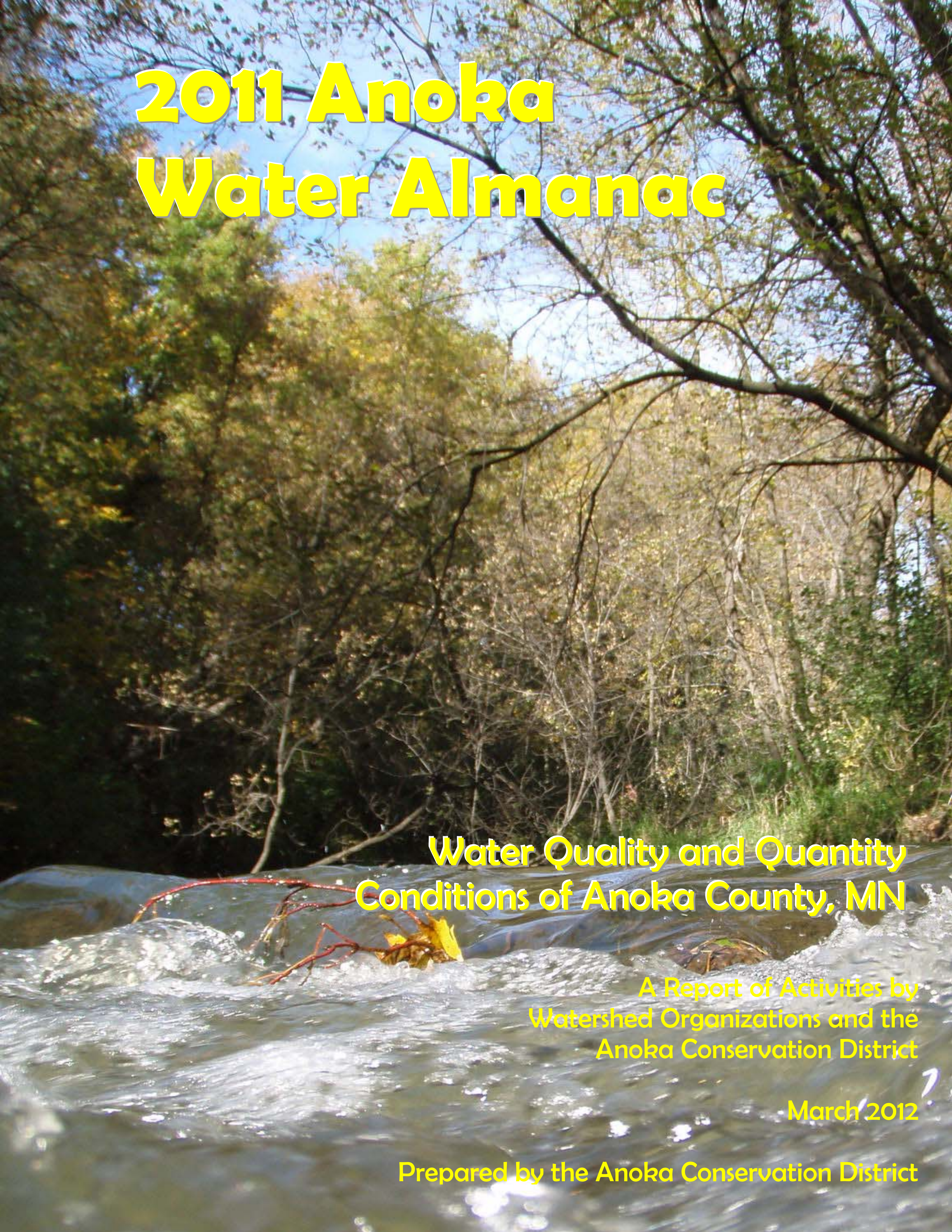
2011 Anoka Water Almanac



Water Quality and Quantity Conditions of Anoka County, MN

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

March 2012

Prepared by the Anoka Conservation District

2011 ANOKA WATER ALMANAC

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

EXECUTIVE SUMMARY
AND ORGANIZATION OF THIS REPORT

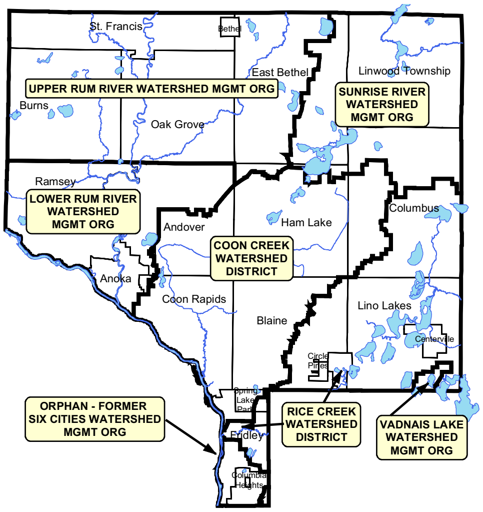
This report summarizes water resources management and monitoring work done as a cooperative effort between the Anoka Conservation District (ACD) and a watershed district or watershed management organization. It includes information about lakes, streams, wetlands, precipitation, groundwater, and water 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:

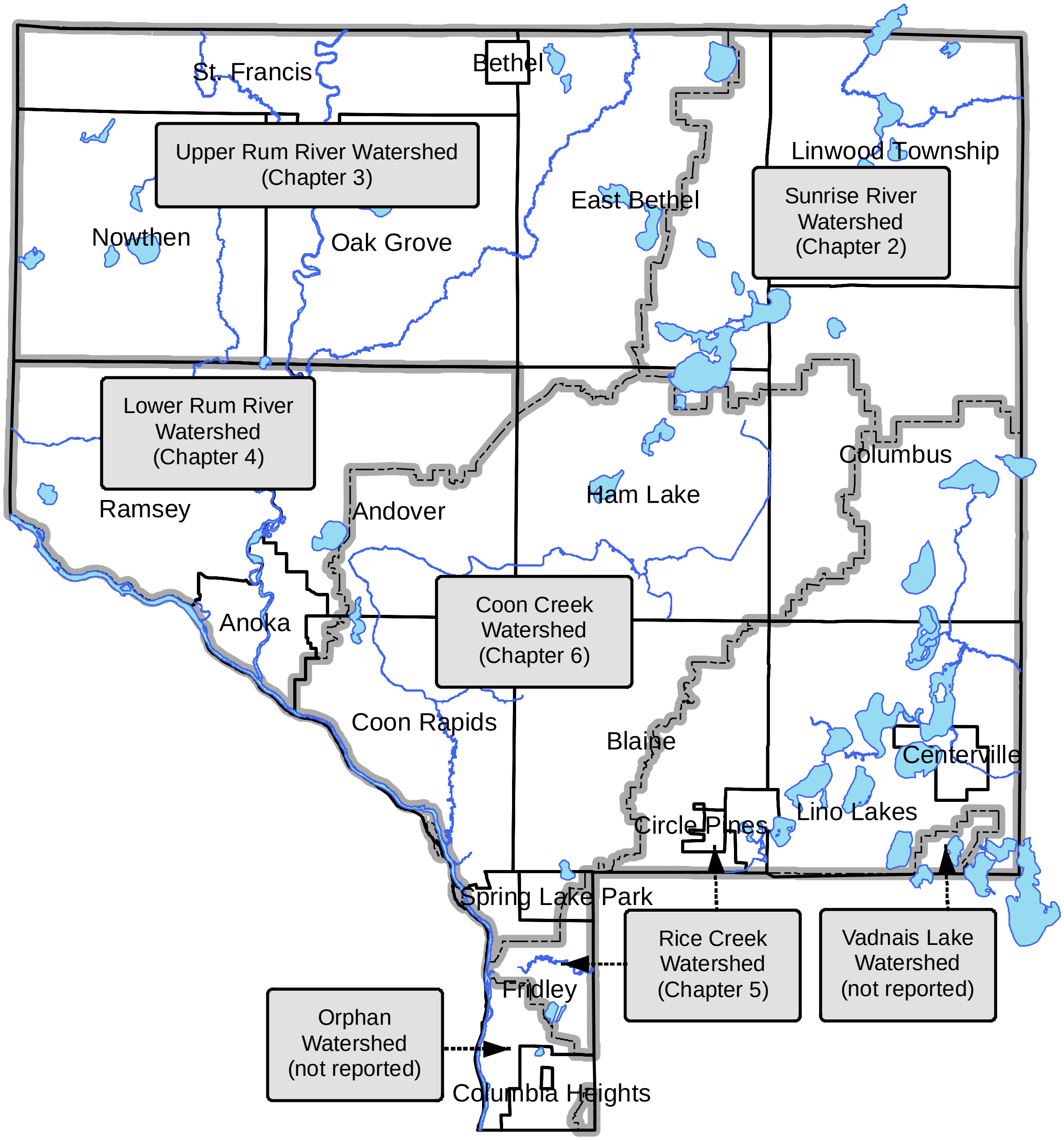
- Monitoring
    - precipitation,
    - lake levels,
    - lake water quality,
    - stream hydrology,
    - stream water quality,
    - stream benthic macroinvertebrates,
    - shallow groundwater levels in wetlands, and
    - deep groundwater in observation wells.
- Water quality improvement projects
    - projects designed, installed, or planned are briefly discussed in this report and detailed in a separate report of water quality improvement projects,
    - 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 2011. 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 2011 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 2011 and in years past is available in digital format from the Anoka Conservation District. All applicable data is also included to state databases for wider availability; these include the MPCA's EQuIS water quality database, the DNR's lakefinder tool for lake levels, and the State Climatology's online precipitation database.

TABLE OF CONTENTS



Chapter 1 - Primer



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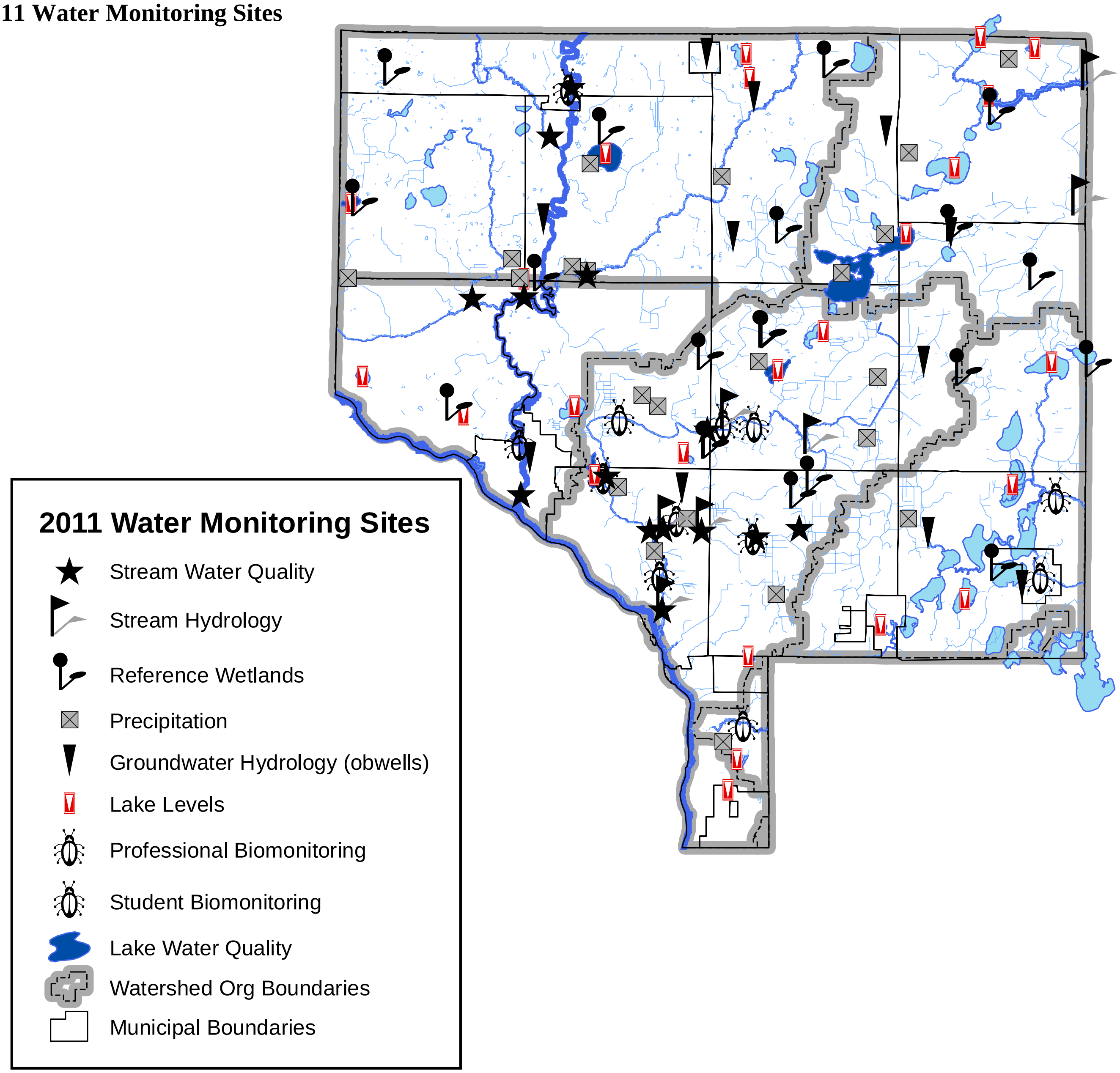
CHAPTER 1:
WATER RESOURCE MONITORING PRIMER

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.

2011 Water Monitoring Sites

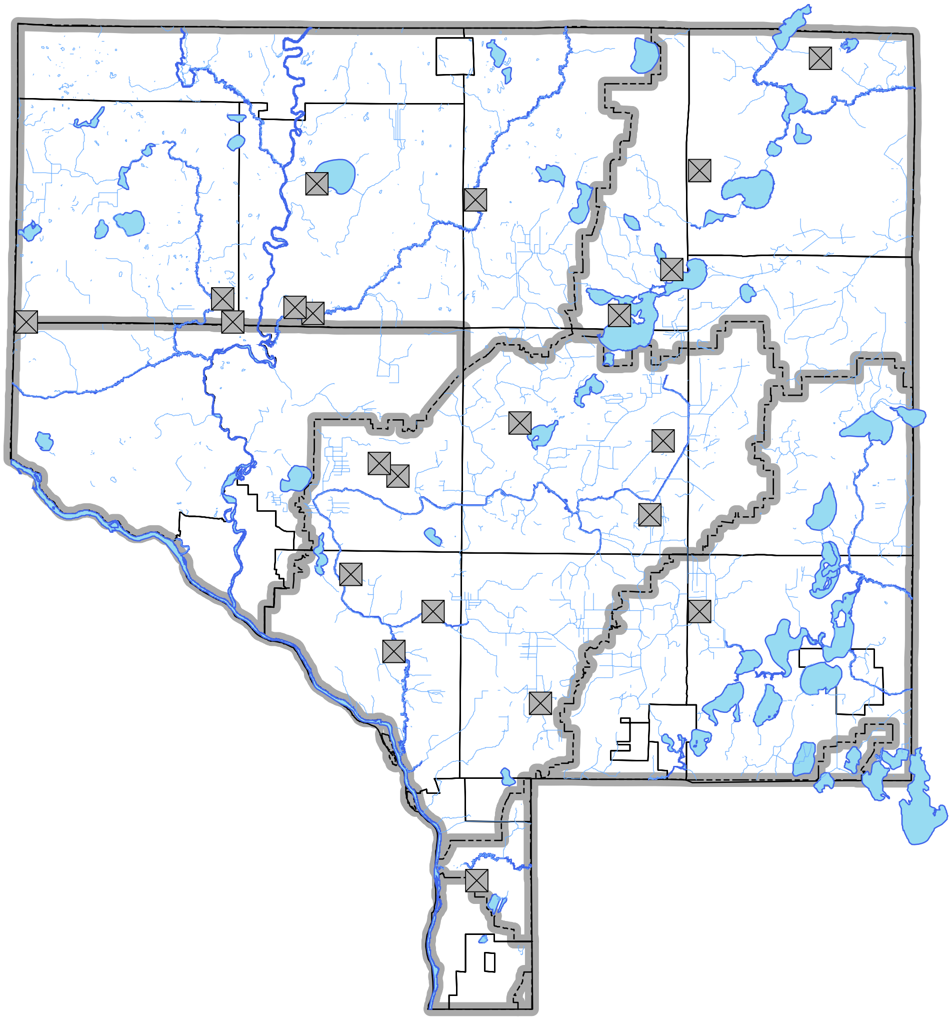


Precipitation

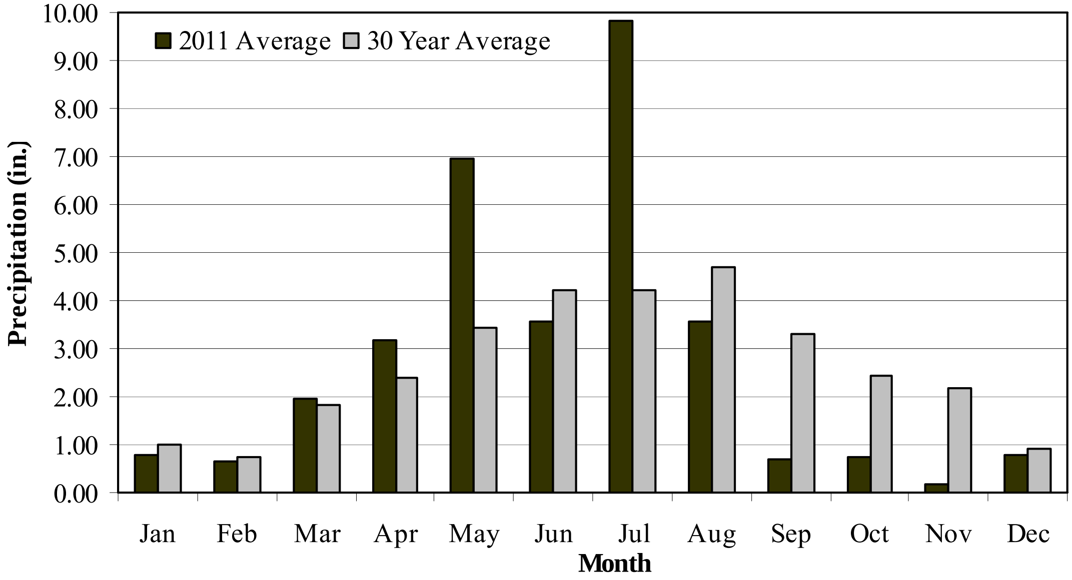
Precipitation data is useful for understanding the hydrology of water bodies, predicting flooding and groundwater limitations, and is needed to guide the use of special regulations that protect property and the environment in times of high or low water. Rainfall can vary substantially, even within one city. The ACD coordinates a network of 22 rain gauges countywide. Sixteen 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.

2011 Precipitation Monitoring Sites



2011 Anoka County Average Monthly Precipitation (average of all sites)



2011 Anoka County Monthly Precipitation at each Monitoring Site

		Month													
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			1.51	3.73	8.36	3.92	12.10	3.37	0.52	0.93				28.27
Blaine Public Works	Blaine				3.33		2.72	9.39	3.30	0.69	0.63				
Coon Rapids City Hall	Coon Rapids			1.36	3.85		4.48	10.79	3.70	0.61	0.23				
Anoka Cons. District office	Ham Lake			1.23	3.59	7.35	1.69		3.19	0.89	0.45				
Hoffman Sod Farm	Ham Lake			1.70	3.52		4.18	9.57	2.94	0.61	0.66				
Northern Nat. Gas substation	Ham Lake			1.58	0.36	5.84	2.41	8.60	3.18	0.45	0.59				20.48
Cylinder rain gauges (read daily)															
N. Myhre	Andover	0.85	0.61	2.28	2.87	8.68	4.01	9.79	3.20	0.69	0.79	0.19	0.55	34.51	26.37
B. Guetzko	Nowthen			2.78	3.05	7.12	2.58	12.95	5.07	0.66		0.20	0.42		28.38
J. Rufsvold	Burns					7.22	4.38	12.68	3.87	0.57	0.57				28.72
S. Scherger	Coon Rapids				3.07	8.52									
S. Solie	Coon Rapids				3.82	5.76	3.67	7.95	3.43	0.55					21.36
M. Gaynor	East Bethel					6.62	3.73	9.05	2.80	1.72					23.92
P. Arzdorf	East Bethel				3.40	7.73	3.98	8.94	3.65	0.55	0.73				24.85
A. Mercil	East Bethel	0.58	0.36	1.44	2.90	6.40	3.46	7.53	4.03	0.67	0.69	0.06	0.73	28.85	22.09
K. Ackerman	Fridley	0.86	0.73	2.52	2.97	5.60	4.82	11.81	4.04	0.36	0.63	0.17	1.00	35.51	26.63
C. Ehler	Lino Lakes				3.25	6.10	3.20	8.05	4.77	0.78	1.13				22.90
B. Myers	Linwood				2.29	5.68	2.97	5.66	4.07	0.65	0.86				19.03
D. Kramer	Linwood				5.46	7.56	3.59	5.51	4.07	0.71	1.03				21.44
A. Dalske	Oak Grove		0.92	3.22	2.96	7.18	3.78	16.54	2.66	0.49	0.73	0.22	0.70		30.65
P. Freeman	Oak Grove				2.87	6.70	3.40	9.81	1.49	0.70	0.75	0.25	1.25		22.10
D. Conger	Oak Grove				2.95	6.87	4.05	10.23	3.56	0.63	1.04				26.38
Y. Lyrenmann	Ramsey				3.39	6.87	3.98	9.71	4.50	0.68					25.74
2011 Average	County-wide	0.76	0.66	1.96	3.18	6.96	3.57	9.83	3.57	0.68	0.73	0.18	0.78	32.85	24.60
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.

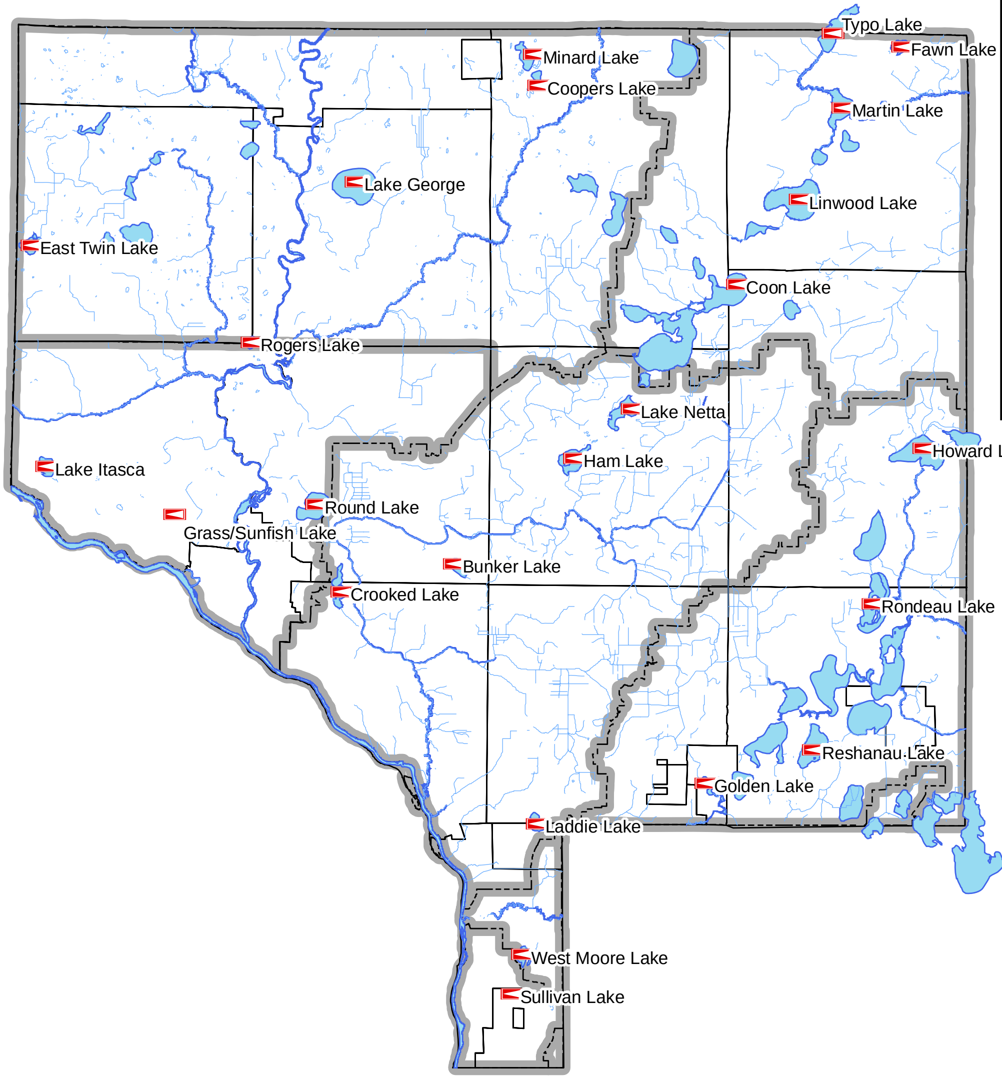
Lake Levels

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.

2011 Lake Level Monitoring Sites



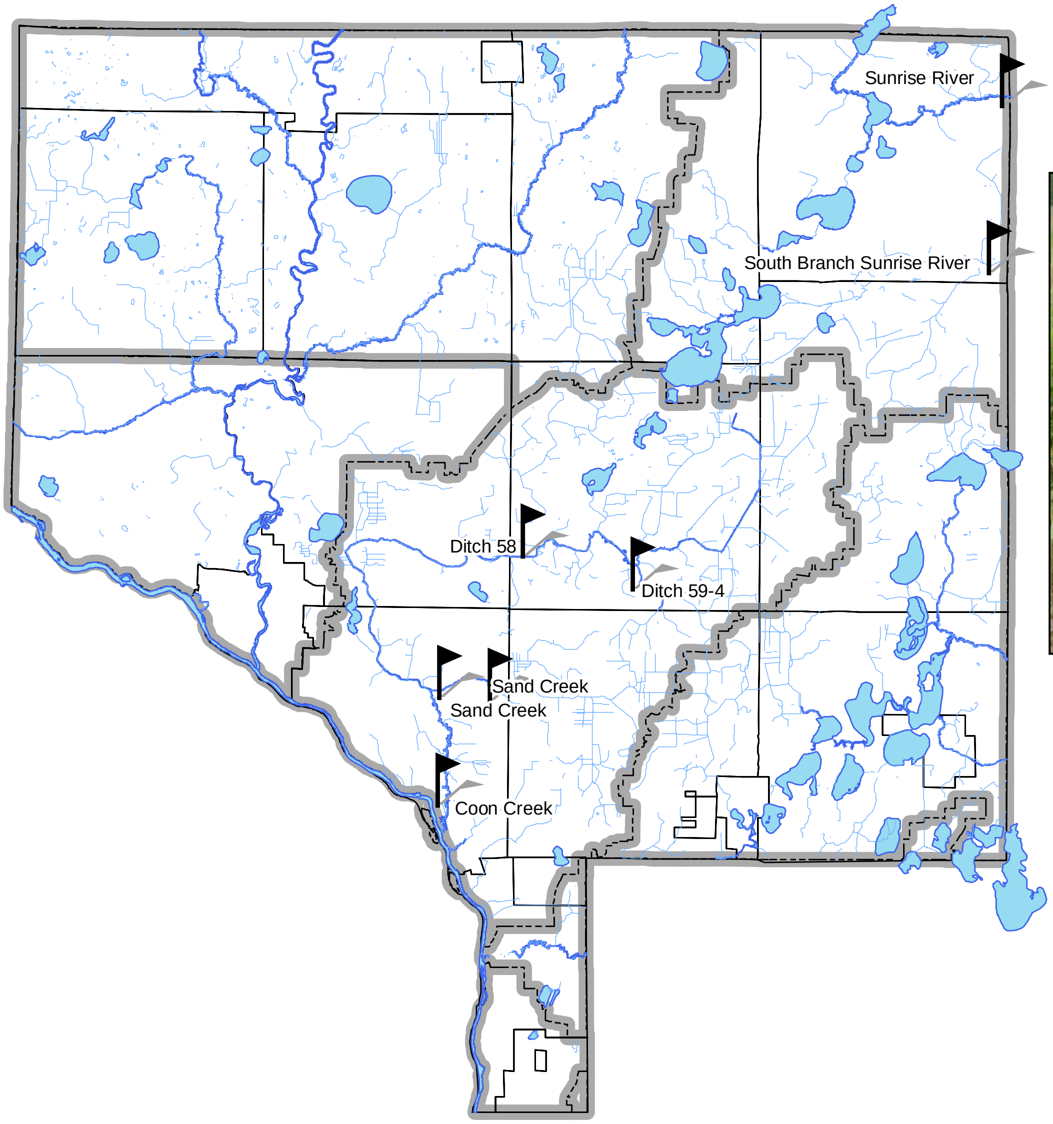
Stream Hydrology

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 7 stream sites in 2011. 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.

2011 Stream Hydrology Monitoring Sites



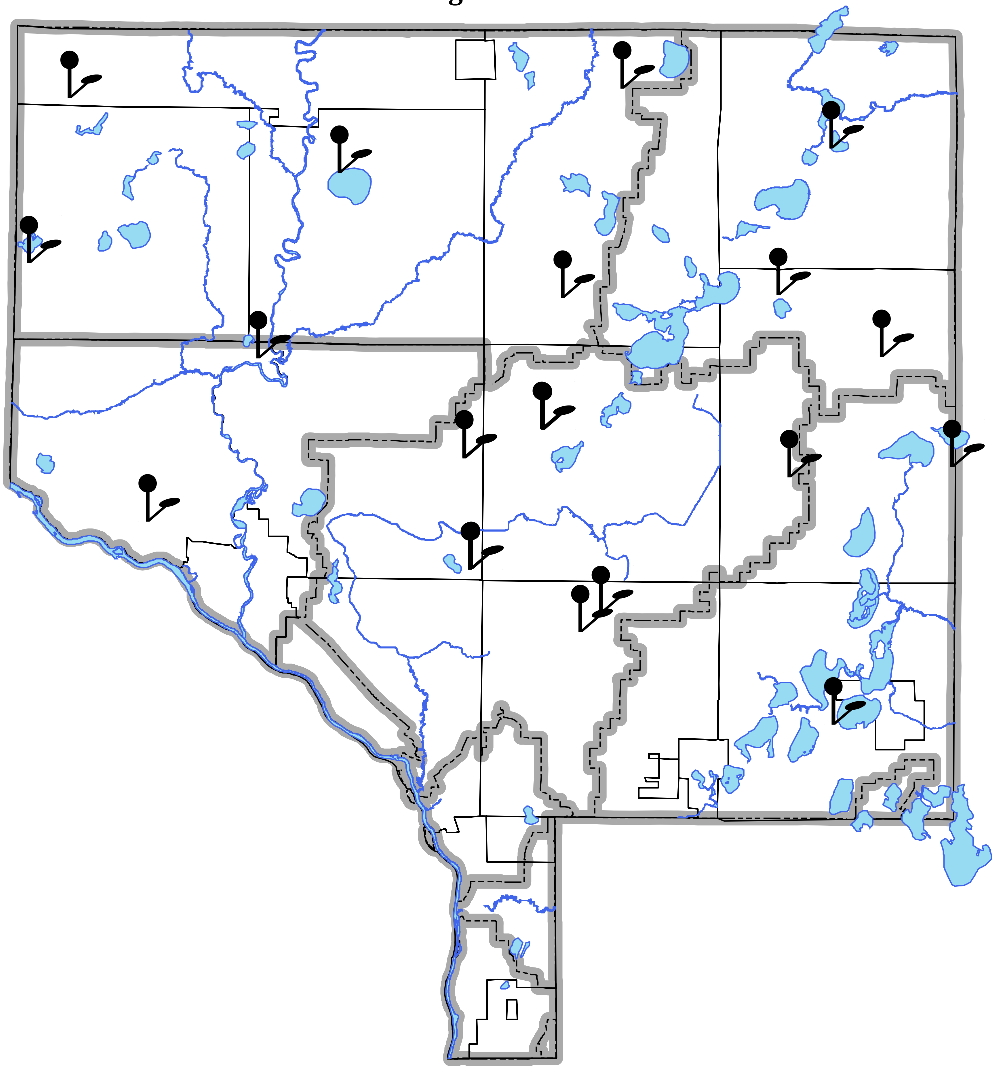
Wetland Hydrology

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.

2010 Reference Wetland Monitoring Sites

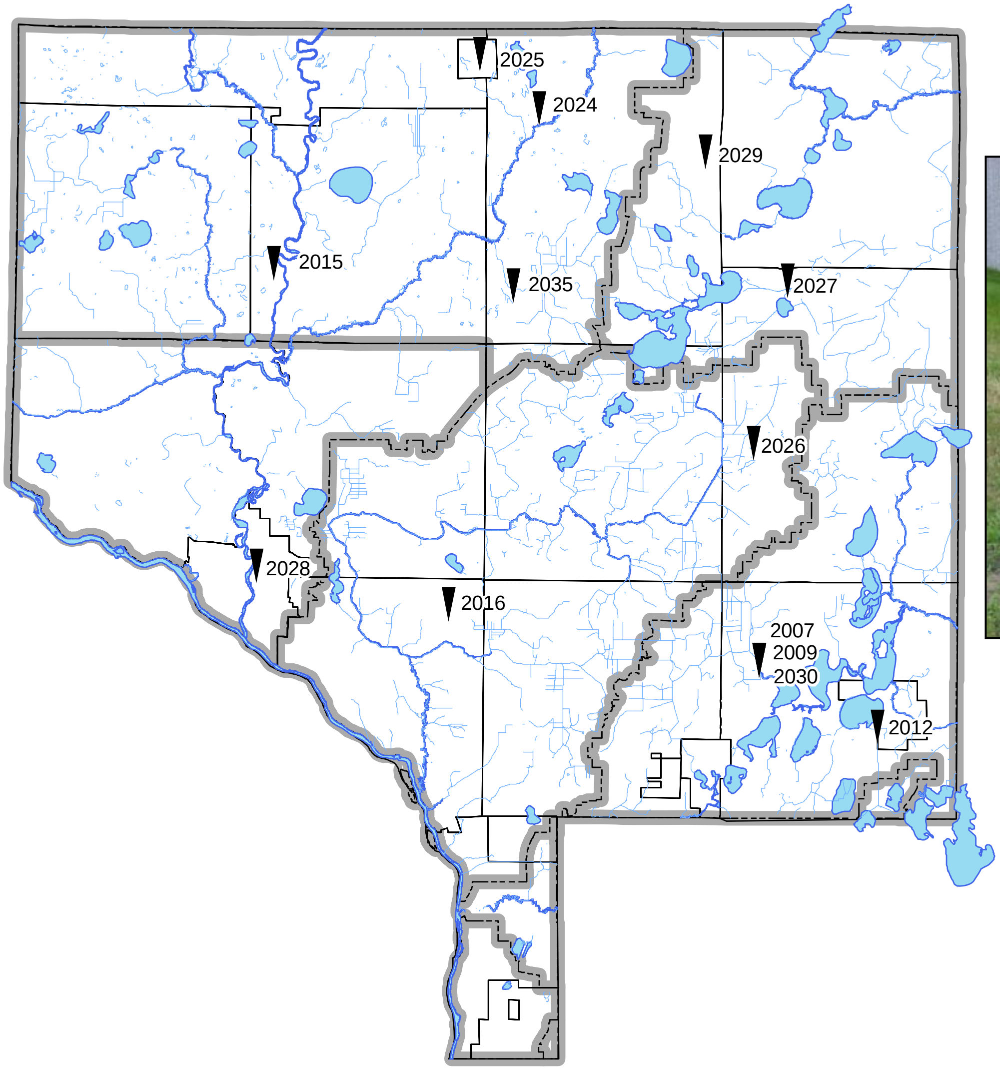


Groundwater Hydrology

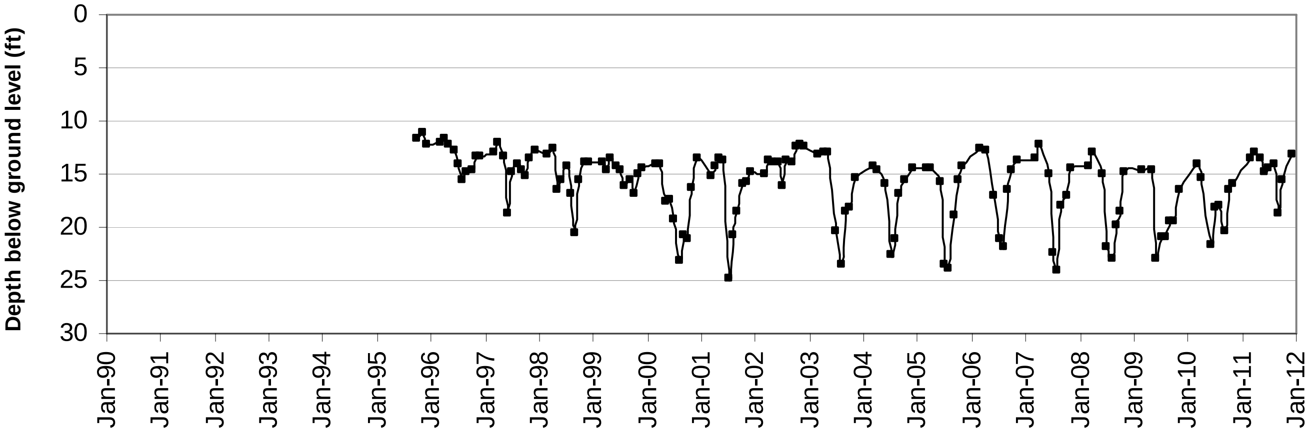
The Minnesota Department of Natural Resources (MN DNR) and ACD are interested in understanding Minnesota's groundwater quantity and flow. The MN DNR maintains a network of groundwater observation wells across the state. The ACD is contracted to take monthly water level readings in wells at 11 sites in Anoka County from March to December. 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 www.dnr.state.mn.us/waters/programs/gw_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 1990-2011. These results are not presented elsewhere in this report. Raw data can be downloaded from the MN DNR website.

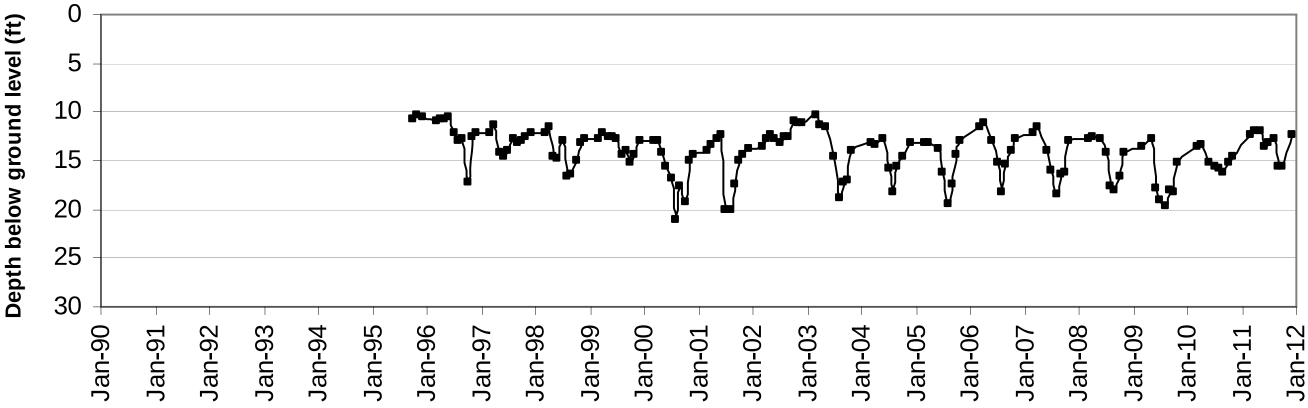
Groundwater Observation Well Sites and Well ID Numbers



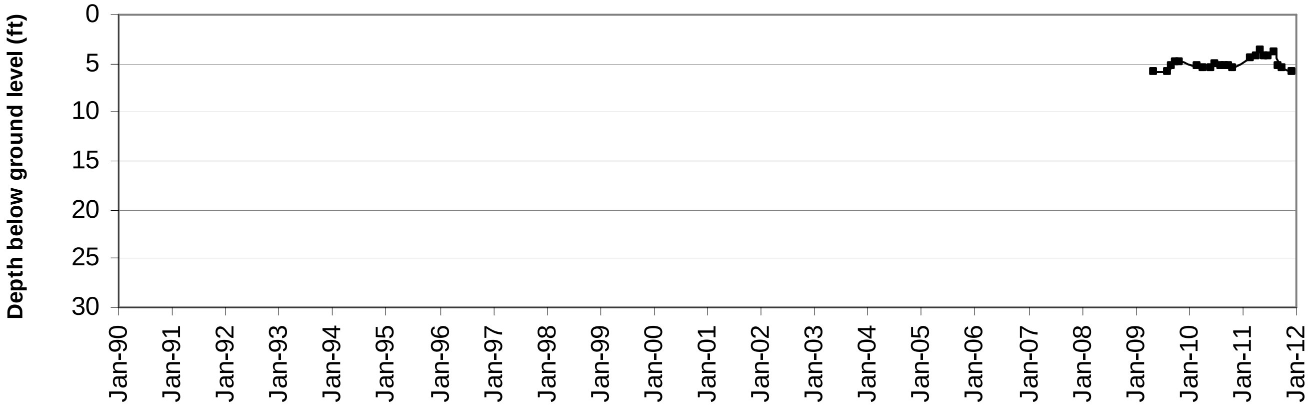
Observation Well #2007 (270 ft deep)—Lino Lakes



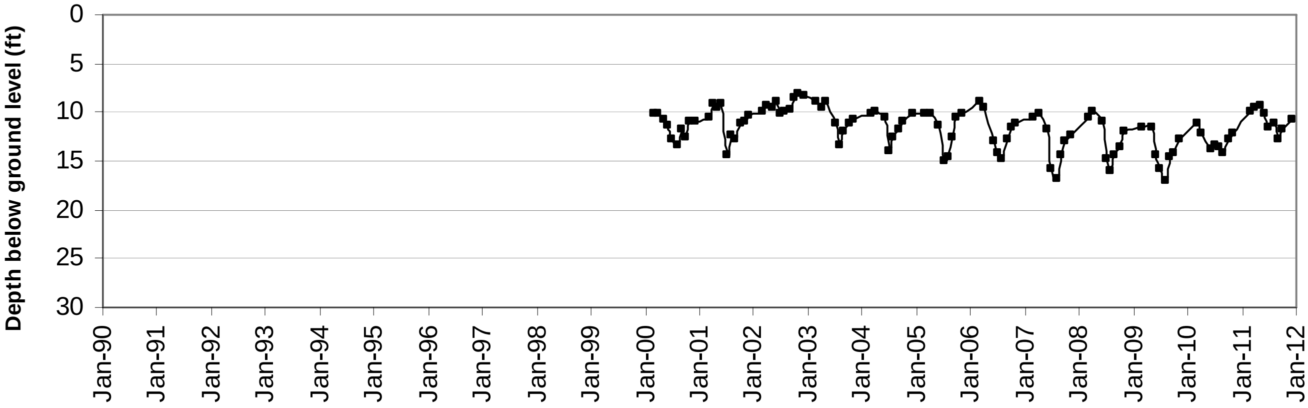
Observation Well #2009 (125 ft deep)—Lino lakes



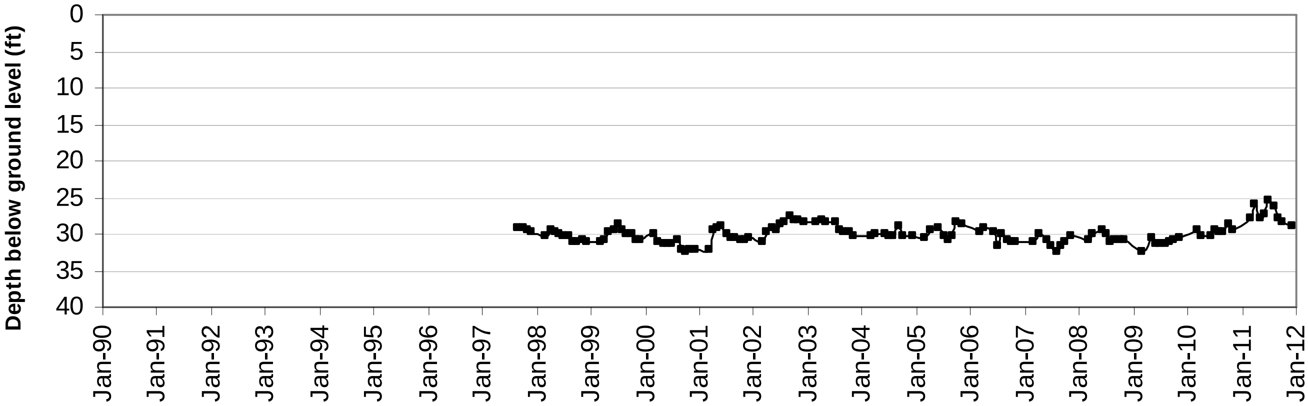
Observation Well #2030 (15 ft deep)—Lino Lakes



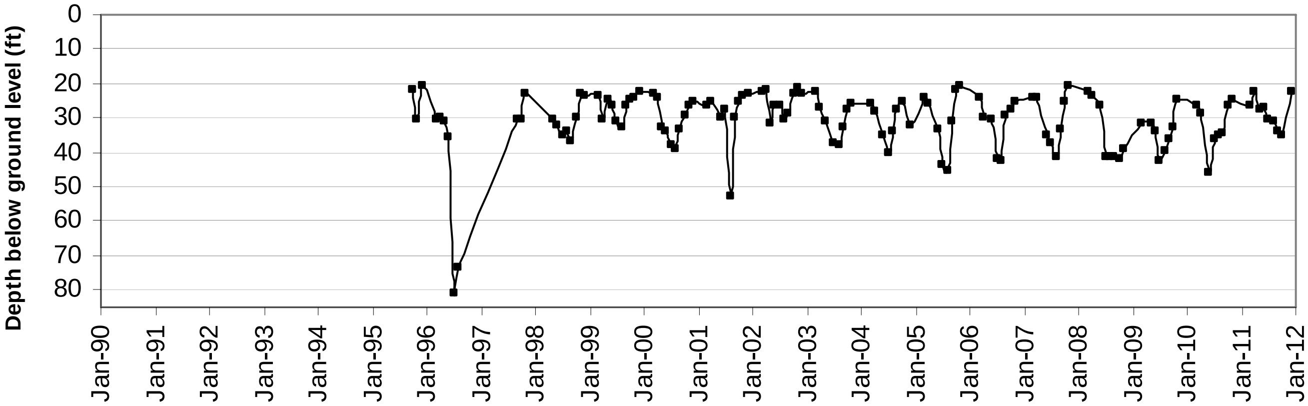
Observation Well #2012 (277 ft deep) – Centerville



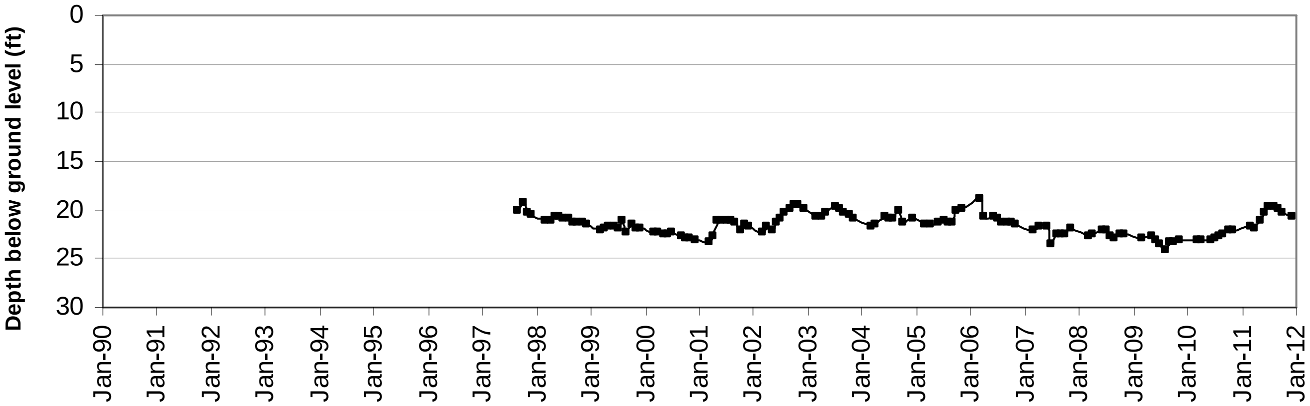
Observation Well #2015 (280 ft deep)—Ramsey



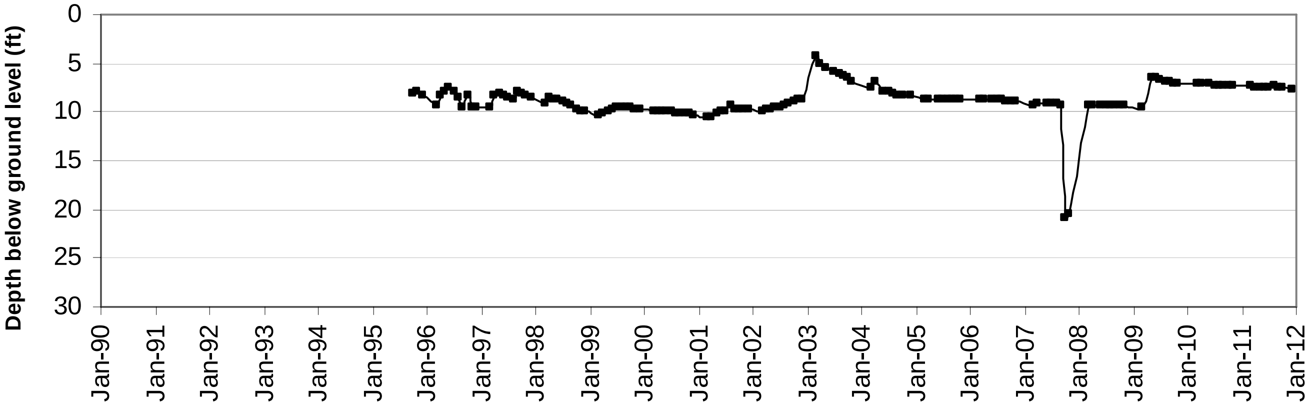
Observation Well #2016 (193 ft deep)—Coon Rapids



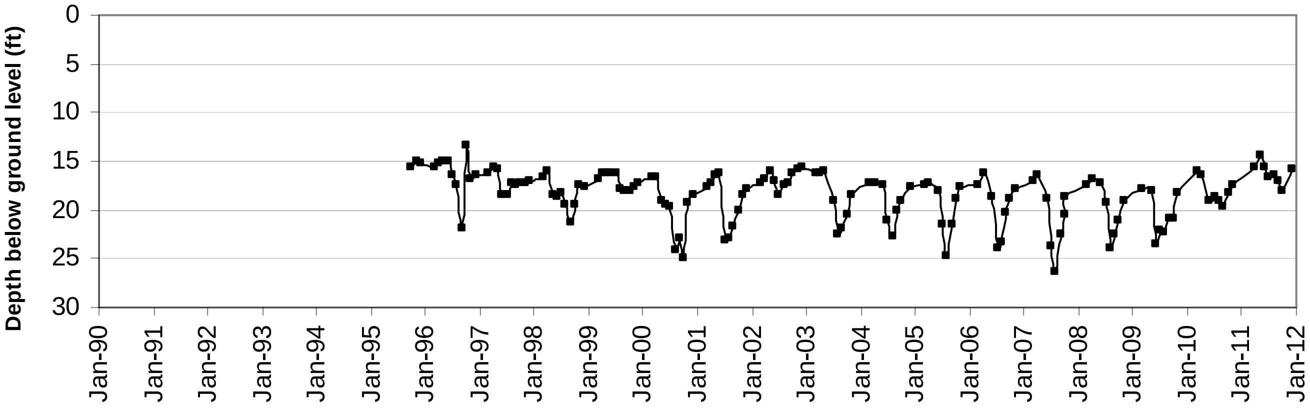
Observation Well #2024 (141 ft deep)—East Bethel



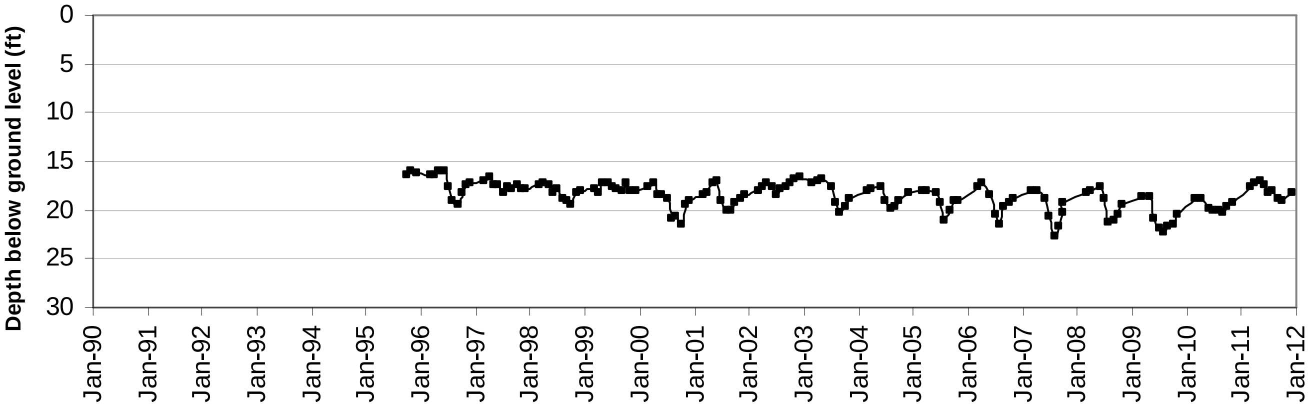
Observation Well #2025 (21 ft deep)—Bethel



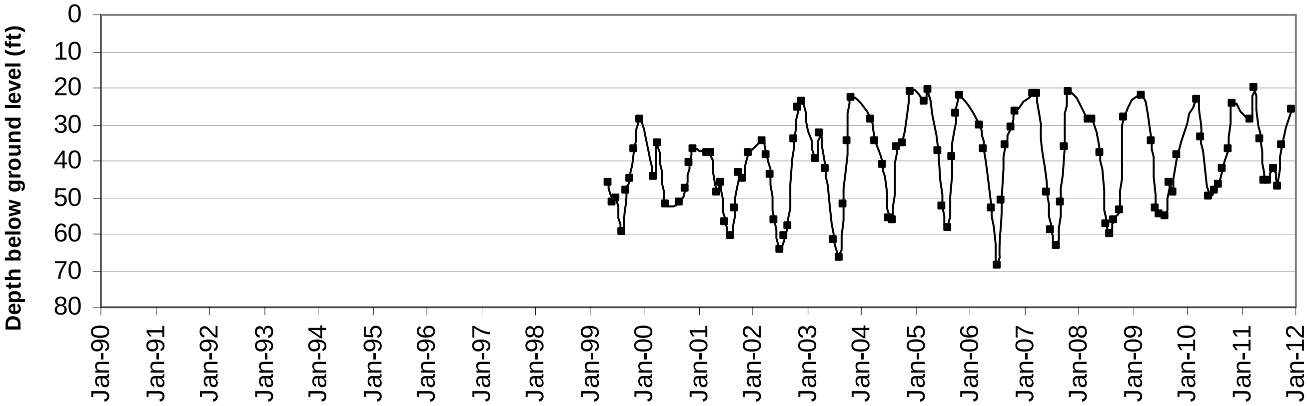
Observation Well #2026 (150 ft deep)— Carlos Avery #4



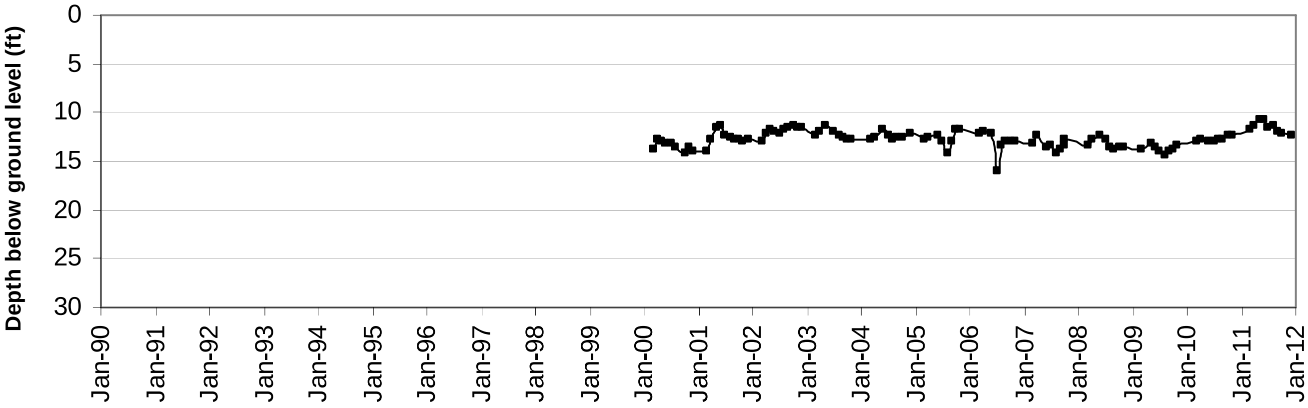
Observation Well #2027 (333 ft deep)— Columbus Twp.



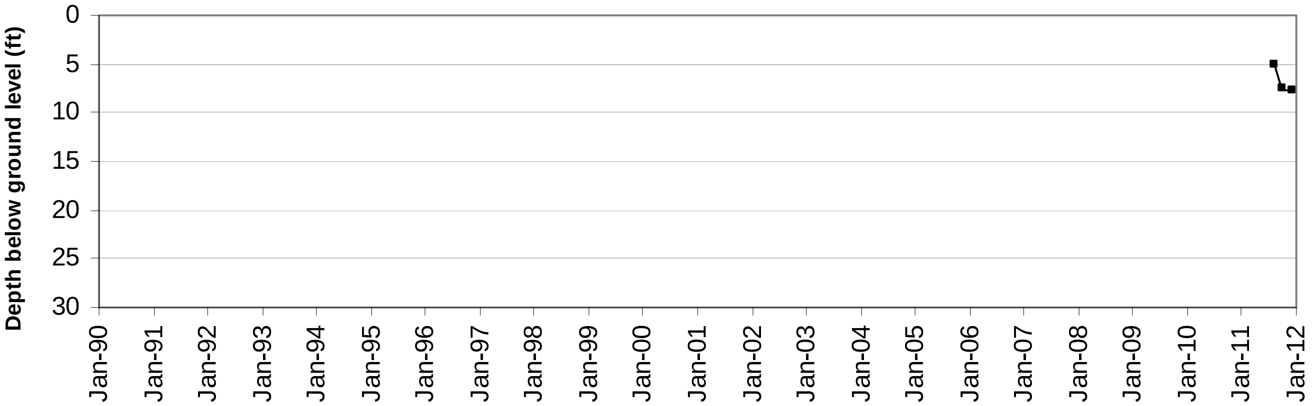
Observation Well #2028 (510 ft deep)—Anoka



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



Observation Well #2035 (20 ft deep)—East Bethel

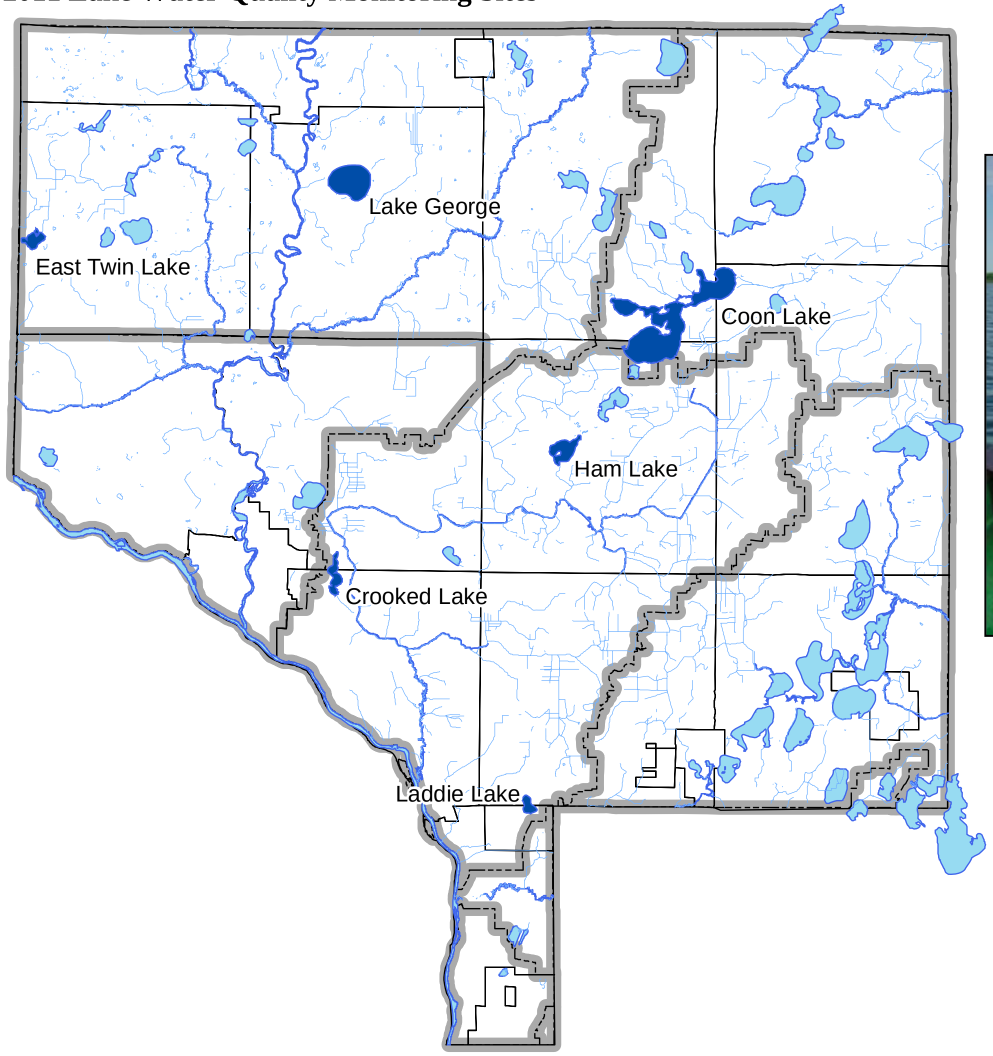


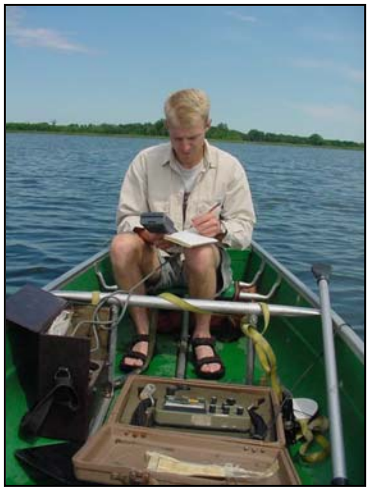
Lake Water Quality

Lake water quality monitoring in Anoka County began in the 1980's and was conducted primarily by the Metropolitan Council, Minnesota Pollution Control Agency (MPCA), and volunteer programs. The Anoka Conservation District (ACD) began a lake monitoring program in 1997 aimed at lakes that were not previously monitored. The purpose of these programs is to detect and diagnose water quality problems that may affect the suitability of lakes for recreation and that may adversely affect people or wildlife. The monitoring regime is designed to ensure all 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. Otherwise, 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.

2011 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. DO is measured in the field using a YSI® DO 200 dissolved oxygen and temperature probe. Conductivity, pH, turbidity, salinity and temperature are measured using the Horiba Water Checker® U-10 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 and total phosphorus. Sample bottles are provided by the laboratory. Total phosphorus sample bottles contain preservative sulfuric acid (H_2SO_4), while bottles for Chlorophyll-a analyses 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. During the winter, ice can restrict the supply of oxygen to the lake (limited aeration and dark conditions under snow-covered ice limiting photosynthesis). 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- A Secchi disk is a device used to measure transparency or clarity of the lake. 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 disk measurement. Shallow measurements typically indicate abundant algae and/or suspended solids.

Total Phosphorus (TP) - Phosphorus is an essential nutrient. Algal growth is commonly limited by low phosphorous supplies. Therefore, phosphorous inputs to a lake can rapidly stimulate algal 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 when the algae decays, and degrade aesthetics for recreation. 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 total 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. However, 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 above (pg. 12) 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 adjacent table). 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.

Trophic state indices are calculated monthly. At the conclusion of the 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?

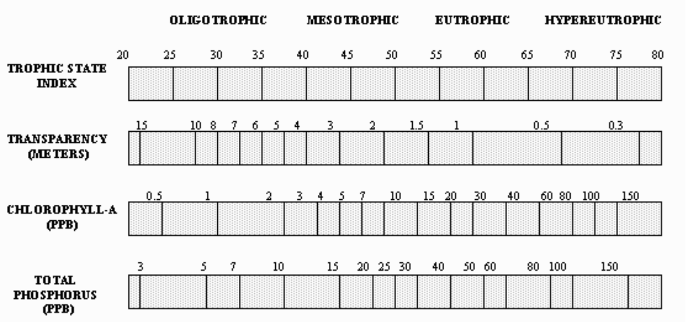
A- Lakes fall into four categories, or trophic states, based on lake productivity and clarity.

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, noticeable and excessive plant and 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. Met Council grades for 2011 are preliminary.)

Year→	1980	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
Cenaiko																		B	A	A	A	B	A	A	A	A	A	A	B	B	B	B
Centerville	D	C		C					D												C	C		C	C	A						
Coon	C				C					C					C			C	B	A	B	C	B		C		C		C			
Coon (East Bay)					C					C	C	C		C	C	C		B	B	A	B	C	B		C	C	C	B	A	B	B	B
Coon (West Bay)																															A	
Crooked				C		C				C					B	C	B	B	B		B		B	B		B	B		B	B		B
E. Twin	A	B		C						B						B		A	B	A	A		A			A			A		A	A
Fawn									B									A	B	A	A	A	A		A		A		A		A	
George	A	A	A		A					A					B			A	B	A	A		A			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
Golden	D					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
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	B
Itasca																			A	B	B											
Laddie	D													B	B	B			C	B	B	B	B	B	B	B			B			B
Linwood	B	C		C						C					C			C	C	C	C	C		C		C		C	C	C		
Lochness																												A	B		B	C
Martin				D														D	D	C	D	D		D		D		D	D	D		
E. Moore	C	C	C	C	C	B	C	C							C				C	B	B	C	C	C		C						
W. Moore	C	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	
Peltier				D										D	F	D	D	D	D	D	D	F	F	D	D	D	F	D				
Pickerel	C															B		A	A	B	C										A	C
Reshanau																											D	D	D	D	D	D
Rogers																			C		C			B			D		B	B		
Round																			B	A	B			A		B		C		C	C	
Sandy														D	D	D		D	D	D	D	D	F	D	D	D						
Typo														F	F	F		F	F	F	F	F		F		F		F		F		

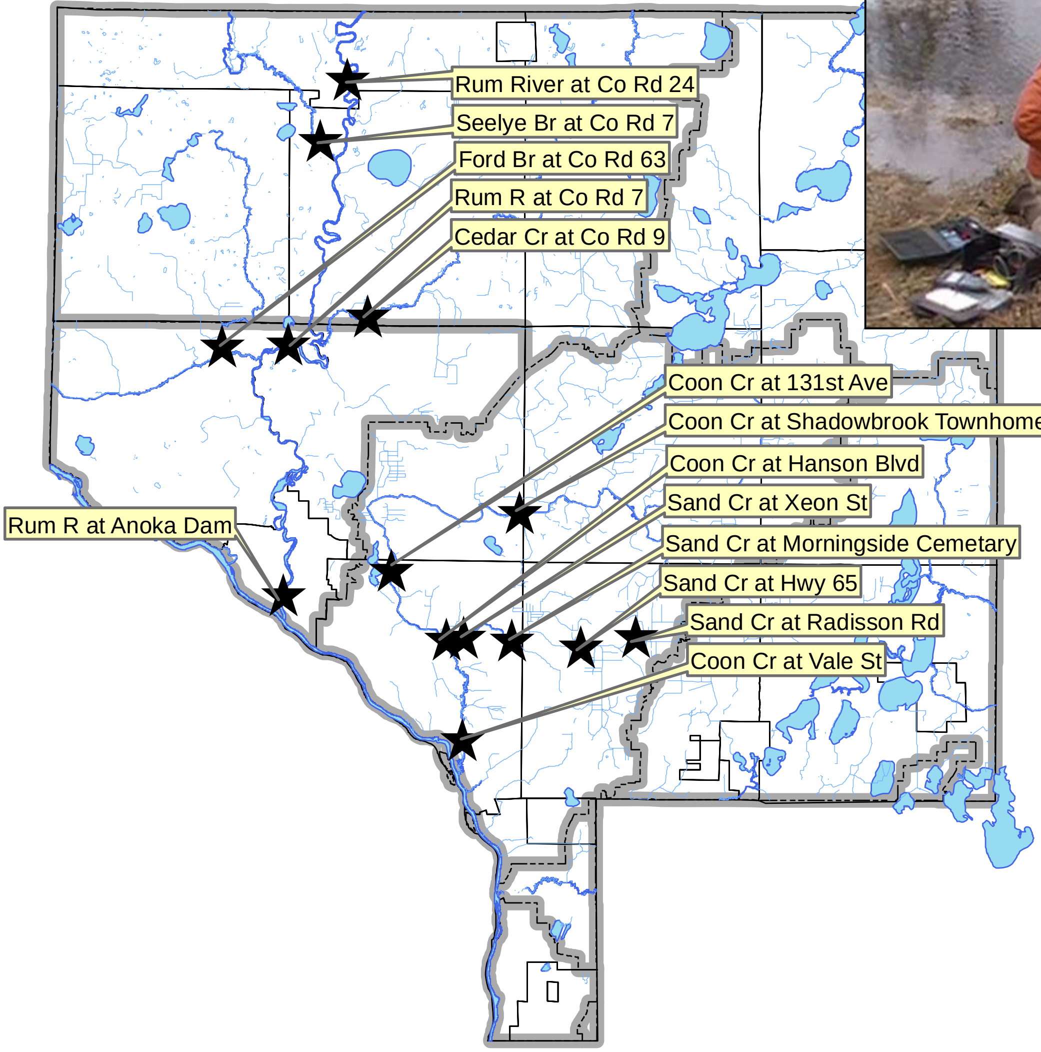
Stream Water Quality – Chemical Monitoring

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

Chemical stream water quality monitoring in 2011 was conducted at three sites on the Rum River, three tributaries to the Rum River, and eight sites in the Coon Creek and Sand Creek drainage. 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.

2011 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.

DO was measured in the field using a YSI® DO 200 dissolved oxygen and temperature probe. pH, turbidity, conductivity, temperature, and salinity were measured in the field using a Horiba Water Checker® U-10 multi-probe. Total phosphorus, chlorides, total suspended solids, sulfate, hardness, and any other parameters were analyzed by an 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. 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	Horiba U-10
Conductivity	0.001	0.001	Horiba U-10
Turbidity	1.0	1.0	Horiba U-10
Dissolved Oxygen	0.01	0.01	YSI DO 200
Temperature	0.1	0.1	Horiba U-10
Salinity	0.01	0.01	Horiba U-10
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

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

A- We make two 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.

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 Horiba U-10 multi-probe and the YSI dissolved oxygen meter used to conduct in-stream monitoring were 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	9
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.

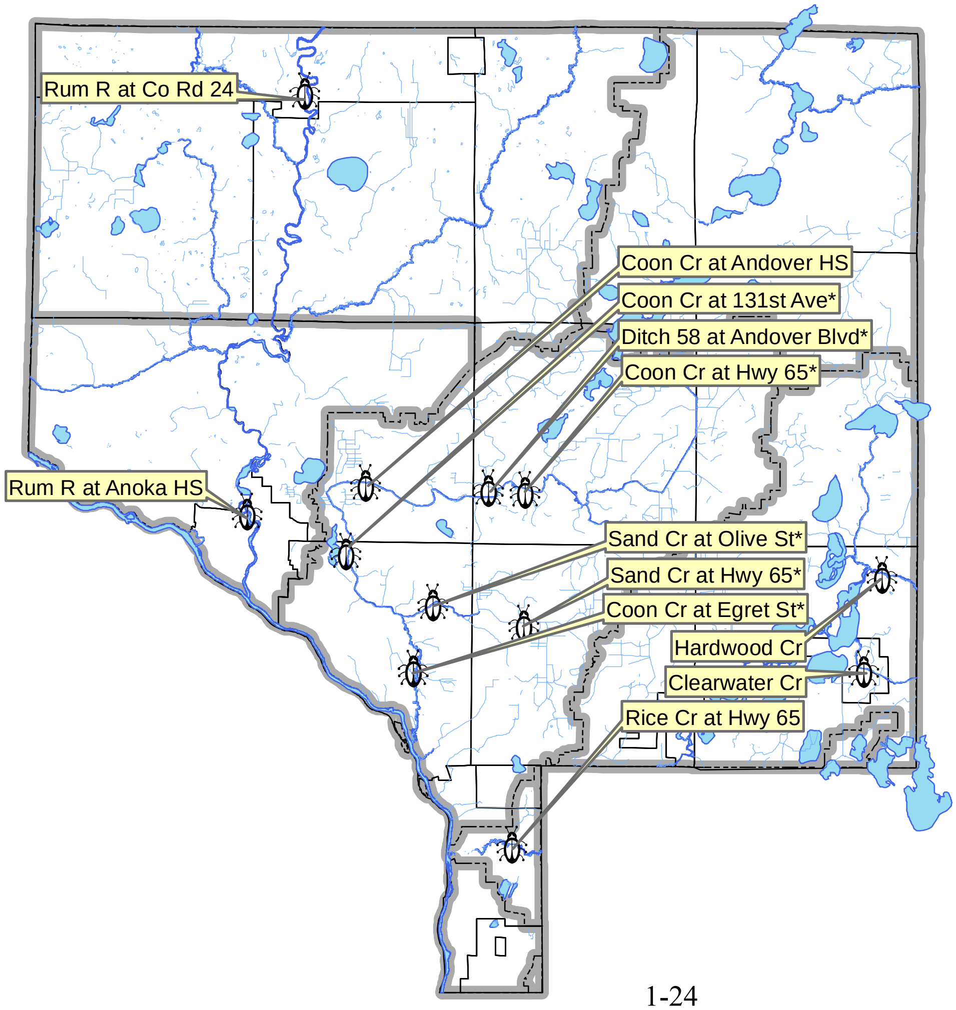
ACD adds an educational component to the program by involving students in the biomonitoring at many of the sites. High school science classes are the primary volunteers. In 2011 there were approximately 199 students from seven high schools who monitored seven sites. Since 2000 approximately 4,522 students have participated. The experience affords students an opportunity to learn scientific methodologies and become involved in local natural resource management.

In 2011 six sites were monitored by professionals without student involvement during both the summer and fall seasons. These sites were all within the Coon Creek drainage. The purpose was to examine sites listed by the MCPA as "impaired" for biota based on a single sample and to compare the biotic community in ditched and unditched stream reaches.

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

2011 Biological Stream Water Quality Monitoring Sites

(*professionally monitored, all others student monitored)



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).

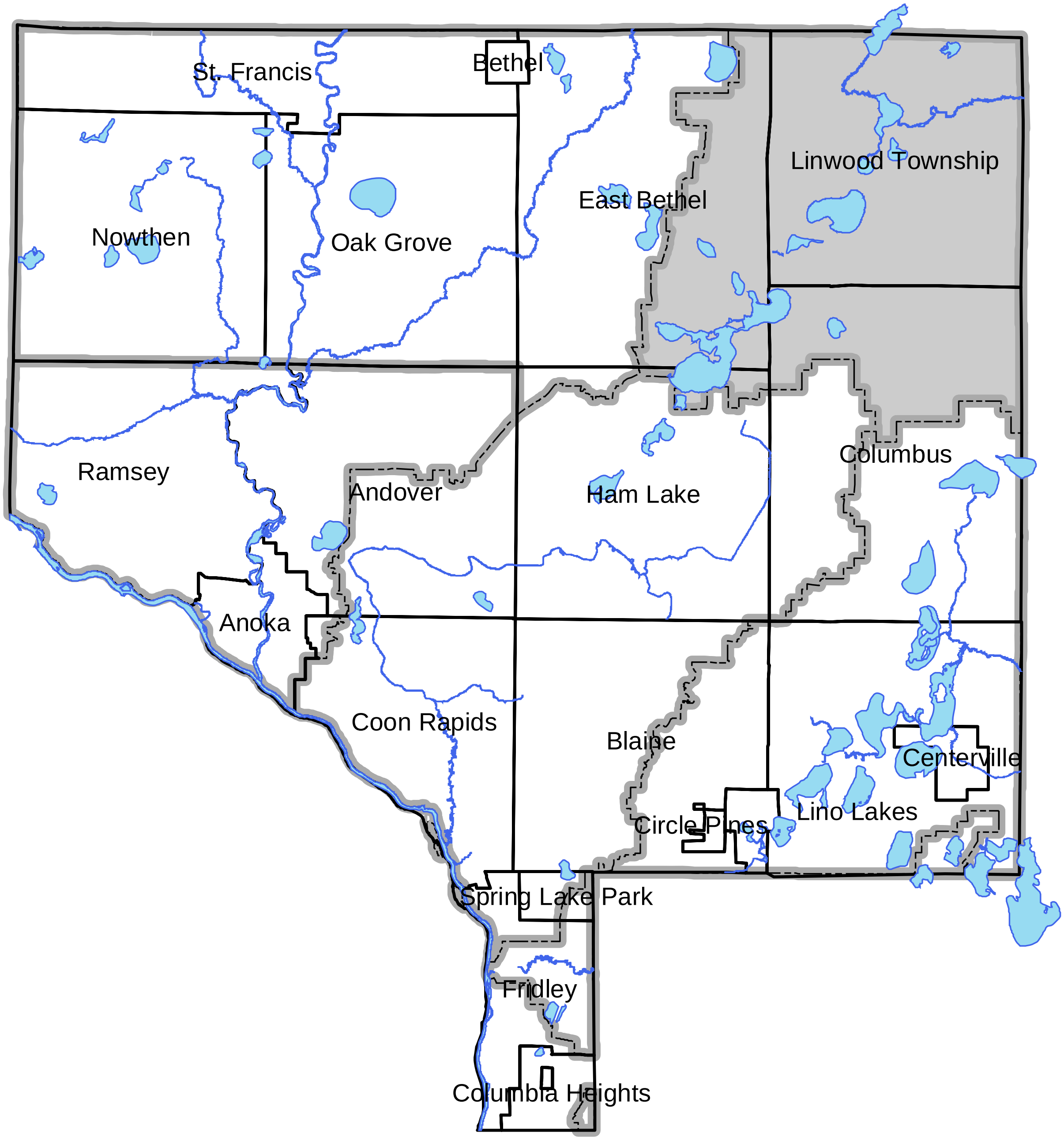
Sites

In 2011, ten sites were monitored for benthic macroinvertebrates. High school classes, with ACD staff supervision, sampled seven of these sites.

2011 Biomonitoring Sites and Corresponding Monitoring Groups

Monitoring Group	Stream
Andover High School	Coon Creek
Anoka High School	Rum River (near Anoka)
Blaine High School	Coon Creek at Egret Blvd.
Centennial High School	Clearwater Creek
Forest Lake Area Learning Center	Hardwood Creek
St. Francis High School	Rum River (St. Francis)
Totino Grace High School	Rice Creek
Anoka Conservation District	Ditch 58 at Andover Blvd
Anoka Conservation District	Sand Cr at Olive St
Anoka Conservation District	Coon Creek at Hwy 65
Anoka Conservation District	Coon Creek at 131st Ave.
Anoka Conservation District	Coon Creek at Egret Blvd.
Anoka Conservation District	Ditch 41 at Hwy 65

Sunrise River Watershed

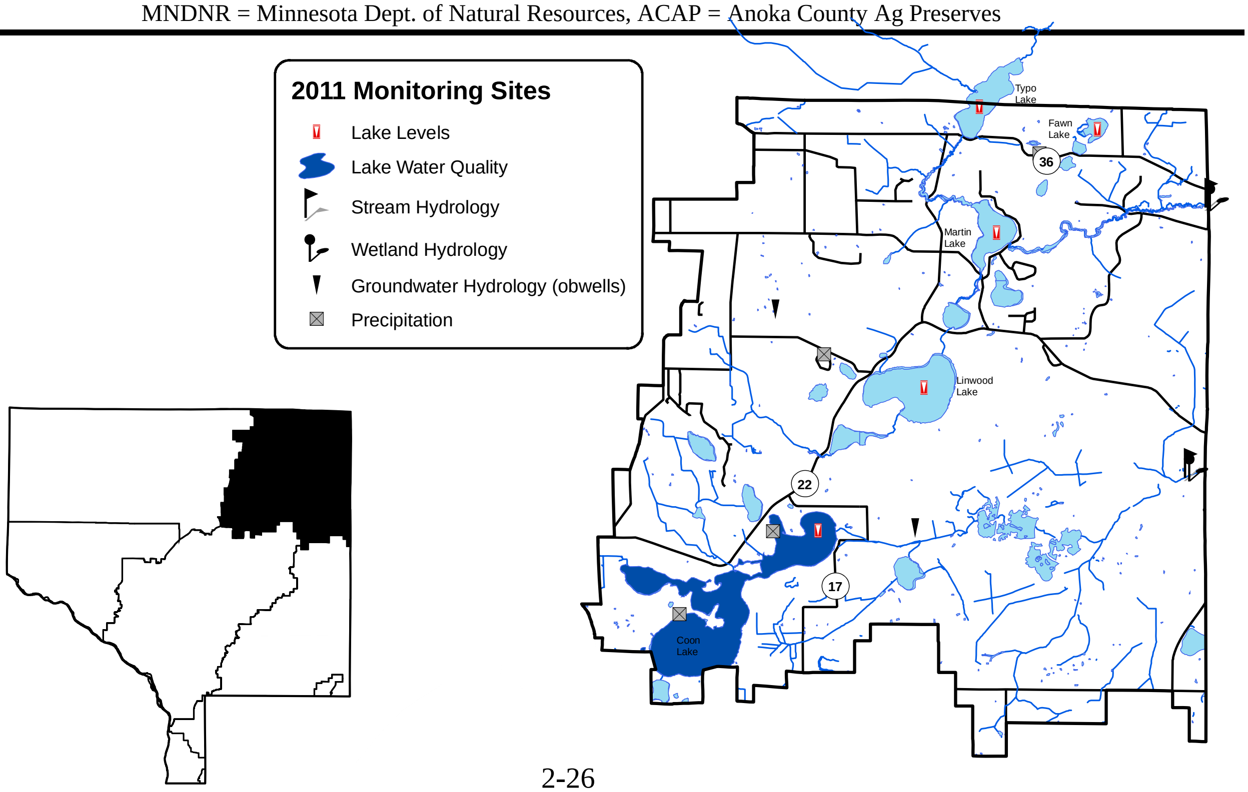


Contact Info:	Sunrise River Watershed Management Organization www.AnokaNaturalResources.com/SRWMO 763-434-9569
	Anoka Conservation District www.AnokaSWCD.org 763-434-2030

CHAPTER 2:
SUNRISE RIVER WATERSHED

Task	Partners	Page
Lake Levels	SRWMO, ACD, volunteers	2-27
Lake Water Quality (volunteers)	SRWMO, ACD, volunteers	2-29
Lake Water Quality (professional)	Coon Lake Imp Assoc, ACD, ACAP	2-30
Stream Hydrology	SRWMO, ACD	2-35
Wetland Hydrology	SRWMO, ACD, ACAP	2-38
SRWMO Phosphorus Export Estimation	SRWMO, ACD	2-42
Water Quality Grant Fund	SRWMO, ACD	2-44
Water Quality Improvement Projects	SRWMO, ACD, landowners	2-45
Martin Lake Stormwater Retrofits	SRWMO, Martin Lakers Association, Linwood Twp, ACD, landowners	2-47
Lakeshore Landscaping Education	SRWMO, ACD	2-49
Aquatic Plant Education Campaign	SRWMO, ACD	2-51
Annual Education Publication	SRWMO, ACD	2-52
SRWMO Website	SRWMO, ACD	2-53
Grant Search and Applications	SRWMO, ACD	2-55
SRWMO 2010 Annual Report	SRWMO, ACD	2-56
Review Local Water Plans	SRWMO, ACD	2-57
On-call Administrative Services	SRWMO, ACD	2-58
Financial Summary		2-59
Recommendations		2-60
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).

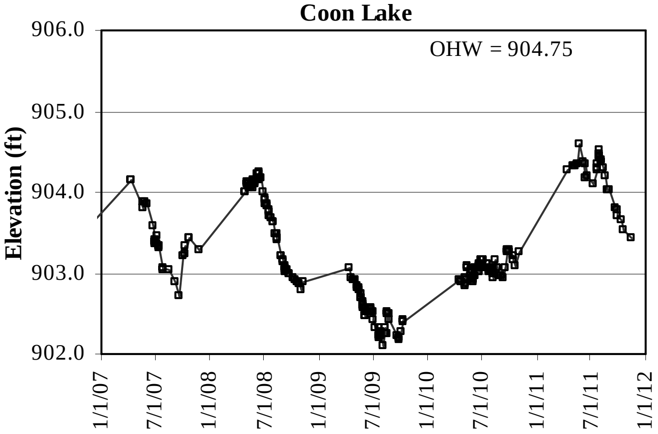
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

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

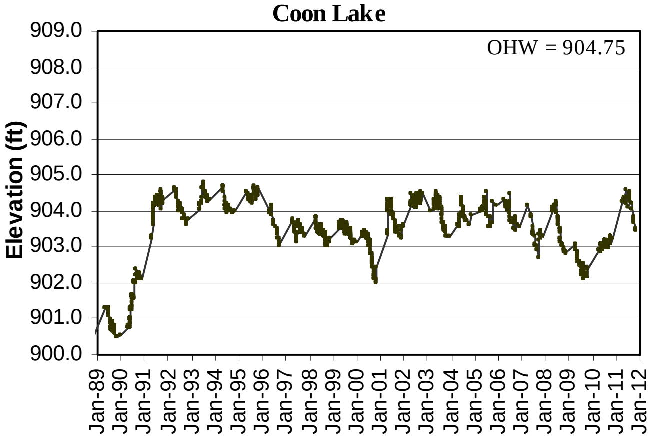
Results: Lake levels were measured by volunteers 23 to 58 times throughout 2011, depending upon the lake. All lakes had sharply increasing water levels in spring and early summer 2011 when extremely high rainfall totals occurred. Generally, water levels in the lakes peaked around May 23. Fawn Lake, which more closely follows groundwater levels than the other lakes, peaked about a month later. Coon Lake had second peaks around August 2, nearly as high as the first. At their peaks, lake levels were up to nearly a foot greater than seen in recent years. Coon Lake was within 0.52 feet of a record high, while Linwood was within 0.3 feet. Other lakes did not approach record highs. After these peaks, all lake levels fell continuously during late summer and fall when very little precipitation fell and drought approached.

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.

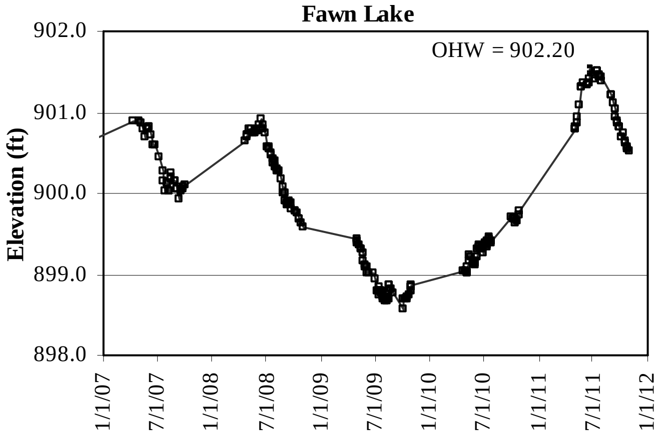
Coon Lake Levels 2007-2011



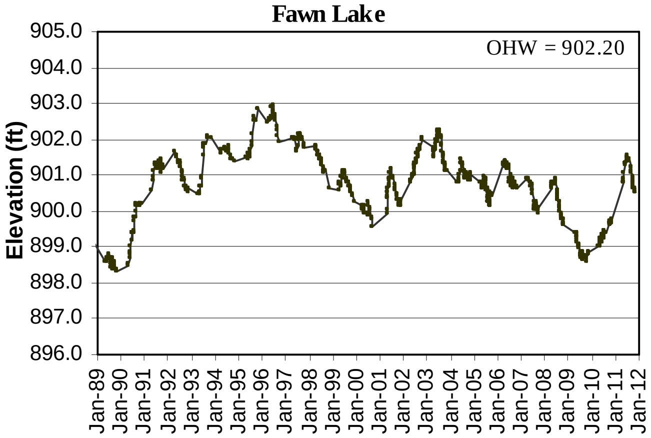
Coon Lake Levels 1990-2011



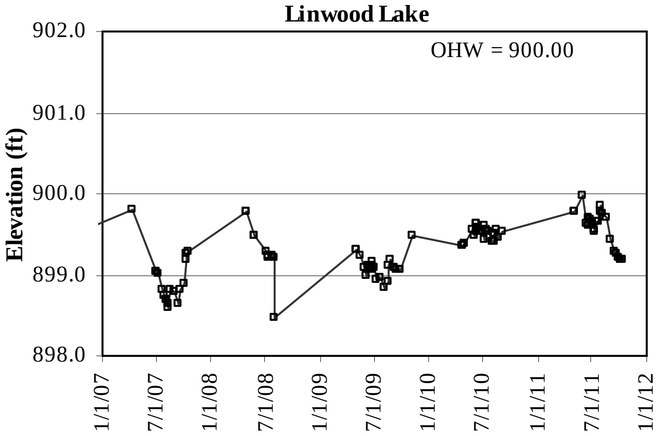
Fawn Lake Levels 2007-2011



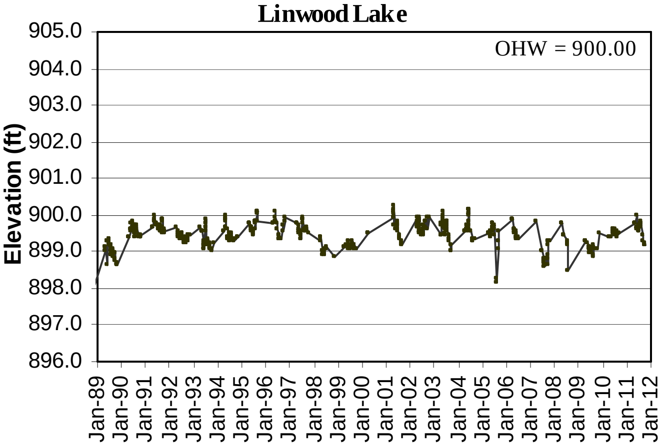
Fawn Lake Levels 1990-2011



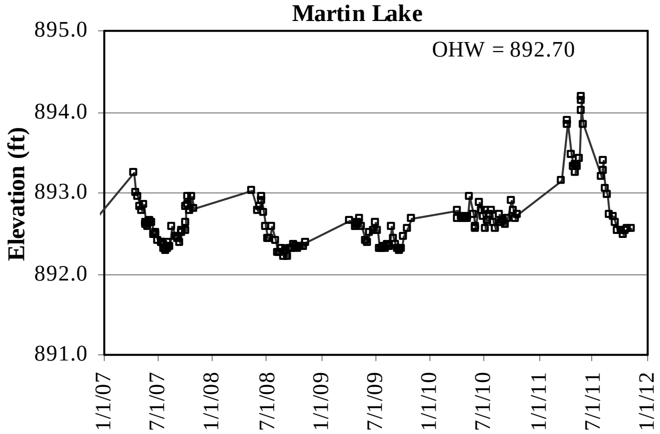
Linwood Lake Levels 2007-2011



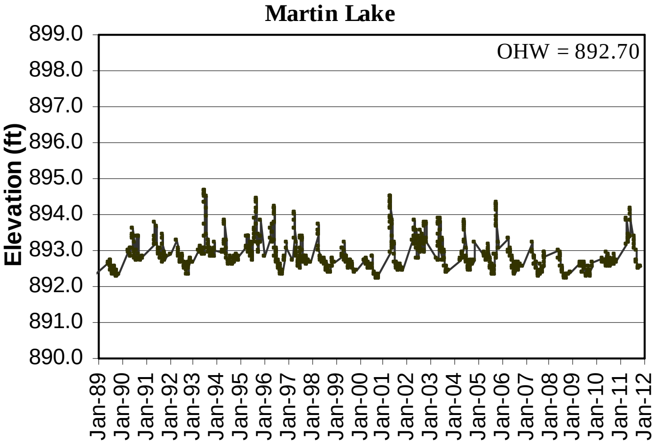
Linwood Lake Levels 1990-2011



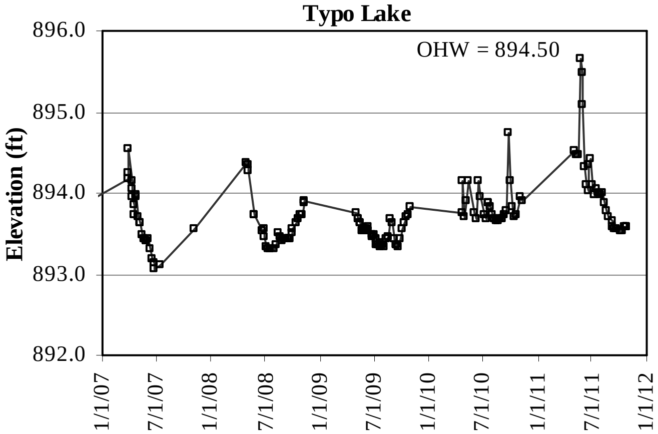
Martin Lake Levels 2007-2011



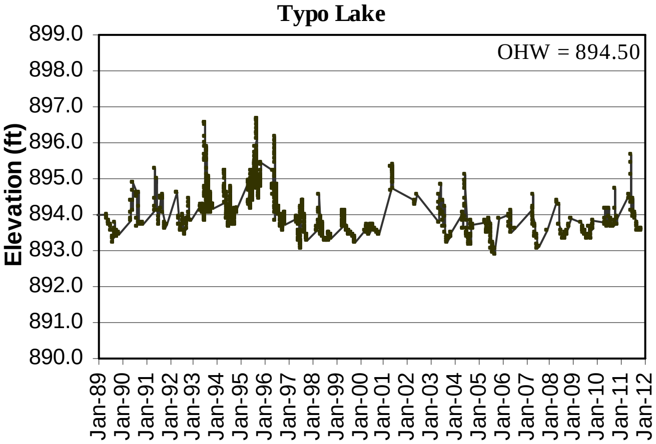
Martin Lake Levels 1990-2011



Typo Lake Levels 2007-2011



Typo Lake Levels 1990-2011



Lake Water Quality (volunteer)

Description: The SRWMO wishes to establish volunteers who on all major recreational lakes who will monitor water quality in years when professional monitoring is not occurring. Volunteers collect a more limited suite of data than professionals, usually just Secchi transparency. However this is fundamentally the most important data. The volunteers are coordinated through the MN Pollution Control Agency's Citizen Lake Monitoring Program (CLMP).

The SRWMO wished to establish volunteers and lakes where none currently exist. This included Typo, Linwood, and Fawn Lakes.

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. To ensure fundamental data is collected in years that professional monitoring

Locations:
Typo Lake
Linwood Lake
Fawn Lake

Results: The Anoka Conservation District solicited and secured volunteers to monitor water quality on the three lakes where none already existed. ACD signed them up for the CLMP program. The MN Pollution Control Agency then provided these volunteers with the necessary equipment. Volunteers submit their data to the MPCA, and it is available to the public on their website.

Volunteers monitoring lake water quality in the SRWMO include:

Typo Lake	Chris Anderson
Linwood Lake	Vern Cardwell
Martin Lake	Frank Kvidera
Coon Lake	Doug Tierney, John Harvey, Arlan Mercil, and Goldie Johnson
Fawn Lake	Dorothy Damon

Lake Water Quality (professional)

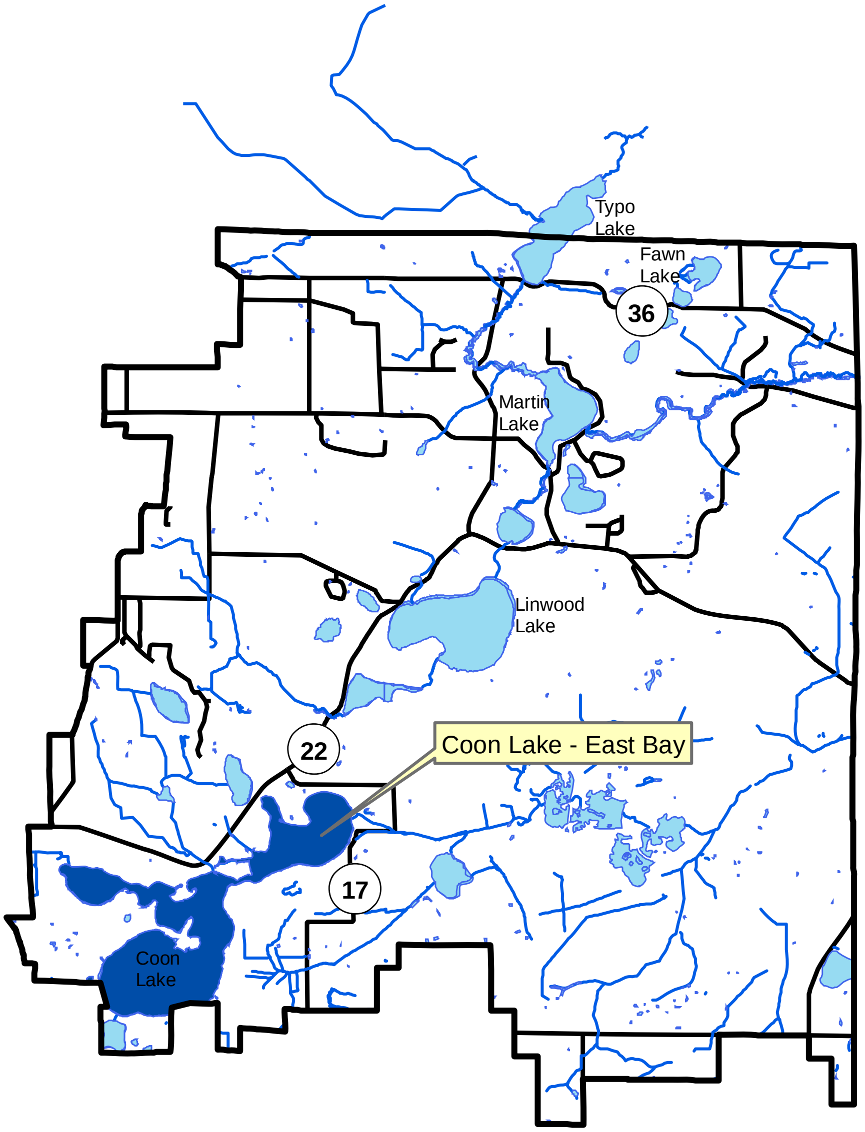
Description: May through September every-other-week monitoring of the following parameters: total phosphorus, chlorophyll-a, secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

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

Locations: Coon Lake – East Bay

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

Sunrise Watershed Lake Water Quality Monitoring Sites



Coon Lake –East and West Bays

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

Background

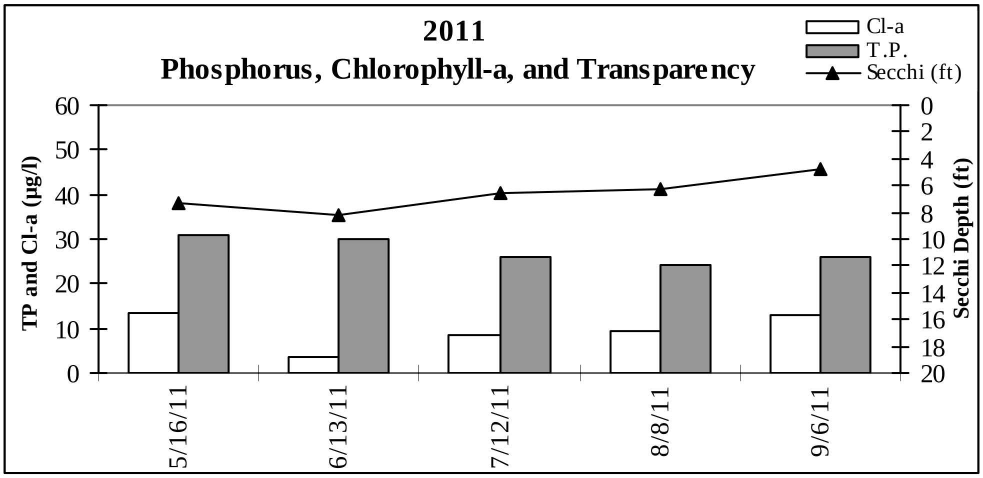
Coon Lake is located in east central Anoka County and is the county's largest lake. Coon Lake has a surface area of 1498 acres and a maximum depth of 27 feet (9 m). Public access is available at three locations with boat ramps, including one park with a swimming beach. The lake is used extensively by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

This report includes separate information for the East Bay (aka northeast or north bay) in 2011 and West Bay (aka southwest or south bay) of Coon Lake in 2011. The 2010-11 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; data from other years do not lend themselves well to direct comparisons because monitoring regimes were likely different.

