	505	170	4802	4190	339	765	2274	3996	11828	4384	1416	6938	618	10276	11854	3758	952	3953	8360	9222	8045	154	2377	101175
Overhead	34	11	323	282	23	51	153	269	795	295	95	466	42	690	796	253	64	266	562	620	541	10	160	6798
Employee Training	4	1	35	30	2	6	17	29	86	32	10	50	4	75	86	27	7	29	61	67	59	1	17	736
Vehicle/Mileage	9	3	85	74	6	14	40	71	210	78	25	123	11	182	210	67	17	70	148	164	143	3	42	1796
Rent	22	7	207	181	15	33	98	173	511	189	61	300	27	444	512	162	41	171	361	398	347	7	103	4370
Program Participants	0	0	0	0	0	0	0	0	0	0	0	320800	0	0	0	0	0	0	0	0	0	0	0	320800
Program Supplies	0	0	0	138	0	3	883	79	5475	124	85	0	0	44	165	0	0	7	0	0	0	0	0	7003
McKay Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	586	198	5575	5003	394	891	3523	4718	19206	5213	1728	328855	717	11973	13926	4363	1105	4596	9705	10706	9339	179	2760	445259

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.
- **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.

Excerpt from the
2014 Anoka Water Almanac

Chapter 7: Mississippi Watershed