2011 Results – East Bay

In 2011 the East Bay was monitored once every four weeks. It had slightly better than average water quality for this region of the state (NCHF Ecoregion), receiving a B grade. Average values of important water quality parameters included 27 ug/L for total phosphorus, 9.6 ug/L chlorophyll-a, and Secchi transparency of 6.6 feet. Chlorophyll-a levels were the lowest of all monitored years. Phosphorus and transparency were similar to previous 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 until August and September, when there was a slight algae impairment.

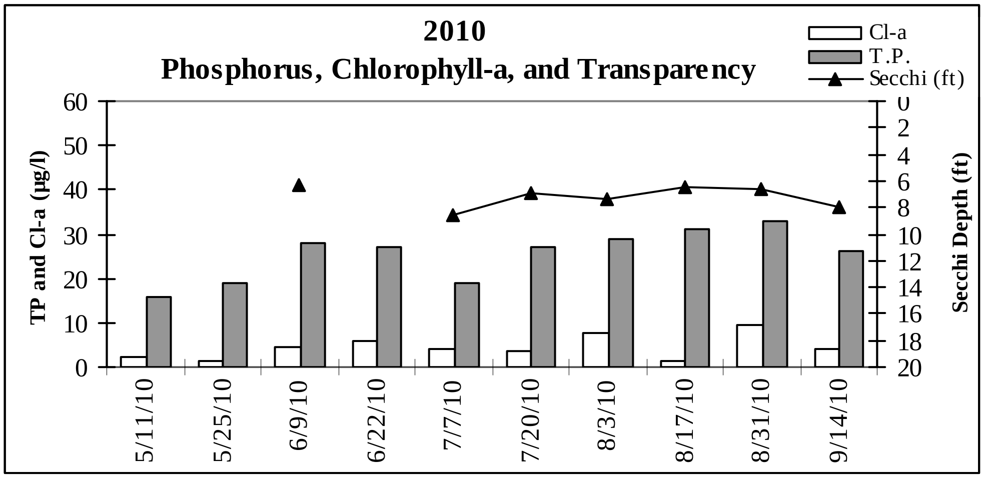
2011 Water Quality Results – East Bay



2010 Results – West Bay

In 2010 the West Bay had slightly better than average water quality for this region of the state (NCHF Ecoregion), receiving an A- letter grade. West Bay total phosphorus averaged 26.0 µg/L and chlorophyll- averaged 4.4 µg/L. Secchi transparency could not be measured on three occasions because it exceeded basin's depth.

2010 Water Quality Results –West Bay



Comparison of the Bays

The East and West Bays of Coon Lake have noticeably different water quality. In 2010 both bays were monitored simultaneously. On every date water quality was better in the West Bay than East, with an average difference of 13 µg/L phosphorus and 5.4 µg/L chlorophyll-a (algae). A direct comparison of average Secchi transparency is not possible because transparency exceeded the lake depth on three occasions in the West Bay and a reading could not be obtained. It is noteworthy, however, that the poorest Secchi transparency in the West Bay was greater than the average in the East Bay.

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.

East Bay Trend Analysis

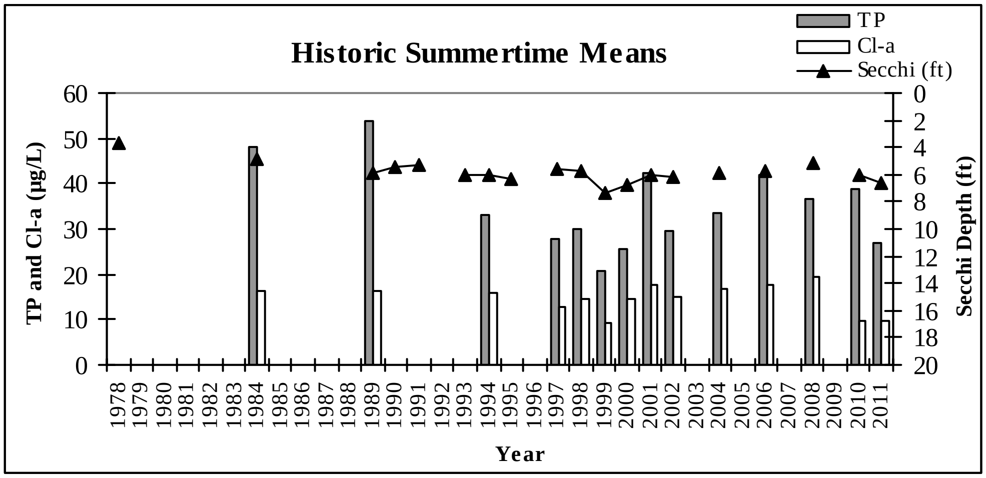
In the East Bay nineteen years of water quality data have been collected since 1978. During the most recent 11 years that were monitored (since 1996), the data collected included total phosphorus, chlorophyll-a, and Secchi transparency. For most of the other eight years (all pre-1997) only Secchi transparency data is available. This provides an adequate dataset for a trend analysis, however given that most of the data is from the last 20 years, the analysis is not strong at detecting changes that occurred prior to 1990.

No water quality trend exists when we examined those years with total phosphorus, chlorophyll-a, and Secchi transparency, excluding the years with only Secchi transparency data. The analysis was a repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth. This is our preferred approach because it examines all three parameters simultaneously. This analysis indicated no trend ($F_{2,11}$=1.0, p=0.4).

We also examined Secchi transparencies alone across all 18 years using a one-way ANOVA. Including all years, a significant trend of improving transparency is found ($F_{1,17}$=8.9, p=0.008). However, this trend is driven by unusually poor transparency in 1978 of 1.11 m. We examined the data from that year and found that no transparency readings were collected in May, when water is often clearest. This would have driven the average transparency down. Therefore, we feel it is appropriate to exclude the 1978 data. When this is done, the trend is no longer statistically significant ($F_{1,16}$=2.35, p=0.14).

It is noteworthy that a water quality improvement seems to have occurred between 1989 and 1994 (see graph below). The reason for such a change, if real, is unknown. Because there are only two years of phosphorus and chlorophyll-a data before 1994 it is difficult to determine if water quality was chronically poorer prior to 1994 or if the available monitoring data is not representative of typical conditions.

Historic Water Quality - East Bay

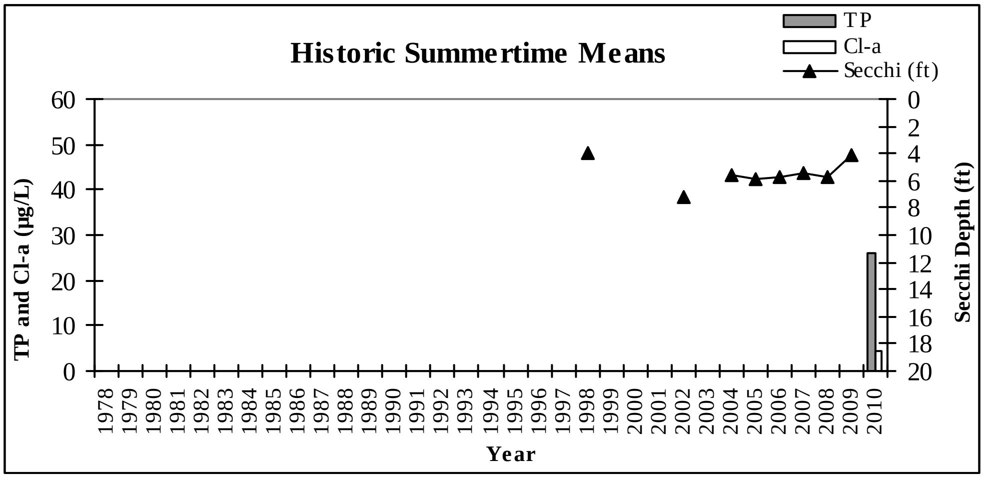


<u>West Bay Trend Analysis</u>

Nine years of data are available for the West Bay including only one year with phosphorus and chlorophyll-a data, so a powerful trend analysis is not possible. We can analyze just Secchi transparency data, but this also has a weakness: 2010 must be excluded because a full suite of Secchi measurements is not available due to clarity exceeding the lake depth occasionally. Despite these limitations, we examined the Secchi data for any trends.

A one-way ANOVA was performed with Secchi transparency from 1998 to 2009 as the response variable. No water quality trend exists ($F_{1,6}$=0.0036, p=0.95). Looking at the data superficially (see graph below), small variations among years is seen but no trend is apparent.

Historic Water Quality - West Bay



Discussion

While Coon Lake is not listed as "impaired" by the MN Pollution Control Agency, the East Bay is close to the state water quality standard of 40 µg/L of phosphorus or greater. In 2006 phosphorus averaged 42 µg/L, was 37 µg/L in 2008, and in 2010 was 39 µg/L. In 2011 phosphorus was lower (averaged 27 ug/L). Voluntary 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. In recent years the City of East Bethel has begun the process of installing municipal sewer and water in their Highway 65 district. An eventual extension of that system to Coon Lake has been discussed but there is no assurance this will happen. That might be most beneficial in the Hiawatha Beach and Interlachen 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 has 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, yet it continues to expand. CLP can cause a spike in phosphorus levels in early summer. CLID started treatment of CLP in 2009. In 2010 the East Bay was accepted into a five year pilot program for treatment of CLP.

2011 Coon Lake East Bay Water Quality Data

Coon Lake East Bay 2011		Date	5/16/2011	6/13/2011	7/12/2011	8/8/2011	9/6/2011			
		Time	13:40	13:30	14:45	14:55	13:00			
	Units	R.L.*	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.49	8.370	8.440	8.550	8.330	8.436	8.330	8.550
Conductivity	mS/cm	0.0	0.205	0	0	0	0	0	0	0
Turbidity	FNRU	1.00	5	3.00	7.00	6.00	9.00	6.00	3.00	9.00
D.O.	mg/L	0.0		995%	839%	814%	735%	846%	735%	995%
D.O.	%	1.00		1.1	1.1	1.0	0.8	1.0	0.8	1.1
Temp.	°C	0.10	13.2	20.4	27.8	27.2	22.0	22.1	13.2	27.8
Temp.	°F	0.1	55.76	68.72	82.04	80.96	71.60	71.82	55.76	82.04
Salinity	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cl-a	ug/L	1.0	13.6	3.5	8.7	9.6	12.8	9.6	3.5	13.6
T.P.	mg/L	0	0.031	0.030	0.026	0.024	0.026	0.027	0.024	0.031
T.P.	ug/L	5	31	30	26	24	26	27	24	31
Secchi	ft	0.1	7.3	8.2	6.6	6.2	4.8	6.6	4.8	8.2
Secchi	m	0.1	2.2	2.5	2.0	1.9	1.5	2.0	1.5	2.5
Physical			1.0	2.0	1.0	3.0	3.0	2.0	1.0	3.0
Recreational			1.0	2.0	2.0	2.0	3.0	2.0	1.0	3.0

*Reporting Limit

2010 Coon Lake West Bay Water Quality Data

Coon Lake West Bay 2010		Date	5/11/2010	5/25/2010	6/9/2010	6/22/2010	7/7/2010	7/20/2010	8/3/2010	8/17/2010	8/31/2010	9/14/2010			
		Time	14:30	11:15	10:40	10:10	12:35	10:50	10:40	10:25	11:00	10:45			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.64	8.38	7.67	8.28	8.14	7.75	7.89	7.68	7.57	7.90	7.89	7.57	8.38
Conductivity	mS/cm	0.01	0.202	0.191	0.169	0.160	0.152	0.155	0.169	0.162	0.169	0.167	0.17	0.15	0.20
Turbidity	FNRU	1.0	1	3	3	3	4	9	7	8	9	6	5.30	1.00	9.00
D.O.	mg/L	0.01	10.52	9.65	8.39	10.72	9.15	7.61	8.81	9.45	8.89	NA	9.24	7.61	10.72
D.O.	%	1.0	90%	108%	89%	118%	107%	85%	100%	97%	96%	NA	0.99	0.85	1.18
Temp.	°C	0.10	10.7	23.6	21.0	23.7	27.3	25.2	26.9	22.1	24.8	18.4	22.4	10.7	27.3
Temp.	°F	0.10	51.3	74.5	69.8	74.7	81.1	77.4	80.4	71.8	76.6	65.1	72.3	51.3	81.1
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	ug/L	1.0	2.2	1.5	4.6	5.7	3.9	3.8	7.5	1.5	9.3	4.0	4.40	1.50	9.30
T.P.	mg/L	0.005	0.016	0.019	0.028	0.027	0.019	0.027	0.029	0.031	0.033	0.026	0.03	0.02	0.033
T.P.	ug/L	5	16	19	28	27	19	27	29	31	33	26	25.50	16.00	33.0
Secchi	ft	0.1	>9.8	>9.6	6.3	>9.8	8.6	6.9	7.4	6.4	6.6	8.0	NA	6.30	>9.8
Secchi	m	0.1	>3.0	>2.9	1.9	>3.0	2.6	2.1	2.3	2.0	2.0	2.4	NA	1.92	>3.0
Physical			1	2	2	2	2	3	3	3	2	2	2.2	1	3
Recreational			1	2	2	2	2	2.5	3	3	2	2	2.2	1	3

*Reporting Limit

Stream Hydrology

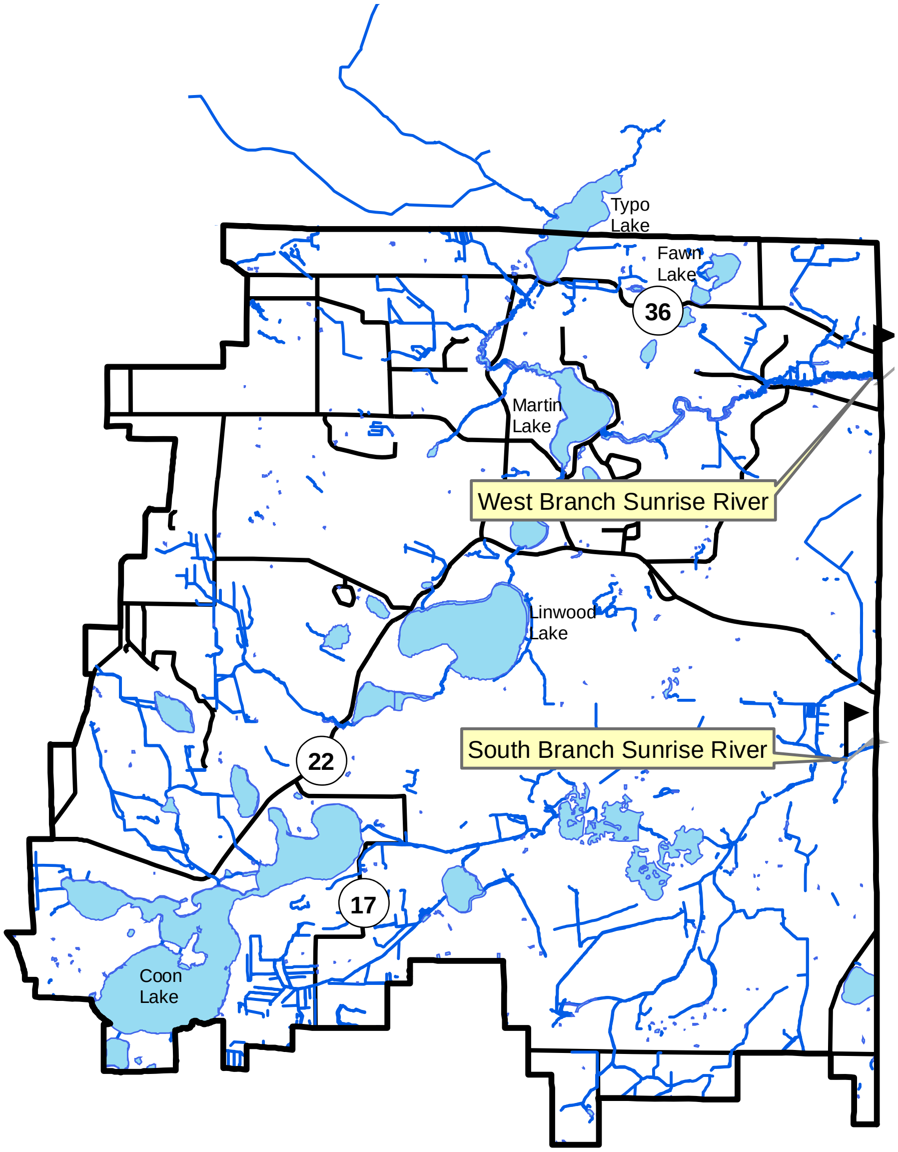
Description: Continuous water level monitoring in streams.

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

Locations: South Branch Sunrise River at Hornsby St NE

West Branch Sunrise River at Co Rd 77

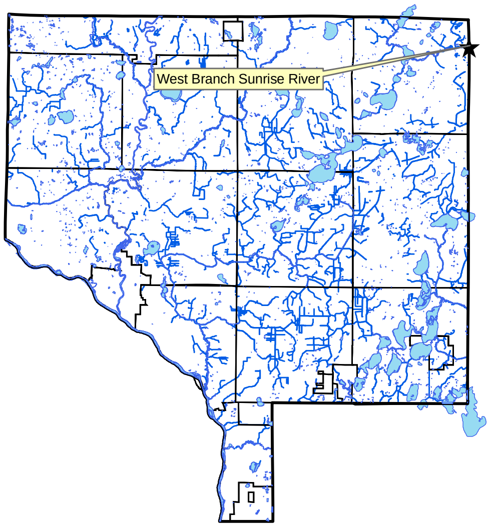
Sunrise Watershed Stream Hydrology Monitoring Sites



WEST BRANCH OF SUNRISE RIVER

At Co Rd 77, Linwood Township

Notes

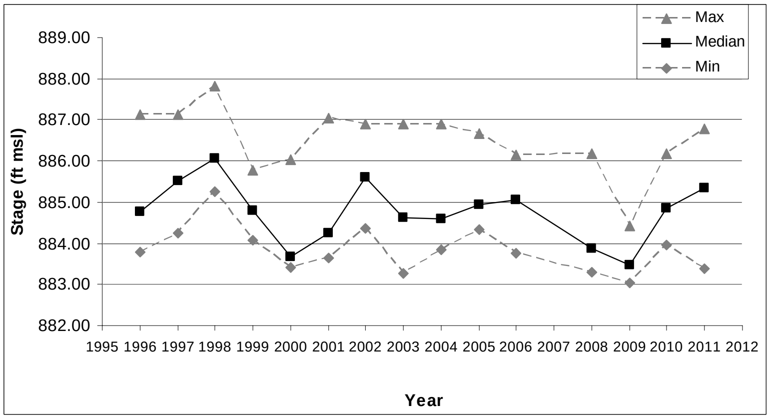


This monitoring site is the bottom of this watershed in Anoka County, at the Chisago County border. Upstream, this river drains through Linwood, Island, Martin, and Typo Lakes. The Sunrise River Watershed Management Organization monitors this site because it is at the bottom of their jurisdictional area. They have done water quality monitoring at this site and created a rating curve to estimate flow volumes from the water level measurements. In 2008 and 2009 this site was also monitored to collect data for a computer model of the entire Sunrise River watershed being done by the US Army Corps of Engineers, Chisago County, and other partners.

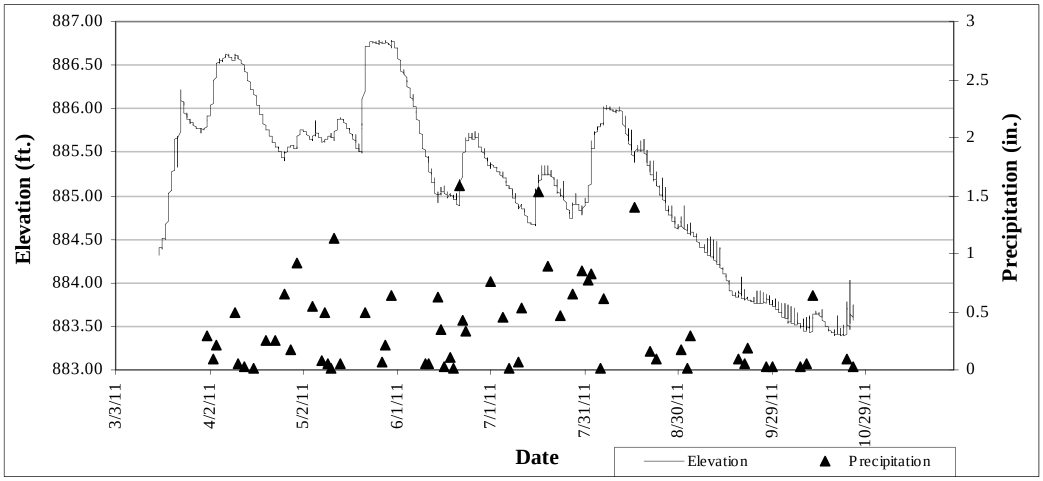
The rating curve to calculate flows (cfs) from stage data is:
Discharge (cfs) = $2.9171(\text{stage}-883.5)^3 - 7.9298(\text{stage}-883.5)^2 + 10.131(\text{stage}-883.5) + 10.18$ $R^2=0.94$

This rating curve was first prepared in 2002. Five additional flow-stage measurements were taken in 2008-09 to keep the equation updated.

Summary of All Monitored Years



2011 Hydrograph

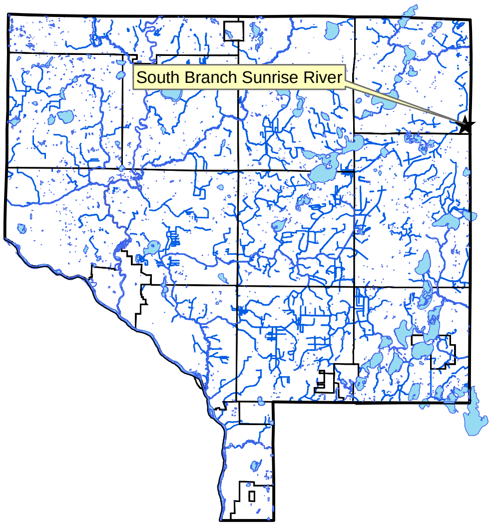


SOUTH BRANCH OF SUNRISE RIVER

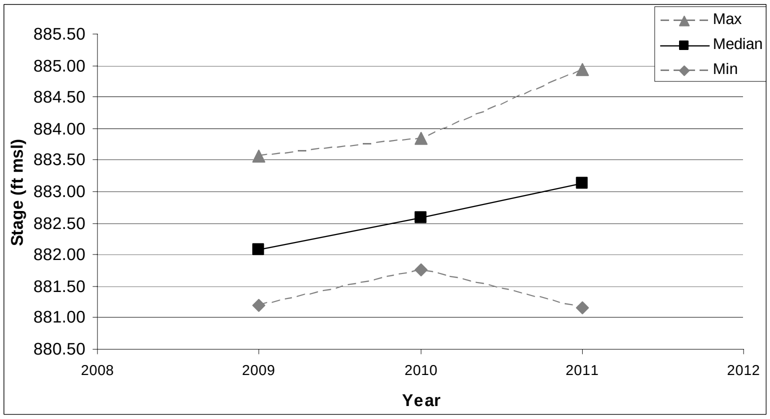
At Hornsby St, Linwood Township

Notes

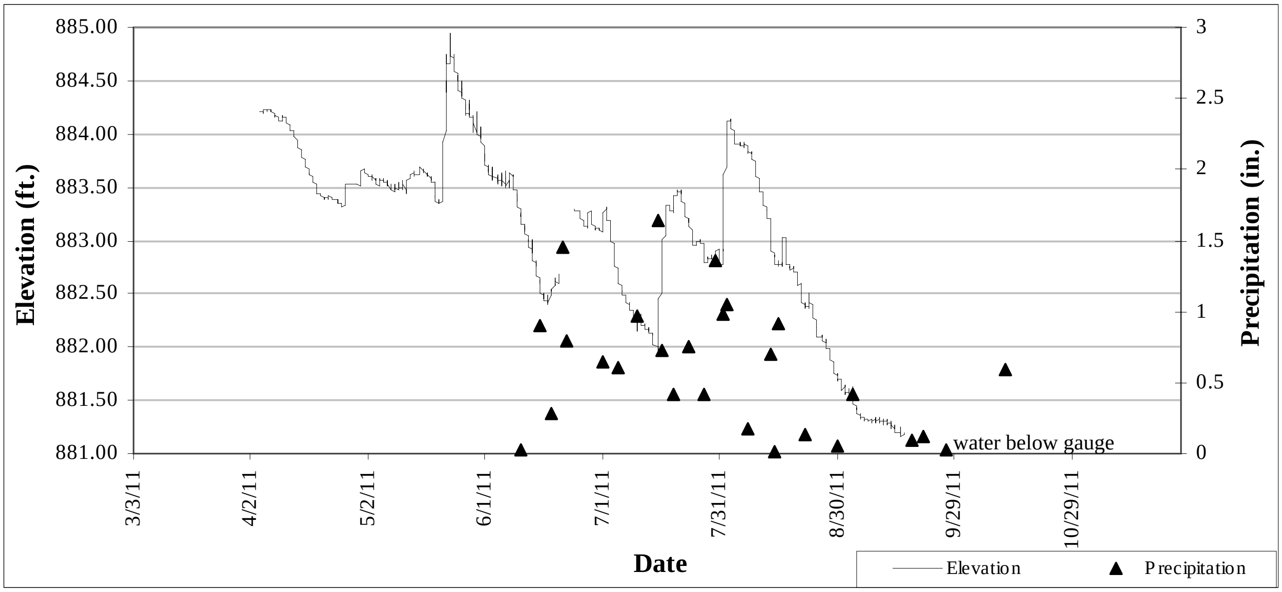
This monitoring site is the bottom of this watershed in Anoka County, at the closest accessible point to the Anoka-Chisago County boundary. Upstream, this river drains from Coon Lake and through the Carlos Avery Wildlife Management Area. The Sunrise River Watershed Management Organization monitors this site because it is at the bottom of their jurisdictional area. This site was first monitored in 2009 to collect data for a computer model of the entire Sunrise River watershed being done by the US Army Corps of Engineers, Chisago County, and other partners. Water quality monitoring has not yet occurred at this site, nor has a rating curve been created to estimate flow volumes from the water level measurements.



Summary of All Monitored Years



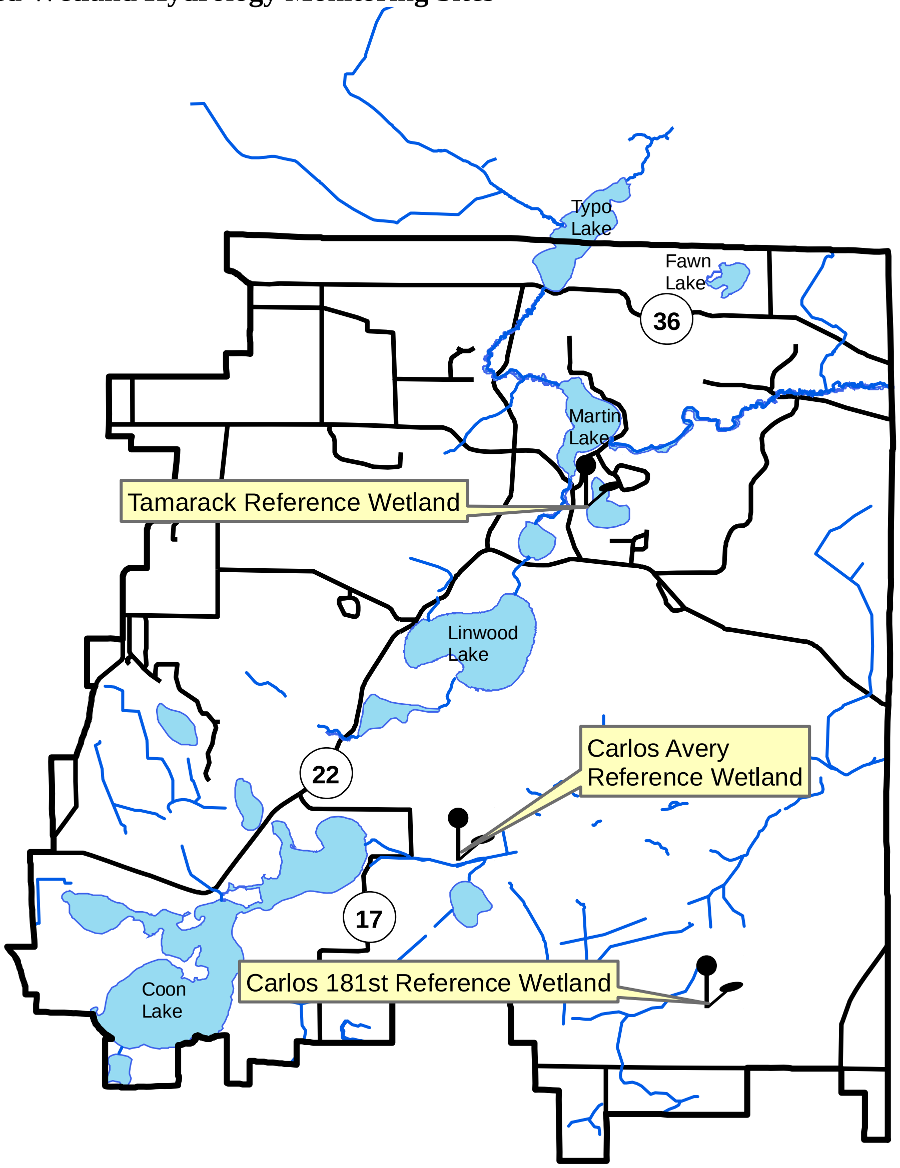
2011 Hydrograph



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 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

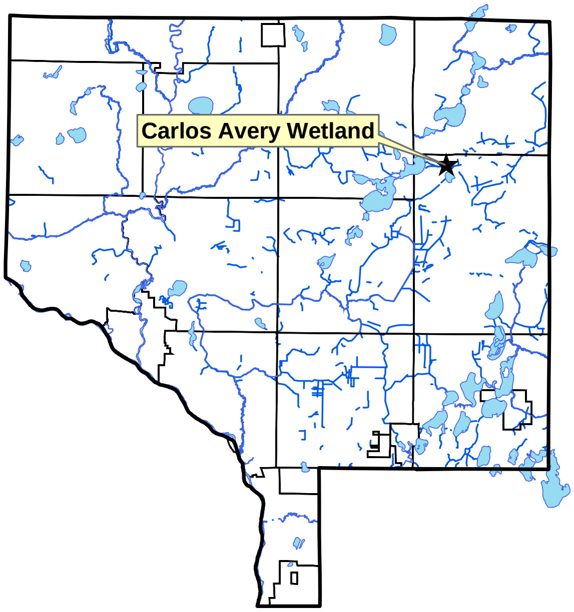
Soils at Well Location:

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

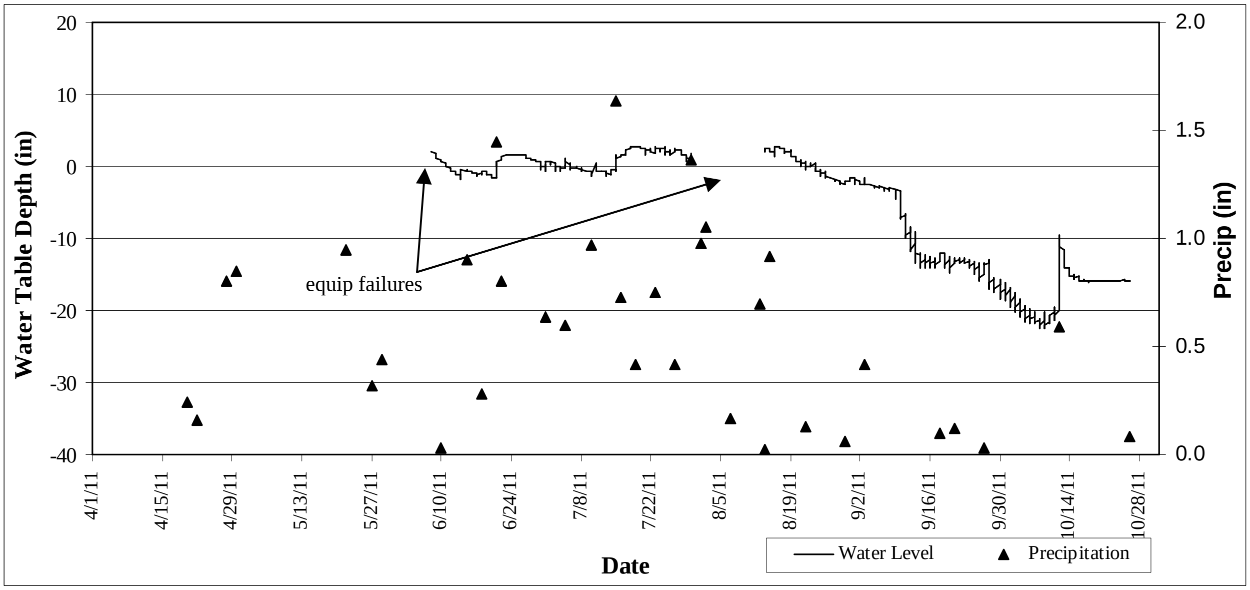
Vegetation at Well Location:

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.

2011 Hydrograph

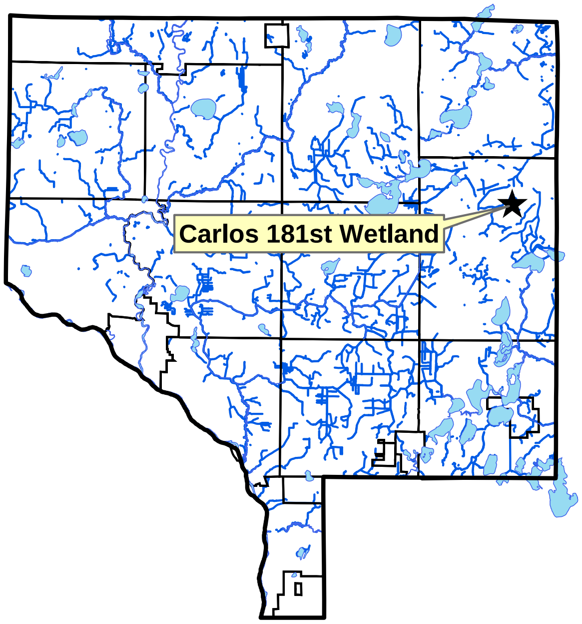


Well depths were 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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	-

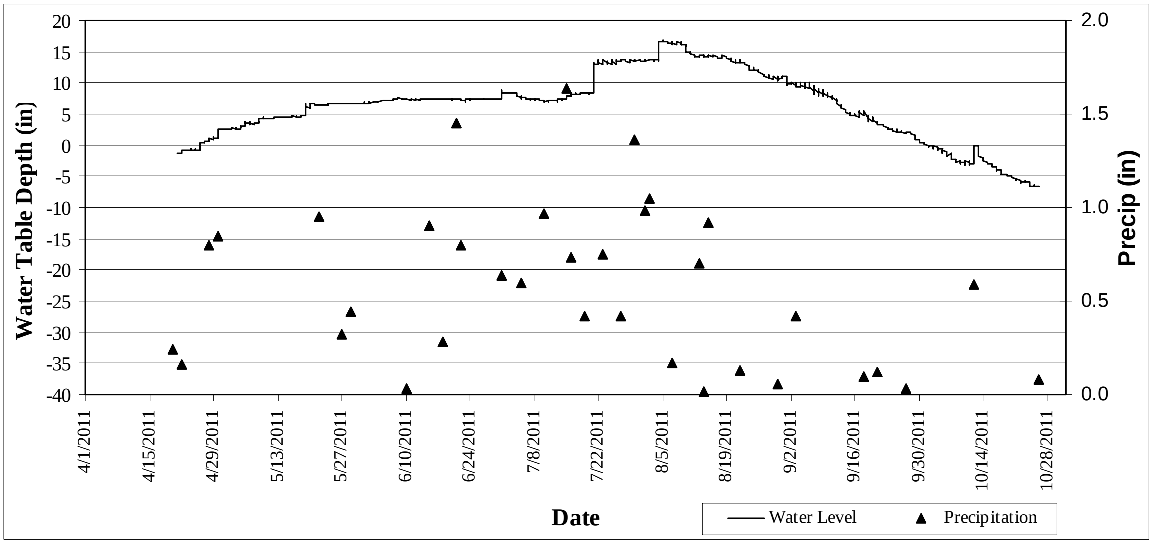
Surrounding Soils: Soderville fine sand

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.

2011 Hydrograph

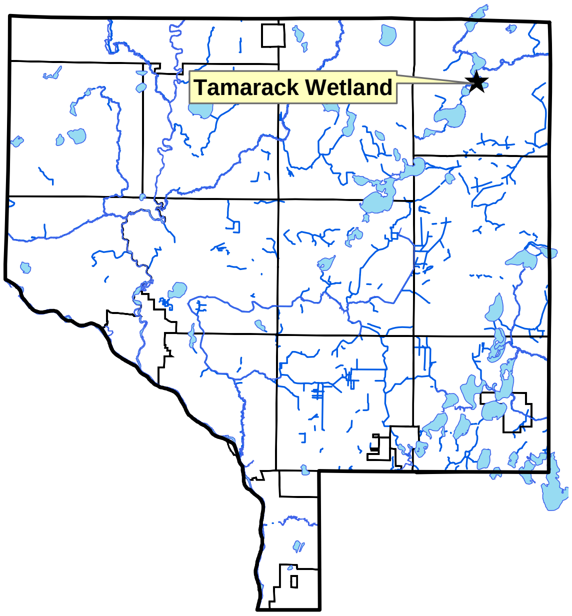


Well depths were 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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	-

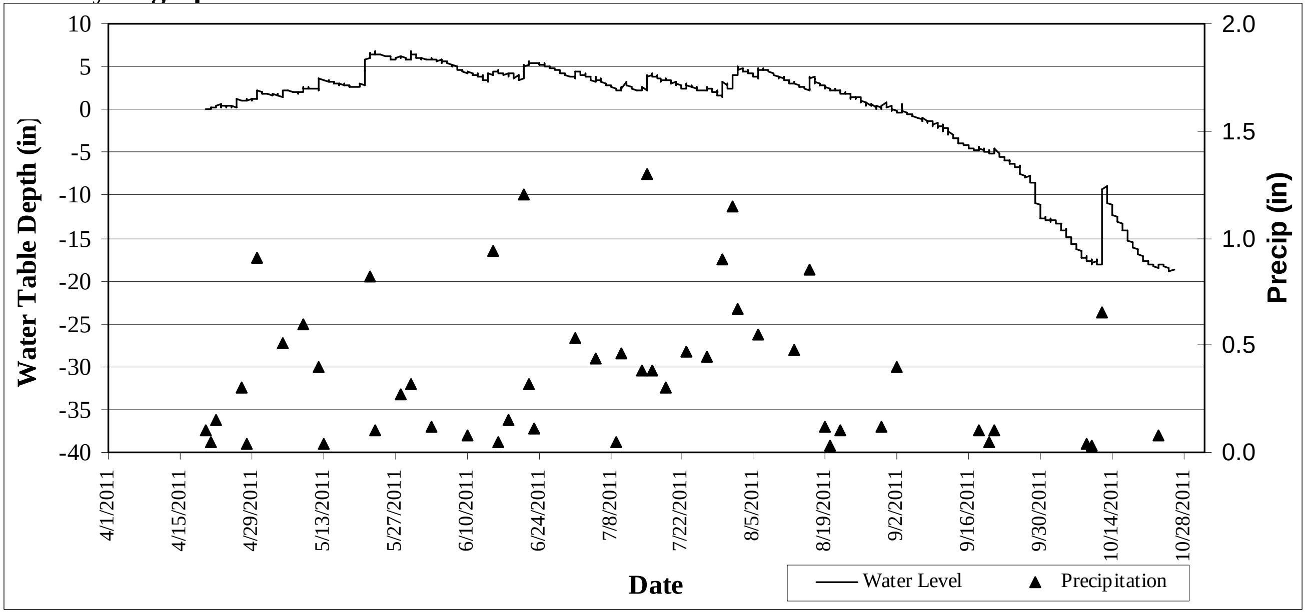
Surrounding Soils: Sartell fine sand

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.

2011 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.

SRWMO Phosphorus Export Estimation

Description: Three methods were used to estimate phosphorus export from the SRWMO jurisdictional area.

Purpose: The purpose of this analysis is to estimate phosphorus export from the Sunrise River WMO jurisdictional area, and thereby quantify the 20% phosphorus reduction goal the organization has set. For each water quality improvement project that is implemented in the SRWMO the phosphorus reduction achieved by that project can be estimated. In this way the SRWMO can track progress toward the 20% phosphorus reduction goal.

Locations: South Branch Sunrise River at Hornsby St NE

West Branch Sunrise River at Co Rd 77

Results: Anoka Conservation District staff compared three estimates of phosphorus export from the SRWMO to arrive at a single number. The three estimates are from FLUX, the Martin Lake TMDL, and the St. Croix River TMDL. FLUX, was done by the Anoka Conservation District for this project while the other two estimates were available from unrelated work by others and help to ensure accuracy. Each method of estimation has inherent strengths and weaknesses, and professional judgment exercised across all the three methods leads to a reasonable estimate.

FLUX Methodology

FLUX is a statistical model that combines continuous flow data with water quality grab samples to estimate continuous phosphorus discharge. This data exists for the West Branch of the Sunrise River at County Road 77. Neither continuous flow nor water quality data is available for the South Branch of the Sunrise River where it exits the SRWMO, so the analysis could not be performed for that area.

The FLUX analysis was done by a flow weighted concentration method. Data used was from 2001, 2003, and 2006, and included 685 days with continuous flow data and 24 water samples. The data were stratified by splitting the flows at the mean to reduce variation in the data. This stratification resulted in 8 samples greater than mean flows and 16 samples less than mean flows.

FLUX estimated a total loading of 4,068 lbs of phosphorus per year for the open water season. Because no sampling data is available from the winter season, the most conservative option is to apply open water season loading rates to winter months. This is conservative because winter loading is often much less than other seasons because there is little runoff. This approach results in an estimate of 2,431 lbs during the unmonitored winter season, or a year round total of 6,499 lbs. The actual total is likely somewhere between the open water estimate of 4,068 lbs and the year round estimate of 6,499 lbs.

It should be stressed that the FLUX estimate excludes the South Branch of the Sunrise River because the necessary data did not exist. The South Branch is a smaller and much less developed portion of the SRWMO, but nevertheless the FLUX estimate is an underestimate of total phosphorus export from the SRWMO.

Martin Lake TMDL Methods

The Martin Lake Total Maximum Daily Load Study estimated phosphorus loading to Martin Lake. The West Branch of the Sunrise River flows through Martin Lake. Martin Lake is 3 miles upstream of the SRWMO jurisdictional boundary, and the area between these points is lightly developed with no tributaries or other large, additional phosphorus sources. Therefore, the estimate of phosphorus loading to Martin Lake is informative when considering export from the SRWMO. The TMDL was completed by the Minnesota Pollution Control Agency using the model BATHTUB in 2011.

Lake St. Croix TMDL

The Lake St. Croix TMDL was also completed by the Minnesota Pollution Control Agency. This TMDL partitioned the watershed. A phosphorus export for just the Anoka County portion of the St. Croix River Watershed, which happens to be the same as the SRMWO's jurisdicational area, is provided. This study found that Anoka Co parts of St. Croix watershed have loading of 4,931 lbs/yr and need to reduce it by 1,607 lbs/yr (32.6%) in order to meet St. Croix River water quality goals.

Comparison of Phosphorus Estimates

A comparison among the three methods, and their strengths and weaknesses, is provided in the table below. The FLUX and Lake St. Croix TMDL estimates are in general agreement, while the Martin Lake TMDL estimate is substantially higher an applies to an undesirably small geographic area. It would be inappropriate to simply use the FLUX estimate, because it applies to only the April-October portion of each year. The Lake St. Croix TMDL estimate (4,931 lbs) is 21% greater than the FLUX estimate for the open water season (4,068 lbs). It's reasonable to think that adding 21% to the FLUX estimate would account for winter loading and loading through the South Branch.

Therefore, we recommend that the SRWMO use 4,931 lbs/yr from the Lake St. Croix TMDL as the phosphorus export estimate for their jurisdictional area.

The SRWMO's goal of 20% phosphorus reduction = 986 lbs

Comparison of three phosphorus export estimation methods for the SRWMO.

Method	**P export estimate**	**Description**	**Strengths**	**Weaknesses**
Martin Lake TMDL study	**7,149 lbs/yr**	• Bathtub modeling for Martin Lake and upstream monitoring sites.	• Based on actual monitoring data in Martin Lake and upstream.	• Estimate is for the outlet of Martin Lake. Excludes the lower 3 miles of the river, though this largely undeveloped area. • Estimate excludes the S Branch of Sunrise River, though this mostly drains the undeveloped Carlos Avery Wildlife Mgmt Area.
Lake St. Croix TMDL study	**4,931 lbs/yr**	• Combination of land uses, each land use's literature values for phosphorus export, and monitoring data.	• Includes both the W and S Branches of the Sunrise River (none of the other methods do).	• Based mostly on literature values of phosphorus export from various land use types, less so on monitoring data from the site of interest.
FLUX	**4,068 lbs** for the open water season (April-Oct)	• Statistical analysis of continuous hydrology and water quality sample data.	• Estimate is calculated from water quality and hydrology data for the Sunrise River at Co Rd 77, our site of greatest interest, in 2001, 2003, and 2006.	• Estimate is for only April-Oct, excludes winter season. • Estimate excludes the S Branch of Sunrise River, though this mostly drains the undeveloped Carlos Avery Wildlife Mgmt Area.

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:	None of the projects installed in 2011 used SRMWO cost share grants.

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
Fund Balance		**$8,178.17**

Water Quality Improvement Projects

Description: Projects on either public or private property that will improve water quality, such as repairing streambank erosion, restoring native shoreline vegetation, or rain gardens. These projects are partnerships between the landowner, the Anoka Conservation District, state agencies, lake associations, or others.

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 installed in 2011 in the SRWMO include:

- **Martin Lake rain gardens.** Three residential, curb-cut rain gardens were installed. These rain gardens intercept stormwater that was previously begin directed into the lake without any treatment. Collectively, these projects will reduce phosphorus entering Martin Lake by 1.8 lbs/yr and suspended solids by 596 lbs/year. These projects were the 3rd, 4th, and 5th most cost effective projects identified in the Stormwater Retrofit Assessment completed in August 2011.
  These projects were a collaboration between the SRWMO, Anoka Conservation District, landowners, Linwood Township, landowners, and the Minnesota Conservation Corps. Partial project dollars were provided by the Clean Water Fund (from the Clean Water, Land, and Legacy Amendment).
- **Coon Lake - East Front Blvd stormwater retrofit.** This project treats stormwater before it enters Coon Lake. The project involved installation of sediment capture devices in a drainageway. Before this project, stormwater runoff from a residential area entered the lake by this route without any treatment. This project was a collaboration between the Coon Lake Improvement Association, Mr. Doug Tierney, and the City of East Bethel.
- **Braido – native plant gardens.** The Braido ecological restoration project focused on restoring the ecological integrity of a 5.1 acre residential property. Practices implemented include the installation of a rain garden, native prairie plantings, and removal of invasive woodland species. The benefits associated with this ecological restoration include water quality improvement and increased biodiversity from the native prairie plantings. The restoration of the woodland community consisted of removing invasive species and replacing them with native species that will provide food and habitat for wildlife.

Projects anticipated soon in the SRWMO include:

- **Carp barriers at Martin and Typo Lakes**. In 2012 and 2013 carp barriers will be installed at four sites around Martin and Typo Lakes. Additionally, commercial carp harvests will be conducted with the aid of radio tracking the schooling fish in wintertime. This project aims to improve water quality in these lakes by reducing the carp population.

  Carp are a high percentage of the fish biomass in these waterbodies. They strongly degrade habitat and water quality throughout their feeding and spawning behaviors. Carp control will improve water clarity, increase plants, improve the game fishery, and enhance wildlife opportunities. 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 is shallow and good for spawning. Stopping migrations between the lakes will reduce overwintering survival and spawning success. The barriers alone will achieve this over time, but we will accelerate results with carp harvests.

This project is a collaboration between the SRWMO, Anoka Conservation District, Martin Lakers Association, MN DNR, and Linwood Township. Major funding is provided by the SRWMO, Martin Lakers Association, and the Outdoor Heritage Fund (from the Clean Water, Land, and Legacy Amendment).

- **Martin Lake Stormwater Retrofits** – In 2012 the SRWMO and Anoka Conservation District will install other stormwater retrofits identified as cost effective in the 2011 Martin Lake Stormwater Assessment.
- **Coon Lake Stormwater Retrofit -** In 2012-13 a stormwater assessment will be conducted to identify and rank the most cost effective stormwater retrofits that will benefit Coon Lake water quality. In 2014-15 the SRWMO plans funding to install the best of these projects.

Martin Lake Stormwater Retrofits

Description: The stormwater retrofits are projects that treat stormwater runoff before it reaches Martin Lake, thereby reducing phosphorus and other pollutants in the lake. In early 2011 a Stormwater Assessment was completed for Martin Lake. That study identified 15 stormwater retrofits and ranked them by cost effectiveness (amount of pollution reduced per dollar spent). Later in 2011, installation of cost effective projects began. These were three residential curb-cut rain gardens.

Purpose: To improve Martin Lake water quality.

Results: In fall 2011 three residential, curb-cut rain gardens were installed in the yards of willing homeowners. All of these rain gardens were located at the end of a long run of curb, and just up-gradient of a catch basin that would direct the water into the lake. A cut in the curb was created, directing the water into the excavated rain garden basin. In the rain garden, storm water soaks into the ground through the engineered soils. Standing water is present for no more than 48 hours after storms, and often much less. If the garden fills to the curb elevation during heavy rains, water will simply pass by the rain garden and go to the catch basin.

These projects were the 3rd, 4th, and 5th most cost effective projects identified in the Stormwater Retrofit Assessment completed earlier in 2011. They will prevent an estimated 1.8 pounds of phosphorus from entering Martin Lake each year, as well as 596 pounds of solids. Phosphorus is the nutrient that fuels algae blooms that are a common problem in Martin Lake. This project and others like it are important steps toward helping Martin Lake meet state water quality standards.

These projects were a collaboration between the SRWMO, Anoka Conservation District, landowners, Linwood Township, and the Minnesota Conservation Corps. Partial project dollars were provided by the Clean Water Fund (from the Clean Water, Land and Legacy Amendment).

Project financial summary:

Funding sources:

$15,127	Clean Water Fund (LRP)
$5,500	MCC grant for labor
$7,000	SRWMO
$27,627	Total cost including ACD project promo and mgmt

The SRWMO committed $10,000 to this project. The funds were used as follows:

$3,037.57	Installation
$3,962.43	ACD reimbursement for promotion, administration, and construction oversight.
$3,000	Funds returned to the SRWMO
$10,000	Total

The Anoka Conservation District contributed an additional $3,457.57 of in-kind efforts to this project which included project promotion, administration, and construction oversight.

Project promotion, administration, and construction oversight tasks included:

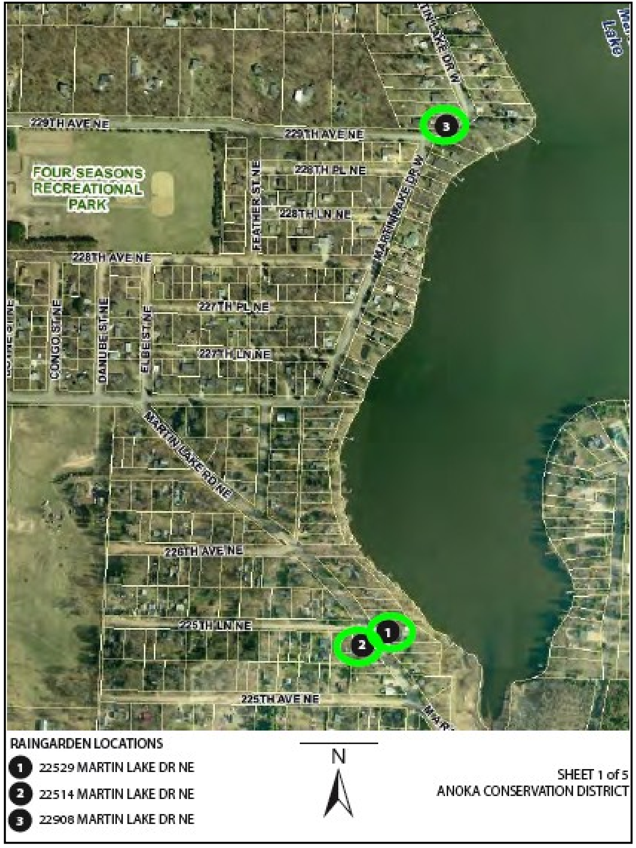
Promotion

-Contact high priority property owners via mailing
-Follow-up with visit to property
-Provide informational meeting for interested property owners
-Coordinate signature of intent forms

Rain Garden Installation

-Develop base maps prior to design work
-Develop online survey for property owners to provide input on design
-Coordinate design process
-Conduct bid process for installation contractor
-Develop and coordinate contracts between contractors and property owners
-Coordinate installation process between contractor and Minnesota Conservation Corps crew
-Construction oversight throughout project
-Verification of proper project installation through on-site surveys and measurements

Map of rain garden locations



22514 Martin Lake Dr.

22529 Martin Lake Dr.

22908 Martin Lake Dr.

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 is doing regular education and marketing of lakeshore restorations to homeowners.

Purpose: To improve lake water quality and lake health.

Results: In 2011 the SRWMO contracted the Anoka Conservation District (ACD) to accomplish four lakeshore landscaping education tasks, including:

Join Blue Thumb **–** 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 2012.

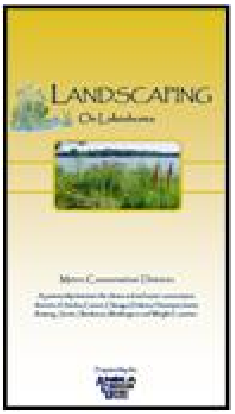
Maintaining a Blue Thumb membership requires an annual contribution of either $1,500 cash or 30 hours of efforts. The SRWMO chooses to meet this requirement by incorporating Blue Thumb into a variety of tasks that are already planned and benefit from Blue Thumb. In 2011 the SRWMO exceeded the 30 hour commitment with the following work:

- Membership administration
- Presentation at Linwood Lake Association annual meeting
- Braido native plant gardens
- Mailing to Fawn Lake residents including lakeshore landscaping mailing
- Placing a link to the Blue Thumb website on the SRWMO website
- Promoting, organizing, and installing the Martin Lake rain gardens.

Blue Thumb Link on SRWMO Website – The ACD added a link to the Blue Thumb website on the SRWMO website. On the Blue Thumb website residents can access a variety of tools including how-to manuals and a plant selection tool.

30-second Web Video – The SRWMO requested that the ACD create a short web video that would promote lakeshore restorations and also serve to improve awareness of the SRWMO. The work includes creating a script, securing video clips and photos, producing the video including audio, and posting it to the SRWMO website.

The two minute video was completed and posted to the SRWMO website in March 2012.



Brochure distribution at Fawn Lake - The SRWMO wished to make a special effort to promote lakeshore restorations at Fawn Lake. This lake's watershed is not much larger than the homes encircling the lake. Therefore, water quality in the lake largely hinges on these homeowners activities. Presently, Fawn Lake has the best water quality of all Anoka County Lakes.
A full-color, 11x17, tri-folded brochure about lakeshore restorations was delivered to all 66 homes on Fawn Lake. The brochure included many photos highlighting the attractiveness of these restorations, as well as how they help address some challenges of landscaping near the lake. It described methods, and technical and financial assistance available. The brochure was accompanied by a letter. Linwood Township staff handled distribution of the addressed envelopes. No phone or email responses to this mailing were received.

Aquatic Plant Education Campaign

Description: Mailings, workshops, signage, and articles to educate lakeshore homeowners about the benefits of native aquatic plants, threat of invasive species, and ecologically-sound and legal lakeshore management. Target neighborhoods are those surrounding Coon, Fawn, Linwood, and Martin Lakes.

Purpose: To educate lakeshore homeowners about the benefits of native aquatic plants, threat of invasive species, and ecologically-sound and legal lakeshore management.

Results: In 2011 the SRWMO contracted with the ACD to replace vandalized SRWMO signage at the Martin Lake boat landing. That signage asks boaters to take measures that prevent that spread of aquatic invasive species. This signage is designed to be a local voice that reinforces messages in DNR signage on this topic. These signs had been installed on the five major recreational lakes in 2007. While the signs at other locations are in good condition, the sign at Martin Lake was destroyed by vandals. The ACD replaced the sign at Martin Lake with another Aluminum sign.

New SRWMO Sign at the Martin Lake Public Boat Landing

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.

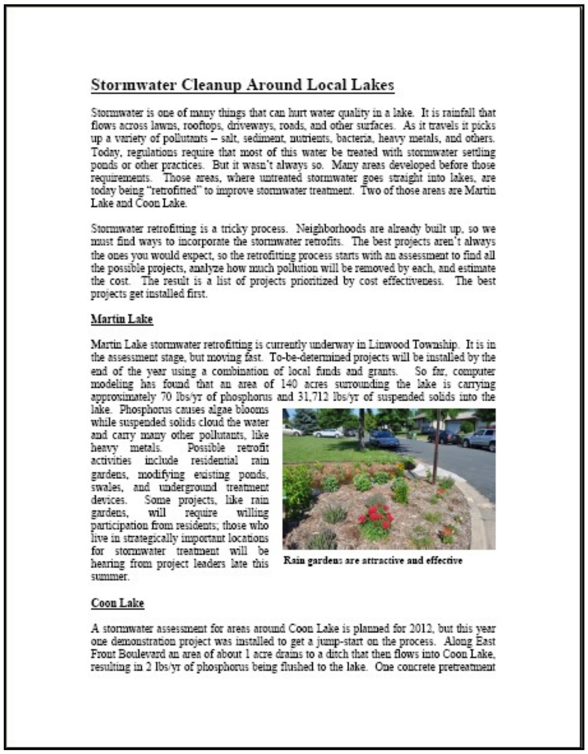
Purpose: To improve citizen awareness of the SRWMO, its programs, and accomplishments.

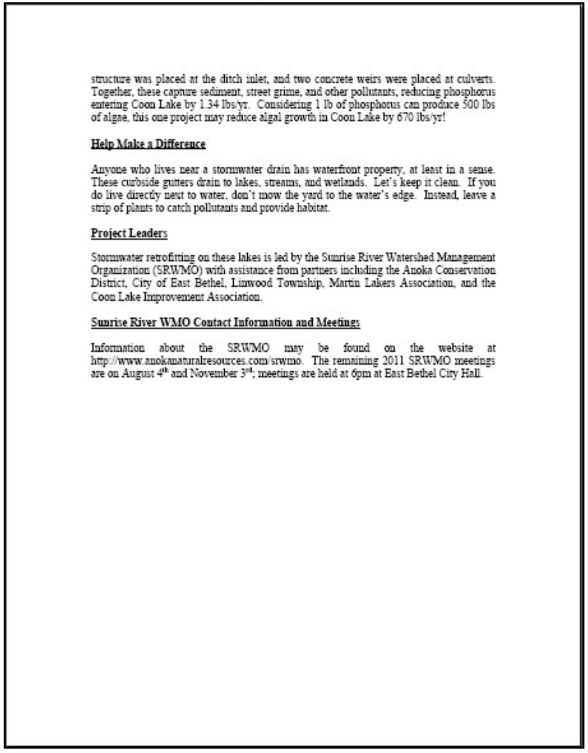
Results: In 2011 the SRWMO contracted with the ACD to write the annual newsletter and provide it to member communities for distribution in their newsletters. Topics for annual newsletter educational efforts were discussed at the February 24, 2011 SRWMO meeting. The article shall be written to cover the following:

- Recent and upcoming efforts to treat stormwater drainage to area lakes (i.e. stormwater retrofitting). These efforts include the Martin Lake stormwater assessment and upcoming projects, Coon Lake stormwater assessment, and East Front Blvd project.
- Ask residents to report any stormwater outfalls into area waterbodies that concern them, especially around Martin or Coon Lakes where assessments are ongoing or planned.
- Good housekeeping practices people can use in their yards to keep stormwater cleaner.
- SRWMO website address and other SRWMO organizational info.

The Anoka Conservation District drafted the newsletter article. It was provided to the SRWMO Board for review before distribution to the member communities. This was accomplished before the end of July so the cities will have ample time to run it in their newsletters sometime during the remainder of the year.

SRWMO 2011 newsletter article, which was published in member city newsletters





Stormwater Cleanup Around Local Lakes

Stormwater is one of many things that can hurt water quality in a lake. It is rainfall that flows across lawns, rooftops, driveways, roads, and other surfaces. As it travels it picks up a variety of pollutants – salt, sediment, nutrients, bacteria, heavy metals, and others. Today, regulations require that most of this water be treated with stormwater settling ponds or other practices. But it wasn't always so. Many areas developed before those requirements. Those areas, where untreated stormwater goes straight into lakes, are today being "retrofitted" to improve stormwater treatment. Two of those areas are Martin Lake and Coon Lake.

Stormwater retrofitting is a tricky process. Neighborhoods are already built up, so we must find ways to incorporate the stormwater retrofits. The best projects aren't always the ones you would expect, so the retrofitting process starts with an assessment to find all the possible projects, analyze how much pollution will be removed by each, and estimate the cost. The result is a list of projects prioritized by cost effectiveness. The best projects get installed first.

Martin Lake

Martin Lake stormwater retrofitting is currently underway in Linwood Township. It is in the assessment stage, but moving fast. To-be-determined projects will be installed by the end of the year using a combination of local funds and grants. So far, computer modeling has found that an area of 140 acres surrounding the lake is carrying approximately 70 lbs/yr of phosphorus and 31,712 lbs/yr of suspended solids into the lake. Phosphorus causes algae blooms while suspended solids cloud the water and carry many other pollutants, like heavy metals. Possible retrofit activities include residential rain gardens, modifying existing ponds, swales, and underground treatment devices. Some projects, like rain gardens, will require willing participation from residents; those who live in strategically important locations for stormwater treatment will be hearing from project leaders late this summer.

Rain gardens are attractive and effective

Coon Lake

A stormwater assessment for areas around Coon Lake is planned for 2012, but this year one demonstration project was installed to get a jump-start on the process. Along East Front Boulevard an area of about 1 acre drains to a ditch that then flows into Coon Lake, resulting in 2 lbs/yr of phosphorus being flushed to the lake. One concrete pretreatment structure was placed at the ditch inlet, and two concrete weirs were placed at culverts. Together, these capture sediment, street grime, and other pollutants, reducing phosphorus entering Coon Lake by 1.34 lbs/yr. Considering 1 lb of phosphorus can produce 500 lbs of algae, this one project may reduce algal growth in Coon Lake by 670 lbs/yr!

Help Make a Difference

Anyone who lives near a stormwater drain has waterfront property, at least in a sense. These curbside gutters drain to lakes, streams, and wetlands. Let's keep it clean. If you do live directly next to water, don't mow the yard to the water's edge. Instead, leave a strip of plants to catch pollutants and provide habitat.

Project Leaders

Stormwater retrofitting on these lakes is led by the Sunrise River Watershed Management Organization (SRWMO) with assistance from partners including the Anoka Conservation District, City of East Bethel, Linwood Township, Martin Lakers Association, and the Coon Lake Improvement Association.

Sunrise River WMO Contact Information and Meetings

Information about the SRWMO may be found on the website at http://www.anokanaturalresources.com/srwmo. The remaining 2011 SRWMO meetings are on August 4th and November 3rd; meetings are held at 6pm at East Bethel City Hall.

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. The website has been in operation since 2003.

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.AnokaNaturalResources.com/SRWMO

Results: 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.

Other tools on the website include:

- an interactive mapping tool that shows natural features and aerial photos
- an interactive data download tool that allows users to access all water monitoring data that has been collected
- narrative discussions of what the monitoring data mean

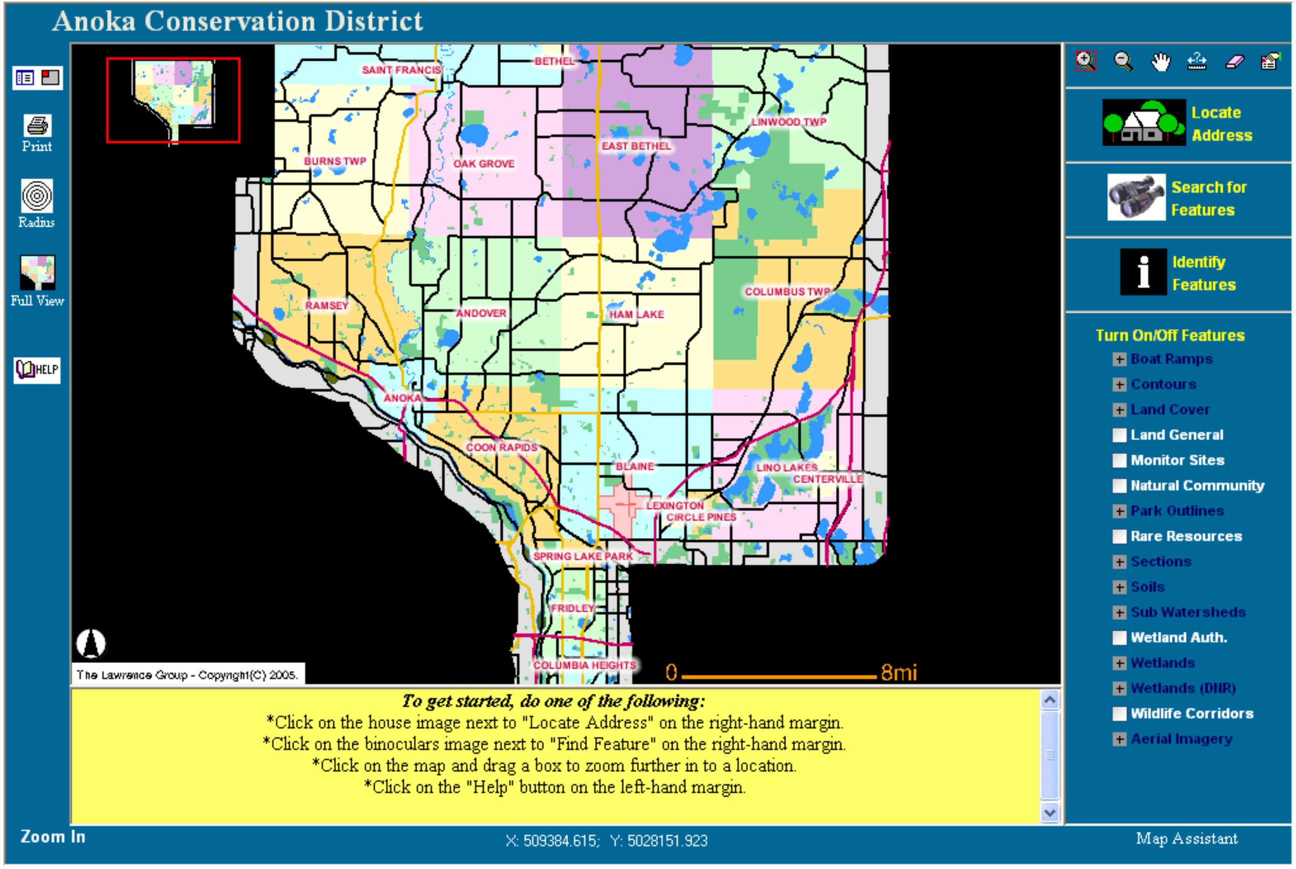
SRMWO Website Homepage

About SRWMO

The SRWMO is a joint powers special purpose unit of government composed of member cities collaborating to manage water resources. This arrangement is based upon the recognition that water-related issues and management rarely stop at municipal boundaries. The SRWMO's boundaries are defined by the west branch of the Sunrise River's watershed to the west and south branch of the Sunrise's watershed to the south. To the north and east the boundaries are defined by the Anoka County boundary. It does not extend into other counties because watershed organizations are only required by law within twin cities metropolitan counties.
The SRWMO is involved in many aspects of water management including planning and regulation, water quality, flooding, shoreland management, recreation, wildlife, and erosion control. The WMO has a state-approved watershed management plan which outlines their policies and plan of work. Cities' and townships' local water management plans must be consistent with the WMO's plan. The

more on next page

Interactive Mapping Tool



To get started, do one of the following:

*Click on the house image next to "Locate Address" on the right-hand margin.

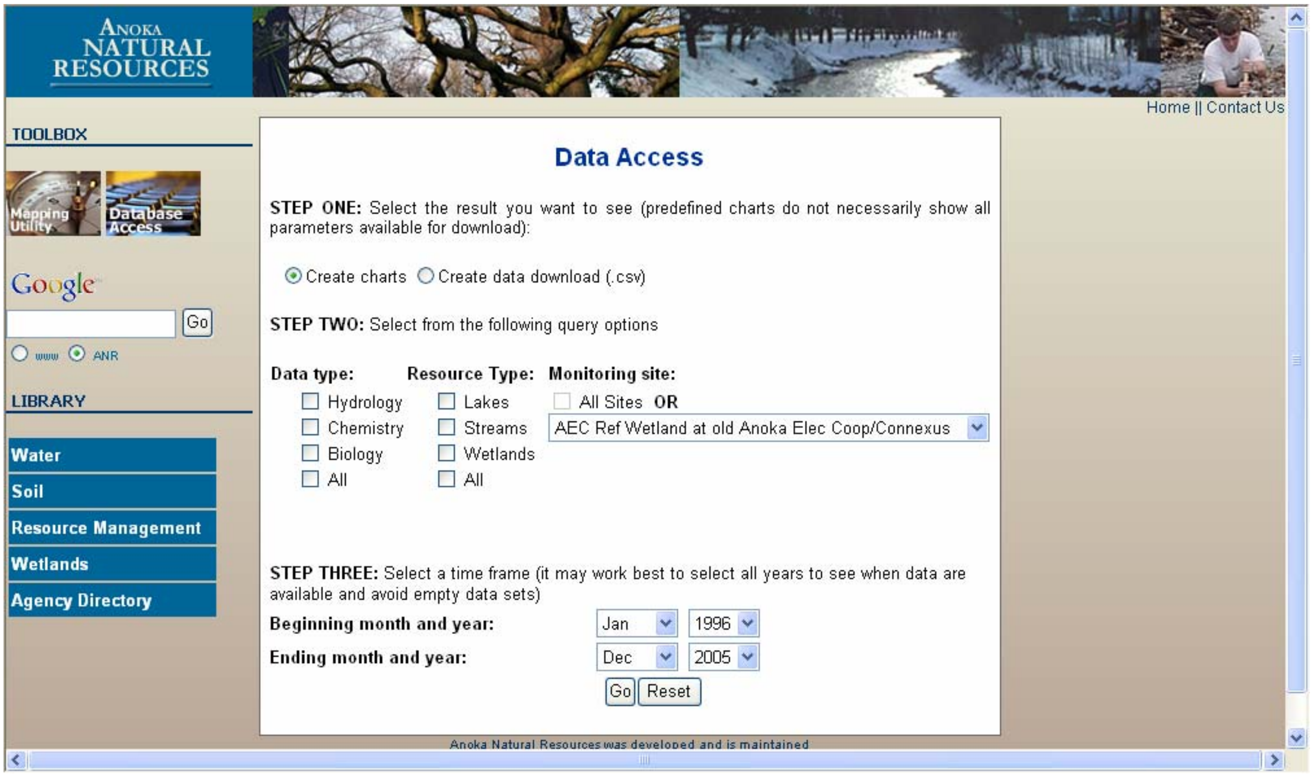
*Click on the binoculars image next to "Find Feature" on the right-hand margin.

*Click on the map and drag a box to zoom further in to a location.

*Click on the "Help" button on the left-hand margin.

X: 509384.615; Y: 5028151.923

Interactive Data Access Tool



Data Access

STEP ONE: Select the result you want to see (predefined charts do not necessarily show all parameters available for download):

● Create charts ○ Create data download (.csv)

STEP TWO: Select from the following query options

Data type:	**Resource Type:**	**Monitoring site:**
☐ Hydrology	☐ Lakes	☐ All Sites **OR**
☐ Chemistry	☐ Streams	AEC Ref Wetland at old Anoka Elec Coop/Connexus
☐ Biology	☐ Wetlands	
☐ All	☐ All	

STEP THREE: Select a time frame (it may work best to select all years to see when data are available and avoid empty data sets)

Beginning month and year: Jan 1996

Ending month and year: Dec 2005

Go Reset

Anoka Natural Resources was developed and is maintained

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: In 2011 two grant applications were prepared for the Martin and Typo Lake Carp barriers, and one was funded. Fees paid to the ACD only covered preparation of only one of these grant applications. Because the carp barriers project is a partnership between the SRWMO and ACD, the ACD bore the cost of preparing the second application.

The grant awarded was from the DNR Conservation Partners Legacy Program which obtains its funding from the Outdoor Heritage Fund (from the Clean Water, Land, and Legacy Amendment). The grant award of $129,938 is sufficient to fund carp barrier at four locations around Martin and Typo Lakes, as well as perform a commercial harvest of carp aided by radio tagging the fish. The 15% required local match for the project is from the SRWMO ($35,000 in 2012-13) and Martin Lakers Association ($5,000 in 2012). Project installation will begin in 2012.

The second grant application was also for the carp barriers project. The application was to the Clean Water Fund from the Board of Water and Soil Resources (BWSR). This application was not awarded, perhaps because the project was already being funded by the DNR grant.

The SRWMO requested that the ACD be the applicant for the DNR grant. This was due to questions about whether the SRWMO’s lack of a recent financial audit would make it ineligible for the grant. State rules regarding financial audits for WMO’s are currently being changed, and the SRMWO is working with the BWSR to ensure they are meeting requirements.

SRWMO 2010 Annual Report to BWSR

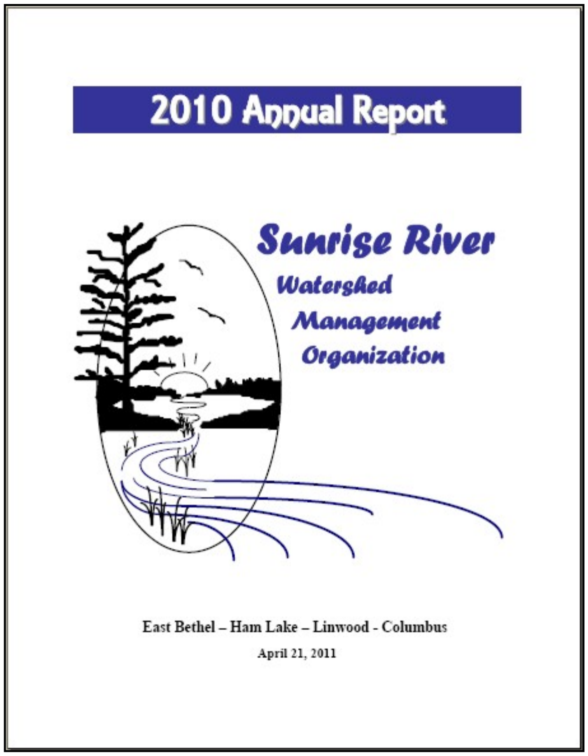
Description: The Sunrise River Watershed Management Organization (SRWMO) is required by law to submit an annual report to the Minnesota Board of Water and Soil Resources (BWSR), the state agency with oversight authorities. This report consists of an up-to-date listing of SRWMO Board members, activities 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).

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 2010 Sunrise River WMO Annual Report. ACD drafted the report and a cover letter. The draft was provided to the SRWMO Board on April 14, 2011. After SRWMO Board review, a final draft was delivered to the Chair on April 21, 2010 for his signature and forwarded to BWSR. On April 22, 2010 a sufficient number 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. A copy was also provided to each SRWMO Board member. The report is available to the public on the SRWMO website.

Cover



2010 Annual Report

Sunrise River
Watershed
Management
Organization

East Bethel – Ham Lake – Linwood - Columbus
April 21, 2011

Table of Contents

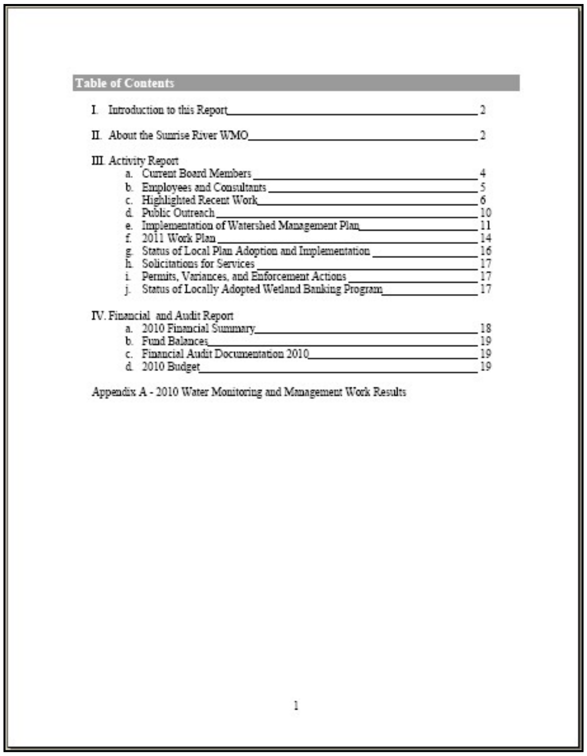


Table of Contents

1

Review Local Water Plans

Description: SRWMO member municipalities must update their Local Water Management Plans and ordinances within 2 years of the adoption of the new SRWMO Plan (MN Rules 8410.0130 and 84100160). All must be consistent with the SRWMO Plan. The SRWMO 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. ACD assists the SRWMO by providing a technical review of Local Water Management Plans, as they are completed, and Metropolitan Council's comments on each.

ACD's assistance includes:

- Reviewing each of the four member municipalities' draft local water management plan, and any relevant ordinances, for consistency with the SRWMO Plan.
- Writing comments in the form of a letter to the municipality and presenting it to the SRWMO Board.
- Sending the comments to the municipality when authorized by the SRWMO Board.
- Do all of the above within the 60 day comment period allowed by law.

Purpose: To ensure consistency between municipal local water plans and the SRWMO Watershed Management Plan.

Results: All local water plans, except Ham Lake, have been approved. The following is the status of each city or township's local water plan, as of January 23, 2012:

Linwood Township – Linwood Township has adopted the SRWMO Watershed Management Plan by reference.

Ham Lake – The Ham Lake Local Water Plan was reviewed in January 2012. The staff recommendation is for approval, contingent upon inclusion of the SRWMO wetland standards. The SRMWO will take action at their Feb. 2, 2012 meeting.

East Bethel – The SRWMO received a draft local water plan in June 2010. Changes were requested. In May 2011 a final draft was received and approved.

Columbus – Approved at the February 2011 SRWMO meeting.

Deadline for all – June 3, 2012 is the deadline for all SRWMO cities and townships to revise local water plans and ordinances to be consistent with the SRWMO 3rd Generation Watershed Management Plan.

On-call Administrative Services

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

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

Results: In 2011 a total of 43 hours of administrative assistance were performed. This was beyond the 22 hours that were pre-paid under contract because of unanticipated, non-routine tasks such as two rounds of amendments to the Watershed Management Plan, updates to the joint powers agreement, changes to insurance, creating a display or a local event, and others. Those hours in excess of 22 were charged at an hourly rate of $70 after approval by the SRWMO Board.

The following tasks were accomplished:

- Two rounds of watershed plan amendments.
- Edited the SRWMO joint powers agreement, and facilitated approvals and distribution.
- Coordinating financial arrangement changes East Bethel Finance Director.
- Coordinated annual reporting.
- Responded to 11 separate email inquiries/questions from Board members. This excludes simple emails and phone calls that took only moments to address.
- Appealed an MPCA decision that SRWMO carp barriers are ineligible for section 319 grant funding.
- Signed up the SRWMO for Blue Thumb reported in-kind contributions.
- Communications with BWSR and the Treasurer regarding SRWMO delinquent financial audits and audit requirements, and grant eligibility.
- Met with the SRWMO Treasurer, as requested, to discuss financial audit requirements.
- Reminders to some communities, at the SRWMO Board's direction, regarding delinquent local water plans and annual reports to the SRWMO.
- Reviewed draft minutes from one meeting. Due to the complex nature of some conversations, the recording secretary requested a technical review of the draft minutes.
- Portions of SRWMO meeting time that were dedicated to advising the board on administrative topics, including budgeting, JPA revisions, watershed plan revisions, soliciting bids for services, and financial arrangements.
- Recorded February 2011 meeting minutes when the recording secretary was absent.
- Phone calls from residents or developers. Most commonly, phone calls are from construction firms inquiring about permit requirements.
- Assembled meeting packets and recommended agenda items to the recording secretary.
- Assisted the Treasurer with insurance company questions and obtaining a quote.
- Assembled a display about the SRWMO and lakeshore landscaping for the SRWMO Board to use at Linwood Family Fun Day.
- Prepared materials for meetings (not including materials relating to tasks that were paid separately by the SRWMO).
- Communications related to returning $3,000 of SRWMO funding that was not needed for the Martin Lake rain gardens project.

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.

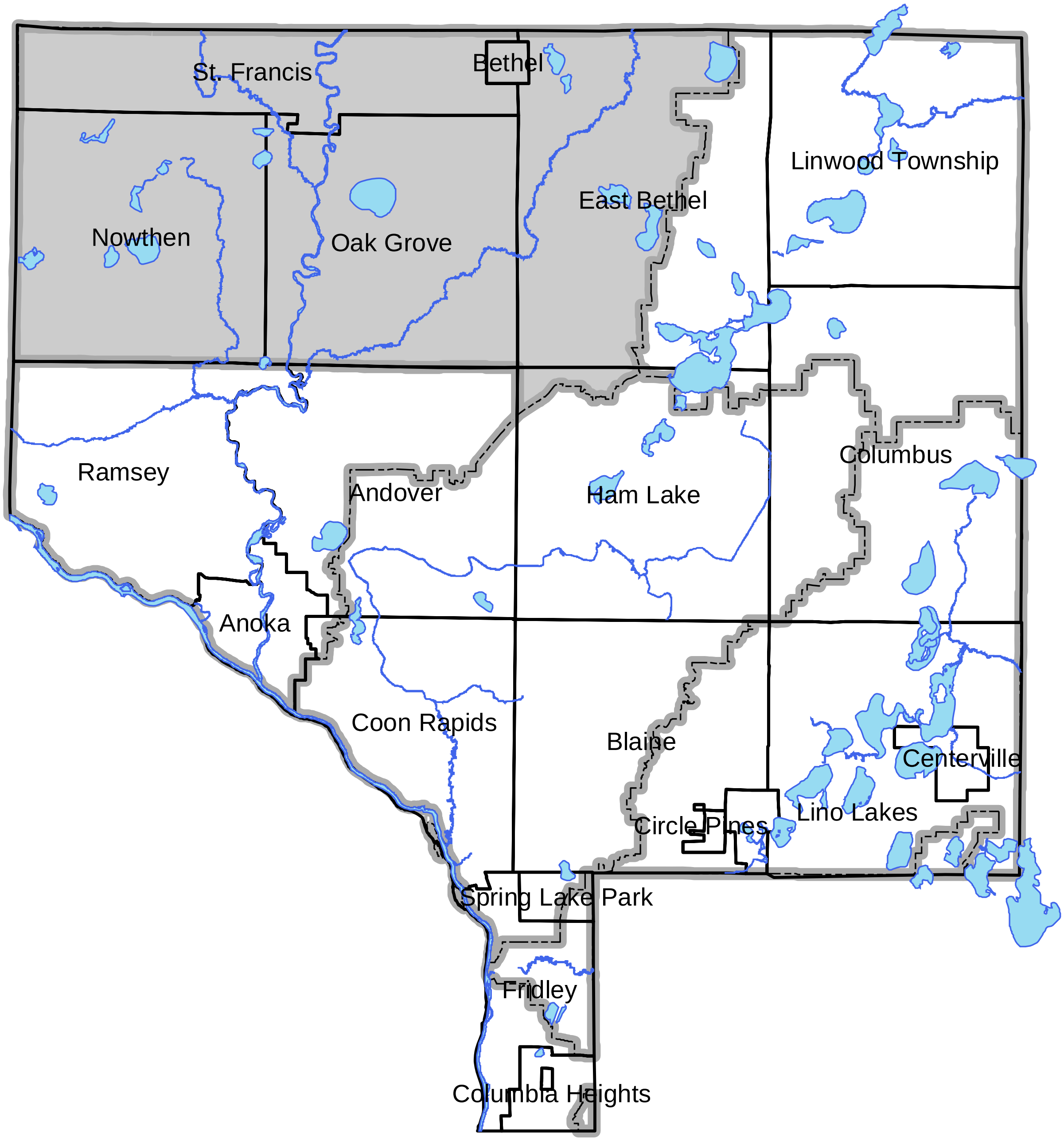
Sunrise River Watershed Financial Summary

Sunrise River Watershed	WMO Asst	WMO Websites	Reference Wetland	Lake Level	Stream Level	Lake WQ	Martin Typo Lake TMDL	Martin Lake Fish Barriers	SRWMO Admin	SRWMO Grant Search	SRWMO P Export	WMO Videos	Lcoal Water Plan reviews	WMO annual rpt	Martin Lk Retro Assess	Martin Lake Retro Promo	Martin Lake Retro Install	Total
Revenues																		
SRWMO	140	770	1620	800	1090	400			2270	1000	1200	1363	1000	675	5000		7000	24328
State																	15127	15127
Anoka Conservation District	2260		9	140	585	1253	776	7639	795	427		908		51	8005	1829	1629	26306
County Ag Preserves																		
Regional/Local																	5640	5640
Other Service Fees																		
Local Water Planning																		
TOTAL	2400	770	1629	940	1675	1653	776	7639	3065	1427	1200	2271	1000	726	13005	1829	29396	71401
Expenses																		
Capital Outlay/Equip	6	2	4	1	9	2	3	12	7				4					50
Personnel Salaries/Benefits	2052	409	1418	822	1412	1076	662	6653	2676	1254	966	2049	286	628	11341	1609	8061	43376
Overhead	175	36	109	61	128	494	62	515	205	76	49	113	36	56	848	95	263	3323
Employee Training	7	2	8	5	7	3	1	23	13	3	11	19	1	1	21	4	46	176
Vehicle/Mileage	38	6	22	14	20	22	13	131	46	30	11	28	3	14	260	39	70	766
Rent	96	19	58	31	68	51	34	305	117	64	25	62	17	28	534	83	157	1748
Program Participants																		
Program Supplies	25		9	6	30	5											20798	20873
Equipment Maintenance																		
TOTAL	2400	475	1629	940	1675	1653	776	7639	3065	1427	1062	2271	347	726	13005	1829	29395	70312

Recommendations

- **Follow the guidance of the SRWMO's 10-year watershed management plan,** which as updated in February 2010.
- **Integrate theTypo and Martin Lake Total Maximum Daily Load (TMDL) Study and Implementation Plan into SRWMO efforts.** These reports are being completed by the MN Pollution Control Agency in 2012.
- **Actively follow development of St. Croix River and Sunrise River TMDLs**, and become involved as appropriate. The St. Croix TMDL is being completed in early 2012. The Sunrise River TMDL is began 2011 and will take several years.
- **Install rough fish barriers round Typo Lake and Martin Lake, and track response of the lakes.** Carp barriers will be installed around Martin and Typo Lakes in 2012-2013. Tracking the lakes' water quality and fishery response to these should be a priority.
- **Install high priority stormwater retrofits around Coon and Martin Lakes.** A stormwater assessment is complete for Martin Lake and will begin in 2012 for Coon Lake. They identify and rank stormwater retrofit projects that will benefit lake water quality. Installation should be a priority.
- **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. New efforts or incentives are planned for 2013, and new approaches should be welcomed.
- **Increase the use of web videos as an effective education and reporting tool.** Web videos are increasingly easy to do. They convey a lot of information quickly by combining visual and audio messages. They can be effective for public education, but also for highlighting successful projects or reporting.
- **Continue the SRWMO cost share grant program** to encourage water quality projects.
- **Encourage communities to report water quality projects to the SRWMO.** An overarching goal in the SRWMO Plan is to reduce phosphorus by 20% (986 lbs). State oversight agencies will evaluate efforts toward this goal. Both WMO and municipal project benefits should be counted.

Upper Rum River Watershed



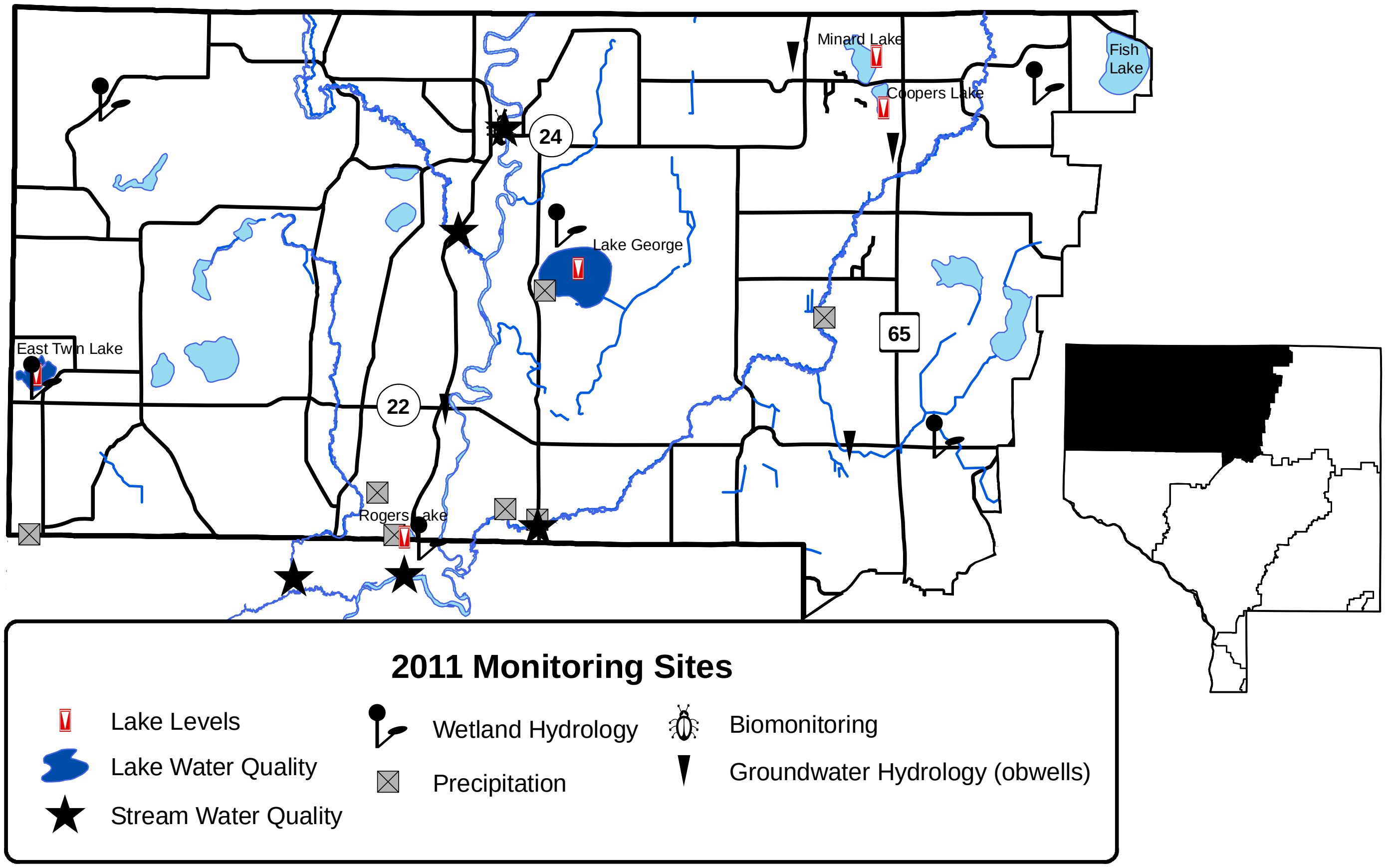
Contact Info: Upper Rum River Watershed Management Organization
www.AnokaNaturalResources.com/URRWMO
763-753-1920

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

CHAPTER 3:
UPPER RUM RIVER WATERSHED

Task	Partners	Page
Lake Level Monitoring	URRWMO, ACD, MN DNR, volunteers	3-62
Lake Water Quality Monitoring	URRWMO, ACD	3-65
Stream Water Quality – Chemical Monitoring	URRWMO, LRRWMO, ACD, MC	3-70
Stream Water Quality – Biological Monitoring	ACD, ACAP, St. Francis High School	3-88
Wetland Hydrology	ACD, ACAP	3-91
Water Quality Grant Fund	URRWMO, ACD	3-97
URRWMO Website	URRWMO, ACD	3-100
URRWMO Annual Newsletter	URRWMO, ACD	3-102
URRWMO 2010 Annual Report to BWSR	URRWMO, ACD	3-103
Financial Summary		3-104
Recommendations		3-105
Groundwater Hydrology (obwells)	ACD, MNDNR	Chapter 1
Precipitation	ACD, volunteers	Chapter 1

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



Lake Levels

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

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

Locations: East Twin Lake, Lake George, Rogers Lake

Results: Water levels on George, Rogers, East Twin, Coopers, and Minard Lakes were measured by volunteers 36, 26, 18, 29, and 30 times, respectively, in 2011.

In 2011 all of these lakes had much higher water levels than in other recent years due to high rainfall totals in spring and early summer. In late summer very little rainfall fell and water levels dropped continuously on all lakes. However the magnitude of these changes were very different on each lake (see graphs on following pages). East Twin and Rogers Lakes rose approximately 3 feet in the spring and early summer, while Lake George rose only one foot. Coopers and Minards Lakes showed little gain in water level, and presumably any increases took place during early spring melting when monitoring was not yet in place.

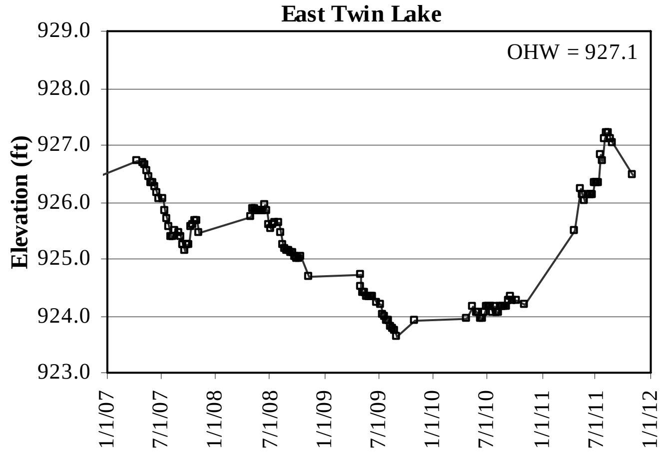
Rogers and Lake George both experienced the highest water levels on record. Rogers reached a record high of 885.31 feet on August 2, 2011. This exceeded the previous highest observed water level by 0.57 feet. George reached its highest ever observed on May 28, when it hit 903.19. This beat the previous record from September 2003 by only 0.01 feet.

This was the first year 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. Minard Lake can flow into Coopers Lake when the water is high enough.

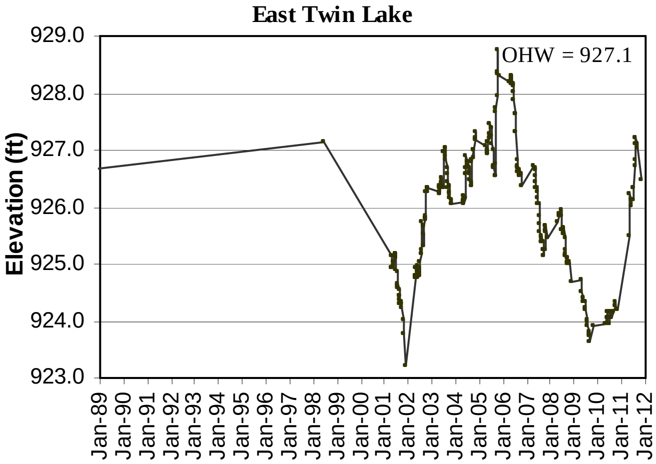
In 2011 there were 25 paired lake level measurements taken on Cooper and Minard Lakes (measurements within 3 days of eachother). On two occasions Minard was lower than Coopers (0.02 and 0.04 ft lower). On all other occasions Minard was higher. Throughout spring and summer, which was an excessively wet period, the elevation difference was 0.4 feet or less. August was the beginning of a very dry period. As both lakes dropped, the difference between them became more exaggerated, from 0.66 to 1.15 starting in September. The reason that Coopers Lake draws down faster in dry weather is unknown, but we speculate that Coopers Lake continues to have outflow from the south end of the lake during these periods, while Minard Lake has little outflow because its outlet flows through a culvert that is often higher than the lake level.

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.

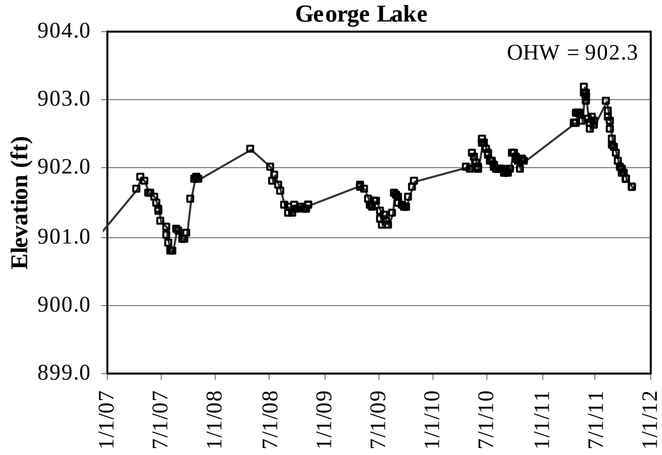
East Twin Lake Levels 2007-2011



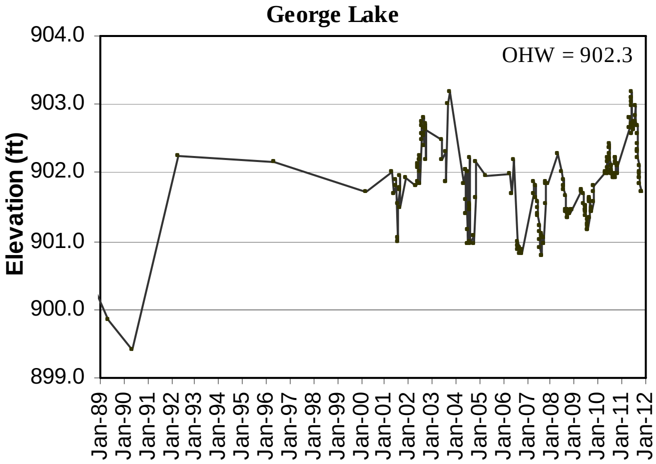
East Twin Lake Levels 1990-2011



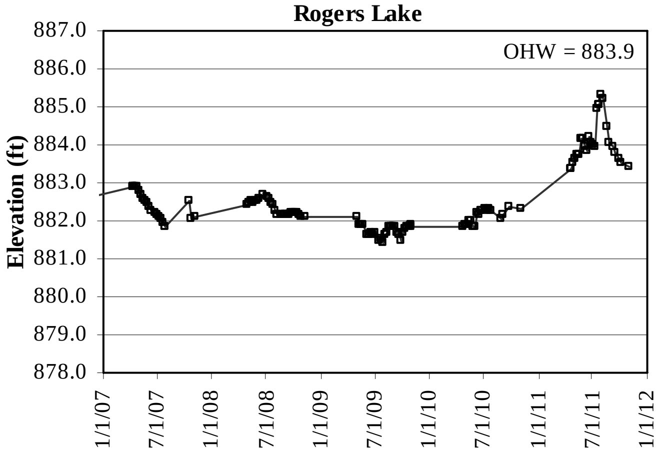
Lake George Levels 2007-2011



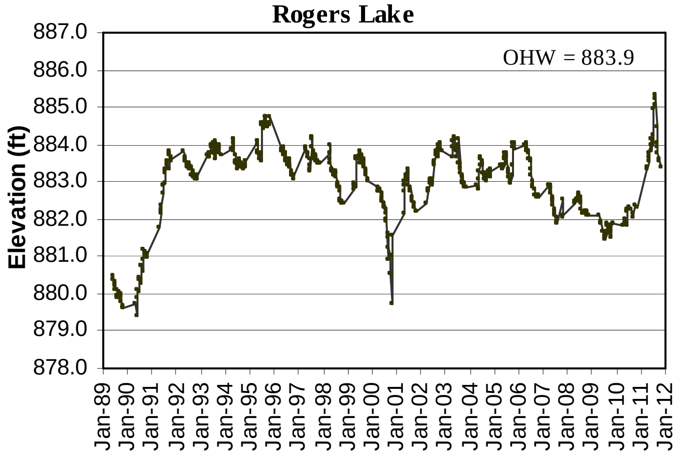
Lake George Levels 1990-2011



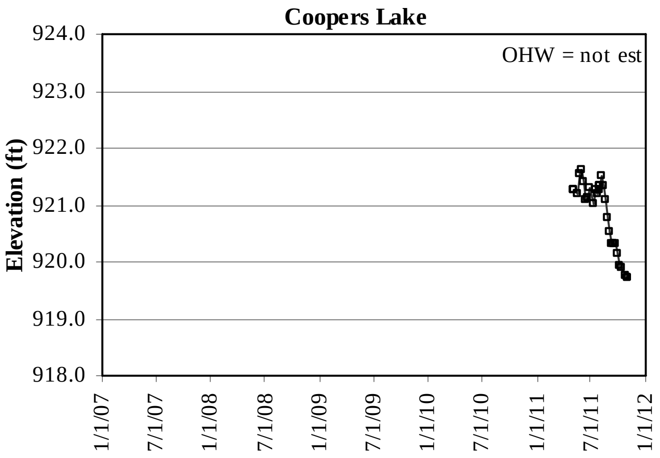
Rogers Lake Levels 2007-2011



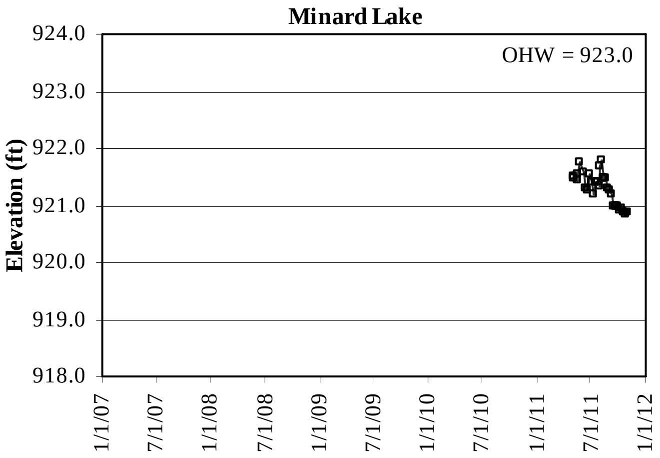
Rogers Lake Levels 1990-2011



Coopers Lake Levels 2007-2011



Minard Lake Levels 2007-2011



Lake Water Quality

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

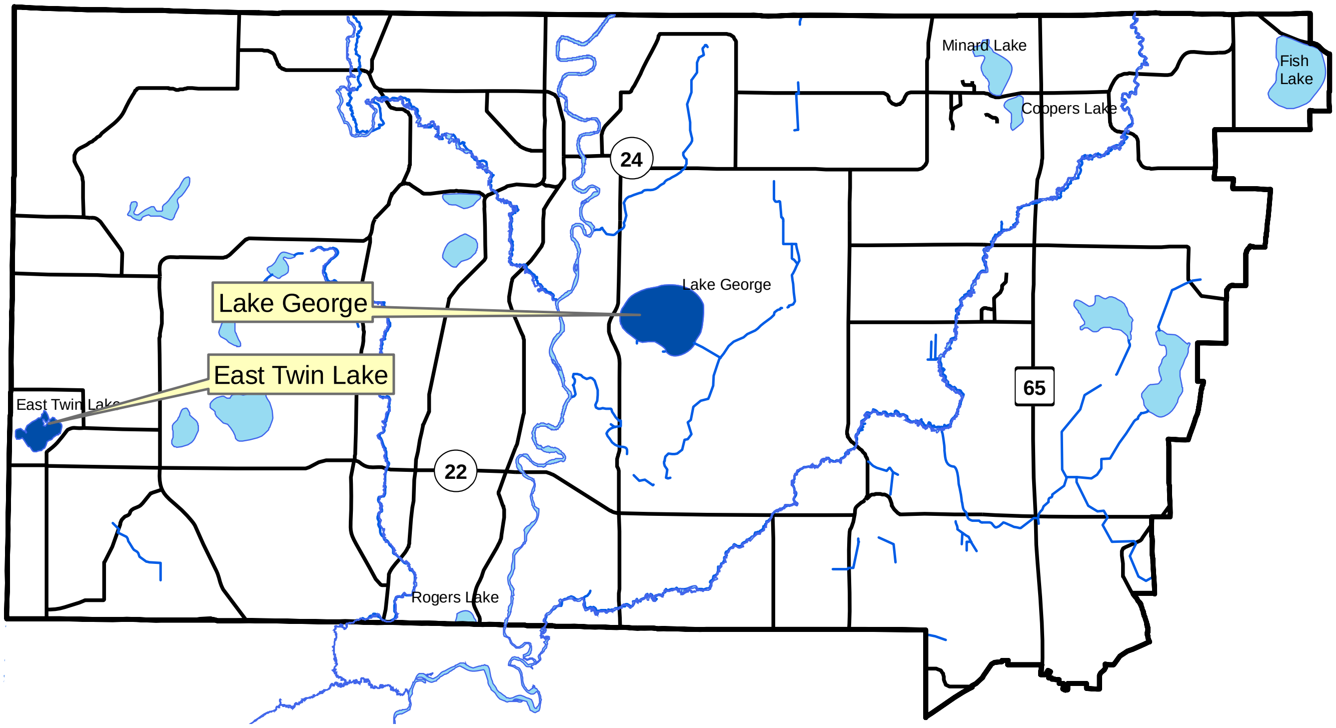
Purpose: To detect water quality trends and diagnose the cause of changes.

Locations: East Twin Lake

Lake George

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 www.AnokaNaturalResources.com. Refer to Chapter 1 for additional information on interpreting the data and on lake dynamics.

Upper Rum River Watershed Lake Water Quality Monitoring Sites



East Twin Lake

City of Nowthen, Lake ID # 02-0133

Background

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

2011 Results

In 2011 East Twin Lake had excellent water quality for this region of the state (NCHF Ecoregion), receiving an overall A grade; the same as in 11 of the previous 12 years monitored. The lake is mesotrophic. Of particular notability is the 18.7 ft Secchi transparency on May 16, 2011 and other exceptional clarity readings of 22 ft on May 28, 2008 and 20 ft in spring 2002; these are the deepest at any Anoka County lake since at least 1996. Even later in summer, transparency is sometimes >10 ft, although in 2011 it was less than 7 feet in August and September. Throughout summer total phosphorus held relatively steady at <31 ug/L and chlorophyll-a was consistently at <13 mg/L. These are low and considered excellent. Subjective observation by ACD staff ranked physical and recreational conditions optimal.

Trend Analysis

Thirteen years of water quality data have been collected by the Metropolitan Council (1980, '81,'83, '95, and '98), the Minnesota Pollution Control Agency (1989), and the Anoka Conservation District (1997, '99, 2000, 2002, 2005, 2008, and 2011). Trend analyses up to 2008 found water quality significantly improved since 1980 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,9}$= 7.31, p=0.01). The most obvious differences are from the 1980's data and the post-1980's data. One-way ANOVAs revealed that reduction in chlorophyll-a is the most important factor in this trend, but total phosphorus reductions also occurred. Secchi transparency changes have been minimal. The analysis with 2011 data finds that the trend is no longer statistically significant ($F_{2,10}$= 3.52, p=0.07). This suggests that water quality has held constant in recent years.

Discussion

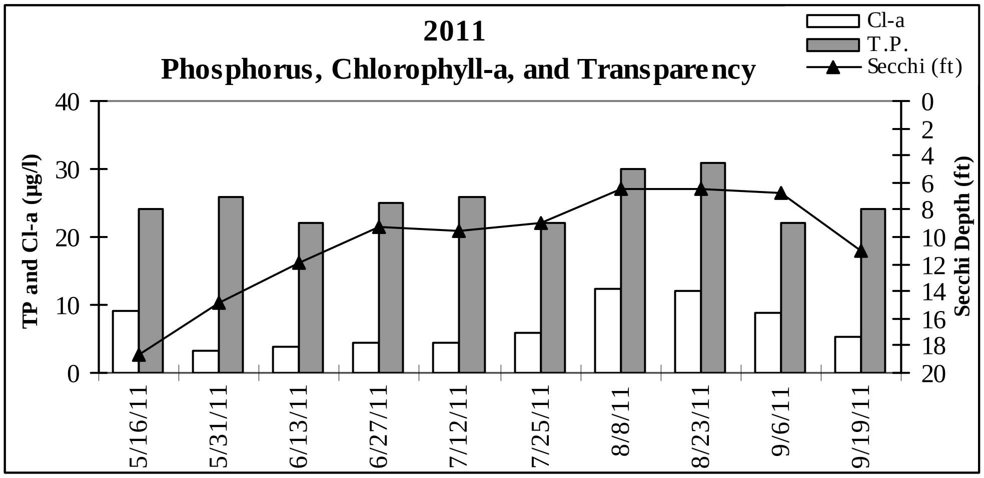
The ecology of this lake is different from that of many other Anoka County Lakes because it is deep. Sediment and dead algae can sink to the bottom and are essentially lost from the system because resuspension by wind, rough fish, and other forces is minimal. In shallower lakes, these nutrients circulate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

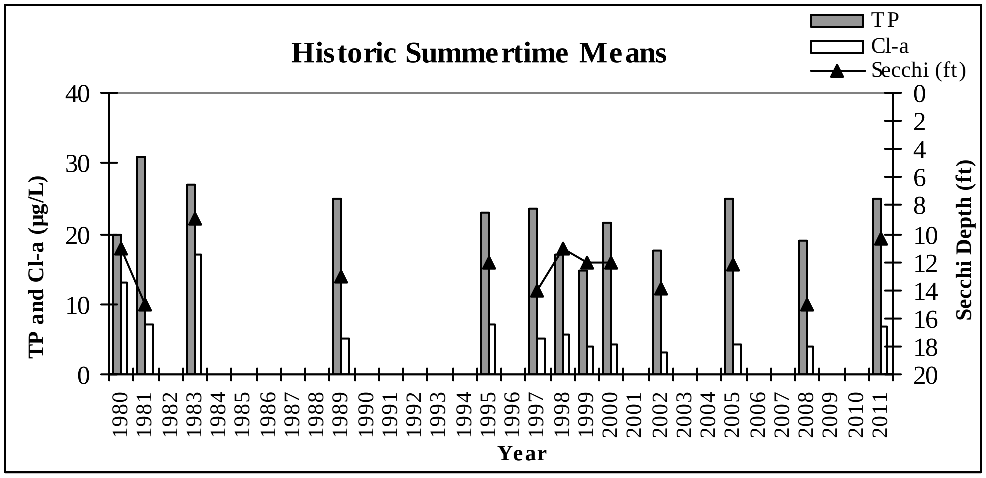
2011 East Twin Lake Water Quality Data

East Twin Lake 2011			5/16/2011	5/31/2011	6/13/2011	6/27/2011	7/12/2011	7/25/2011	8/8/2011	8/23/2011	9/6/2011	9/19/2011			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.02	8.14	8.50	8.36	8.07	8.00	7.94	7.97	8.16	8.05	8.12	7.94	8.50
Conductivity	mS/cm	0.01	0.192	0.196	0.196	0.196	0.203	0.175	0.177	0.166	0.158	0.150	0.181	0.150	0.203
Turbidity	FNRU	1	2.00	2.00	1.00	2.00	3	2	4.00	4.00	5.00	2.00	3	1	5
D.O.	mg/L	0.01		10.32	10.54	9.18	7.64	7.83	6.66	5.92	4.85	5.08	7.87	4.85	10.54
D.O.	%	1		110%	117%	103%	96%	99%	83%	71%	55%	53%	88%	53%	117%
Temp.	°C	0.1	13.1	19.3	20.8	21.4	27.2	27.5	26.6	24.6	21.1	17.3	21.9	13.1	27.5
Temp.	°F	0.1	55.6	66.7	69.4	70.5	81.0	81.5	79.9	76.3	70.0	63.1	71.4	55.6	81.5
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	ug/L	0.5	9.1	3.1	3.9	4.3	4.3	6.0	12.5	12.2	8.7	5.2	6.9	3.1	12.5
T.P.	mg/L	0.010	0.024	0.026	0.022	0.025	0.026	0.022	0.030	0.031	0.022	0.024	0.025	0.022	0.031
T.P.	ug/L	10	24	26	22	25	26	22	30	31	22	24	25	22	31
Secchi	ft	0.1	18.7	14.9	11.9	9.2	9.5	8.9	6.4	6.5	6.8	11.1	10.4	6.4	18.7
Secchi	m	0.1	5.70	4.54	3.63	2.80	2.90	2.71	1.95	1.98	2.07	3.38	3.2	2.0	5.7
Physical			1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	1.0	1.4	1.0	2.0
Recreational			1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	1.5	1.0	2.0

*reporting limit

East Twin Lake Water Quality Results





East Twin Lake Summertime Annual Mean

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

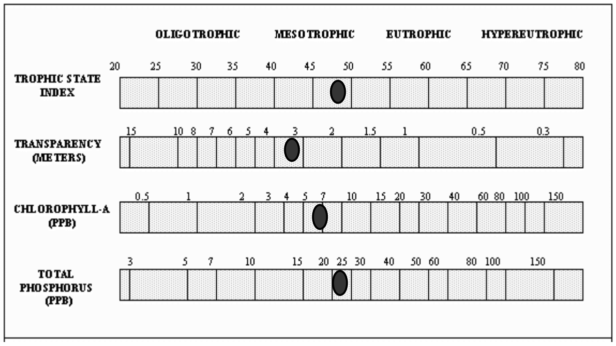
Carlson's Tropic State Indices

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

East Twin Lake Water Quality Report Card

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

Carlson's Trophic State Index



Lake George

CITY OF OAK GROVE, LAKE ID # 02-0091

Background

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

2011 Results

In 2011 Lake George had good water quality for this region of the state (NCHF Ecoregion), receiving an overall B grade, however it was the poorest water quality of all years monitored. The lake is normally mesotrophic, but this year was mildly eutrophic. Total phosphorus averaged 29 ug/L, the highest observed in 14 monitored years. Secchi transparency was nearly 13 feet in mid-May, but only 3.4 feet throughout August. Average Secchi transparency was 6.7 feet, the poorest observed. Chlorophyll-a averaged 12.4 mg/L, the second highest observed in all years monitored. Chlorophyll-a and transparency were poorest in August, while phosphorus climbed nearly continuously from May through September. Another notable observation for this lake in 2011 is that Eurasian Water Milfoil continues to expand despite treatments to control it.

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 and 2011). Water quality has not significantly changed from 1980 to 2011 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,12}= 0.30$, $p>0.05$).

Discussion

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

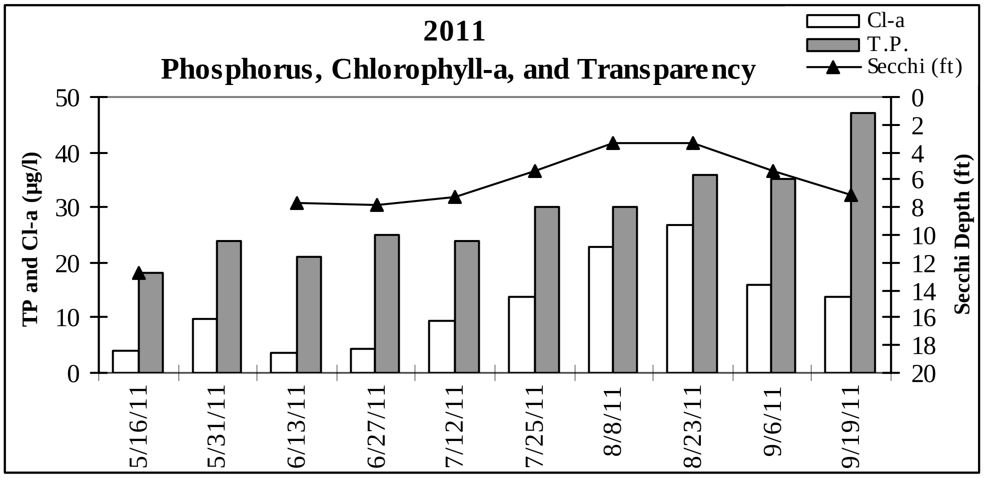
Two exotic invasive plants are present in Lake George. Curly leaf pondweed causes only a brief nuisance in the spring and dies back by mid-June. This die-back causes a brief pulse of phosphorus and algae growth on some lakes, but this is not apparent at Lake George. Eurasian Water Milfoil is also present, and in recent years has begun to affect recreation by matting to the surface in some localized areas. A Lake Improvement District as been formed to orchestrate control of this plant and multiple years of localized treatments have occurred. Despite this, Eurasian Water Milfoil has expanded. Its effects, if any, on water quality in Lake George are unknown.

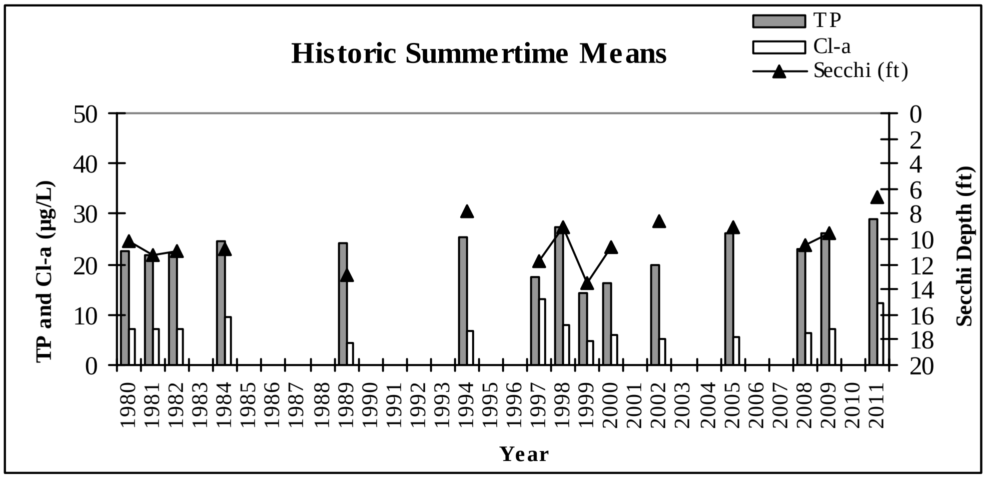
2011 Lake George Water Quality Data

Lake George 2011			5/16/2011	5/31/2011	6/13/2011	6/27/2011	7/12/2011	7/25/2011	8/8/2011	8/23/2011	9/6/2011	9/19/2011			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.98	8.29	8.28	8.40	8.60	8.61	8.92	8.80	8.27	8.24	8.44	7.98	8.92
Conductivity	mS/cm	0.01	0.206	0.198	0.200	0.199	0.196	0.169	0.169	0.161	0.155	0.146	0.180	0.146	0.206
Turbidity	FNRU	1	2.00	6.00	3.00	3.00	8.00	9.00	11.00	15.00	21.60	6.00	8	2	22
D.O.	mg/l	0.01		11.06	9.90	9.32	8.65	8.55	9.56	8.73	6.40	7.08	8.81	6.40	11.06
D.O.	%	1		121%	109%	104%	109%	108%	120%	106%	73%	75%	103%	73%	121%
Temp.	°C	0.1	13.2	19.7	20.3	21.0	27.0	27.4	27.0	25.2	21.6	17.5	22.0	13.2	27.4
Temp.	°F	0.1	55.8	67.5	68.5	69.8	80.6	81.3	80.6	77.4	70.9	63.5	71.6	55.8	81.3
Salinity	%	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl-a	ug/L	0.5	3.9	9.9	3.5	4.3	9.5	13.6	22.8	26.7	15.9	13.8	12.4	3.5	26.7
T.P.	mg/l	0.010	0.018	0.024	0.021	0.025	0.024	0.030	0.030	0.036	0.035	0.047	0.029	0.018	0.047
T.P.	ug/l	10	18	24	21	25	24	30	30	36	35	47	29.0	18.0	47.0
Secchi	ft	0.1	12.8		7.7	7.9	7.3	5.3	3.4	3.4	5.3	7.1	6.7	3.4	12.8
Secchi	m	0.03	3.90		2.35	2.39	2.23	1.62	1.04	1.04	1.62	2.16	2.0	1.0	3.9
Physical			1.0	2.0	2.0	2.0	1.0	3.0	3.0	4.0	3.0	4.0	2.5	1.0	4.0
Recreational			1.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	2.2	1.0	3.0

*reporting limit

Lake George Water Quality Results





Lake George Summertime Annual Means

Agency	MC	MC	MC	MC	MC	MC	ACD	MC	ACD	ACD	ACD	ACD	ACD	MC	MC
Year	1980	1981	1982	1984	1989	1994	1997	1998	1999	2000	2002	2005	2008	2009	2011
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
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
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
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

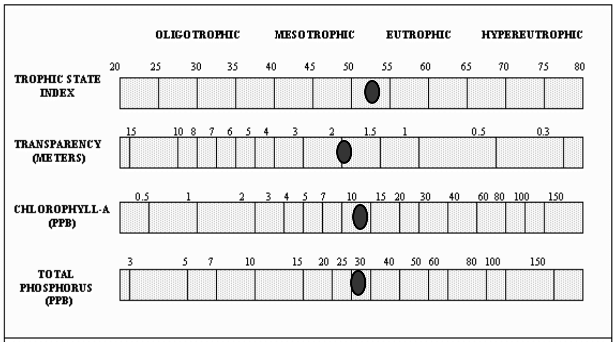
Carlson's Tropic State Indices

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

Lake George Water Quality Report Card

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

Carlson's Trophic State Index



Stream Water Quality - Chemical Monitoring

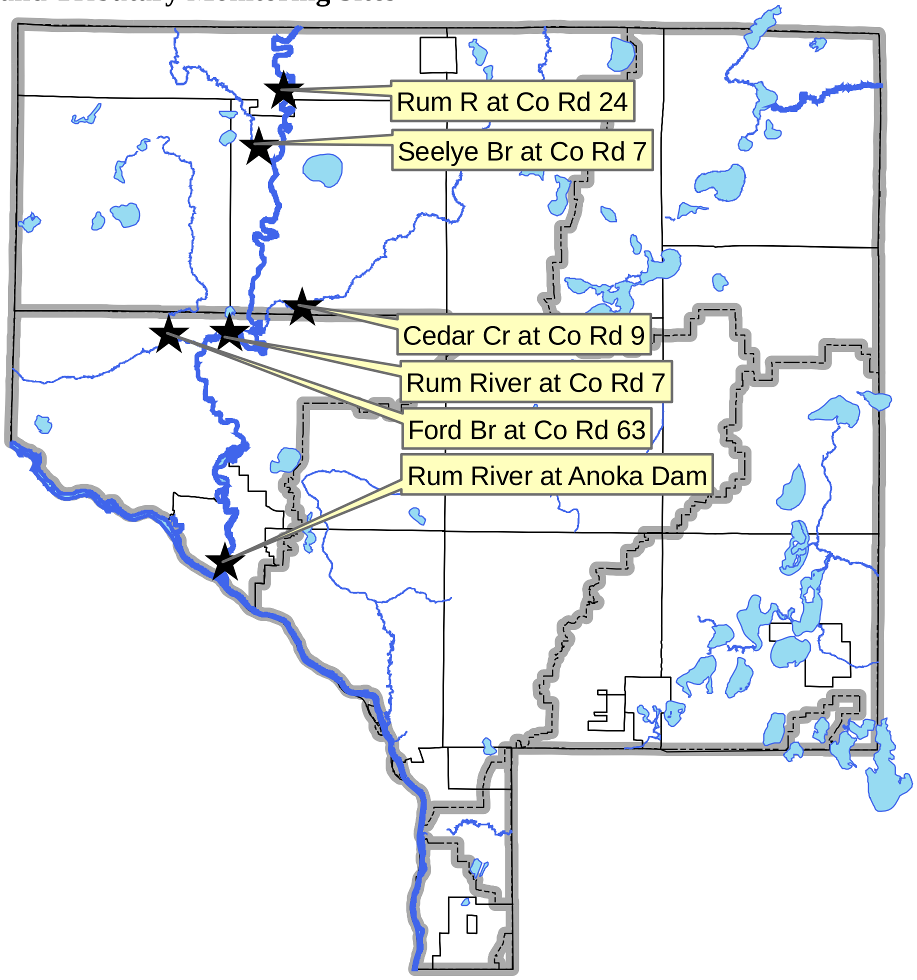
Description: The Rum River has simultaneously monitored the Rum River at three strategic locations in 2004 and 2009-11. The locations include the approximate top and bottom of the Upper and Lower Rum River Watershed Management Organizations. Additionally, the three largest tributaries in the URRWMO were monitored in 2011, simultaneous with the Rum River monitoring for greatest comparability. Collectively, these data allow for an upstream to downstream water quality comparison within Anoka County, as well as within each watershed organization. It also allows us to examine whether the tributaries degrade Rum River water quality.

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

Locations:
Rum River at Co Rd 24
Rum River at Co Rd 7
Rum River at the Anoka Dam
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. For the Rum River sites, the analysis is focused on comparing river conditions from upstream to downstream. For the tributaries, the analysis is focused on determining whether the tributaries improve or degrade Rum River water quality.

2011 Rum River and Tributary Monitoring Sites

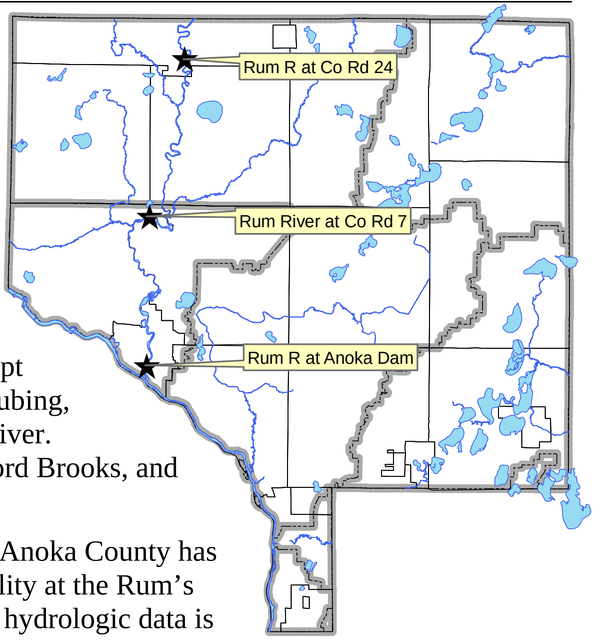


RUM RIVER

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
At Co. Rd. 7 –	2004, 2009, 2010, 2011
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 and 2011 monitoring was conducted at three locations simultaneously to determine if Rum River water quality changes in Anoka County, and if so, generally where changes occur. The Upper and Lower Rum River Watershed Management Organizations contributed to this work and monitoring sites were strategically located near the upper and lower boundary of each organization's jurisdictional boundary. The Metropolitan Council maintains a permanent monitoring station at the Anoka Dam, the farthest downstream monitoring site. The Metropolitan Council monitoring was coordinated to occur with the watershed organization monitoring so the data and costs could be shared. The Anoka Conservation District did the field work for both Metropolitan Council and the watershed organizations, ensured monitoring for both programs was conducted simultaneously so the data and costs could be shared, and reports the data together for a more comprehensive analysis of the river from upstream to downstream.

The river 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. 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, sulfates, and hardness. Ten additional parameters were tested by the Metropolitan Council at their laboratory for the Anoka Dam site only and are not reported here. 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 and dates that were simultaneously tested at all three sites. 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

Overall, Rum River water quality is good throughout Anoka County, however it does decline slightly below the County Road 7 bridge (i.e. in the Cities of Andover, Anoka, and Ramsey) and during storms. The declines in water quality below that point are modest, as are declines in water quality during storms. Dissolved pollutants (as measured by conductivity and chlorides), total phosphorus, turbidity, and total suspended solids were all generally near or below the median of all 34 Anoka County streams that have been monitored, while pH and dissolved oxygen levels were appropriate.

Two areas of concern were noted. First, dissolved pollutants increased at each monitoring site downstream. Dissolved pollutants were highest during baseflow, indicating pollutants have infiltrated into the groundwater which feeds the river and tributaries during baseflow. Road deicing salts are likely the most significant dissolved pollutant. Secondly, total suspended solids increased notably below County Road 7. This was most pronounced during storms.

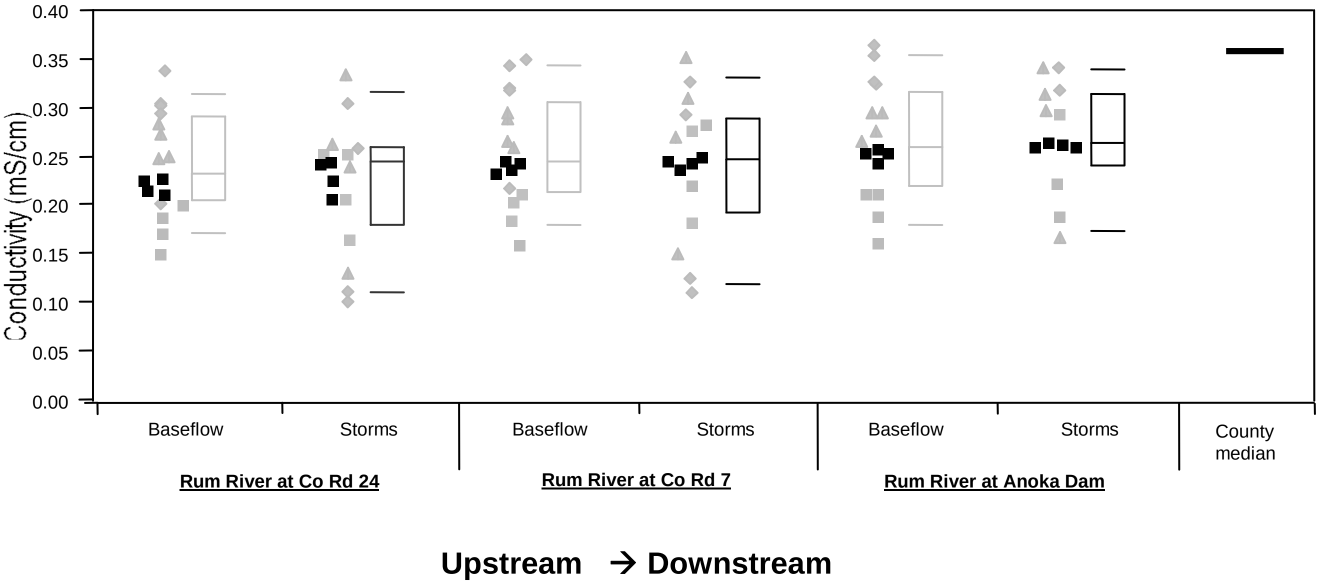
It is important to recognize the limitations of this report. The data is only from 2004, 2009, 2010, and 2011 when all three sites were monitored simultaneously to allow comparisons. It includes drought years (2009), years with slightly above normal precipitation (2010), and years with some excessively wet and some excessively dry months (2004 and 2011). We did not sample any extreme floods when river water quality is likely worst. If a more detailed analysis of river water quality is desired, data from many years and a variety of conditions is available for the Anoka Dam site through the Metropolitan Council. Their work includes composite samples throughout storms.

On the following pages data are presented and discussed for each parameter. The last section outlines management recommendations. The Rum River is an exceptional waterbody, and its protection and improvement should be a high priority.

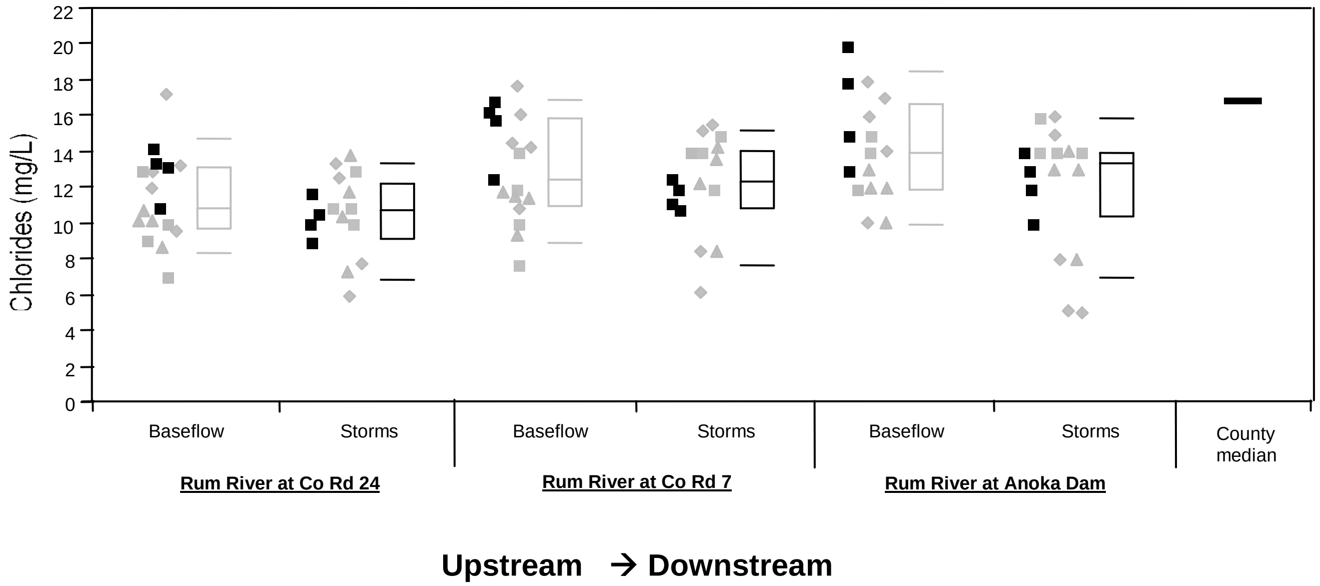
Conductivity and chlorides

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 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. 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 Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Chloride during baseflow and storm conditions Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th 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 was 0.245 mS/cm, 0.248 mS/cm, and 0.266

mS/cm, respectively. This is lower than the median for 34 Anoka County streams of 0.362 mS/cm. The maximum observed conductivity in the Rum River was 0.365 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.

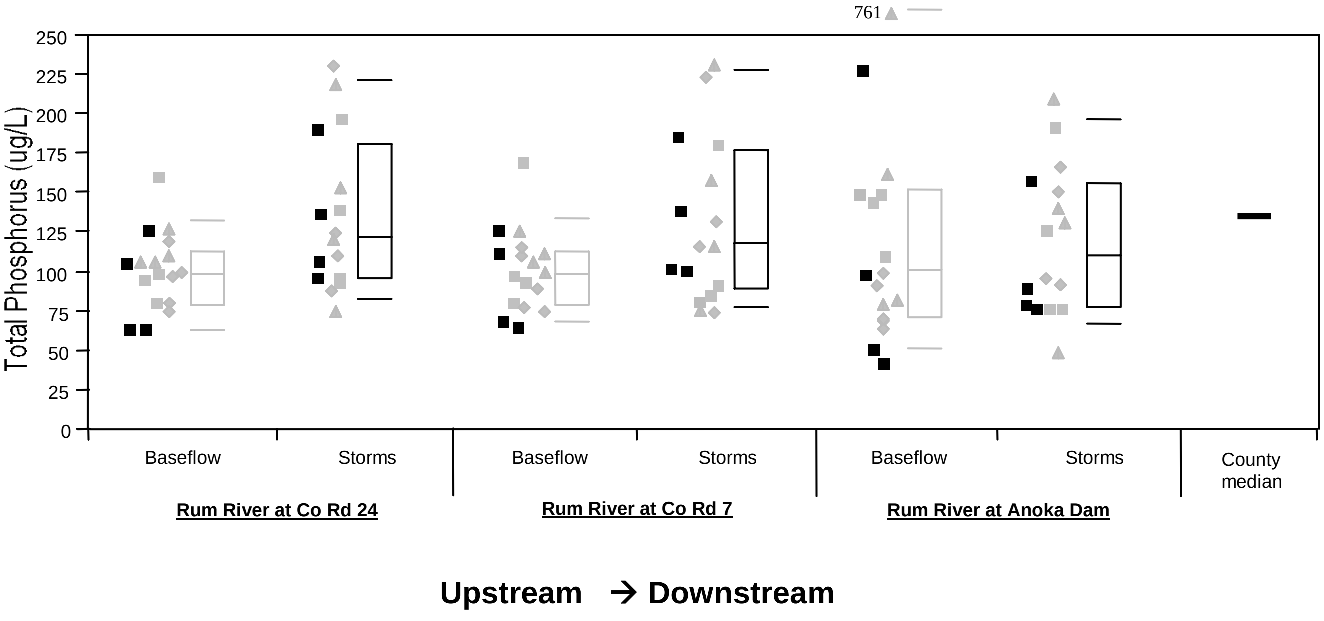
Chloride results parallel those found for conductivity (see figures above), supporting the hypothesis that chloride is an important dissolved pollutant. Chloride levels in the Rum River (median 11, 13, and 14 mg/L from upstream to downstream) are slightly lower than the median for Anoka County streams of 17 mg/L. The highest observed value was 20 mg/L, though higher levels may have occurred during snowmelts which were not monitored. The levels observed are much lower than the Minnesota Pollution Control Agency's (MPCA) chronic standard for aquatic life of 230 mg/L. Like conductivity, chlorides were slightly higher during baseflow than storms at each site and increased from upstream to downstream. Road deicing salt infiltration into the shallow groundwater is likely the primary contributor, as described above.

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). 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 each of the three monitored sites was 106, 106, and 101 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. All of the highest observed total phosphorus readings were during storms, including the maximums at each site of 230, 234, and 761 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.

One 2010 total phosphorus reading was excessively high, but we feel this outlier is likely an error. On September 22 a reading of 761 ug/L was recorded at the Anoka Dam. This was recorded as a baseflow sample because no recent rains had occurred, but was during a period of extended high water. River stage was approximately 0.5 feet higher than during the other baseflow samples. During this event dissolved phosphorus was analyzed in addition to total phosphorus. Dissolved phosphorus was only 13% of total phosphorus. Therefore most of the total phosphorus must be particulate phosphorus. Yet, inconsistently, there were few particulates in the water; total suspended solids was only 6 mg/L. Likewise, nothing in the field notes suggest unusually high turbidity. If this reading of 761 ug/L total phosphorus is excluded, as it probably should be, the next highest observed TP at this site is 209 ug/L.

Total phosphorus during baseflow and storm conditions Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. 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. Suspended solids in the Rum River are moderate, and highest during storms and at the farthest downstream site. The results for turbidity and TSS differ, lending insight into the types of particles that are problematic.

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 9, 8, 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. The maximum observed was 66 FNRU during a snowmelt event in 2011. The Rum River's turbidity exceeded the Minnesota Pollution Control Agency's water quality standard of 25 NTU during only five of 99 events (5%).

Across all years, TSS was similar at the two upstream sites, but higher at the Anoka Dam (see figure below). The countywide TSS median for streams is 12 mg/L. The median at all the Rum River sites was the same - 8 mg/L. However the readings ranged highest at the farthest downstream site, the Anoka Dam.

At all the sites median TSS during storms was higher than during baseflow. At the upstream site the difference between median TSS during storms and baseflow was 3 mg/L, while at County Road 7 it was 4 mg/L and at the Anoka Dam 9 mg/L. TSS during storms was much more variable due to variability in storms sampled.

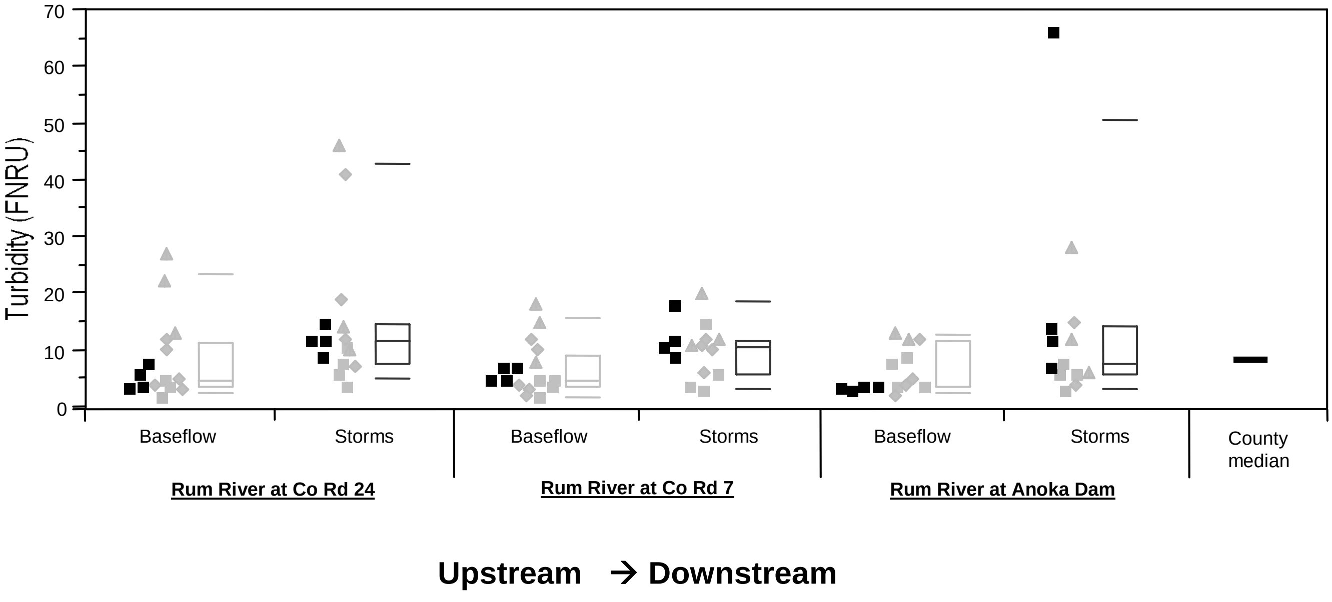
The maximum readings and moderate increases during storms are not unexpectedly high for a large river, and are within the range that should be considered healthy. At the same time, the increase in TSS between County Road 7 and the Anoka Dam during storms is noteworthy. It is not unexpected given the more dense land development between these two sites, but also speaks to the effectiveness of stormwater management practices like settling ponds. The river's water quality is in good condition, likely due in part to these practices, however they do not eliminate all impact. 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.

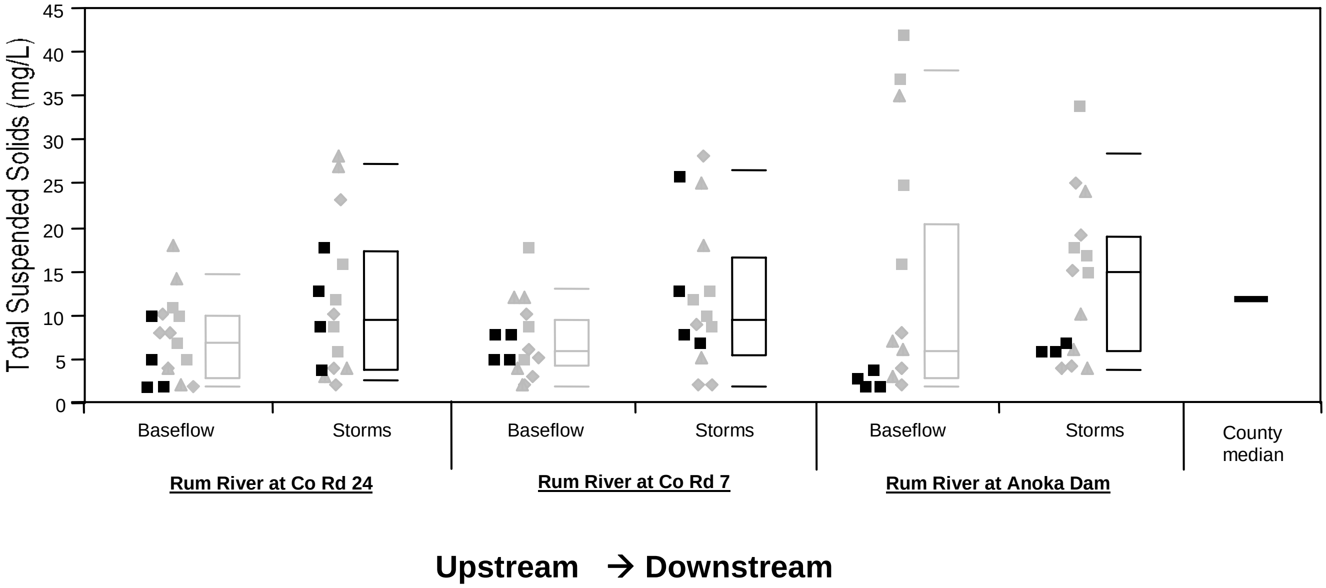
In 2011 TSS during storms was very low at the two farthest downstream monitoring sites, and this is likely due to hydrologic conditions. The first half of 2011, when our storm samples were taken, was an extremely wet period. River levels were chronically high. While we did sample immediately following storms, the runoff from that storm was a relatively low percentage of overall flow. Because TSS was low during these periods of very high flow, sediment from the stream bed and bank erosion is relatively low in the Rum River. Sediment carried by storm runoff is the larger source of suspended solids.

It should be noted that the data presented here do not include monitoring of any large flood events. The water is known to become muddier during such floods.

Turbidity during baseflow and storm conditions Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



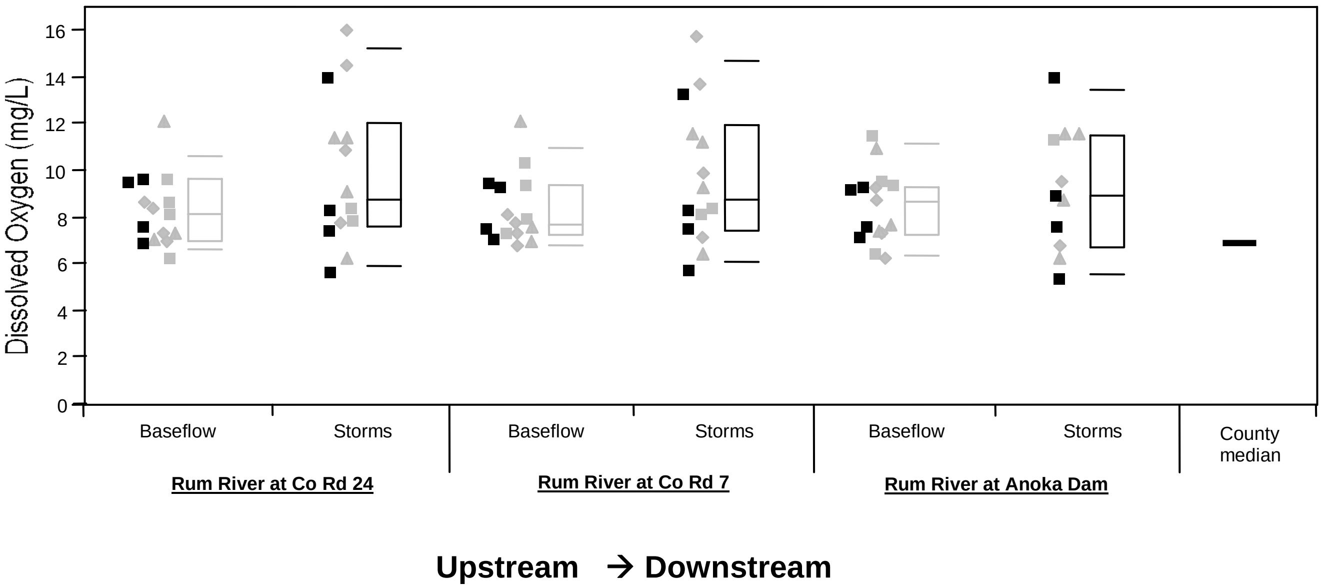
Total suspended solids during baseflow and storm conditions Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Dissolved Oxygen

Dissolved oxygen 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 Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

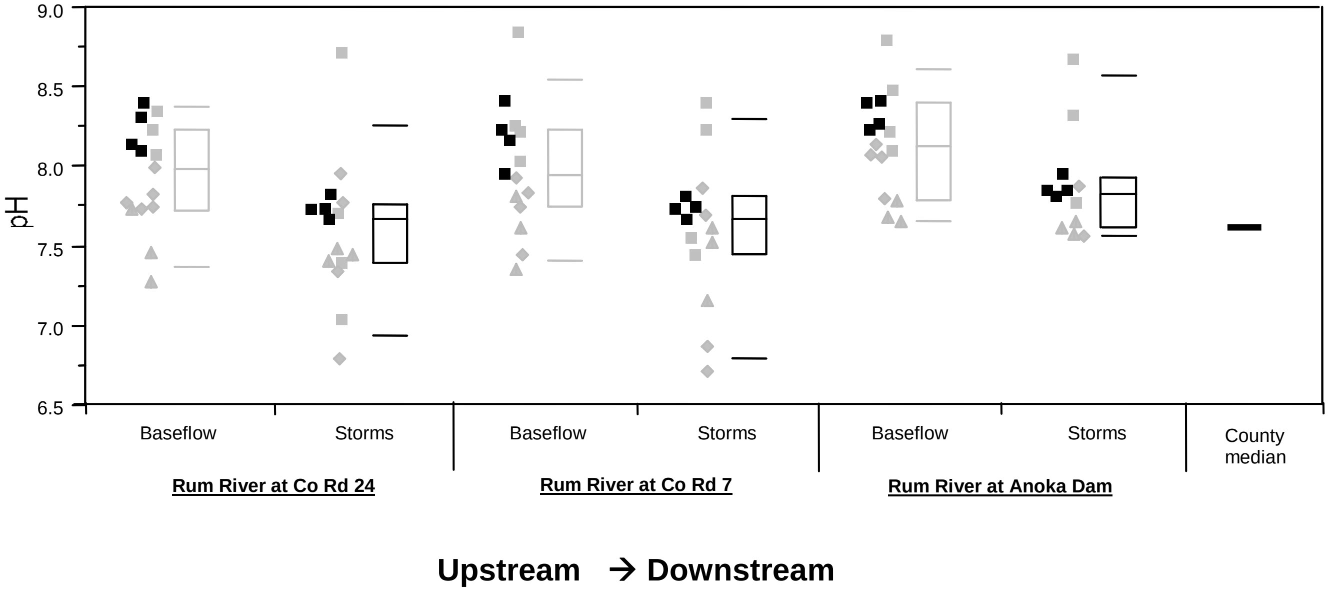


pH

pH 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). Each of the three sites exceeded 8.5 on one occasion, but the highest was only 8.85. This rare and modest exceedance of the state water quality standard is not concerning.

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 Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. 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 some deterioration in the downstream areas that are most developed. 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. Measures to maintain the Rum River's good water quality should include:

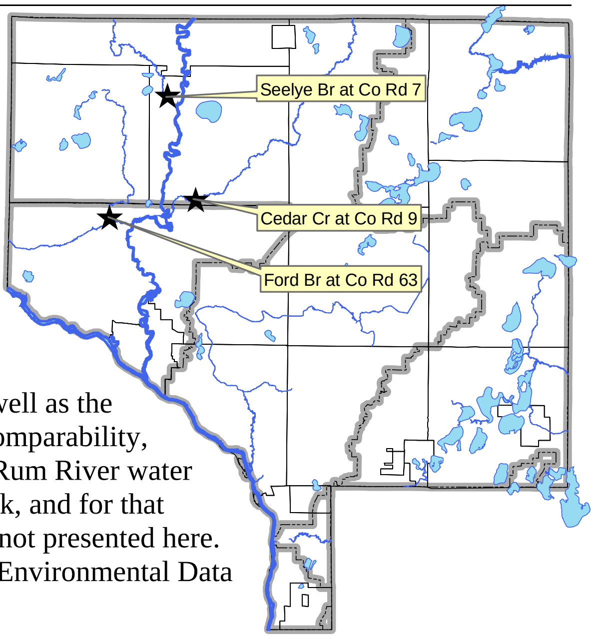
- Enforce the building and clear-cutting setbacks from the river required by state scenic rivers laws to avoid bank erosion problems and protect the river's scenic nature.
- Use the best available technologies to reduce pollutants delivered to the river and its tributaries through the storm sewer system. Any new development should consider low impact development strategies that minimize stormwater runoff production. Aggressive stormwater treatment should be pursued in all areas of the watershed, not just those adjacent to the river. The area's soils are well suited to stormwater treatment by infiltration.

- Seek improvements to the existing stormwater conveyance system below County Road 7. Total suspended solids in the river increase in this portion of the watershed during storms.
- Utilize all practical means to reduce road deicing salt applications. These may include more efficient application methods, application only in priority areas, alternate chemicals, or others. Road salt infiltration into the shallow groundwater has become a regional problem. Deicing salts are apparent year-round in the groundwater that feeds area streams.
- Survey the river by boat for bank erosion problems and initiate projects to correct them. Both the Lower and Upper Rum River Watershed Management Organizations, which serve Anoka County, have completed this work. It should be periodically repeated.
- Continue education programs to inform residents of the direct impact their actions have on the river's health.
- Continue regular water quality monitoring. A reasonable baseline of four years of data that has been collected, so future monitoring every 1-3 years seems reasonable. Frequency of monitoring should be most frequent in the next few years and following any major projects that might positively or negatively impact the river. Additionally, periodic monitoring of the primary tributary streams should also occur every 2-3 years. Coordinating simultaneous monitoring across communities and watershed organizations is highly desirable.
- Investigate E. coli bacteria. In 2011 the MPCA sampled for E. coli at the outlet of the Rum River into the Mississippi River. They found levels that exceeded state standards. It is unknown how much of the Rum River's length might be declared "impaired" based upon this data. It is desirable to do additional bacteria monitoring upstream to define the extent of the problem. Bacteria is a difficult pollutant to reduce.
- Engage the entire watershed. To date, most efforts to monitor the Rum River have occurred in Anoka County by the Upper and Lower Watershed Management Organizations. This is the farthest downstream part of the watershed. A broader scale effort is needed to protect the river. Strong encouragement from already-active partners is needed to engage those who are inactive.

Stream Water Quality Monitoring

SEELYE BROOK, CEDAR CREEK, AND FORD BROOK

Seelye Brook at Co Rd 7 (Roanoke St), St. Francis	STORET SiteID =	S003-204
Cedar Creek at Co Rd 9 (Lake George Blvd), Oak Grove	STORET SiteID =	S003-203
Ford Brook at Co Rd 63 (Green Valley Rd), Ramsey	STORET SiteID =	S003-200



Years Monitored (# occasions)

Seelye Brook at Co Rd 7 – 1998 (4), 2002 (2), 2005 (2), 2011 (8)

Cedar Creek at Co Rd 9 – 1998 (4), 2002 (1), 2003 (1), 2005 (2), 2006 (8), 2011 (8)

Ford Brook at Co Rd 63 – 1998 (4), 2001 (9), 2002 (1), 2003 (8), 2004 (1), 2005 (2), 2006 (1), 2011 (8)

Years Reported

This report analyzes only data from 2011 when all three sites, as well as the Rum River, were monitored simultaneously. This allows direct comparability, and examination of whether these tributaries improve or degrade Rum River water quality. The analysis also examines the water quality in each creek, and for that purpose may occasionally refer to pre-2011 data that is otherwise not presented here. All data, including pre-2011 data, is available through the EQuIS Environmental Data Access tool on the MN Pollution Control Agency website.

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. Within the Upper Rum River Watershed Management Organization (URRWMO), three majoro tributaries drain to the Rum River, including Seelye Brook, Cedar Creek, and Ford Brook.

Limited monitoring has been done to determine water quality in these creeks, and they have never been compared to the Rum River to determine whether positively or negatively impact the river's water quality. In 2011 all three tributaries and the Rum River were monitored simultaneously so that direct comparisons can be done without confounding factors.

Methods

In 2011 monitoring was conducted at the bottom of each creek's watershed, as well as in the Rum River at the top and bottom of the URRWMO. The Anoka Conservation District did the field work at all sites ensuring simultaneous monitoring and consistent methods. Eight water quality grab samples were taken; 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. 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, sulfates, and hardness. Water level was recorded during each monitoring event with a surveyed staff gauge. Water level and flow for the Rum River was obtained from the US Geological Survey, who maintains a hydrological monitoring site at Viking Boulevard.

2011 was a year of weather extremes. Spring and early summer were characterized by record rainfall and continuously high flows. All storm sampling happened during this period. Beginning in August, there were record low rainfalls and stream flows were low. All baseflow monitoring happened during this period.

The data analysis in this report displays only 2011 data. This is because 2011 was the only year when all the creeks were monitored simultaneously with the Rum River for direct comparability. This allows us to examine whether inflows from each creek are a positive or negative impact on the river, as well as compare the creeks to each other. In this report there is also discussion of each creek's water quality, and for that purpose pre-2011 data is periodically referenced.

Results and Discussion

On the following pages data are presented and discussed for each parameter. The last section outlines management recommendations.

Conductivity and chlorides

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 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. They can also be of concern because the Rum River is upstream from the Twin Cities drinking water intakes on the Mississippi River.

Conductivity in each of the tributaries was typical for local streams, but higher than in the Rum River. The median for streams in Anoka County is 0.362 mS/cm. The median value in 2011 for Seelye, Cedar, and Ford Brooks were 0.339, 0.323, and 0.350 mS/cm, respectively. If we look at all the available data from each stream, including non-2011, the medians are similar. Generally, this is acceptably low. However, conductivity in the Rum River before these tributaries enter it averages 0.230 mS/cm, or approximately one-third lower.

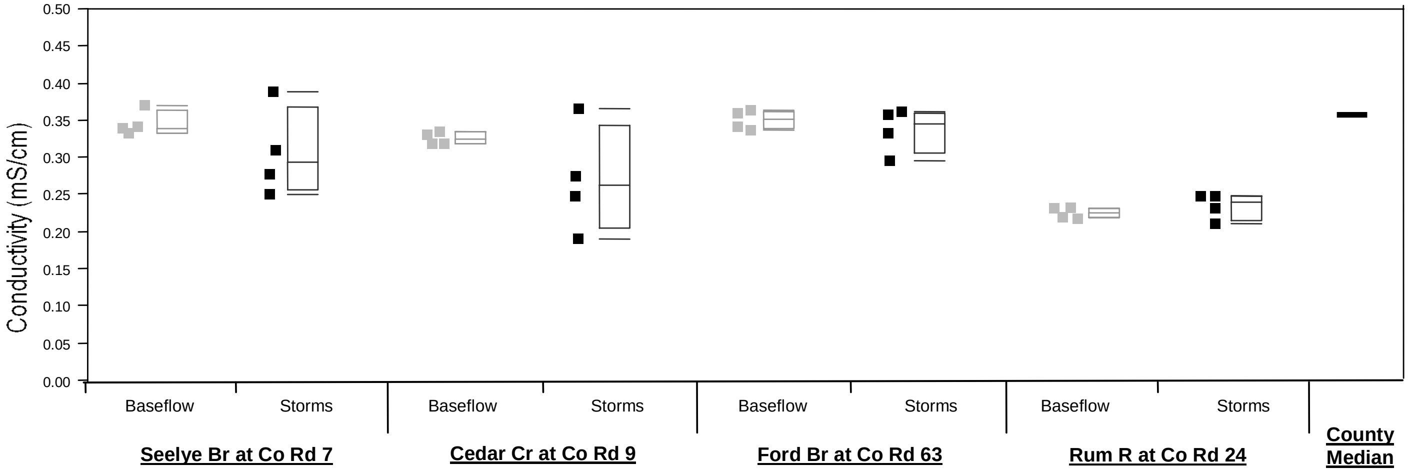
Conductivity in all the streams was similar during baseflow and stormflow, but more variable during storms. Higher variability during storms is expected, as storms vary in intensity and the amount of runoff generated. However it is notable that the median conductivity all the streams was slightly lower during storms. This suggests that surface runoff is not always the source of dissolved pollutants. Groundwater contributions to flow during baseflow may be a more important source of dissolved pollutants.

Chlorides in these streams were often higher than the median for Anoka County streams, double that of the Rum River, but well below the MCPA's chronic water quality standard of 230 mg/L. The median chloride for Anoka County streams is 17 mg/L. Median chloride in Seelye, Cedar, and Ford Brooks were 25, 29, and 22 mg/L, respectively. The median in the Rum River was less than half, at 11 mg/L. Looking at all readings from all years, the medians are slightly lower in the streams (18-22 mg/L) but identical in the Rum River.

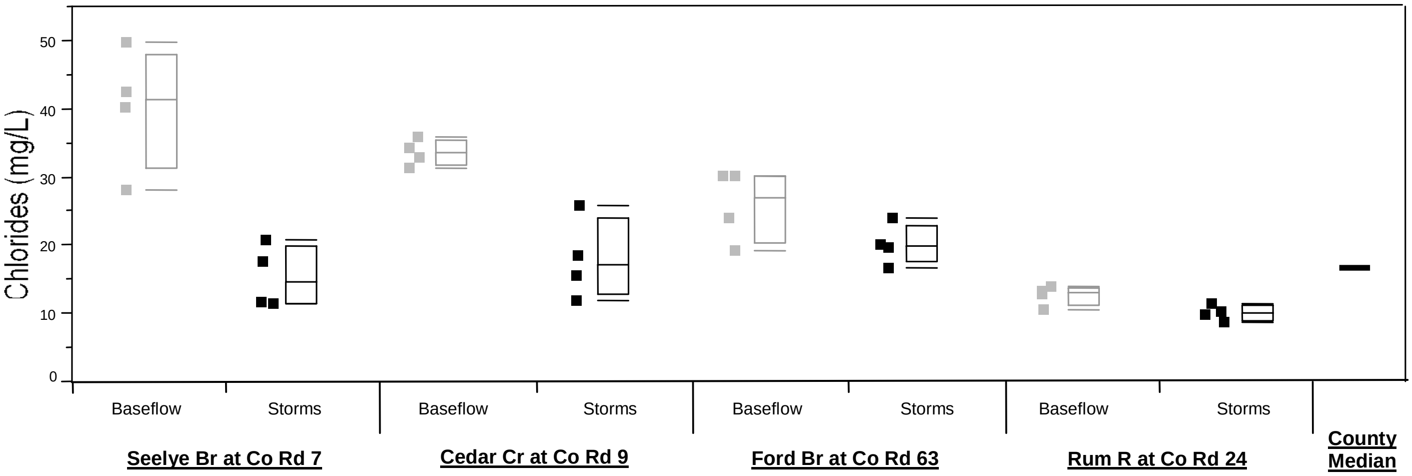
Conductivity was lowest at all sites during storms, suggesting that stormwater runoff contains fewer dissolved pollutants than the surficial water table that feeds the river during baseflow. At Cedar and Seeyle Brooks the baseflow chlorides were more than double that of storms. At Ford Brook the difference was much less, and only the slightest difference between storms and baseflow was observed in the Rum River. High baseflow conductivity and chlorides has been observed in most other nearby streams, 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. We speculate that differences in chlorides among the streams probably are due to road densities in their subwatersheds and subwatershed size.

Overall, dissolved pollutants in Seelye, Cedar, and Ford Brooks are relatively reasonably low, but 33-50% higher than in the Rum River. All well below the levels at which stream biota is negatively affected. The most important management strategy to reduce dissolved pollutants is to reduce road deicing salt application to the greatest degree practical. Trainings for public works employees are available from the University of Minnesota and others.

Conductivity during baseflow and storm conditions Baseflow data is in grey, storm data is black. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Chloride during baseflow and storm conditions Baseflow data is in grey, storm data is black. 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 is the nutrient most responsible for eutrophication (excessive algal growth) in freshwaters. Eutrophication is problematic for recreational uses of waterbodies, and decomposition of the excessive growth can deplete dissolved oxygen that fish and other aquatic life require. The Minnesota Pollution Control Agency is developing phosphorus standards for rivers; the recommended upper limit for rivers in this region is 100 ug/L.

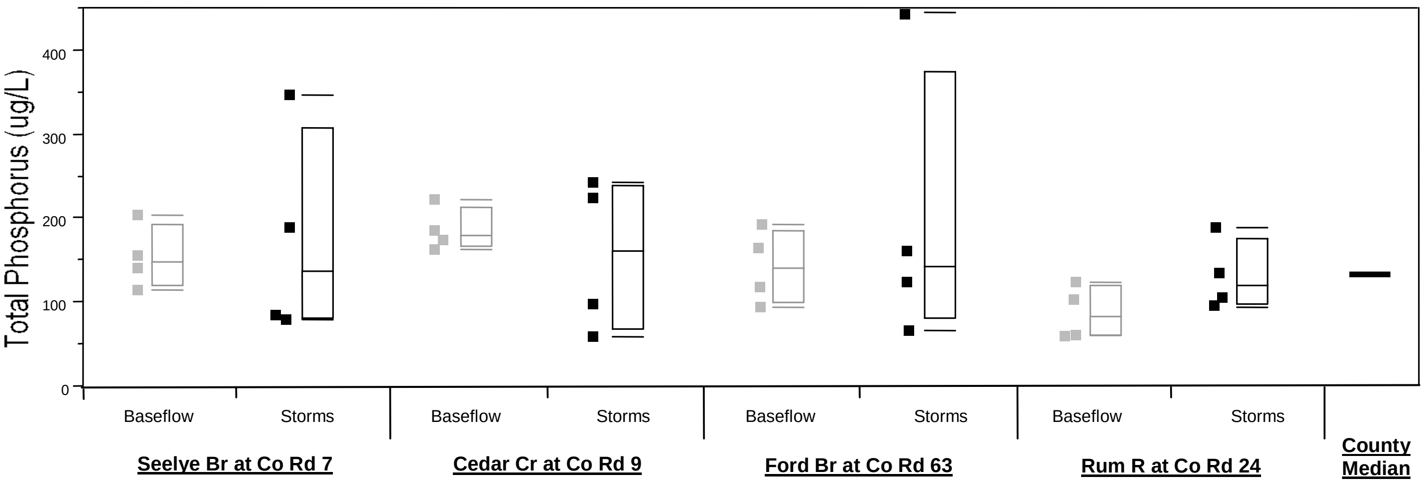
Total phosphorus in these streams, as well as the Rum River, was often above 100 ug/L. The streams had slightly higher phosphorus than the River. The median total phosphorus in Seelye, Cedar, and Ford Brooks was 129, 144, and 145 ug/L, respectively, while for the Rum River it was 106 ug/L. Likewise, the maximums recorded at each stream in 2011 were higher than the Rum River. The maximum phosphorus at Seelye, Cedar, and Ford Brooks was 348, 245, and 448 ug/L, respectively, while for the Rum River it was 191 ug/L.

For the streams, median total phosphorus was similar during base and storm flows but levels were much more variable during storms. The higher variability during storms is expected, as the magnitude and nature of storms varies. It is noteworthy that in the Rum River phosphorus was slightly higher during storms than baseflow (84 vs 122 ug/L).

All three streams appear to have relatively similar total phosphorus, though this is difficult to determine from just eight readings in 2011. If we look at all years, there is slightly more data – 12 total readings for Seeyle Brook, 20 for Cedar Creek, and 29 for Ford Brook. Using this data, the median phosphorus in Seelye Brook was 129 ug/L, in Cedar Creek was 144 ug/L, and in Ford Brook was 145 ug/L. There is no large or apparent difference. While the median for Seeyle Brook is lowest, this is also the site with the fewest readings.

Overall, total phosphorus in Seelye, Cedar, and Ford Brooks are slightly elevated and approximately 35-71% higher than in the Rum River. The median phosphorus levels seen in each of these streams is only slightly higher than the median for all Anoka County streams (135 ug/L).

Total phosphorus during baseflow and storm conditions Baseflow data is in grey, storm data is black. 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. The turbidity and TSS results for these streams are similar.

Seelye Brook stands out for having lower turbidity and TSS than the other streams or the Rum River. Median turbidity and TSS in Seelye Brook were 5 FNRU and 5.5 mg/L, respectively, in 2011. It was similar during base and storm conditions. Looking at other years of data there were a total of 12 readings, but the median values were the same as the 2011 medians.

Ford Brook had the next lowest turbidity and TSS. Median turbidity and TSS in Ford Brook were 11.5 FNRU and 8.5 mg/L, respectively, in 2011. Like Seelye Brook, readings were similar during base and storm conditions. Using all years' data (nearly 30 observations), the median turbidity was 7 FNRU and the median TSS was 10 mg/L, similar to in 2011 alone.

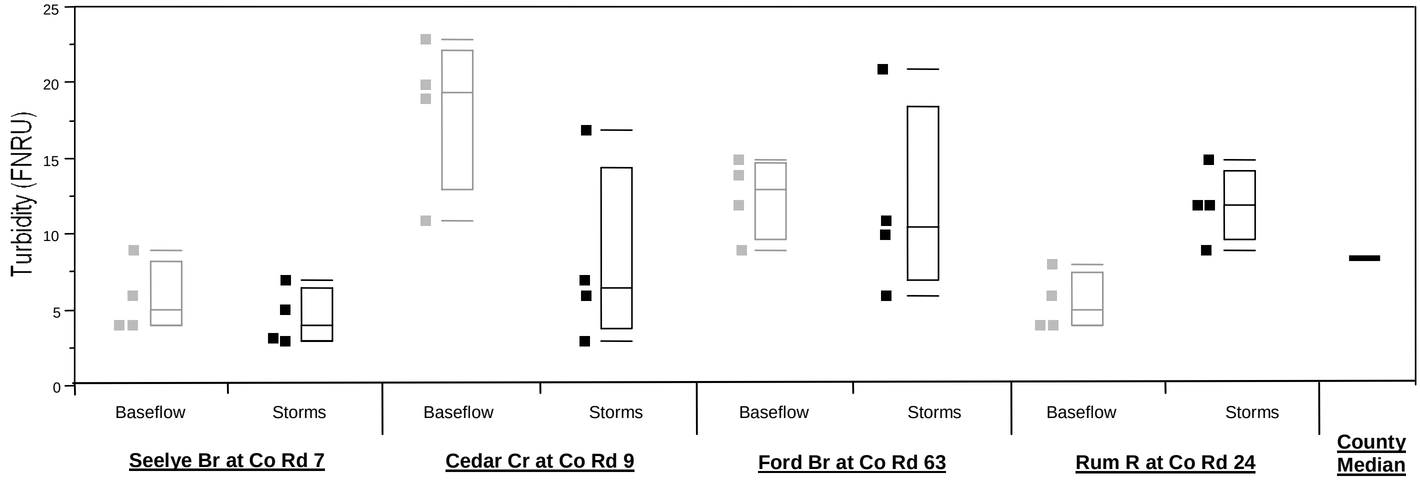
Cedar Creek had the highest turbidity and TSS of these streams, but it was not excessively high. Median turbidity and TSS were 14 FNRU and 15 mg/L, respectively, in 2011. Using all years' data (nearly 20 observations), the median turbidity was 8 FNRU and the median TSS was 12 mg/L.

None of these streams approaches or exceeds state water quality standards for total suspended solids or turbidity. The state standard for turbidity is violated when three observations, and at least 10% of all observations are >25 NTU. In 2011 none of the observations at any of these streams exceeded 25 NTU. The highest was 23 in Cedar Creek. Looking at all years of available data, Cedar Creek exceeded turbidity of 25 NTU two of 24 occasions, Ford Brook one of 32 occasions, and Seelye Brook zero of 16 occasions. The Rum River also has low turbidity, exceeding 25 NTU in only three of 47 monitoring occasions.

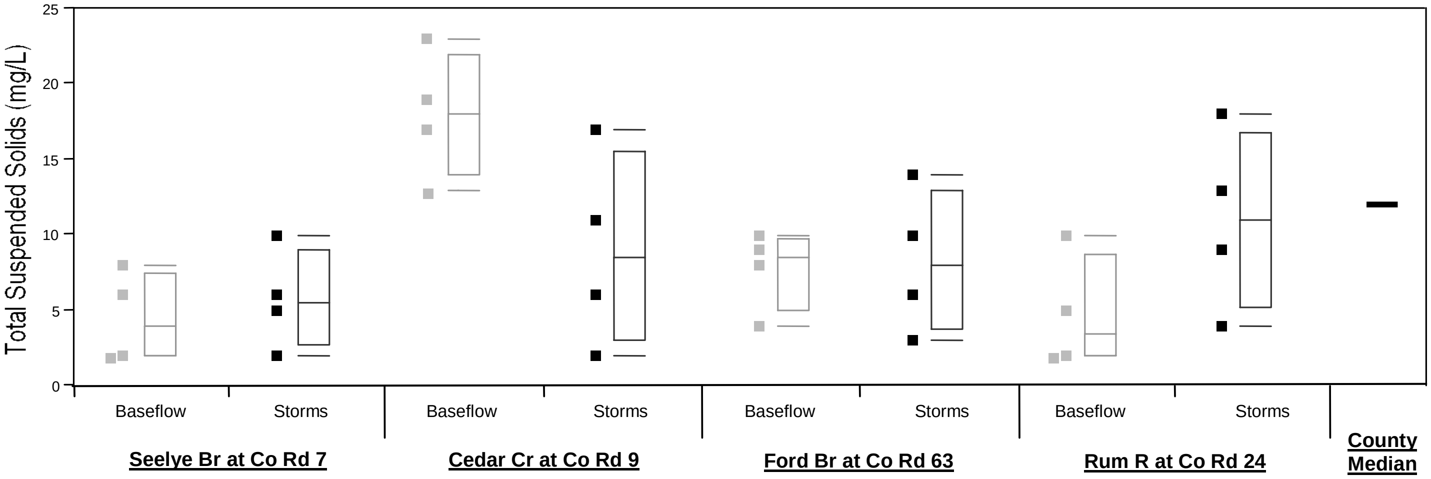
When turbidity data is lacking, the MPCA has a surrogate water quality standard for TSS of 100 mg/L. The maximum observed at any of these streams in 2011 was 23 mg/L. Examining all years of data at all the sites the maximum TSS observed was 74 mg/L at Ford Brook. It is clear that none of these streams is impaired, nor close to being impaired, for excessive turbidity or suspended solids.

In comparison to the Rum River, Seelye Brook has lower suspended solids while Ford and Cedar Creeks have more. In 2011 median turbidity and TSS in the Rum River at County Road 24 were 8.5 FNRU and 7 mg/L. In 2011 Ford Brook's median turbidity was 23% greater than the Rum River, and Cedar Creek's was 65% greater. Median turbidity in each stream was more than double that of the Rum River. It is important to keep in mind that these percentages are large in part because we are dealing with relatively small numbers. While we should strive to make sure these streams do not contribute to degradation of the Rum River, we must also note that their water quality is not excessively poor.

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



Dissolved Oxygen

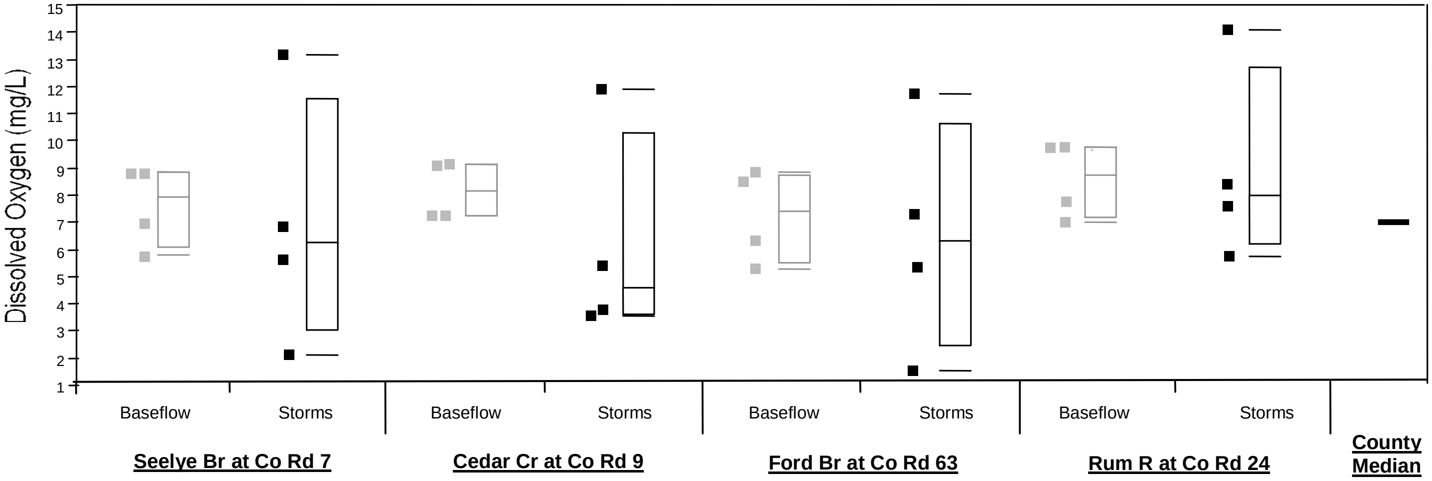
Dissolved oxygen (DO) is necessary for aquatic life, including fish. Organic pollution consumes oxygen when it decomposes. If oxygen levels fall below 4 mg/L aquatic life begins to suffer.

In the Rum River dissolved oxygen was always above 5.5 mg/L at all monitoring sites, however it occasionally dips lower in each of the tributary streams. All three streams had their lowest observed reading on July 27, 2011, a storm event. At that time, dissolved oxygen in Seelye, Cedar, and Ford Brooks was 2.09, 3.52, and 1.48 mg/L, respectively. This was a period of extended high flows, and a modest storm fell before sunrise on the morning of sampling. Because all streams had their lowest DO on this day, climatological factors are likely responsible.

If we exclude the lowest DO readings on July 27, 2011, only one other reading below 5 mg/L was observed. Cedar Creek's dissolved oxygen was 3.76 mg/L on June 22, 2011. Looking back through all years of data collected from these sites, there are no other instances if DO below 5 mg/L. It is reasonable to conclude that low dissolved oxygen is not a chronic problem in any of these streams, nor in the Rum River.

Median DO in these tributary streams are similar to that of the Rum River.

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

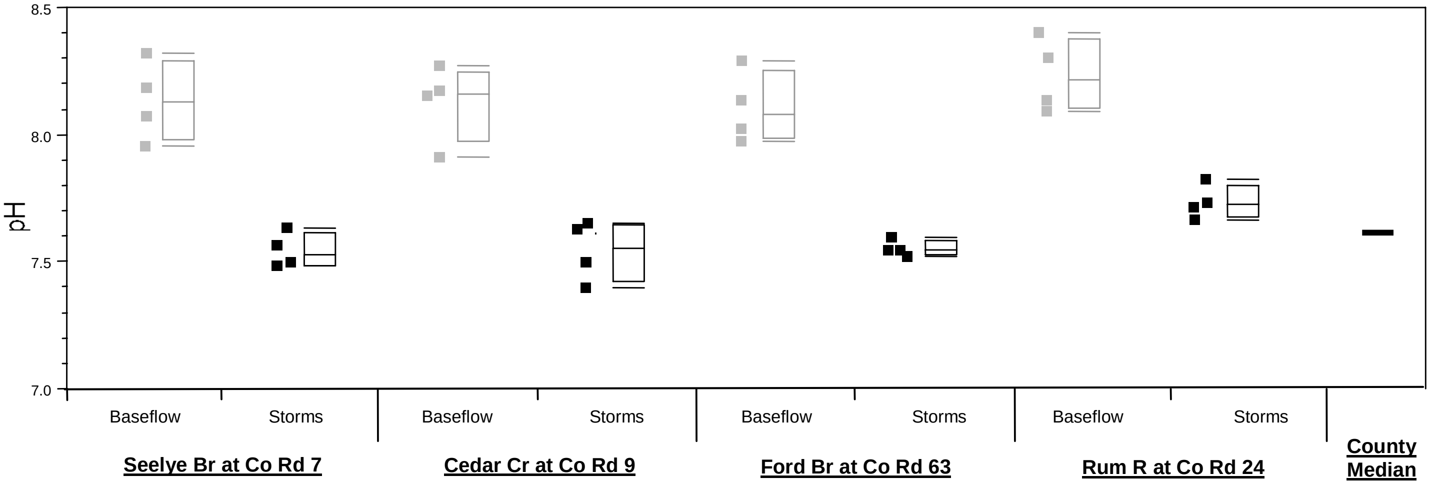


pH

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. Seelye, Cedar, and Ford Brooks, as well as the Rum River, were consistently 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 Baseflow data is in grey, storm data is black. 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

While Seelye, Cedar, and Ford Brooks all generally have good water quality, Seelye Brook stands out for having the best water quality of the three. While dissolved pollutants were similar in all three streams, Seelye Brook had lower phosphorus and suspended solids, the pollutants that are most often of concern in the region. The next best water quality is arguably Ford Brook, although it is similar to Cedar Creek. Ford Brook had slightly lower suspended solids than Cedar Creek.

While water quality is generally good in these streams, it is not as good as the Rum River. The streams have a moderately negative impact on the Rum River when they join it. Conductivity in the Rum River is approximately one-third lower than in the tributary streams. Chlorides in the streams are approximately double that found in the Rum River. Phosphorus is variable among the streams, and 35-71% higher than in the Rum River. Ford Brook's median turbidity was 23% greater than the Rum River, and Cedar Creek's was 65% greater.

While the streams have poorer water quality than the Rum River, monitoring upstream and downstream of the confluences with Seeyle and Cedar Creeks have not found a deterioration in river water quality. The river has been monitored in multiple years at County Road 24 in St. Francis and County Road 7 in Ramsey/Andover to make upstream to downstream comparisons. Between these monitoring sites are the confluence of Seelye and Cedar Creeks with the Rum River. All off the parameters monitored are essentially the same at the two monitoring sites. The exception is a slight increase in conductivity and chlorides.

It is noteworthy that monitoring sites further downstream do find an overall decline in Rum River water quality before and after Ford Brook enters (via Trott Brook). However Ford Brook is not the only influence that might cause this, and likely plays a minor role.

Seelye, Cedar, and Ford Brooks do not violate state water quality standards, with the possible exception of total phosphorus. Currently, the state has not adopted a standard for this parameter, but will do so soon using 100 ug/L. The standard will likely apply to larger rivers, not streams. These streams all exceed 100 ug/L total phosphorus on a regular basis. All the streams are better than the state standards for chlorides, turbidity, total suspended solids, and dissolved oxygen.

Overall, Seelye, Cedar, and Ford Brooks have good water quality, but efforts should be made to improve them for the benefit of the Rum River. Given that degradation of the Rum River is not readily apparent when comparing upstream and downstream of each stream in the river, the urgency for such improvements could be argued. If nothing else, it is clear that a heavy emphasis should be on maintaining the existing water quality whenever new development occurs in the watershed.

Measures that could be used to improve or protect water quality include:

- Minimize road deicing salt applications to the greatest extent possible. Train public works employees in methods for maximizing effectiveness of deicing agent applications.
- Retrofit stormwater treatment practices in areas that are served by curb-and-gutter and were built prior to stormwater treatment requirements.
- Require adequate stormwater treatment for all new development.
- Enforce existing erosion and sediment control rules, as well as scenic river district rules.
- Use a variety of water quality best management practices across the landscape, but particularly in areas with a direct connection to the streams.
- Encourage agricultural operators to adopt best management practices, such as livestock exclusions along waterways and appropriate manure disposal. Many properties with a few horses each exist in the watershed, and they should be using conservation practices to avoid water quality impacts.

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:

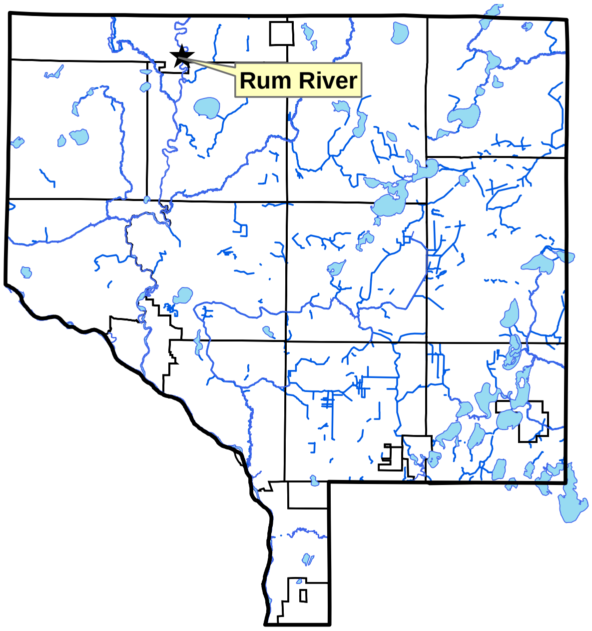
# Families	Number of invertebrate families. Higher values indicate better quality.
EPT	Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.
Family Biotic Index (FBI)	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 2011

Monitored Since

2000

Student Involvement

50 students in 2011, approximately 1,120 since 2000

Background

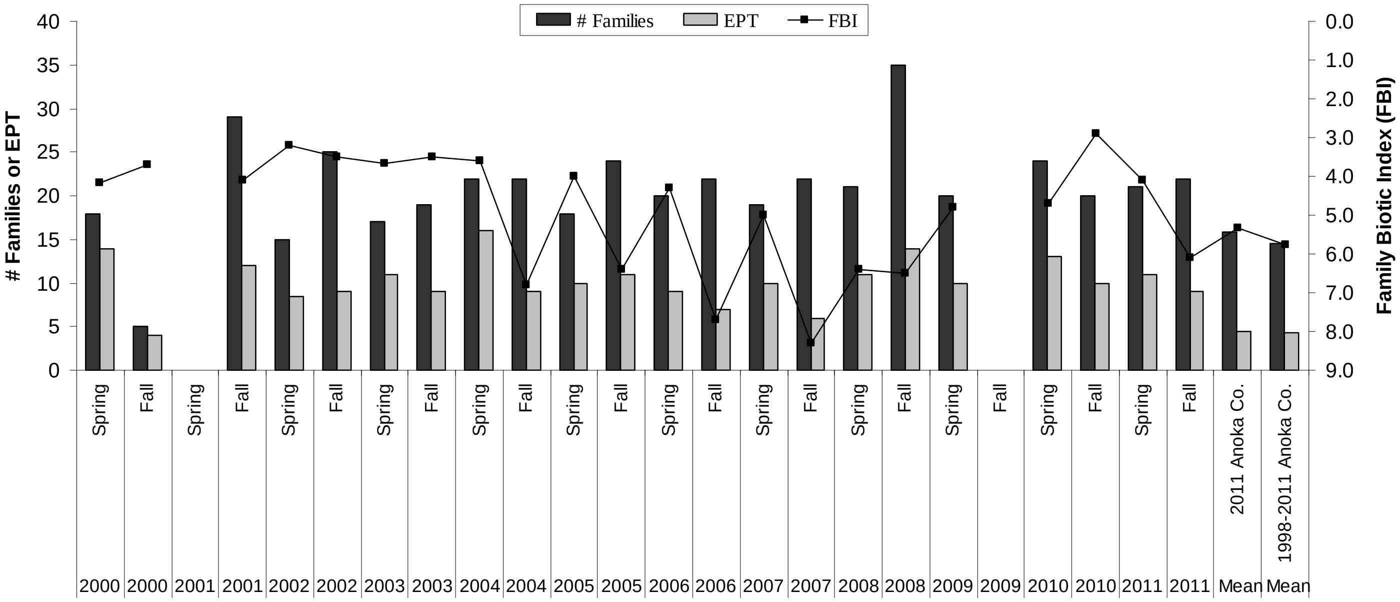
The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. Other than the Mississippi, this is the largest river in the county. In Anoka County the river has both rocky ripples as well as pools and runs with sandy 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 ripple areas.

Results

St. Francis High School classes monitored the Rum River in fall 2011, with Anoka Conservation District (ACD) oversight. ACD staff sampled in spring 2011 when high water persisted past the end of the school year. Biological data for 2011, and historically, indicate the Rum River in northern Anoka County has the best conditions of all streams and rivers monitored throughout Anoka County. In 2011 the number of families and number of EPT families were substantially above the county averages. The Family Biotic Index (FBI) was slightly lower than the county average in fall 2011.

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	2007	2007	2008	2008	2009	2009	2010	2010	2011	2011	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	2011 Anoka Co.	1998-2011 Anoka Co.
FBI	5.00	8.30	6.40	6.50	4.80	Unusable	4.7	2.9	4.1	6.1	5.3	5.8
# Families	19	22	21	35	20	Sample	24	20	21	22	15.8	14.5
EPT	10	6	11	14	10		13	10	11	9	4.4	4.3
Date	16-May	11-Oct	27-May	30-Sep	29-Apr	13-Oct	27-Apr	29-Oct	10-Jun	28-Sep		
Sampled By	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	SFHS	ACD	ACD	SFHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	262	502	348	156	267		142	274	418	443		
# Replicates	2	2	2	4	2		3	1	1	2		
Dominant Family	Hydropsychidae	Corixidae	Corixidae	Corixidae	Corixidae		Nemouridae	Leptophlebiidae	baetidae	hydrophilidae		
% Dominant Family	42.7	58.8	57.5	61.4	24.3		28.1	39.4	66.3	21.4		
% Ephemeroptera	17.2	2	11.9	17.9	18.7		23.9	51.1	81.3	3.6		
% Trichoptera	44.3	1.0	5.9	6.9	20.2		10.8	6.2	6.0	4.3		
% Plecoptera	8.0	0.2	17.1	2.1	27.7		32.8	26.6	3.8	9.7		

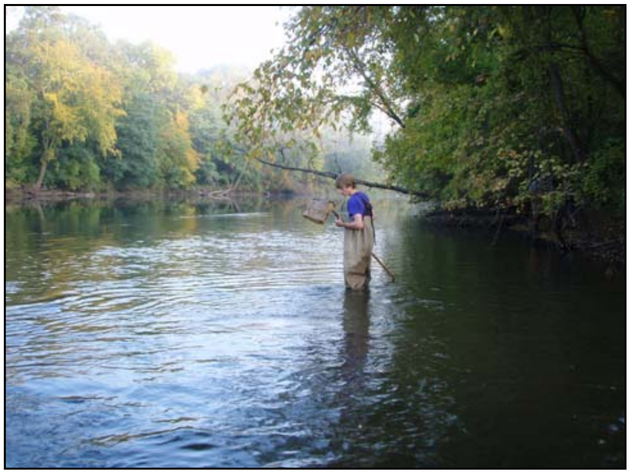
Supplemental Stream Chemistry Readings

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

Parameter	5/16/2007	10/11/2007	5/27/2008	9/30/2008	4/29/2009	10/13/2009	4/27/2010	10/29/2010	4/27/2010	9/28/2011
pH	8.53	7.76	7.73	7.7	7.62	7.87	na	7.51	na	8.35
Conductivity (mS/cm)	0.278	0.242	0.284	0.341	0.266	0.291	0.324	0.249	0.324	0.228
Turbidity (NTU)	11	17	7	4	6	na	2	362	2	362
Dissolved Oxygen (mg/L)	10.34	9.66	10.18	7.83	10.53	12.22	9.14	na	9.14	8.7
Salinity (%)	0.01	0	0.01	0.01	0.01	0.01	0.01	0	0.01	0
Temperature (°C)	16.8	12.3	15.3	13.4	12.2	5.2	12	7.2	12	13.8

Discussion

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



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

- Enforce the building and clear cutting setbacks from the river required by state scenic river laws.
- Use the best available technologies to reduce pollutants delivered to the river and its tributaries through the storm sewer system. This should include all of the watershed, not just those adjacent to the river.
- Education programs to encourage actions by residents that will benefit the river's health.
- Continue water quality monitoring programs.

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

Cedar Creek, Cedar Creek Natural History Area, East Bethel

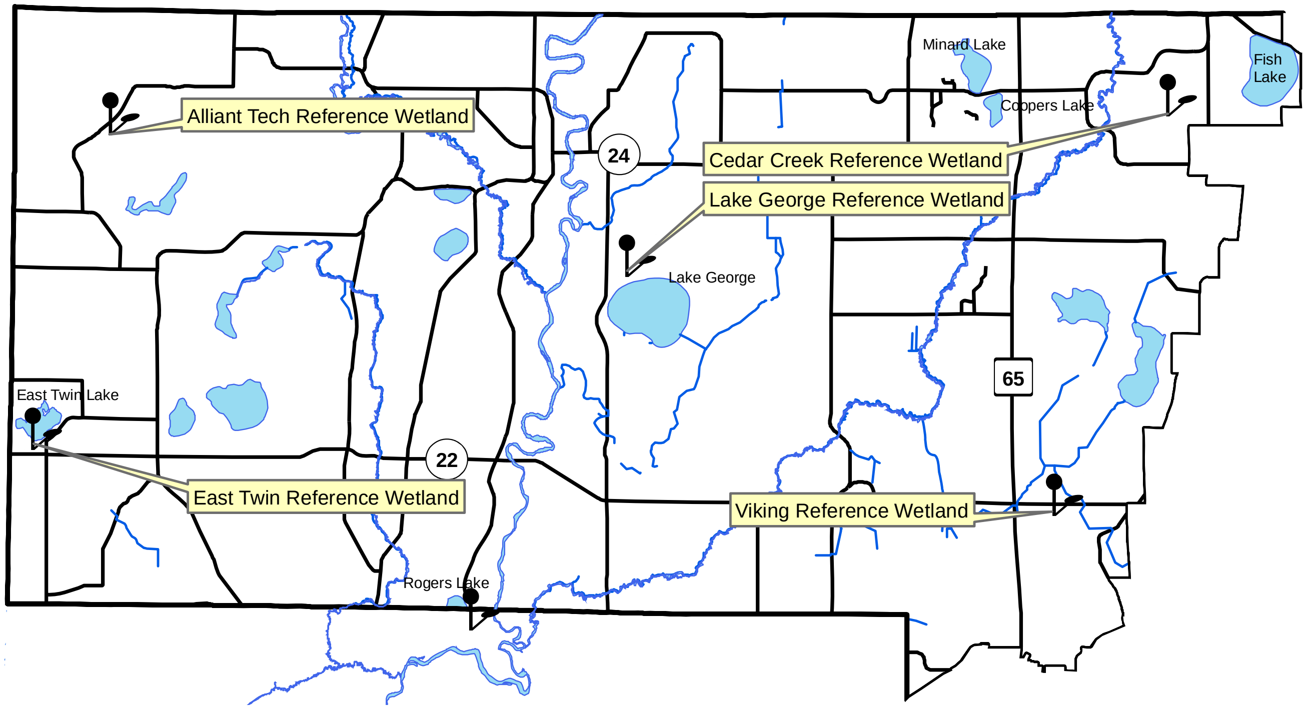
East Twin Reference Wetland, East Twin Township Park, Nowthen

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.

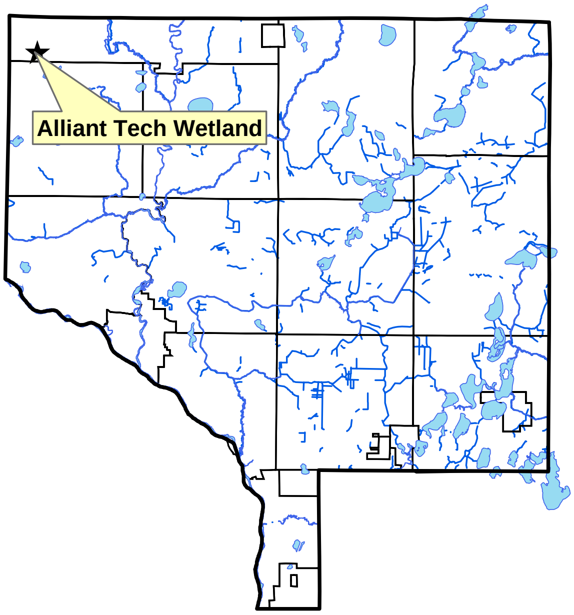
Upper Rum River Watershed Wetland Hydrology Monitoring Sites



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	-

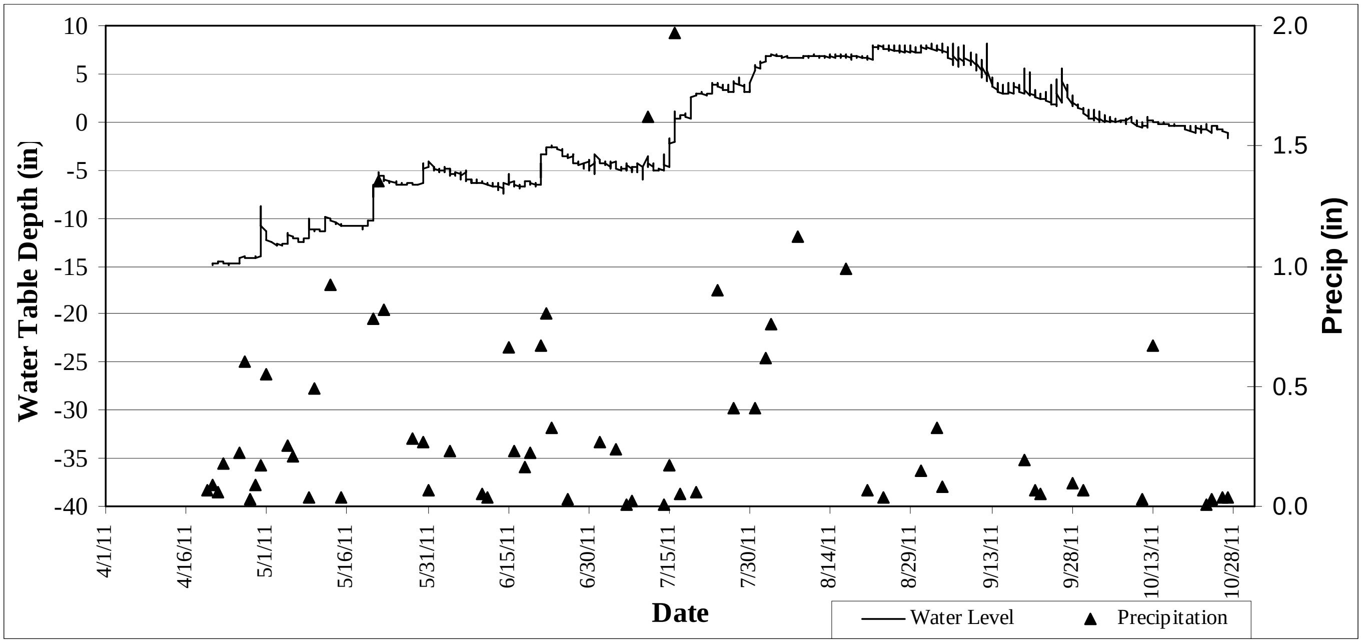
Surrounding Soils: Emmert

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.

2011 Hydrograph

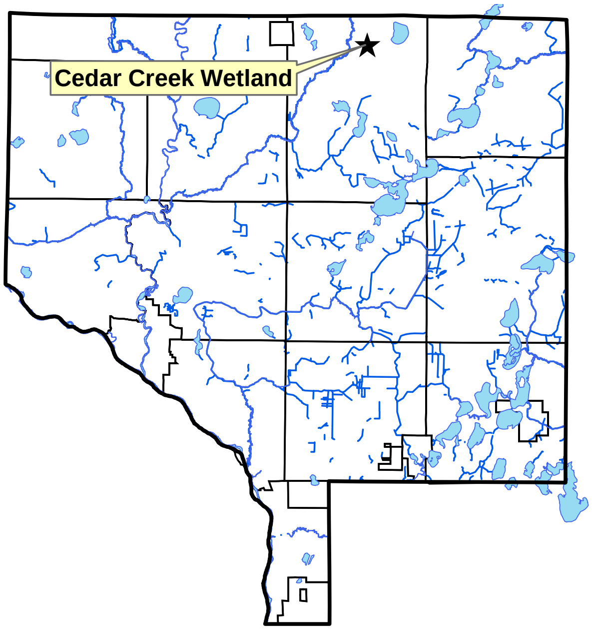


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

CEDAR CREEK REFERENCE WETLAND

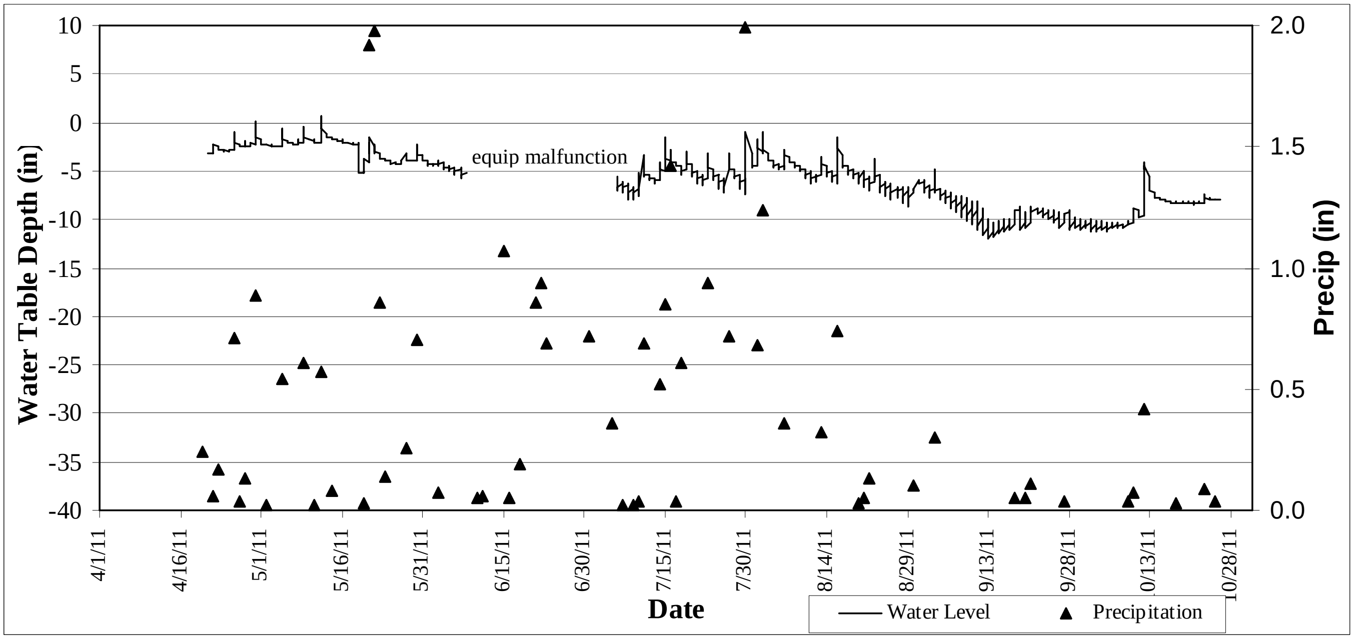
Univ. of Minnesota Cedar Creek Natural History Area, East Bethel



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.