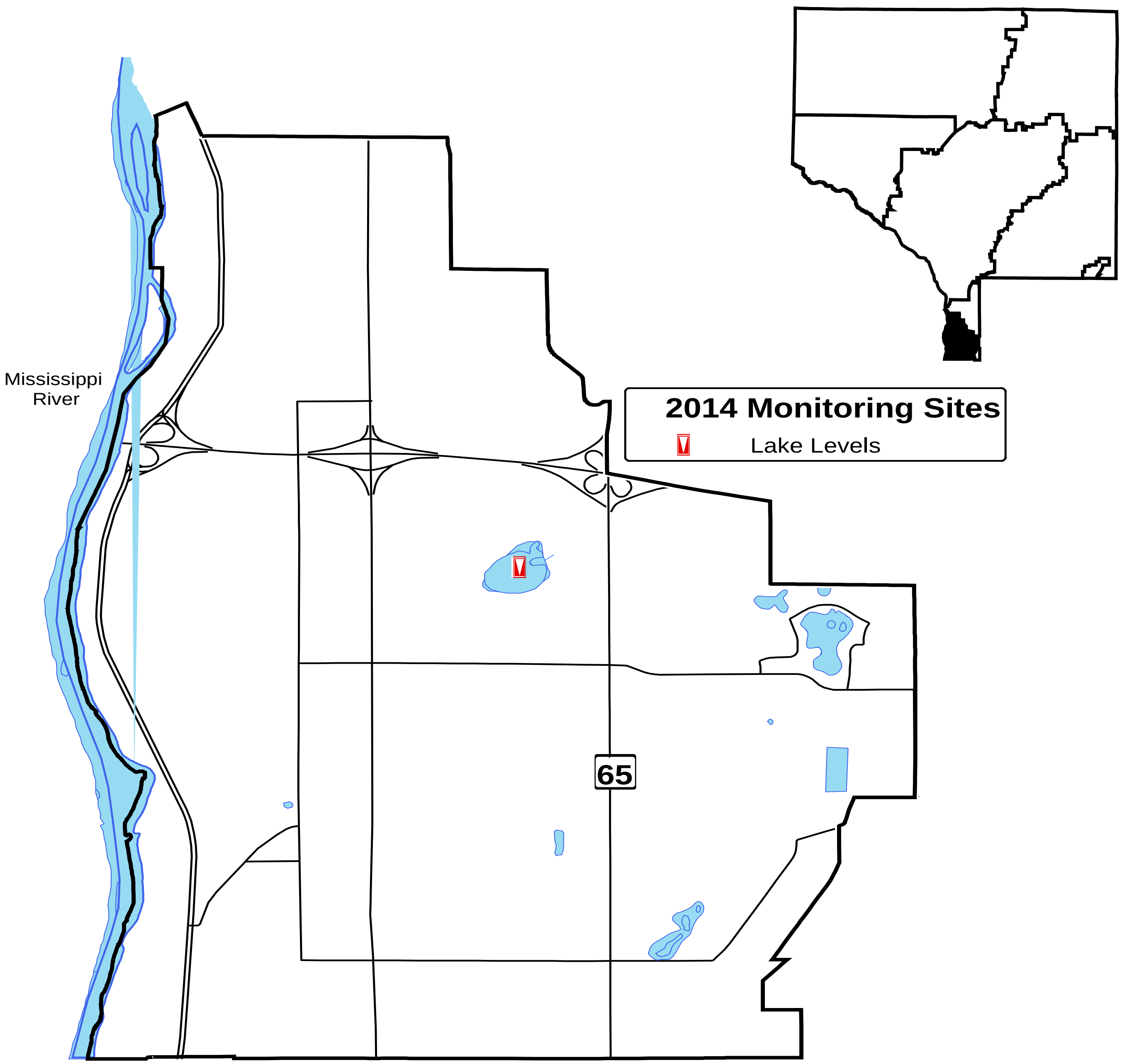


Prepared by the Anoka Conservation District

2014 WORK RESULTS:
MISSISSIPPI WATERSHED

Monitoring	Partners	Page
Lake Levels	ACD, MNDNR, volunteers	7-1
Stormwater Retrofit Analysis	MWMO, ACD, City of Columbia Heights, City of Minneapolis	7-3
Financial Summary		7-4
Recommendations		7-4

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).

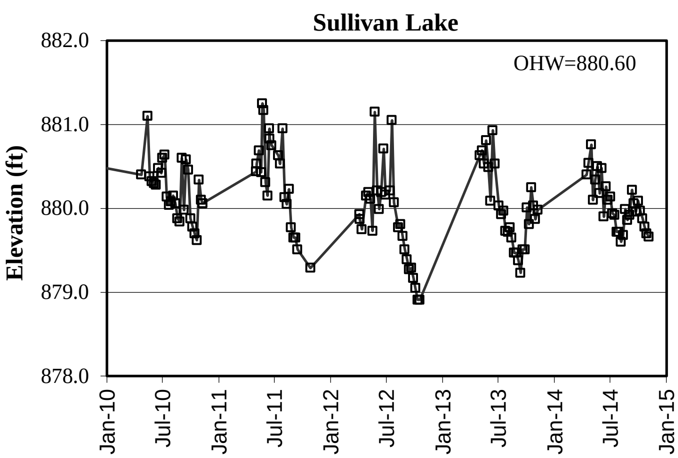
Purpose: To provide understanding of lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake hydrology manipulation decisions.

Locations: Sullivan/Sandy Lake

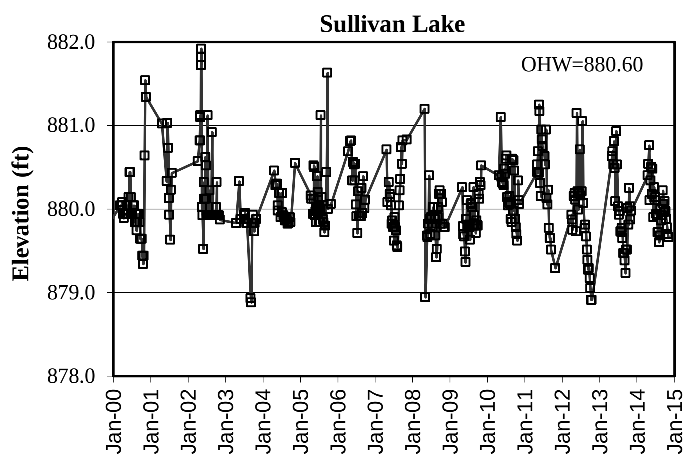
Results: Lake levels were measured 27 times for Sullivan Lake. Readings were taken at least weekly. Sullivan water levels fluctuate frequently, routinely bouncing by half a foot in response to rainfall because it receives a large amount of storm water relative to its size and its outlet releases water 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 2010-2014