2011 Hydrograph



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

Wetland Hydrology Monitoring

EAST TWIN REFERENCE WETLAND

East Twin Lake Township Park, Nowthen

Site Information

Monitored Since: 2001

Wetland Type: 5

Wetland Size: ~5.9 acres

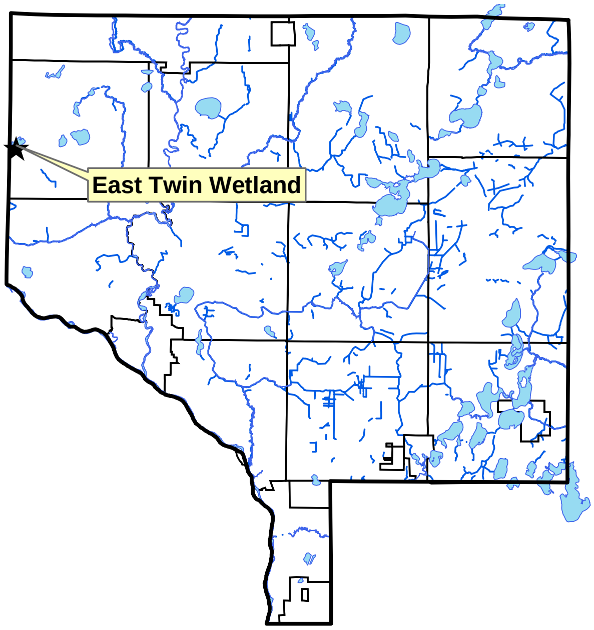
Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

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

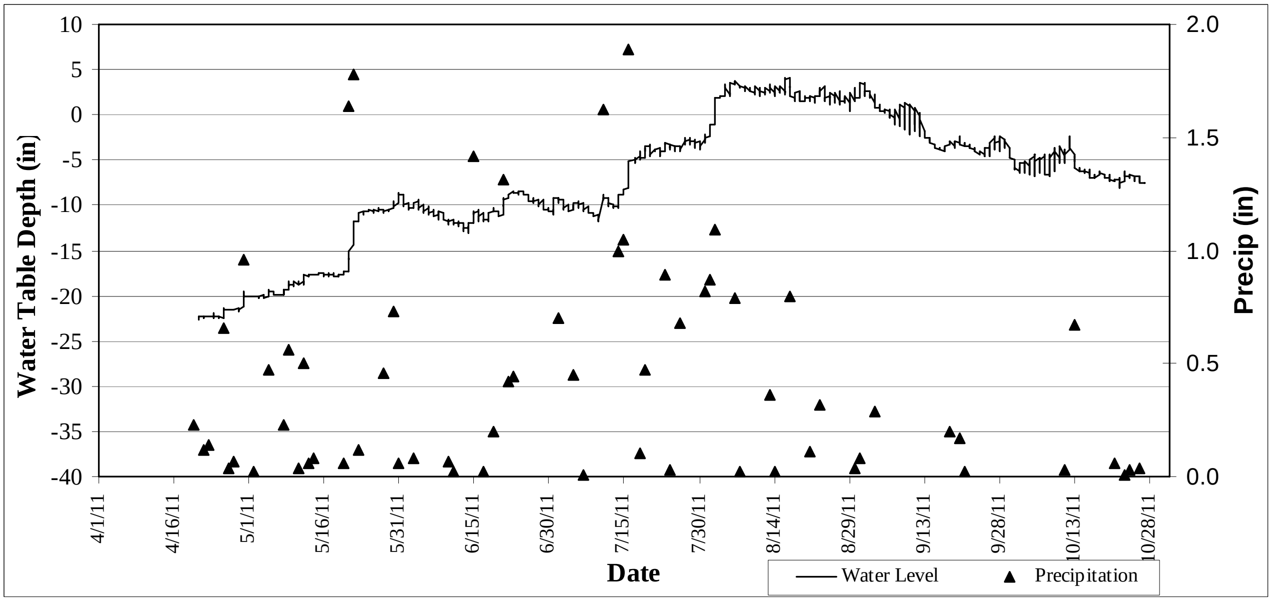


Vegetation at Well Location:

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

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

2011 Hydrograph

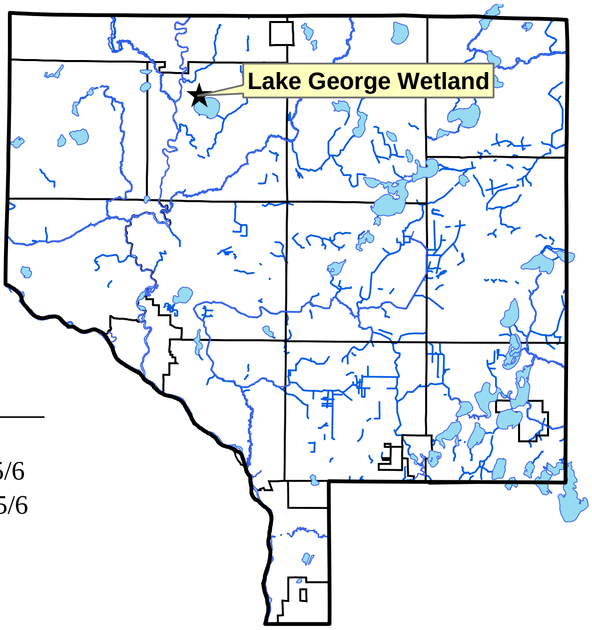


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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

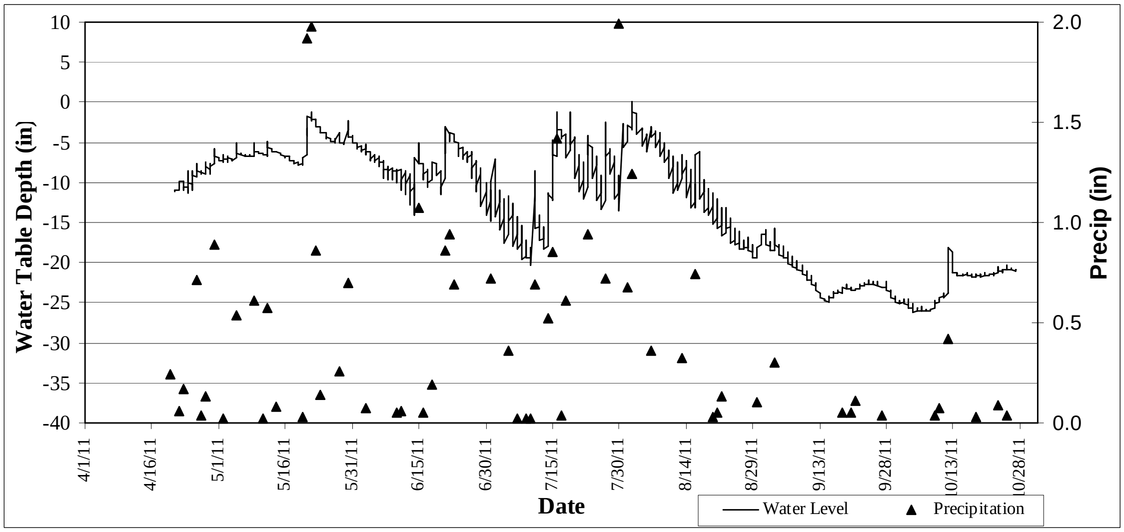
Surrounding Soils: Lino loamy fine sand and Zimmerman fine sand

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.

2011 Hydrograph

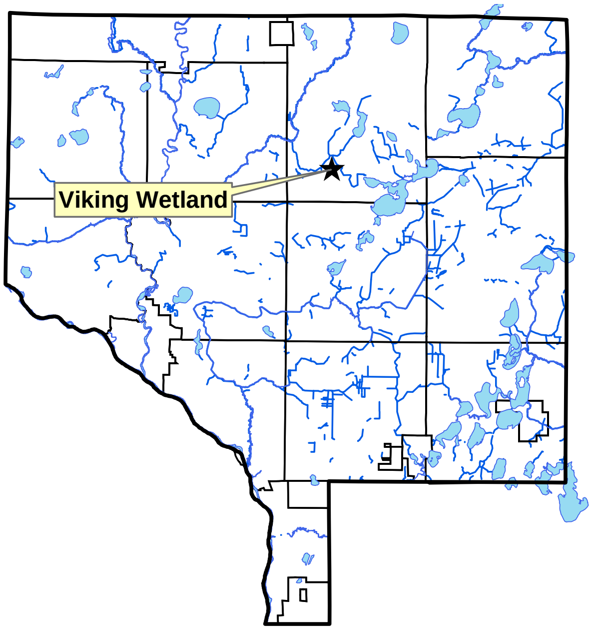


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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

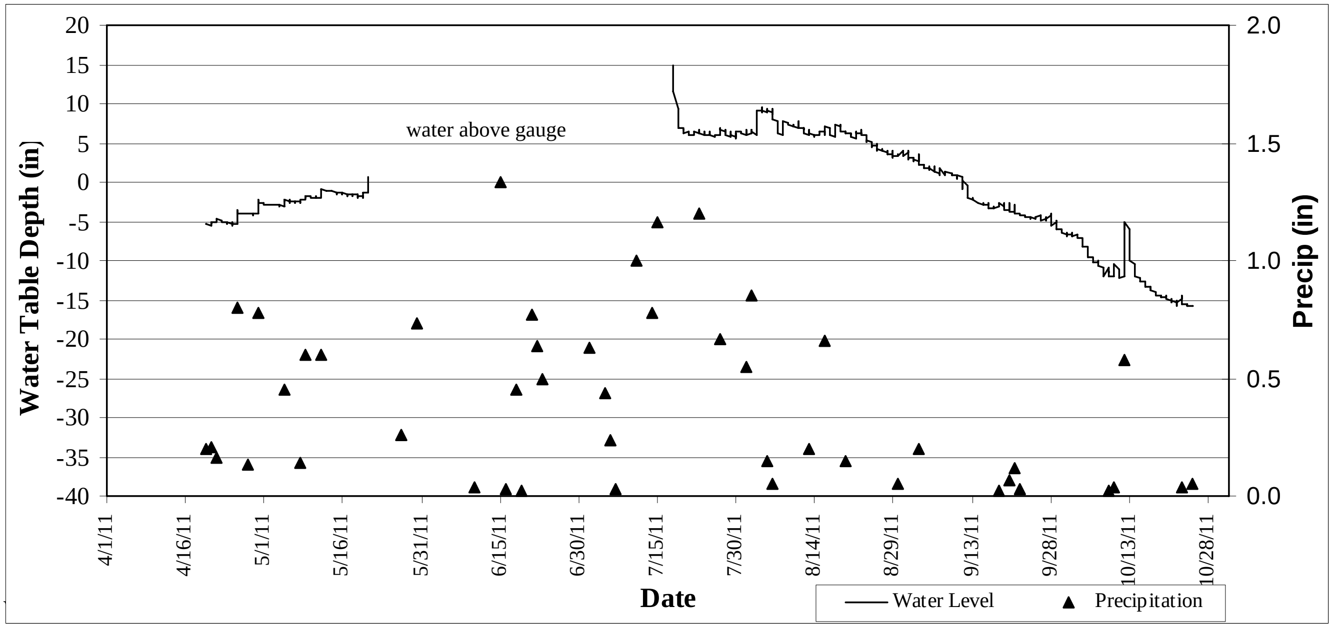
Surrounding Soils: Zimmerman fine sand

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).

2011 Hydrograph



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 provide project consultation and design services at low or no cost, which is highly beneficial for grant applicants. ACD staff also have 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. For example, in 2007 the URRWMO did a customized mailing to 20 homeowners on East Twin and George Lakes who had been identified with erosion problems or likely to develop problems. The ACD mentions the grants during presentations to lake associations and other community groups, in newsletters, and in website postings. In order to promote these types of projects the ACD also assists landowners throughout projects, including design, materials acquisition, installation, and maintenance.

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

Locations: Throughout the watershed.

Results: Projects are reported in the year they are installed. In 2010 installation began on a Crooked Brooked (Ditch 67) streambank stabilization at the Petro Property.

<u>URRWMO Cost Share Fund Summary</u>

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 Petro streambank stabilization (encumbered)	-	$ 76.98
2011 Expenditure Erickson lakeshore restoration (encumbered)	-	$ 371.60
Fund Balance		**$ 1,580.90**

<u>Petro Streambank Stabilization Summary</u>

Full project details are available in the Anoka Conservation District's Annual Water Quality Projects Report.

<u>Brief Description:</u>

Crooked Brook flows to Cedar Creek and eventually the Rum River. The project location is 0.8 miles west of Highway 65 and 0.1 mile south of Viking Boulevard. Prior to the project the stream bank was actively eroding. The project will involve invasive species removal, grading, stabilization using fabrics and biologs, and a buffer planting using native plants. The project serves as an example for neighboring property owners, all of whom mow to the edge of the streambank and have varying degrees of streambank erosion. Project installation began in September 2010 and will conclude in 2011.

<u>Funding sources</u>**:**

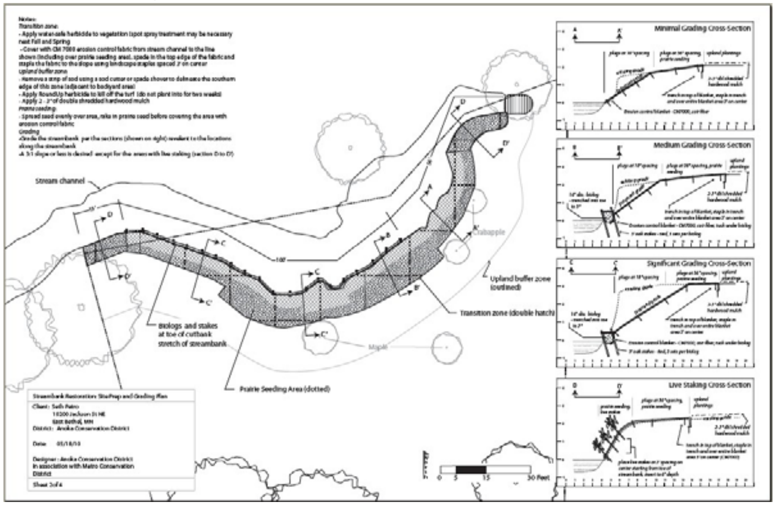
State native buffer cost-share grant	$ 755.33
URRWMO water quality cost share grant	$1,027.51
Landowner	$1,782.85
TOTAL	$3,565.69

<u>In-kind contributions:</u>

Landowners provided labor

Project design was provided by the Anoka Conservation District.

<u>Project Design</u>



<u>Site after grading and stabilization, but before planting</u>

Erickson Lakeshore Restoration Summary

Brief Description:

This project will restore 54 feet of Lake George shoreline with native plants and correct minor erosion. Site is at the bottom of a moderately steep slope on a residential property. This shoreline restoration will provide native plants that filter stormwater runoff to the lake and provide habitat benefits. Habitat benefits will be for all shoreline animals including fish, insects, birds, and others. Because the project includes aquatic plantings the benefits to fish and in-lake ecology are greater.

The landowner is active member of the Lake George Improvement District and plans to promote lakeshore restorations with others who live around the lake.
The project is anticipated to be completed by June 30, 2012.

Funding sources:

URRWMO water quality cost share grant	$ 371.60
Landowner	$ 371.60
TOTAL	$ 743.20

In-kind contributions:
Landowner provides installation labor
Project design was provided by the Anoka Conservation District and landowner

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 website has been in operation since 2003.

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.AnokaNaturalResources.com/URRWMO

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

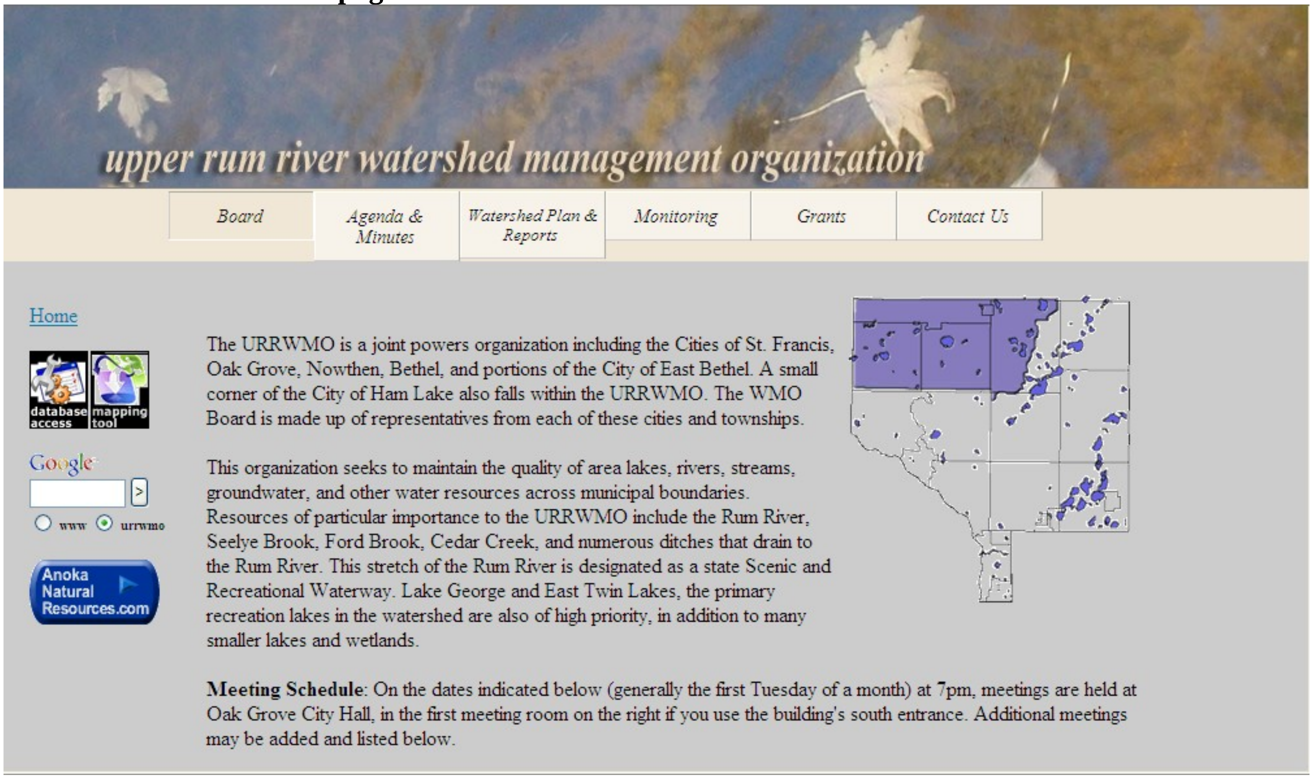
Information about the URRWMO includes:

- 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.

Other tools on the website include:

- an interactive mapping tool that shows natural features and aerial photos
- an interactive data download tool that allows users to access all water monitoring data that has been collected
- narrative discussions of what the monitoring data mean

URRWMO Website Homepage



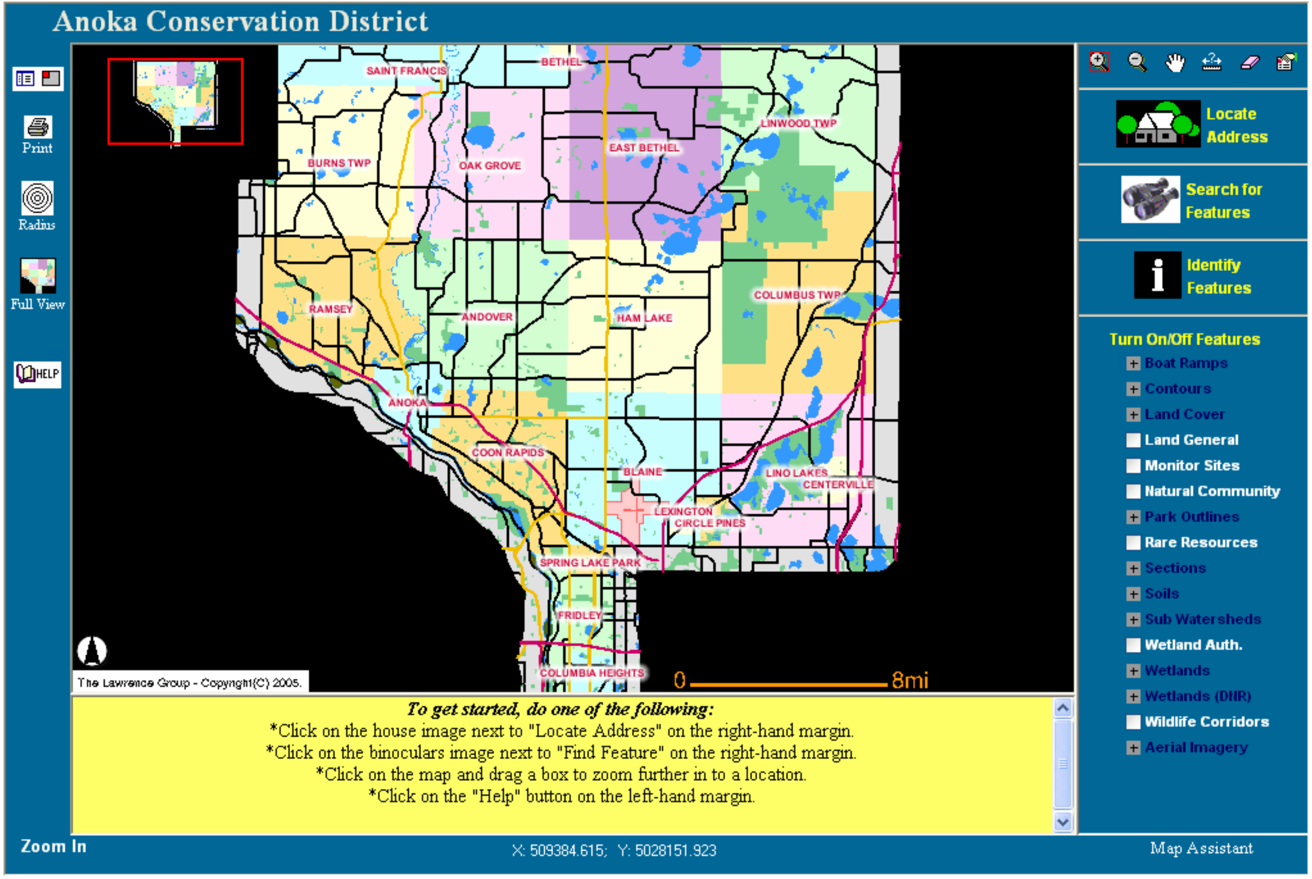
The URRWMO is a joint powers organization including the Cities of St. Francis, Oak Grove, Nowthen, Bethel, and portions of the City of East Bethel. A small corner of the City of Ham Lake also falls within the URRWMO. The WMO Board is made up of representatives from each of these cities and townships.

This organization seeks to maintain the quality of area lakes, rivers, streams, groundwater, and other water resources across municipal boundaries. Resources of particular importance to the URRWMO include the Rum River, Seelye Brook, Ford Brook, Cedar Creek, and numerous ditches that drain to the Rum River. This stretch of the Rum River is designated as a state Scenic and Recreational Waterway. Lake George and East Twin Lakes, the primary recreation lakes in the watershed are also of high priority, in addition to many smaller lakes and wetlands.

Meeting Schedule: On the dates indicated below (generally the first Tuesday of a month) at 7pm, meetings are held at Oak Grove City Hall, in the first meeting room on the right if you use the building's south entrance. Additional meetings may be added and listed below.

more on next page

Interactive Mapping Tool



To get started, do one of the following:

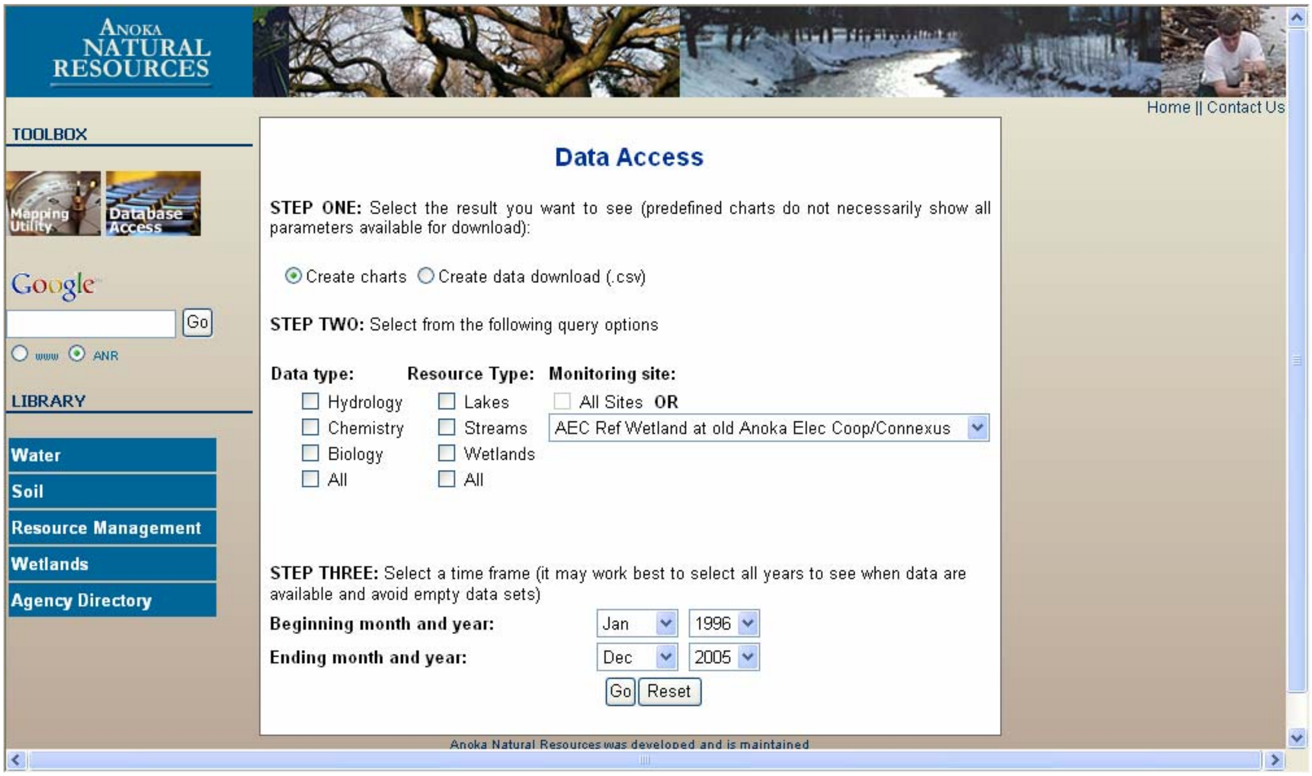
*Click on the house image next to "Locate Address" on the right-hand margin.

*Click on the binoculars image next to "Find Feature" on the right-hand margin.

*Click on the map and drag a box to zoom further in to a location.

*Click on the "Help" button on the left-hand margin.

Interactive Data Access Tool



Data Access

STEP ONE: Select the result you want to see (predefined charts do not necessarily show all parameters available for download):

● Create charts ○ Create data download (.csv)

STEP TWO: Select from the following query options

Data type:
- ☐ Hydrology
- ☐ Chemistry
- ☐ Biology
- ☐ All

Resource Type:
- ☐ Lakes
- ☐ Streams
- ☐ Wetlands
- ☐ All

Monitoring site:
- ☐ All Sites **OR**
- AEC Ref Wetland at old Anoka Elec Coop/Connexus

STEP THREE: Select a time frame (it may work best to select all years to see when data are available and avoid empty data sets)

Beginning month and year: Jan 1996

Ending month and year: Dec 2005

Go Reset

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 provided to each member city, and they will be asked to include it in their city newsletters.

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

Locations: Watershed-wide.

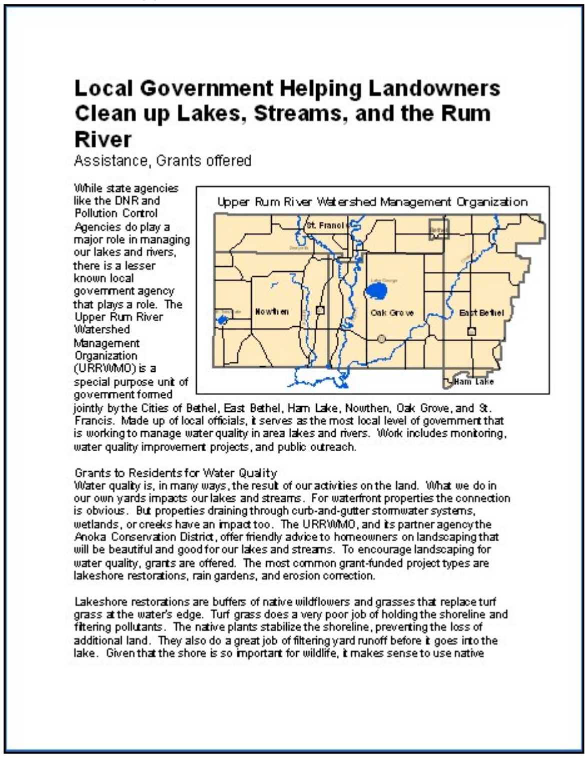
Results: The Anoka Conservation District (ACD) assisted the URRWMO by drafting the annual newsletter article. At their January 5, 2011 the URRWMO discussed topics to be covered in the article. Those contents included:

- a map of the URRWMO area,
- description of the URRWMO role,
- the URRWMO cost share grant program,
- water levels in lakes and wetlands, if drought continues,
- how wetland laws work,
- URRWMO meeting dates and times, website, and a phone number for more information.

On May 20 ACD staff sent a draft to the URRWMO Board for review. The URRWMO Board reviewed and edited the draft article. The finalized article was sent to each member community on June 2, 2011 with a request that they include it in their city newsletter. Additionally, it was sent to the Independent School District 15 publication, “The Courier.”

The ACD received one resident inquiry as a result of this publication. A landowner was concerned about water quality in Seelye Brook and suspected a nearby feedlot as a source of some problems. ACD staff verified the problem, and have since been working with Isanti County and MN Pollution Control Agency staff to correct the situation.

2011 URRWMO Newsletter Article



Local Government Helping Landowners Clean up Lakes, Streams, and the Rum River

Assistance, Grants offered

While state agencies like the DNR and Pollution Control Agencies do play a major role in managing our lakes and rivers, there is a lesser known local government agency that plays a role. The Upper Rum River Watershed Management Organization (URRWMO) is a special purpose unit of government formed jointly by the Cities of Bethel, East Bethel, Ham Lake, Nowthen, Oak Grove, and St. Francis. Made up of local officials, it serves as the most local level of government that is working to manage water quality in area lakes and rivers. Work includes monitoring, water quality improvement projects, and public outreach.

Grants to Residents for Water Quality

Water quality is, in many ways, the result of our activities on the land. What we do in our own yards impacts our lakes and streams. For waterfront properties the connection is obvious. But properties draining through curb-and-gutter stormwater systems, wetlands, or creeks have an impact too. The URRWMO, and its partner agency the Anoka Conservation District, offer friendly advice to homeowners on landscaping that will be beautiful and good for our lakes and streams. To encourage landscaping for water quality, grants are offered. The most common grant-funded project types are lakeshore restorations, rain gardens, and erosion correction.

Lakeshore restorations are buffers of native wildflowers and grasses that replace turf grass at the water's edge. Turf grass does a very poor job of holding the shoreline and filtering pollutants. The native plants stabilize the shoreline, preventing the loss of additional land. They also do a great job of filtering yard runoff before it goes into the lake. Given that the shore is so important for wildlife, it makes sense to use native

plants along much of the shoreline. Most lakeshore projects still leave traditional access to the water for boating, swimming, and fishing.

Rain gardens also filter runoff, but work differently. They are small basins. Usually, they are dry gardens. When it rains, water is directed into the garden, and it fills. The water soaks into the ground within 48 hours, a process that does a great job removing pollutants. An ideal place for a rain garden is next to the street's curb, just uphill from a storm drain. Anything that flows into a storm drain generally ends up in a river, wetland, or lake.

For people who live on a stream or river, bank erosion can be a serious issue. On one hand, it is a loss of property and unsightly. On the other hand, it is adding sediment to the river that hurts water quality. Some erosion occurs naturally, but more significant erosion demands attention. The Anoka Conservation District and URRWMO assist homeowners with correcting this streambank erosion.

The URRWMO competitive grants can cover 50-70% of materials for a project. The landowner is responsible for the remainder, plus the labor. Advice and design assistance is available through the Anoka Conservation District. A competitive grant application process is open as long as funds are available. More information and application materials are available at www.anokaswcd.org/fin_assist/acd_wq_share.htm or contact Jamie Schurbon at 763-434-2030 ext. 12.

To learn more about these types of projects, see the brochures at http://www.anokaswcd.org/acd/tech_assist/brochures/brochures.htm

A lakeshore restoration with native plants.

A rain garden during a rain storm.

Bank erosion along the Rum River.

URRWMO 2010 Annual Report to BWSR

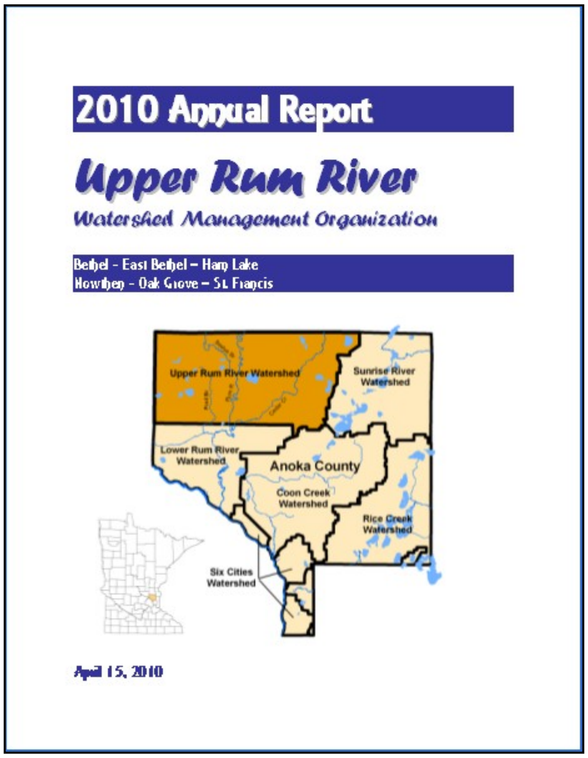
Description: The Upper Rum River Watershed Management Organization (URRWMO) is required by law to submit an annual report to the Minnesota Board of Water and Soil Resources (BWSR), the state agency with oversight authorities. This report consists of an up-to-date listing of URRWMO Board members, activities 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).

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 2010 Upper Rum River WMO Annual Report. ACD provided copies of this report and a cover letter to the entire URRWMO Board on April 15, 2011 for review. On April 20, 2011 the final draft was sent to the URRWMO Chair, Todd Miller. The Chair submitted the report to BWSR. The full report can be viewed at the URRWMO website.

Cover



2010 Annual Report

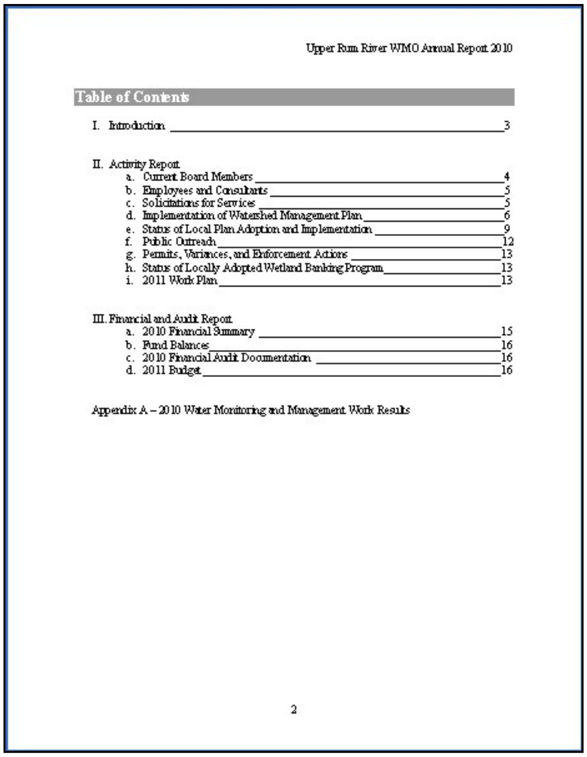
Upper Rum River

Watershed Management Organization

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

April 15, 2010

Table of Contents



Upper Rum River WMO Annual Report 2010

Table of Contents

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**	**WMO Websites**	**Reference Wetland**	**Lake Level**	**Lake WQ**	**Stream WQ**	**WOMP**	**Student Biomon**	**WMO annual rpt**	**Total**
Revenues										
URRWMO		620		940	2090	6060			630	10340
State										
Anoka Conservation District	1600		853		1216		1613	19	96	5397
County Ag Preserves								558		558
Regional/Local							500			500
Other Service Fees										
Local Water Planning			1862					583		2445
TOTAL	1600	620	2715	940	3306	6060	2113	1159	726	19240
Expenses										
Capital Outlay/Equip	4	2	7	1	4	15	4	2		38
Personnel Salaries/Benefits	1368	330	2364	658	2151	2289	1825	1000	628	12612
Overhead	117	29	182	49	988	2931	156	68	56	4576
Employee Training	4	2	14	4	6	8	5	8	1	52
Vehicle/Mileage	26	5	37	11	43	36	36	14	14	222
Rent	64	15	97	25	102	118	85	36	28	569
Program Participants						0				
Program Supplies	16		15	5	11	132	2	32		213
Equipment Maintenance						0				
TOTAL	1600	382	2715	752	3306	5529	2113	1159	726	18282

Recommendations

- **Become actively involved in the MPCA Rum River WRAPP planned to start in 2012.** This Watershed Restoration and Protection Plan is an assessment of the entire Rum River watershed. MPCA will use the results to determine if portions of the river are “impaired” and set overall management. This is a chance for the URRWMO to work with upstream entities.
- **Coordinate Rum River monitoring during the MPCA WRAPP, or suspend monitoring if duplication would occur.**
- **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.
- **Create a new water monitoring plan to cover 2013-17.** The monitoring schedule in the URRWMO Watershed Management Plan covers through 2012.
- **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 water quality 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.
- **Encourage public works departments to implement measures to minimize road deicing salt applications**. These salts are the most noticeable form of Rum River deterioration in the URRWMO. MN DOT, University of Minnesota Extension, and others offer training on this topic.
- **Investigate the condition of Ditch 19, the only inlet to Lake George**. Residents have complained that condition of the ditch and water control structures are contributing to low lake water levels in recent years. Anoka County is the legal ditch authority.
- **Facilitate resident efforts to control aquatic plant growth on Rogers Lake** as a means to improving low dissolved oxygen problems. In 2010 a neighborhood meeting was held, and while there was enthusiasm from residents, the needed follow-up by residents did not occur.
- **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.

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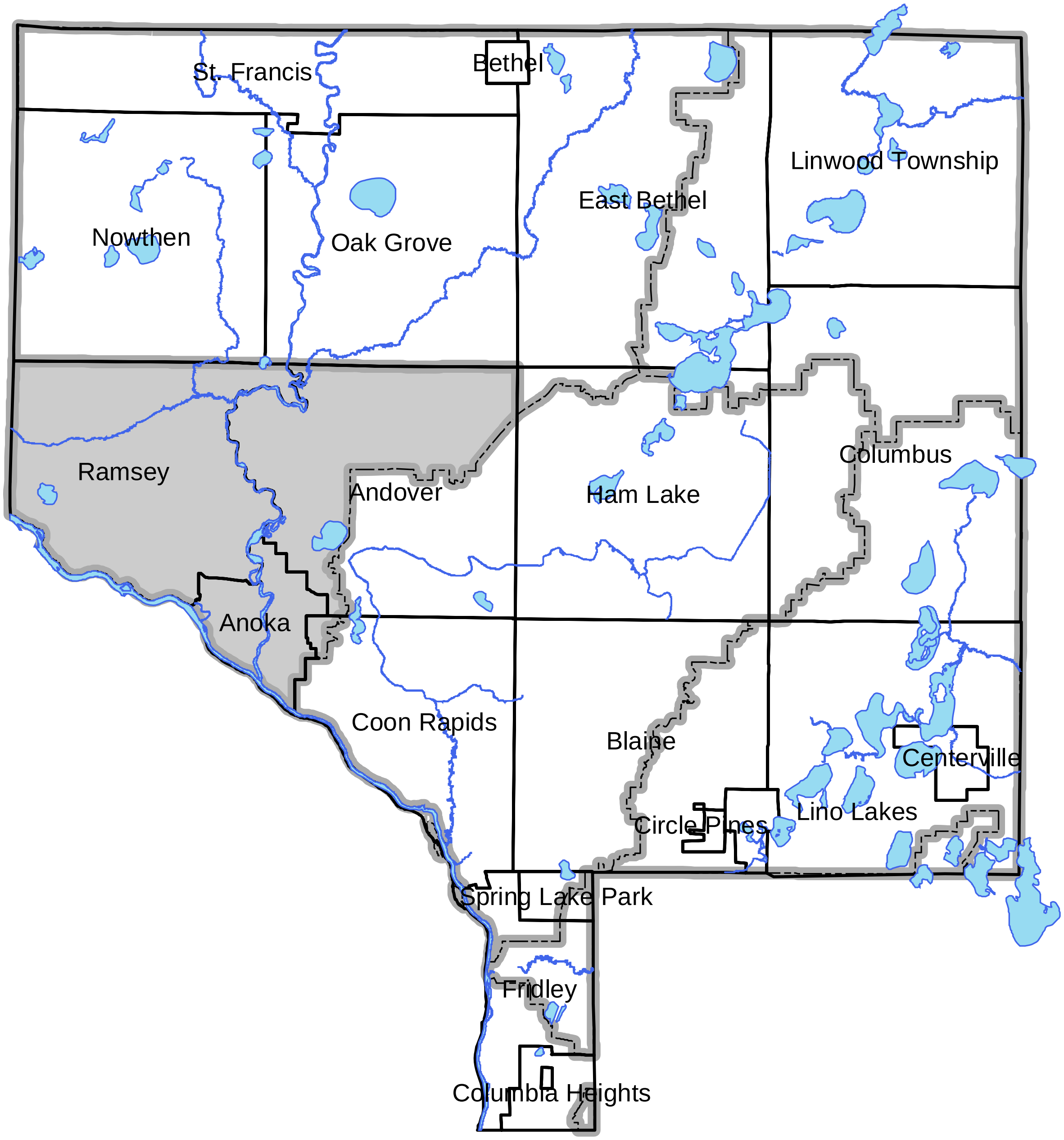
Lower Rum River Watershed

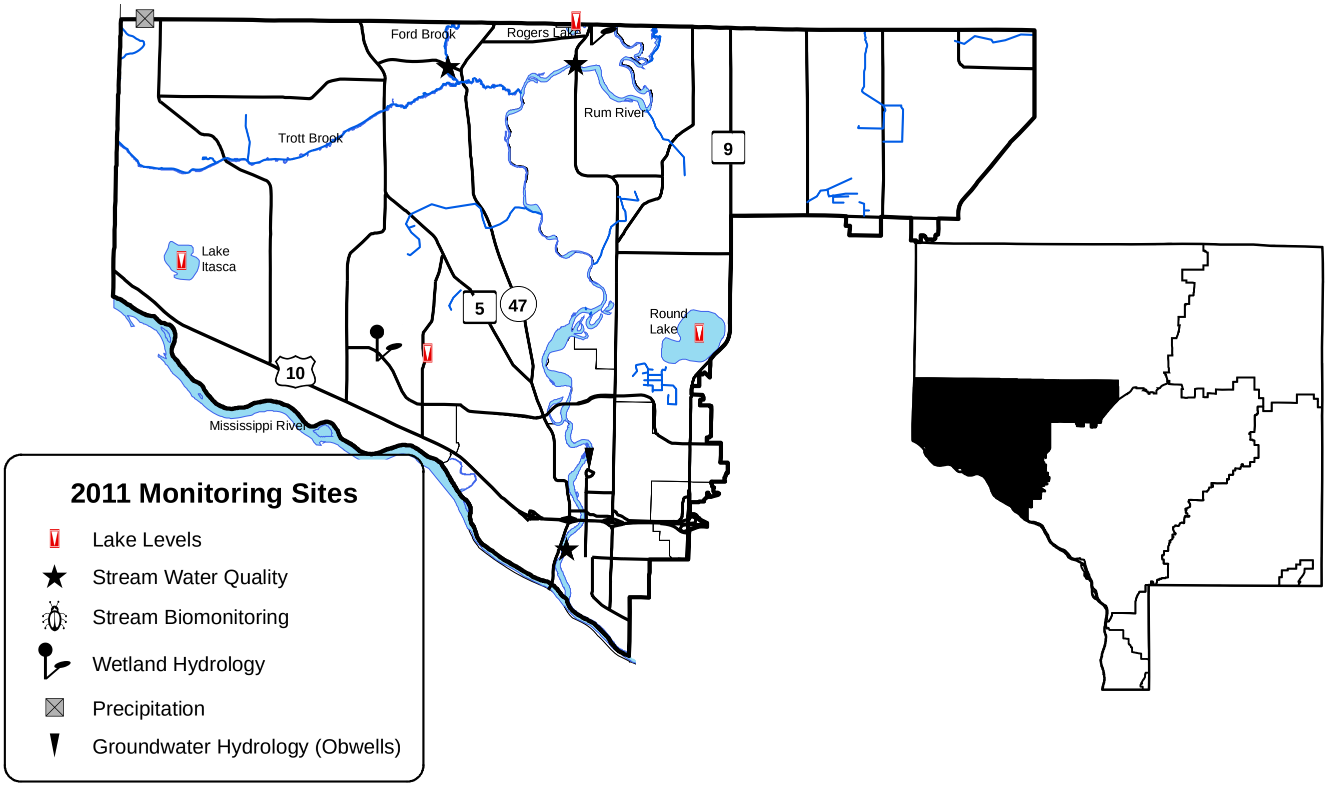


Contact Info:	Lower Rum River Watershed Management Organization www.AnokaNaturalResources.com/LRRWMO 763-421-8999
	Anoka Conservation District www.AnokaSWCD.org 763-434-2030

CHAPTER 4
LOWER RUM RIVER WATERSHED

Task	Partners	Page
Lake Levels	LRRWMO, ACD, volunteers, MN DNR	4-108
Stream Water Quality – Chemical	LRRWMO, MC, ACD	4-110
Stream Water Quality – Biological	LRRWMO, ACD, ACAP, Anoka High School	4-121
Wetland Hydrology	LRRWMO, ACD, ACAP	4-124
Water Quality Grant Fund	LRRWMO, ACD, landowners	4-127
Public Education - Web Video	LRRWMO, ACD	4-128
LRRWMO Website	LRRWMO, ACD	4-129
Member Community Annual Reporting Template	LRRWMO, ACD	4-131
Financial Summary		4-132
Recommendations		4-133
Groundwater Hydrology (obwells)	ACD, MNDNR	Chapter 1
Precipitation	ACD, volunteers	Chapter 1

ACAP = Anoka County Ag Preserves, ACD = Anoka Conservation District, LRRWMO = Lower Rum River Watershed Mgmt Org, MC = Metropolitan Council, MNDNR = 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: Water levels were measured on Rogers, Round, and Sunfish lakes 26, 20, and 10 times respectively. The level in Itasca Lake was measured much more frequently because a WL40 data logger was installed to record daily water levels. Reading a manual gauge was not possible because water was low, forcing placement of the gauge far from shore where volunteers could not read it.

In 2011 all of these lakes had much higher water levels than in other recent years due to high rainfall totals in spring and early summer. In late summer very little rainfall fell and water levels dropped continuously on all lakes. However the magnitude of these changes were very different on each lake (see graphs below).

Round Lake had its highest water levels since 1998. Between 1991 and 1998 water levels were regularly at or higher than the peak seen in 2011. The lake retreated 0.71 feet in late summer.

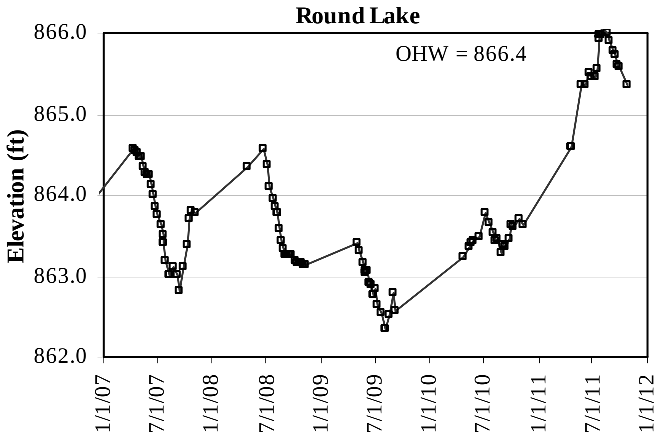
Rogers Lake exceeded the previous highest observed water level by 0.57 feet.

Itasca Lake had less impressive water levels. While it rose about 3 feet from fall 2010 and reached the highest water level since 2009, it was still 2-3 feet lower than the water levels that were historically observed. While all the lakes in the Lower Rum River watershed are mostly groundwater drive, with few or no surface inlets, Itasca may be the most reflective of groundwater because it lies within an undeveloped area. Therefore, it is not surprising that its response to rainfall is dampened. The long term water level decline at this lake and Round Lake are concerning indicators of groundwater depletion.

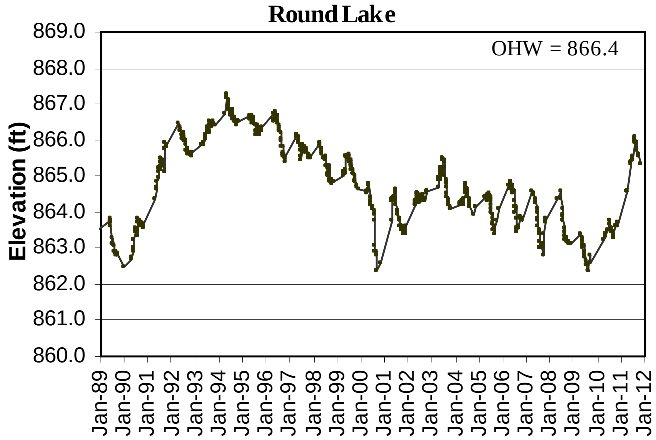
Sunfish Lake reached its highest water level since 1991.

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.

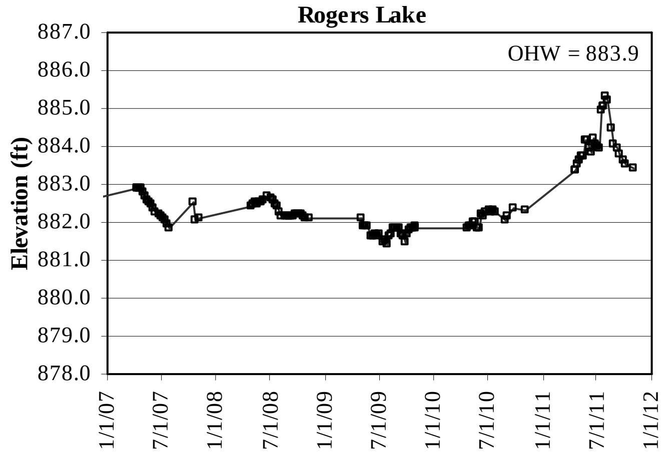
Round Lake Levels 2007-2011



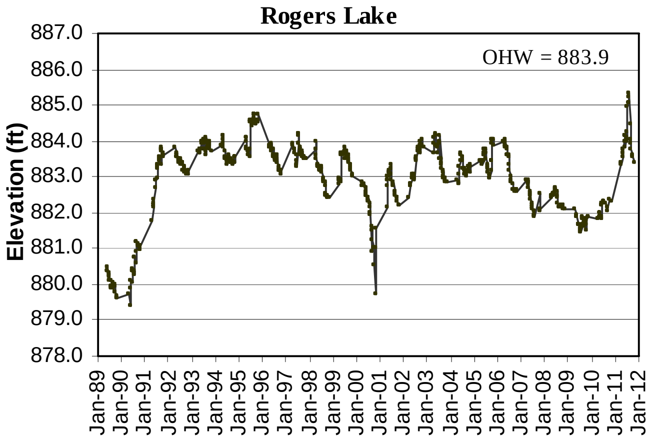
Round Lake Levels 1990-2011



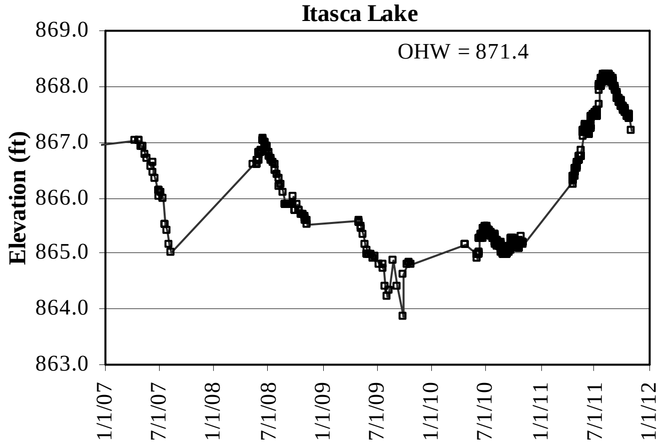
Rogers Lake Levels 2007-2011



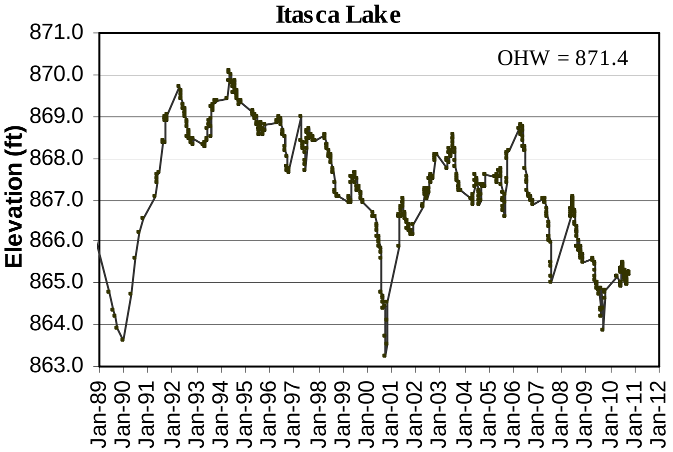
Rogers Lake Levels 1990-2011



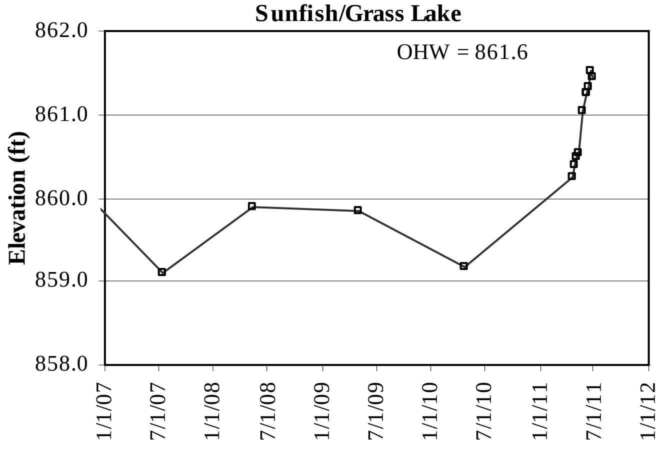
Itasca Lake Levels 2007-2011



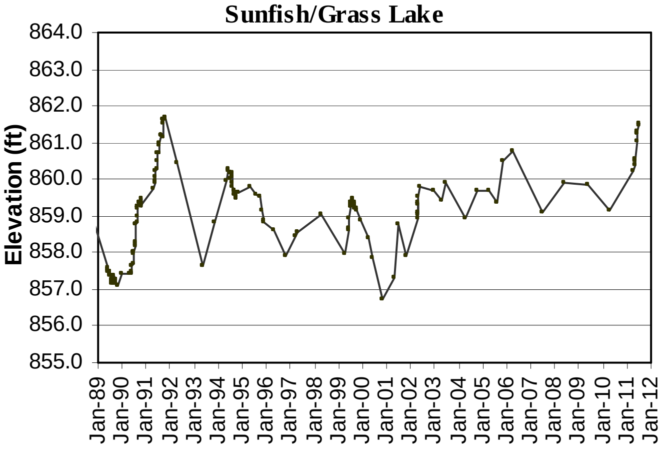
Itasca Lake Levels 1990-2011



Sunfish/Grass Lake Levels 2007-2011



Sunfish/Grass Lake Levels 1990-2011



Stream Water Quality - Chemical Monitoring

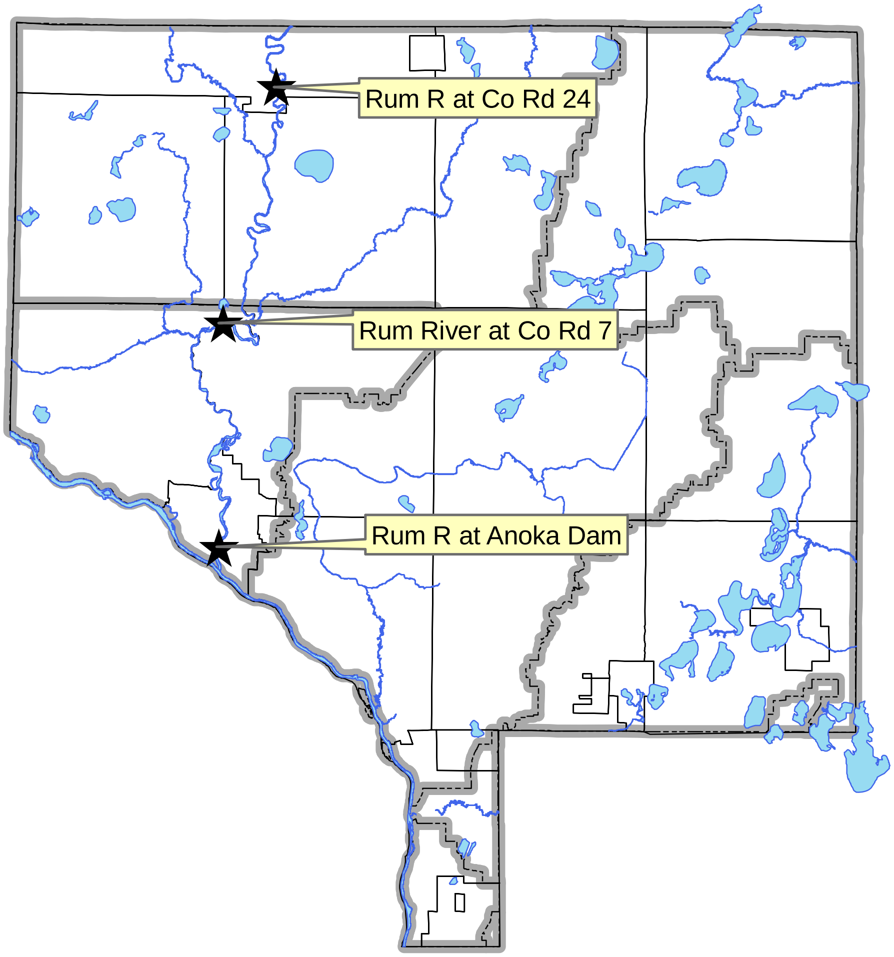
Description: The Rum River has been monitored simultaneously at three strategic locations in 2004, 2009, 2010, and 2011. The locations include the approximate top and bottom of the Upper and Lower Rum River Watershed Management Organizations. The two organizations share the middle location. The Metropolitan Council collects additional data at the farthest downstream location. Collectively, the data collected allow for an upstream to downstream water quality comparison within Anoka County, as well as within each watershed organization. While other Rum River monitoring has occurred, it is excluded from this report in order to include only data that were collected simultaneously for the greatest comparative value.

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

Locations: Rum River at Co Rd 24
Rum River at Co Rd 7
Rum River at the Anoka Dam

Results: Results are presented on the following page, with a focus on comparing river conditions from upstream to downstream. More detailed reporting for the Metropolitan Council WOMP monitoring station, including additional parameters and analysis are presented elsewhere by the Metropolitan Council (see http://www.metrocouncil.org/Environment/RiversLakes/).

2011 Rum River Monitoring Sites

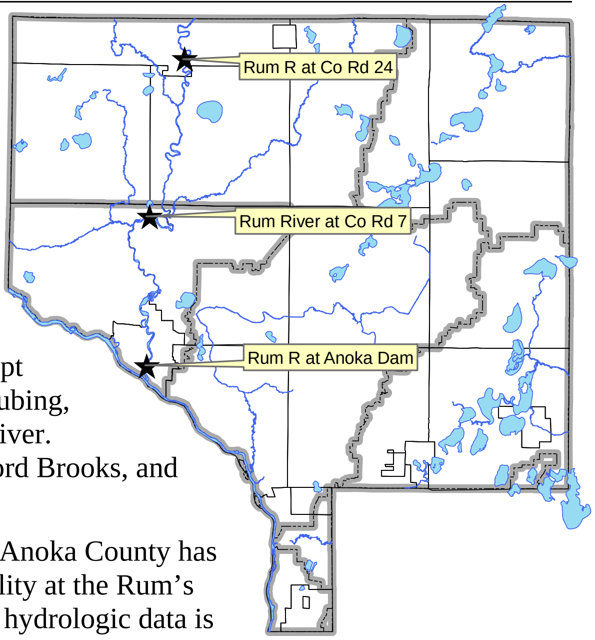


RUM RIVER

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
At Co. Rd. 7 –	2004, 2009, 2010, 2011
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 and 2011 monitoring was conducted at three locations simultaneously to determine if Rum River water quality changes in Anoka County, and if so, generally where changes occur. The Upper and Lower Rum River Watershed Management Organizations contributed to this work and monitoring sites were strategically located near the upper and lower boundary of each organization's jurisdictional boundary. The Metropolitan Council maintains a permanent monitoring station at the Anoka Dam, the farthest downstream monitoring site. The Metropolitan Council monitoring was coordinated to occur with the watershed organization monitoring so the data and costs could be shared. The Anoka Conservation District did the field work for both Metropolitan Council and the watershed organizations, ensured monitoring for both programs was conducted simultaneously so the data and costs could be shared, and reports the data together for a more comprehensive analysis of the river from upstream to downstream.

The river 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. 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, sulfates, and hardness. Ten additional parameters were tested by the Metropolitan Council at their laboratory for the Anoka Dam site only and are not reported here. 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 and dates that were simultaneously tested at all three sites. 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

Overall, Rum River water quality is good throughout Anoka County, however it does decline slightly below the County Road 7 bridge (i.e. in the Cities of Andover, Anoka, and Ramsey) and during storms. The declines in water quality below that point are modest, as are declines in water quality during storms. Dissolved pollutants (as measured by conductivity and chlorides), total phosphorus, turbidity, and total suspended solids were all generally near or below the median of all 34 Anoka County streams that have been monitored, while pH and dissolved oxygen levels were appropriate.

Two areas of concern were noted. First, dissolved pollutants increased at each monitoring site downstream. Dissolved pollutants were highest during baseflow, indicating pollutants have infiltrated into the groundwater which feeds the river and tributaries during baseflow. Road deicing salts are likely the most significant dissolved pollutant. Secondly, total suspended solids increased notably below County Road 7. This was most pronounced during storms.

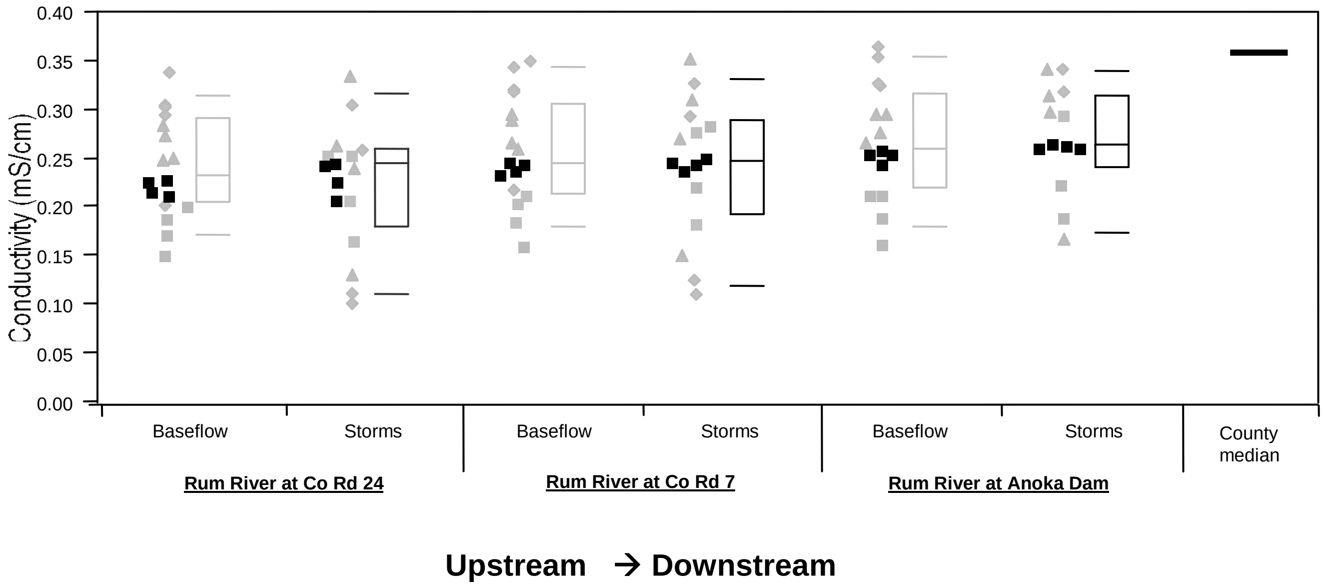
It is important to recognize the limitations of this report. The data is only from 2004, 2009, 2010, and 2011 when all three sites were monitored simultaneously to allow comparisons. It includes drought years (2009), years with slightly above normal precipitation (2010), and years with some excessively wet and some excessively dry months (2004 and 2011). We did not sample any extreme floods when river water quality is likely worst. If a more detailed analysis of river water quality is desired, data from many years and a variety of conditions is available for the Anoka Dam site through the Metropolitan Council. Their work includes composite samples throughout storms.

On the following pages data are presented and discussed for each parameter. The last section outlines management recommendations. The Rum River is an exceptional waterbody, and its protection and improvement should be a high priority.

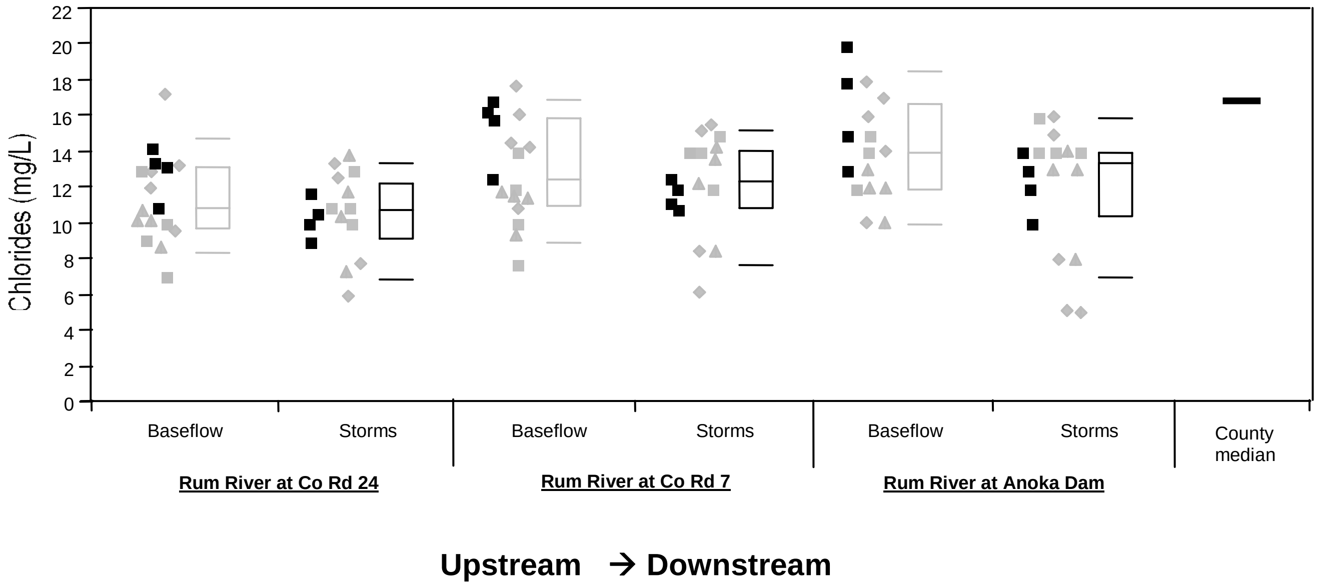
Conductivity and chlorides

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 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. 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 Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Chloride during baseflow and storm conditions Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th 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 was 0.245 mS/cm, 0.248 mS/cm, and 0.266

mS/cm, respectively. This is lower than the median for 34 Anoka County streams of 0.362 mS/cm. The maximum observed conductivity in the Rum River was 0.365 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.

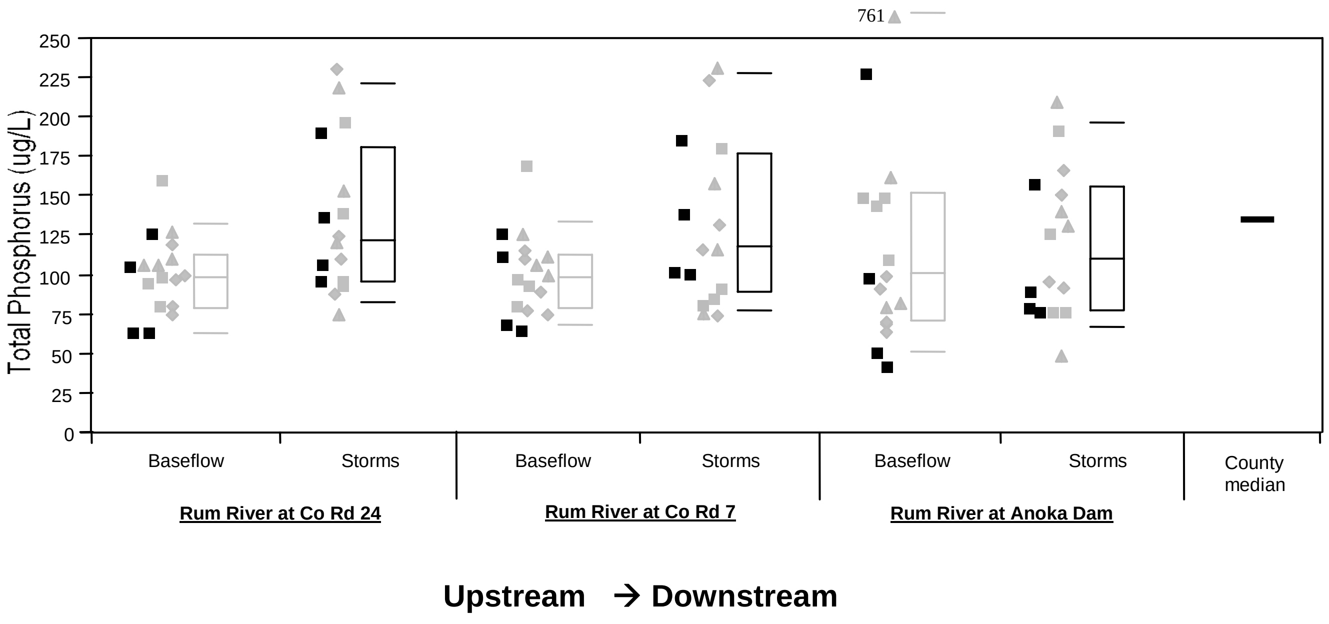
Chloride results parallel those found for conductivity (see figures above), supporting the hypothesis that chloride is an important dissolved pollutant. Chloride levels in the Rum River (median 11, 13, and 14 mg/L from upstream to downstream) are slightly lower than the median for Anoka County streams of 17 mg/L. The highest observed value was 20 mg/L, though higher levels may have occurred during snowmelts which were not monitored. The levels observed are much lower than the Minnesota Pollution Control Agency's (MPCA) chronic standard for aquatic life of 230 mg/L. Like conductivity, chlorides were slightly higher during baseflow than storms at each site and increased from upstream to downstream. Road deicing salt infiltration into the shallow groundwater is likely the primary contributor, as described above.

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). 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 each of the three monitored sites was 106, 106, and 101 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. All of the highest observed total phosphorus readings were during storms, including the maximums at each site of 230, 234, and 761 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.

One 2010 total phosphorus reading was excessively high, but we feel this outlier is likely an error. On September 22 a reading of 761 ug/L was recorded at the Anoka Dam. This was recorded as a baseflow sample because no recent rains had occurred, but was during a period of extended high water. River stage was approximately 0.5 feet higher than during the other baseflow samples. During this event dissolved phosphorus was analyzed in addition to total phosphorus. Dissolved phosphorus was only 13% of total phosphorus. Therefore most of the total phosphorus must be particulate phosphorus. Yet, inconsistently, there were few particulates in the water; total suspended solids was only 6 mg/L. Likewise, nothing in the field notes suggest unusually high turbidity. If this reading of 761 ug/L total phosphorus is excluded, as it probably should be, the next highest observed TP at this site is 209 ug/L.

Total phosphorus during baseflow and storm conditions Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. 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. Suspended solids in the Rum River are moderate, and highest during storms and at the farthest downstream site. The results for turbidity and TSS differ, lending insight into the types of particles that are problematic.

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 9, 8, 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. The maximum observed was 66 FNRU during a snowmelt event in 2011. The Rum River’s turbidity exceeded the Minnesota Pollution Control Agency’s water quality standard of 25 NTU during only five of 99 events (5%).

Across all years, TSS was similar at the two upstream sites, but higher at the Anoka Dam (see figure below). The countywide TSS median for streams is 12 mg/L. The median at all the Rum River sites was the same - 8 mg/L. However the readings ranged highest at the farthest downstream site, the Anoka Dam.

At all the sites median TSS during storms was higher than during baseflow. At the upstream site the difference between median TSS during storms and baseflow was 3 mg/L, while at County Road 7 it was 4 mg/L and at the Anoka Dam 9 mg/L. TSS during storms was much more variable due to variability in storms sampled.

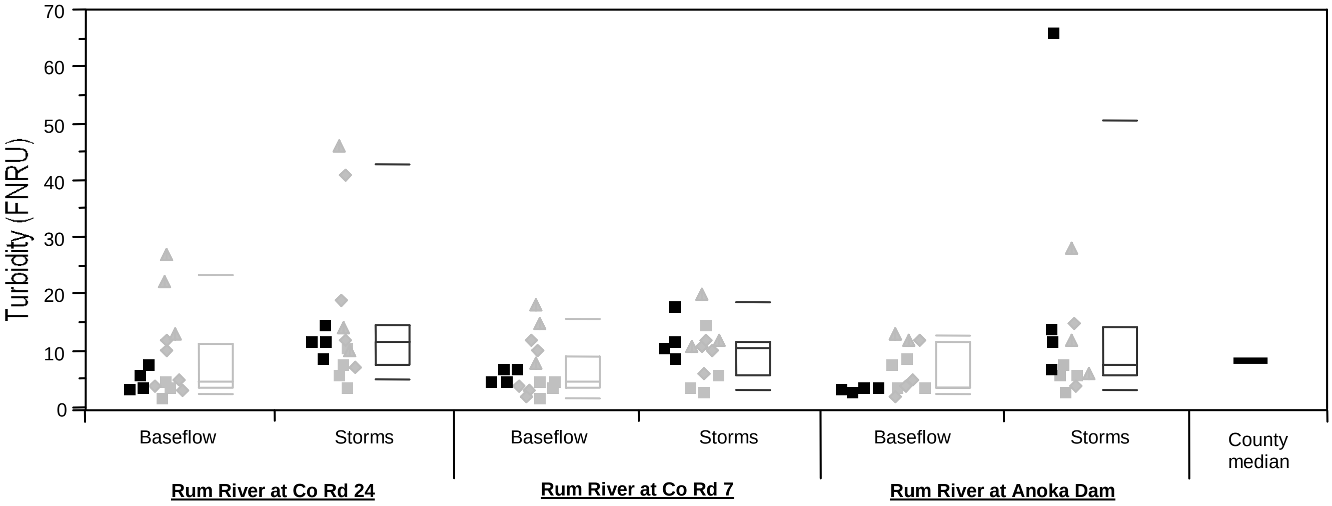
The maximum readings and moderate increases during storms are not unexpectedly high for a large river, and are within the range that should be considered healthy. At the same time, the increase in TSS between County Road 7 and the Anoka Dam during storms is noteworthy. It is not unexpected given the more dense land development between these two sites, but also speaks to the effectiveness of stormwater management practices like settling ponds. The river's water quality is in good condition, likely due in part to these practices, however they do not eliminate all impact. 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.

In 2011 TSS during storms was very low at the two farthest downstream monitoring sites, and this is likely due to hydrologic conditions. The first half of 2011, when our storm samples were taken, was an extremely wet period. River levels were chronically high. While we did sample immediately following storms, the runoff from that storm was a relatively low percentage of overall flow. Because TSS was low during these periods of very high flow, sediment from the stream bed and bank erosion is relatively low in the Rum River. Sediment carried by storm runoff is the larger source of suspended solids.

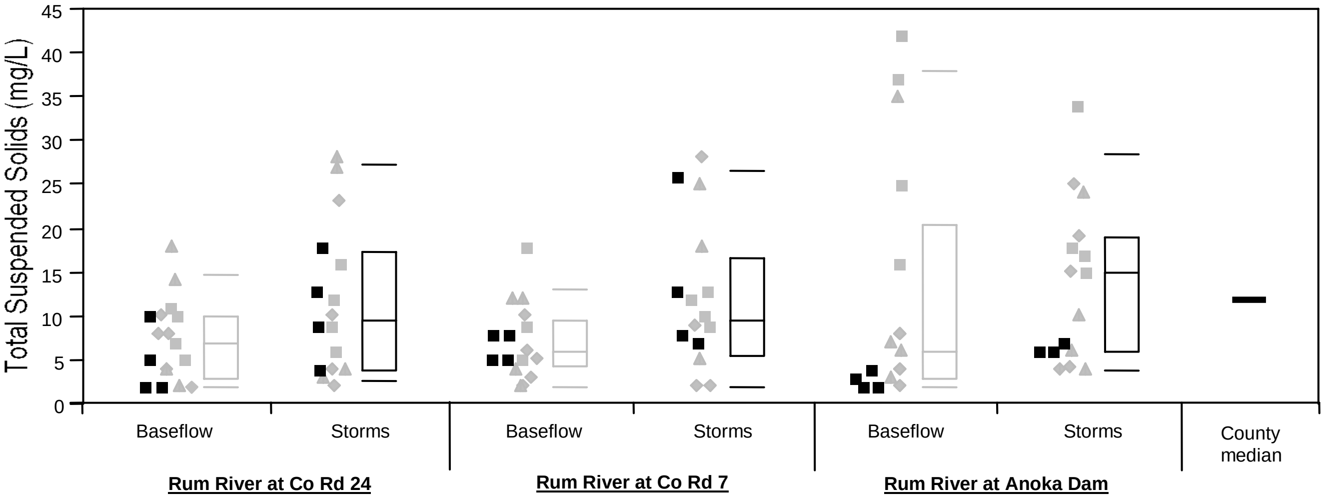
It should be noted that the data presented here do not include monitoring of any large flood events. The water is known to become muddier during such floods.

Turbidity during baseflow and storm conditions Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Upstream → Downstream

Total suspended solids during baseflow and storm conditions Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

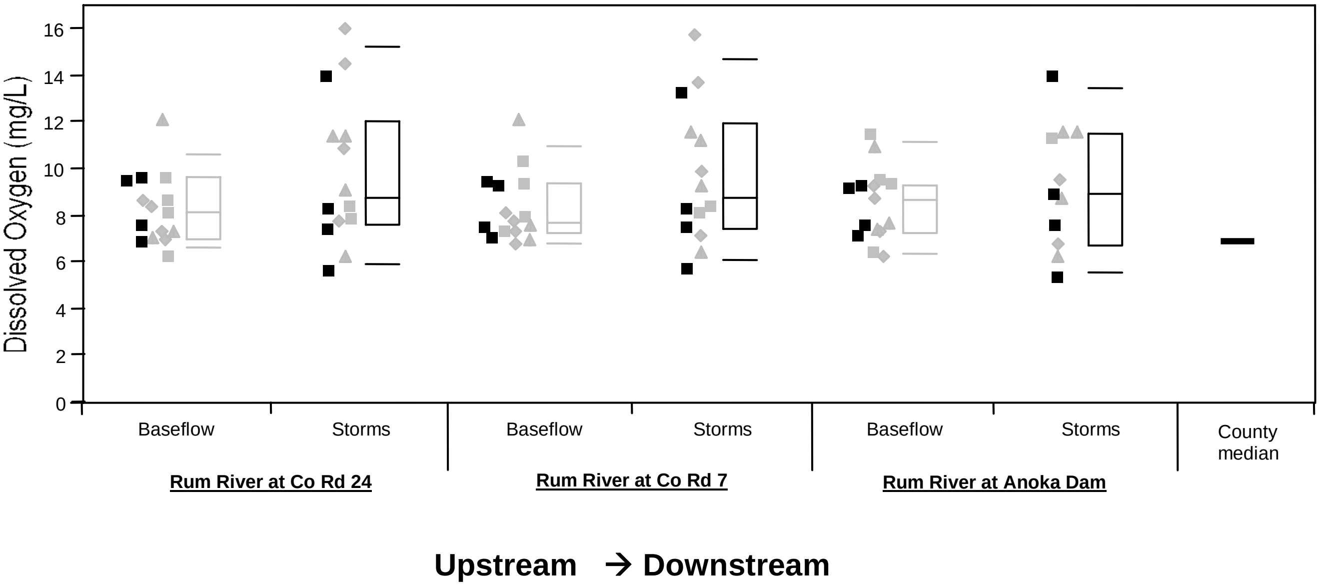


Upstream → Downstream

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 Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 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 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). Each of the three sites exceeded 8.5 on one occasion, but the highest was only 8.85. This rare and modest exceedance of the state water quality standard is not concerning.

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 Grey squares are individual readings from 2004, grey diamonds are 2009 readings, grey triangles are 2010 readings, and black squares are 2011 readings. 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 some deterioration in the downstream areas that are most developed. 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. Measures to maintain the Rum River's good water quality should include:

- Enforce the building and clear-cutting setbacks from the river required by state scenic rivers laws to avoid bank erosion problems and protect the river's scenic nature.
- Use the best available technologies to reduce pollutants delivered to the river and its tributaries through the storm sewer system. Any new development should consider low impact development strategies that minimize stormwater runoff production. Aggressive stormwater treatment should be pursued in all areas of the watershed, not just those adjacent to the river. The area's soils are well suited to stormwater treatment by infiltration.
- Seek improvements to the existing stormwater conveyance system below County Road 7. Total suspended solids in the river increase in this portion of the watershed during storms.
- Utilize all practical means to reduce road deicing salt applications. These may include more efficient application methods, application only in priority areas, alternate chemicals, or others. Road salt infiltration into the shallow groundwater has become a regional problem. Deicing salts are apparent year-round in the groundwater that feeds area streams.
- Survey the river by boat for bank erosion problems and initiate projects to correct them. Both the Lower and Upper Rum River Watershed Management Organizations, which serve Anoka County, have completed this work. It should be periodically repeated.
- Continue education programs to inform residents of the direct impact their actions have on the river's health.

- Continue regular water quality monitoring. A reasonable baseline of four years of data that has been collected, so future monitoring every 1-3 years seems reasonable. Frequency of monitoring should be most frequent in the next few years and following any major projects that might positively or negatively impact the river. Additionally, periodic monitoring of the primary tributary streams should also occur every 2-3 years. Coordinating simultaneous monitoring across communities and watershed organizations is highly desirable.
- Investigate E. coli bacteria. In 2011 the MPCA sampled for E. coli at the outlet of the Rum River into the Mississippi River. They found levels that exceeded state standards. It is unknown how much of the Rum River's length might be declared "impaired" based upon this data. It is desirable to do additional bacteria monitoring upstream to define the extent of the problem. Bacteria is a difficult pollutant to reduce.
- Engage the entire watershed. To date, most efforts to monitor the Rum River have occurred in Anoka County by the Upper and Lower Watershed Management Organizations. This is the farthest downstream part of the watershed. A broader scale effort is needed to protect the river. Strong encouragement from already-active partners is needed to engage those who are inactive.

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 Industry Ave, 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:

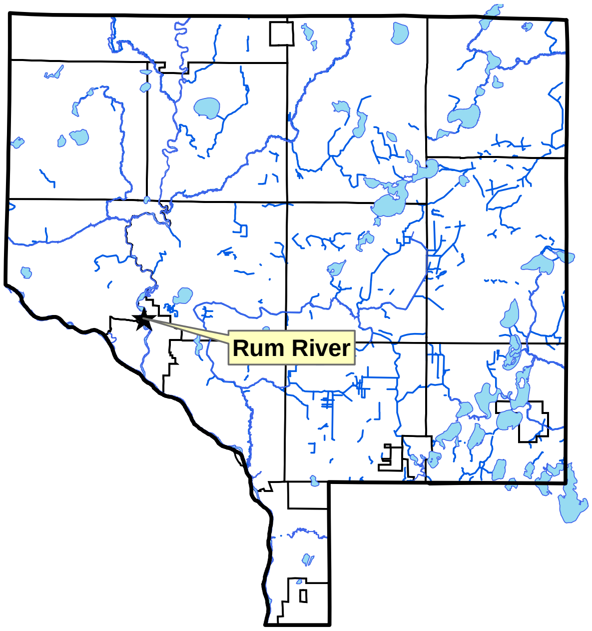
# Families	Number of invertebrate families. Higher values indicate better quality.
EPT	Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.
Family Biotic Index (FBI)	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 ACD staff in 2011

Monitored Since

2001

Student Involvement

0 students in 2011, approximately 410 since 2001

Background

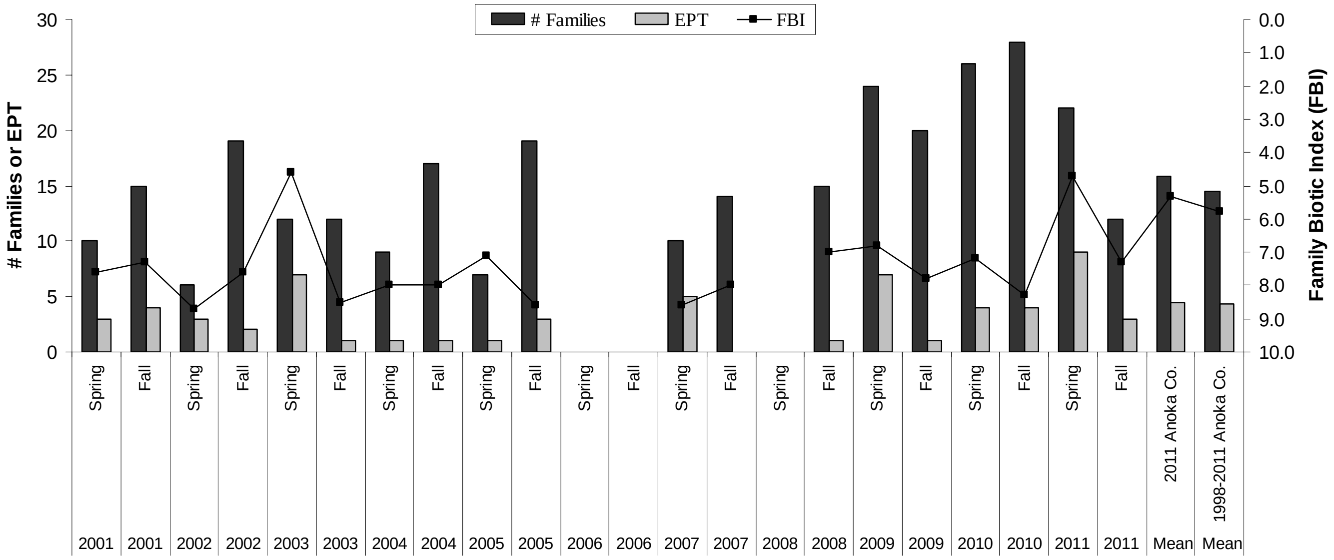
The Rum River originates from Lake Mille Lacs, and flows south through western Anoka County where it joins the Mississippi River in the City of Anoka. In Anoka County the river has both rocky riffles (northern part of county) as well as pools and runs with sandy bottoms. The river's condition is generally 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 is not conducted in a backwater rather than the main channel.

Results

Anoka High School planned to monitor the river in 2011 but was unable so the monitoring was done by Anoka Conservation District staff. The school could not monitor in spring because of chronic high water that did not recede until June. In fall, no ecology class was taught.

The results for spring 2011 were better than most previous years, while fall results were typical of the past. In spring more EPT families were found than ever before at this site and the FBI score was the second best. This was well above the indices typical of Anoka County streams. This sampling was different from most previous efforts in that sampling was done by professionals and a greater percentage of sampling was in the main channel rather than backwaters. However this was also true in fall when indices were typical of past efforts at this site and near or below typical results for the county.

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	2007	2007	2008	2008	2009	2009	2010	2010	2011	2011	Mean	Mean
Season	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**2011 Anoka Co.**	**1998-2011 Anoka Co.**
FBI	8.60	8.00		7.00	6.80	7.80	7.20	8.30	4.70	7.30	5.3	5.8
# Families	10	14		15	24	20	26	28	22	12	15.8	14.5
EPT	5	0		1	7	1	4	4	9	3	4.4	4.3
Date	7-May	22-Oct		13-Oct	8-May	28-Sep	18-May	7-Oct	10-Jun	5-Oct		
Sampled By	AHS	AHS		AHS	AHS	AHS	AHS	AHS	ACD	ACD		
Sampling Method	MH	MH		MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	208	244		626	880	585	443	816	604	188		
# Replicates	1	1		1	1	2	1	1	1	1		
Dominant Family	Corixidae	Coenagrionidae		Baetidae	Siphlonuridae	Hyalellidae	Gastropoda	Hyalellidae	baetidae	hyalellidae		
% Dominant Family	91.8	37.3		26.5	40.7	39.1	31.8	34.1	57.5	63.3		
% Ephemeroptera	5.3	0		26.5	48.2	0.9	8.1	0.9	59.3	11.2		
% Trichoptera	0	0		0	0.1	0	0	0.2	1	0		
% Plecoptera	0.5	0		0	2.6	0	0.5	0	3.8	0.5		

Supplemental Stream Chemistry Readings

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

Parameter	5/7/2007	10/22/2007	10/10/2008	5/8/2009	9/28/2009	5/18/2010	10/7/2010	6/10/2011	10/5/2011
pH	8.5	7.42	7.75	7.91	7.82	7.24	7.22	7.84	7.98
Conductivity (mS/cm)	0.283	0.243	0.348	0.276	0.421	0.207	0.399	0.296	0.296
Turbidity (NTU)	17	13	3	6	5	7	7	18	10
Dissolved Oxygen (mg/L)	11.41	9.72	8.99	10.82	8.76	6.93	na	6.85	7.91
Salinity (%)	0.01	0	0.01	0.01	0.01	0	0.01	0.01	0.01
Temperature (°C)	15.3	10.6	12.3	17.2	15.5	14.8	12.2	20.7	15.3

Discussion

Biomonitoring results for this site are much different from the monitoring farther upstream in St. Francis. In St. Francis the Rum River harbors the most diverse and pollution-sensitive macroinvertebrate community of all sites monitored in Anoka County. At the City of Anoka location diversity has been high in recent samplings, but the biotic indices indicate a poorer than average river health because most families found were generalists.

The reason for the dramatic difference between St. Francis and Anoka invertebrate communities is probably habitat differences. The river near St. Francis has a steeper gradient, moves faster, and has a variety of pools, riffles, and runs. Downstream, near Anoka, the river is much slower moving, lacking pools, riffles and runs. The bottom is heavily silt laden. The area is more developed, so there are more direct and indirect human impacts to the river.

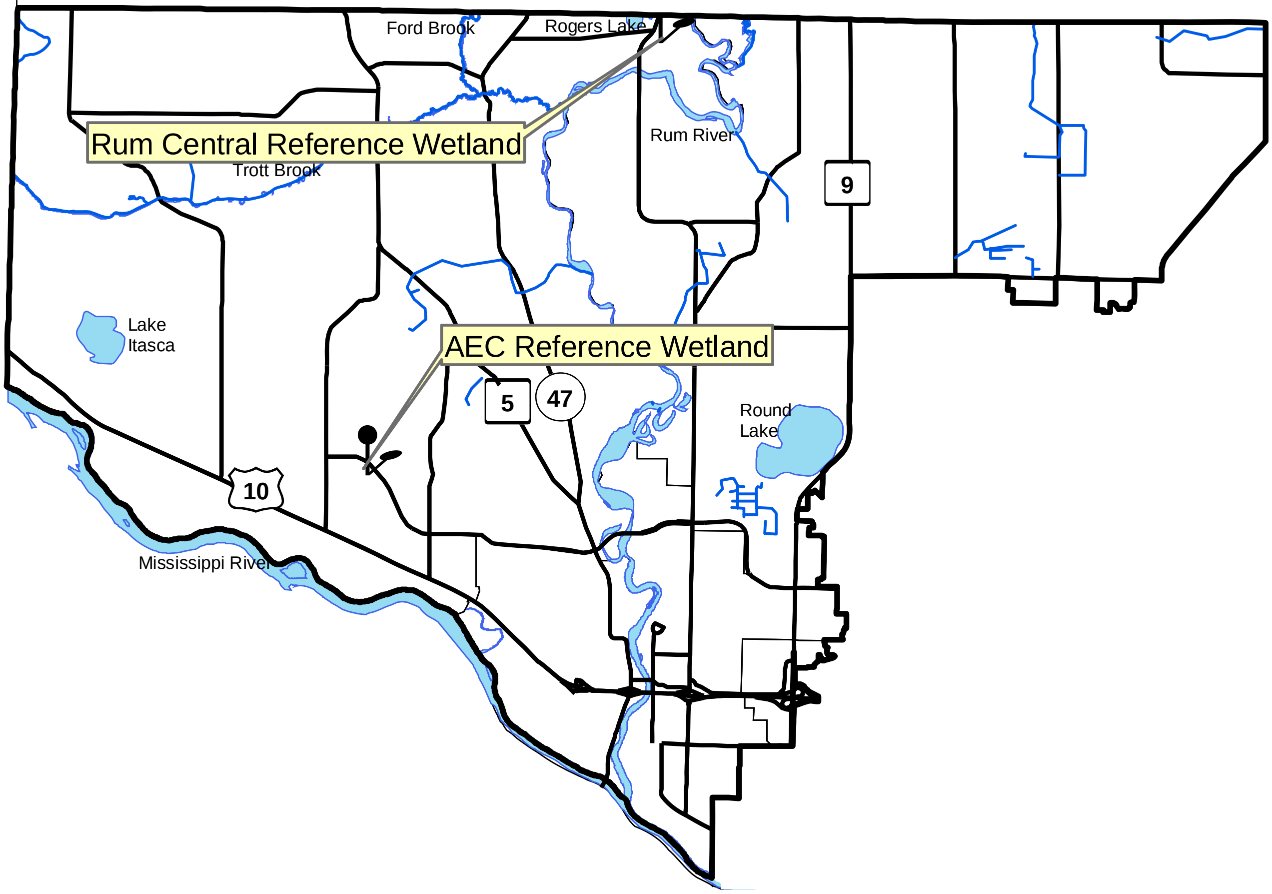
Water quality is good throughout the Rum River, though slightly poorer in Anoka than St. Francis. Chemical monitoring in 2004, 2009, 2010, and 2011 revealed that total suspended solids, conductivity, and chlorides were all slightly higher near Anoka than upstream. This is probably due to more urbanized land uses and the accompanying storm water inputs. Given that water quality is still very good even in these downstream areas, it is unlikely that water quality is the primary factor limiting macroinvertebrates at the City of Anoka.

One additional factor to consider when comparing the up and downstream monitoring results is the type of sampling location. Sampling 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 because those families generally favor rocky habitats and require high dissolved oxygen not found in stagnant areas.

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 21 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 Industry Ave, Ramsey Rum River Central Reference Wetland, Rum River Central 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

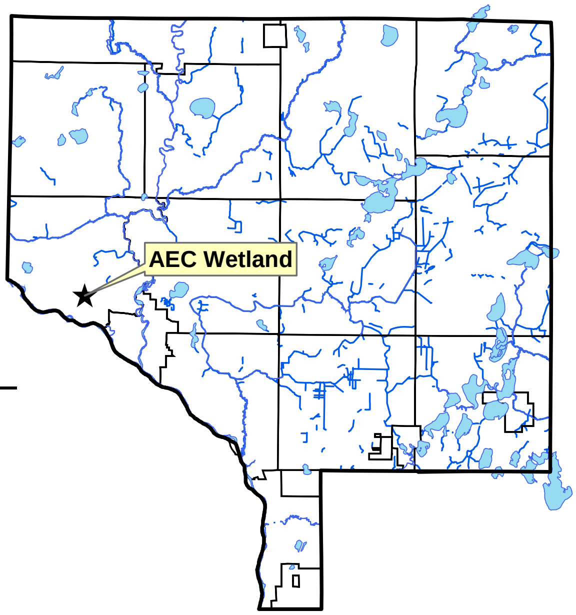


AEC REFERENCE WETLAND

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	-

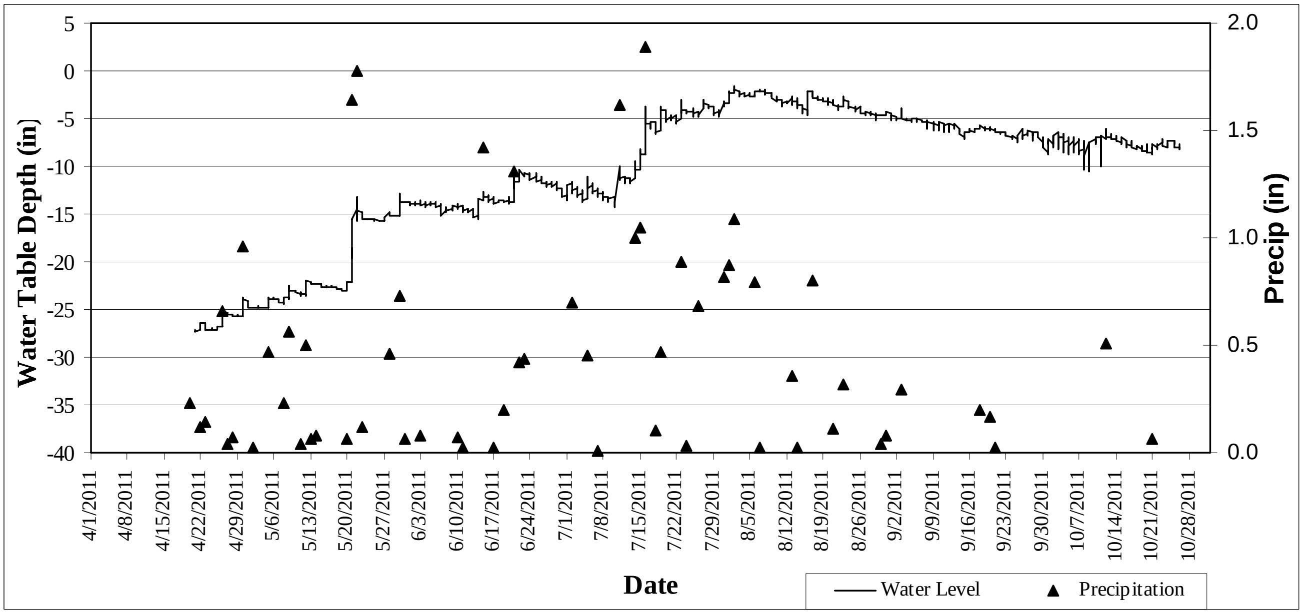
Surrounding Soils:	Hubbard coarse sand

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.

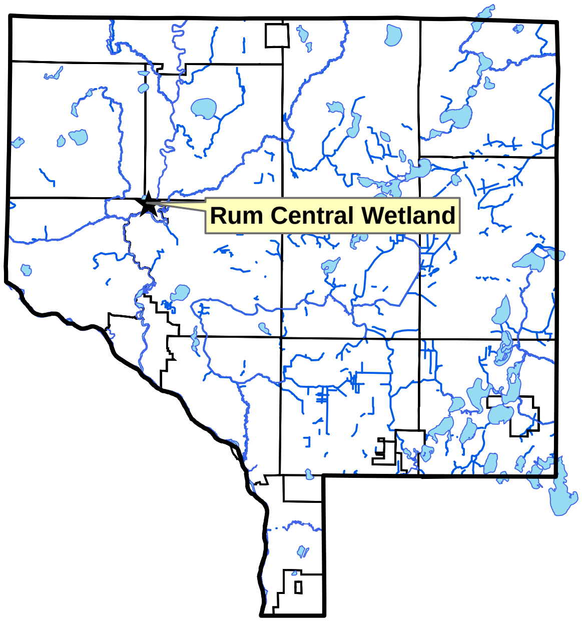
2011 Hydrograph



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.

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	-

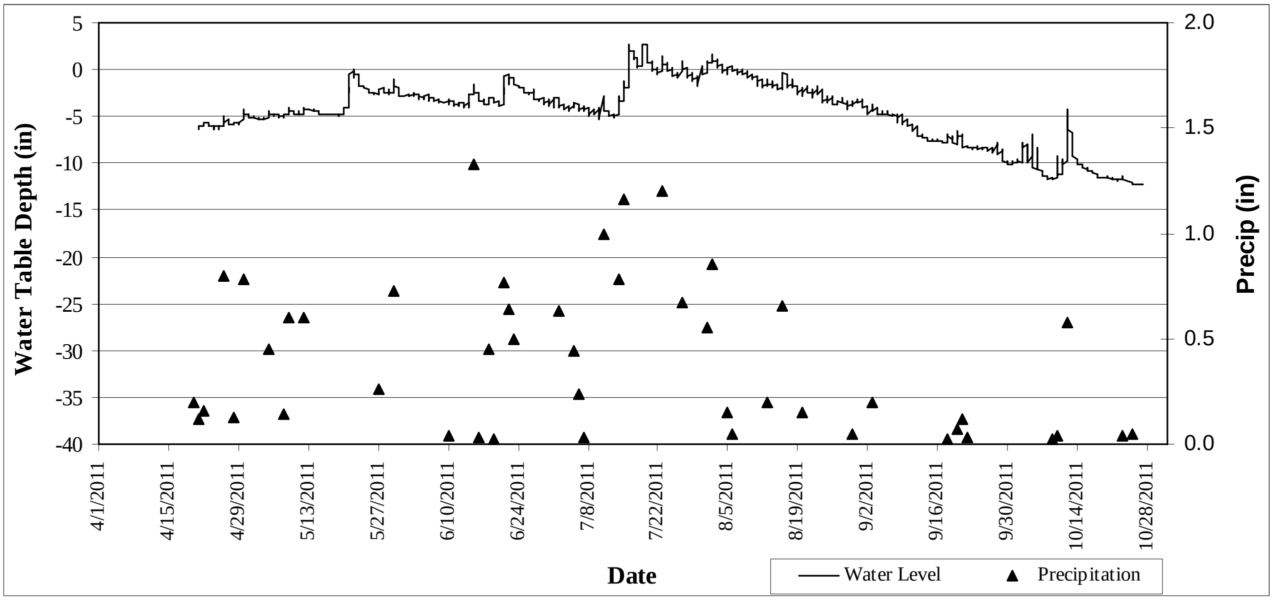
Surrounding Soils: Zimmerman fine sand

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.

2011 Hydrograph



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

Water Quality Grant Fund

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

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

Results: Projects reported in the year they are installed. In 2011 the Blackburn Rum Riverbank Stabilization used $543.46 of LRRWMO cost share dollars.

LRRWMO Cost Share Fund Summary

2006 LRRWMO Contribution	+	$1,000.00
2008 Expense – Herrala Rum Riverbank stabilization	-	$ 150.91
2008 Expense – Rusin Rum Riverbank stabilization	-	$ 225.46
2009 LRRWMO Contribution	+	$1,000.00
2009 Expense – Rusin Rum Riverbank bluff stabilization	-	$ 52.05
2010 LRRWMO Contribution	+	$ 0
2010 LRRWMO Expenses	-	$ 0
2011 LRRWMO Contribution	+	$ 0
2011 LRRWMO Expenses - Blackburn riverbank	-	$ 543.46
Fund Balance		**$1,028.12**

Blackburn Rum Riverbank Stabilization

Anoka Conservation District (ACD) staff installed a cedar tree revetment on a residential property that borders the Rum River in Ramsey during the fall of 2011. Cedar tree revetments are a cost-effective, bioengineering practice that can be used to stabilize actively eroding streambanks. The Blackburn property had moderate bank undercutting that was in the beginning stages of creating a more serious issue. Installation of the 55 foot cedar tree revetment will slow or stop the erosion and reduce the likelihood of a much larger and more expensive corrective project in the future. It benefits river water quality by reducing sediment delivered to the river, and improves habitat.

Cedar tree revetments are created by anchoring cut cedar trees to the bank. In this case, the trees were harvested at no cost from an Anoka County park where they were undesirable. Each tree was anchored to the toe of the slope using cable, horseshoe clamps, and a duckbill anchor driven 3-4 feet into the bank. The tree's many branches deflect the water's energy from the bank. This low cost treatment is highly effective on mild to moderate problem areas.

Project Funding

LRRWMO Water Quality Cost Share	$543.46
ACD Water Quality Cost Share	$543.45
Landowner	$1,086.91
TOTAL	$2,173.82


Before


Methods


After

Public Education – Web Video

Description: The Lower Rum River Watershed Management Organization (LRRWMO) contracted the Anoka Conservation District (ACD) to create a short web video about the LRRWMO. The video is to be posted on the LRRWMO website.

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

Location: www.AnokaNaturalResources.com/LRRWMO

Results: As of January 27, 2012 the video production is in process. Appropriate video clips have been compiled. Many of these video clips were collected by ACD staff during the LRRWMO's boat tour of the river in September 2011. A script for the video has been completed and sent to the LRRWMO Board for review. The video compilation will be complete before March 31, 2012.

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. The LRRWMO pays the ACD annual fees for maintenance and update of the website.

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. The website serves as the LRRWMO's alternative to a state-mandated newsletter.

Location: www.AnokaNaturalResources.com/LRRWMO

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

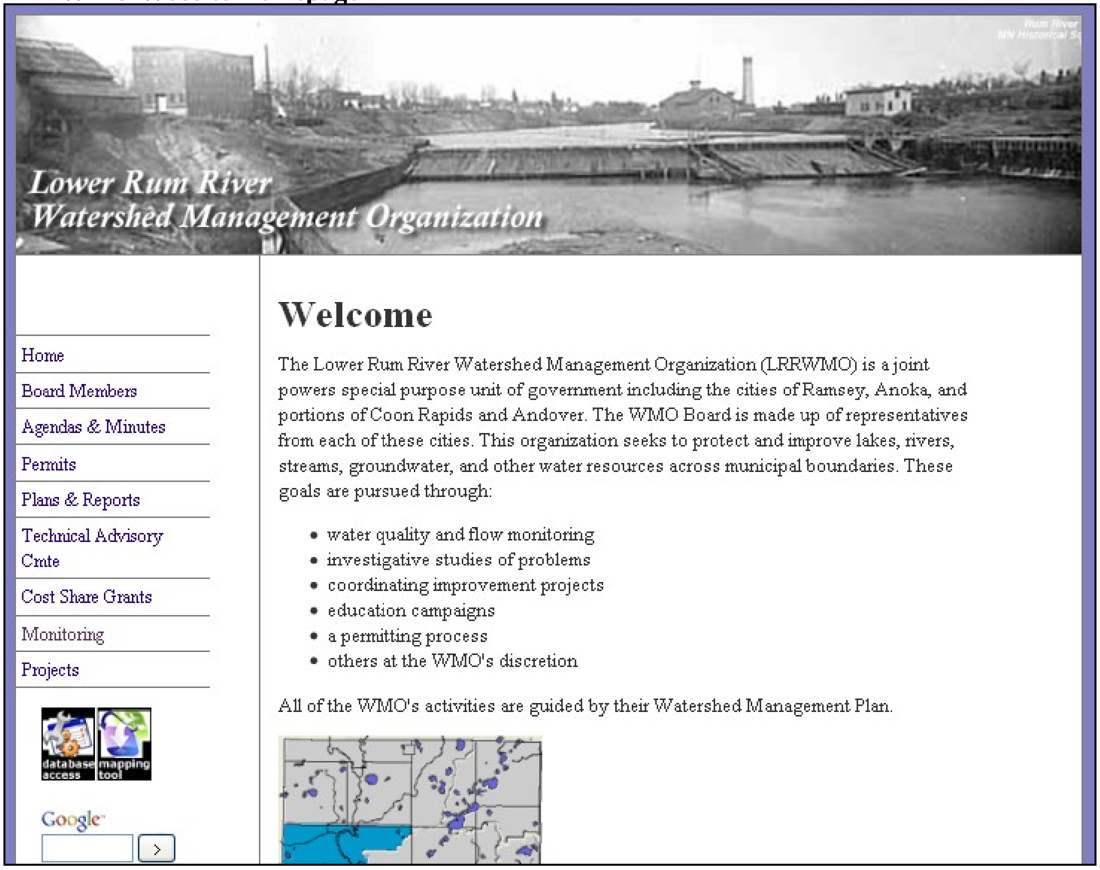
Information about the LRRWMO includes:

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

Other tools on the website include:

- an interactive mapping tool that shows natural features and aerial photos
- an interactive data download tool that allows users to access all water monitoring data that has been collected
- narrative discussions of what the monitoring data mean

LRRWMO Website Homepage



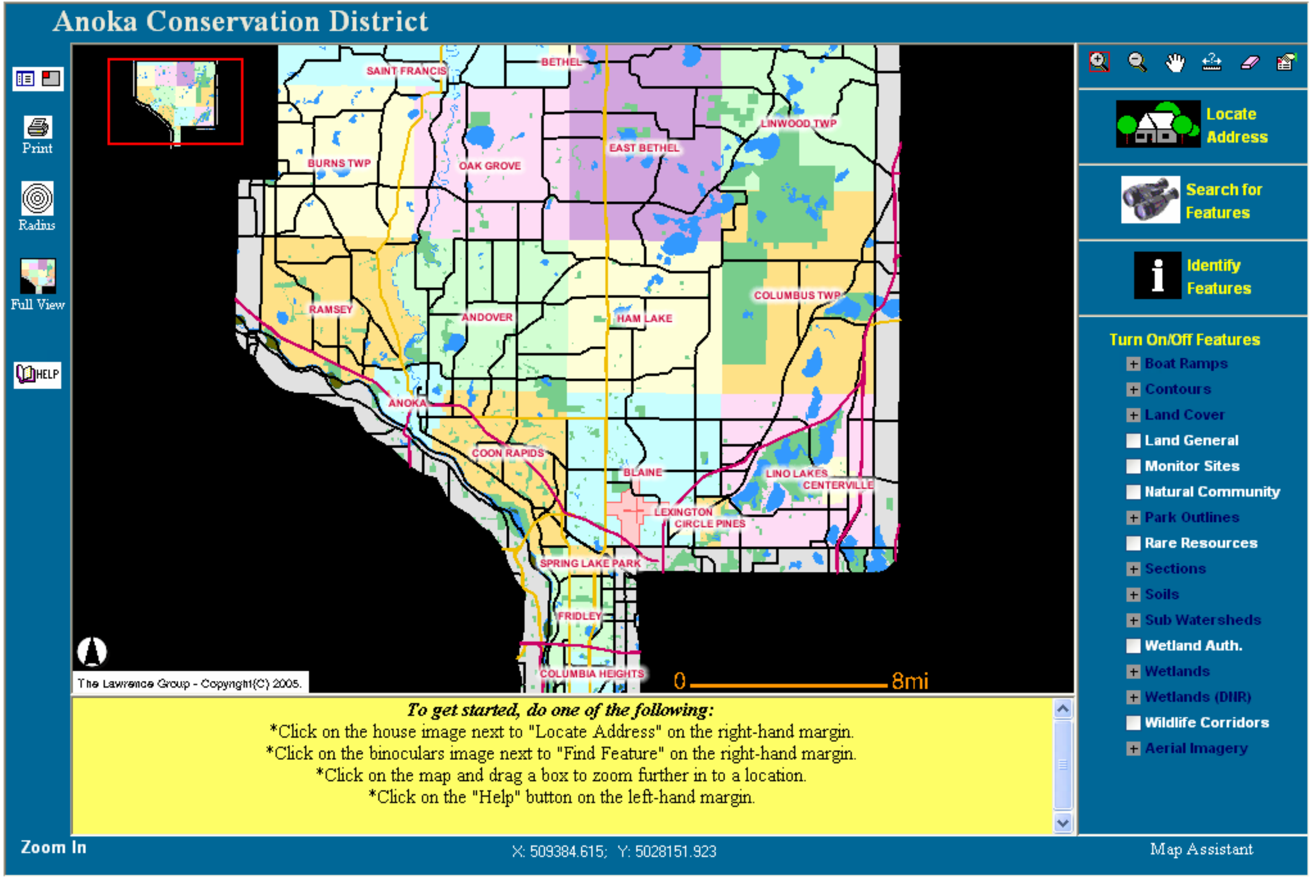
Welcome

The Lower Rum River Watershed Management Organization (LRRWMO) is a joint powers special purpose unit of government including the cities of Ramsey, Anoka, and portions of Coon Rapids and Andover. The WMO Board is made up of representatives from each of these cities. This organization seeks to protect and improve lakes, rivers, streams, groundwater, and other water resources across municipal boundaries. These goals are pursued through:

- water quality and flow monitoring
- investigative studies of problems
- coordinating improvement projects
- education campaigns
- a permitting process
- others at the WMO's discretion

All of the WMO's activities are guided by their Watershed Management Plan.

Interactive Mapping Tool



To get started, do one of the following:

*Click on the house image next to "Locate Address" on the right-hand margin.

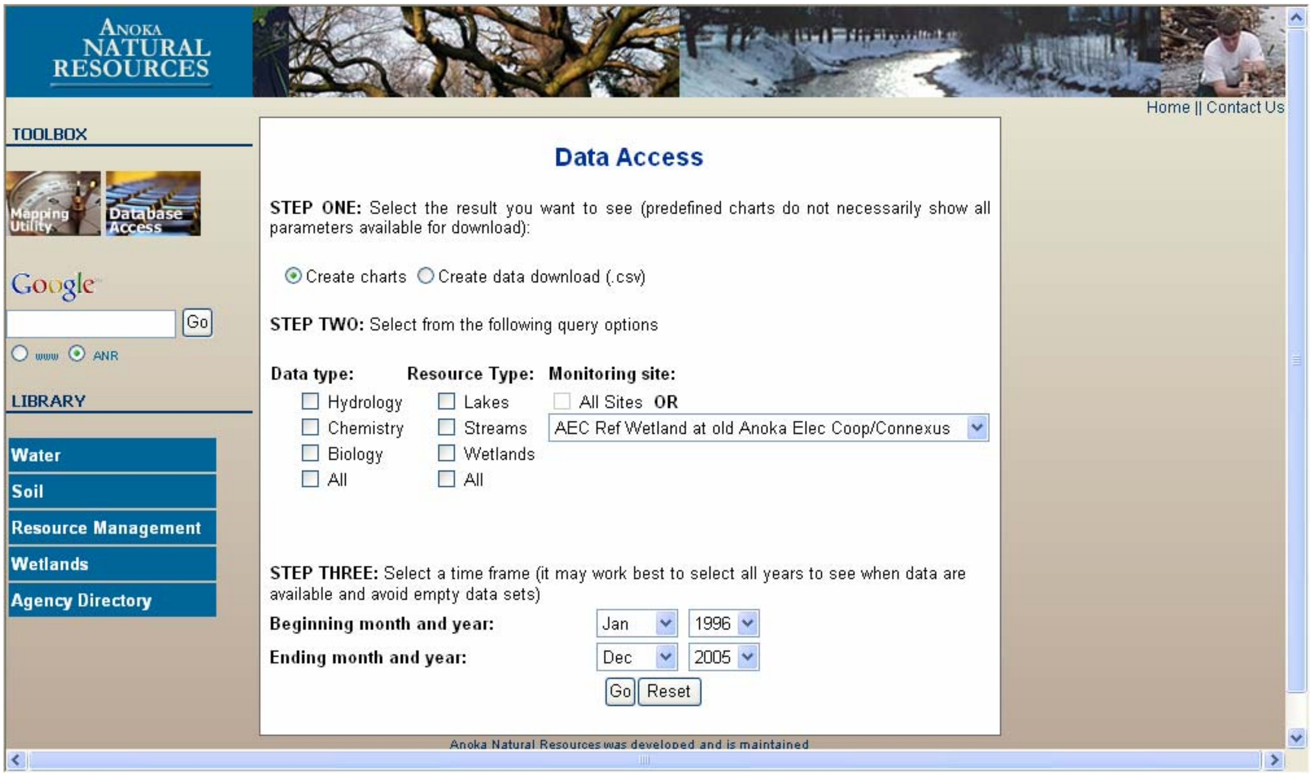
*Click on the binoculars image next to "Find Feature" on the right-hand margin.

*Click on the map and drag a box to zoom further in to a location.

*Click on the "Help" button on the left-hand margin.

X: 509384.615; Y: 5028151.923

Interactive Data Access Tool



Data Access

STEP ONE: Select the result you want to see (predefined charts do not necessarily show all parameters available for download):

● Create charts ○ Create data download (.csv)

STEP TWO: Select from the following query options

Data type:	Resource Type:	Monitoring site:
☐ Hydrology	☐ Lakes	☐ All Sites **OR**
☐ Chemistry	☐ Streams	AEC Ref Wetland at old Anoka Elec Coop/Connexus
☐ Biology	☐ Wetlands	
☐ All	☐ All	

STEP THREE: Select a time frame (it may work best to select all years to see when data are available and avoid empty data sets)

Beginning month and year: Jan 1996

Ending month and year: Dec 2005

Anoka Natural Resources was developed and is maintained

Member City Annual Reporting Template

Description: The LRRWMO Watershed Management Plan, adopted in January 2012, states:

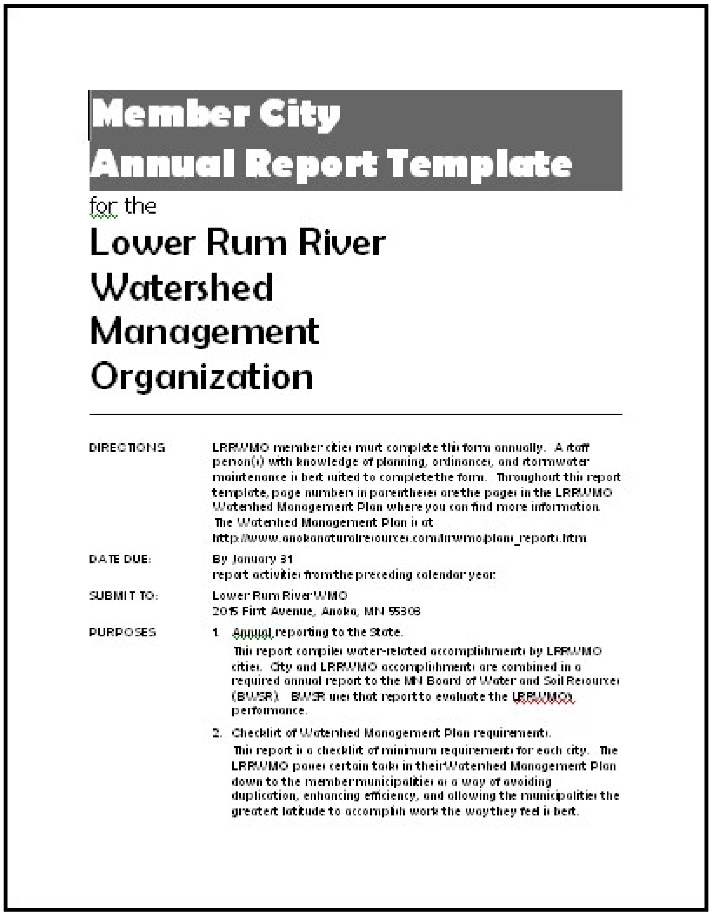
> "Member communities shall prepare and submit an annual status report to the LRRWMO by January 1 of each year reviewing the status of their local plans, the status of the implementation of their plans, and a review of the implementation of policies that are outlined in the LRRWMO plan… The LRRWMO will create a template for this report in 2011 with the assistance of the ACD."

Purpose: To collect information the LRRWMO will need in their annual report to the State Board of Water and Soil Resources (BWSR).
To allow the WMO to defer some responsibilities to the communities, thereby allowing communities more control. BWSR allowed a smaller LRRWMO role on the condition that the LRRWMO have a reporting mechanism that allows them to track city accomplishments.

Location: Watershed wide.

Results: The member city annual reporting template was created by the ACD in January 2012, following adoption of the LRRWMO 3rd Generation Watershed Management Plan on January 19th. It is a three-page, checklist and fill-in-the blank style report that is intended to be brief and quick to fill out. It would be appropriate for cities to complete this report at the end of 2012 (the first year under the new watershed plan), and annually thereafter.

Cover Page of the Member City Reporting Template



Member City
Annual Report Template

for the

Lower Rum River
Watershed
Management
Organization

DIRECTIONS LRRWMO member cities must complete this form annually. A staff person(s) with knowledge of planning, ordinances, and stormwater maintenance is best suited to complete the form. Throughout this report template, page numbers in parentheses are the pages in the LRRWMO Watershed Management Plan where you can find more information. The Watershed Management Plan is at http://www.anokanaturalresources.com/lrrwmo/plans_reports.htm

DATE DUE: By January 31
report activities from the preceding calendar year.

SUBMIT TO: Lower Rum River WMO
2015 First Avenue, Anoka, MN 55303

PURPOSES
1. Annual reporting to the State.
   This report compiles water-related accomplishments by LRRWMO cities. City and LRRWMO accomplishments are combined in a required annual report to the MN Board of Water and Soil Resources (BWSR). BWSR uses that report to evaluate the LRRWMOs performance.
2. Checklist of Watershed Management Plan requirements.
   This report is a checklist of minimum requirements for each city. The LRRWMO passes certain tasks in their Watershed Management Plan down to the member municipalities as a way of avoiding duplication, enhancing efficiency, and allowing the municipalities the greatest latitude to accomplish work the way they feel is best.

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

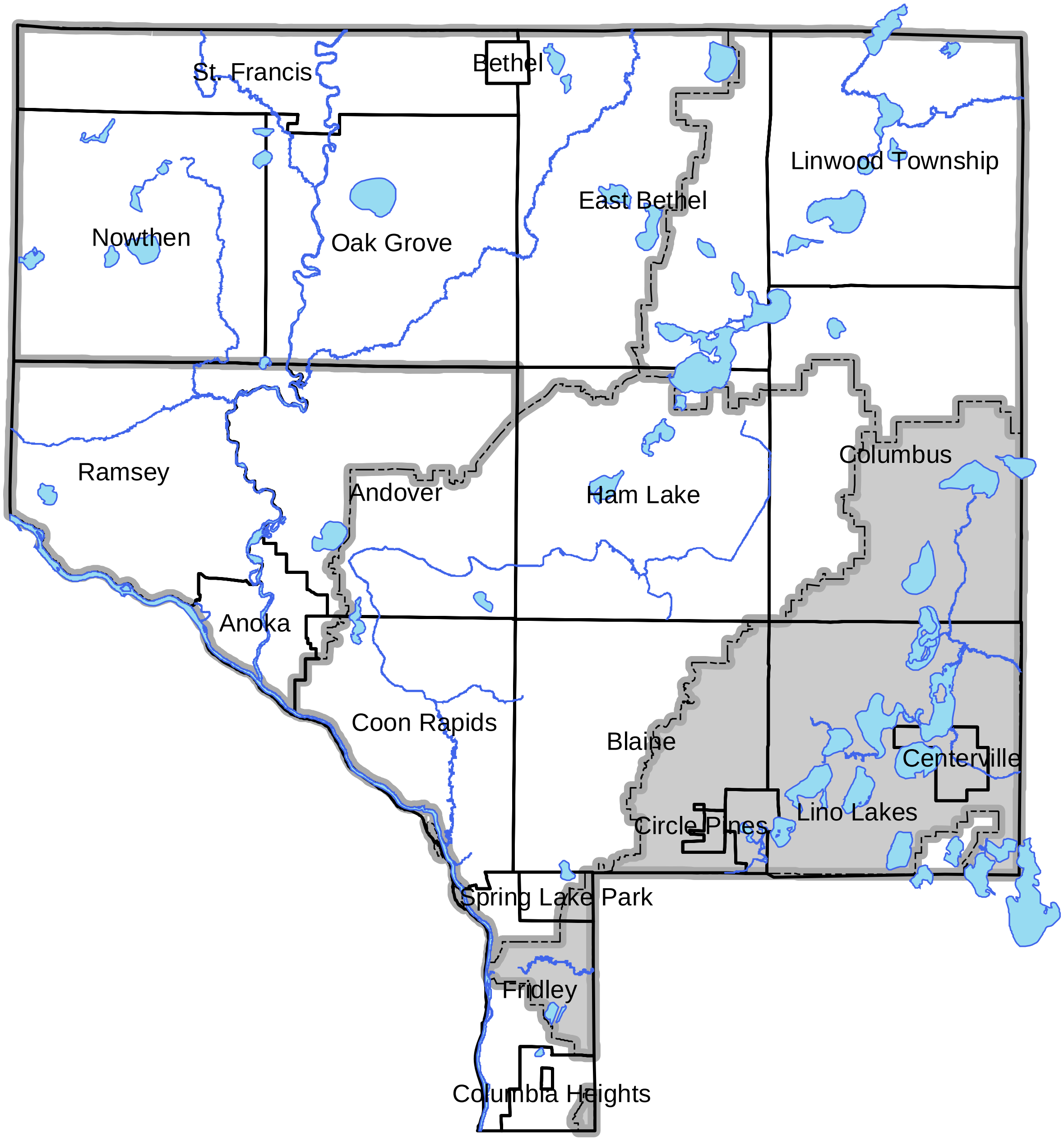
Lower Rum River Watershed	**WMO Asst**	**WMO Websites**	**Reference Wetland**	**Lake Level**	**Stream WQ**	**WOMP**	**Student Biomon**	**LRRWMO TAC**	**WMO Videos**	**Total**
Revenues										
LRRWMO		420	1080	640	1685		790	8703	910	14228
State										
Anoka Conservation District	1600		2		128	1613	6	7056	593	10998
County Ag Preserves							178			178
Regional/Local						500				500
Other Service Fees					30					30
Local Water Planning			4	112			186			301
TOTAL	1600	420	1086	752	1843	2113	1159	15759	1503	26236
Expenses										
Capital Outlay/Equip	4	1	3	1	5	4	2	90		109
Personnel Salaries/Benefits	1368	223	945	658	763	1825	1000	13291	1356	21430
Overhead	117	20	73	49	977	156	68	1338	75	2872
Employee Training	4	1	6	4	3	5	8	35	13	78
Vehicle/Mileage	26	3	15	11	12	36	14	227	18	362
Rent	64	10	39	25	39	85	36	717	41	1056
Program Participants										
Program Supplies	16		6	5	44	2	32	61		167
Equipment Maintenance										
TOTAL	1600	259	1086	752	1843	2113	1159	15759	1503	26074

Recommendations

- **Consult the newly-completed LRRWMO 3rd Generation Watershed Management Plan** for guidance on priorities and tasks.
- **Repeat periodic tours of the Rum River by the LRRWMO Board.** These boat tours are useful for identifying problems and the overall condition of the resource.
- **Continue coordinating monitoring of the Rum River** with the neighboring Upper Rum River WMO and the Metropolitan Council, who runs a monitoring site at the Anoka Dam.
- **Continue monitoring Round Lake** water quality at least every other year to determine if poorer water quality recently is within this lake's natural variation, due to low water levels, or is indicative of new negative influences on the lake.
- **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.
- **Diagnose the cause of periodically low dissolved oxygen in Trott Brook.** Water quality and hydrology monitoring is planned for 2012.
- **Facilitate resident efforts to control aquatic plant growth on Rogers Lake** as a means to improving low dissolved oxygen problems. Treatments should occur in early spring, occur on no more than 15% of the lake, be coordinated, and proceed under DNR permits. In early 2010 a meeting for residents was held, interest expressed, but coordination and work needed by residents did not materialize.
- **Emphasize protection of Rum River water quality.** The river's water quality declines slightly in the LRRWMO and anticipated future development could cause further deterioration. Continued retrofitting existing stormwater treatment in built-up areas is recommended.
- **Continue the existing cost share grant program for water quality improvement projects** on private properties. This program should be actively promoted by identifying problems and contacting landowners.
- **Encourage public works departments to implement measures to minimize road deicing salt applications**. Monitoring and special investigations in the LRRWMO and elsewhere nearby have shown that road salts are a serious and widespread sources of stream degradation. A metro-wide chlorides TMDL study is underway that will provide additional guidance.
- **Promote groundwater conservation.** Water tables in the LRRWMO appear depressed due to regional over-pumping. Metropolitan Council models predict 3+ft drawdown of surface waters in certain areas by 2030, and 5+ft by 2050.

- ➢

Rice Creek Watershed



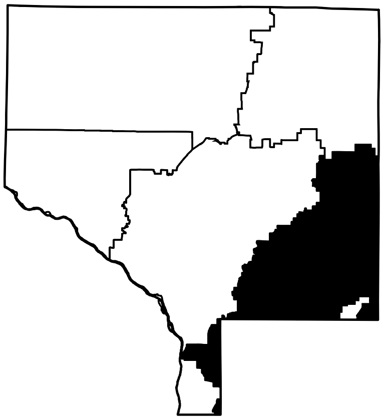
Contact Info: Rice Creek Watershed District
www.ricecreekwd.com
763-398-3070

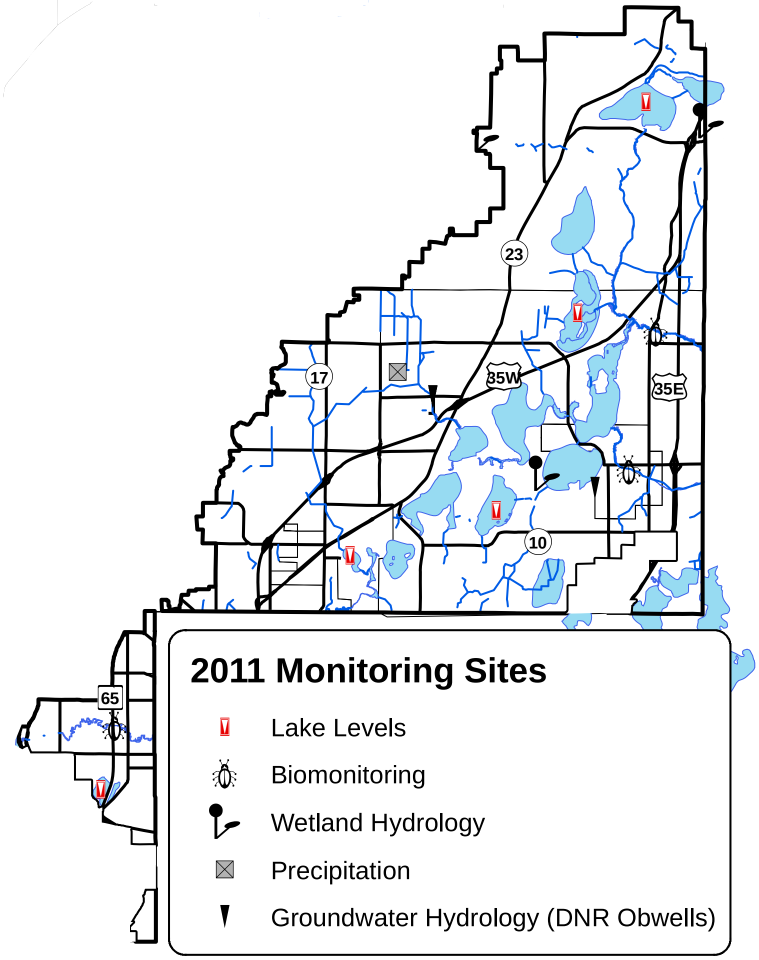
Anoka Conservation District
www.AnokaSWCD.org
763-434-2030

CHAPTER 5:
RICE CREEK WATERSHED

Task	Partners	Page
Lake Levels	RCWD, ACD	5-136
Wetland Hydrology	RCWD, ACD	5-138
Stream Water Quality – Biological	RCWD, ACD, ACAP, Centennial HS, Forest Lake Area Learning Center, Totino Grace HS	5-141
Water Quality Grant Administration	RCWD, ACD	5-148
Golden Lake Subwatershed Assessment	RCWD, ACD	5-149
Financial Summary		5-150
Recommendations		5-151
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. 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.

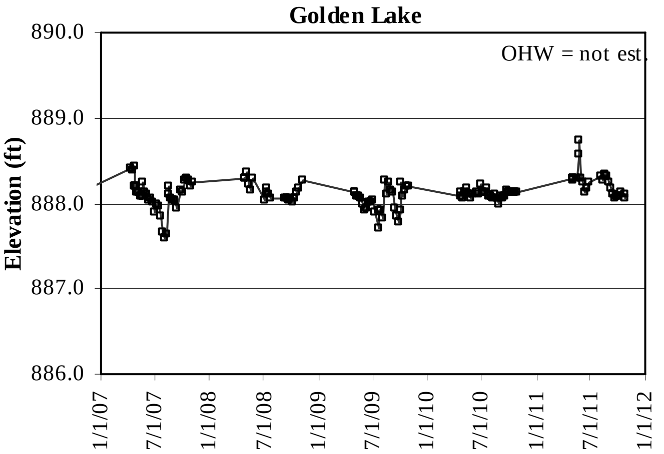
Locations: Golden Lake, Howard Lake, Moore Lake, Reshanau Lake, and Rondeau Lake

Results: Lake levels were measured by volunteers 20 to 47 times in 2011, depending upon the lake. In 2011 all of these lakes had higher water levels than in other recent years due to high rainfall totals in spring and early summer. All except Golden Lake reached water levels more than a foot higher than the preceding fall. After about August 5th very little rainfall fell and water levels dropped continuously on all lakes through ice-up. By the end of fall, all lakes except Reshanau had retreated to levels in the previous fall, or lower.

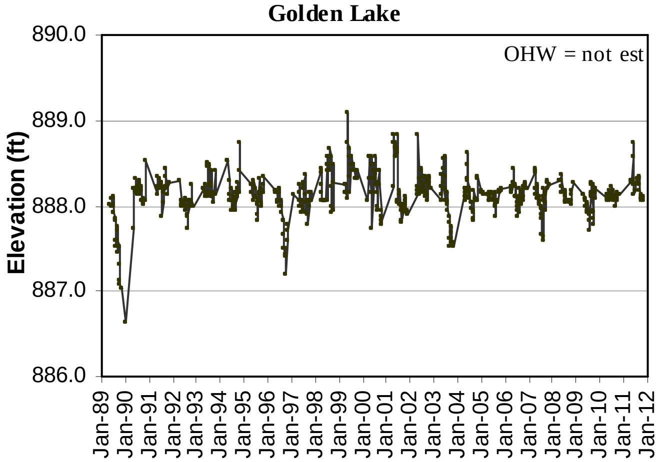
Records for both high and low water were set in 2011. On May 25 Howard Lake exceeded its previous high observed water level by 0.02 feet. On July 16 Moore Lake exceeded its previous record high by 1.02 feet. Rondeau Lake set a new record low on November 28. All of these lakes have lake level records going back to approximately 1990.

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.

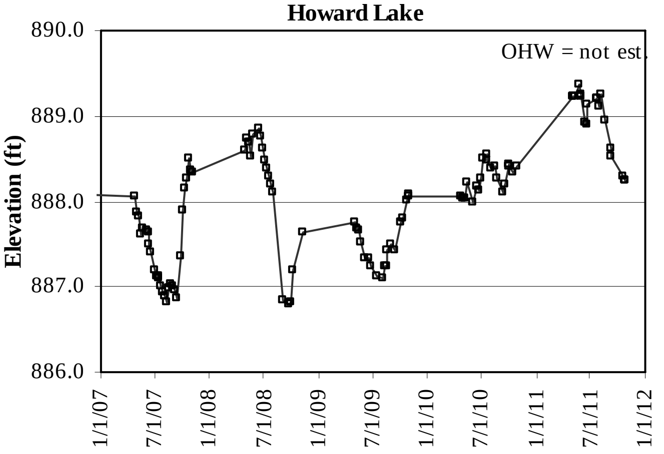
Golden Lake Levels 2007-2011



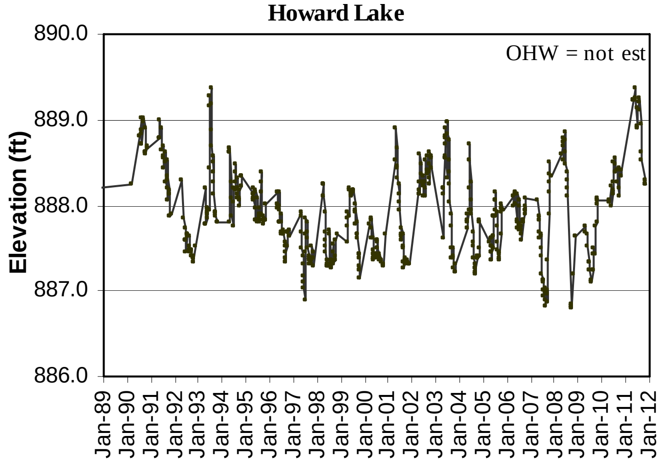
Golden Lake Levels 1990-2011



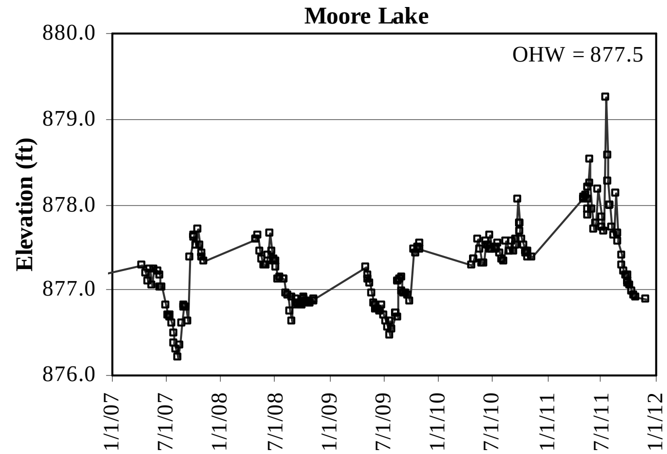
Howard Lake Levels 2007-2011



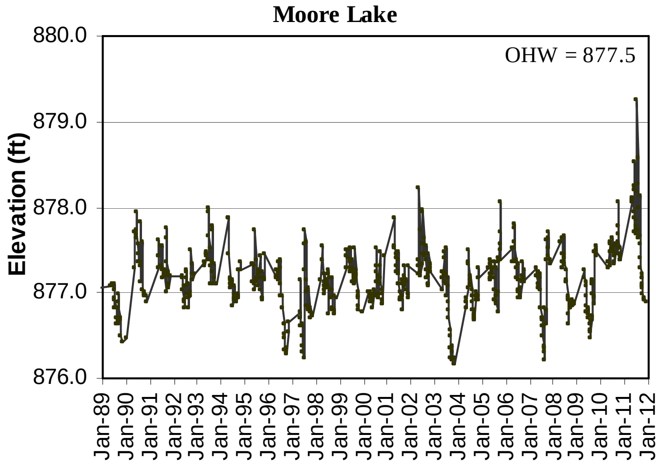
Howard Lake Levels 1990-2011



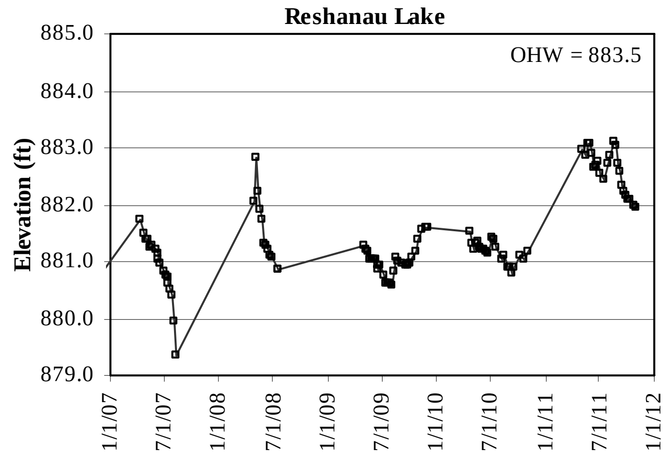
Moore Lake Levels 2007-2011



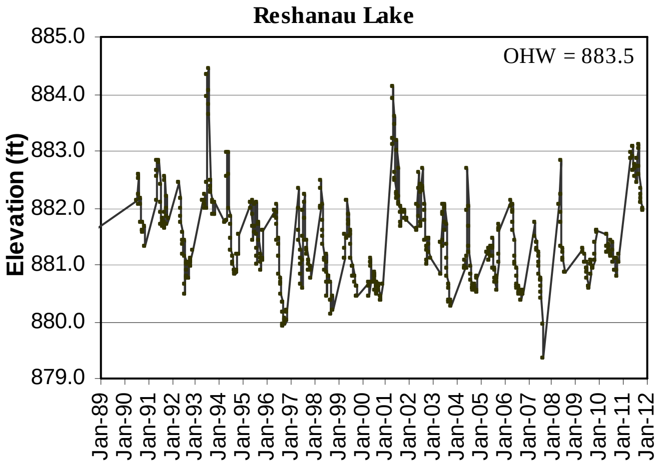
Moore Lake Levels 1990-2011



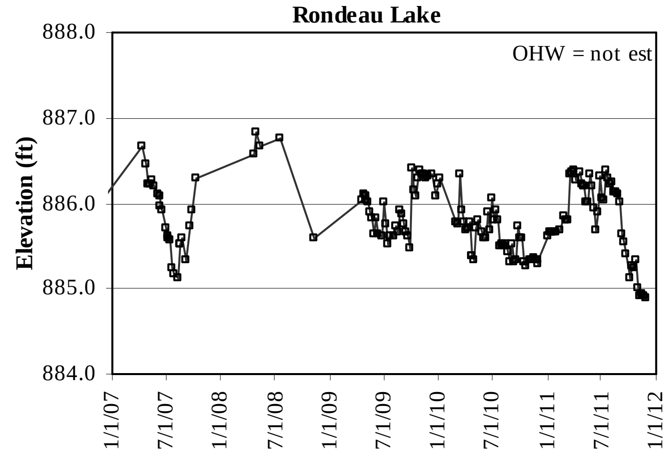
Reshanau Lake Levels 2007-2011



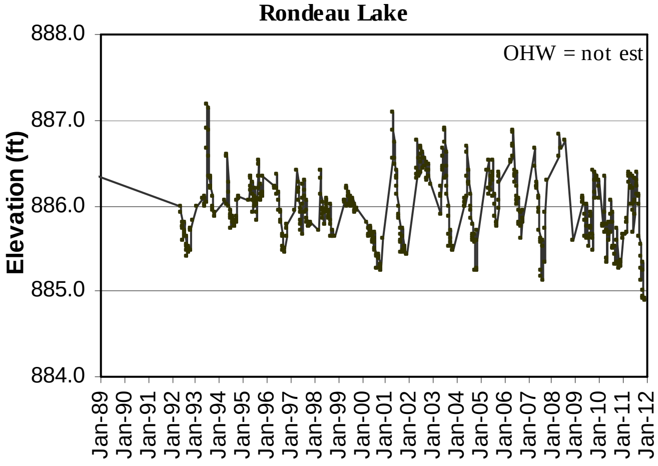
Reshanau Lake Levels 1990-2011



Rondeau Lake Levels 2007-2011



Rondeau Lake Levels 1990-2011



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.

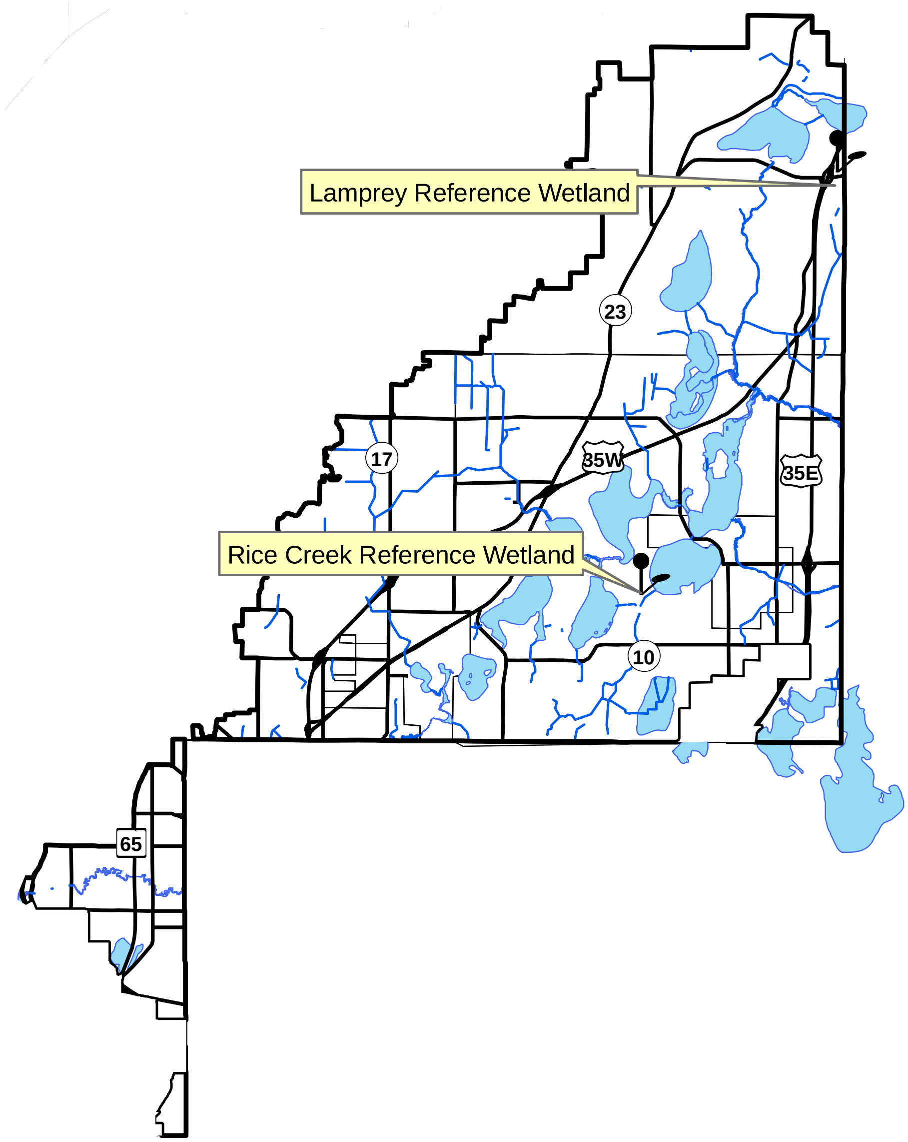
Purpose: To provide an understanding of wetland hydrology, including the impact of climate and land use. These data aid in delineation of nearby wetlands by documenting hydrologic trends including the timing, frequency, and duration of saturation.

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. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

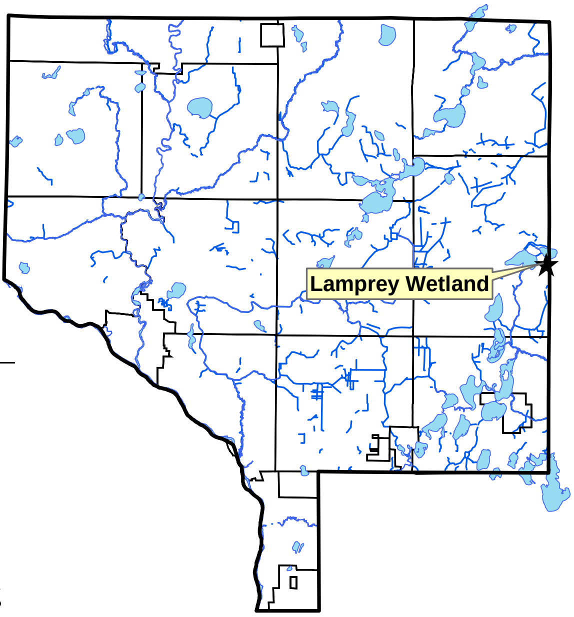
Rice Creek Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

LAMPREY REFERENCE WETLAND

Lamprey Pass Wildlife Mgmt Area, Columbus



Site Information

Monitored Since: 1999

Wetland Type: 4

Wetland Size: ~0.5 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

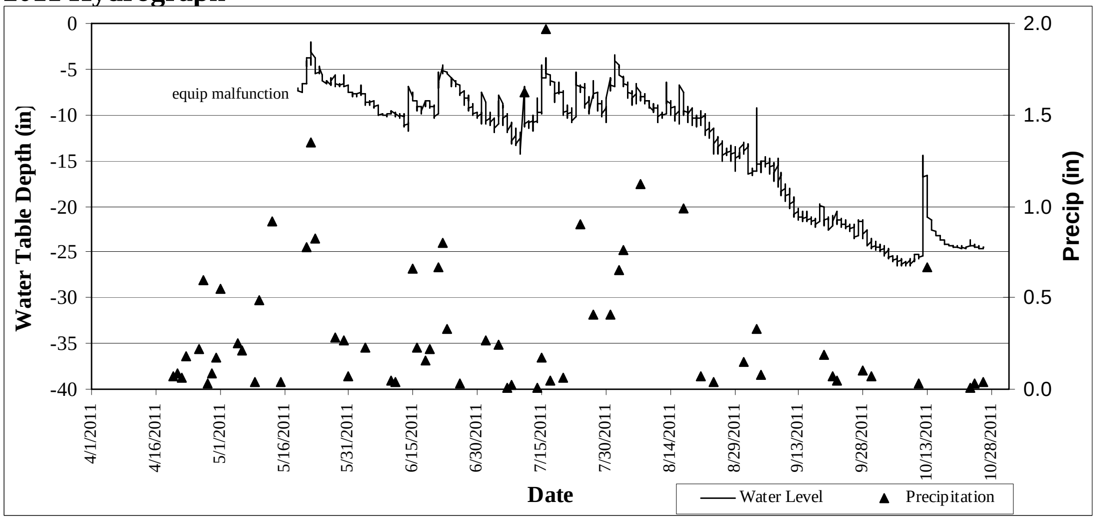
Surrounding Soils: Braham loamy fine sand

Vegetation at Well Location:

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

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

2011 Hydrograph

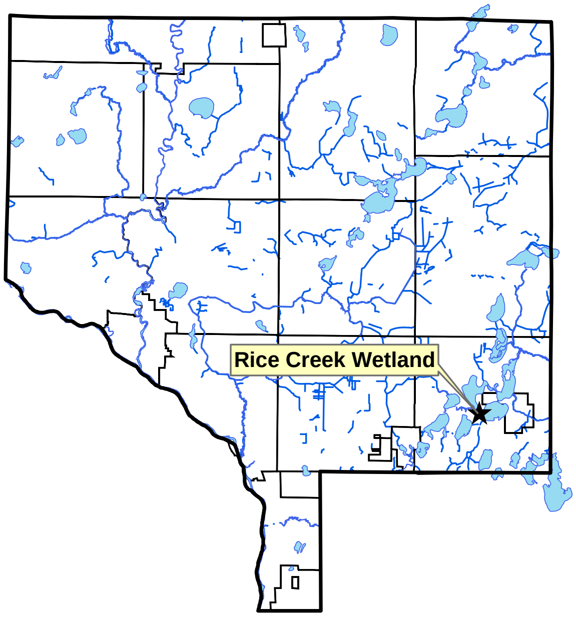


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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

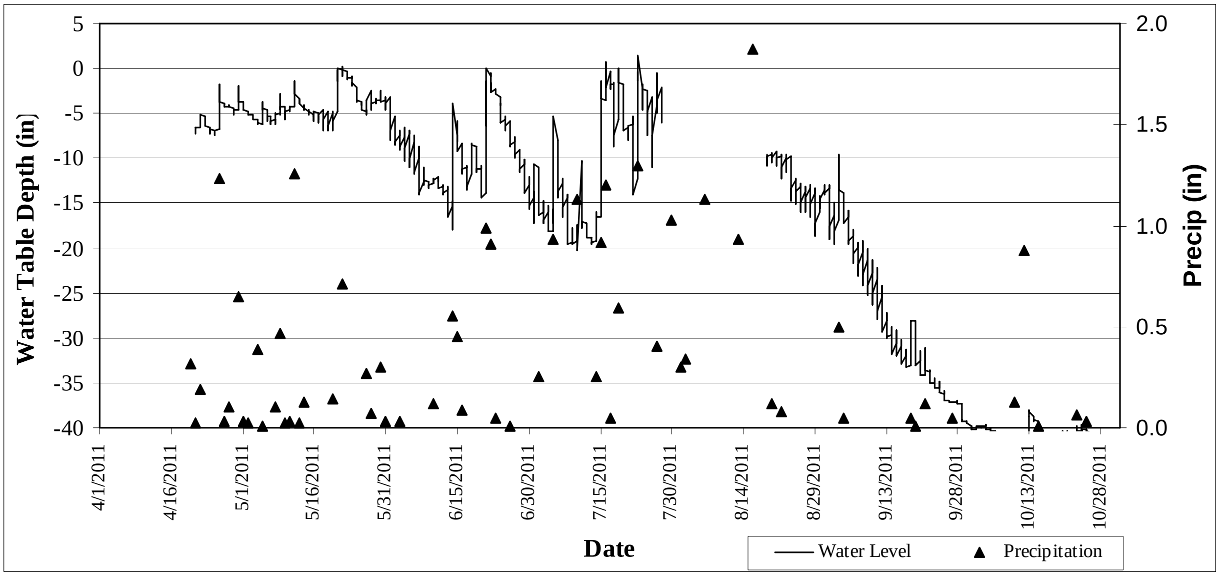
Surrounding Soils: Nessel fine sandy loam and Blomford loamy fine sand

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.

2011 Hydrograph



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

Stream Water Quality – Biological Monitoring

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

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

Locations: Clearwater Creek at Centerville City Hall, Centerville
Hardwood Creek at several locations, Lino Lakes
Rice Creek at Hwy 65, Fridley

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

Tips for Data Interpretation

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

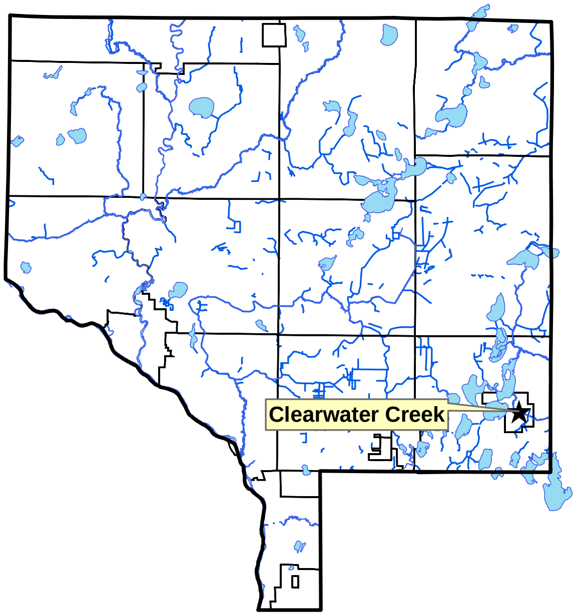
# Families	Number of invertebrate families. Higher values indicate better quality.
EPT	Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.
Family Biotic Index (FBI)	An index that utilizes known pollution tolerances for each family. Lower numbers indicate better stream quality.

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

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

CLEARWATER CREEK

at Centerville City Hall, Centerville



Last Monitored

By Centennial High School in 2011

Monitored Since

1999

Student Involvement

44 students in 2011, approximately 574 since 2001

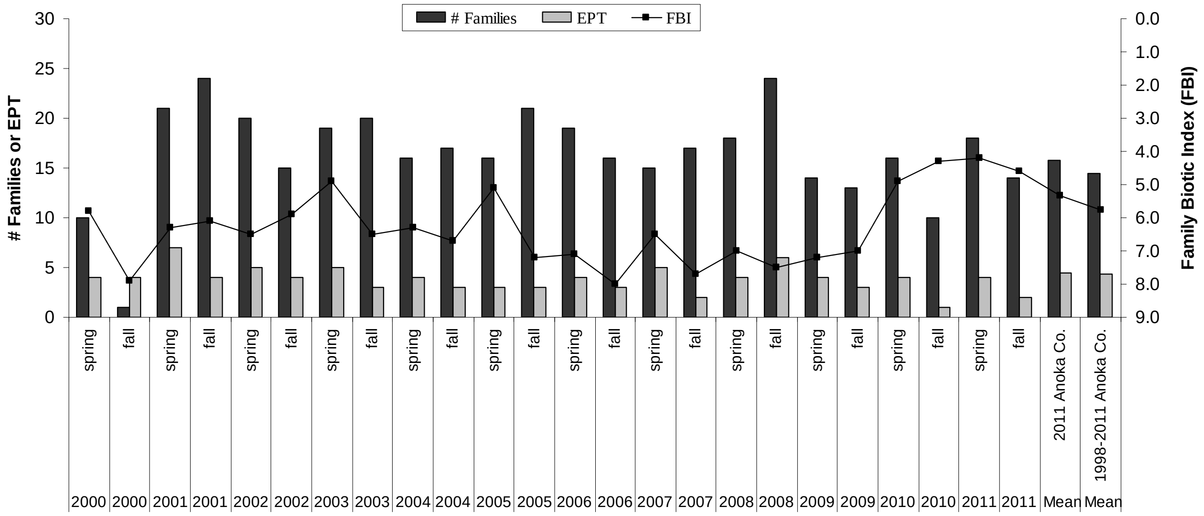
Background

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

Results

Centennial High School classes monitored Clearwater Creek in both spring and fall 2011, with oversight by the Anoka Conservation District (ACD). ACD staff also monitored in spring because it looked like the school would be unable to sample; these data were pooled with the student data. Overall, this stream has average or slightly below average conditions based upon the invertebrate data, though fluctuations occur. Data from 2010-11 represented an interesting deviation from previous years. A dramatic decrease in the family biotic index (FBI) occurred. The lower FBI value suggests an increase in pollution tolerant species. However, this change was likely driven by the dominance of the invertebrate community by Gammaridae, which has a moderate tolerance value of four. Gammaridae comprised 78%, 90%, 94%, and 80% of the invertebrate community in the spring 2010 through and fall 2011 samplings, respectively. Comparison of total number of families and EPT with previous years suggests the overall stream health is similar to previous years.

Summarized Biomonitoring Results for Clearwater Creek in Centerville



Biomonitoring Data for Clearwater Creek in Centerville

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

Year	2007	2007	2008	2008	2009	2009	2010	2010	2011	2011	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	2011 Anoka Co.	1998-2011 Anoka Co.
FBI	6.50	7.70	7.00	7.50	7.20	7.00	4.9	4.3	4.2	4.6	5.3	5.8
# Families	15	17	18	24	14	13	16	10	18	14	15.8	14.5
EPT	5	2	4	6	4	3	4	1	4	2	4.4	4.3
Date	18-May	9-Oct	8-May	1-Oct	20-May	9-Oct	14-May	6-Oct	31-May, 6-Jun	12-Oct		
Sampled By	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS	CHS & ACD	CHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	213	200	180	450	238	386	664	532	2003	146		
# Replicates	1	1	1	1	1	1	1	1	2	1		
Dominant Family	Chironomidae	Corixidae	Simuliidae	Corixidae	Hyalellidae	Corixidae	Gammaridae	Gammaridae	Gammaridae	Gammaridae		
% Dominant Family	20.2	53	27.8	42.3	26.1	53.9	77.7	89.7	93.5	80.1		
% Ephemeroptera	34.7	17.5	10.6	4.7	28.2	8.5	1.8	0.6	0.6	0.7		
% Trichoptera	0.0	0.0	2.2	0.7	0.8	2.8	0.6	0.0	0.1	0.7		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

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

Parameter	5/5/2007	10/9/2007	5/5/2008	10/1/2008	5/20/2009	10/9/2009	5/14/2010	10/6/2010	5/31/2011	6/6/2011	10/6/2011
pH	8.31	7.34	8	7.65	7.56	7.27	7.23	7.29	7.66	7.88	7.74
Conductivity (mS/cm)	0.639	0.4	0.452	0.607	0.699	0.558	0.788	0.701	0.551	0.560	0.551
Turbidity (NTU)	3	13	10	13	4	8	10	21	0	6	16
Dissolved Oxygen (mg/L)	12.57	6.52	11.84	8.74	4.85	9.25	10.31	na	6.32	7.98	1.42
Salinity (%)	0.02	0.01	0.01	0.02	0.02	0.02	0.03	0.04		0.02	0.02
Temperature (°C)	15.8	15.3	14.3	9.5	16.9	7.6	10.0	12.2	18.6	22.9	17.3

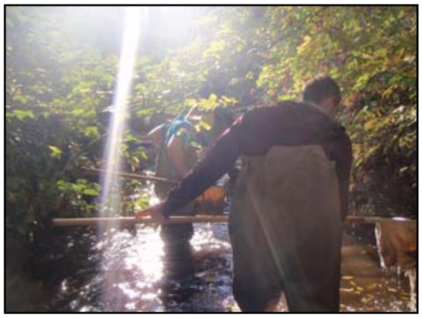
Discussion

This creek's biological community is probably limited by a combination of habitat, hydrology, and water chemistry factors. The portion of the creek that is monitored has been ditched, and is straight with steep banks, no pools or riffles, and homogeneous bottom composition. There is a strip of forested land approximately 20-50 feet wide on each side of the stream, but other areas upstream and downstream have less adjacent natural habitat. Flows are generally slow and water levels are low during much of the year, such that the stream sides are seldom submerged to provide habitat. When higher water does occur, it is usually during large storms. In our supplemental water chemistry measurements we have found occasions when one or more water quality parameters are substandard, but not necessarily during storms when runoff to the creek would be greatest. For example, a highly turbid condition was noted in October 2004 during a baseflow period when the water was barely moving. Likewise, high conductivity values in 2006-2011 were during low water levels. October 6, 2011 we found dissolved oxygen of just 1.42 mg/L, much lower than required by most aquatic life. Overall, this creek seems to provide adequate habitat and water quality for a pollution-tolerant invertebrates, but more sensitive varieties are unable to survive.

Particularly in the last two years, species evenness has been low. Captures were dominated by gammaridae, moderately pollutation-tolerant a scud. They accounted for 78%, 90%, 94%, and 80% of the invertebrate community in the spring 2010 through and fall 2011 samplings, respectively. While 9-17 other families were also found, there were in low abundance, even those that are generalists.

Collectively, this information indicates a very limited invertebrate community is able to thrive in Clearwater Creek.

Centennial High School students at Clearwater Creek in 2010.



HARDWOOD CREEK

see list of monitoring locations below

Last Monitored

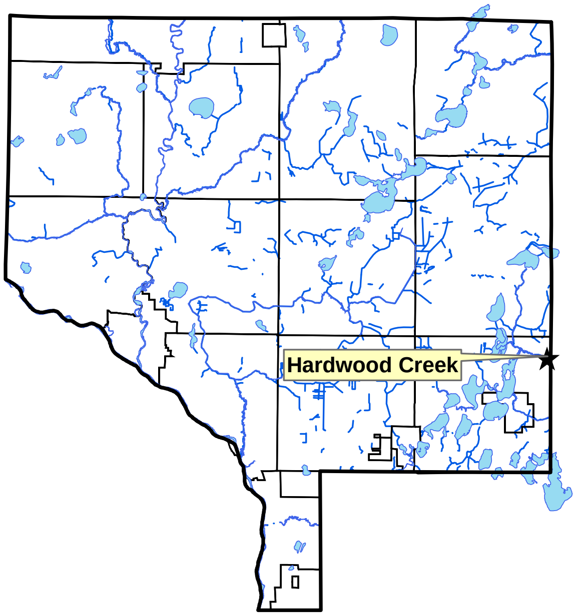
By Forest Lake Area Learning Center in 2011

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
2009-11 at Cecelia LaRoux property 600 m W of I-35

Student Involvement

22 students in 2010, approximately 208 since 2001



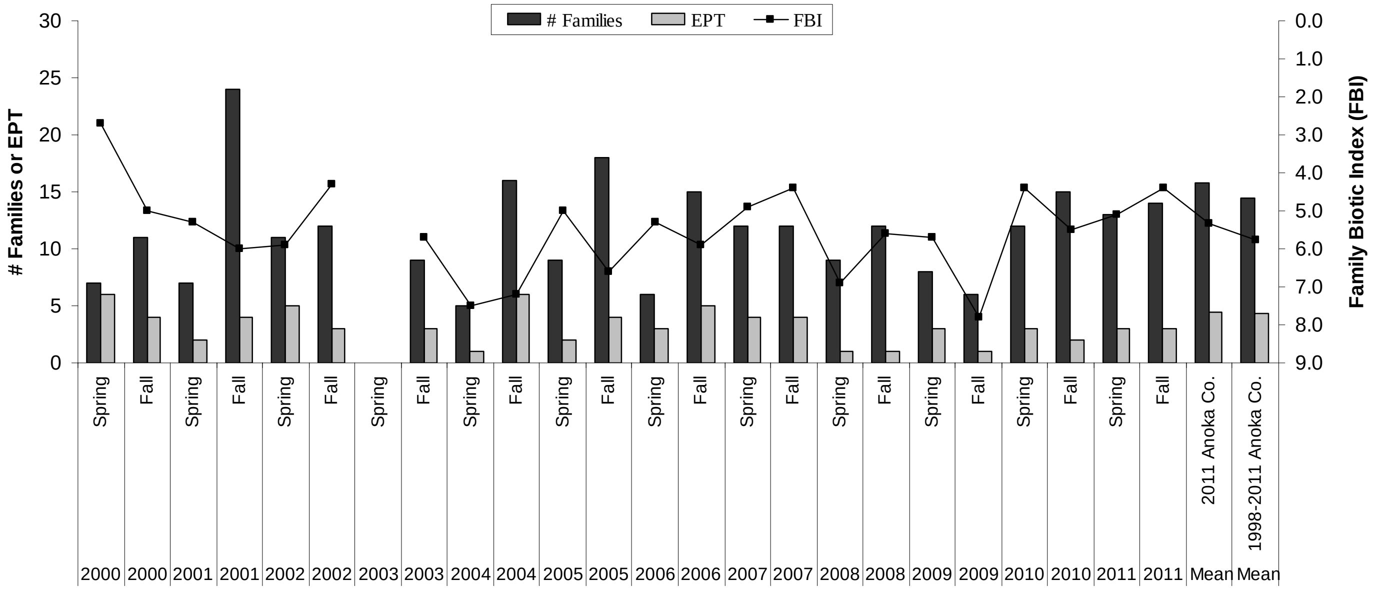
Background

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 2009-11 monitoring site was the subject of a recent stream restoration project. All other monitoring sites have had poor habitat.

Results

Forest Lake Area Learning Center classes monitored Hardwood Creek in the spring and fall 2011, facilitated by the Anoka Conservation District. This site was the subject of a recent stream restoration project that included rock veins, brush bundles, and willow staking. Comparing same-site monitoring in 2009-2011, there is an improvement in 2010-11. This may be due to maturing of the stream rehabilitation project that was done around 2008, or it may simply reflect normal variation. Examining all years and all sites biological data indicate poorer than average stream health before 2010, and near average after 2010.

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	**2007**	**2007**	**2008**	**2008**	**2009**	**2009**	**2010**	**2010**	**2011**	**2011**	**Mean**	**Mean**
Season	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**2011 Anoka Co.**	**1998-2011 Anoka Co.**
FBI	4.90	4.40	6.90	5.60	5.70	7.80	4.40	5.50	5.1	4.4	5.3	5.8
# Families	12	12	9	12	8	6	12	15	13	14	15.8	14.5
EPT	4	4	1	1	3	1	3	2	3	3	4.4	4.3
Date	8-May	5-Oct	15-May	8-Oct	19-May	8-Oct	5-May	14-Oct	11-May	5-Oct		
Sampled By	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC	FLALC		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	290	80	440	159	400	391	290	110	237	190		
# Replicates	1	1	1	1	1	1	1	1	1	1		
Dominant Family	Baetidae	Heptageniidae	Simuliidae	Dystidae	Simuliidae	Corixidae	Baetidae	Gammaridae	Gammaridae	Gammaridae		
% Dominant Family	27.9	48.8	49.1	57.2	67.3	74.7	68.6	51.8	50.2	62.6		
% Ephemeroptera	39.7	60	0	0.6	19.5	0.3	69	9.1	2.5	16.3		
% Trichoptera	1.4	2.5	0.2	0	0.8	0	1.4	0	0.4	1.1		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

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

	Hwy 140 Site	**165th Ave Site**	**Fenway Ave Site**		**C. LaRoux Property**					
Parameter	**5/8/2007**	**10/12/2007**	**5/15/2008**	**10/8/2008**	**5/19/2009**	**10/8/2009**	**5/5/2010**	**10/14/2010**	**5/11/2011**	**10/5/2011**
pH	7.97	7.26	7.13	7.46	8.1	7.43	na	7.57	7.76	7.97
Conductivity (mS/cm)	0.4	0.326	0.361	0.431	0.426	0.37	0.457	0.509	0.411	0.314
Turbidity (NTU)	3	5	13	11	6	22	7	6	13	4
Dissolved Oxygen (mg/L)	11.95	9.1	10.88	7.14	12.3	11.5	11.6	na	9.67	7.01
Salinity (%)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Temperature (°C)	14.5	10.4	12.4	12.4	16.5	9.7	10.4	9.8	17.3	14.5

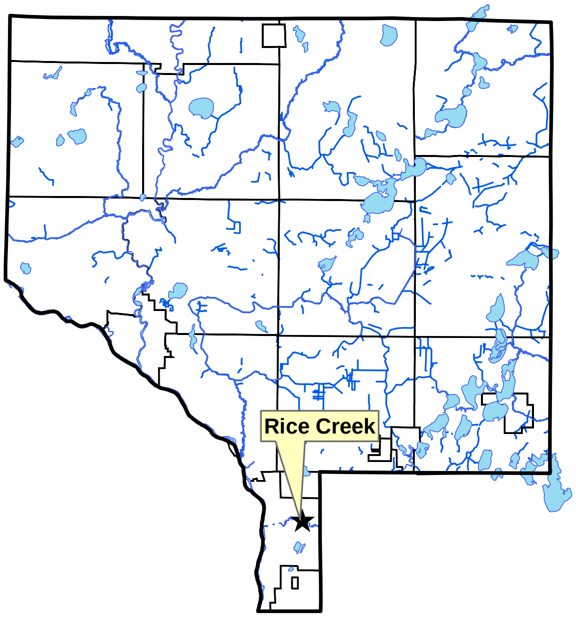
Discussion

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 a stream restoration site.   Invertebrate indices seemed to decline when monitoring was moved from the north side of Highway 140, where habitat was moderate to good, to Fenway Avenue where little in-stream habitat exists.

Forest Lake Area Learning Center students at Hardwood Creek in 2010

RICE CREEK

at Hwy 65, Locke Park, Fridley



Last Monitored

By Totino Grace High School in fall 2011

Monitored Since

1999

Student Involvement

60 students in 2011, approximately 760 since 2001

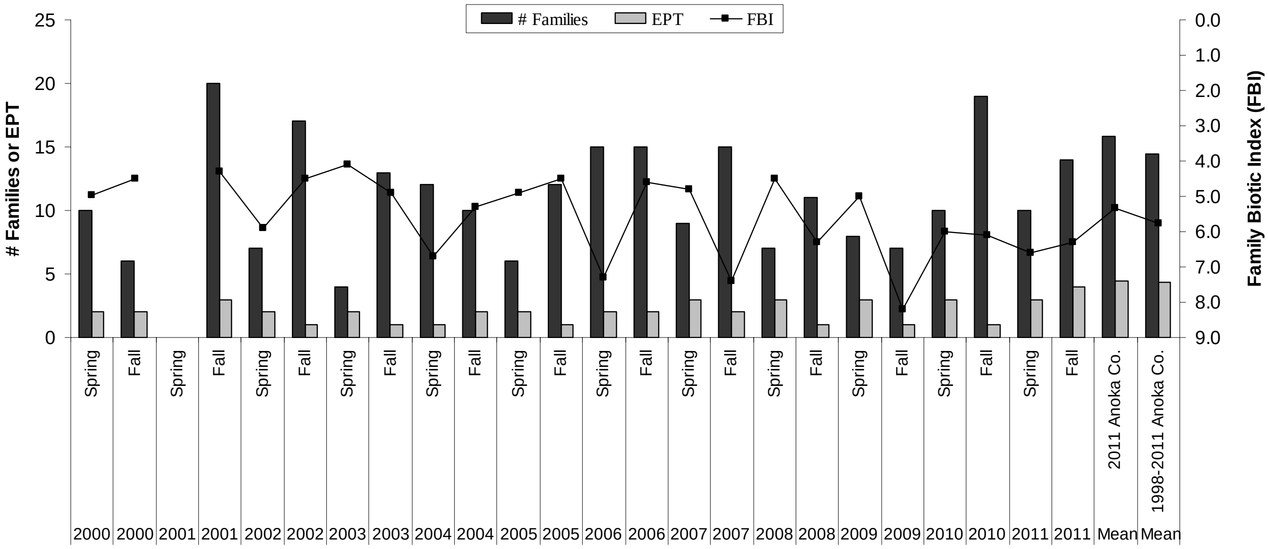
Background

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 2011, facilitated by the Anoka Conservation District (ACD). ACD staff monitored it in spring, when class schedules prevented students from sampling. At this site Rice Creek has an impaired macroinvertebrate community. While the number of families found has been similar to the average for Anoka County streams on several occasions (fall 2010 and 2011 most recently), most of these are generalist species that can tolerate polluted conditions. The number of EPT families have been low 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. Hydropsychidae has been the most abundant family in 12 of 21 creek samplings, often >50% of catches. The Family Biotic Index (FBI) for this site is usually below the mean of Anoka County streams, and has not met or exceeded it more than two years.

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	**2007**	**2007**	**2008**	**2008**	**2009**	**2009**	**2010**	**2010**	**2011**	**2011**	**Mean**	**Mean**
Season	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**2011 Anoka Co.**	**1998-2011 Anoka Co.**
FBI	4.80	7.40	4.5	6.3	5.0	8.2	6	6.1	6.6	6.3	5.3	5.8
# Families	9	15	7	11	8	7	10	19	10	14	15.8	14.5
EPT	3	2	3	1	3	1	3	1	3	4	4.4	4.3
Date	10-May	2-Oct	23-May	10-Oct	11-May	8-Oct	14-May	13-Oct	31-May	7-Oct		
Sampled By	ACD	TGHS	ACD	TGHS	ACD	TGHS	ACD	TGHS	ACD	TGHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
# Individuals	116	132	180	104	148	111	154	132	126	215		
# Replicates	1	2	1	1	1	1	1	1	1	1		
Dominant Family	Baetidae	Corixidae	Baetidae	Hydropsychidae	Baetidae	Corixidae	Chironomidae	Hydropsychidae	Chronomidae	Simulidae		
% Dominant Family	49.1	61.2	70.0	40.0	50.0	74.8	29.2	31.1	39.7	23.3		
% Ephemeroptera	49.1	0.4	74.4	0.0	50.7	0.0	23.4	0.0	15.9	12.1		
% Trichoptera	13.8	27.6	7.2	42.3	6.8	9.0	3.2	31.1	0.8	14.0		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Supplemental Stream Chemistry Readings

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

Parameter	**5/10/2007**	**10/2/2007**	**5/23/2008**	**10/10/2008**	**5/11/2009**	**10/8/2009**	**5/14/2010**	**10/13/2010**	**5/31/2011**	**10/7/2011**
pH	8.25	7.85	8.12	7.73	8.23	4.76	7.85	7.92	7.62	8.02
Conductivity (mS/cm)	0.401	0.402	0.461	0.639	0.624	0.638	0.545	0.535	0.504	0.364
Turbidity (NTU)	65	25	15	13	16	18	13	15	0	6
Dissolved Oxygen (mg/L)	Na	9.06	9.56	9.01	12.29	10.74	12.64	na	7.94	7.34
Salinity (%)	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	na	0.01
Temperature (°C)	20.6	16.8	19	12.9	14.5	11.2	12.8	16.5	19.6	17.1

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 probably degrade water quality.

Totino Grace High School students at Rice Creek in 2010 and 2011.

Water Quality Grant Administration

Description: ACD worked with RCWD to develop and coordinate 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: The RCWD grant program is dedicated to assisting property owners with the implementation of BMPs that improve water quality within the District.

Results: In 2011 ACD provided technical/design assistance valued at $38,960 and was reimbursed $4,670 through the Clean Water Fund (from the Clean Water, Land, and Legacy Amendment). Efforts resulted in the design and installation of 15 practices. Designs for five additional projects were completed and are likely to be installed in 2012.

Project Management Details. The entries in this table provide details on ACD's efforts toward the RCWD BMP cost share program summarized in the project management column of the financial summary table at the end of this chapter.

TASK DESCRIPTION	HOURS	RATE	VALUE
2011 Rice Lake Residential Rain Gardens			
Promotion/Admin (Specialist)	70.5	$ 70.00	$ 4,935.00
Promotion/Admin (Technician)	23	$ 60.00	$ 1,380.00
Design	117	$ 70.00	$ 8,190.00
Construction Oversight (Specialist)	103.5	$ 70.00	$ 7,245.00
Construction Oversight (Technician)	43.5	$ 60.00	$ 2,610.00
Rice Lake Elementary			
Construction Coordination/Oversight (Specialist)	74.5	$ 70.00	$ 5,215.00
Construction Coordination/Oversight (Technician)	20.5	$ 60.00	$ 1,230.00
2010 Rice Lake Residential Rain Gardens			
Repairs/Troubleshooting (Specialist)	18.5	$ 70.00	$ 1,295.00
Other RCWD Cost Share			
TA Hours (Specialist)	80.5	$ 70.00	$ 5,635.00
Design Hours	17.5	$ 70.00	$ 1,225.00
Total Value of Services	**569**		**$ 38,960.00**

Example project – Students planting one of three rain gardens installed at Rice Lake Elementary in 2011. ACD provided technical/design assistance and construction oversight. The project was fully funded by the RCWD cost share program, and Clean Water Funds (from the Clean Water, Land, and Legacy Amendment). The school agreed to do long-term maintenance. More details on projects installed in RCWD are included in a separate report produced by the Anoka Conservation District.

Golden Lake Subwatershed Assessment

Description: The stormwater retrofit assessment takes a systematic approach to identifying and prioritizing water quality improvement projects that provide the greatest amount of stormwater treatment per dollar spent. The Rice Creek Watershed District identified Golden Lake as a high priority water resource and contracted with the Anoka Conservation District to assess the subwatershed in the Cities of Circle Pines, Lexington, and Blaine. The goal is to implement projects in a systematic way that maximizes the use of limited financial resources by identifying and prioritizing projects according to cost-effectiveness.

Purpose: To improve stormwater quality and reduce the volume of runoff entering the stormwater system from neighborhoods that most greatly contribute to the degradation of Golden Lake.

Results: The assessment is detailed in a separate report and summarized here.

We delineated the Golden Lake subwatershed into nine smaller stormwater drainage areas, or "catchments." For each catchment, we modeled stormwater volume and pollutants using the software WinSLAMM. First, we modeled existing conditions, including existing stormwater treatment practices. Currently, the 1,070 acre area contributes an estimated 512 acre feet of runoff, 330 pounds of phosphorus and 97,243 pounds of total suspended solids to the lake each year. Then we modeled possible stormwater retrofits to estimate reductions in volume, total phosphorus (TP), and total suspended solids (TSS). Finally, we estimated the cost of each retrofit project, including 30-year lifespan operations and maintenance. Projects were ranked by cost effectiveness with respect to total phosphorus reduction.

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

- Maintenance of, or alterations to, existing stormwater treatment practices.
- Residential curb-cut rain gardens,
- Permeable asphalt, and
- Iron enhanced sand filters.

The table on the next page summarizes potential projects. Potential projects are organized from most cost effective to least, based on cost per pound of total phosphorus removed. Reported treatment levels are dependent upon optimal siting and sizing.

Summary of stormwater retrofits identified during the Golden Lake Stormwater Assessment

Project ID	Catchment ID	Retrofit Type (refer to catchment profile pages for additional detail)	Projects Identified	TP Reduction (lb/yr)	TSS Reduction (lb/yr)	Volume Reduction (ac-ft/yr)	Estimated Installation Cost	Estimated cost/ 1,000lb-TSS/year (30-year)	Estimated cost/ lb-TP/year (30-year)
1	GL-2	Pond Modification - Iron Enhanced Sand Filter	1	35.2	0	0.0	$89,180	N/A	$167
2	GL-4*	Residential Rain Gardens	5 - 15	5.4 - 13.5	865 - 2,281	4.1 - 10.8	$25,020 - $71,420	$1,398 - $1,537	$224 - $260
3	GL-3	Residential Rain Gardens	5	4.1	674	3.2	$25,020	$1,794	$295
4	GL-5*	Pond Modification - Iron Enhanced Sand Filter	1	8.3 - 11.5	0	0.0	$39180 - $64,180	N/A	$308 - $367
5	GL-7	Residential Rain Gardens	5	3.9	676	3.2	$25,020	$1,788	$310
6	GL-5*	Residential Rain Gardens	5 - 10	3 - 5.6	687 - 1,354	4.1 - 7.6	$25,020 - $48,220	$1,741 - $1,760	$403 - $421
7	GL-4*	New Pond with Expanded Drainage Area and Iron Enhanced Sand Filter	1	24.2	3,679	0.0	$172,655 - $228,215	$3,129 - $4,135	$476 - $629
8	GL-4*	New Pond with Expanded Drainage Area	1	13.9	3,679	0.0	$120,780 - $176,340	$2,189 - $3,195	$579 - $845
9	GL-4*	New Pond	1	9.7	2,249	0.0	$95,630 - $151,190	$2,835 - $4,482	$657 - $1,039
10	GL-1*	Golden Lake Park Rain Garden	1	0.7	371	1.1	$19,960	$1,996	$1,139
11	GL-1*	Golden Lake Park Permeable Asphalt	1	0.7	432	1.2	$133,014	$10,752	$6,531

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

Financial Summary

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

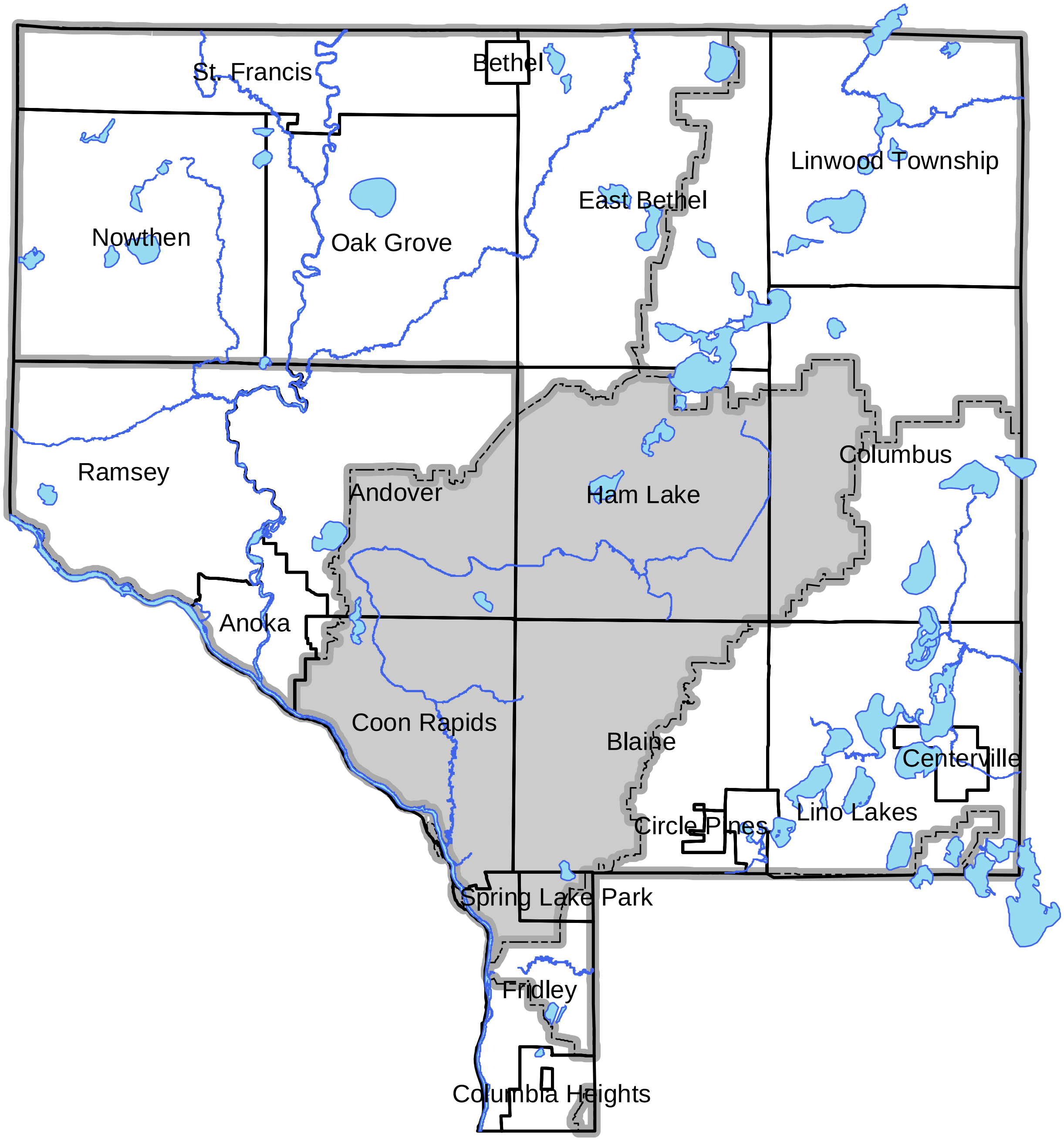
Rice Creek Watershed Financial Summary

Rice Creek Watershed	Reference Wetland	Lake Level	Student Biomon	Golden Lk Retro Assess	Rice Lk Retro Promo	Rice Lake Retrofit Install	Total
Revenues							
RCWD	1080	800	2370	10000		10000	24250
State						4670	4670
Anoka Conservation District	2		18	18221	7013	17277	42531
County Ag Preserves			533				533
Regional/Local							
Other Service Fees							
Local Water Planning	4	140	557				701
TOTAL	1086	940	3478	28221	7013	31947	72685
Expenses							
Capital Outlay/Equip	3	1	5		40	4	52
Personnel Salaries/Benefits	945	822	2999	25659	6315	30689	67431
Overhead	73	61	204	1315	409	648	2709
Employee Training	6	5	23	282	10	33	358
Vehicle/Mileage	15	14	43	293	42	182	588
Rent	39	31	107	672	198	391	1437
Program Participants							
Program Supplies	6	6	97				110
Equipment Maintenance							
TOTAL	1086	940	3478	28221	7013	31947	72685

Recommendations

- **Install and maintain water quality improvement projects identified through the Rice and Golden Lake Subwatershed Assessments.**
- **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 Creeks 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 indicates for Rice Creek show a depleted invertebrate community.
- **Address water quality problems in Moore Lake**. Storm water inputs and over-abundant waterfowl are likely sources of water quality problems.
- **Expand the network of reference wetlands** to include altered and ditched sites. These aid in accurate wetland regulatory determinations.
- **Reduce road salt use.** Elevated chlorides are pervasive throughout shallow aquifers and the streams that feed them.

Coon Creek Watershed



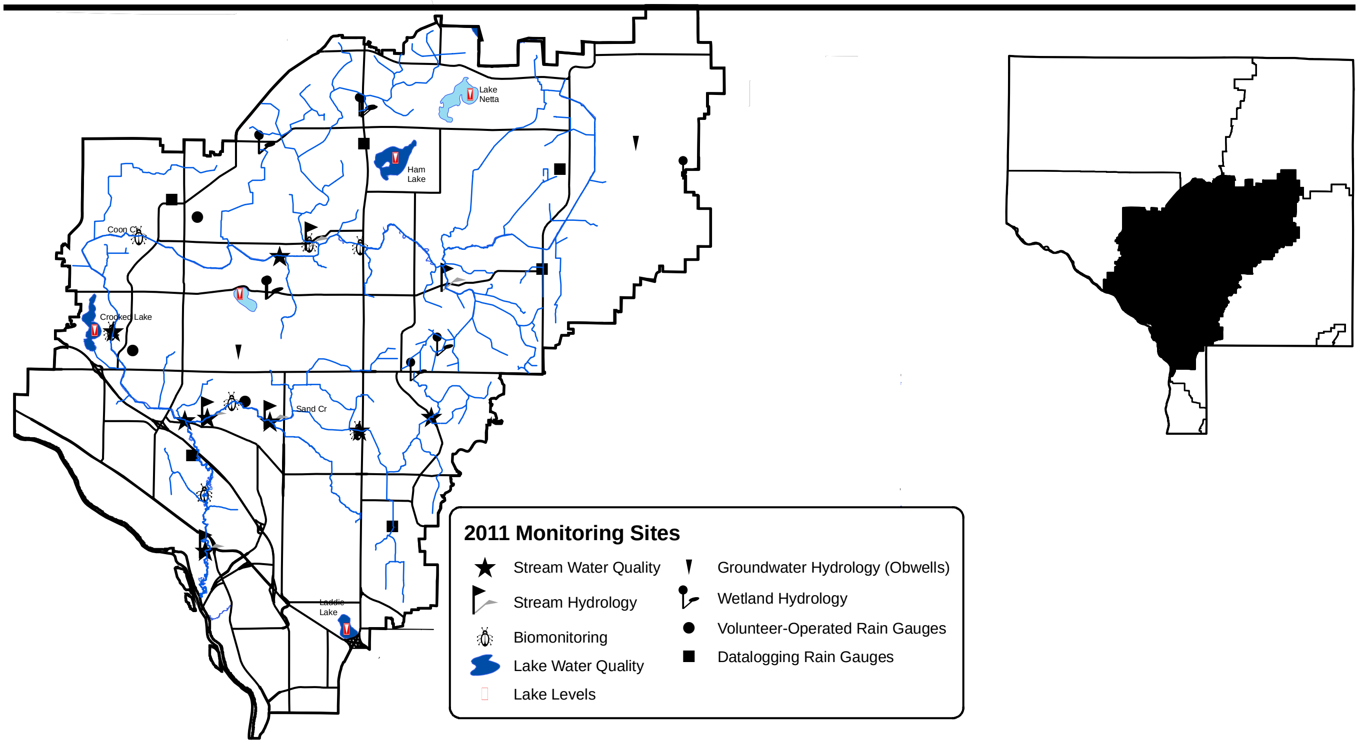
Contact Info: Coon Creek Watershed District
www.cooncreekwd.org
763-755-0975

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

CHAPTER 6:
COON CREEK WATERSHED

Task	Partners	Page
Precipitation	CCWD, ACD, volunteers	6-154
Precipitation Analyses	CCWD, ACD	6-156
Lake Levels	CCWD, ACD, volunteers	6-158
Lake Water Quality	CCWD, ACD, ACAP	6-160
Stream Hydrology and Rating Curves	CCWD, ACD	6-168
Stream Water Quality - Chemical	CCWD, ACD	6-175
Stream Water Quality - Biological (student)	ACD, CCWD, ACAP, Andover HS	6-208
Stream Water Quality - Biological (professional)	CCWD, ACD	6-213
Wetland Hydrology	CCWD, ACD, ACAP	6-216
Reference Wetland Analyses	CCWD, ACD	6-226
Reference Wetland Vegetation Transects	CCWD, ACD	6-230
Lower Coon Creek Subwatershed Assessment	CCWD, ACD	6-251
Sand Creek Rain Garden Promotion and Design	CCWD, ACD	6-252
Financial Summary		6-253
Recommendations		6-254
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.

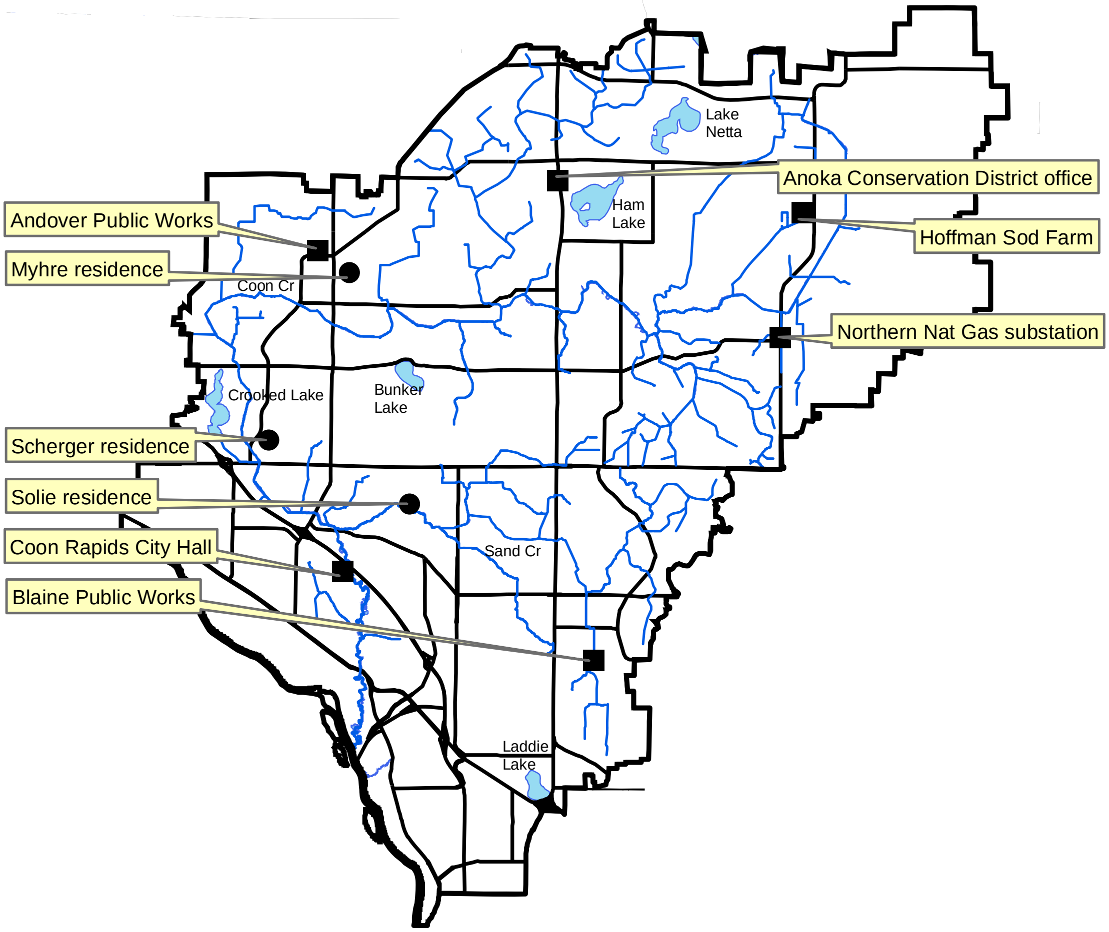
Locations: Datalogging gauges:
Andover City Hall, Andover
Anoka Conservation District office, Ham Lake
Blaine Public Works, Blaine
Coon Rapids City Hall, Coon Rapids
Hoffman Sod Farm, Ham Lake
Northern Natural Gas Substation at Lexington Blvd and Bunker Lake Blvd, Ham Lake

Cylinder gauges read by volunteers:
Myhre residence, Andover
Scherger residence, Coon Rapids
Solie residence, Coon Rapids

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

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

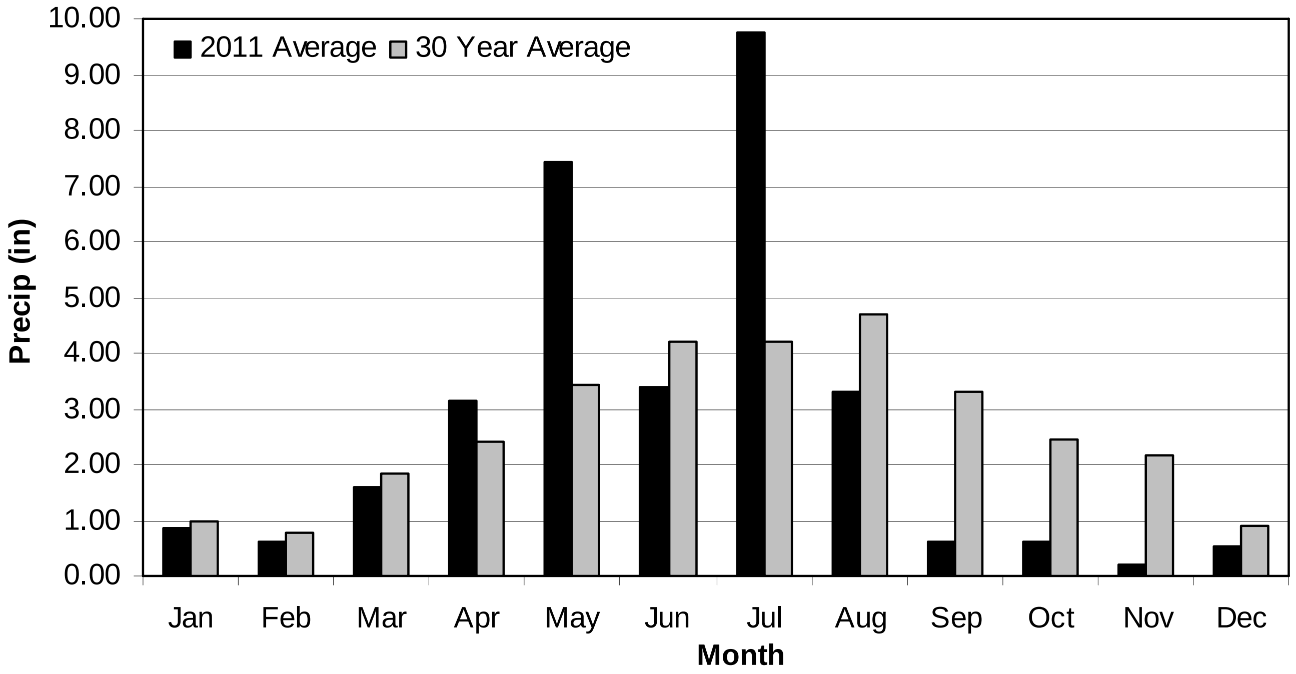
Coon Creek Watershed 2011 Precipitation Monitoring Sites



Coon Creek Watershed 2011 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			1.51	3.73	8.36	3.92	12.10	3.37	0.52	0.93				28.27
Blaine Public Works	Blaine				3.33		2.72	9.39	3.30	0.69	0.63				16.10
Coon Rapids City Hall	Coon Rapids			1.36	3.85		4.48	10.79	3.70	0.61	0.23				19.58
Anoka Cons. District office	Ham Lake			1.23	3.59	7.35	1.69		3.19	0.89	0.45				13.12
Hoffman Sod Farm	Ham Lake			1.70	3.52		4.18	9.57	2.94	0.61	0.66				17.30
Northern Nat. Gas substation	Ham Lake			1.58	0.36	5.84	2.41	8.60	3.18	0.45	0.59				20.48
Cylinder rain gauges (read daily)															
N. Myhre	Andover	0.85	0.61	2.28	2.87	8.68	4.01	9.79	3.20	0.69	0.79	0.19	0.55	34.51	26.37
S. Scherger	Coon Rapids				3.07	8.52									
S. Solie	Coon Rapids				3.82	5.76	3.67	7.95	3.43	0.55					21.36
2011 Average	County-wide	0.85	0.61	1.61	3.13	7.42	3.39	9.74	3.29	0.63	0.61	0.19	0.55	32.01	24.46
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) 2011 storms analyses and 2) long term precipitation trend analysis.

1.) **2011 Storms 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. For those storms 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: Andover City Hall, Andover

Anoka Conservation District office, Ham Lake

Blaine Public Works, off 101st Ave, Blaine

Coon Rapids City Hall, Coon Rapids

Hoffman Sod Farm, Lexington Blvd near 155th Ave, Ham Lake

Northern Natural Gas Substation at Lexington Blvd and Bunker Lake Blvd, Ham Lake

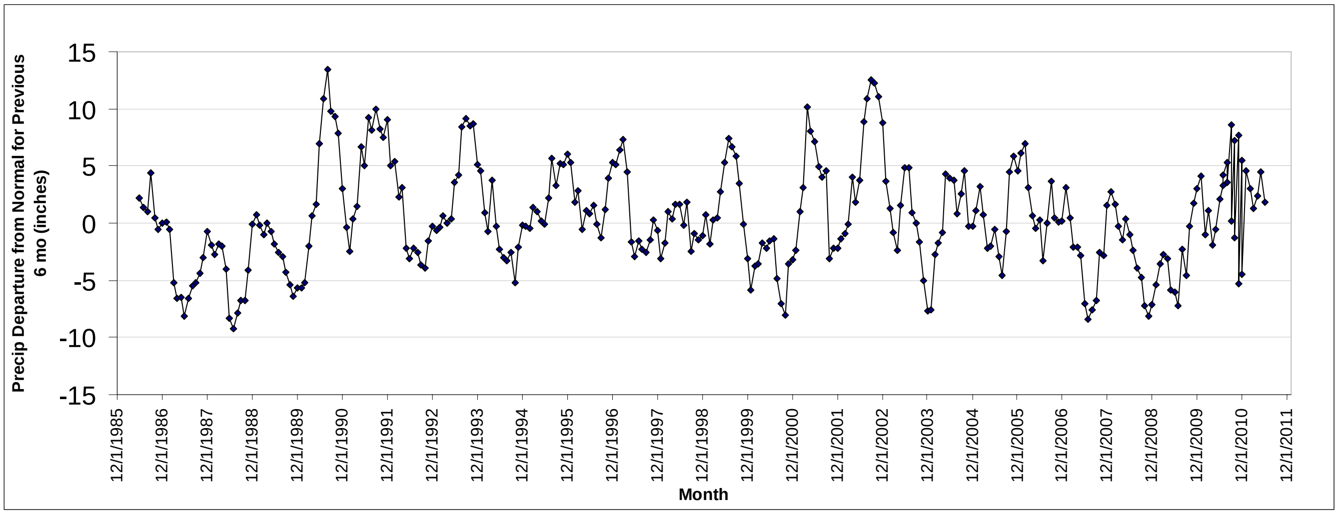
Results: 1.) **2011 Storms Analyses:** The results of these analyses were delivered to the Coon Creek Watershed District in digital form and are not reported here due to complexity and lengthiness.