Sullivan/Sandy Lake Levels 2000-2014



Lake Levels Summary

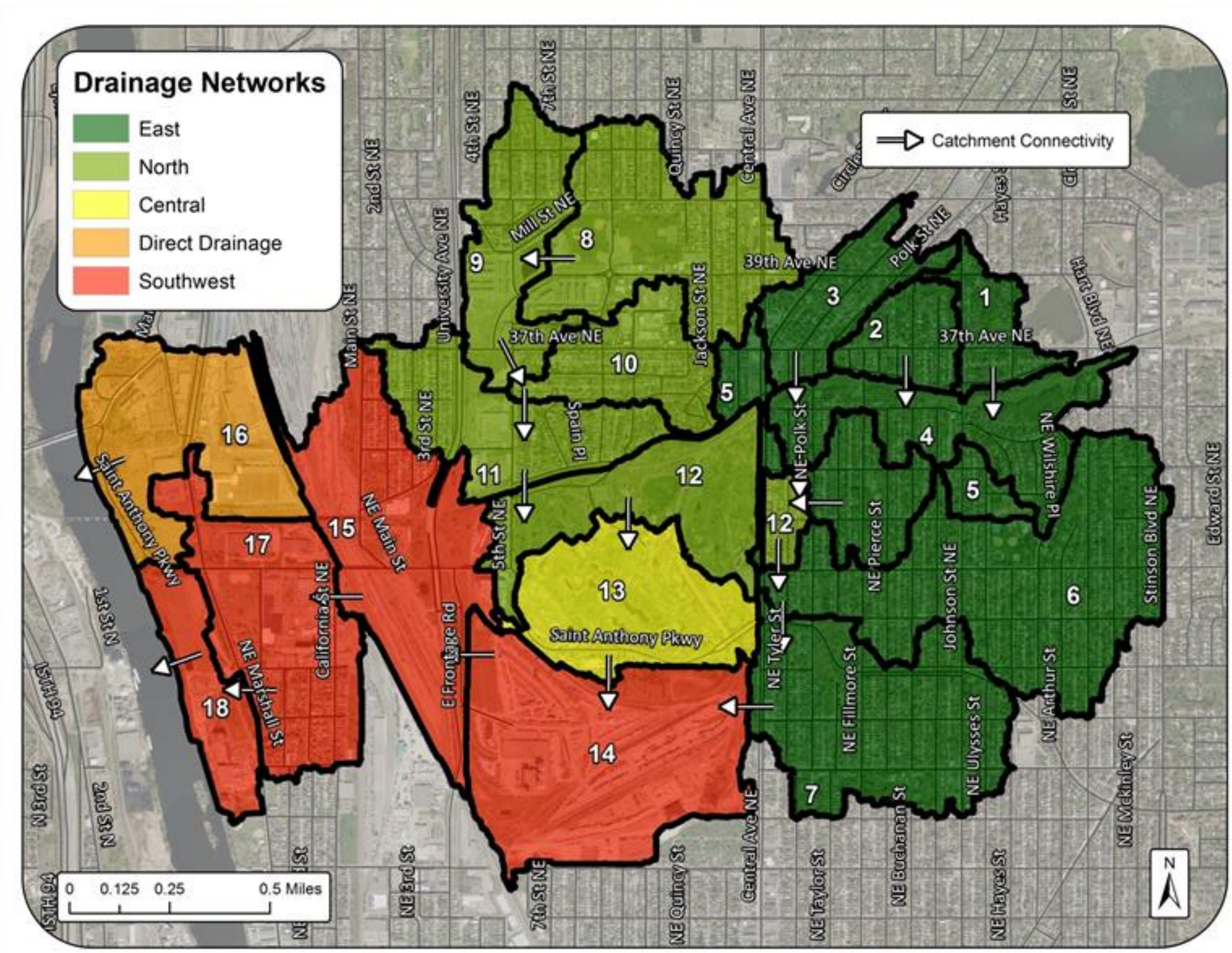
Lake	Year	Average	Min	Max
Sullivan	2008	880.22	879.42	881.24
	2009	879.92	879.36	880.52
	2010	880.23	879.62	881.10
	2011	880.36	879.29	881.25
	2012	879.86	878.91	881.15
	2013	880.00	879.23	880.93
	2014	880.08	878.88	881.92

Stormwater Retrofit Analyses –
Southern Columbia Heights and Northeast Minneapolis

Description:

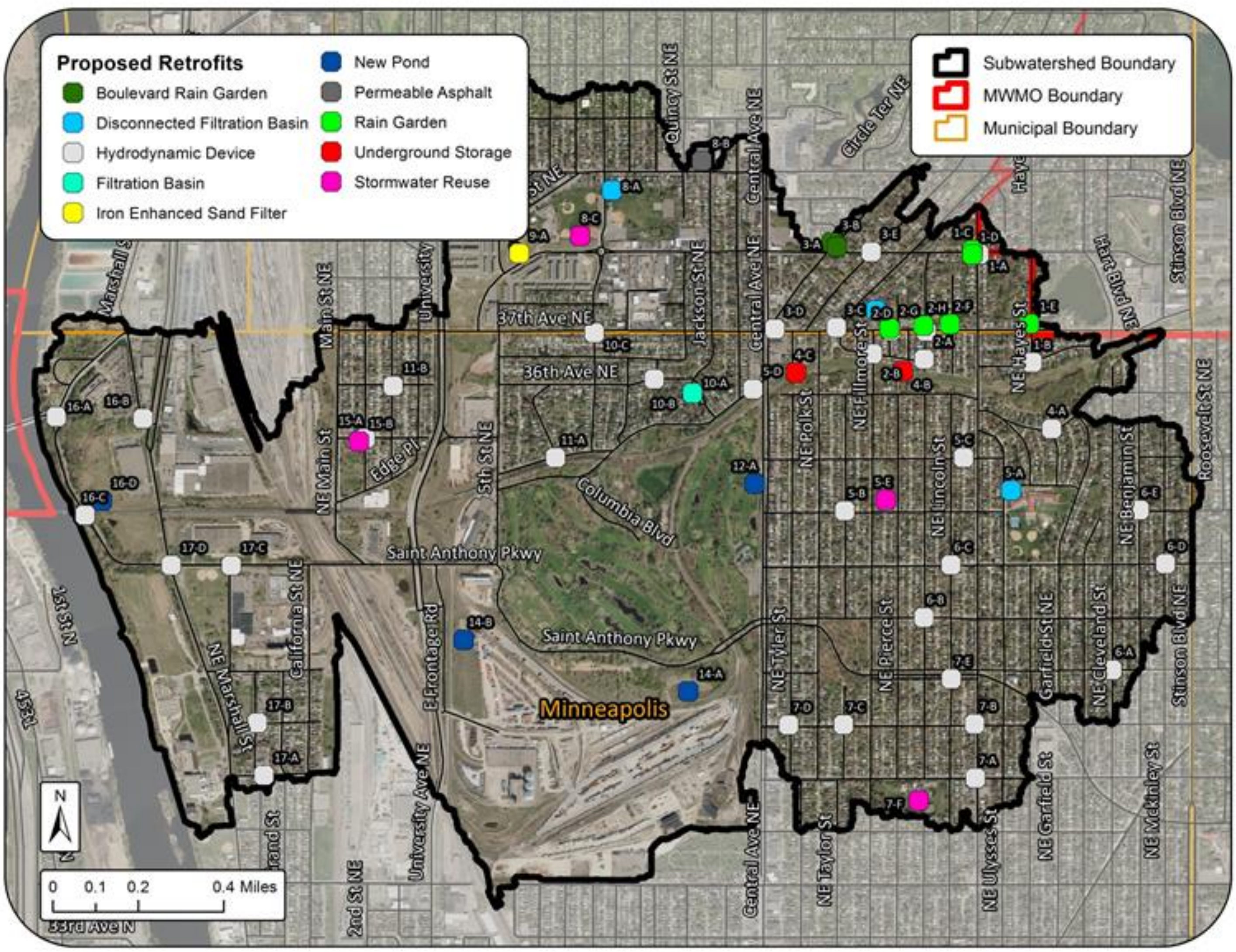
The Mississippi Watershed Management Organization (MWMO) contracted the Anoka Conservation District (ACD) to complete this stormwater retrofit analysis (SRA) for the purpose of identifying and ranking water quality improvement projects in the 1NE outfall drainage area. The 1NE outfall drainage area consists of portions of southern Columbia Heights and Northeast Minneapolis that drain to the Mississippi River. The MWMO specified total phosphorus (TP) and total suspended solids (TSS) as the target pollutants for the analysis. An overall annual subwatershed-wide reduction goal of 25% for both TP and TSS was identified. The intent of this goal is for use in judging the overall impact of implementing BMPs in the study area.

Map of 1NE Boundary and Drainage Catchments.



This analysis is primarily intended to identify potential projects within the target area to improve water quality in the Mississippi River through stormwater retrofits. Stormwater retrofits refer to best management practices (BMPs) that are added to an already developed landscape where little open space exists. The process is investigative and creative. Stormwater retrofits can be improperly judged by the total number of projects installed or by comparing costs alone. Those approaches neglect to consider how much pollution is removed per dollar spent. In this SRA, both costs and pollutant reductions were estimated and used to calculate cost effectiveness for each potential retrofit identified.

Map of 1NE Boundary and Proposed Retrofits.



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MWMO Financial Summary

***Table to be Added**

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.