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

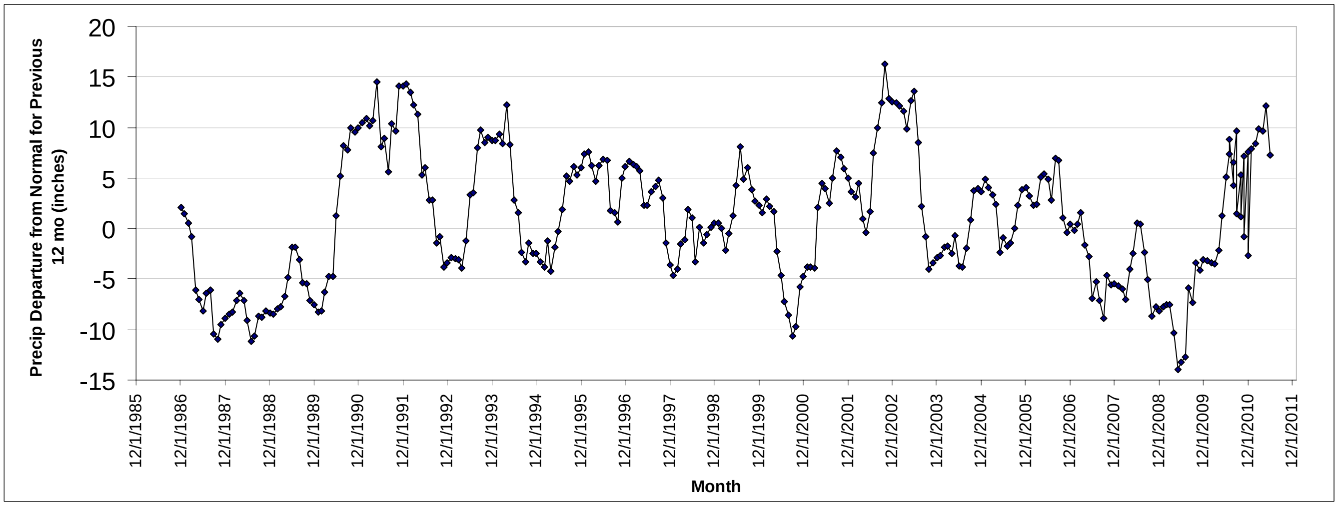
Long Term Precipitation Trends

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.

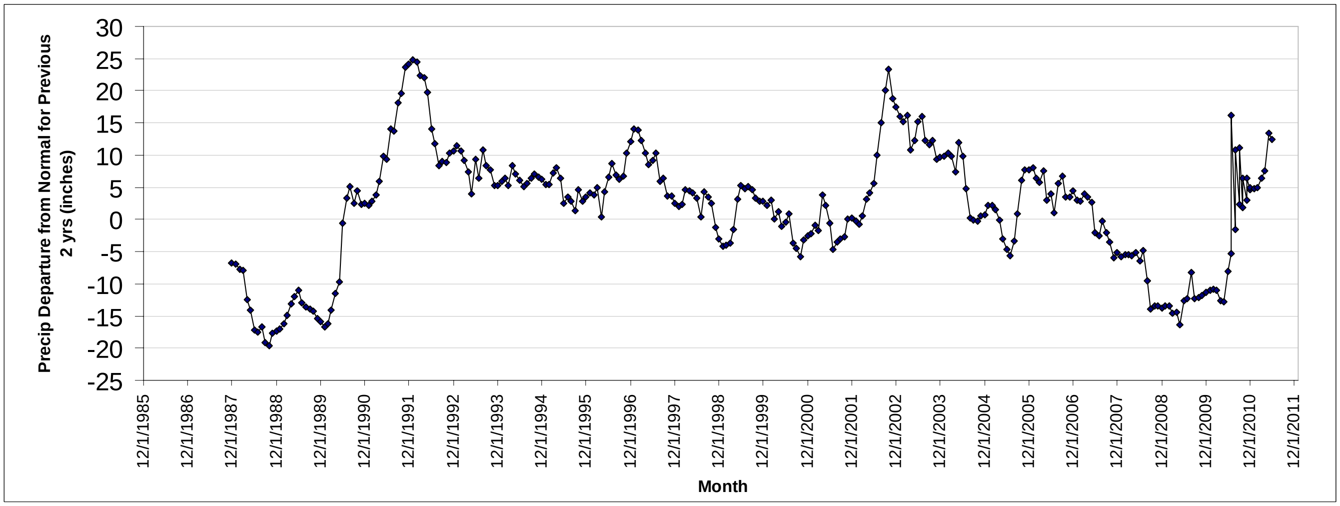
Precipitation departure from normal during the previous 6 months



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: Bunker Lake, Ham Lake, Lake Netta, Crooked Lake

Results: Lake levels were measured by volunteers 69 times at Ham Lake, 37 times at Crooked Lake, and 25 at Lake Netta. The exception was Bunker Lake, where water level was measured twice daily for 193 days because an electronic gauge was used instead of measurements by volunteers.

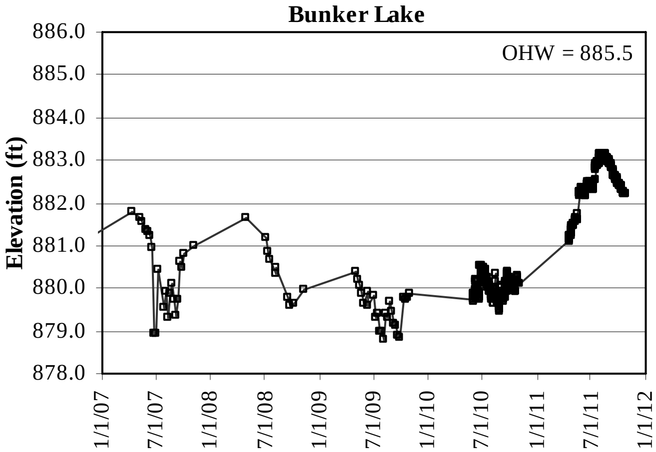
In 2011 there were extremes of high and low water. Following a wet winter, spring water levels were nearly a foot higher than the preceding fall at most lakes. Lake levels rose nearly continuously through spring and early summer when precipitation was plentiful and frequent, peaking in late July. But starting in August and continuing through fall there was very little rainfall. Lakes fell steadily. Crooked, Ham, and Netta Lakes all ended the year lower than they began in spring.

Ham Lake approached its record highest observed water level. On August 2nd it reached 897.39. The record high is only 0.12 feet higher. Ham Lake has had diligent recording of water levels since 1985.

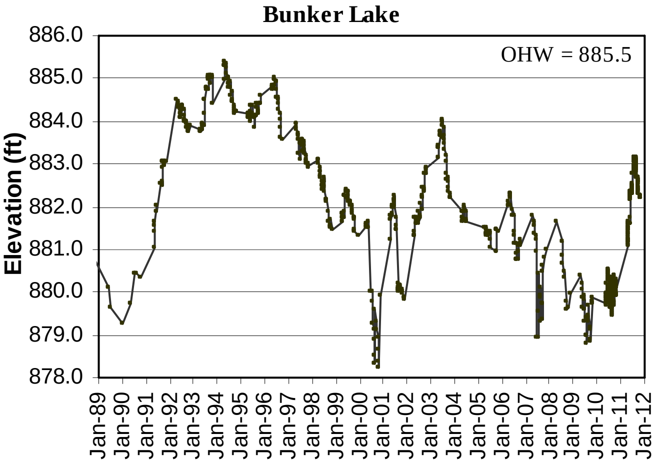
Around Anoka County, several other lakes did set new record observed water levels, both high and low. It is noteworthy that both high and low water level records would occur in the same year. It speaks to the unusual abundance of precipitation in the first part of the year, and lack of rainfall beginning in August.

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.

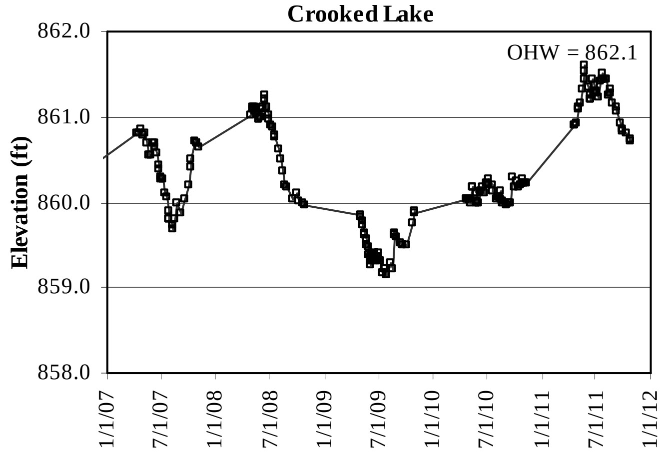
Bunker Lake Levels 2007-2011



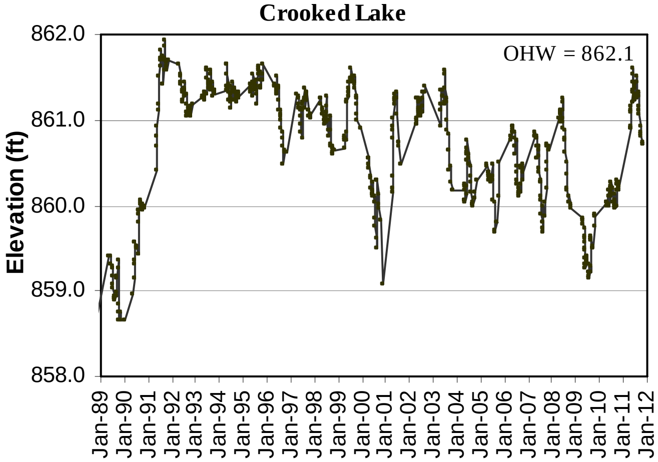
Bunker Lake Levels 1990-2011



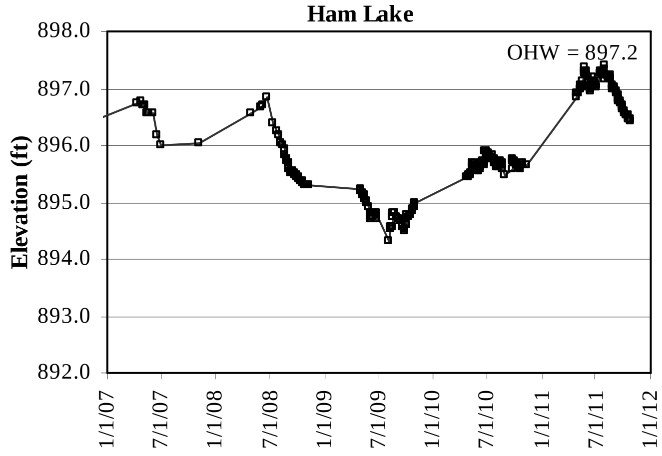
Crooked Lake Levels 2007-2011



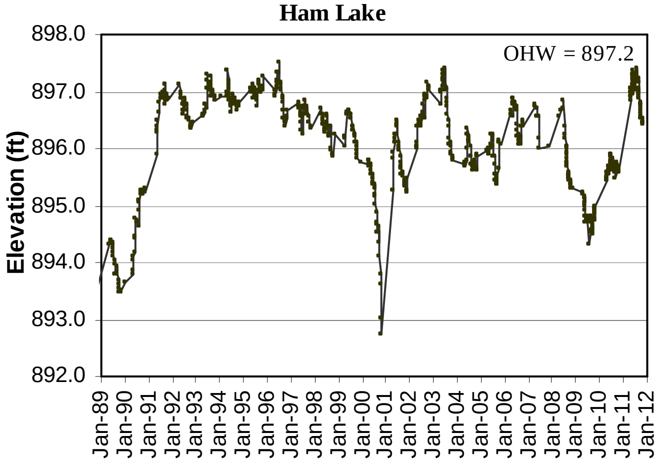
Crooked Lake Levels 1990-2011



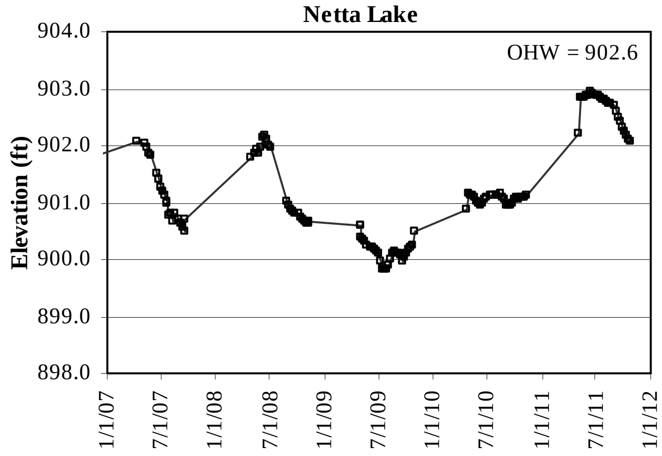
Ham Lake Levels 2007-2011



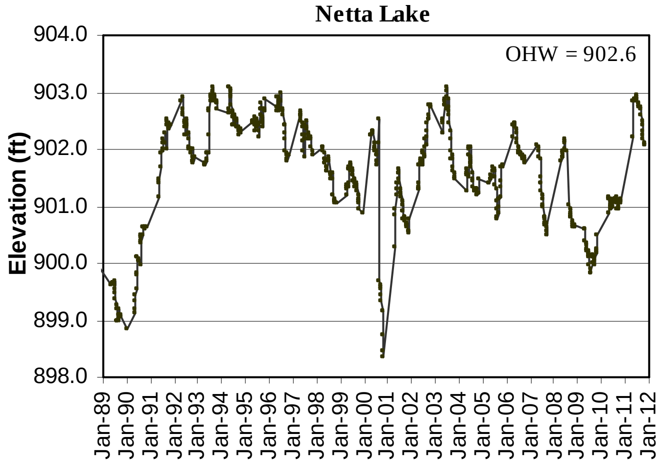
Ham Lake Levels 1990-2011



Lake Netta Levels 2007-2011



Lake Netta Levels 1990-2011



Lake Water Quality

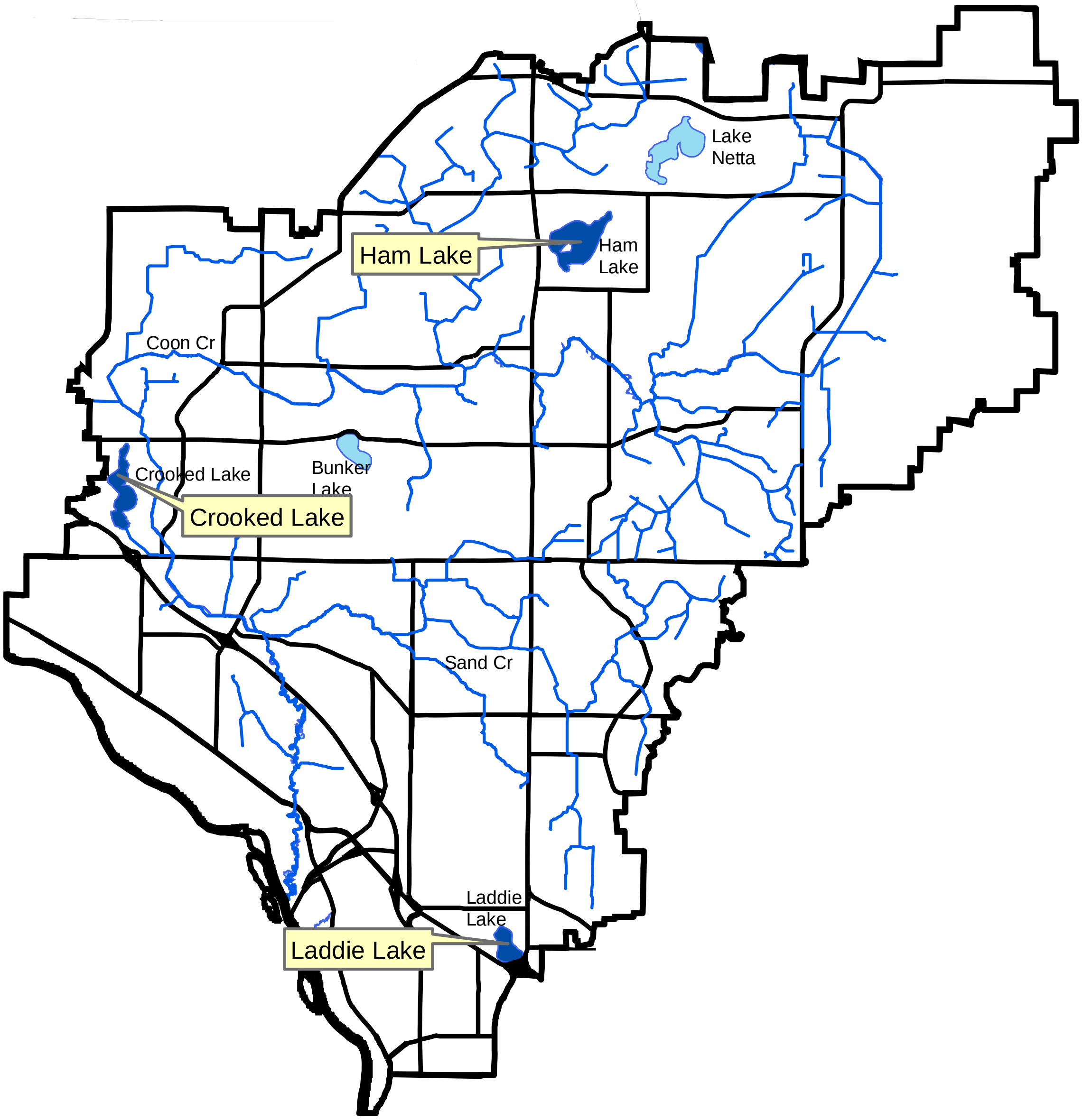
Description: May through September twice-monthly monitoring of the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, conductivity, pH, and salinity.

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

Locations:
Crooked Lake
Ham Lake
Laddie Lake

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

Coon Creek Watershed 2011 Lake Water Quality Monitoring Sites



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 watershed is urban/developed.

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. In 2010 and 2011 spot treatments have been conducted. EWM is still at nuisance levels in some areas, and may be expanding or becoming more dense. In other areas the similar-looking, native, northern milfoil is abundant. The exotic, invasive plant curly leaf pondweed is also present, but rarely to nuisance levels.

2011 Results

In 2011 Crooked Lake had above-average water quality for this region of the state (NCHF Ecoregion), receiving an overall B grade. It earned a B letter grade the previous 10 monitored years. The lake is slightly eutrophic.

In 2011 water quality was the best of all monitored years since 1975, when monitoring began. Average total phosphorus in 2011 was 27 ug/L, which is similar to 2000 and 2008. Chlorophyll-a averaged 5.2 ug/L, which is 2.8 ug/L lower than the next best year. Secchi transparency averaged 9.5 feet, which is 1.7 feet better than 2009, the next highest year. This is in contrast to water clarity that rarely averaged more than 4 feet before 1995.

Trend Analysis

Sixteen years of water quality data have been collected between 1983 and 2011, with eight additional years of transparency measurements by citizens. Water quality has significantly improved from 1983 to 2011 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,13}$=27.25, p=0.0001). The most dramatic improvements occurred between 1989 and 1994. However, if only data after 1993 are examined a statistically significant trend of improvement is still found (same analysis, $F_{2,10}$=5.53, p=0.02). Examining the trend during this period for each parameter (graphs on following page; one-way ANOVAs) we find no change in phosphorus, but a trend toward lower chlorophyll-a and greater transparency. This pattern could be indicative of large plants out-competing algae for available nutrients.

Discussion

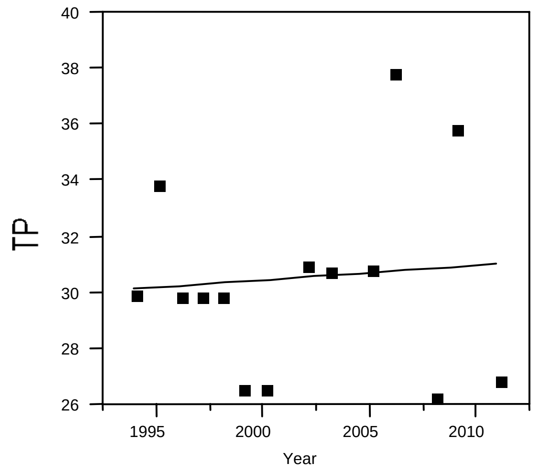
Water quality in Crooked Lake is remarkably good considering its urban watershed and intensely manicured shorelines. Continued efforts to improve stormwater draining to the lake and manage shorelines in a more lake-friendly manner are encouraged. Invasive aquatic plants continue to be a challenge in Crooked Lake. EWM seems to be becoming more of a nuisance, despite herbicide treatments. Native plants like the native northern milfoil are abundant 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.

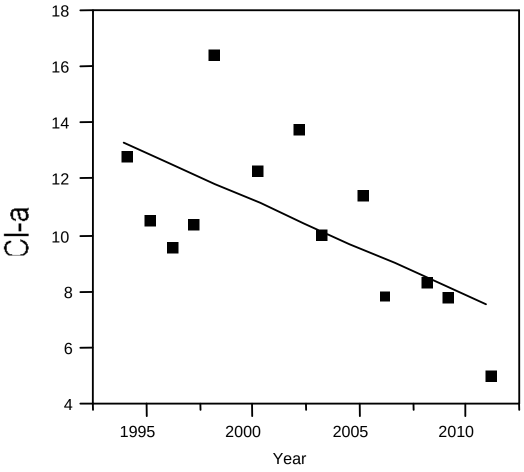
2011 Crooked Lake Water Quality Data

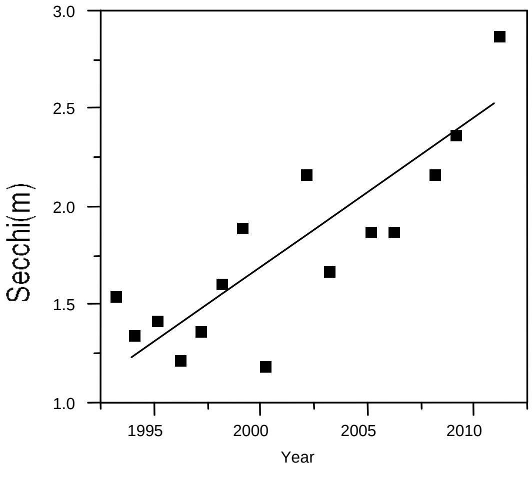
Crooked Lake 2011			5/16/2011	5/31/2011	6/13/2011	6/27/2011	7/12/2011	7/25/2011	8/8/2011	8/23/2011	9/6/2011	9/19/2011			
			10:45	11:30	11:00	11:15	11:40	11:05	11:30	10:45	10:20	10:50			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.36	8.31	8.52	8.50	8.49	8.61	8.55	8.63	8.47	8.40	8.48	8.31	8.63
Conductivity	mS/cm	0.01	0.502	0.486	0.483	0.479	0.469	0.400	0.409	0.382	0.359	0.345	0.431	0.345	0.502
Turbidity	FNRU	1	4	2	3	2	4	5	3	3	4	6	4	2	6
D.O.	mg/L	0.01		9.87	10.32	9.42	8.21	8.49	7.84	8.37	7.11	7%	7.74	0.07	9.87
D.O.	%	1		106%	116%	107%	104%	109%	99%	102%	82%	74%	100%	74%	116%
Temp.	°C	0.10	13.8	19.0	21.1	21.6	27.3	28.0	27.4	25.1	22.1	18.00	22.3	13.8	28.0
Temp.	°F	0.10	56.8	66.2	70.0	70.9	81.1	82.4	81.3	77.2	71.8	64.4	72.2	56.8	82.4
Salinity	%	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Cl-a	ug/L	1	6.2	3.1	3.0	3.2	6	5.1	4.5	6.7	7.0	7.4	5.2	3.0	7.4
T.P.	mg/L	0.005	0.034	0.034	0.029	0.024	0.025	0.020	0.023	0.026	0.025	0.027	0.027	0.020	0.034
T.P.	ug/L	5	34	34	29	24	25	20	23	26	25	27	27	20	34
Secchi	ft	0.1	7.6	14.9	12.9	11.1	9.4	9.3	7.4	7.7	7.4	7.6	9.5	7.4	14.9
Secchi	m	0.1	2.3	4.5	3.9	3.4	2.9	2.8	2.3	2.3	2.3	2.3	2.9	2.3	4.5
Physical			1.0	1.0	2.0	2.0	1.0	3.0	2.0	2.0	2.0	4.0	2.0	1.0	4.0
Recreational			1.0	1.0	2.0	2.0	1.0	3.0	2.0	2.0	2.0	3.0	1.9	1.0	3.0

*reporting limit

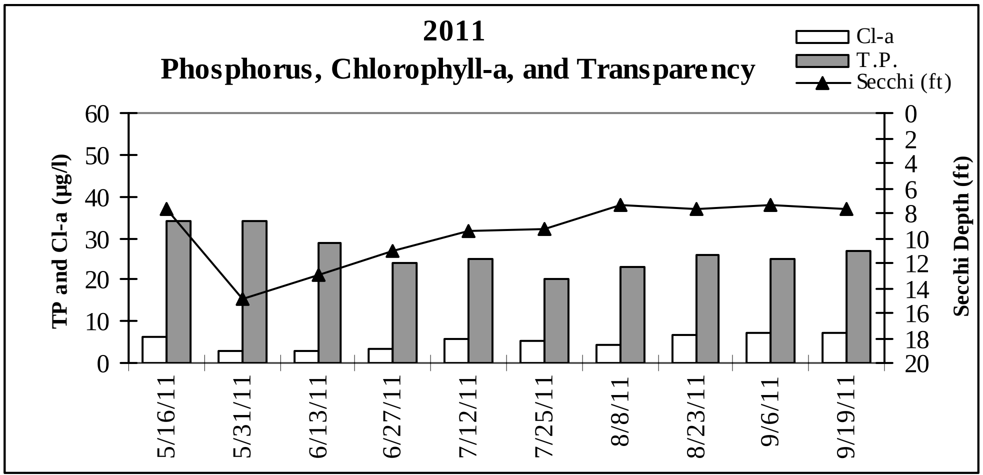
Crooked Lake Water Quality Changes for Each Parameter, 1994-2011

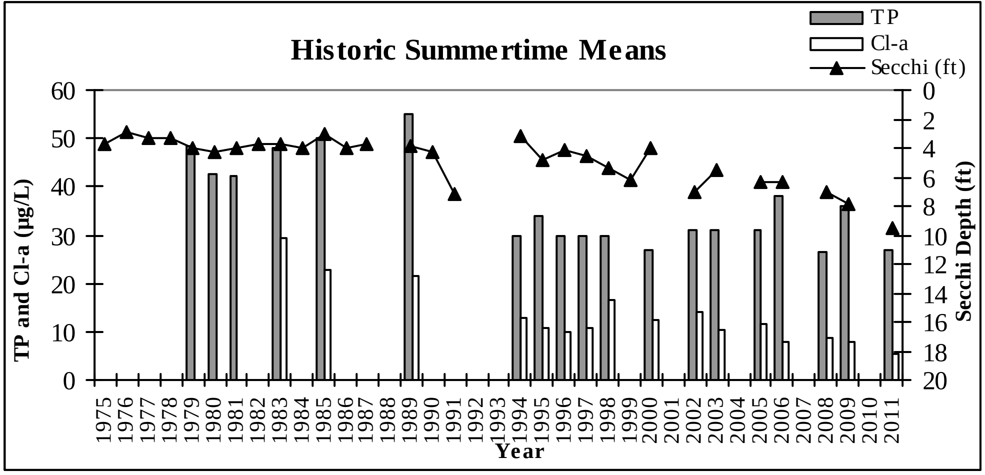






Crooked Lake Water Quality Results





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 Lake Historical 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
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
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
Secchi (m)	1.4	1.5	1.3	1.4	1.6	1.9	1.2	2.2	1.7	1.9	1.9	2.2	2.4	2.9
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

Carlson's Tropic State Indices

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

Crooked Lake Water Quality Report Card

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

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.

2011 Results

Ham Lake water quality received a slightly above-average rating for this region of the state (NCHF Ecoregion) in 2011, receiving a B letter grade. Total phosphorus, the nutrient that is most responsible stayed relatively the same at 26 ug/L from May to September. Chlorophyll-a, a measure of algal growth, averaged 6.2 mg/L. Chlorophyll-a was highest in August and early September, but still at reasonable levels for recreation. Transparency was similar, and remained >9 feet until early August and September when it was as low as 4.5 feet. This is similar to the previous year when algal growth was strong in August, but relatively level the remaining months. Curly-leaf pondweed growth appeared less abundant in the spring 2011 than other recent years. This exotic, invasive plant has grown densely on the south end of the lake near the public boat landing in some years.

Trend Analysis

Fifteen 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 2011). Lake water quality has fluctuated from “A” to “C” water quality grades, but there is no significant long-term trend (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,12} = 0.72$, $p = 0.51$).

Discussion

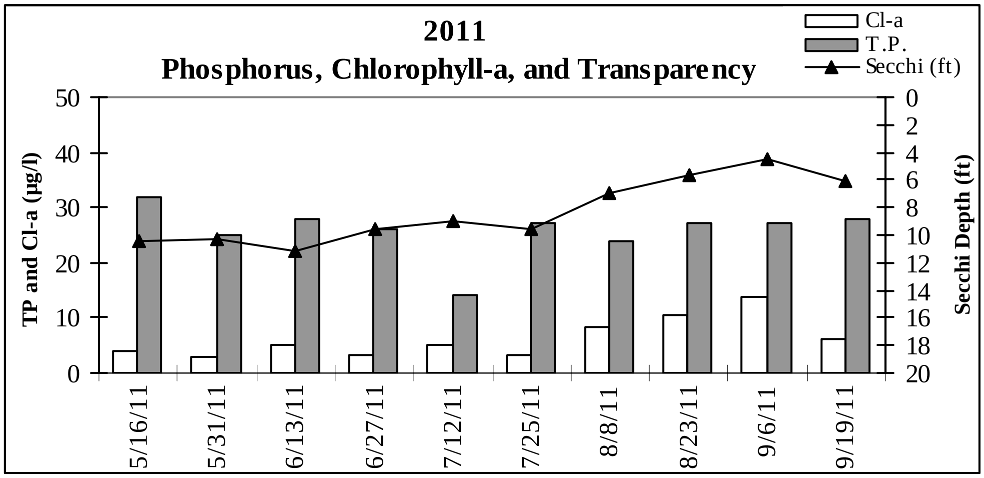
Water quality in Ham Lake is very good for a metro-area lake. Current threats to lake water quality include shoreline activities and aquatic plant removal by lakeshore homeowners, and curly leaf pondweed. The fact that curly leaf pondweed has been observed in this lake for many years, but does not appear to be expanding is encouraging.

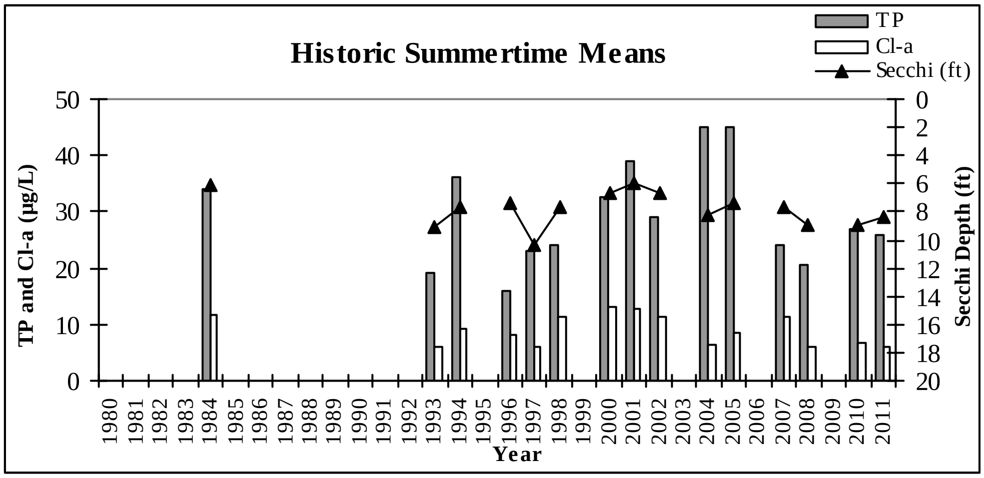
2011 Ham Lake Water Quality Data

Ham Lake 2011			5/16/2011	5/31/2011	6/13/2011	6/27/2011	7/12/2011	7/25/2011	8/8/2011	8/23/2011	9/6/2011	9/19/2011			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.10	8.08	8.25	8.23	8.27	8.05	8.20	8.26	8.09	8.23	8.18	8.05	8.27
Conductivity	mS/cm	0.010	0.312	0.305	0.300	0.296	0.282	0.246	0.256	0.245	0.237	0.230	0.271	0.230	0.312
Turbidity	FNRU	1	2.00	3.00	3.00	3.00	3.00	3.00	5.00	5.00	7.00	4.00	4	2	7
D.O.	mg/L	0.01		10.15	9.45	8.96	7.95	6.87	7.07	7.33	4.13	5.60	7.26	4.13	10.15
D.O.	%	1		109%	104%	100%	100%	86%	88%	88%	46%	59%	87%	46%	109%
Temp.	°C	0.1	13.2	18.9	20.3	21.0	26.6	26.9	26.5	24.6	21.3	17.3	21.66	13.20	26.90
Temp.	°F	0.1	55.8	66.0	68.5	69.8	79.9	80.4	79.7	76.3	70.3	63.1	71	56	80
Salinity	%	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Cl-a	ug/L	0.5	3.9	3.0	5.0	3.2	5.0	3.4	8.4	10.4	13.8	6.0	6.2	3.0	13.8
T.P.	mg/L	0.010	0.032	0.025	0.028	0.026	0.014	0.027	0.024	0.027	0.027	0.028	0.026	0.014	0.032
T.P.	ug/L	10	32	25	28	26	14	27	24	27	27	28	26	14	32
Secchi	ft	0.1	10.4	10.3	11.2	9.6	9.0	9.5	6.9	5.6	4.5	6.1	8.3	4.5	11.2
Secchi	m	0.1	3.2	3.1	3.4	2.9	2.7	2.9	2.1	1.7	1.4	1.9	2.5	1.4	3.4
Physical			1.0	1.0	2.0	2.0	1.0	2.0	3.0	3.0	3.0	2.0	2.0	1.0	3.0
Recreational			2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	2.0	2.3	2.0	3.0

*reporting limit

Ham Lake Water Quality Results





Ham Lake Summertime Historic Mean

Agency	MC	MC	MC	MC	MC	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	84	93	94	96	97	98	2000	2001	2002	2004	2005	2007	2008	2010	2011
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
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
Secchi (m)	1.84	2.76	2.35	2.27	3.14	2.35	2.04	1.81	2.1	2.5	2.2	2.3	2.7	2.7	2.5
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

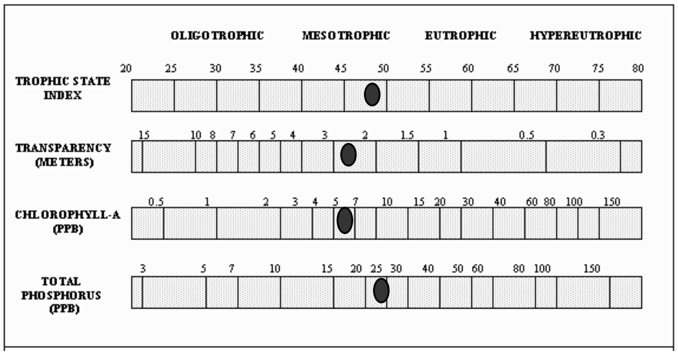
Carlson's Tropic State Indices

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

Ham Lake Water Quality Report Card

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

Carlson's Trophic State Index



Laddie Lake

CITIES OF BLAINE AND SPRING LAKE PARK, LAKE ID # 02-0072

Background

Laddie Lake is located in south-central Anoka County, half in Blaine and half in Spring Lake Park. It has a surface area of 77 acres and maximum depth of 4 feet (1.2 m). Public access is limited to a city park at the north end of the lake. There is no easy access to the water's edge from this park, as the lake's cattail fringe is wide. The lake is used little for recreation because of its shallow depths, abundance of aquatic plants, and lack of public access to the water's edge. It does, however, attract waterfowl. The west side of the lake is bordered by single family homes, the south and east by four-lane highways and associated businesses, and the north by the city park.

2011 Results

In 2011 Laddie Lake had slightly above-average water quality for this region, receiving an overall B grade; the same as since 1993. Total phosphorus averaged 28 ug/L and chlorophyll-a averaged 6.7 mg/L. Secchi transparency exceeded the 3-4 feet lake depth on all occasions.

The lake is slightly eutrophic, but much of the plant growth is manifested as marcophytes (large plants), not algae. Large numbers of plants are healthy in a shallow lake such as this one. Macrophytes grew to the surface on 95% of the lake from June through September. Even when the reached the surface, the plants were not excessively dense from an ecological perspective, spaced about 1-2 feet apart. However, these plants do eliminate most recreational uses of the lake such as boating, swimming, and fishing.

Trend Analysis

Fourteen years of water quality data have been collected by the Metropolitan Council and the Anoka Conservation District. This lake was first monitored in 1980. After 1980 there was a 13 year hiatus from monitoring. From 1993 to the present monitoring has occurred regularly, though not every year.

In 1980 water quality was quite poor. In 1993 and after it was much improved. To search for trends since 1993, a repeated measures MANOVA with response variables total phosphorus and Chlorophyll-a was used on those years only. Secchi depth was excluded because measurements were not available in all years. No statistically significant water quality trend was detected ($F_{1,11}$=3.43, p=0.09). However, when this same analysis was done after the previous monitoring year (1993) a trend of declining water quality was found ($F_{1,10}$=7.23, p=0.02). The difference in these analyses is that 2011 had slightly better water quality than previous years. This lake should be watched closely in coming years to see if a real, but weak, trend exists.

Based on linear regressions, any water quality trend is due to increases in total phosphorus, but not chlorophyll-a. Chlorophyll-a has remained relatively constant over years, while total phosphorus has an increasing trend (though not statistically significant). It is likely that additional phosphorus is consumed by macrophytes, and therefore algae are not increasing and water clarity is not suffering. If this trend continues, at some point macrophytes will be overwhelmed by phosphorus and the lake will shift toward algae-domination.

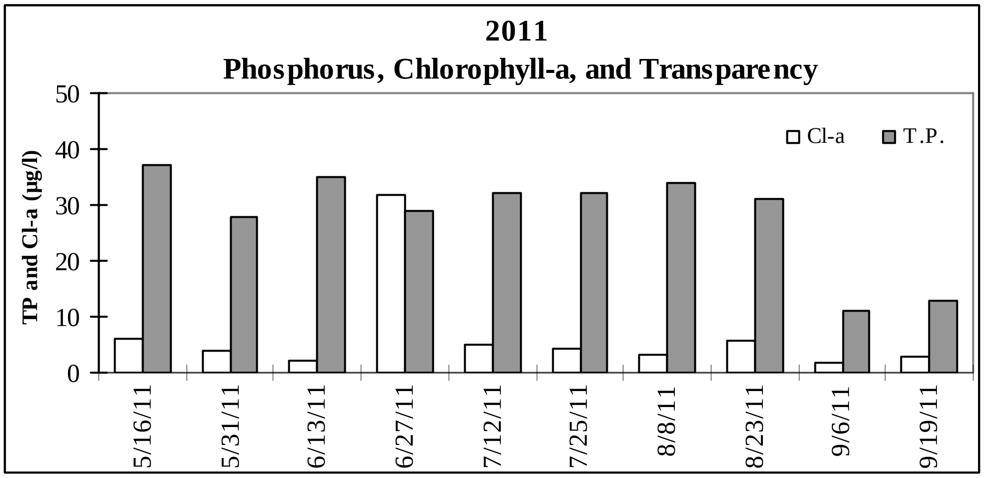
Discussion

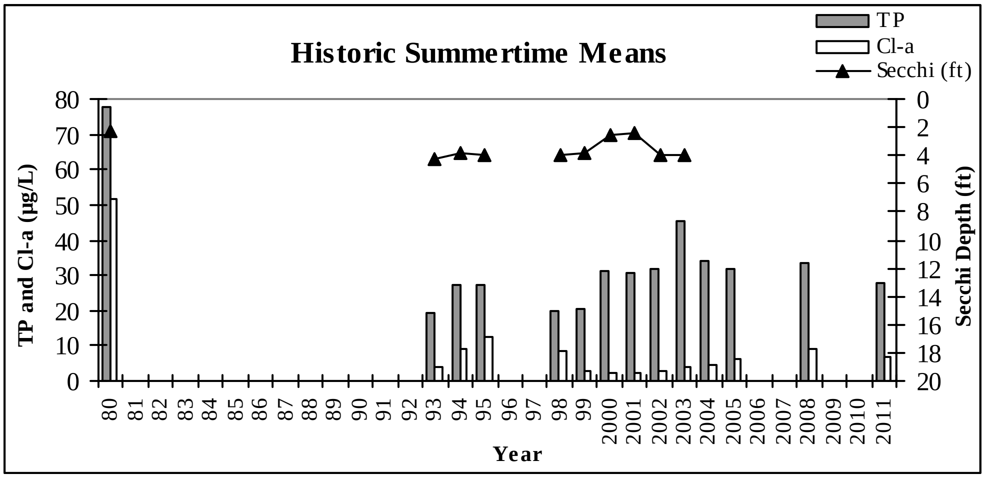
Abundant macrophytes in this lake are an indication of a healthy system, not an impairment. As a shallow lake, macrophytes should be expected throughout and contribute to clear water. They are consuming nutrients that would otherwise fuel algae blooms and they provide excellent waterfowl habitat. The lake should be watched closely for any water quality deterioration. Given the lake's setting, changes to stormwater management are likely to be means for improving the lake.

2011 Laddie Lake Water Quality Data

Laddie Lake 2011			5/16/2011	5/31/2011	6/13/2011	6/27/2011	7/12/2011	7/25/2011	8/8/2011	8/23/2011	9/6/2011	9/19/2011			
			9:55	10:40	10:10	11:55	11:00	10:05	10:40	10:00	9:40	10:00			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.59	8.36	8.96	9.33	8.92	9.20	9.34	9.49	9.27	9.54	9.10	8.36	9.54
Conductivity	mS/cm	0.010	0.453	0.396	0.433	0.428	0.443	0.303	0.327	0.286	0.312	0.310	0.369	0.286	0.453
Turbidity	FNRU	1	3	2	3	3	4	3	3	1	2	1	3	1	4
D.O.	mg/L	0.01		9.62	11.51	10.75	8.30	9.52	10.89	9.74	11.27	9.40	10.11	8.30	11.27
D.O.	%	1		107%	123%	123%	104%	120%	137%	118%	123%	93%	116%	93%	137%
Temp.	°C	0.1	13.4	20.8	18.9	22.3	26.7	27.4	27.0	24.9	19.8	14.7	21.59	13.40	27.40
Temp.	°F	0.1	56.1	69.4	66.0	72.1	80.1	81.3	80.6	76.8	67.6	58.5	71	56	81
Salinity	%	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cl-a	ug/L	0.5	6.2	4.0	2.2	31.8	5.0	4.4	3	5.7	1.9	2.9	6.7	1.9	31.8
T.P.	mg/L	0.01	0.037	0.028	0.035	0.029	0.032	0.032	0.034	0.031	0.011	0.013	0.028	0.011	0.037
T.P.	ug/L	10	37	28	35	29	32	32	34	31	11	13	28	11	37
Secchi	ft	0.1	>3	>3.1	>3.1	>3.8	>3.5	>4	>4	>4	>3.6	>4	>3	0.00	0.00
Secchi	m	0.1	0.9	0.9	0.9	1.2	1.1	1.2	1.2	1.2	1.1	1.2	>0.9	0.90	1.22
Physical			1.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0	2.0	1.0	1.6	1.0	2.0
Recreational			1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.0	2.0

*reporting limit





Laddie Lake Historic Summertime Mean Values

Agency	MC	MC	MC	MC	ACD	ACD	MC	MC	MC	MC	ACD	ACD	ACD	ACD
Year	80	93	94	95	98	99	2000	2001	2002	2003	2004	2005	2008	2011
TP	78.0	19.1	27.5	27.0	20.0	20.4	31.0	30.9	31.7	45.2	33.8	32	34	28
Cl-a	51.6	4.0	8.9	12.6	8.5	2.9	2.3	2.5	2.6	4.0	4.6	6.2	9.0	6.7
Secchi (m)	0.70	1.30	1.18	1.23	1.22	1.18	0.77	0.75	1.20	1.20	na	na	na	na
Secchi (ft)	2.3	4.3	3.9	4.0	4.0	3.9	2.5	2.5	3.9	3.9	na	na	na	na

Carlson's Tropic State Indices

TSIP	67	47	52	52	47	48	54	54	54	59	55	54	55	52
TSIC	69	44	52	56	52	41	39	40	40	44	46	49	52	49
TSIS	65	56	58	57	57	58	64	64	57	57	na	na	na	na
TSI	67	49	54	55	52	49	52	52	50	54	50	51	54	51

Laddie Lake Water Quality Report Card

Year	80	93	94	95	98	99	2000	2001	2002	2003	2004	2005	2008	2008
TP	D	A	B	B	B	B	B	B	B	C	C	B	C	B
Cl-a	D	A	A	B	A	A	A	A	A	A	A	A	A	A
Secchi	D	C	C	C	C	C	D	C	C	C	na	na	na	na
Overall	**D**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**

Stream Hydrology and Rating Curves

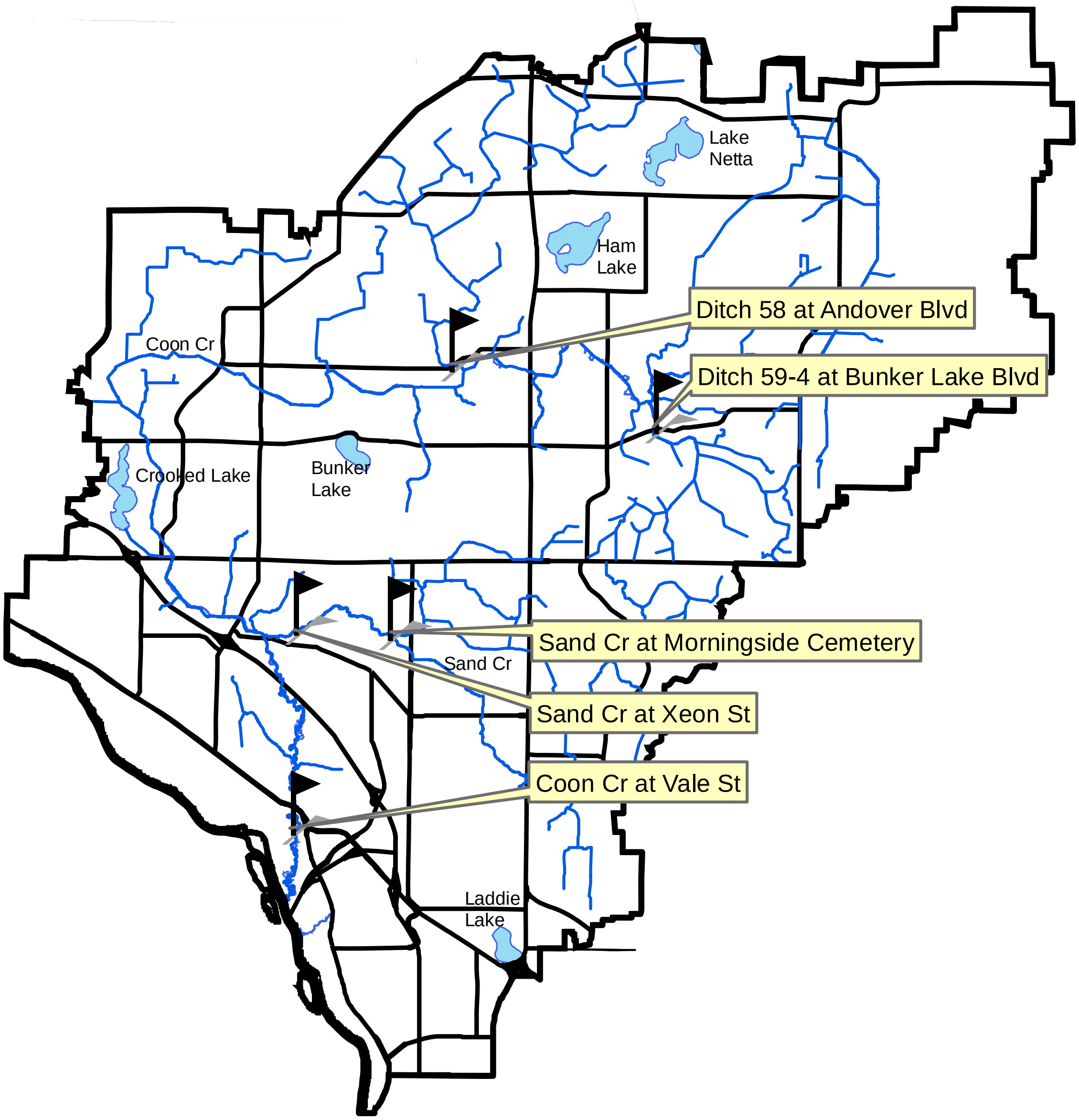
Description: Continuous water level monitoring in streams.

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:
Coon Creek at Coon Hollow, Coon Rapids
Ditch 58 at Andover Blvd (Highway 16), Ham Lake
Ditch 59-4 at Bunker Lake Boulevard NE, Ham Lake
Sand Creek at Xeon Street, Coon Rapids
Sand Creek at Morningside Cemetery, Coon Rapids

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

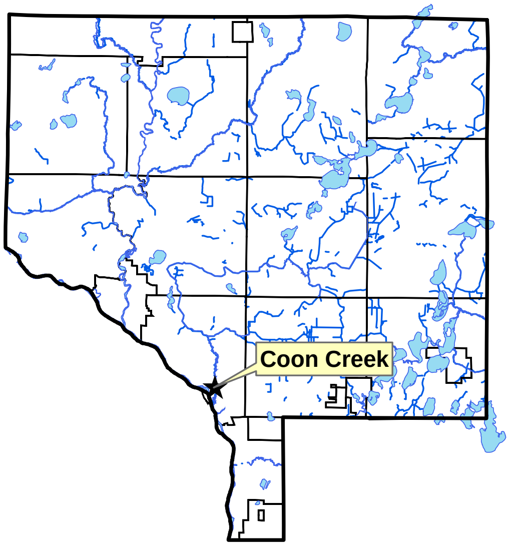
Coon Creek Watershed 2011 Stream Hydrology Monitoring Sites



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.

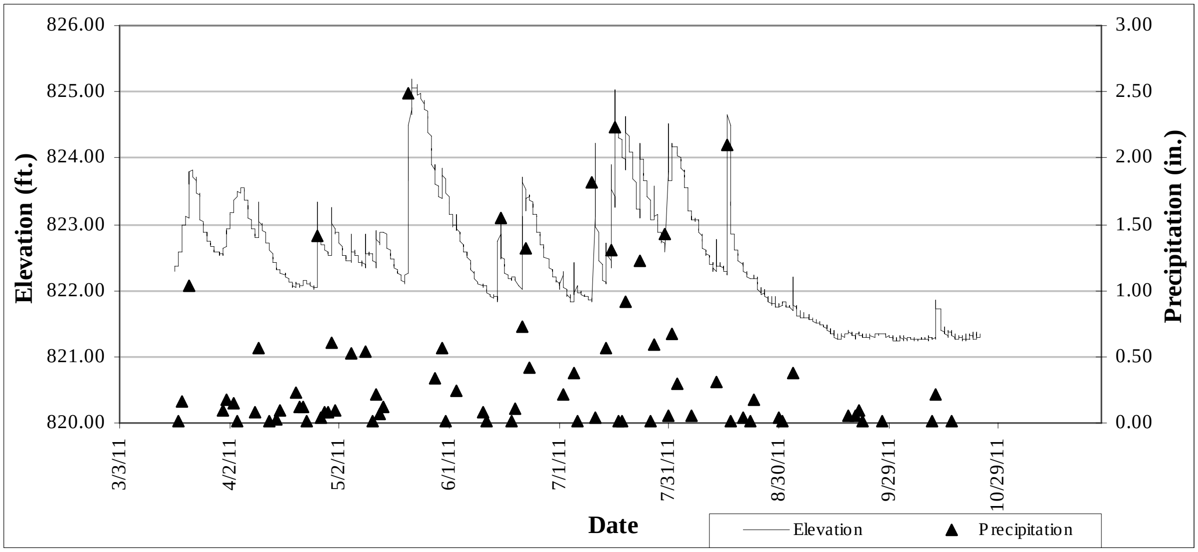
In 2011 Coon Creek maintained high water until late summer (see chart on next page). Abundant precipitation occurred until August, and the creek's water levels stayed about a foot higher than baseflow levels seen in most other years. In mid-August the creek began retreating. By mid-September it was at a more typical baseflow, and maintained near that level throughout the remainder of the year when precipitation was light.

Coon Creek has flashy responses to storms (see hydrograph on 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 2006-2011 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 in 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.

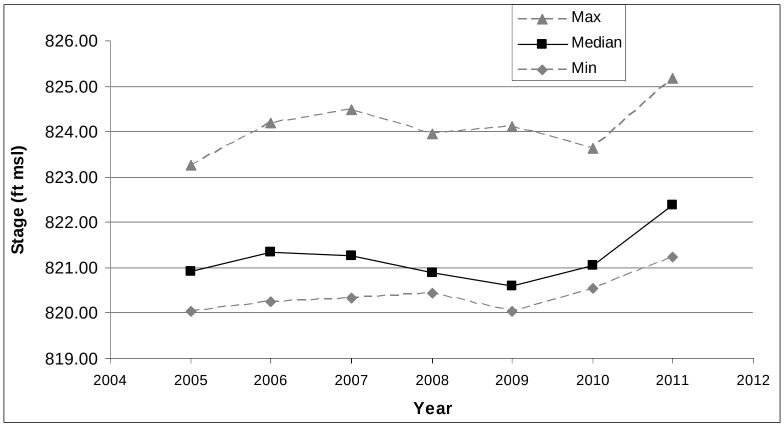
Increases in Coon Creek's water level are also substantial when analyzed using a per inch of rainfall perspective. Examining 29 relatively isolated storms ranging in size from 0.72 to 2.49 inches in 2006-11, the creek rose an average of 1.79 feet per inch of rainfall. The creek increase per inch of rain ranged from 0.76 to 2.64 feet. This discussion, as well as the one in the preceding paragraph, is obviously simplified because it neglects to consider the phenology of each of the storms. It only serves to emphasize that this creek responds quickly and dramatically to storms but water levels fall much more slowly.

The rating curve developed in 2005 was updated with six additional measurements taken during the summer of 2010. The supplemental measurements were taken during a variety of stream flow conditions, ranging from baseflow to high flow following storm events. A rating curve is the mathematical relationship between water level and flow, and allows estimates of creek flow to be calculated from the continuous water level record (see next page). This mathematical relationship is determined by taking manual measurements of creek flow during many different water levels. Under extremely high water levels flow measurements could not be safely taken, so the rating curve is only considered accurate for water levels less than 822.21 ft msl (i.e. flows <46.19 cfs). During 2010, creek flows ranged from 12.52 cfs to over 43.03 cfs. The maximum water level observed since monitoring began in 2005 was 2.26 feet greater than the capacity of the rating curve; if the rating curve is projected forward this water level would correspond to a flow of 115.8 cfs. However, this estimate is not accurate because the rating curve has not been calibrated for creek elevations that high. Nevertheless, the extrapolation displays the magnitude of the potential increase in flow following large rainfall events.

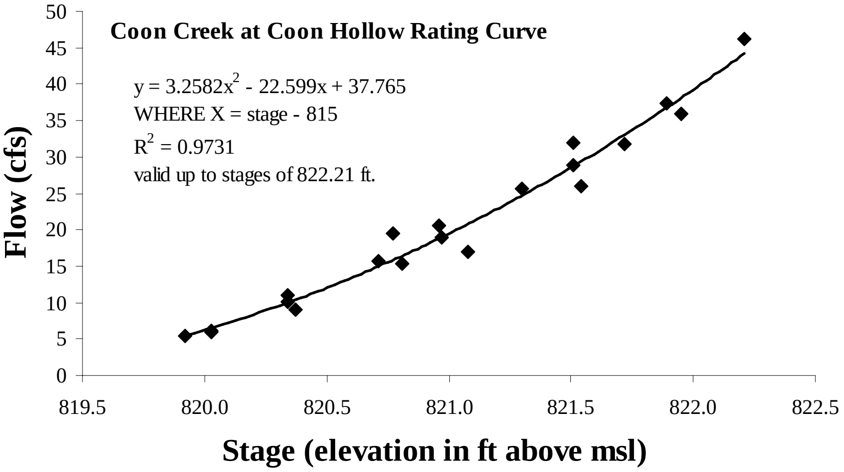
2011 Hydrograph



Summary of All Monitored Years



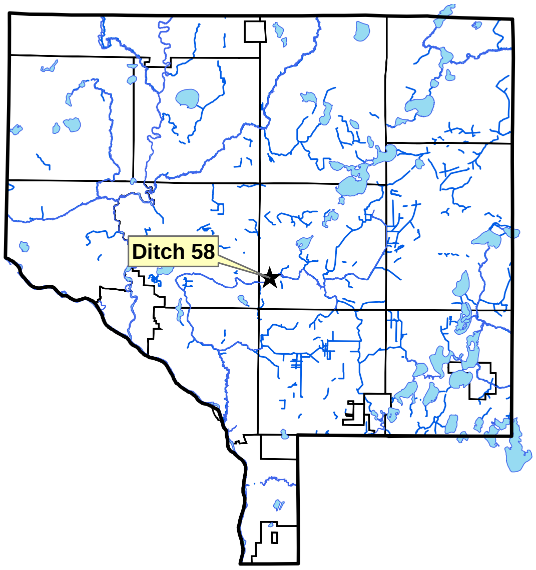
Rating Curve (2010)



DITCH 58

at Andover Boulevard, Ham Lake

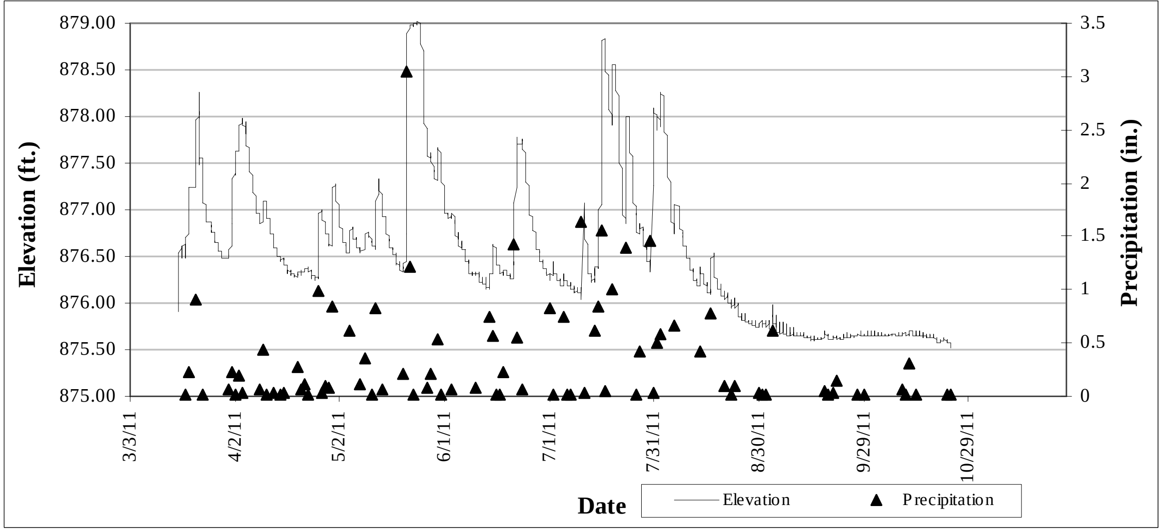
Notes



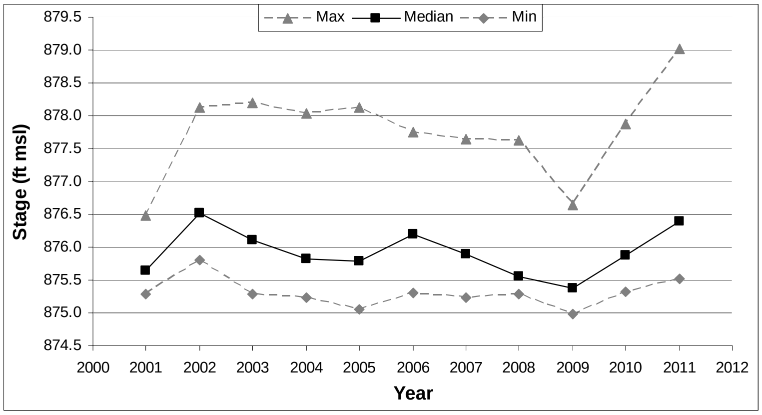
Ditch 58 is a tributary to Coon Creek. Upstream of the monitoring site, Ditch 58 consists of 20 miles of ditch, including many small tributaries. Its light bulb-shaped watershed is roughly delimited by Lake Netta to the northeast, Crosstown Boulevard to the northwest and southwest, and highway 65 to the southeast. Watershed land uses are dominated by 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 more during 2011 than in previous years because of the increased frequency of larger rainfall events. Water levels spanned a total range of 3.5 feet in response to rainfall events, nearly a one foot larger range than seen in previous years. Of particular note was a 2.51 foot increase in water level over 22hours following a 3.05 inch rain event on May 21, 2011. At one point following that storm, water levels rose 0.88 feet in a two hour period.

2011 Hydrograph



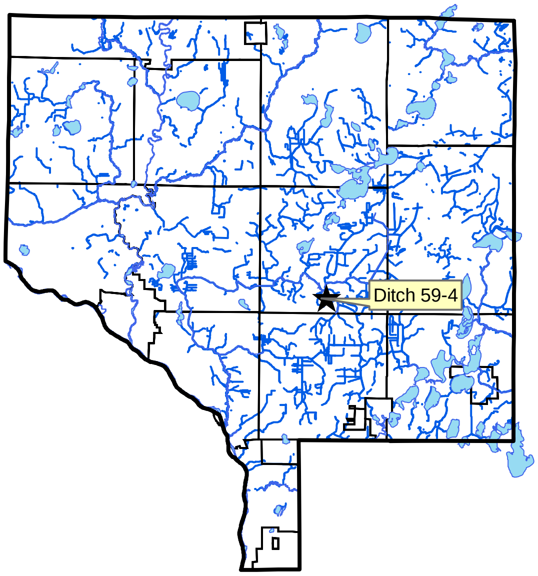
Summary of All Monitored Years



DITCH 59-4

at Bunker Lake Boulevard NE, Ham Lake

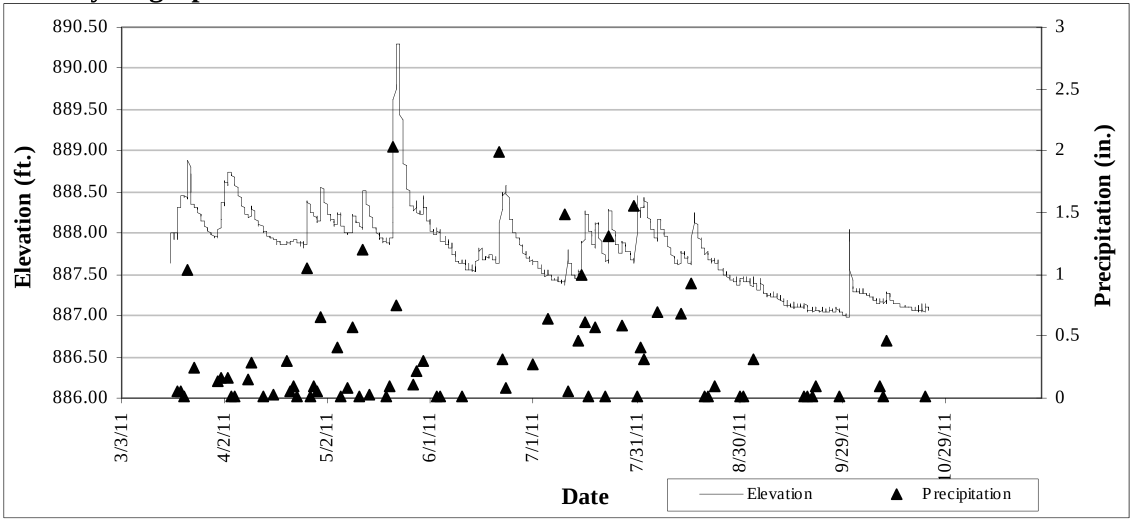
Notes



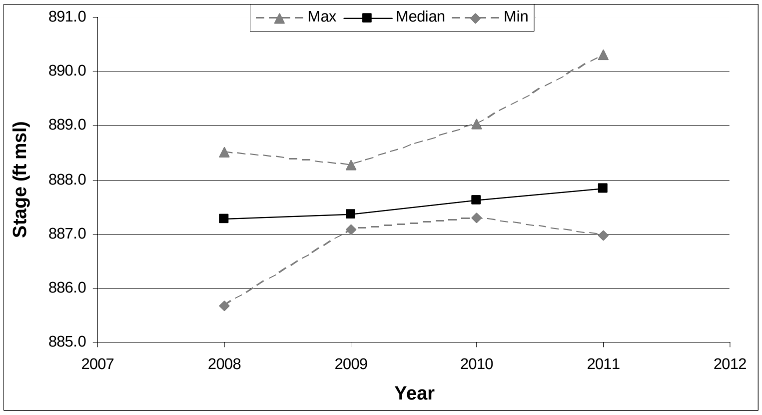
Ditch 59-4 originates in northeast Blaine and flows northwest to join Coon Creek approximately 0.3 miles downstream of the monitoring site. Upstream of the monitoring site, Ditch 59-4 has three main branches which have a total length exceeding 5 miles. Watershed land uses are dominated by suburban residential and sod fields. The ditch is about 7 feet wide and 1.5 feet deep at the monitoring site during baseflow.

Ditch 59-4 was monitored for the third consecutive year in 2010. Water levels fluctuations in this ditch are generally mild. It has a relatively small watershed with abundant wetlands. The total range in water levels over the four monitored years has been as little as 1.19 feet. In 2011 the first half of the year was very wet, and the second half very dry. As a result of this, and a number of large storms, water levels fluctuated more this year than in the previous three years – 3.33 feet. The ditch also reached its highest observed water level in 2011, exceeding the previous high by 1.28 feet.

2011 Hydrograph



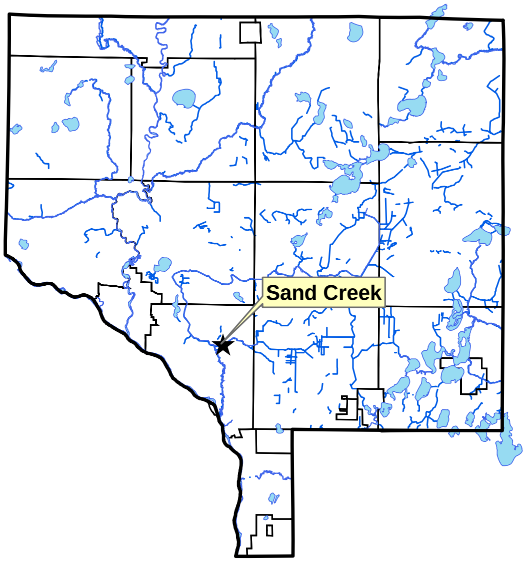
Summary of All Monitored Years



SAND CREEK

at Xeon Street, Coon Rapids

Notes

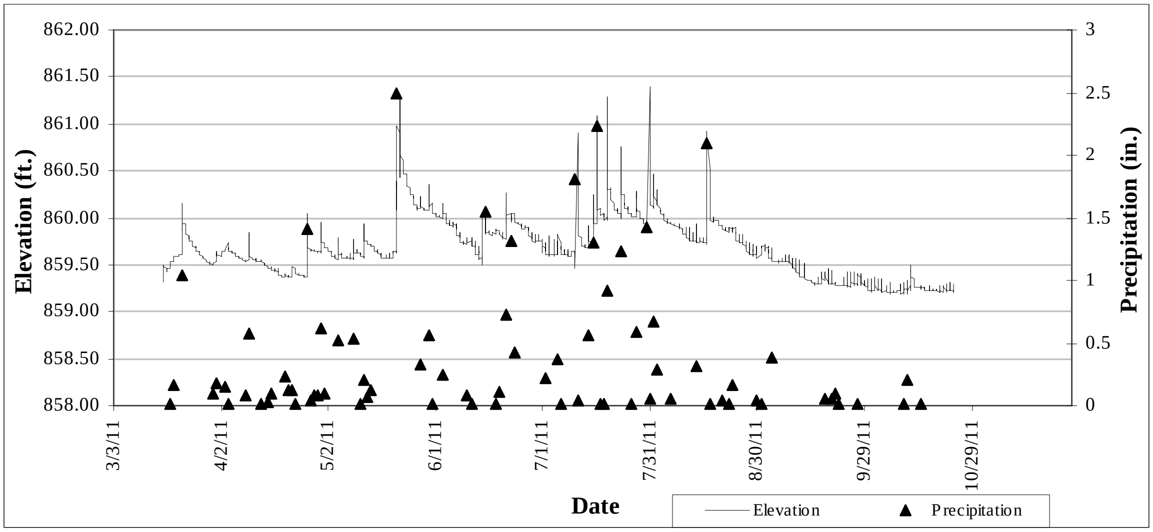


Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. The stream is about 15 feet wide and 3 feet deep at the monitoring site during baseflow.

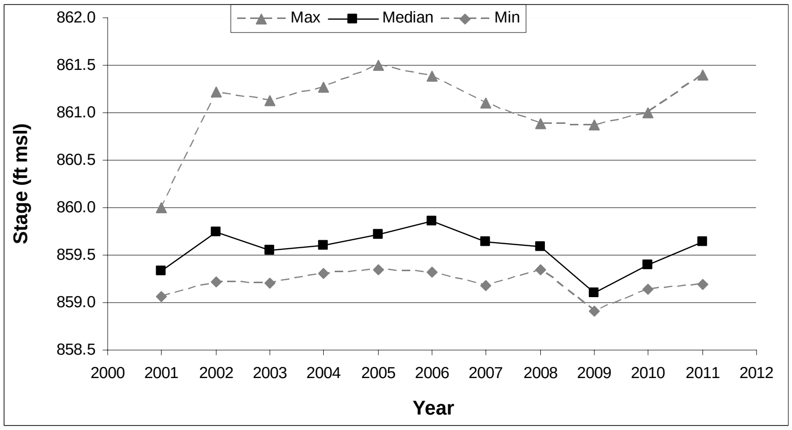
In most years, Sand Creek shows little variation in water levels but in 2011 several large storms caused rapid water level increases. Sand Creek water levels fluctuated 2.22 feet in 201, more than any other monitored year.

Still, the creek can have more dramatic hydrologic changes in the first hours immediately following larger storms. For example, in 2007 Sand Creek rose 1.93 feet in 4 hours in response to a 2.25-inch storm on August 1. 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.

2011 Hydrograph



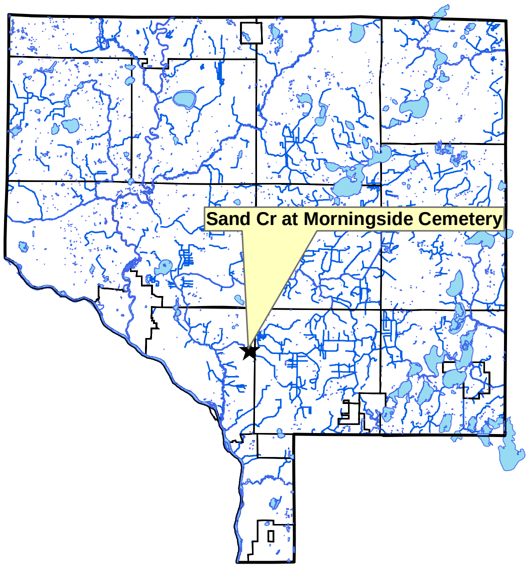
Summary of All Monitored Years



SAND CREEK

at Morningside Cemetery, Coon Rapids

Notes

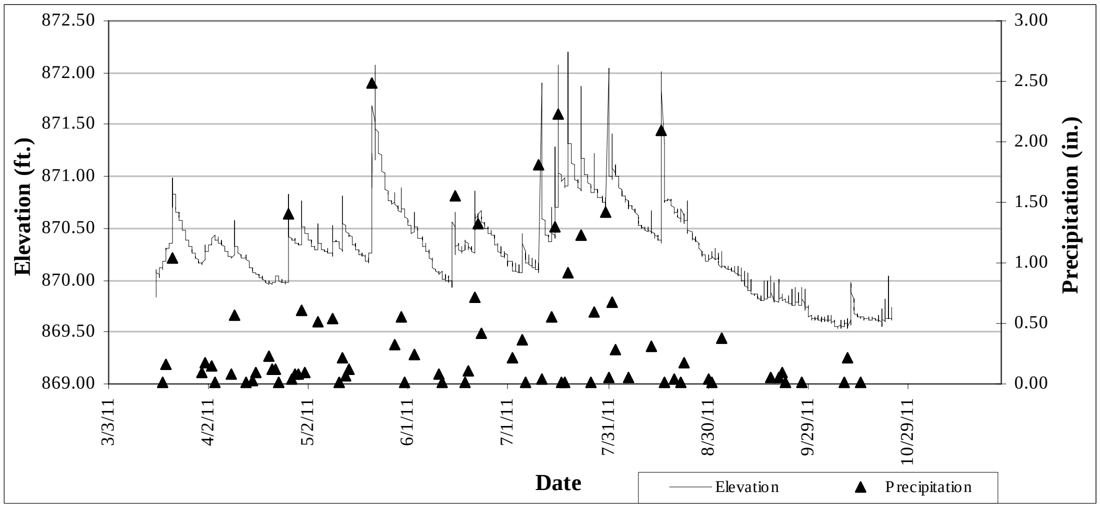


Sand Creek is the largest tributary to Coon Creek. It drains suburban residential, commercial and retail areas throughout northeastern Coon Rapids and western Blaine. The stream is approximately 8 feet wide and 3 feet deep at the monitoring site during baseflow.

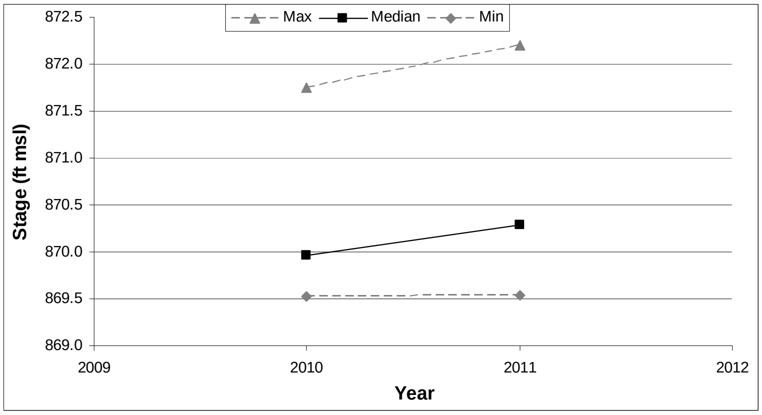
Sand Creek at Morningside Cemetery was monitored for the first time in 2010. The site was added because of its position between the cities of Blaine and Coon Rapids, which provides an estimate of the stormflow contributions from Blaine. In addition, the site is located immediately downstream of the confluence of Ditch 39 with Sand Creek. Water levels in the creek fluctuated 2.67 feet between baseflow and peak flow conditions during 2011.

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.

2011 Hydrograph



Summary of All Monitored Years



Stream Water Quality – Chemical Monitoring

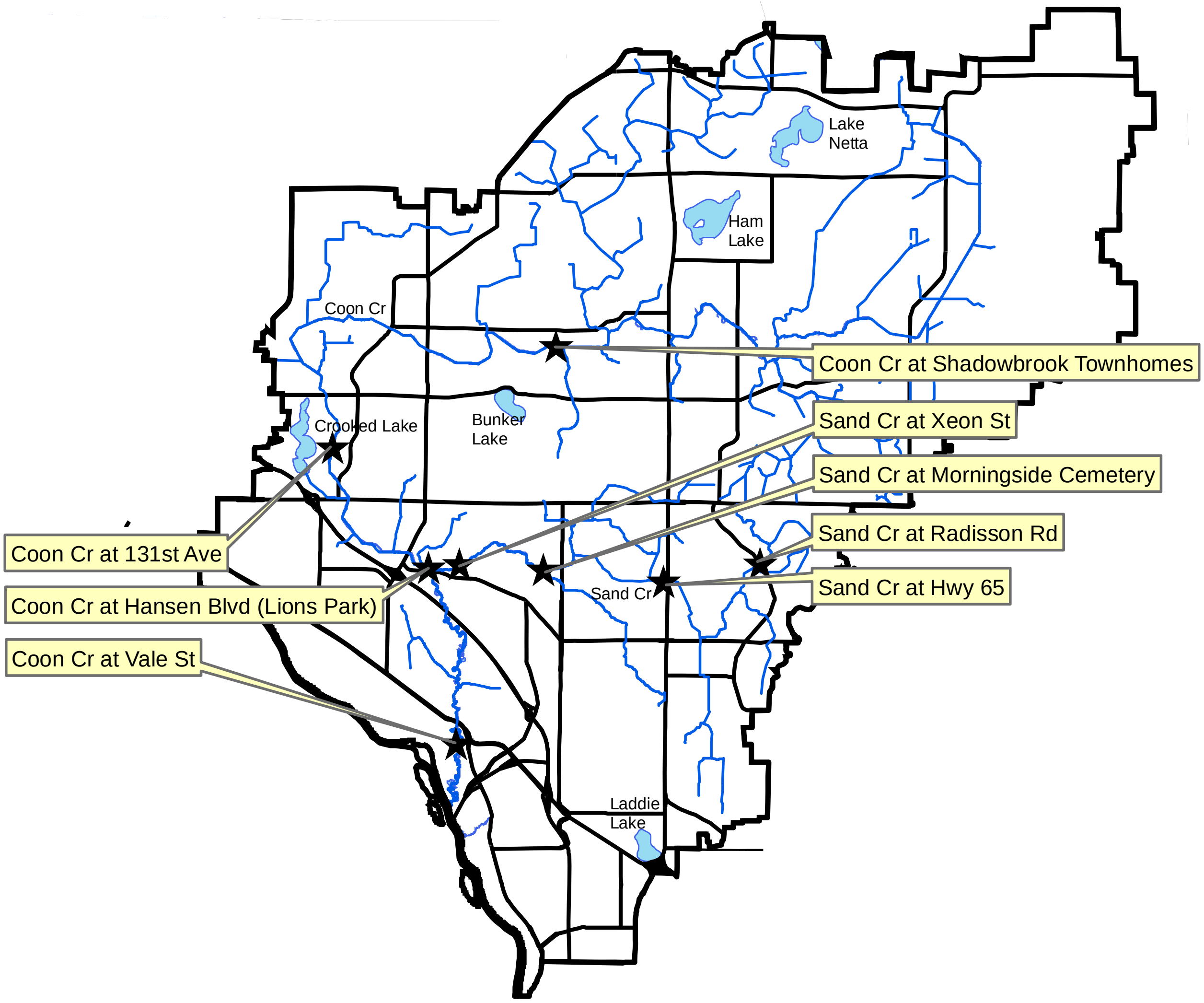
Description: Each stream was monitored eight times during the open water season; four times during baseflow and four times during storm flow. Storm flow events were defined as an approximately one-inch rainfall in 24 hours, though totals vary from location to location. Each stream was tested for pH,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

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

Locations:
Coon Creek at Shadowbrook Townhomes, Andover
Coon Creek at 131st Avenue, Coon Rapids
Coon Creek at Lions Park, Coon Rapids
Coon Creek at Vale Street, Coon Rapids
Sand Creek at Radisson Road, Blaine
Sand Creek at Highway 65, Blaine
Sand Creek at Morningside Memorial Gardens Cemetery, Coon Rapids
Sand Creek at Xeon Street, Coon Rapids

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

Coon Creek Watershed Stream Water Quality Monitoring Sites



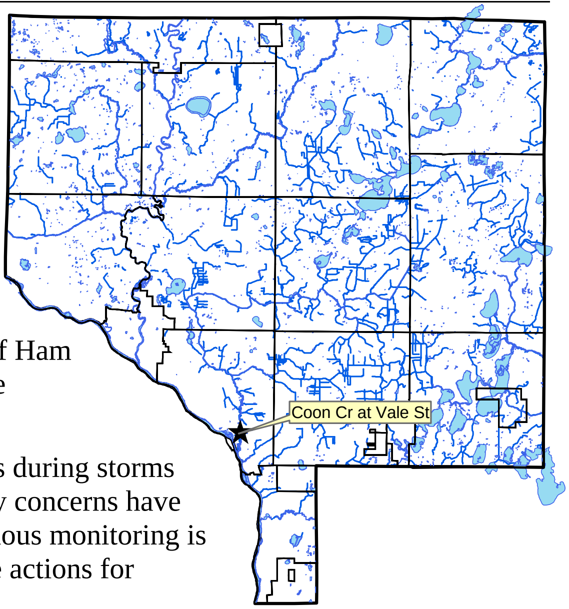
Hydrolab Continuous Stream Water Quality Monitoring

COON CREEK

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

Years Monitored

Coon Cr at Vale Street	2011



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, especially turbidity and total suspended solids. Continuous monitoring is needed to gain further insight into the nature and possible corrective actions for problems.

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

Methods

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

Coon Creek at Vale Street was monitored immediately before, during, and after storms with a Hydrolab MS5 water quality sonde. The sonde was suspended inside a PVC pipe by a chain from a locked lid. The PVC pipe was secured to a metal fence post. The sonde sensors protruded from the bottom of the pipe approximately 6-12 inches from the stream bottom, ensuring they would stay submerged even if flow was low. The sonde was programmed to take readings every 30 minutes. Readings included pH, salinity, specific conductance, temperature, dissolved oxyen, 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. The first half of 2011 was an extremely wet period, and therefore the storms monitored were not all distinct events. In some instances, water level was already high before the storm and remained high after the storm. In all instances, the Hydrolab was left in the field for several days following the storm.

Water levels were continuously monitored before, during, and after all Hydrolab monitoring. A Measura WM-80 water level monitoring device recorded water levels every two hours. This stream stage is presented with the water quality data. It would be preferable to present flow, and a rating curve does exist, however during most 2011 sampling events water was exceptionally high and exceeded the capacity of the rating curve so that flow could not be accurately calculated. To make graphs from all storms comparable, stage is shown for all.

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

Results and Discussion

A variety of storm sizes were analyzed. The storms analyzed included 0.44, 0.6, 1.04, 0.92, 2.46, and 4.11 inches. The wide distribution is helpful in discerning the creek's response to different events. Still, the results must be interpreted with caution, as they are based on relatively few storms. Future monitoring will help refine our understanding. More hydrolab monitoring is planned for 2012.

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. A separate graph shows each water quality parameter. The text below discusses summarizes findings across all storms for each parameter.

Turbidity

- There are substantial turbidity sources both in the lower and upper parts of the Coon Creek watershed.
    - For most storms there is a brief, large turbidity spike during or immediately following rainfall. This is due to the first flush of urban stormwater from the lower portions of the watershed.
    - For most storms turbidity increased slowly and continuously in the days following a storm, even when water levels were dropping. This turbidity likely originates from the upper portions of the watershed.
- The observation of increasing turbidity days after a storm when the creek is receding suggests that this turbidity is not just bed load, or movement of stream bed and bank sediments. Bed load usually increases when flow or water level are higher.
- Turbidity was highest following storms >1 inch. Stormwater treatment practices often are sized to accommodate the half to one inch of runoff.

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

- Dissolved oxygen generally stayed above 5 mg/L. Below this level some fish species begin to suffer. An exception was the largest storm, 4.11 inches, when dissolved oxygen dropped with rising water levels and was maintained between four and five mg/L for an extended period.
- In a few instances, when stream level rose, dissolved oxygen dropped mildly.

Temperature

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

pH

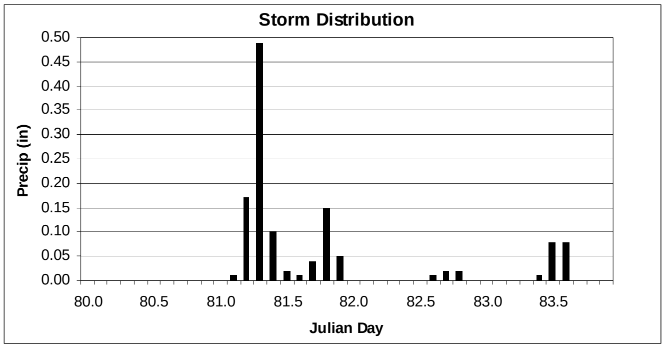
- pH often drops mildly immediately following storms and maintains that new, lower level for multiple days. This is because rainwater has a lower pH than that of local shallow groundwater.
- pH was always within the desired range of 6.5 to 8.5 that is specified in state water quality standards.

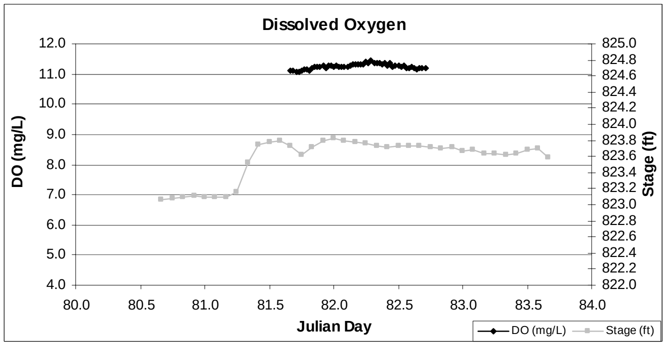
In addition to the data presented, the hydrolab was deployed into Coon Creek on two other occasions. During these events, no usable data was collected because of battery problems.

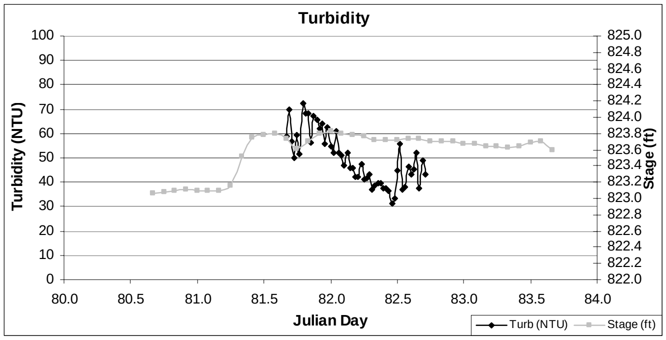
Hydrolab Continuous Monitoring
Storm 1 - 2011

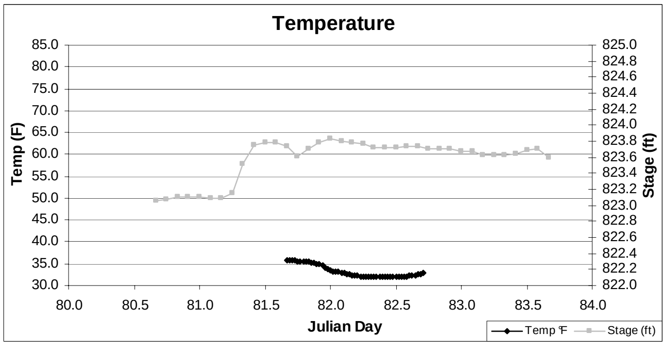
Storm Summary:

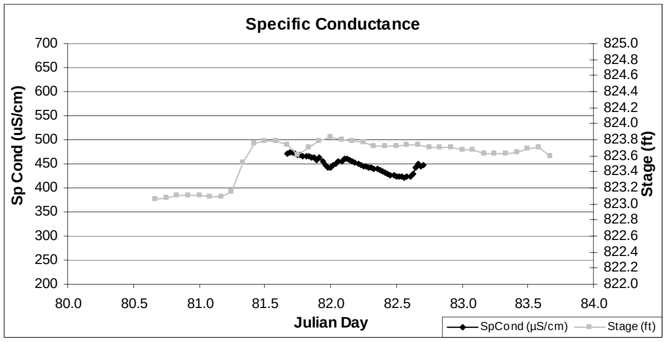
Dates: 22 March 2011 (day 81)
Precipitation: 1.04 inches plus snowmelt ongoing
Notes: Hydrolab was deployed after most rainfall. Only 0.2 inches fell after deployment.

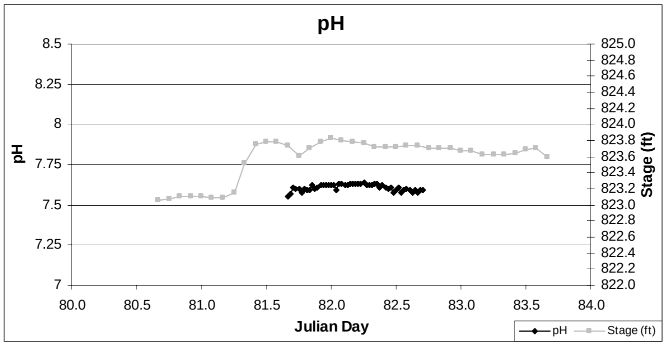








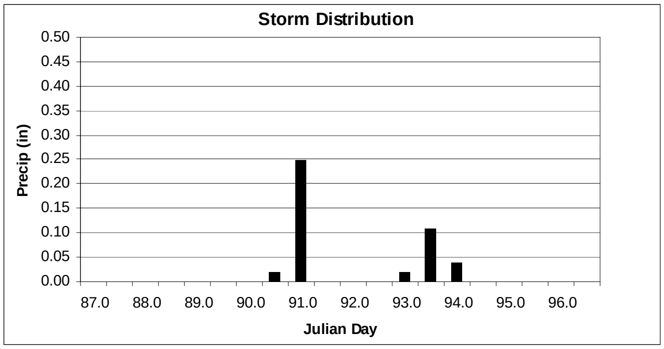


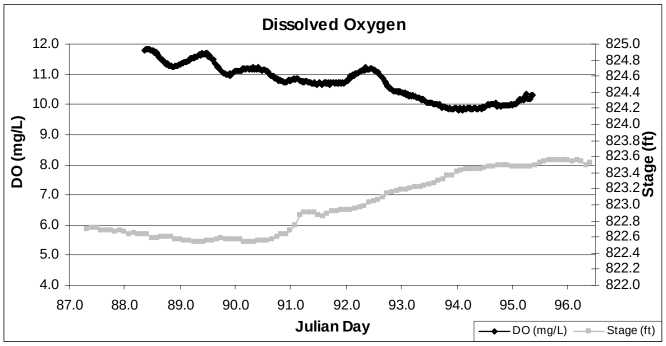


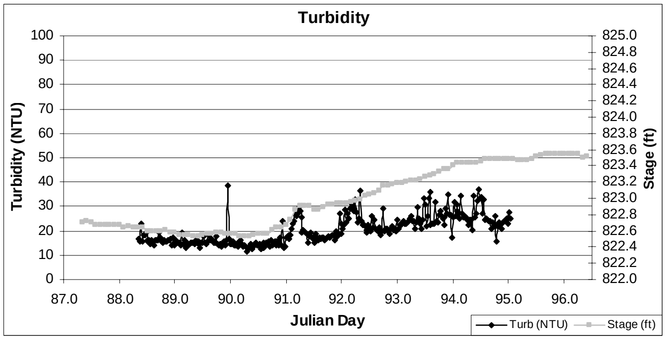
Hydrolab Continuous Monitoring
Storm 2 - 2011

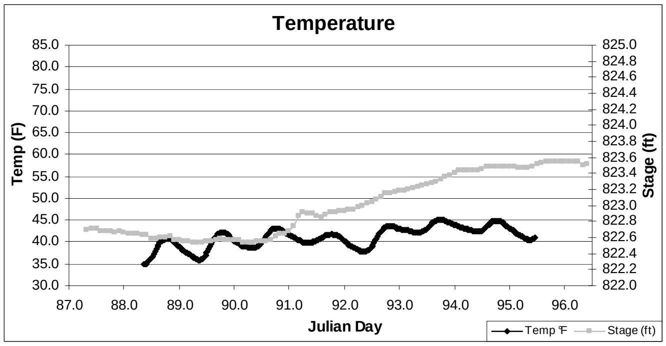
Storm Summary:

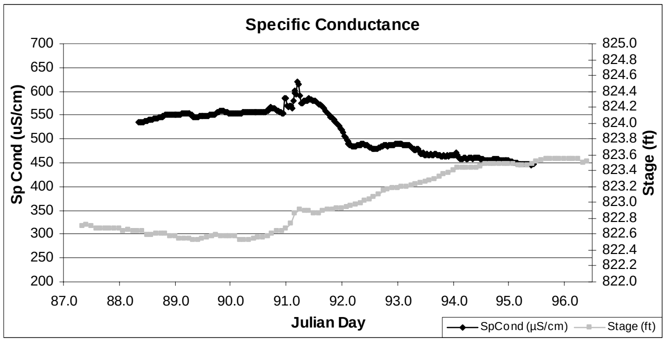
Dates:	29 March 2011 (day 88) to 5 April 2011 (day 95)
Precipitation:	0.44 inches
Notes:	Heavier rainfall was anticipated, but didn't materialize. This event was a double deployment – the Hydrolab was deployed, exhausted its batteries, and was immediately re-deployed.

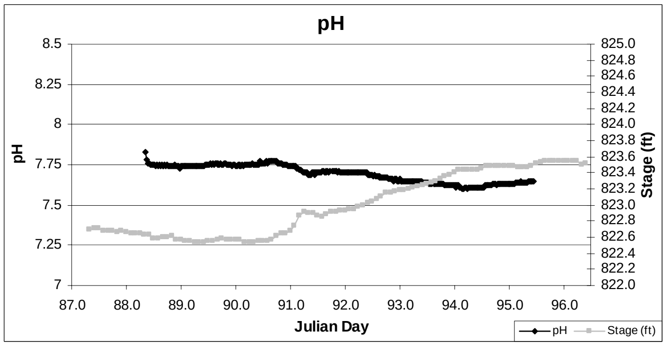

Storm Distribution


Dissolved Oxygen


Turbidity


Temperature

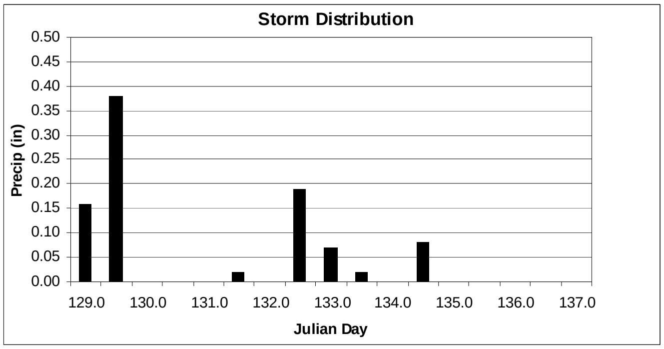

Specific Conductance

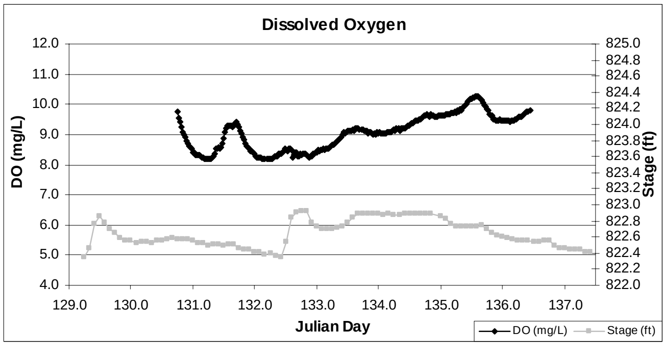

pH

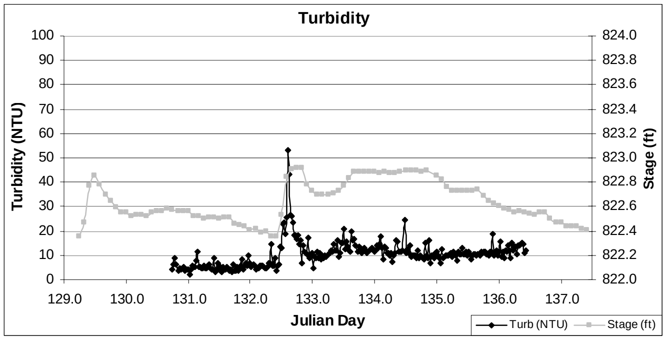
Hydrolab Continuous Monitoring
Storm 3 - 2011

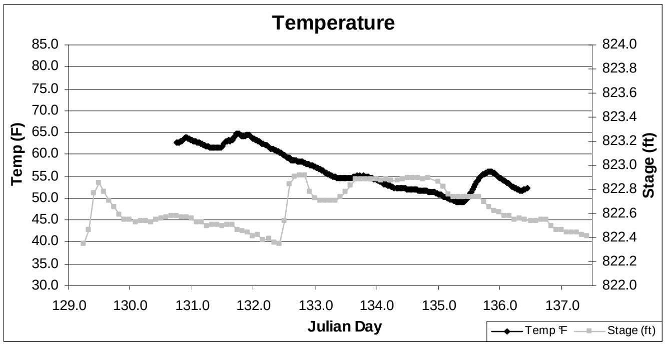
Storm Summary:

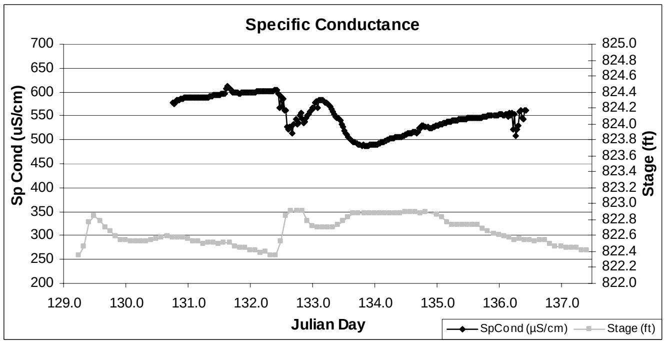
Dates:	10 May 2011 (day 130) to 16 May 2011 (day 136)
Precipitation:	0.92 inches
Notes:	Rainfall totals differed in the upper and lower portions of the watershed. On May 9 the lower watershed got 0.36 inches, while the upper watershed got only 0.36 inches. On May 12 the lower watershed got 0.21 inches, but the upper watershed got 0.83 inches. In total, the upper watershed got 0.32 inches more during the period analyzed. This event was a double deployment – the Hydrolab was deployed, exhausted its batteries, and was immediately re-deployed.

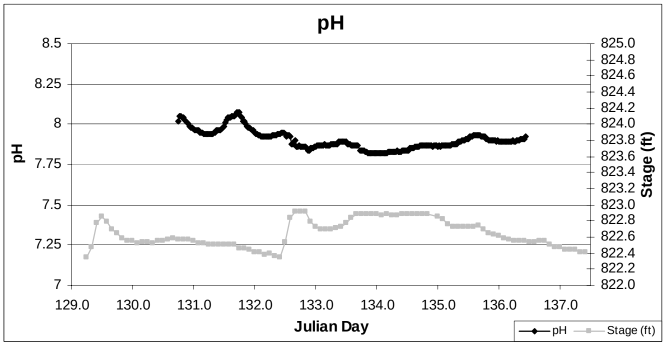












Hydrolab Continuous Monitoring
Storm 4 - 2011

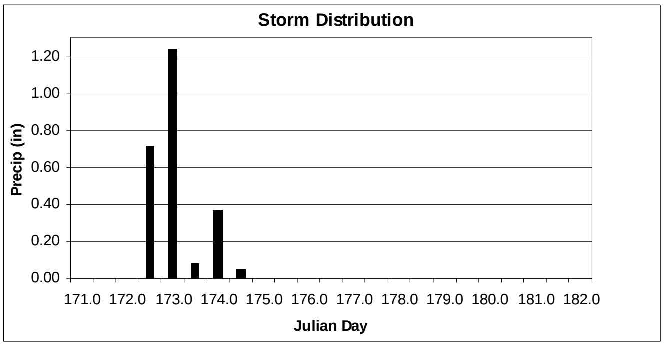
Storm Summary:

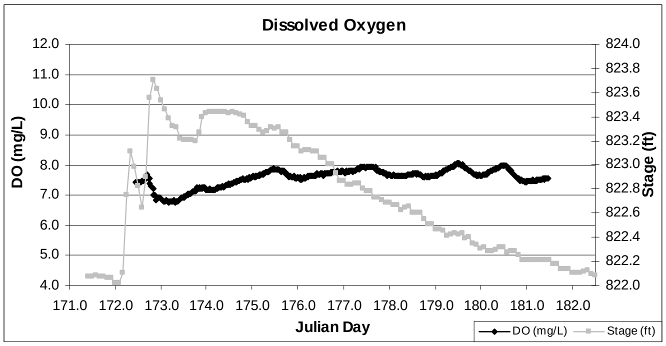
Dates: 21 June 2011 (day 172) to 30 June 2011 (day 181)
Precipitation: 2.46 inches
Notes: Over the period analyzed the upper and lower portions of the watersheds received similar precipitation totals, 2.46 inches in the lower watershed and 2.32 inches in the upper watershed. However the timing of the rainfall was quite different. The table below illustrates:

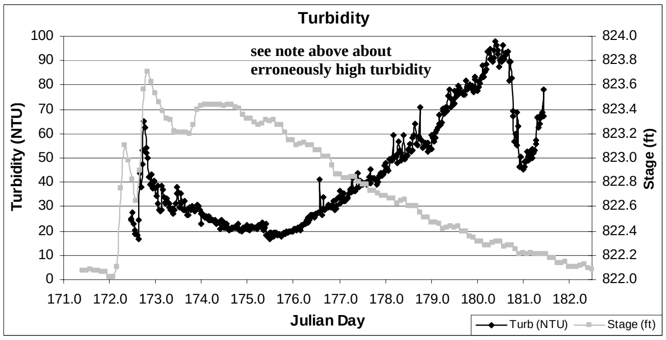
Date	Lower Watershed Precip (in)	Upper Watershed Precip (in)
June 21, 2011	0.72	1.87
June 22, 2011	1.32	0.36
June 23, 2011	0.42	0.08

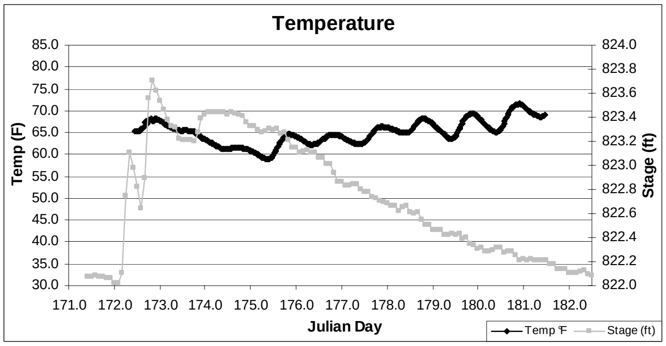
This event was a double deployment – the Hydrolab was deployed, exhausted its batteries, and was immediately re-deployed.

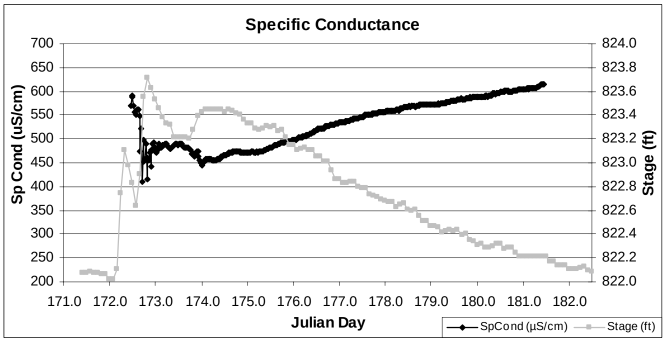
Turbidity readings during this sampling were erroneously high. Calibration was found to be reading 23 NTU too high at the end of sampling. The data are presented only to show the trend.

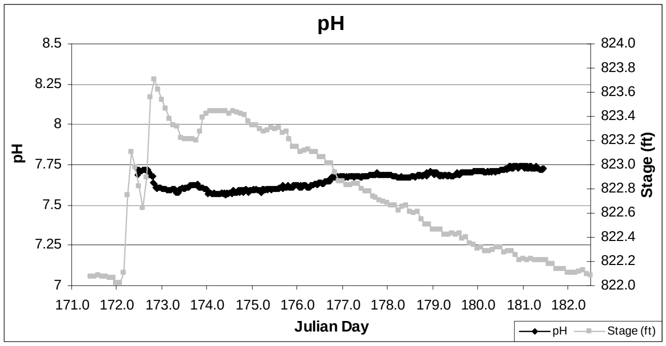








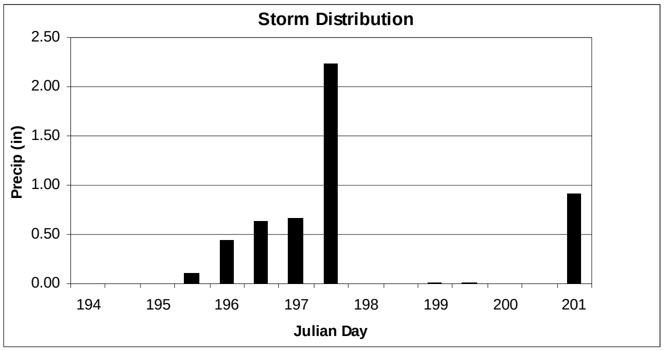


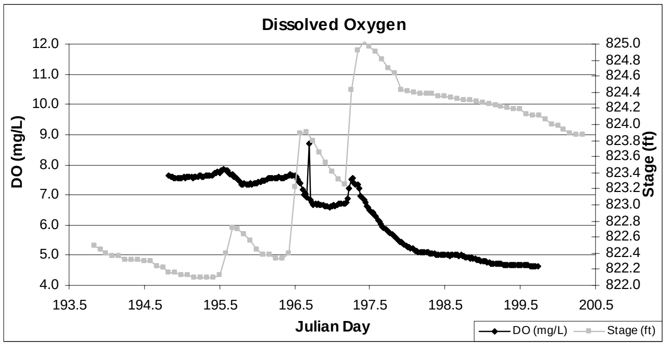


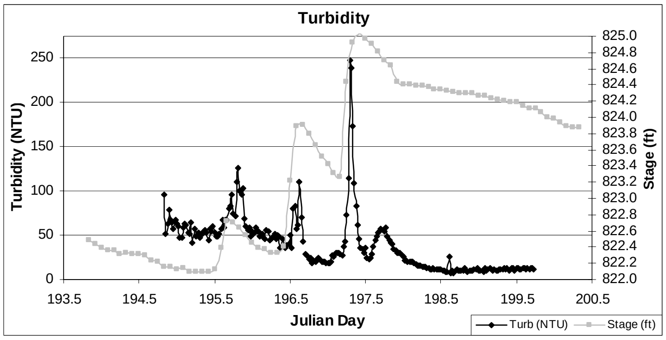
Hydrolab Continuous Monitoring
Storm 5 - 2011

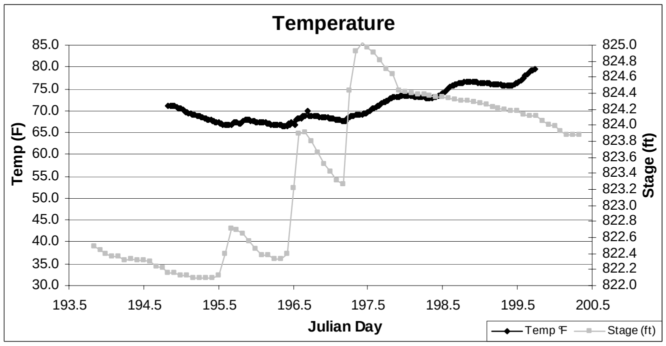
Storm Summary:

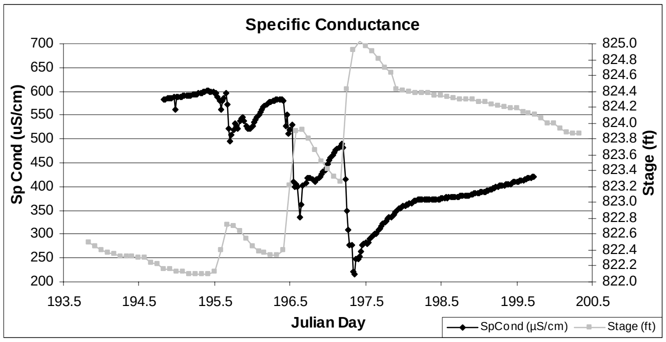
Dates:	13 July 2011 (day 194) to 18 July 2011 (day 199)
Precipitation:	4.11 inches
Notes:	During this storm, more rain fell in the lower portions of the watershed (4.11 inches) compared to the upper watershed (3.07 inches).

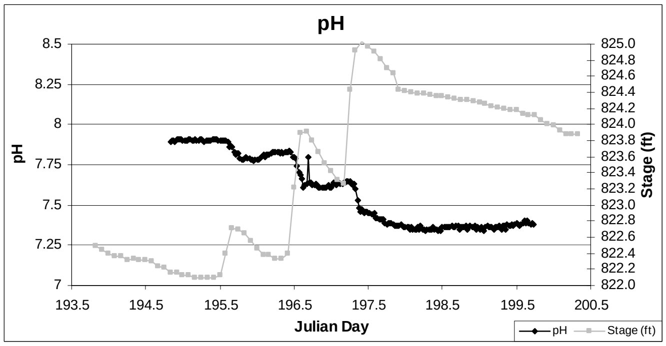








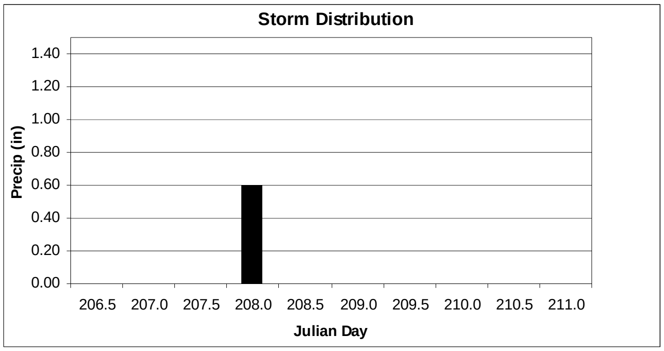


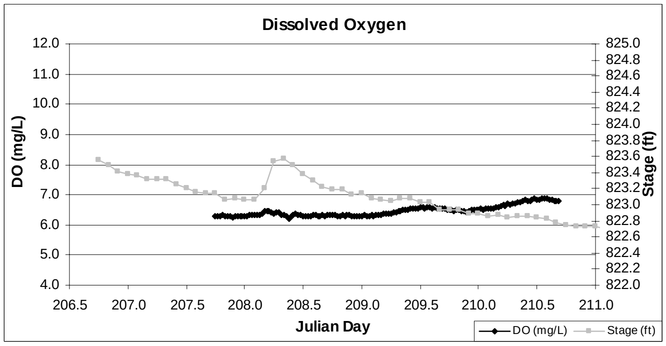


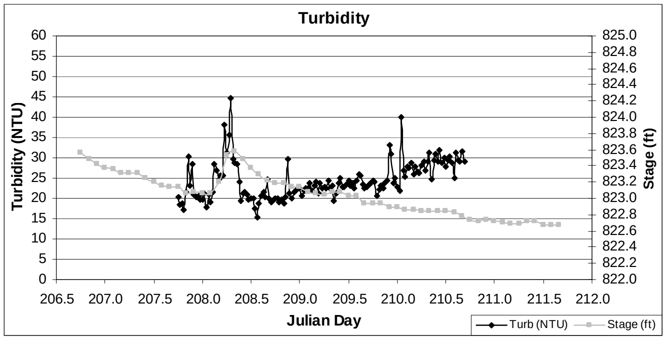
Hydrolab Continuous Monitoring
Storm 6 - 2011

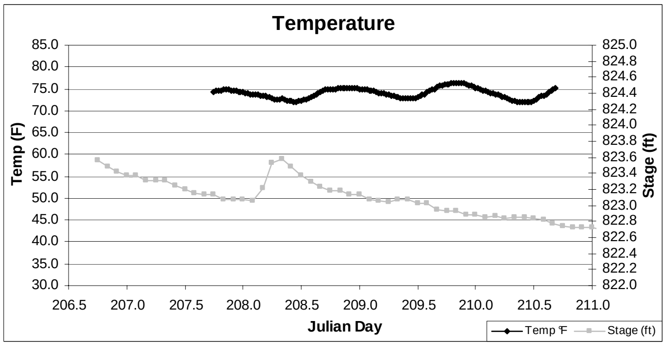
Storm Summary:

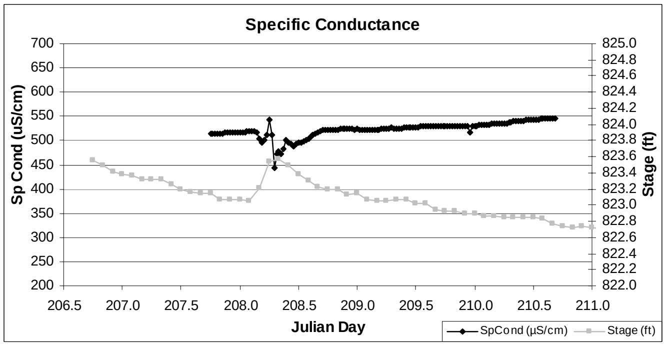
Dates:	26 July 2011 (day 207) to 29 July 2011 (day 210)
Precipitation:	0.60 inches
Notes:	

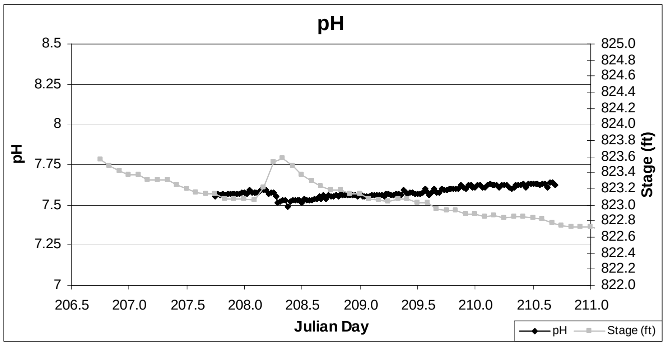












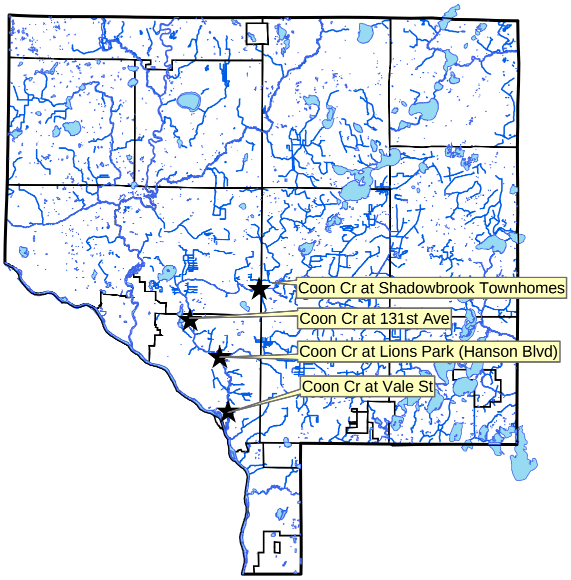
COON CREEK

Coon Creek at Shadowbrook Townhomes, Andover	STORET SiteID = S004-620
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 St., Coon Rapids	STORET SiteID = S003-993

Years Monitored

Coon Cr at Vale Street	2005-2011
Coon Cr at 131st Ave	2010-2011
Coon Cr at Shadowbrook Townhomes	2007-2011
Coon Cr at Lions Park (Hanson Blvd)	2007-2011

Additional, intermittent data available at some other sites



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.

Methods

Coon Creek has been monitored for several years at Vale Street, near its outlet to the Mississippi River as well as at three upstream sites. The monitoring sites were selected to be at the confluence of Coon Creek with tributaries, at municipal boundaries, or other significant locations. All Coon Creek sites, as well as Sand Creek, were monitored at synchronously to allow comparisons.

Streams 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. 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. 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, and chlorides. Beginning in 2011 lab analyses also included hardness and sulfates because the toxicity of chlorides scales with these parameters. Utilizing future state chloride standards will likely require knowledge of hardness and sulfates.

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 Vale Street stream crossing (farthest downstream).

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. Sand Creek monitoring is reported elsewhere, but some comparisons between Sand Creek and Coon Creek are made here.

Coon Creek water quality is moderate upstream and during baseflow, but declines downstream and during storms. Following is a summary, including a management discussion:

- Dissolved pollutants, as measured by conductivity and chlorides, in Coon Creek were 2.5 times greater than the median for other streams in Anoka County, showed little variability in different flow conditions and little variability from upstream to downstream.

  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 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 lower than the MPCA's not-yet-adopted water quality standard of 130 ug/L. However phosphorus doubles during storms, likely exceeding state standards that will soon be adopted. Phosphorus increases from upstream to downstream.

  Management discussion: Phosphorus increases are most prevalent in the lower watershed, where stormwater treatment is the most likely remediation technique.

- Suspended solids and turbidity were acceptably low at baseflow, but increased 1.7 to 5-fold during storms and increased from upstream to downstream. These parameters were two times higher at the Vale Street site than any of the upstream sites. Coon Creek likely exceeds state water quality standards for turbidity due to conditions during and after storms.

  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 near and in-stream significant 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). However, the Hydrolab found it was common for turbidity to increase for several days after a storm, even when flows were dropping. We would expect bedload and streambank erosion to increase with flow.

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

Conductivity and Chlorides

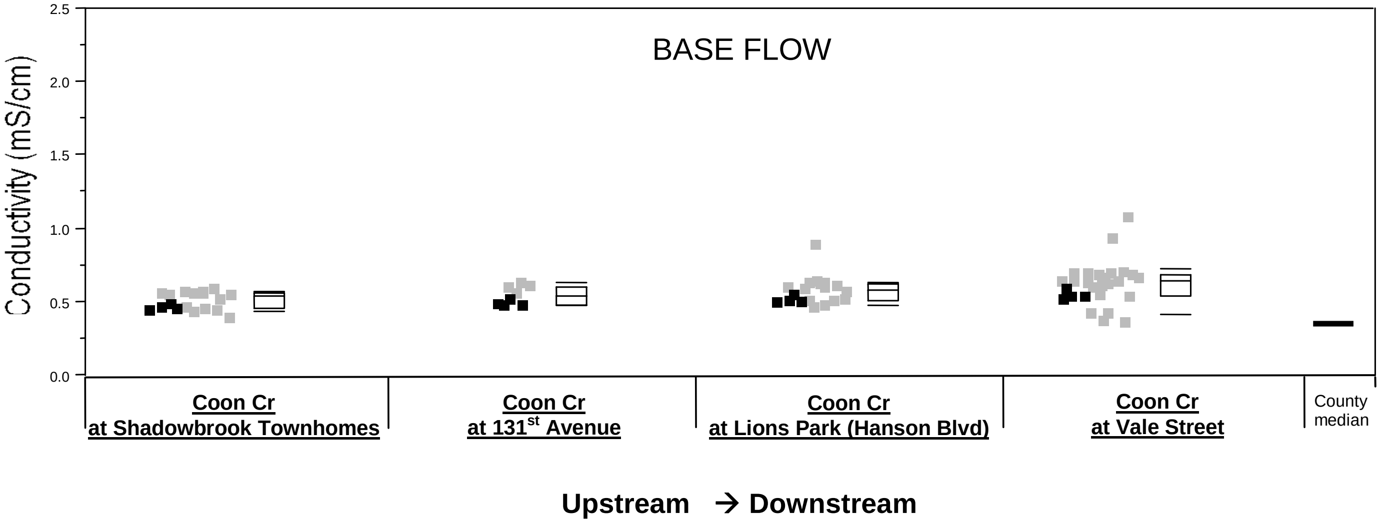
Conductivity, chlorides, and salinity are all measures of a broad range of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial sources, and others. Metals, hydrocarbons, road salts, and others are often of concern in a suburban environment. Conductivity is the broadest 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.

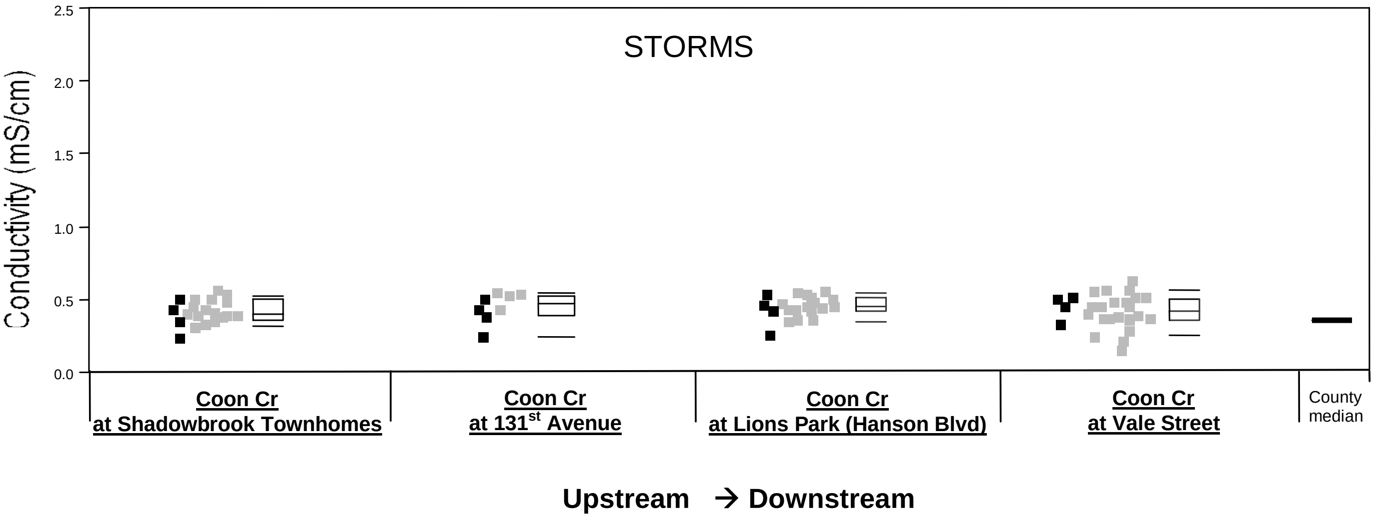
Both measures of dissolved pollutants in Coon Creek were notably higher than the median for other Anoka County streams (see figures below). Median conductivity in Coon Creek (all sites, all conditions) was 0.552 mS/cm compared to the countywide median of 0.362 mS/cm. Median chlorides in Coon Creek (all sites, all conditions) were more than two and a half times higher than the countywide median (46 vs 17 mg/L).

Dissolved pollutants were higher in downstream reaches of Coon Creek, where there is more impervious area (see figures below). Median baseflow conductivity increased modestly from upstream to downstream (0.550, 0.553, 0.586, and 0.654 mS/cm, respectively). The largest increase was between Hanson Blvd and Vale Street. The difference from upstream to downstream for chlorides was also greatest between the farthest downstream monitoring sites, and the magnitude of change was greater. Median baseflow chlorides from upstream to downstream were 37, 44, 51, and 64 mg/L, respectively during baseflow. The increases in dissolved pollutants from upstream to downstream were dampened during storms.

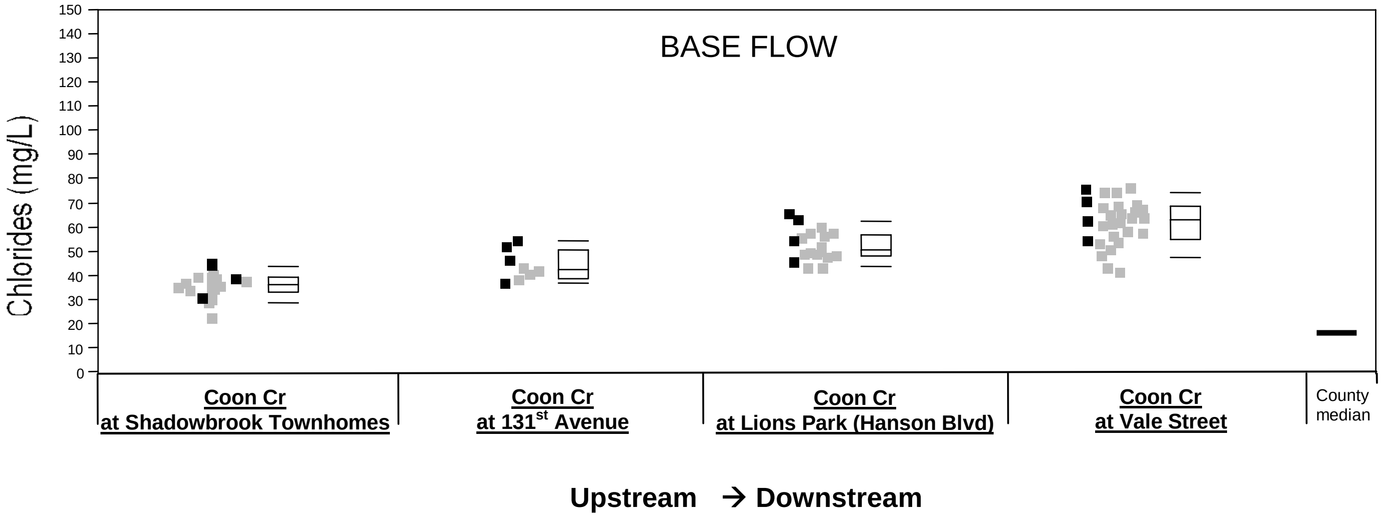
Dissolved pollutants were lower during storms. For example, median chlorides during baseflow were 64 mg/L during baseflow and 51 mg/L during storms at Vale street. Similarly, median conductivity during baseflow was 0.654 mS/cm, but 0.429 mS/cm during storms at Vale Street. This lends some insight into 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 as 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.

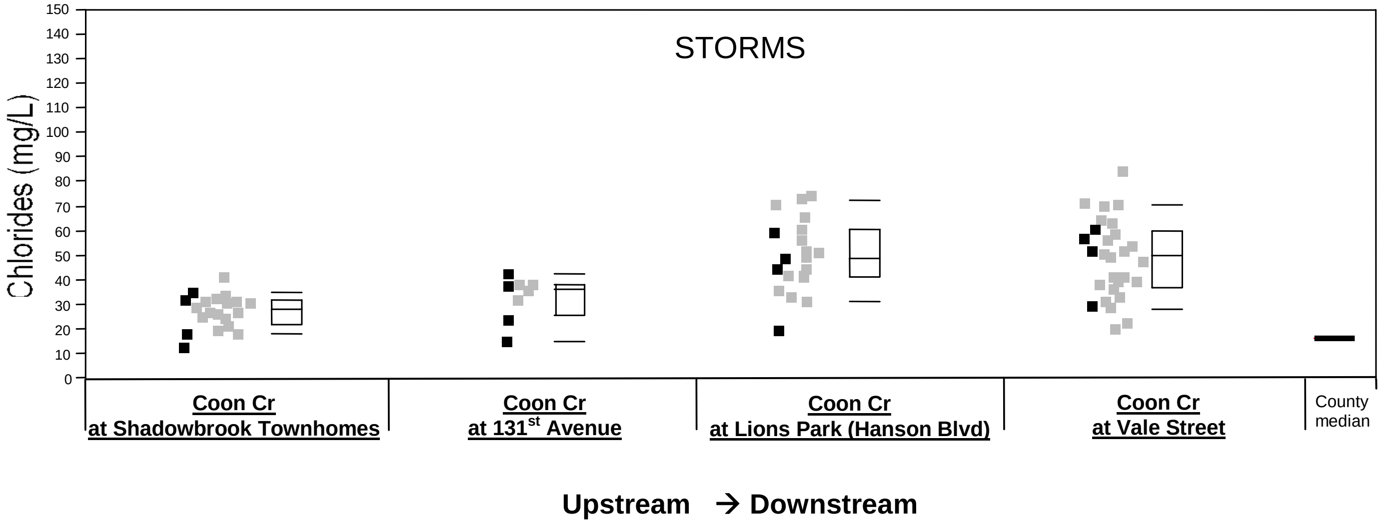
Conductivity Coon Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Chlorides Coon Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Recent research has shown that chloride toxicity is heavily dependent upon water hardness, and to a lesser degree, sulfate levels in the water. Therefore, these parameters were measured eight times in 2011. This was the first year of monitoring these parameters. This data is summarized in the table below.

Sulfate and hardness at Coon Creek. The median of eight measurements taken in 2011 from Coon Creek at Xeon Street is shown. No other years of data are available. Data from other sites are available.

	Coon Creek at Vale Street
Sulfate (mg/L)	61.9
Hardness (mg/L CaCO3)	230.8

Iowa has revised its water quality standards to reflect the impact of sulftates and hardness on chloride toxicity, and Minnesota is in the process of doing so. Iowa has developed the following equations to calculate acute and chronic chloride standards for each waterbody:

Acute chloride standard = $287.8(\text{Hardness})^{0.205797}(\text{Sulfate})^{-0.07452}$
Chronic chloride standard = $177.87(\text{Hardness})^{0.205797}(\text{Sulfate})^{-0.07452}$

These equations are applied to Coon Creek data in the table below.

Coon Creek chloride standards using Iowa equations that account for sulfate and hardness. Data used are eight hardness and sulfate measurements in Coon Creek at Vale Street in 2011.

	Stream-specific chloride standard as calculated with Iowa equations	**Current Minnesota Standard**	**Coon Creek Observations**
Acute (one hour average)	**649 mg/L**	**860 mg/L**	**85.2 mg/L** = Maximum observed
Chronic (four day average)	**401 mg/L**	**230 mg/L**	**47.1 mg/L** = Average of all observations

The effect of these site-specific standards for Coon Creek, once adopted in Minnesota, would be to make the acute standard more strict, and the chronic standard less strict. Presently, Coon Creek is far below both standards. It will become even less likely that the stream will violate the chronic standard once it is relaxed. However, there is a greater likelihood that Coon Creek might exceed the acute standard, particularly during winter or snowmelt when chlorides are likely to be highest. The only winter monitoring that has occurred has been late in the snowmelt process.

Total Phosphorus

Total phosphorus (TP) is a common nutrient pollutant. It is limiting for most algae growth. Total phosphorus in Coon Creek was consistently low during baseflow conditions, but approximately doubled during storms (see figure below). The Minnesota Pollution Control Agency is developing 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.

Baseflow TP was low. During baseflow the four monitoring sites had median TP of 73, 112, 88, and 80 ug/L, respectively, from upstream to downstream. This is much 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 130 ug/L. There was little variability among baseflow samples, with only 15 of 78 (19%) baseflow samples exceeding 130 ug/L. The maximum was 194 ug/L.

During storms TP was higher, and sometimes much higher. Median TP during storms was 1.7 (131St Ave) to 2.3 (Vale St) greater than the median for baseflow. Storms also had much greater variability. The standard deviation for storm readings were 85 ug/L at Shadowbrook, 112 ug/L at 131st Ave, 85 at Lions Park, and 142 at Vale Street. By contrast, the standard deviations during baseflow were 45, 45, 39, and 34 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.

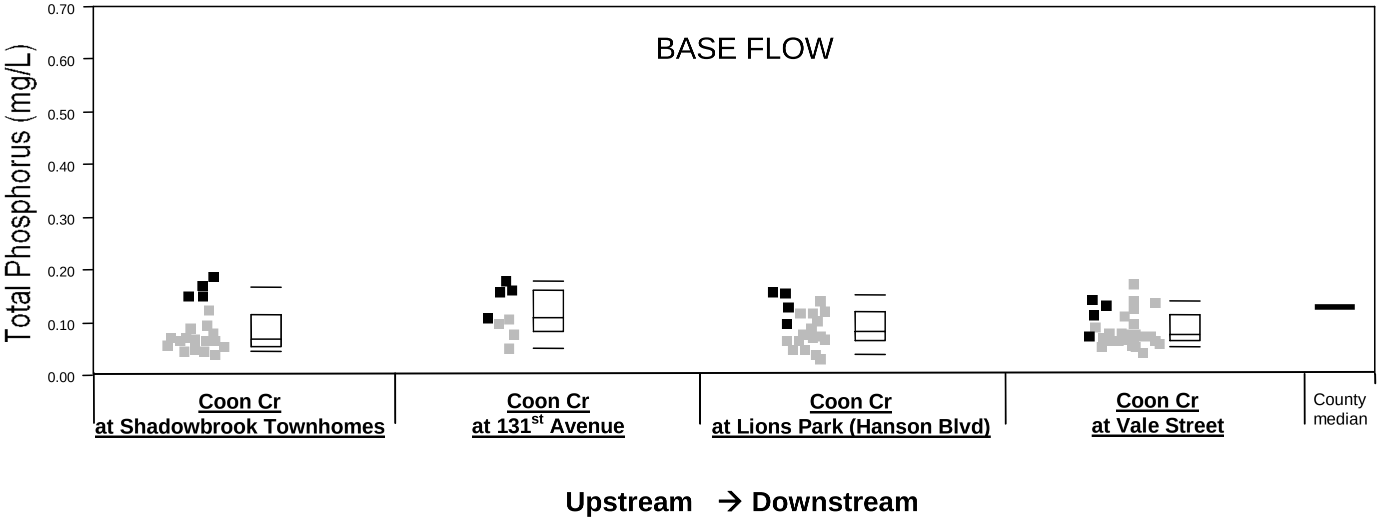
TP increased in an upstream to downstream direction during storms. Median storm TP at the four sites from upstream to downstream were 129, 190, 169, and 187 ug/L, respectively. The second site (131st Avenue) has much less data (eight measurements) than the other sites, and so its high median is less refined than the medians for other sites which have much more data.

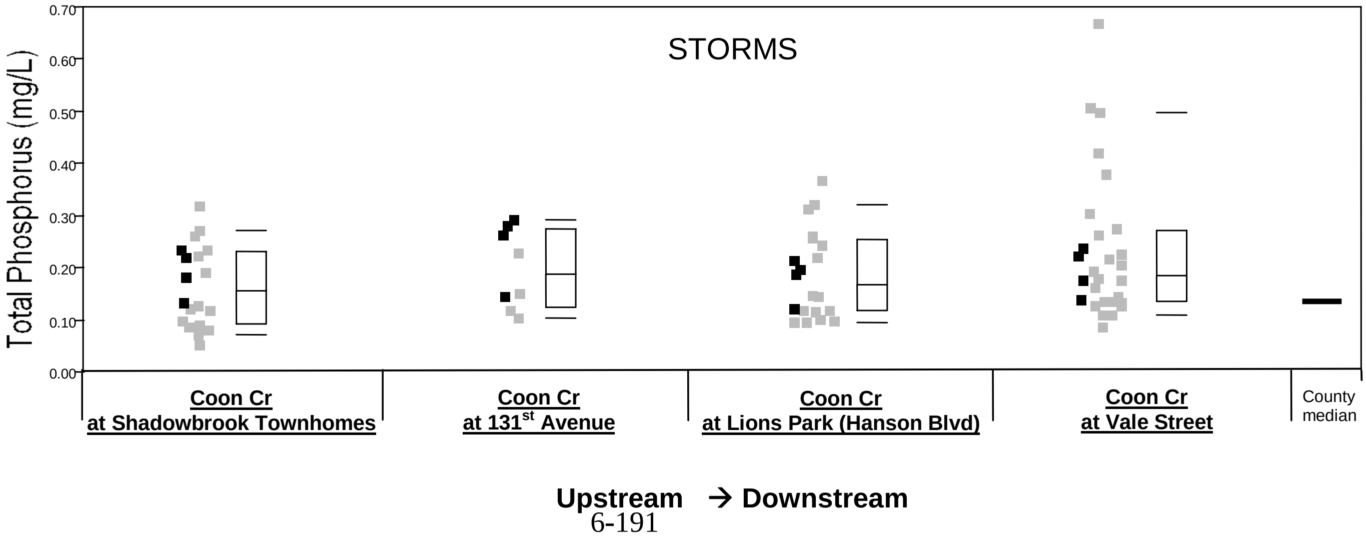
TP at the farthest downstream monitoring site regularly exceed the likely and not-yet-finalized state standard of 130 ug/L. At Vale Street only five of 27 TP measurements during storms (18%) were lower than 130 ug/L. The maximum observed was 672 ug/L.

The dominant phosphorus source is likely different in upstream and downstream stream reaches. Upstream is less developed and development 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 during storms 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.

Total phosphorus at Coon Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Suspended Solids and Turbidity

Total suspended solids (TSS) and turbidity both measure solid particles in the water. TSS measures these particles by weighing materials filtered out of the water. Turbidity measures by defraction of a beam of light sent though the water sample, and is therefore most sensitive to large particles. In Coon Creek TSS and turbidity were low upstream and during baseflow, but increase dramatically during storms and in downstream reaches (see figures below). The stream appears to exceed state water quality standards for turbidity, though it has not yet been listed as impaired by the MPCA.

During baseflow TSS and turbidity were acceptably low and showed little upstream to downstream increase. Median turbidity during baseflow from upstream to downstream were 8, 17, 8, and 12 FRNU, respectively. This is similar to the countywide median of 8 FRNU and less than the MPCA's water quality standard of 25. Median TSS during baseflow from upstream to downstream was 6, 7, 9, and 8 mg/L, respectively. This is lower than the median for streams county-wide of 12 mg/L.

During storms TSS and turbidity were higher and increased from upstream to downstream. Median TSS during storms was 1.7 to 5.0 times higher than during baseflow (comparison is among site medians). Median storm TSS was 11, 19, 19, and 41 mg/L from upstream to downstream. Median turbidity during storms was 1.7 to 3.9 times higher than during baseflow (comparison is among site medians). Median storm turbidity was 14, 37, 13, and 41 mg/L from upstream to downstream. The greatest increase from baseflow to storms was at the Vale Street monitoring site (farthest downstream).

Turbidity and TSS are highest in downstream reaches. Readings at Vale Street were typically two-times higher than those from upstream areas during storms. Higher flows in downstream areas probably contribute to greater bedload transport of sediment. Greater impervious area in downstream portions of the watershed results more urban stormwater runoff, which is often high in suspended materials. The lower portions of the Coon Creek watershed were mostly developed before rigorous stormwater treatment regulations were enacted.

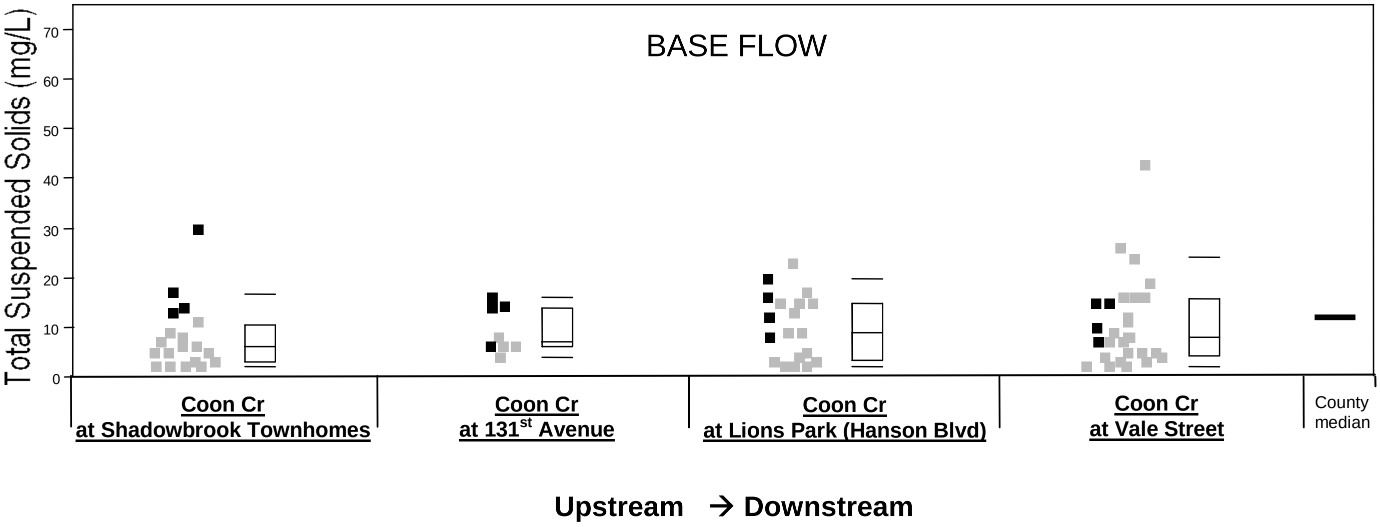
There is likely enough data for the MPCA to consider Coon Creek "impaired" due to violations of turbidity water quality standards. Whenever possible, MPCA prefers to use turbidity for these determinations rather than use TSS and transparency tube as surrogates. A minimum of 20 readings are required. At least three observations and 10% of all observations must exceed the water quality standard of 25 NTU to be considered impaired. At the Shadowbrook monitoring site (farthest upstream), 9 of 38 (24%) readings exceeded the standard. Too few measurements are available at 131st Avenue to determine if state standards are exceeded. At the Lions Park monitoring site, 14 of 40 readings (35%) exceeded the standard. At the Vale Street monitoring site (farthest downstream), 24 of 56 (43%) of readings exceeded the standard. Keep in mind that half of all readings are during storms and half during baseflow. All except five exceedences at Vale Street were during storms. Based on this, the MPCA is likely to list Coon Creek as impaired for high turbidity.

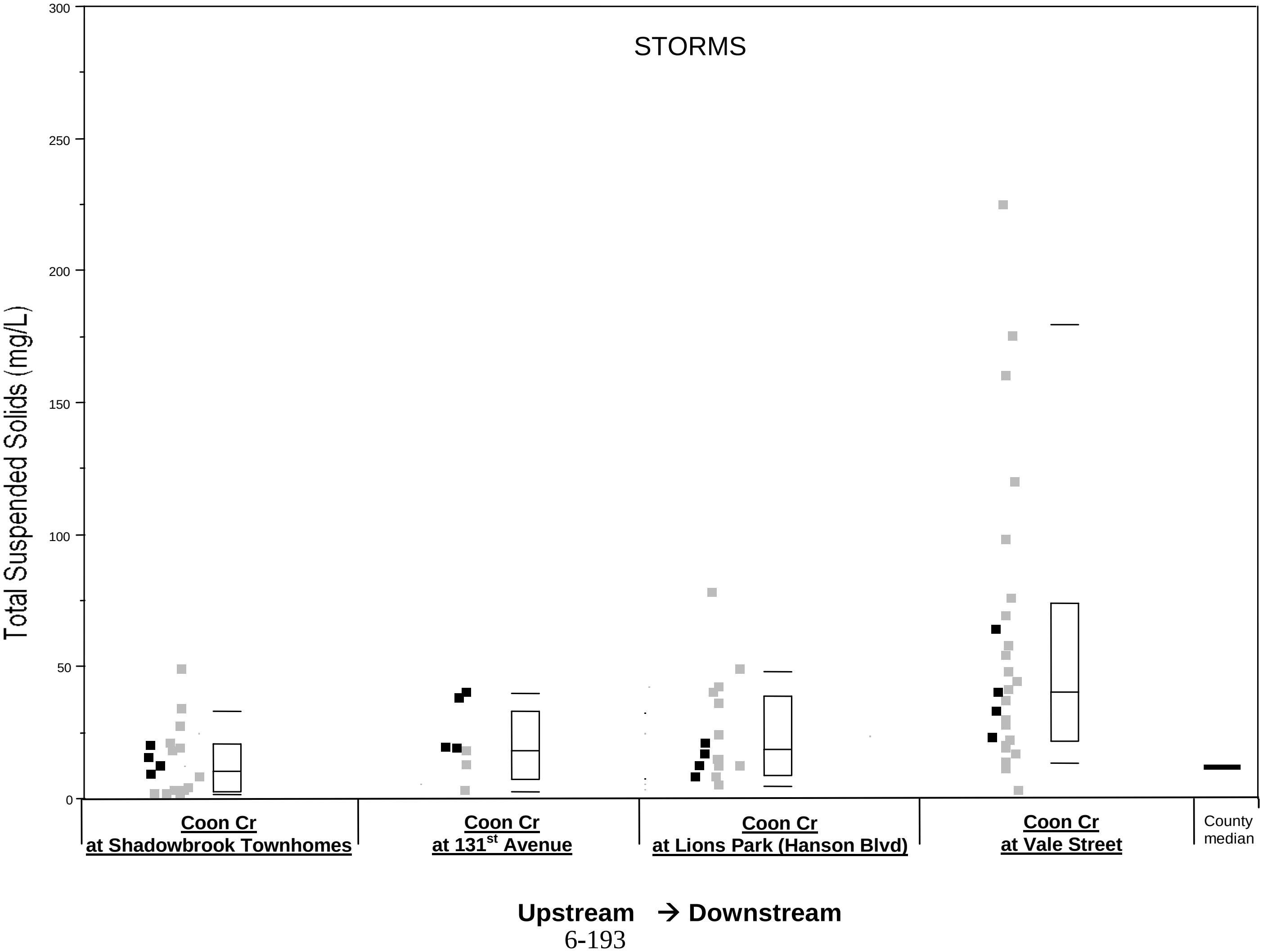
There are some questions regarding the appropriateness of such an impaired listing. Coon Creek exceeded the surrogate standard of 100 mg/L TSS only five times across all sites. The surrogate standard is used when insufficient turbidity data exists.

From a management perspective, water quality improvement projects should focus upon treating stormwater, especially in the lower half of the watershed. Retrofitting the existing stormwater conveyance and treatment system will be necessary in many instances. Where redevelopment occurs, improved stormwater practices should be installed. In some areas, stabilization of the creek itself is needed; several areas of significant streambank erosion exist. This is not surprising given that upper reaches of the creek have been ditched.

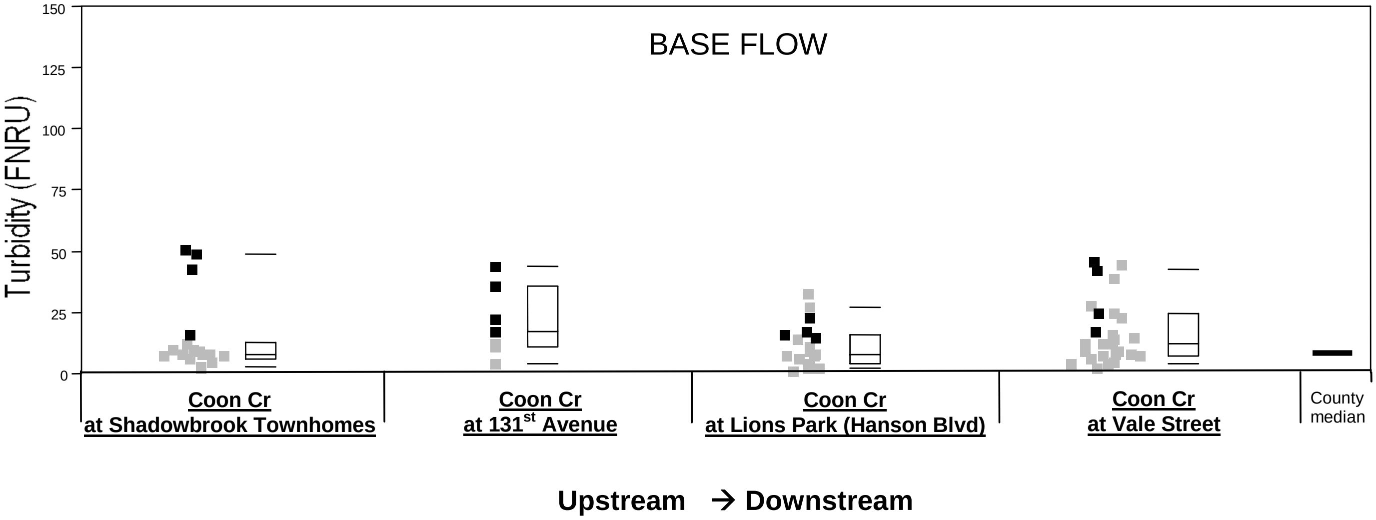
Research should be done to determine the extent to which bed load transport of sediment is contributing to high turbidity and TSS. Presently, it appears that it has the potential to be important but data do not indicate it is large. Suspended solids are much lower in the upper portions of the watershed where most of the channel is ditched. Ditched channels are inherently more instable and therefore more prone to sediment movement on the banks and bed. Yet it is in the lower watershed, with more naturalized channels, that we find the highest sediment concentrations. Moreover, 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. More research may lend new insights to these coarse observations.

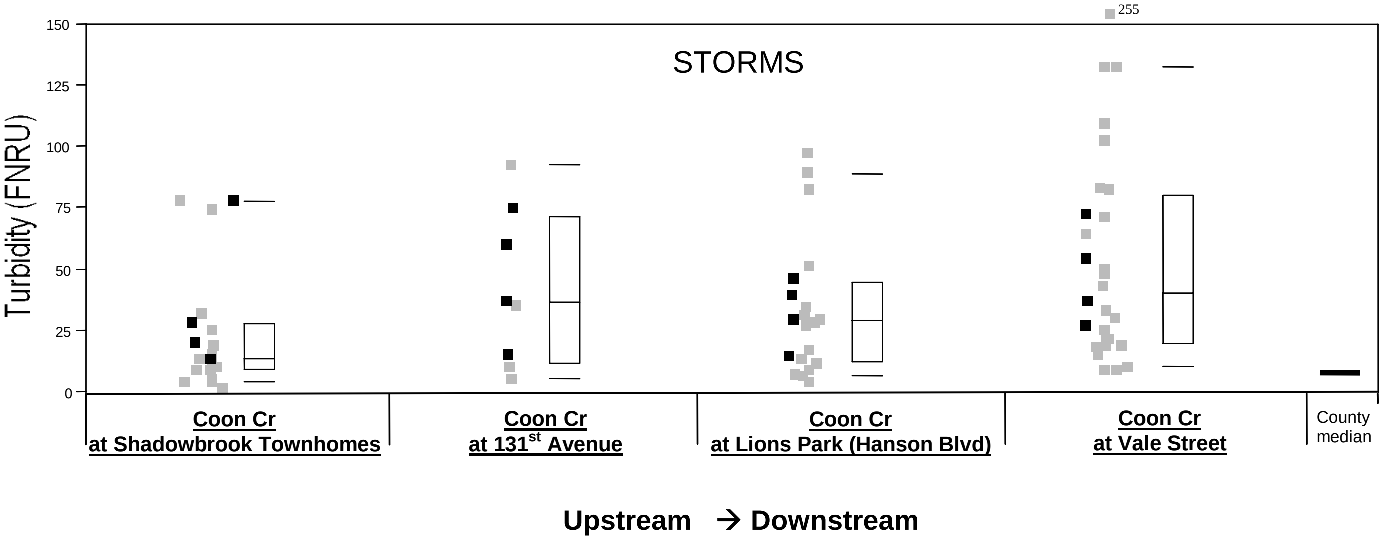
Total suspended solids at Coon Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Turbidity at Coon Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

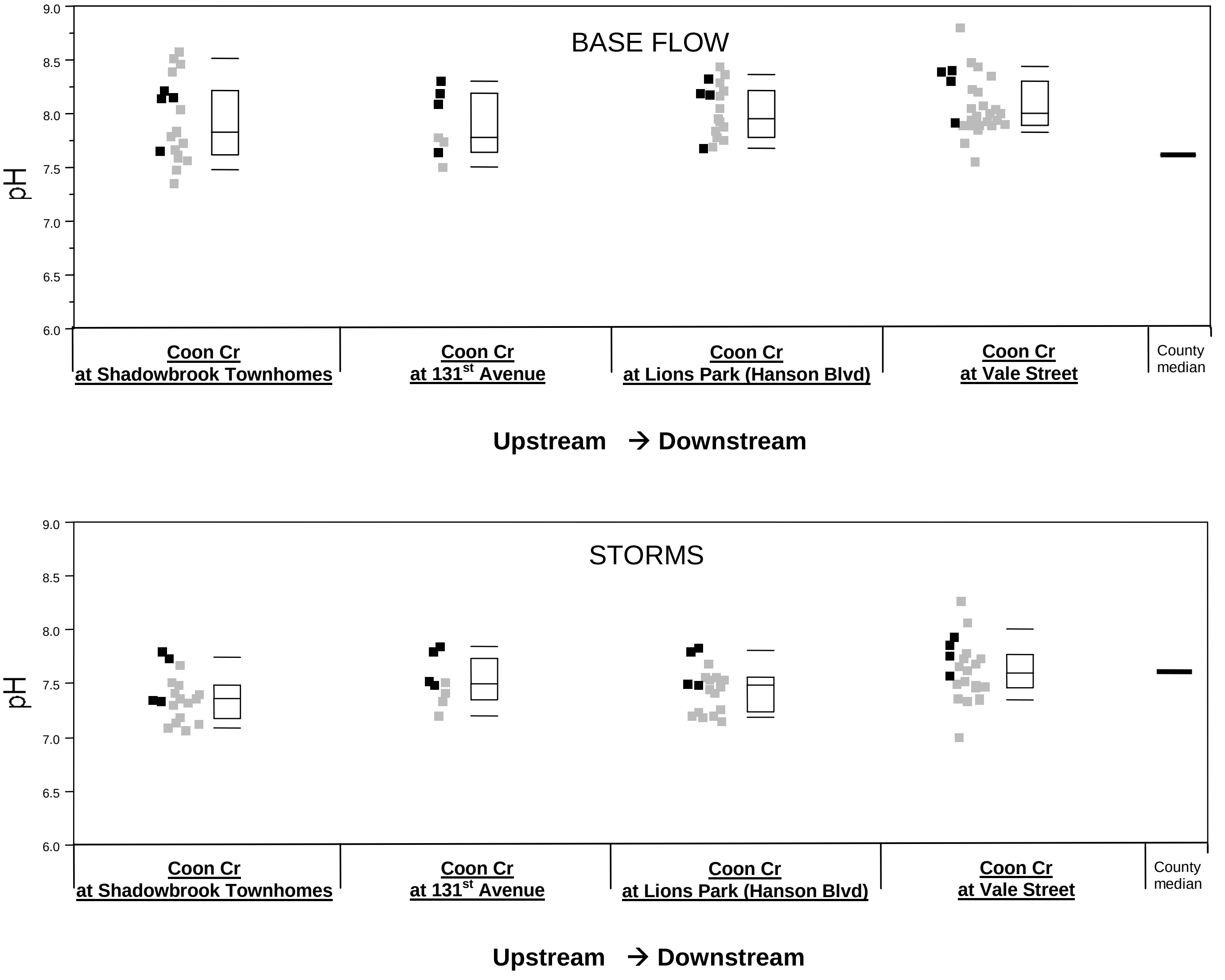




pH

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. One unusually low pH reading of 6.24 occurred on July 20, 2009. The reason for this low reading is unknown, but it appears to be isolated.

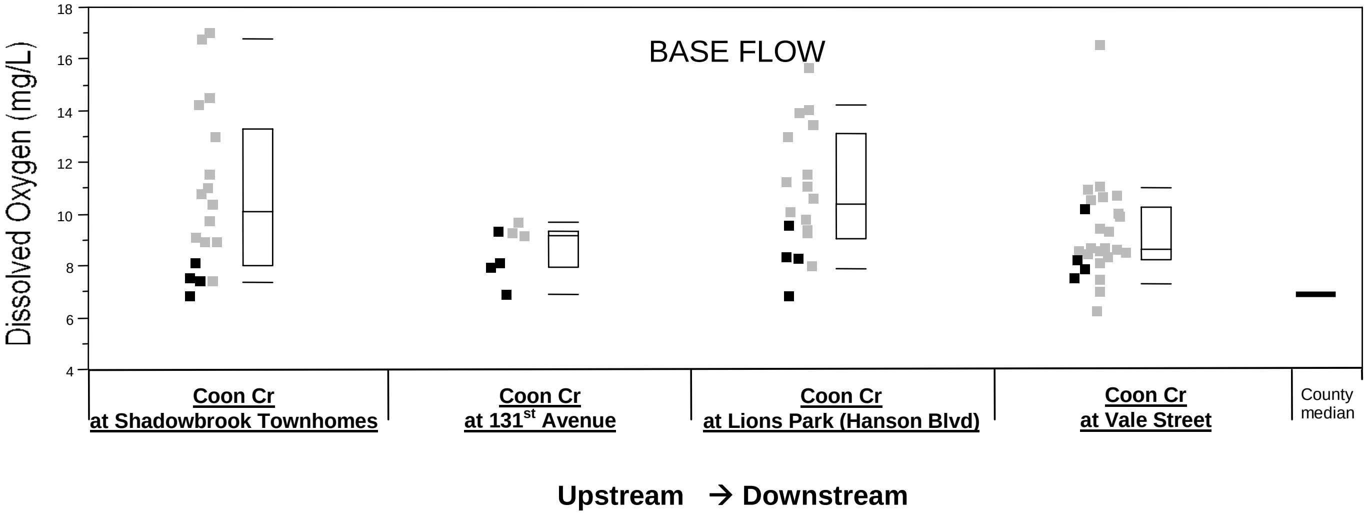
pH at Coon Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

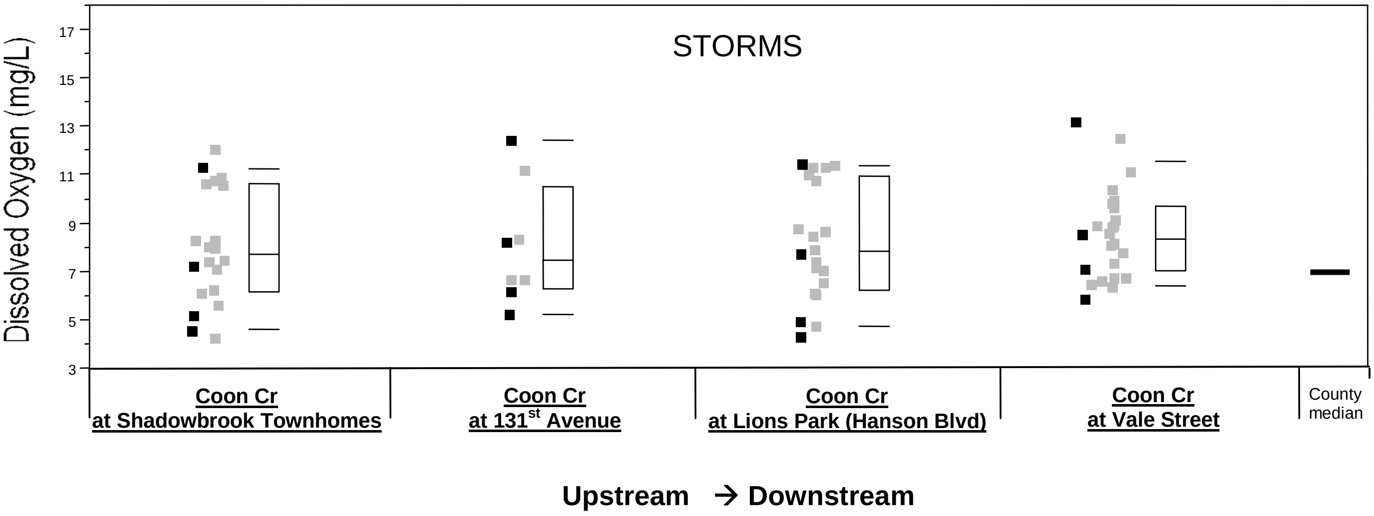


Dissolved Oxygen

Dissolved oxygen was similar at all sites and adequate for most aquatic live (i.e. >5 mg/L). On two occasions it dropped below 5 mg/L at Shadowbrook Townhomes, and did so three times at Lions Park. The other sites had no instances of dissolved oxygen below 5 mg/L. In sum, no dissolved oxygen problems are present.

Dissolved oxygen at Coon Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



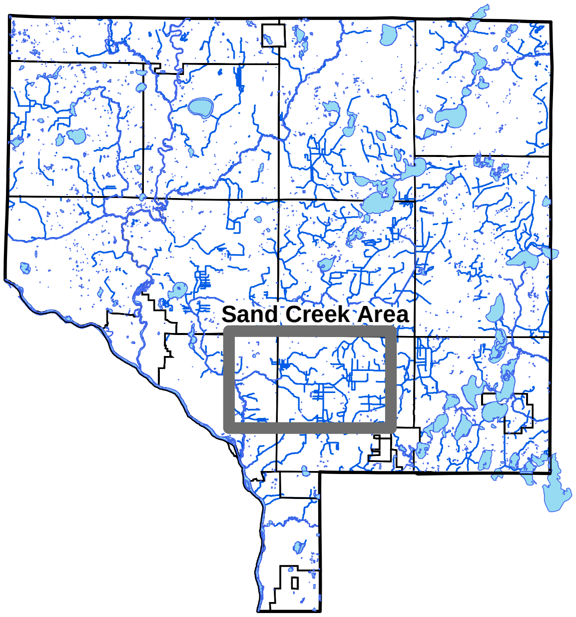


SAND CREEK SYSTEM

Sand Cr (Ditch 41) at Radisson Rd, Blaine	STORET SiteID = S006-421
Sand Cr (Ditch 41) at Highway 65, Blaine	STORET SiteID = S005-639
Sand Cr at Happy Acres Park, Blaine	STORET SiteID = S005-641
Ditch 60 at Happy Acres Park, Blaine	STORET SiteID = S005-642
Sand Cr at University Avenue, Coon Rapids	STORET SiteID = S005-264
Ditch 39 at University Avenue, Coon Rapids	STORET SiteID = S005-638
Sand Cr at Morningside Mem. Gardens Cemetery, Coon Rapids	STORET SiteID = S006-420
Sand Cr at Xeon Street, Coon Rapids	STORET SiteID = S004-619

Years Monitored

Sand Cr (Ditch 41) at Radisson Rd	2010-2011
Sand Cr (Ditch 41) at Highway 65	2009-2011
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	2010-2011
Sand Cr at Xeon Street	2007-2011



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.

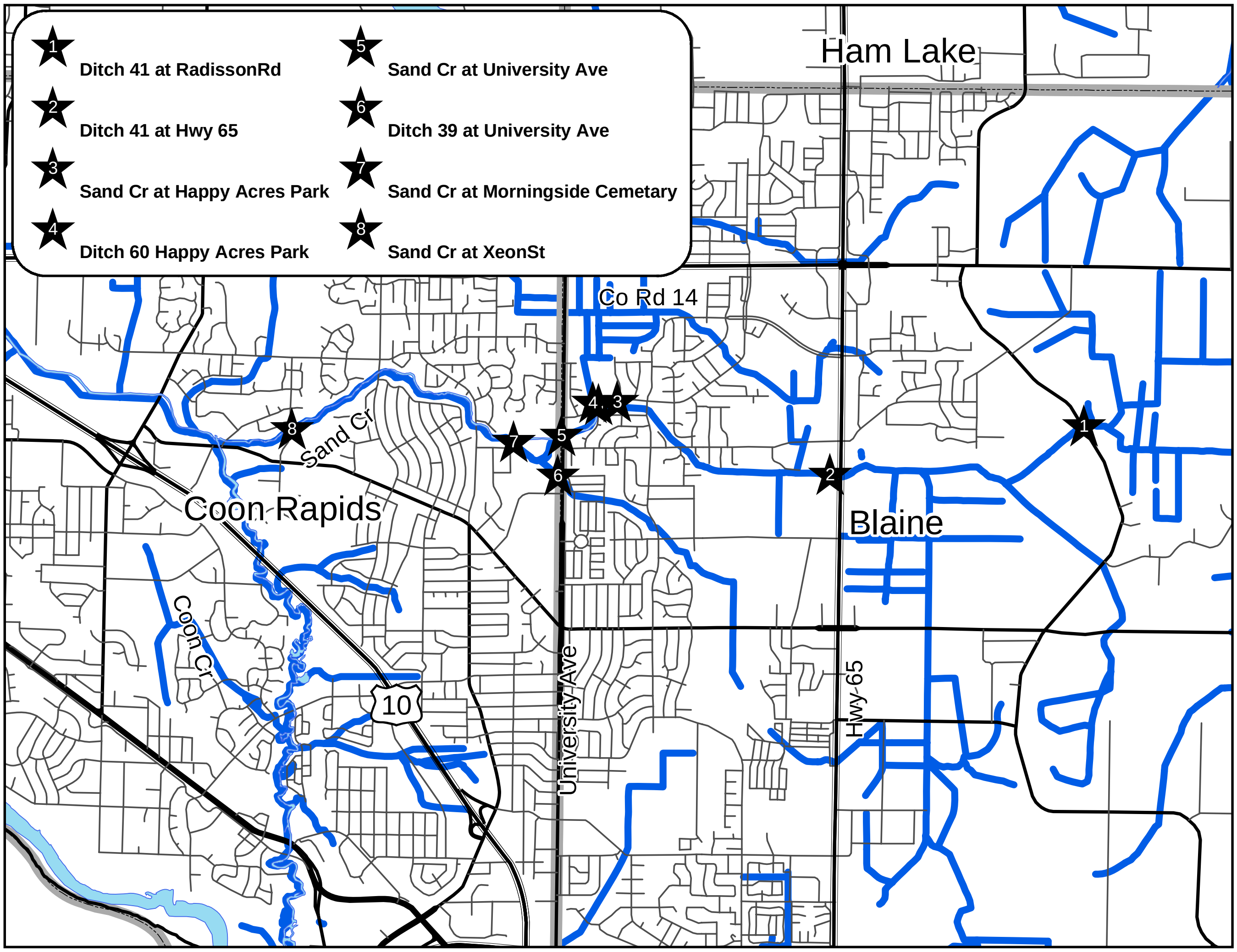
Methods

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. 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, 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 at the 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. 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.

  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. Phosphorus increases modestly during storms, but is still relatively low. Phosphorus does not increase noticably from upstream to downstream in Sand Creek.

  Management discussion: Phosphorus increases are most prevalent in the lower watershed, where stormwater treatment is the most likely remediation technique.

- Suspended solids and turbidity are similar at the Sand Creek monitoring sites except for higher readings upstream during baseflow and downstream during storms. Baseflow turbidity is highest in at the farthest upstream monitoring sites, probably due to algal production in ponds and lakes in the upper watershed. Turbidity during storms is highest at the downstream monitoring sites, probably due to higher percentages of impervious surfaces, and therefore stormwater runoff, in the lower watershed.

  Management discussion: Data from all sites is lower than the state turbidity standard of 25 FNRU. Yet local water managers should consider efforts to reduce TSS and turbidity because of turbidity problems in Coon Creek, to which Sand Creek flows. Efforts to manage suspended solids in Sand Creek should focus upon stormwater in the lower part of the watershed.

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

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 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 (0.720 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 (68 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.

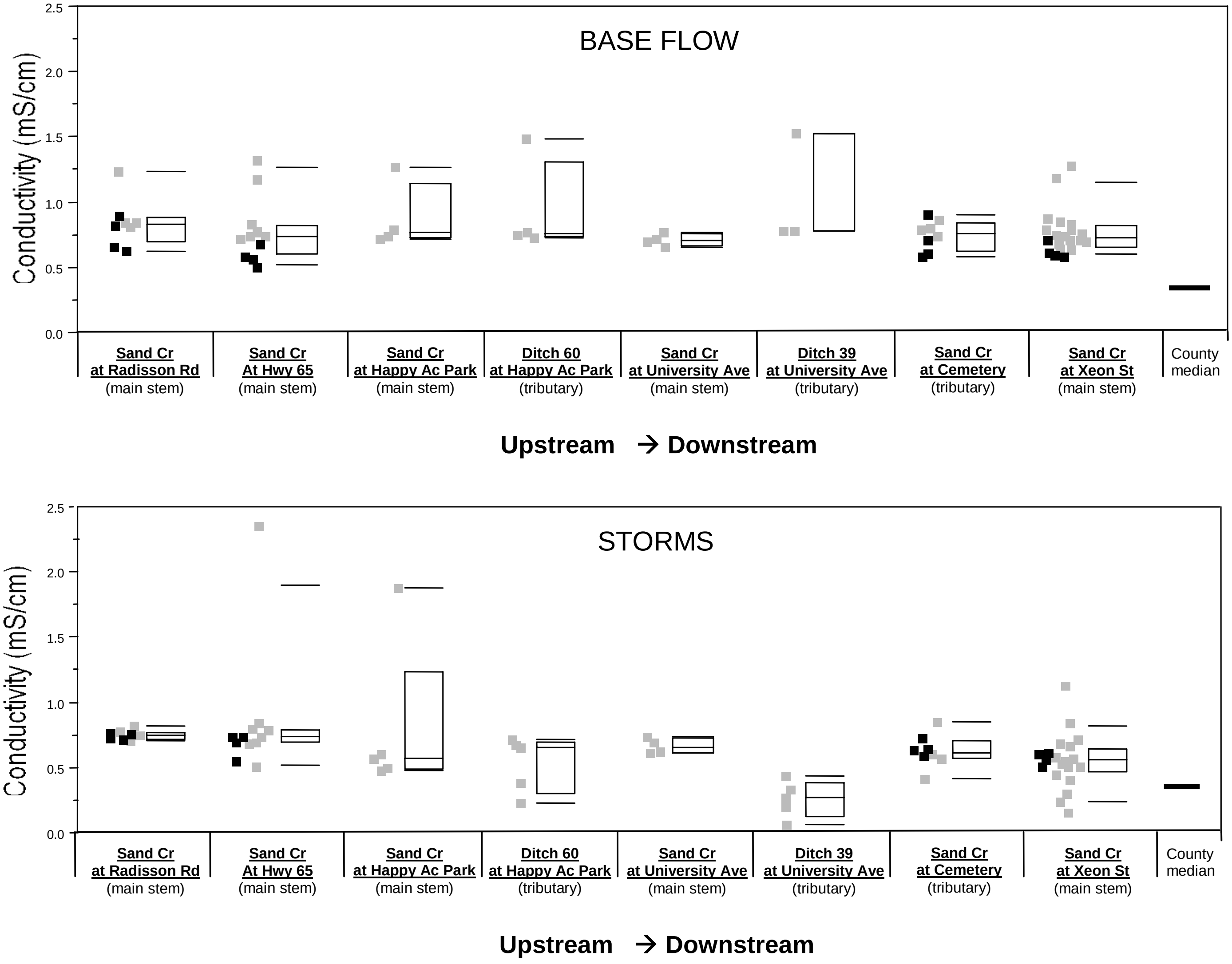
It’s not surprising that Sand Creek, which lies in a suburban area, would have greater dissolved pollutants than the county-wide median. The county spans rural to urban areas. Sand Creek’s upper watershed has an abundance of current and retired sod farms, where salt-containing chemicals are used. The 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.

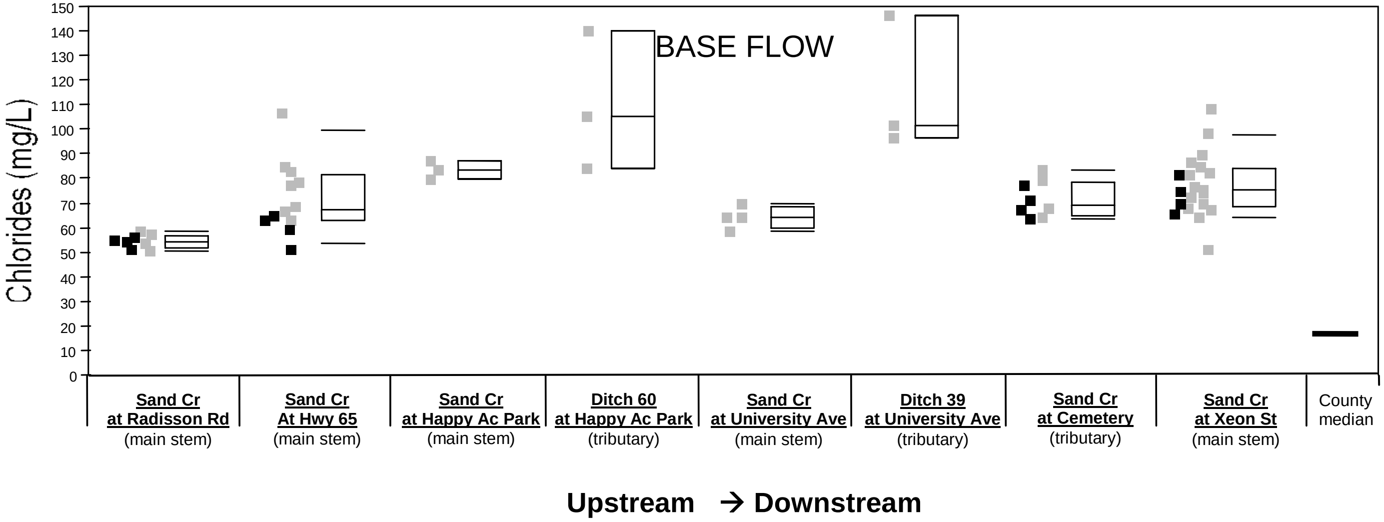
Dissolved pollutants were slightly lower during storms than during baseflow (see figures below). Dissolved pollutants can easily infiltrate into the shallow groundwater that feeds streams during baseflow. If this has occurred, dissolved pollutants will be high during baseflow. If road runoff was the primary dissolved pollutant source, then readings would be highest during storms. The mean conductivity from all Sand Creek sites during baseflow was 22% higher than during storms (0.763 vs 0.624 mS/cm). The mean chlorides from all Sand Creek sites during baseflow was 20% higher than during storms (72 vs 60 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.

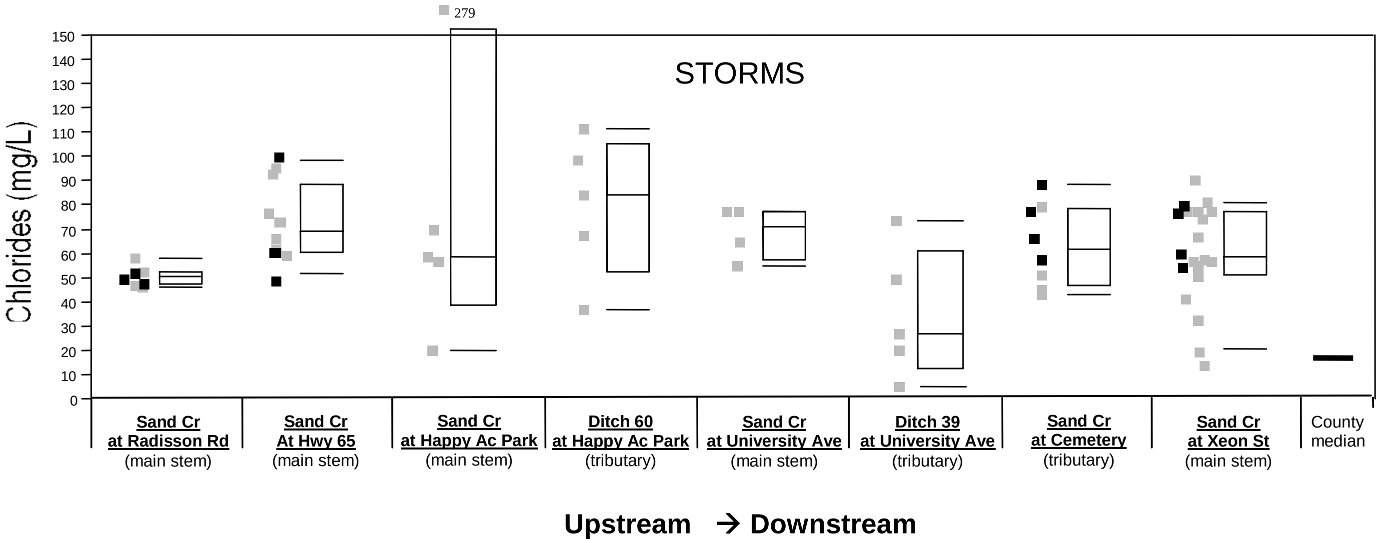
Sand Creek degrades Coon Creek with dissolved pollutants. Both creeks were monitored just before they join. Across all years monitored, Sand Creek's median conductivity was 28% higher than Coon Creek (0.665 vs 0.519 mS/cm). Sand Creek's median chlorides were 45% higher than Coon Creek (74 vs 51 mg/L).

Conductivity at Sand Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Chlorides at Sand Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Recent research has shown that chloride toxicity is heavily dependent upon water hardness, and to a lesser degree, sulfate levels in the water. Therefore, these parameters were measured eight times in 2011. This was the first year of monitoring these parameters. This data is summarized in the table below.

Sulfate and hardness at Sand Creek. The median of eight measurements taken in 2011 from Sand Creek at Xeon Street is shown. No other years of data are available. Data from other sites are available.

	Sand Creek at Xeon Street
Sulfate (mg/L)	93.5
Hardness (mg/L CaCO3)	263.0

Iowa has revised its water quality standards to reflect the impact of sulftates and hardness on chloride toxicity, and Minnesota is in the process of doing so. Iowa has developed the following equations to calculate acute and chronic chloride standards for each waterbody:

$\text{Acute chloride standard} = 287.8(\text{Hardness})^{0.205797}(\text{Sulfate})^{-0.07452}$

$\text{Chronic chloride standard} = 177.87(\text{Hardness})^{0.205797}(\text{Sulfate})^{-0.07452}$

These equations are applied to Sand Creek data in the table below.

Sand chloride standards using Iowa equations that account for sulfate and hardness. Data used are eight hardness and sulfate measurements in Sand Creek at Xeon Street in 2011.

	Stream-specific chloride standard as calculated with Iowa equations	**Current Minnesota Standard**	**Sand Creek Observations**
Acute (one hour average)	**646 mg/L**	**860 mg/L**	**279 mg/L** = Maximum observed
Chronic (four day average)	**399 mg/L**	**230 mg/L**	**70.0 mg/L** = Average of all observations

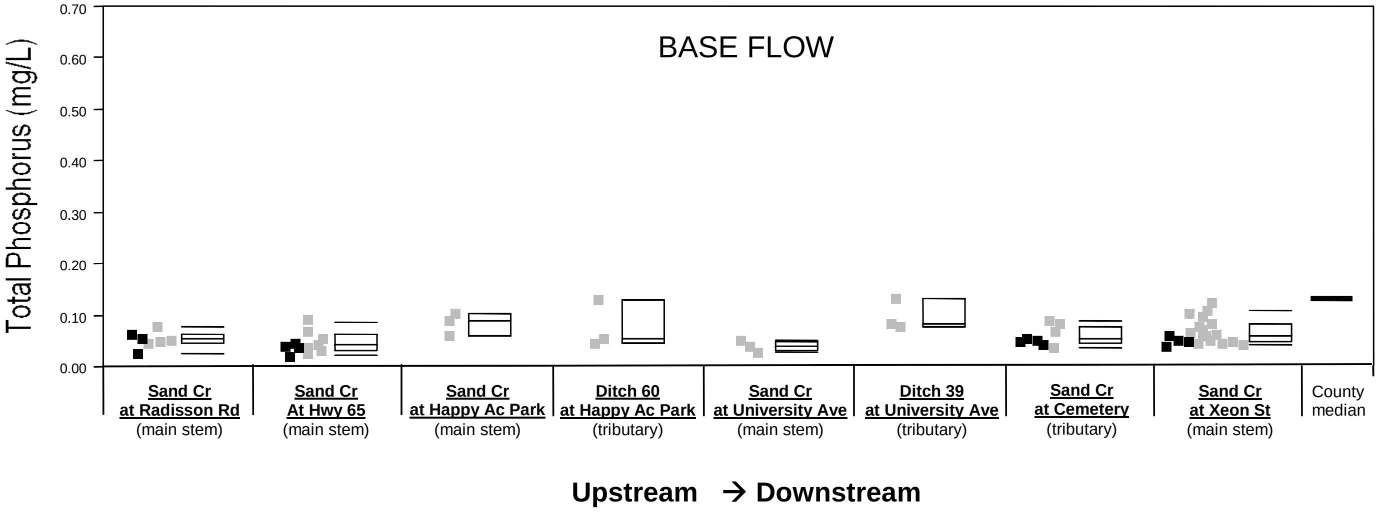
The effect of these site-specific standards for Sand Creek, once adopted in Minnesota, would be to make the acute standard more strict and the chronic standard less strict. Presently, Sand Creek is far below the chronic standard, and making the standard less strict only makes it less likely Sand Creek will be in violation. However, there is a greater likelihood that Sand Creek might exceed the acute standard, particularly during winter or snowmelt when chlorides are likely to be highest. The only winter monitoring that has occurred has been late in the snowmelt process.

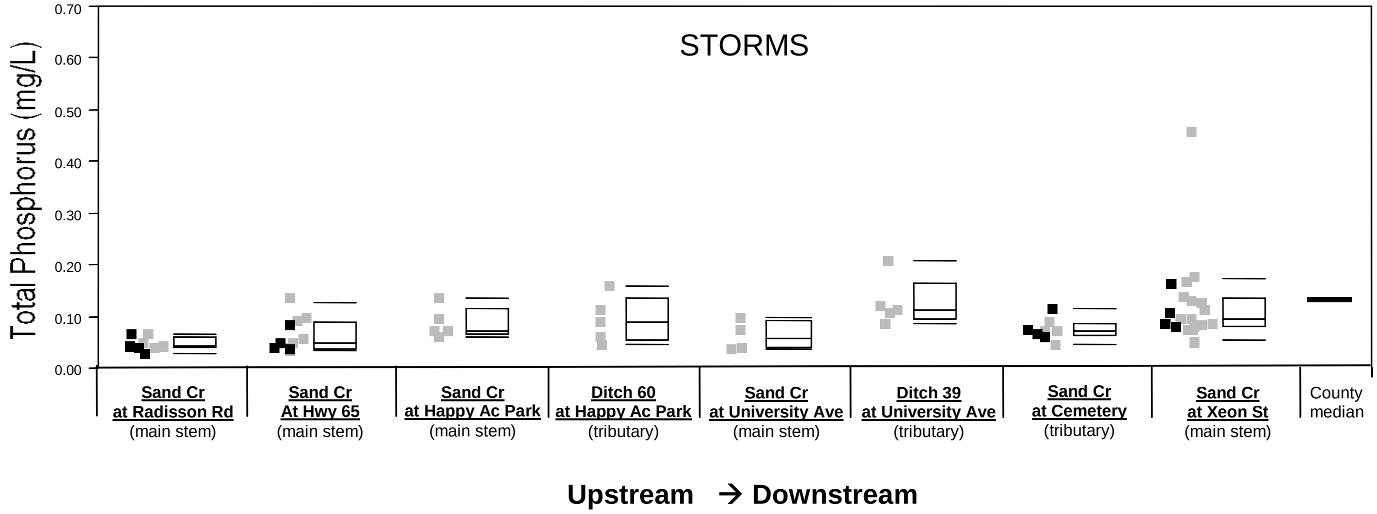
Total Phosphorus

Total phosphorus (TP) is a common nutrient pollutant. It is limiting for most algae growth. TP was low in Sand Creek (see figures below). Median Sand Creek TP for all sites in all years during baseflow (0.055 mg/L) and storms (0.077 mg/L) were below the median for Anoka County streams (0.135 mg/L) and below the water quality standard that the MN Pollution Control Agency seems likely to adopt (0.130 mg/L). While TP is slightly higher at most sites during storms compared to baseflow, this difference was minor. No apparent TP increase occurs from upstream to downstream, however the highest TP readings observed were during storms at the downstream monitoring sites.

Sand Creek TP is lower than Coon Creek. In Coon Creek, just before the confluence with Sand Creek, the median TP is 0.120 mg/L. The median in Sand Creek at this same junction is 0.082 mg/L.

Total phosphorus at Sand Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Suspended Solids and Turbidity

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

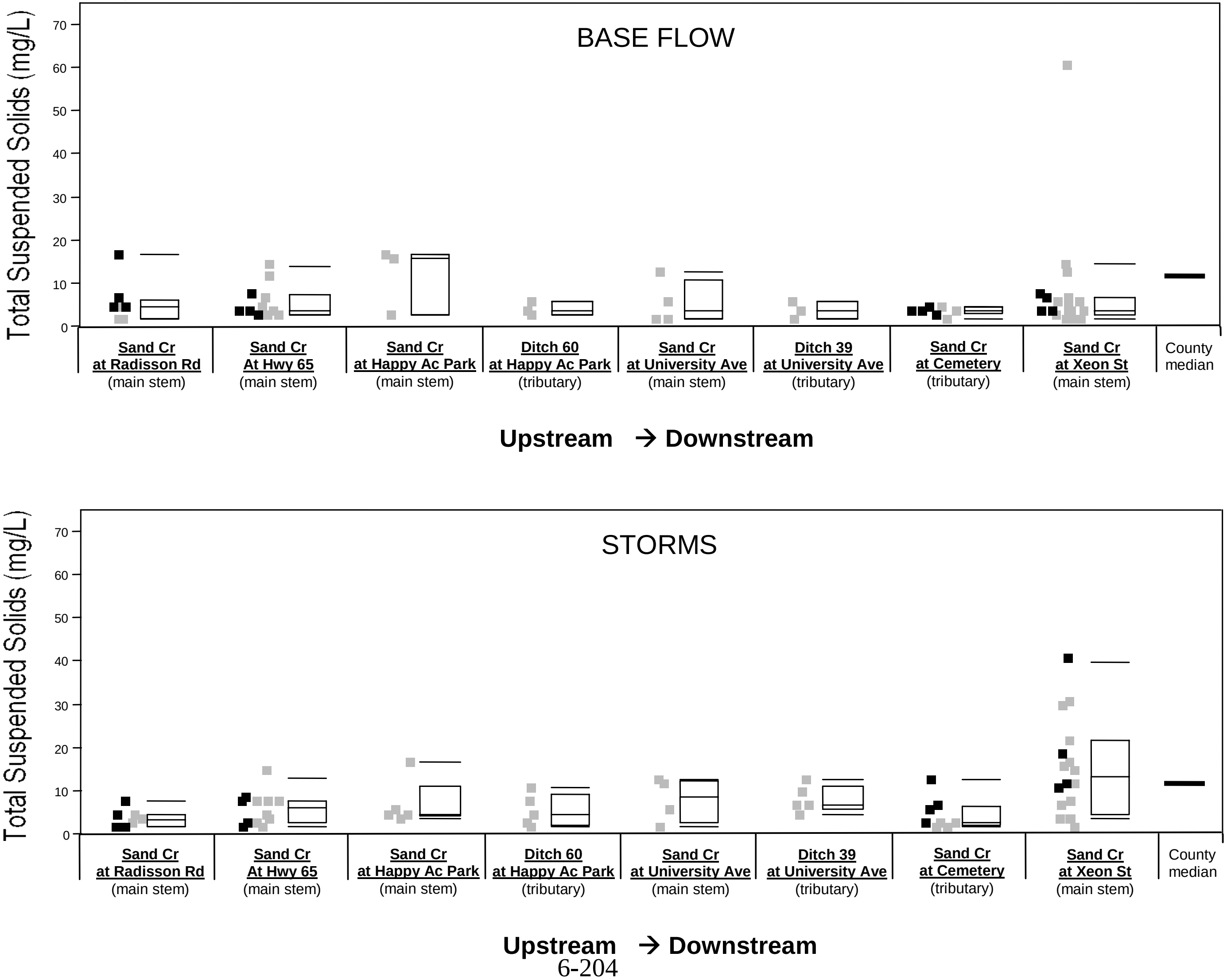
TSS and turbidity are similar at the Sand Creek monitoring sites except for higher readings upstream during baseflow and downstream during storms. Baseflow turbidity is highest in at the farthest upstream monitoring sites, probably due to algal production in ponds and lakes in the upper watershed. Turbidity during storms is highest at the downstream monitoring sites, probably due to higher percentages of impervious surfaces, and therefore stormwater runoff, in the lower watershed.

During baseflow, turbidity was highest at the farthest upstream monitoring sites, Radisson Road and Highway 65, but this is primarily driven by pre-2011 samples (see figures below). These elevated readings may be from algae in water exiting ponds and lakes that the creek flows through. At Radisson Road, the outlet of the largest lakes, median turbidity was 12 FRNU during baseflow. At Highway 65, median turbidity was 6 FRNU. The remaining sites downstream had a median turbidity of 5 FRNU, so dominance of algal turbidity decreases as distance form the lakes and ponds increases. During storms, turbidity was lower at the outlet of the lakes and ponds; it appears that stormwater flushing dilutes the algae. Unlike turbidity, TSS was not elevated at the exit of lakes and ponds, presumably because TSS is less sensitive to large algal particles than turbidity.

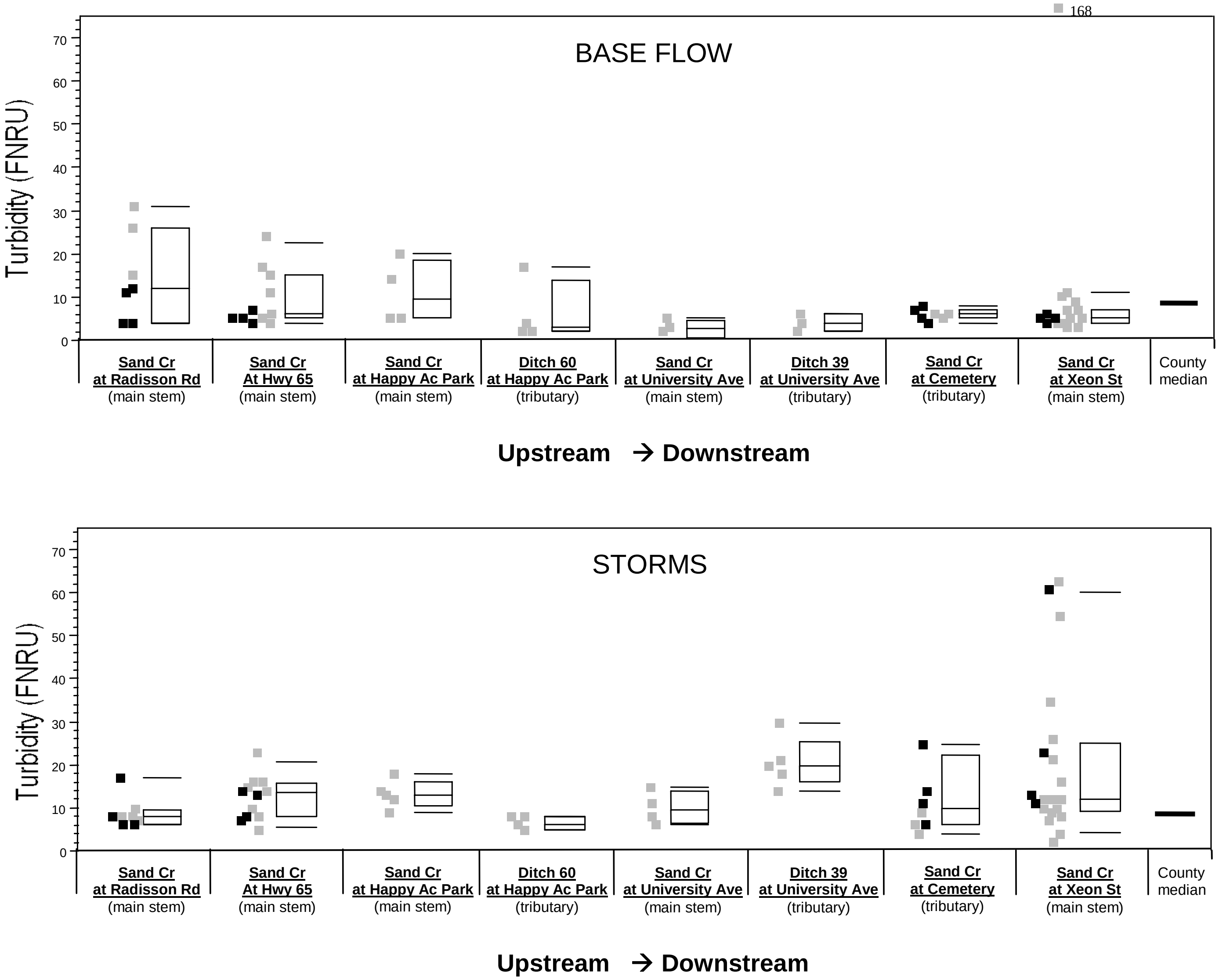
Comparing upstream to downstream, higher TSS and turbidity were observed downstream of University Avenue during storms (see figures below). Considering all readings from all sites, median TSS and turbidity are 5 mg/L and 8 FRNU. At the farthest downstream site, Xeon Street, median TSS and turbidity during storm are 6 mg/L and 11 FRN, respectively. Readings as high as turbidity of 168 FNRU and TSS of 114 mg/L were occasionally encountered during storms. However, if we look only during baseflow the median TSS and turbidity were 4 mg/L and 5 FRN.

Data from all sites is lower than the state turbidity standard of 25 FNRU. Yet local water managers should consider efforts to reduce TSS and turbidity because of turbidity problems in Coon Creek, to which Sand Creek flows. Coon Creek, just before Sand Creek joins it, has median turbidity of 15 FRNU and median TSS of 14 mg/L. Efforts to manage suspended solids in Sand Creek should focus upon stormwater in the lower part of the watershed.

Total suspended solids at Sand Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



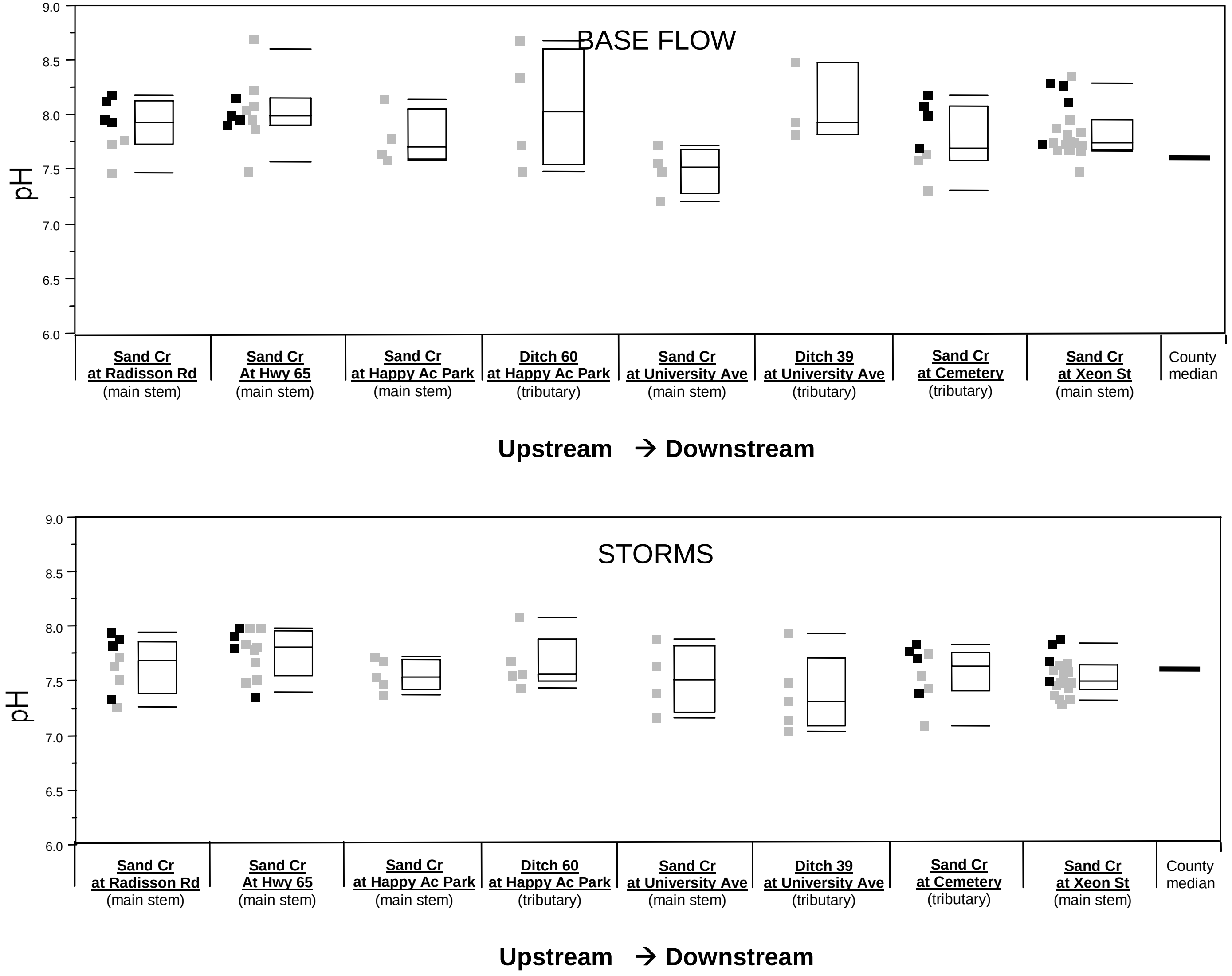
Turbidity at Sand Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



pH

Sand Creek pH was within the expected range at all sites and during all conditions (see figures below), ranging from 7.05 to 8.71. The median was 7.73. 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.

pH at Sand Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

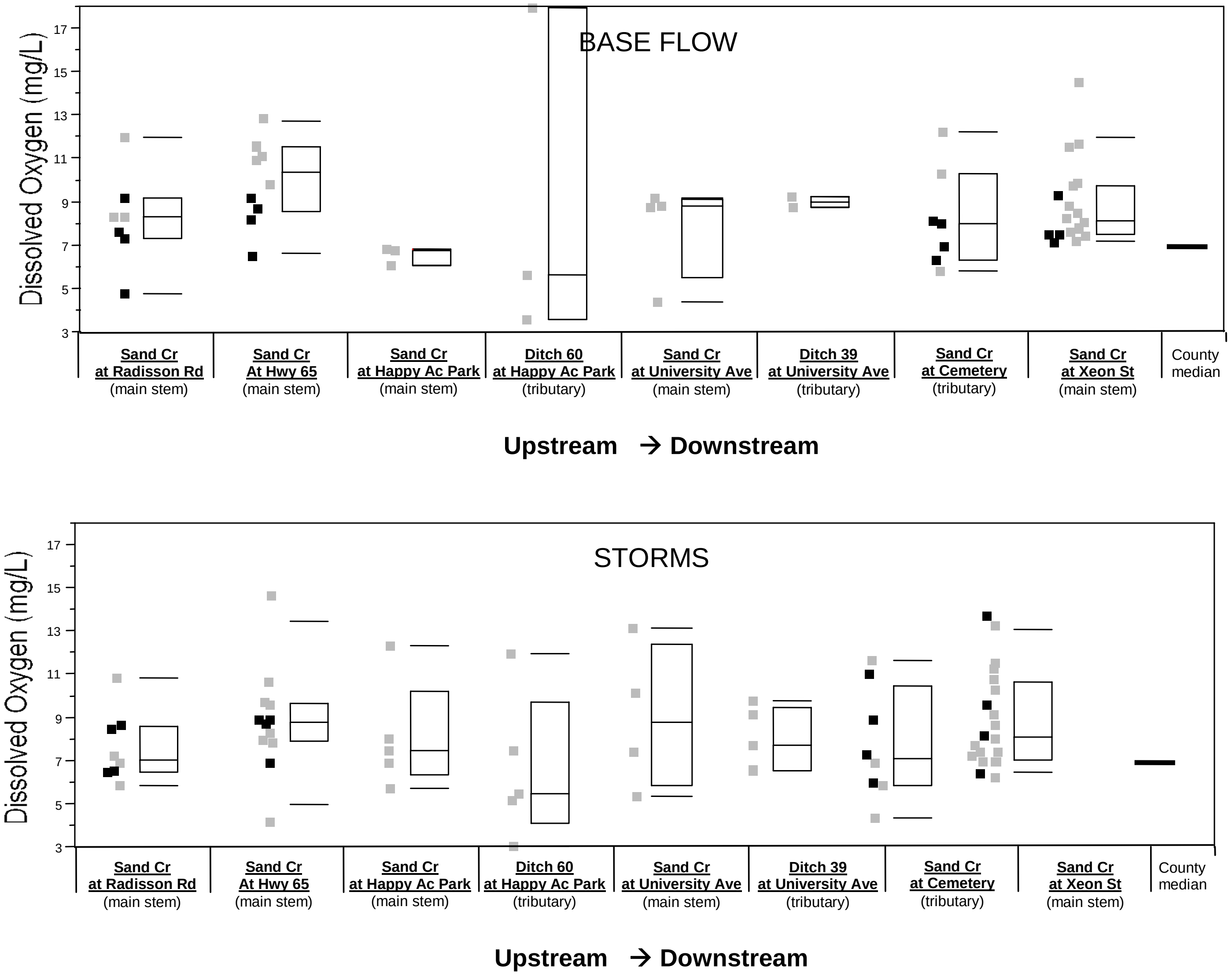


Dissolved Oxygen

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

Dissolved oxygen in Sand Creek was within the acceptable level (>5 mg/L) on 95% of the site visits (see figure below). On six occasions it dropped below 5 mg/L. These six readings occurred at five different sites, suggesting there is not a chronic problem at any one locality. Three were during storms and three during baseflow, suggesting the issue is not flow-dependent. Three occurred in 2009, which was a severe drought year. Stagnant conditions are probably responsible for these low oxygen conditions, and are likely natural. Overall, we do not have concerns about dissolved oxygen levels in Sand Creek.

Dissolved Oxygen at Sand Creek. Dots are individual readings. Black dots are 2011 readings; grey dots are from previous years. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



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 Coon Creek at Erlandson Park (Egret St.)
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:

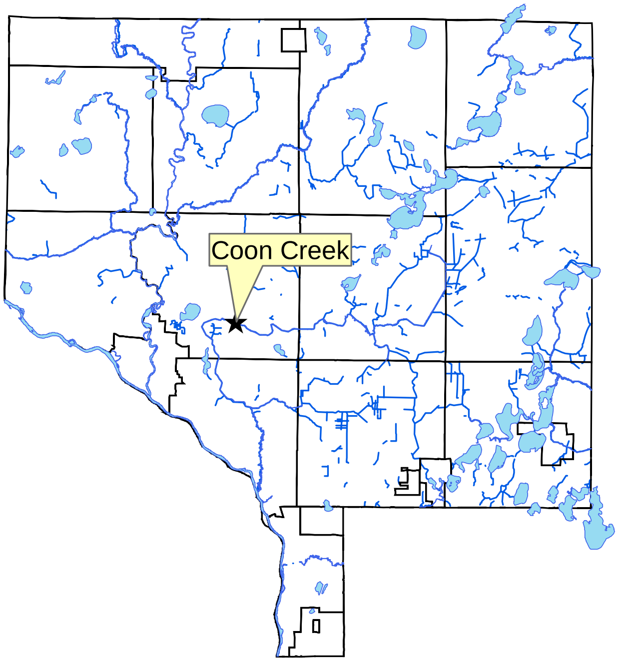
# Families	Number of invertebrate families. Higher values indicate better quality.
EPT	Number of families of the generally pollution-intolerant orders Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies). Higher numbers indicate better stream quality.
Family Biotic Index (FBI)	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.

COON CREEK

at Crosstown Blvd near Andover High School, Andover



Last Monitored

By Andover High School in 2011

Monitored Since

Fall 2003

Student Involvement

23 students in 2011, approximately 973 since 2003

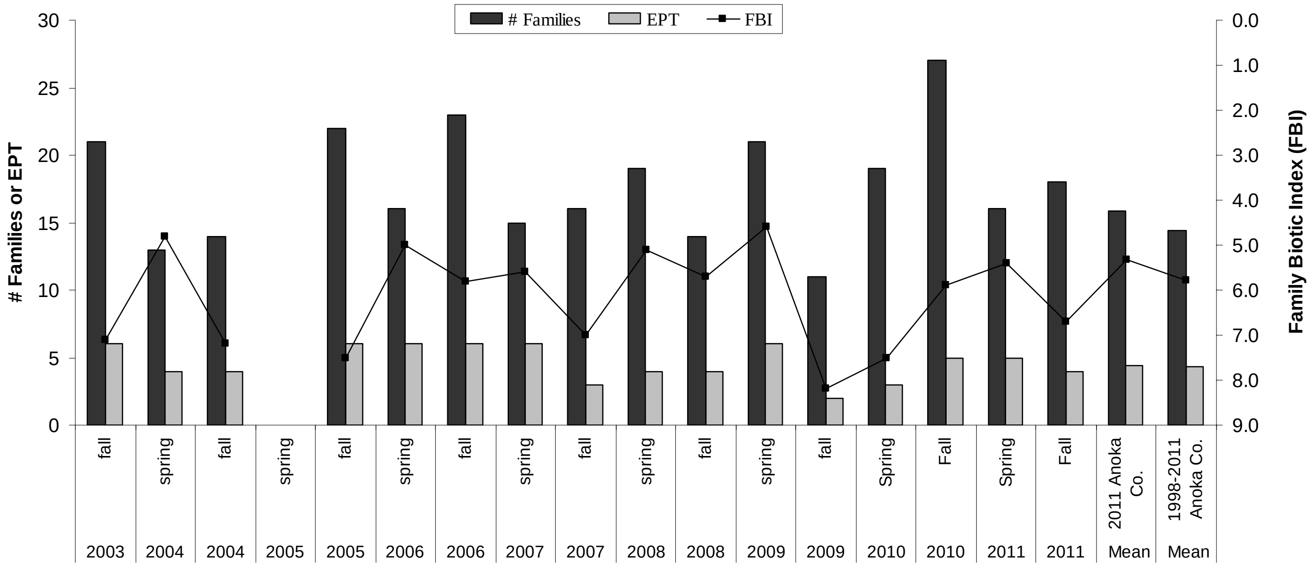
Background

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 2011, but not spring. In spring water levels were too high until after school released for summer break, so ACD staff sampled in June. 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 2011, both spring and fall samples produced invertebrate indices that were similar to 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	2007	2007	2008	2008	2009	2009	2010	2010	2011	2011	Mean	Mean
Season	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	2010 Anoka Co.	1998-2010 Anoka Co.
FBI	5.60	7.00	5.10	5.70	4.60	8.20	7.5	5.9	5.4	6.7	5.5	5.8
# Families	15	16	19	14	21	11	19	27	16	18	19.4	14.3
EPT	6	3	4	4	6	2	3	5	5	4	4.7	4.3
Date	1-May	3-Oct	30-May	2-Oct	15-May	29-Sep	13-Apr	5-Oct	10-Jun	23-Sep		
Sampled By	AHS	AHS	AHS	AHS	AHS	AHS	AHS	AHS	ACD	AHS		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	317	176	90.7	195	679	203	207	446	165	154		
# Replicates	2	1	3	1	1	1	1	1	1	1		
Dominant Family	Calopterygidae	Corixidae	Baetidae	Calopterygidae	Baetidae	Corixidae	Corixidae	Calopterygidae	Baetidae	Belostomatidae		
% Dominant Family	31.9	36.4	38.2	25.6	68.9	51.2	45.4	28.7	24.2	27.9		
% Ephemeroptera	13.9	1.7	40.4	23.1	70.3	1.5	0.5	14.1	28.5	10.4		
% Trichoptera	6.0	4.5	12.5	2.6	3.2	2.0	1.9	2.0	9.7	9.1		
% Plecoptera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7	0.0		

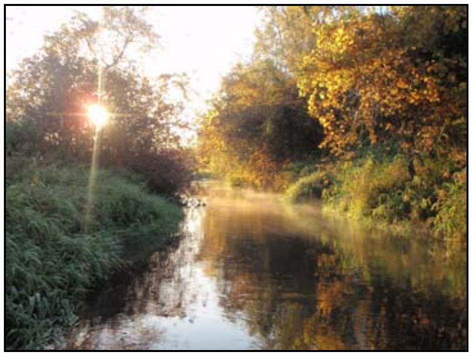
Supplemental Stream Chemistry Readings

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

Parameter	5/1/2007	10/3/2007	5/30/2008	10/2/2008	5/15/2009	9/29/2009	4/13/2010	10/5/2010	6/10/2011	9/23/2011
pH	8.5	7.62	7.41	7.66	7.65	7.79	na	7.65	7.62	8.27
Conductivity (mS/cm)	0.454	0.417	0.458	0.609	0.582	0.64	0.553	0.634	0.538	0.470
Turbidity (NTU)	11	14	12	4	15	5	25	6	13	31
Dissolved Oxygen (mg/L)	11.19	8.93	8.79	9.52	8.4	8.6	10.48	na	7.31	8.59
Salinity (%)	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01
Temperature (°C)	13.3	15.1	13	8.2	13	10	11.1	9.3	14.9	10.9

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. Turbidity was also high. These factors, as well as the general lack of habitat in this ditched stream, probably limit the invertebrate community.

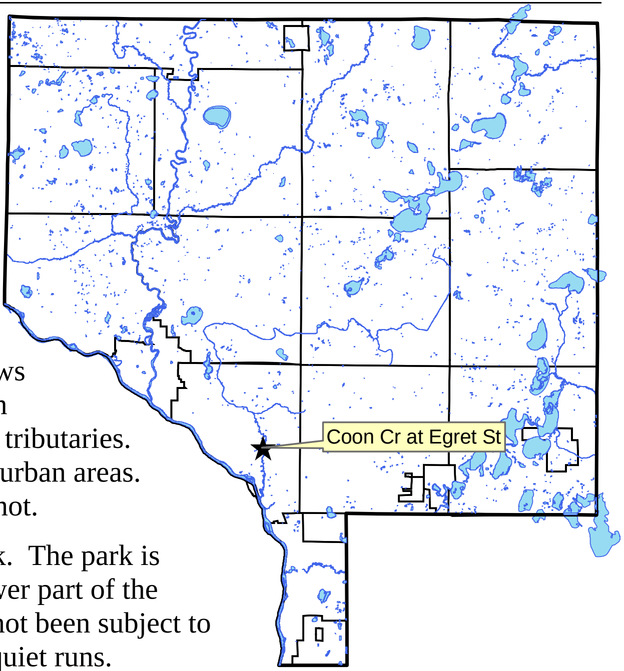


Coon Creek at Andover High School sampling site.

Andover High School Students at Coon Creek.

COON CREEK

at Erlandson Park (Egret St.)



Last Monitored

By ACD staff in 2011

Monitored Since

Fall 2009

Student Involvement

0 students in 2011, approximately 62 since 2009

Background

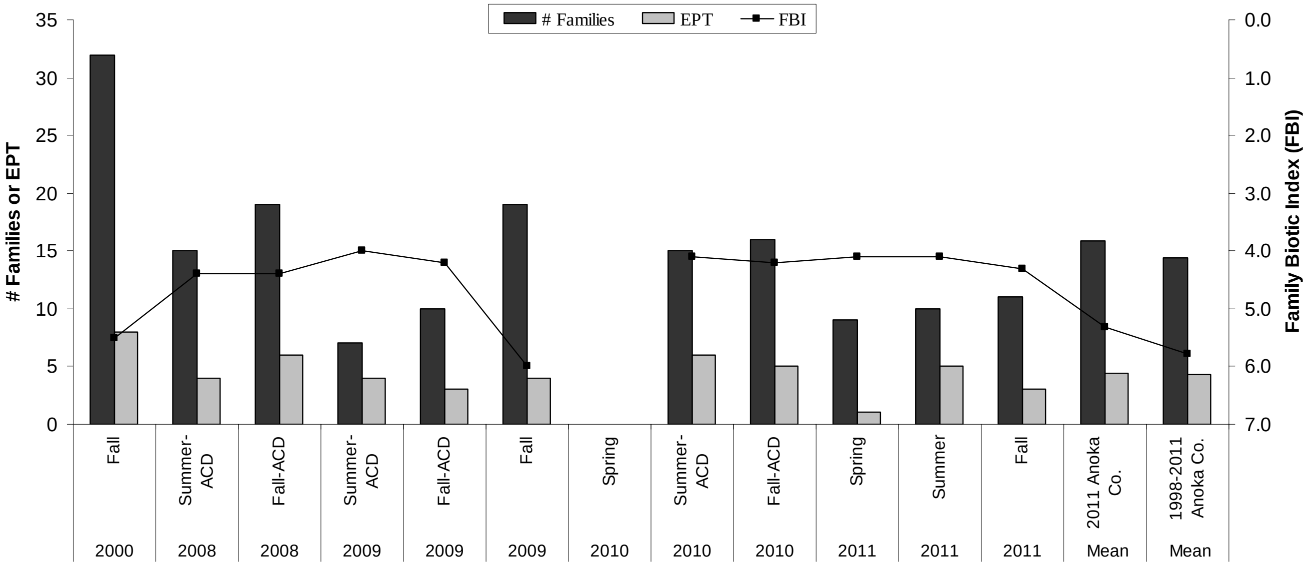
Coon Creek originates in the southern part of the Carlos Avery Wildlife Management Area in western Columbus. It flows west, then south, and empties into the Mississippi River at Coon Rapids Dam Regional Park. Coon Creek has a number of ditch tributaries. The stream flows from rural residential settings to high density urban areas. Upstream reaches have been ditched while lower reaches have not.

The Egret Street sampling site is within the Erlandson City Park. The park is forested, but surrounding areas are urban. This site is in the lower part of the watershed and therefore carries relatively larger flows and has not been subject to ditching in the past. This site has rock riffles, deep pools, and quiet runs.

Results

Blaine High School did not sample this site in 2011 because of curriculum conflicts. ACD staff monitored it in spring, fall, and summer. The three invertebrate indices of stream health are conflicting, and make it difficult to clearly label the results and “good” or “bad.” Family Biotic Index (FBI) has been consistently higher than the county average, and this is often our most reliable indice. However, the number of families and number of pollution sensitive families (EPT) has been similar to, or lower than county averages. All three samplings in 2011 found few families and EPT.

Summarized Biomonitoring Results for Coon Creek at Egret St.



Biomonitoring Data for Coon Creek at Egret Street

Year	2008	2008	2009	2009	2009	2010	2010	2011	2011	2011	Mean	Mean
Season	Summer-ACD	Fall-ACD	Summer-ACD	Fall-ACD	Fall	Summer-ACD	Fall-ACD	Spring	Summer	Fall	2010 Anoka Co.	1998-2010 Anoka Co.
FBI	4.40	4.40	4.00	4.20	6.00	4.10	4.20	4.1	4.1	4.3	5.5	5.8
# Families	15	19	7	10	19	15	16	9	10	11	19.4	14.3
EPT	4	6	4	3	4	6	5	1	5	3	4.7	4.3
Date	27-Aug	9-Oct	24-Aug	5-Oct	7-Oct	5-Aug	1-Oct	10-Jun	12-Aug	4-Oct		
Sampled By	ACD	ACD	ACD	ACD	BHS	ACD	ACD	ACD	ACD	ACD		
Sampling Method	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH		
Mean # Individuals/Rep.	202	177	142	143	296	426	447	303	246	272		
# Replicates	1	1	1	1	1	1	1	1	1	1		
Dominant Family	Baetidae	Heptageniidae	Baetidae	Hydropsychidae	Corixidae	Gammaridae	Gammaridae	Gammaridae	Gammaridae	Gammaridae		
% Dominant Family	41.1	30.5	57.7	39.9	29.1	57.6	32.3	83.2	63	272		
% Ephemeroptera	59.9	53.1	74.6	46.2	2.7	13.6	40	12.9	2.8	19.1		
% Trichoptera	10.4	15.3	19	39.9	14.2	22.1	19.5	0	30.5	21.3		
% Plecoptera	0	0	0	0	0	0	0	0	0	0		

Supplemental Stream Chemistry Readings

Parameter	8/27/2008	10/9/2008	8/24/2009	10/5/2009	10/7/2009	8/5/2010	10/1/2010	6/10/2011	8/12/2011	10/4/2011
pH	7.79	7.78	7.73	7.89	7.55	7.98	7.18	7.63	7.99	8.02
Conductivity (mS/cm)	0.614	0.654	0.613	0.660	0.570	0.633	0.668	0.630	0.517	0.522
Turbidity (NTU)	5	3	11	6	15	11	9	20	26	18
Dissolved Oxygen (mg/L)	8.5	10.26	7.96	10.27	10.82	10.21	na	7.92	7.33	9.47
Salinity (%)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Temperature (°C)	18.4	10.2	18.7	9.1	9.7	22.1	12.7	15.9	19.3	14.0
Total Suspended Solids (mg/L)	3	4	16	2	na	8	3		32	8

Discussion

An interesting upstream-downstream comparison is available at Coon Creek. Upstream, Andover High School monitors near Crosstown Blvd, approximately half way up the watershed. This site is ditched, with little habitat. The Egret St site is in the downstream reaches of the watershed, and has much better habitat in a natural channel.

The three invertebrate indices of stream health provide a mixed bag of comparisons. The best FBI is typically found at Egret Street. The greatest number of families is found at Crosstown Blvd. Both sites have a similar EPT.

Chemical monitoring has found that Coon Creek's water quality declines from upstream to downstream, which corresponds with an increase in urbanization. So while habitat may be better at Egret Street, water quality is poorer. These factors may play against each other.

Stream Water Quality – Biological Monitoring (Professional)

Description: The professional biological monitoring program is more comprehensive than student biomonitoring. All field work, identifications, and analyses are completed by professional aquatic ecologists. Sampling and habitat assessment methods are taken from the U.S. EPA or MPCA. Interpretation of results is based on invertebrate communities sampled and is 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 generally pollution intolerant, while other families can thrive in low quality water. Therefore, a comprehensive 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 131st Street

Coon Creek at Highway 65

Coon Creek at Egret Boulevard

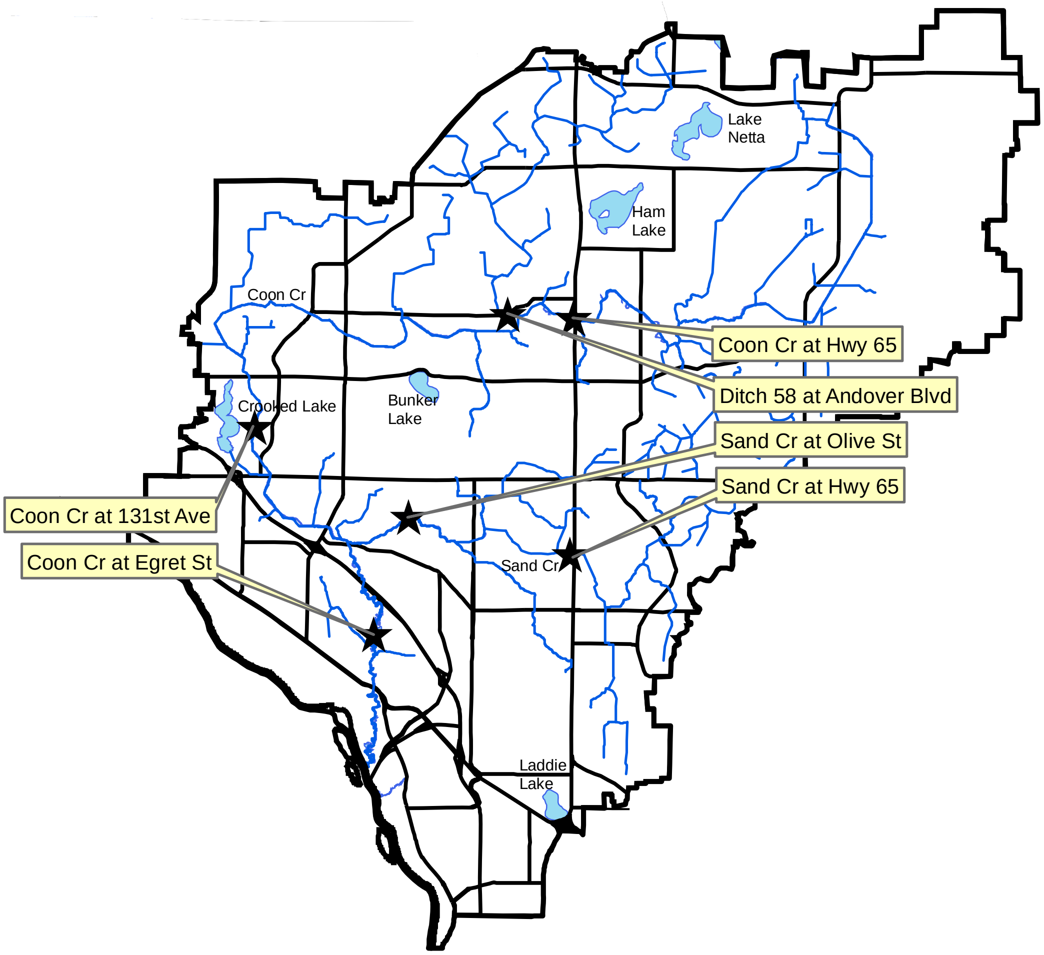
Ditch 58 at Andover Boulevard

Ditch 41 at Ulysses Street (west side of Lowes)

Sand Creek at Olive Street

Results: Results are detailed on the following pages.

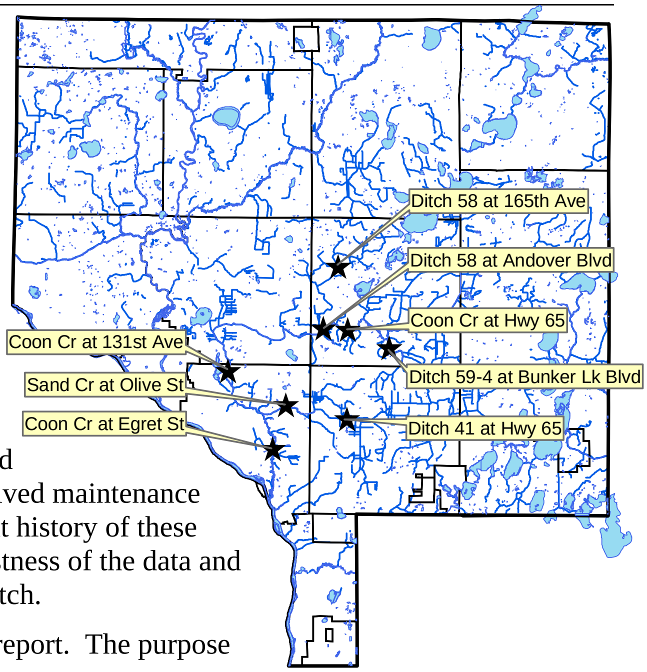
Coon Creek Watershed Professional Biomonitoring Sites



COON CREEK SYSTEM

		Monitoring Agency			
Maintenance Regime	**Site**	**2000**	**2008**	**2009**	**2010**
Unmaintained	Ditch 58 at 165th Ave.		ACD	ACD	
Not ditched or cleaned	Ditch 58 at Andover Blvd.			ACD	MPCA
in last 10 years	Sand Creek at Olive St.			ACD	MPCA
	Coon Creek at Egret St.	MPCA	ACD	ACD	ACD
Maintained	Ditch 59-4 at Bunker Lake Blvd.		ACD		
Ditched or cleaned	Ditch 41 at Highway 65		ACD	ACD	ACD
in last 10 years	Coon Creek at Highway 65	MPCA	ACD	ACD	MPCA
	Coon Creek at 131st Ave.		ACD	ACD	ACD
Anoka Conservation District (ACD), Minnesota Pollution Control Agency (MPCA)					

Background



Coon Creek is a major drainage through central Anoka County. Development in the watershed ranges from rural residential (upstream) to urbanized (downstream). Upstream reaches have been subject to a history of ditching and cleaning, and many ditch tributaries exist. Farther downstream, ditching activity has been minimal, but the effects of the urban environment are more pronounced. The creek has been monitored both chemically and biologically.

The Minnesota Pollution Control Agency (MPCA) has listed Coon Creek as biologically impaired based on single samples from two sites in August of 2000. One of the sites was an actively maintained ditch that had been recently cleaned to sustain desired flow. In contrast, the other site had not received maintenance in the previous 10 years. The drastically different management history of these two reaches caused local water managers to question the robustness of the data and appropriate biological expectations for an actively managed ditch.

The Coon Creek Watershed District initiated the study in this report. The purpose of this work is to:

- compare the macroinvertebrate communities between maintained and unmaintained creek reaches,
- compare the biological integrity of the Coon Creek system with similar nearby streams,
- examine the effect of total suspended solids on invertebrate communities, and
- corroborate the MPCA's findings.

Professional biomonitoring was conducted for this study within the stream and ditch reaches identified in the table above during 2008, 2009, and 2010. All sites within each year were examined twice per year – in August when the MPCA performs invertebrate monitoring and again at the beginning of October for comparison with student stream biomonitoring performed at other sites. Professional biomonitoring is more rigorous and more comprehensive than student biomonitoring programs. All of the field work, identifications, and analyses are performed by professional aquatic ecologists. In this case, both staff possess Master's degrees in aquatic ecology and combined have over 10 years of biological monitoring experience. The sampling methods used were the same as those used by the MPCA, the US EPA's multihabitat method. In addition, the MCPA's Stream Habitat Assessment (MSHA) worksheet was completed for each site. Going beyond MPCA's standard operating procedures, water chemistry data was collected, including pH, conductivity, turbidity, temperature, dissolved oxygen (DO), salinity, and total suspended solids (TSS). TSS was chosen as a parameter of interest because impaired water studies (TMDLs) for biological impairments have often identified TSS as an important stressor.

Several measures of stream biological health were calculated. After identification of macroinvertebrates to the family level, total number of families present, EPT, and FBI indices were determined. The number of different families identified within each sample provides an overall measure of the species richness at a given location. EPT is a count of families belonging to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). With a few exceptions, macroinvertebrates in these three orders are sensitive to pollution. Therefore, more EPT families present in a stream indicate a healthier system. FBI, the Family Biotic Index, incorporates pollution tolerance scores for each family present. The FBI ranges from 0-10 (see table below), with 0 being best because it represents a macroinvertebrate community with the lowest tolerance for pollution.

Qualitative water quality ratings corresponding to quantitative FBI scores.

FBI Score	Corresponding Water Quality Rating
0-3.75	Excellent
3.76-4.25	Very Good
4.26-5	Good
5.01-5.75	Fair
5.76-6.5	Fairly Poor
6.51-7.25	Poor
7.26-10	Very Poor

Results and Discussion

Results are not available at the time of printing of the 2010 Anoka Water Almanac (this document). In 2010 three sites were monitored by the Anoka Conservation District and three by the MN Pollution Control Agency. The MPCA hires a consulting firm to identify their invertebrates, and those identifications are not yet complete. Anticipated completion date is spring 2011. Once that data is available, ACD will compile a separate report and deliver it to the Coon Creek Watershed District.

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: 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)

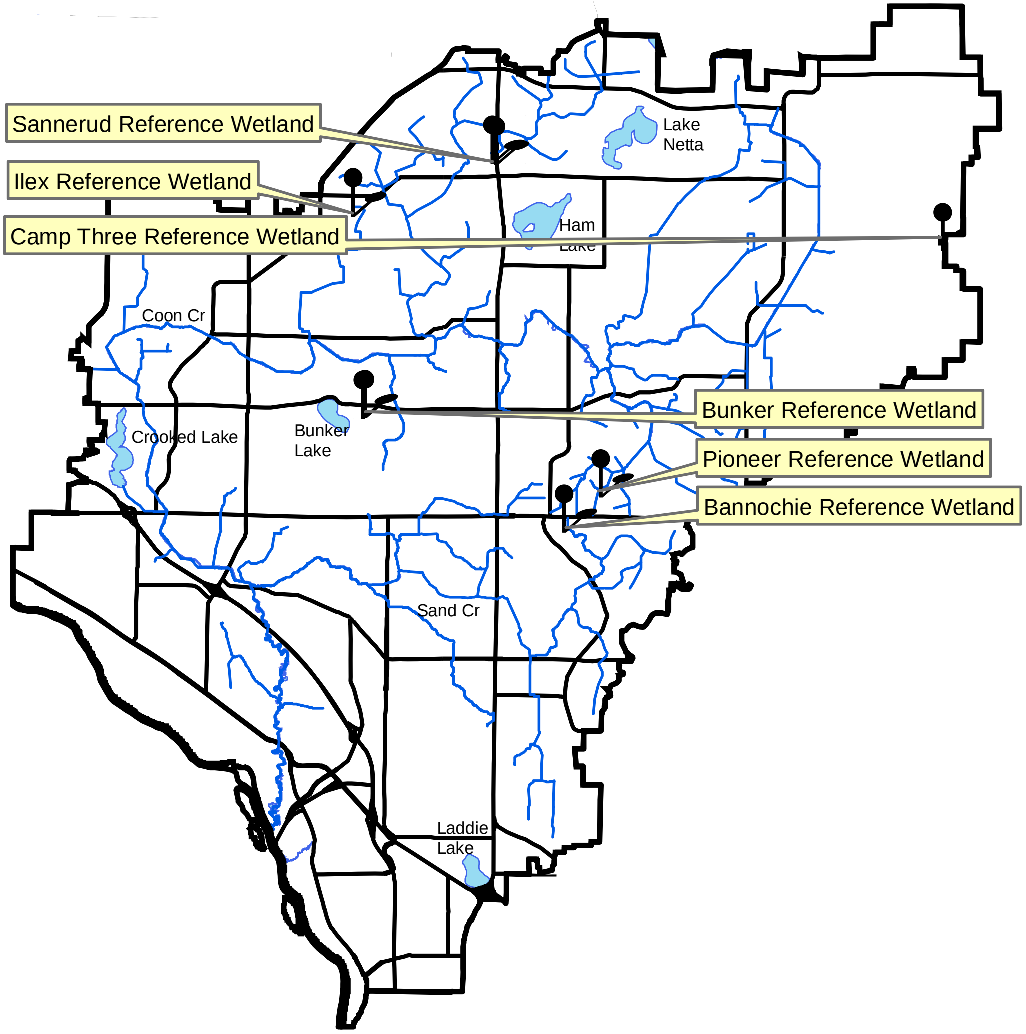
Pioneer Park Wetland, Pioneer Park off Main St., Blaine

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 2011 Wetland Hydrology Monitoring Sites

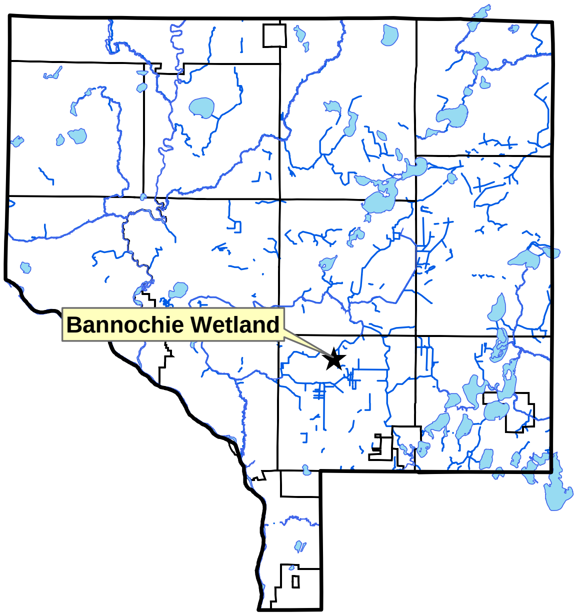


Wetland Hydrology Monitoring

BANNOCHIE REFERENCE WETLAND

SE quadrant of Radisson Rd and Hwy 14, Blaine

Site Information



Monitored Since:	1997
Wetland Type:	2
Wetland Size:	~21.5 acres
Isolated Basin?	No
Connected to a Ditch?	Yes, on edges, but not the interior of wetland

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oe1	0-6	10yr 2/1	Organic	-
Oe2	6-40	10yr 2/1-7.5yr2.5/1	Organic	-

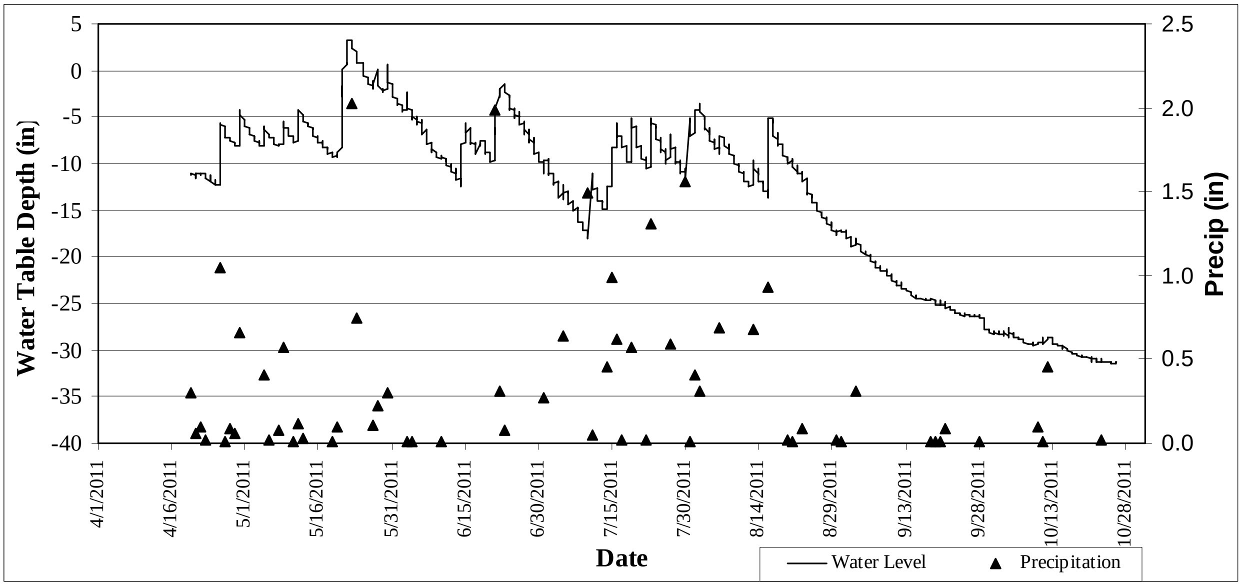
Surrounding Soils: Rifle and some Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phragmites australis	Giant Reed	80
Rubus spp.	Dewberry	100
Onoclea sensibilis	Sensitive Fern	10

Other Notes: This well is not at the wetland boundary, but rather is within the basin. Intense residential construction has occurred nearby in recent years, including construction dewatering.

2011 Hydrograph



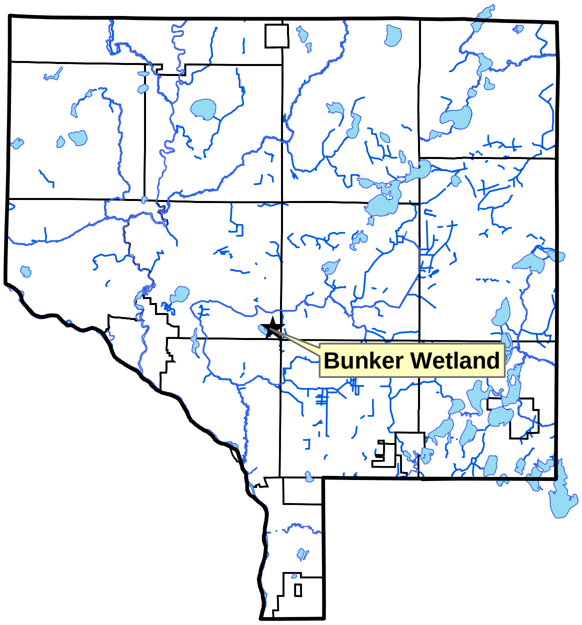
Well depth was 40 inches, so a reading of –40 or less indicates water levels were at an unknown depth greater than or equal to 40 inches.

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	-

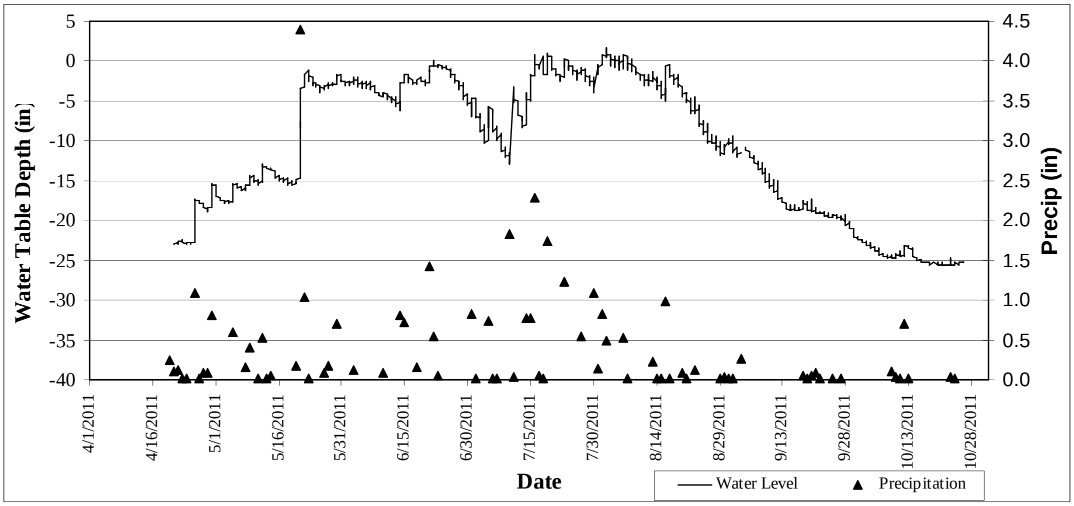
Surrounding Soils: Zimmerman fine sand

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.

2011 Hydrograph



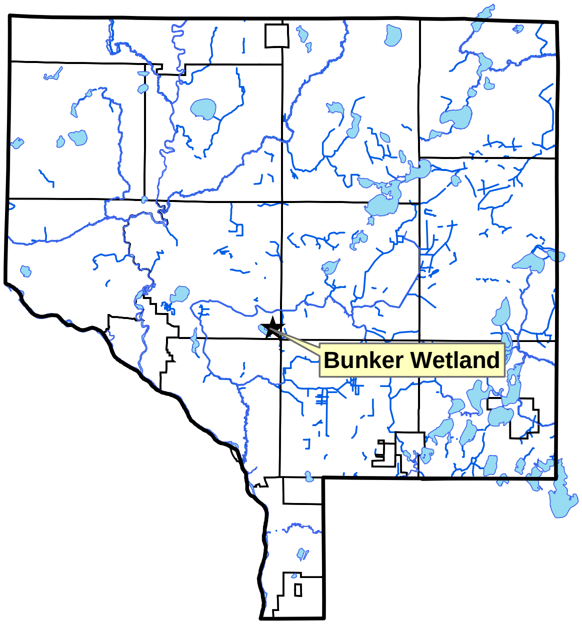
Well depth was 36 inches, so a reading of –36 indicates water levels were at an unknown depth greater than or equal to 36 inches.

Wetland Hydrology Monitoring

BUNKER REFERENCE WETLAND - MIDDLE

Bunker Hills Regional Park, Andover

Site Information



Monitored Since: Wetland edge monitored since 1996, but this well in middle of wetland began in 2006.

Wetland Type: 2

Wetland Size: ~1.0 acre

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-22	N2/0	Organic	-
Oe1	22-41	10yr2/1	Organic	-
Oe2	41-48	7.5yr3/4	Organic	-

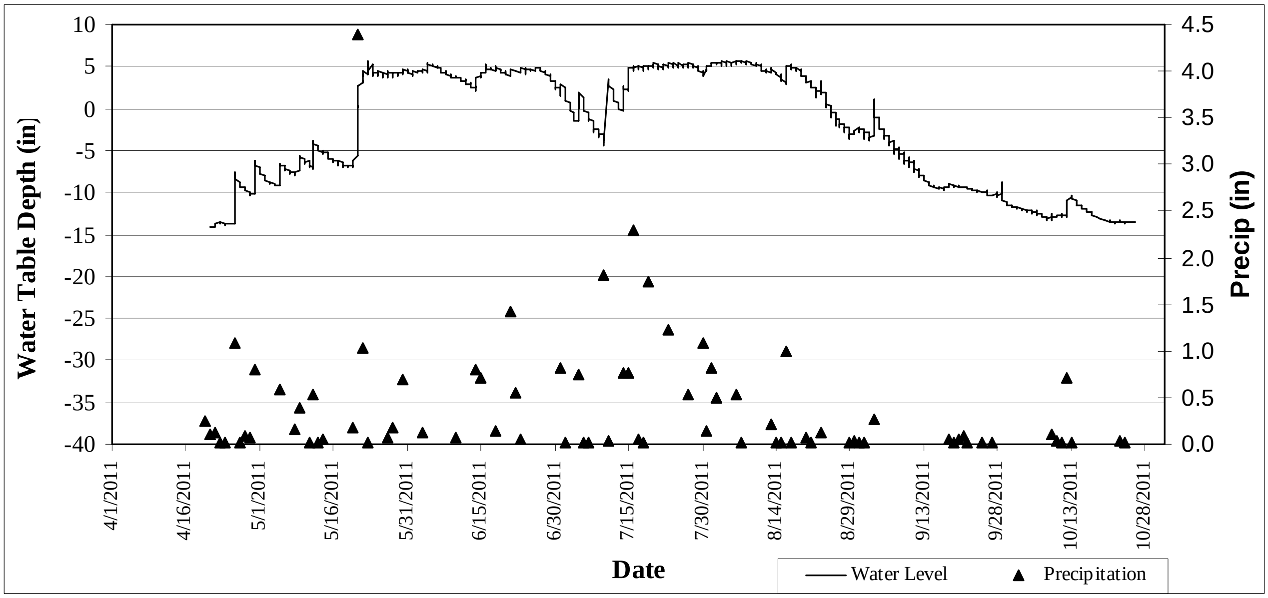
Surrounding Soils: Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Poa palustris	Fowl Bluegrass	90
Polygonum sagitatum	Arrow-leaf Tearthumb	20
Aster spp.	Aster undiff.	10

Other Notes: This well at the middle of the wetland and was installed at the end of 2005 and first monitored in 2006.

2011 Hydrograph

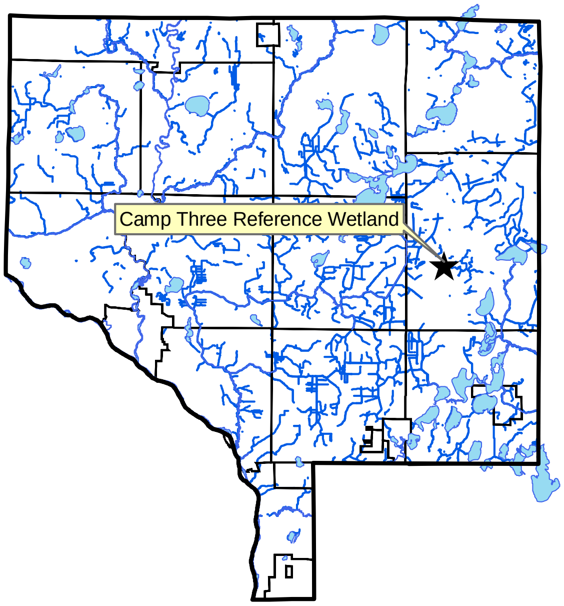


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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

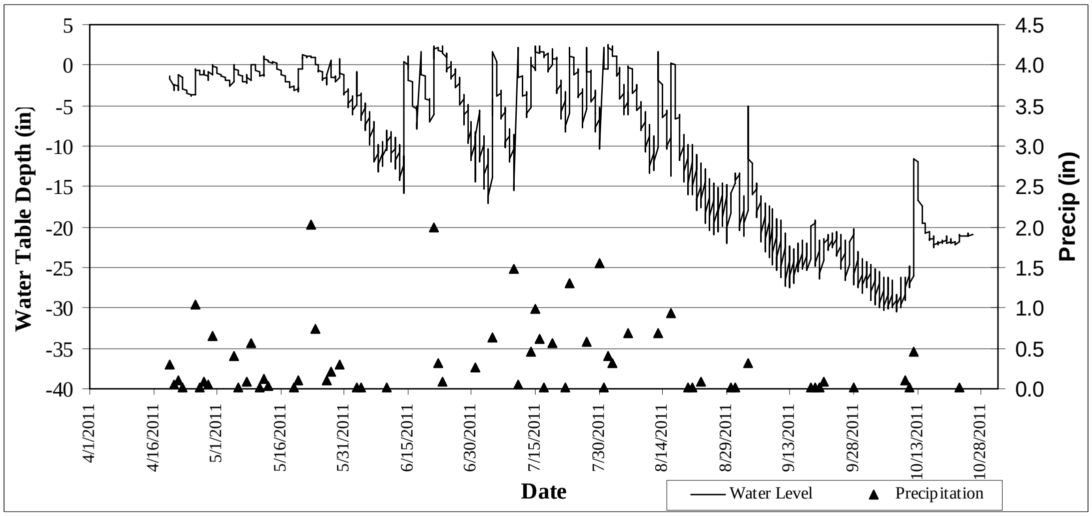
Surrounding Soils: Zimmerman Fine Sand

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.

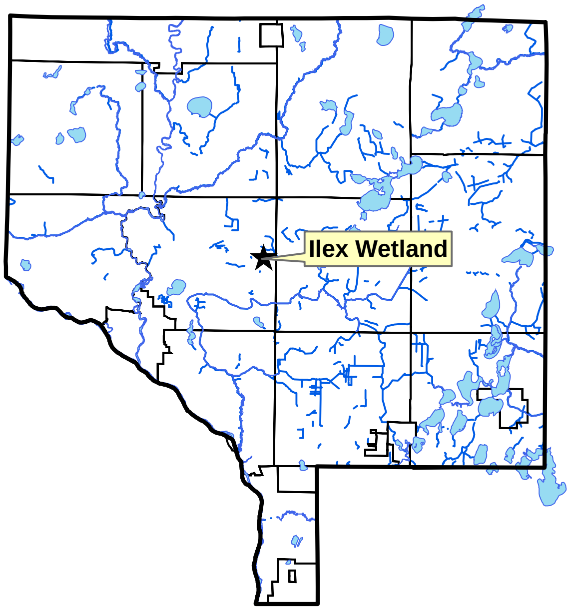
2011 Hydrograph



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	-

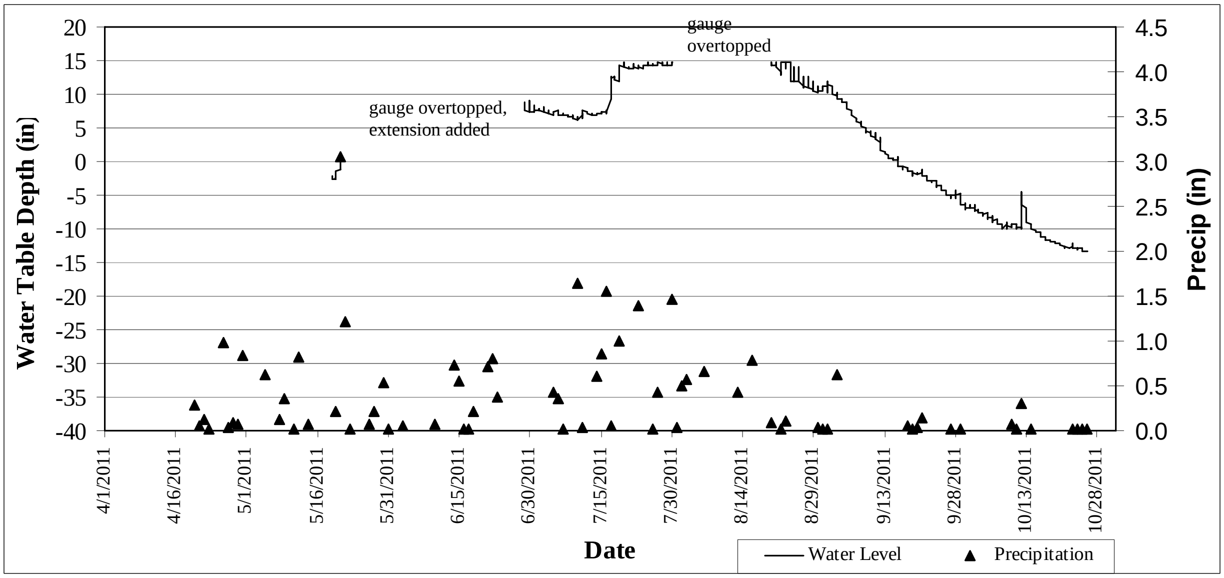
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

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.

2011 Hydrograph



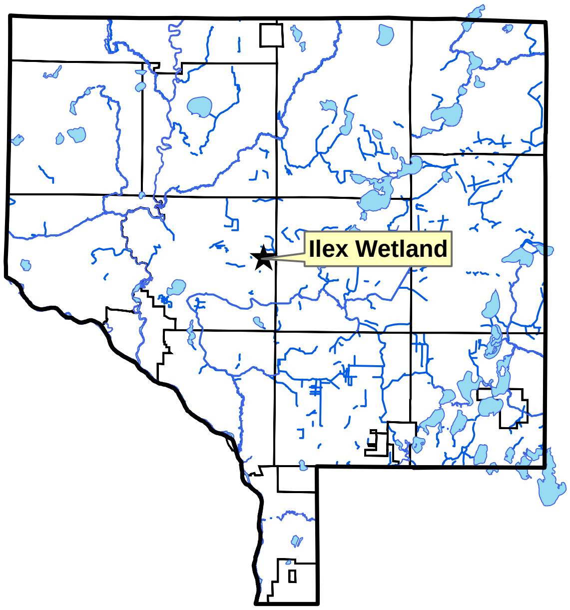
Well depth was 40 inches, so a reading of –40 indicates water levels at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

ILEX REFERENCE WETLAND - MIDDLE

City Park at Ilex St and 159th Ave, Andover

Site Information



Monitored Since:	2006
Wetland Type:	2
Wetland Size:	~9.6 acres
Isolated Basin?	Yes
Connected to a Ditch?	No

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-9	N2/0	Organic	-
Bg1	9-19	10yr4/2	Fine Sandy Loam	-
Bg2	19-45	10yr5/2	Fine Sand	-

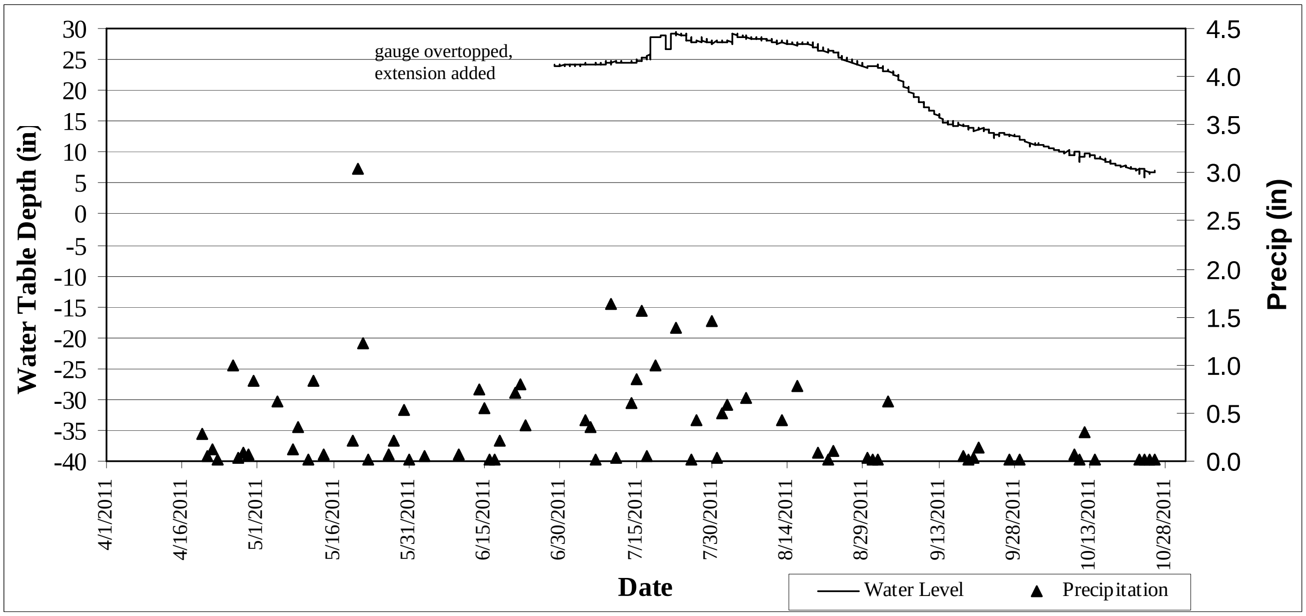
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	80
Typha angustifolia	Narrow-leaf Cattail	40

Other Notes: This well is located near the middle of the wetland basin.

2011 Hydrograph

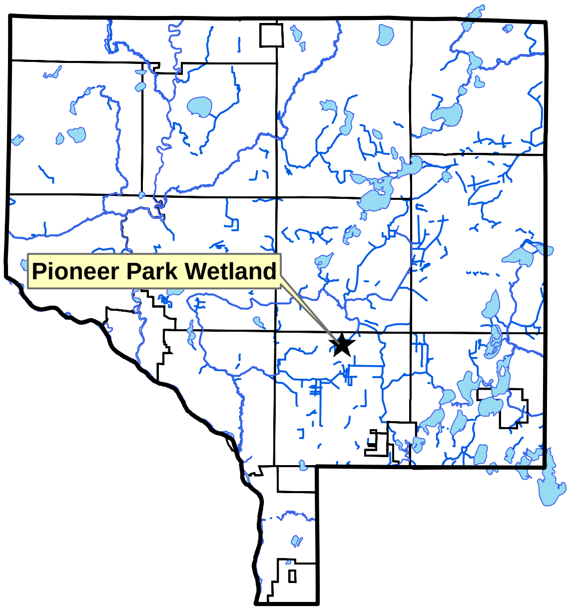


Well depth was 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

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	-

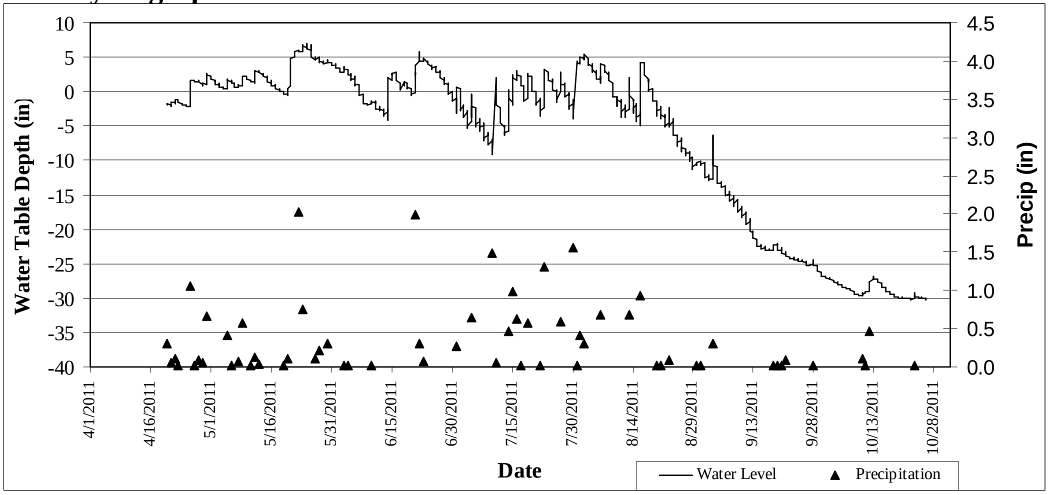
Surrounding Soils: Rifle and loamy wet sand.

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.

2011 Hydrograph



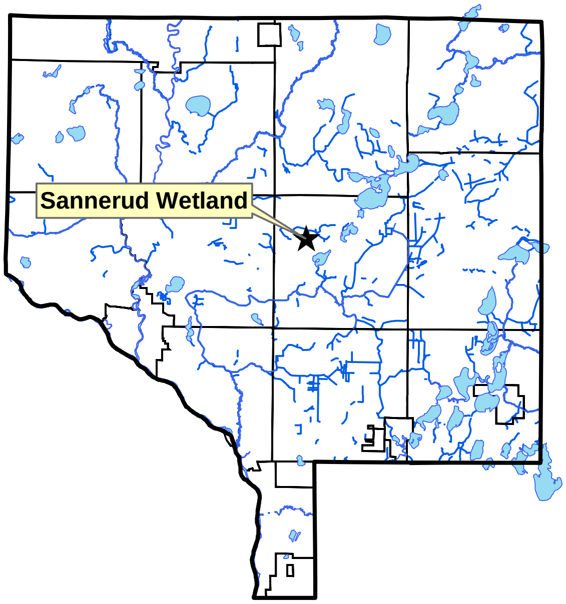
Well depth was 40 inches, so a reading of –40 indicates water levels at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

SANNERUD REFERENCE WETLAND - EDGE

W side of Hwy 65 at 165th Ave, Ham Lake

Site Information



Monitored Since:	2005
Wetland Type:	2
Wetland Size:	~18.6 acres
Isolated Basin?	Yes
Connected to a Ditch?	Is adjacent to Hwy 65 and its drainage systems. Small remnant of a ditch visible in wetland.

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa	0-8	N2/0	Sapric	-
Bg1	8-21	10yr 4/1	Sandy Loam	-
Bg2	21-40	10yr 4/2	Sandy Loam	-

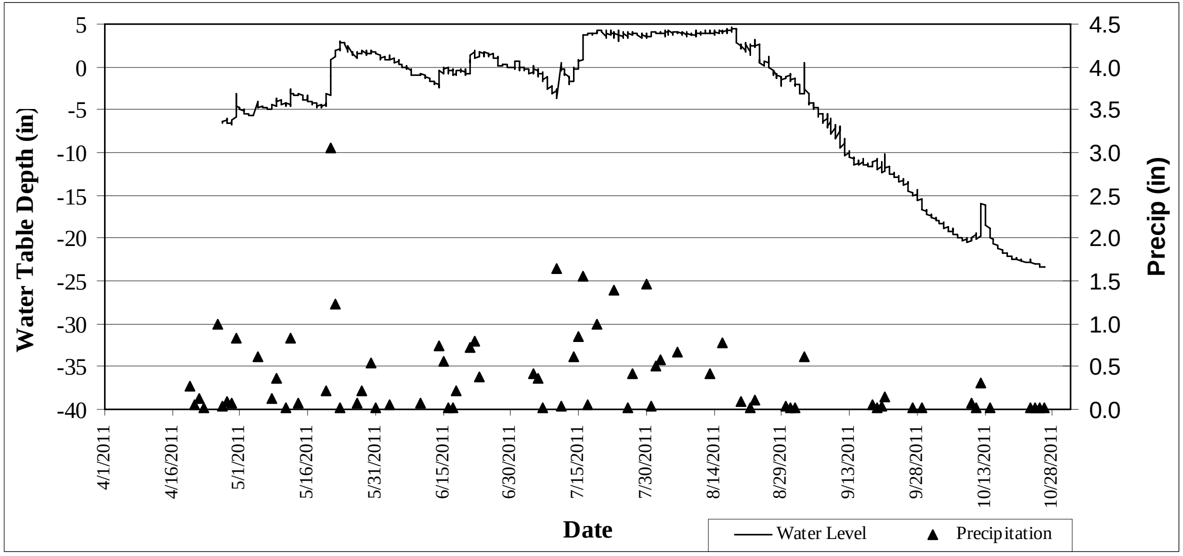
Surrounding Soils: Zimmerman and Lino.

Vegetation at Well Location:

Scientific	Common	% Coverage
Rubus spp.	Undiff Rasberry	70
Phalaris arundinacea	Reed Canary Grass	40
Acer rubrum (T)	Red Maple	30
Populus tremuloides (S)	Quaking Aspen	30
Betula papyrifera (T)	Paper Birch	10
Rhamnus frangula (S)	Glossy Buckthorn	10

Other Notes: This is one of two monitoring wells on this wetland. This one is at the wetland's edge, while the other is near the middle. The wetland edge well is slightly deeper than most reference wetland wells, at 43.5 inches deep.

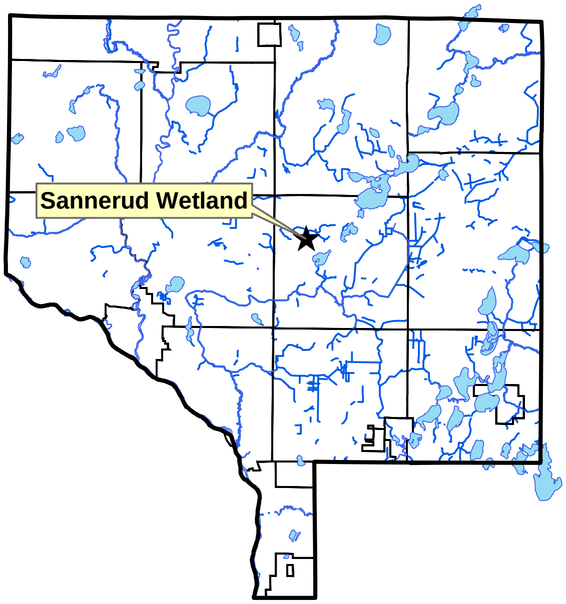
2011 Hydrograph



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	-

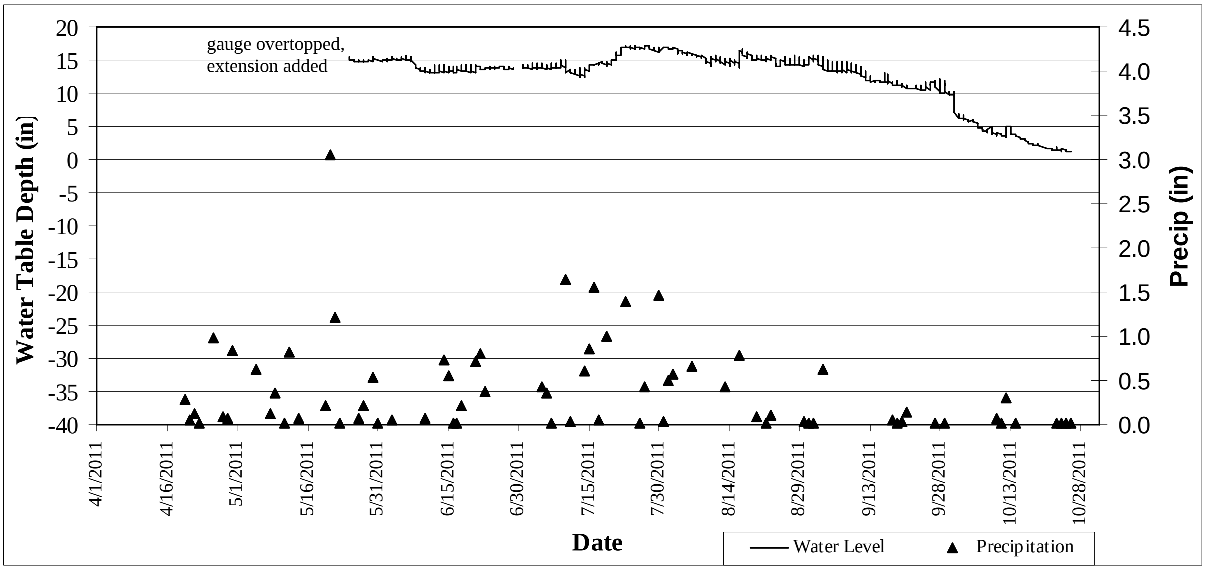
Surrounding Soils: Zimmerman and Lino.

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.

2011 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

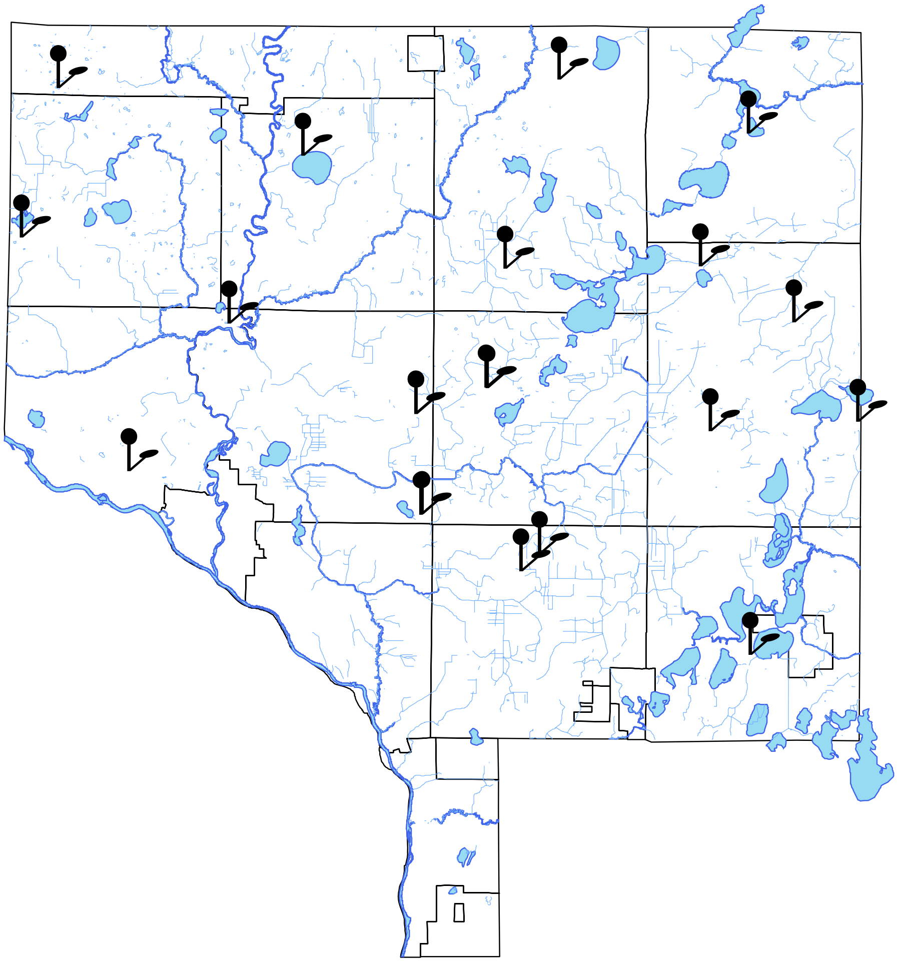
Description: This section includes analyses of wetland hydrology data that has been collected at 18 reference wetland sites. Shallow groundwater levels at the edge of these wetlands are recorded every four hours. Many have been monitored since 1996. These analyses summarize this enormous multi-year, 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.

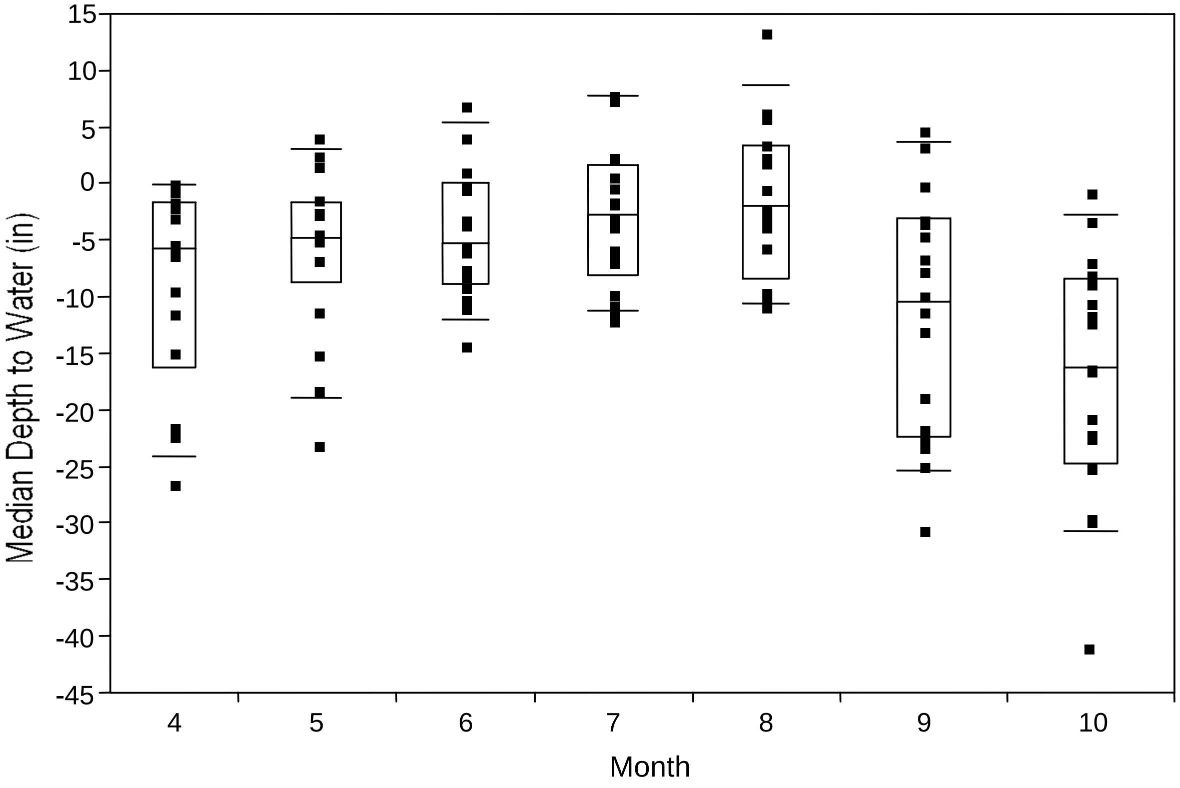
Locations: All 18 reference wetland hydrology monitoring sites in Anoka County.

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



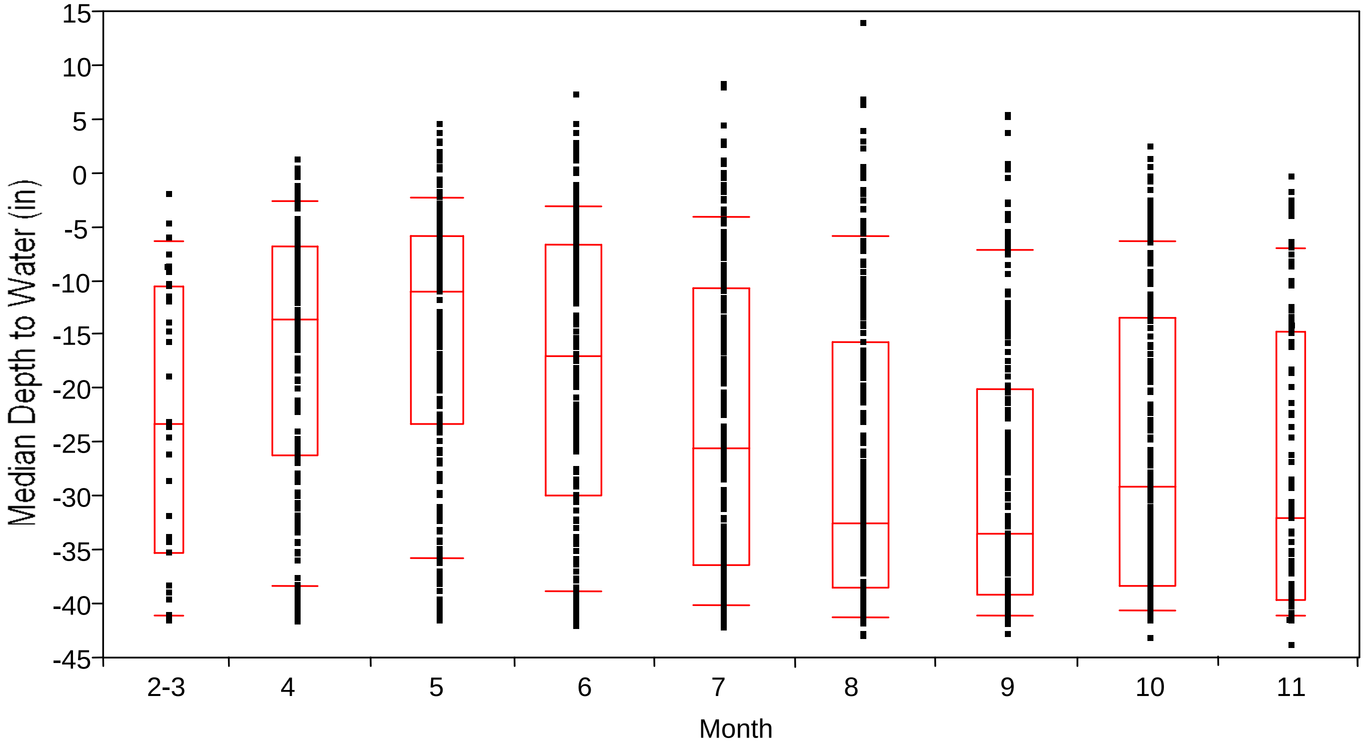
2011 Reference Wetland Water Levels Summary: Each dot represents the median depth to the water table at the edge of one reference wetland for a given month in 2011. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines). Maximum well depths were 40 to 45 inches, so a reading <40 inches likely indicates water was below the well at an unknown depth.

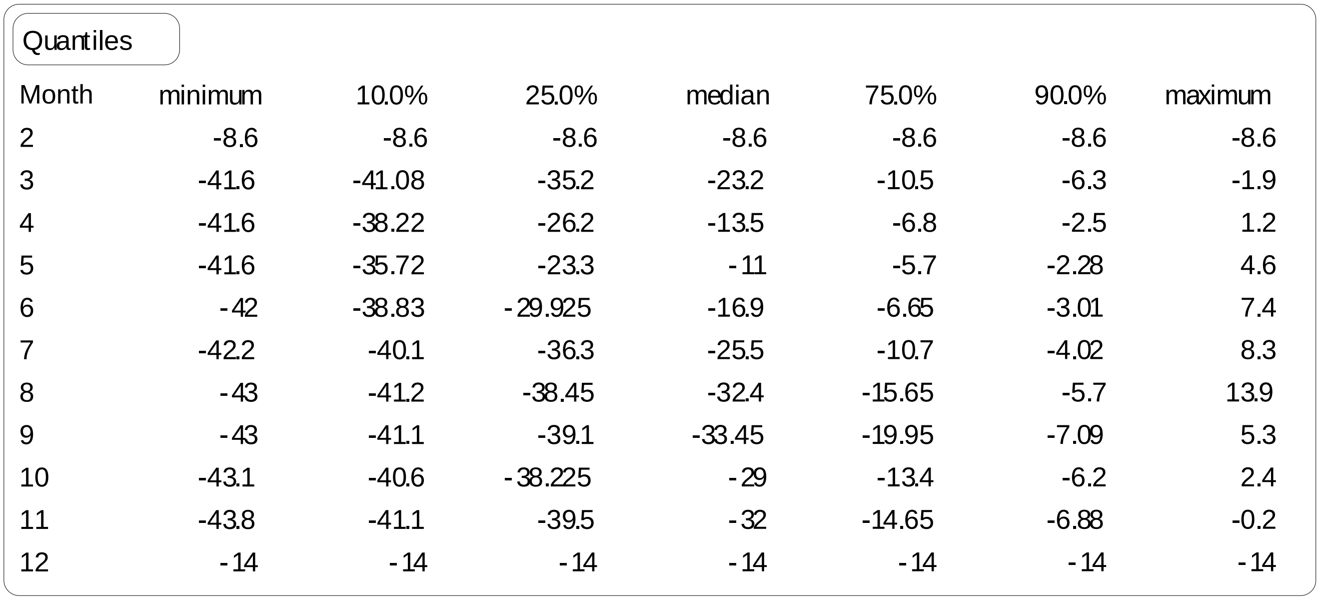


Quantiles

Month	minimum	10.0%	25.0%	median	75.0%	90.0%	maximum
4	-26	-23.95	-16.075	-5.5	-1.475	0.2	0.5
5	-22.6	-18.68	-8.55	-4.6	-1.45	3.32	4.6
6	-13.8	-11.82	-8.7	-5.1	0.4	5.72	7.4
7	-11.6	-10.96	-7.85	-2.5	1.9	7.98	8.3
8	-10.4	-10.4	-8.125	-1.8	3.65	8.93	13.9
9	-30.2	-25.07	-22.075	-10.15	-2.85	3.94	5.2
10	-40.6	-30.43	-24.55	-15.95	-8.2	-2.55	-0.3

1996-2011 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 2011. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines). Maximum well depths were 40 to 45 inches, so a reading <40 inches likely indicates water was below the well at an unknown depth.




Quantiles

Month	minimum	10.0%	25.0%	median	75.0%	90.0%	maximum
2	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
3	-41.6	-41.08	-35.2	-23.2	-10.5	-6.3	-1.9
4	-41.6	-38.22	-26.2	-13.5	-6.8	-2.5	1.2
5	-41.6	-35.72	-23.3	-11	-5.7	-2.28	4.6
6	-42	-38.83	-29.925	-16.9	-6.65	-3.01	7.4
7	-42.2	-40.1	-36.3	-25.5	-10.7	-4.02	8.3
8	-43	-41.2	-38.45	-32.4	-15.65	-5.7	13.9
9	-43	-41.1	-39.1	-33.45	-19.95	-7.09	5.3
10	-43.1	-40.6	-38.225	-29	-13.4	-6.2	2.4
11	-43.8	-41.1	-39.5	-32	-14.65	-6.88	-0.2
12	-14	-14	-14	-14	-14	-14	-14

Discussion:

The purpose of reference wetland data is to help assure that wetlands are accurately identified by regulatory personnel, as well as to aid understanding of shallow groundwater hydrology. State and federal laws place restrictions on filling, excavations, and other activities in wetlands. Commonly, citizens wish to do work in an area that is sometimes, or perhaps only rarely, wet. Whether this area is a wetland under regulatory definitions is often in dispute. Complicating the issue is that conditions in wetlands are constantly changing—an area that is very wet and clearly wetland at one time may be completely dry only a few weeks later (dramatically displayed in the graphs above). As a result, regulatory personnel look at a variety of factors, including soils, vegetation, and current moisture conditions. Reference wetland data provide a benchmark for comparing moisture conditions in a disputed, thereby helping assure accurate regulatory decisions. Likewise, it allows us to compare current shallow water levels to the range of observed levels in the past; this is useful for purposes ranging from flood prediction to drought severity indexing. The analysis of reference wetland data is a quantitative, non-subjective tool.

The simplest use of the reference wetland data in a regulatory setting is to compare water levels in the reference wetlands to water levels in a disputed area. The graphics and tables above are based upon percentiles of the water levels experienced at known wetland boundaries. The quantile boxes in the figures delineate the 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.

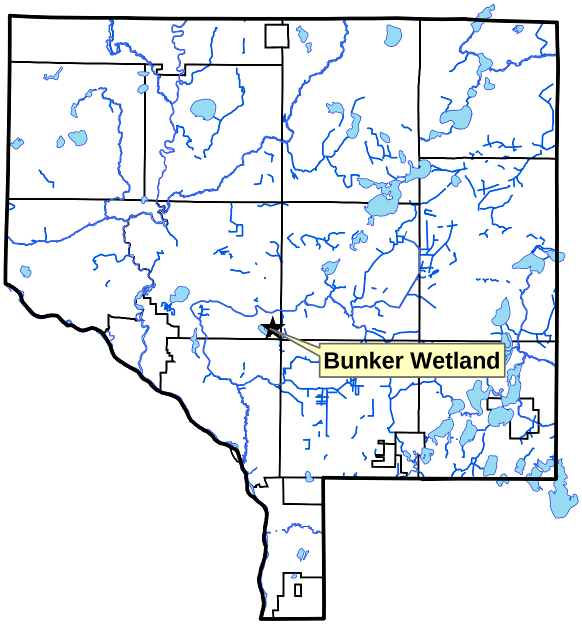
Water table levels are recorded every 4 hours at all 18 reference wetlands (except during winter), and the raw water level data are available through the Data Access tool at www.AnokaNaturalResources.com, or from the Anoka Conservation District.

Reference Wetland Vegetation Transects

Description:	This project is designed to track hydrology and vegetation changes in high quality wetlands that are under a number of pressures. The goal is to understand changes occurring to these wetlands and others that are similar. The project includes monitoring of hydrology and vegetation in multiple years. Shallow groundwater hydrology is monitored every year at the wetland edge and in the middle of the wetland as part of the Anoka Conservation District's Reference Wetland Program. Vegetation is monitored each year by assessing percent cover of various species along transects that were established in 2007.
Purpose:	To understand the influence of pressures upon this, and other similar wetlands, especially with respect to hydrology and vegetation. Pressures include increased traffic on adjacent highways and potential future road expansions, building and increased impervious surface, dewatering associated with nearby construction projects, depression of the water table due to climate or groundwater usage, and the presence (and possible expansion) of the invasive reed canary grass. Of particular interest is how wetland hydrology will affect invasive species expansion.
Locations:	Bunker Reference Wetland, City of Andover Sannerud Reference Wetland, City of Ham Lake
Results:	On the following pages

BUNKER REFERENCE WETLAND

Bunker Hills Regional Park, Andover



Wetland Description

The Bunker Hills reference wetland is approximately; a one-acre sized Circular 39, depressional Type 2 inland fresh wet meadow. The wetland is located in a concave landscape position with no discernable outlet, but is in close proximity to two similar type wetlands. One of similar size, located to the west, and a second, much larger wetland, located to the south.

The soils in the Bunker Hills are mapped by the Anoka County Soil Survey as the very poorly drained (water table within 0-2 feet) *Isanti Fine Sandy Loam.* While that classification is accurate on the perimeter, the interior is more akin to *Rife Mucky Peat* with the depth of the organic material ranging from a few inches to greater than four feet. In general, the organic deposits deepen towards the center of the basin. The surrounding uplands are a mix prairie and oak. The upland soils are mapped as the excessively well drained (water table > 6-feet) *Zimmerman Fine Sand*, which rapidly conducts water through its soil column.

The hydrology appears to be both surface water and groundwater driven. The hydrology data indicates the water table is generally within a few inches of the surface during the early spring and draws down to 30-40 inches during mid-summer. In addition, during the summer months the water tables rise and fall rapidly in response to rain events, while fall season data indicates a recharging water table.

There are three distinct vegetative communities within the wetland. Located along the perimeter is an invasive dominated community, with Reed Canary Grass as the primary species. The interior of the basin contains a diverse native, and an invasive/native species mix. Listed below are the specific plant species, with percent cover. The communities are further illustrated in the attached Bunker Hills Reference Wetland Vegetation Inventory figures.

Photo of Bunker Wetland in April

Introduction

At the request of the Coon Creek Watershed District, the Anoka Conservation District (ACD) is continuing to study the vegetation communities of the Bunkers Hills Reference Wetland. This site is located in the SW ¼ of the NE ¼ of Section 36 Township 32N Range 24W, Andover, Mn. Locally it is in the northeast corner of Bunker Hills Regional Park.

Study of this wetland is two-fold. First, to measure the wetland hydrology on a continuously basis during the growing season, as part of the ACD’s network of reference wetlands, which gives an indication of how shallow water tables, (<40 inches) are reacting for jurisdictional purposes. In 1996, the ACD placed a well on the wetland edge to measure growing season hydrology. We found, with the exception of the first two years, the water levels were at or below the required level. In fact, Seven out of ten years failed to meet wetland hydrology standards. We also found the water table was decreasing over time. Thus, the edge was no longer considered a jurisdictional wetland. This created the question of how the water table is reacting to changes in the local landscape. Therefore, in 2006 it was decided to move the well down slope, and add an additional well in the center of the wetland. This allows us to capture the full range of hydrology readings throughout the growing season.

The second goal is to inventory the plant species, and assign plant community boundaries. Then monitor the vegetation communities observing how the species composition and boundaries change over time.

Data Collection Methods

Two perpendicular transects each with seven sample plots each were established. Each plot used 1-meter quadrants for the herbaceous layer, 15-foot radius for the shrub/vine layer, and 30-foot radius for the tree layer. Sample sites that over lapped into the upland, or other plant communities were modified, while keeping the same square footage to stay within the wetland, and respective plant community.

Within each plot, vegetation was identified and cataloged to the species level with both common and scientific names, percent aerial coverage, indicator status and weather the species is native or invasive. These data were then used to establish plant community composition and aerial photograph interpretation was used to extrapolate the boundaries throughout the wetland. Due to seasonal vegetative variation, the community species composition is collected at the same time of year.

The boundary location and plot data were recorded with a hand held Garmin GPS unit with WAAS (Wide Area Augmentation System) correction and uploaded into Arc Map 9.1. These data were then used to create the vegetation inventory figures.

Collectively these data will serve to monitor plant community composition and boundaries over time. Listed below are brief narratives of each plant community along with a plant species table. Please note the sample sites are grouped with their respective plant community rather than in numeric order. For illustration of sample site locations, see the attached vegetation inventory figures.

Results

1. **Monotypic Non-Native**

   This plant community, while having a few sparsely placed native species, has a greater than 100 percent aerial coverage of non-native species Reed Canary Grass *(Phalaris arundinacea).* This species is very aggressive and out competes native species. It spreads by the use of underground roots (stolons) and seed. This species thrives in soil and hydrologically disturbed areas.

   This community is approximately one third of the total wetland, and is located in the northeast portion. The boundary is diffuse, which may indicate it is creeping towards, and possibly overtaking the native plant communities. This boundary will continue to be monitored for encroachment into the adjacent native communities.

Sample Site 1-1

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	120	Invasive	FACW
Solidago gigantia	Giant Goldenrod	5	Native	FACW
Rubus flagellaris	Dewberry	5	Native	FACU

Sample 1-2

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	120	Invasive	FACW

Sample 1-3

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	100	Invasive	FACW

Sample 2-1

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	100	Invasive	FACW
Rubus strigosis	Raspberry	10	Native	FACW
Solidago Canadensis	Canada Goldenrod	2	Native	FACU

Sample 2-2

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	90	Invasive	FACW
Urtica dioca	Stinging Nettle	2	Native	FAC
Carex lacustris	Lake Sedge	5	Native	OBL

2. Diverse Native/Non- Native Mix

This plant community is comprised of a mixture of native and non-native species, with clear boundaries. The plant community is comprised of species such as, Red Raspberry *(Rubus strigosis)*, Quaking Aspen *(Populas tremulas)*, and Reed Canary Grass *(Phalaris arundinacea)* these are species commonly associated with wetland edges, where the hydrology fluctuates and inundation in not common. There is high percentage of Reed Canary Grass, which may at some time overwhelm the natives, thus merging with the adjacent monotypic non-native plant community. It also may encroach into the native community.

Sample 1-7

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	90	Invasive	FACW
Rubus strigosis	Raspberry	30	Native	FACW
Populus trembulas	Quacking Aspen	10	Native	FAC

Sample 2-7

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Phalaris arundinacea	Reed Canary Grass	90	Invasive	FACW
Rubus strigosis	Raspberry	30	Native	FACW

Populus trembulas	Quacking Aspen	30	Native	FAC

3. Diverse Native

The center of this wetland contains the native species and is the most diverse of all the plant communities. It has a clear boundary, but is adjacent to the non-native community. Therefore, encroachment will be closely monitored. The native diversity is likely due to the hydrology being less affected than the perimeter. The early 2011 growing season had higher than normal precipitation leading to prolonged inundation. This caused the formation of algae mats in some of the sample plots. This also may have caused the facultative species of Canada Thistle, and Stinging Nettle to decrease in population.

Sample 1-4

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Polygonum sagittatum	Tear thumb	40	Native	OBL
Lycopus uniflorus	Northern Bugleweed	40	Native	OBL
Carex lacustris	Lake Sedge	10	Native	OBL
Polygonum amphibium	Water Smartweed	10	Native	OBL
Thelypteris thelypteroides	Marsh Fern	2	Native	FACW
Solidago gigantia	Giant Goldenrod	2	Native	FACW

Sample 1-5

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Solidago gigantia	Giant Goldenrod	40	Native	FACW
Thelypteris thelypteroides	Marsh Fern	30	Native	FACW
Rubus flagellaris	Dewberry	30	Native	FACU
Calamagrostis canadensis	Canada blue-joint	10	Native	OBL
Carex lacustris	Lake Sedge	10	Native	OBL
Polygonum amphibium	Water Smartweed	10	Native	OBL

Sample 1-6

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Solidago gigantia	Giant Goldenrod	40	Native	FACW
Carex lacustris	Lake Sedge	10	Native	OBL
Rubus strigosis	Raspberry	20	Native	FACU
Polygonum sagittatum	Tear thumb	30	Native	OBL

Sample 2-3

Scientific Name	Common Name	%Cover	Native/Invasive	Indicator
Carex lacustris	Lake Sedge	80	Native	OBL
Cirsium arvense	Canada Thistle	<1	Invasive	FACU
Lycopus uniflorus	Northern Bugleweed	30	Native	OBL
Polygonum	Tear thumb	20	Native	OBL

sagittatum				
Algea mat	-	20	-	Inundation

Sample 2-4

Scientific Name	**Common Name**	**%Cover**	**Native/Invasive**	**Indicator**
Carex lacustris	Lake Sedge	40	Native	OBL
Lycopus uniflorus	Northern Bugleweed	30	Native	OBL
Rubus strigosis	Raspberry	10	Native	FACW
Polygonum sagittatum	Tear thumb	20	Native	OBL
Polygonum amphibium	Water Smartweed	10	Native	OBL
Solidago gigantia	Giant Goldenrod	5	Native	FACW
Algea mat	-	20	-	Inundation

Sample 2-5

Scientific Name	**Common Name**	**%Cover**	**Native/Invasive**	**Indicator**
Polygonum hydropiper	Marshpepper smartweed	40	Native	OBL
Lycopus uniflorus	Northern Bugleweed	40	Native	OBL
Solidago gigantia	Giant Goldenrod	20	Native	FACW
Carex lacustris	Lake Sedge	20	Native	OBL
Polygonum amphibium	Water Smartweed	10	Native	OBL
Algea mat	-	20	-	Inundation

Sample 2-6

Scientific Name	**Common Name**	**%Cover**	**Native/Invasive**	**Indicator**
Carex lacustris	Lake Sedge	70	Native	OBL
Lycopus uniflorus	Northern Bugleweed	30	Native	OBL
Polygonum sagittatum	Tear thumb	30	Native	OBL
Polygonum amphibium	Water Smartweed	10	Native	OBL

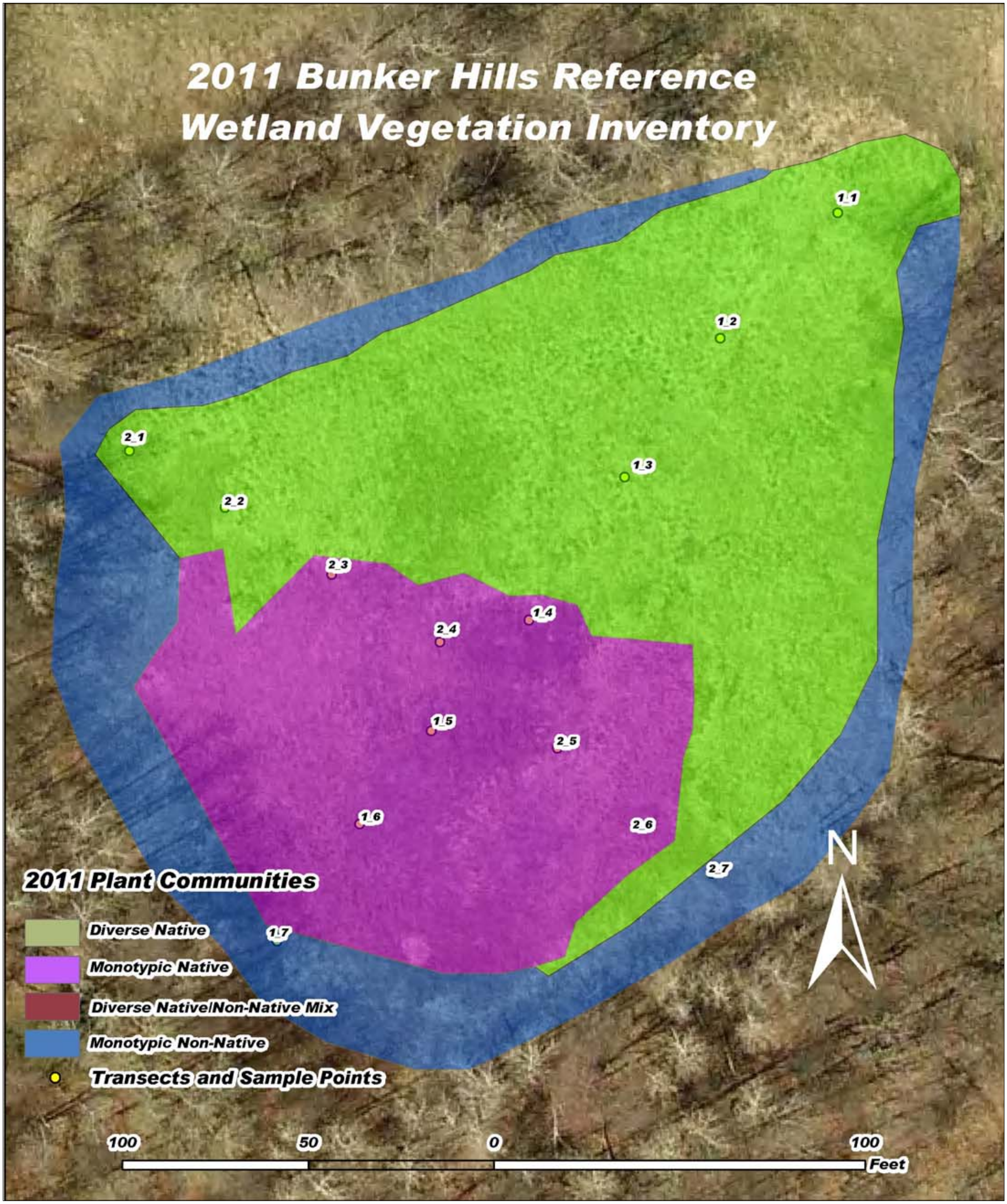
Conclusion

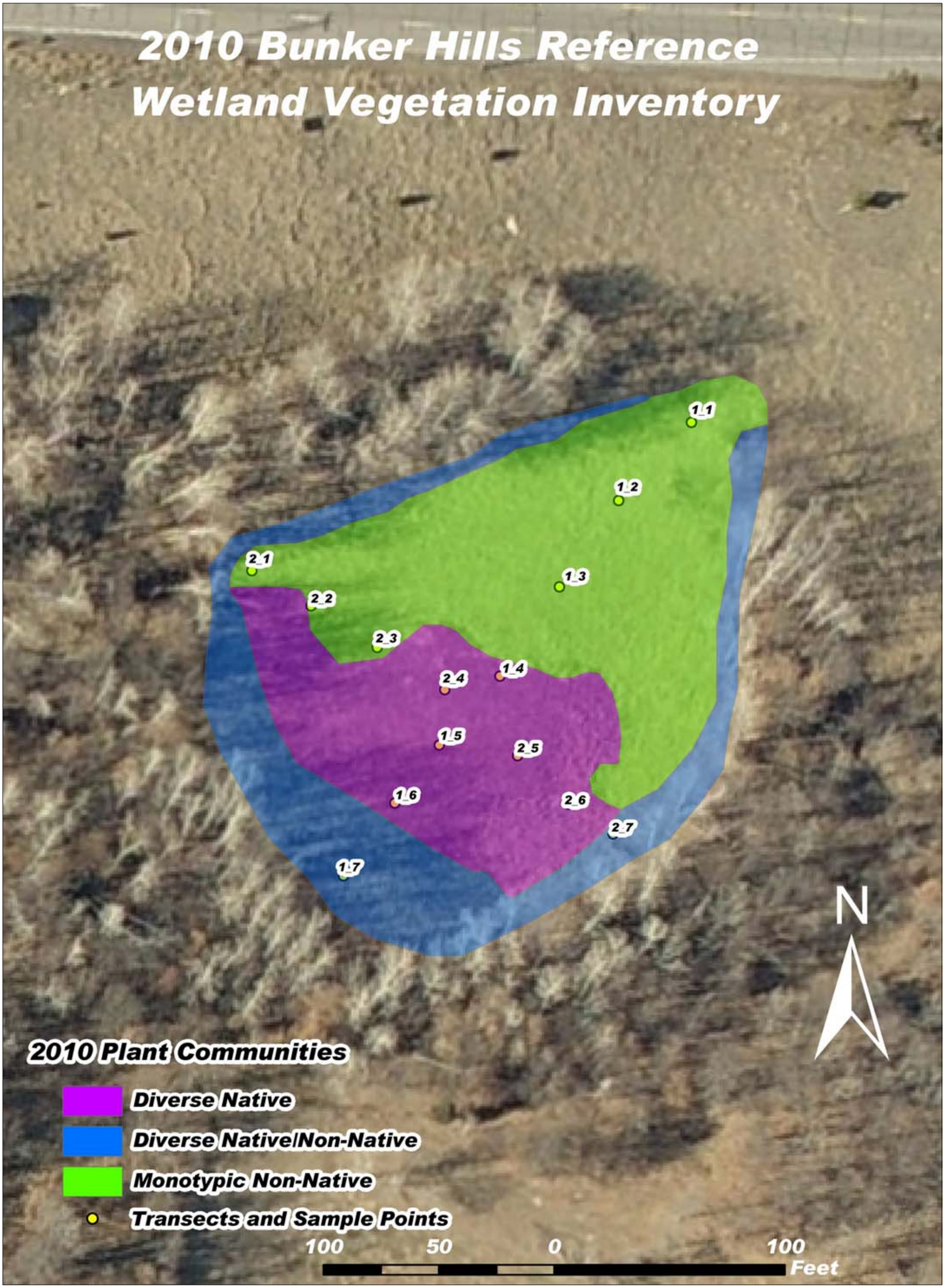
We now have three years of vegetative data, in which to compare. During this period, the species composition has resulted in some boundary changes, and minor species composition changed. For illustration of the boundary changes, refer to the attached figures for 2009-2011.

The Monotypic invasive plant community remains relatively unchanged, although appears to be gradually moving inward towards the native plant communities. This is seen as increased invasive species aerial converge in composition of the Diverse Native/Invasive community.

The Diverse Native community appears to be largely unchanged. However, the above normal precipitation resulted in prolonged inundation resulting in algae mat production, and suppressed the germination of facultative species e.g. Canada Thistle, Stinging Nettle.

Further monitoring of this wetland is expected during the 2012 growing season.


2011 Bunker Hills Reference
Wetland Vegetation Inventory
1_1
1_2
2_1
1_3
2_2
2_3
1_4
2_4
1_5
2_5
1_6
2_6
2_7
1_7
N
2011 Plant Communities
Diverse Native
Monotypic Native
Diverse Native/Non-Native Mix
Monotypic Non-Native
Transects and Sample Points
100
50
0
100
Feet


2010 Bunker Hills Reference Wetland Vegetation Inventory
1_1
1_2
2_1
1_3
2_2
2_3
2_4
1_4
1_5
2_5
1_6
2_6
2_7
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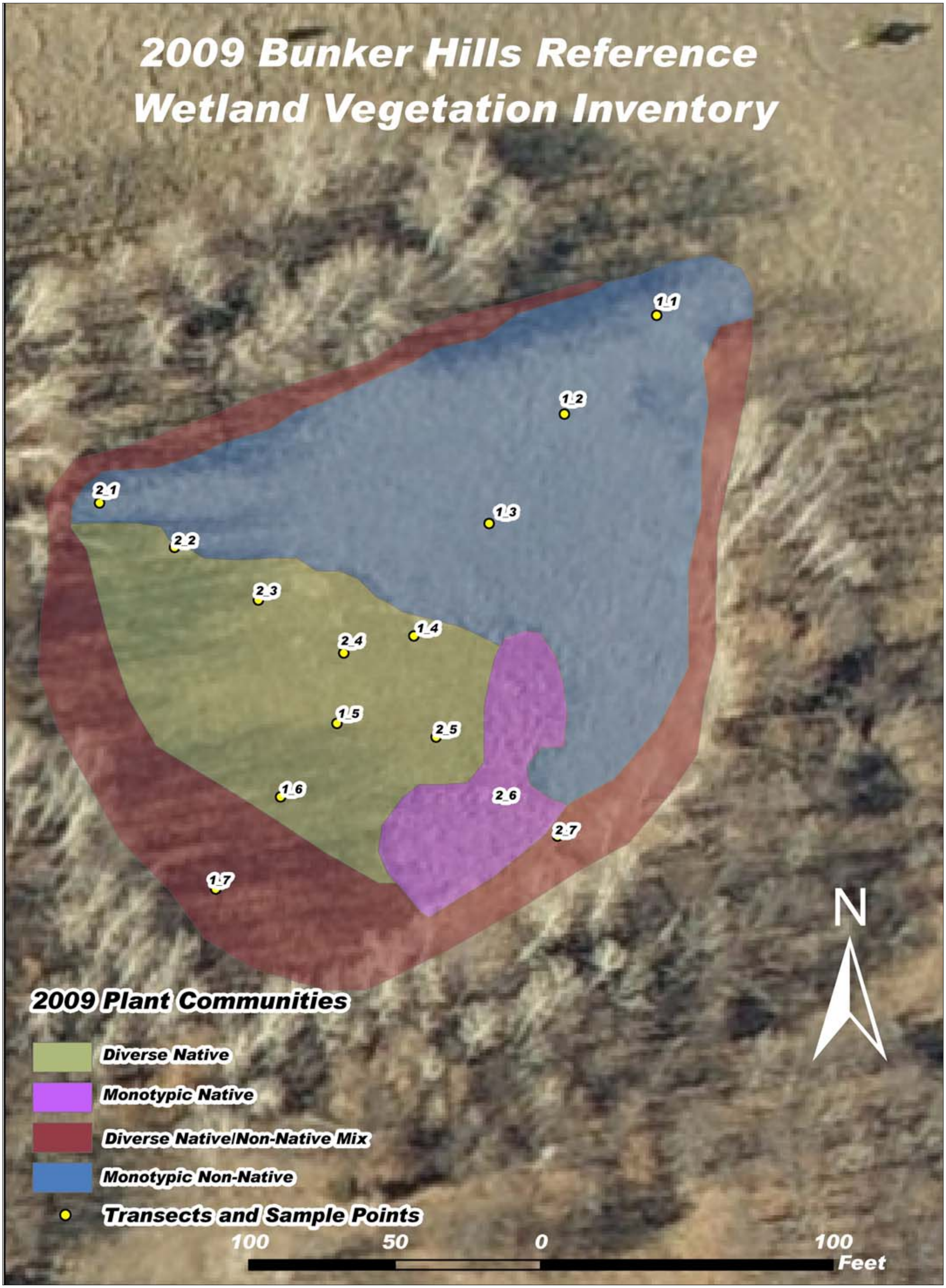
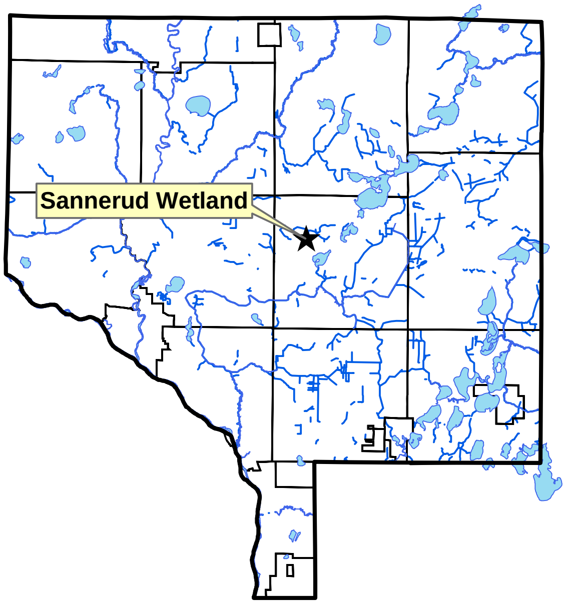
N
2010 Plant Communities
🟪 Diverse Native
🟦 Diverse Native/Non-Native
🟩 Monotypic Non-Native
● Transects and Sample Points
100
50
0
100
Feet


2009 Bunker Hills Reference
Wetland Vegetation Inventory
1_1
1_2
2_1
1_3
2_2
2_3
1_4
2_4
1_5
2_5
1_6
2_6
2_7
1_7
N
2009 Plant Communities
Diverse Native
Monotypic Native
Diverse Native/Non-Native Mix
Monotypic Non-Native
Transects and Sample Points
100
50
0
100
Feet

SANNERUD REFERENCE WETLAND

W side of Hwy 65 at 165th Ave, Ham Lake

Wetland Description



The Sannerud wetland is approximately 18.9 acres, and is classified as a Circular 39 Type 2 Inland fresh sedge meadow. This wetland is a depressional basin with deep organic soil deposits e.g. > 51 inches. The soil is classified as *Rifle Mucky Peat* with a sandy substrate. The surrounding uplands are oak woodlands on the somewhat poorly drained (water table within 2-4 feet) *Lino Fine Sand*, and the excessively well drained (water Table > 6-feet) *Zimmerman Fine Sand* soils. Both of these sandy soils rapidly conduct water, and discharge to the wetland.

This hydrology of this wetland shows typical early season high water tables at or above the ground surface, which decrease as the growing season progresses. The responses to rain events is pronounced especially on the wetland edge. A contributing factor is the high permeable rates of the upland soils. There is an inlet ditch on the east side of the wetland coming from under TH 65, and a created outlet ditch on the southwest corner. Both have been over grown and appear to be non-functional.

The dominate plant species within this wetland are native sedges and grasses, specifcally *Carex lasiocarpa* (Wooly-fruit sedge) and *Calamagrostis canadensis* (Canada bluejoint). Both of these native species are indicative of a high quality wetland habitat. Located on the perimeter of the wetland are various mixtures of *Rubus flagellaris* (Dew Berrry), *Phalaris arundinace* (Phalaris arundinacea), *Calamagrostis canadensis* (Canada Bluejoint), and *Populas trembelodies* (Quaking Aspen).

Introduction

At the request of the Coon Creek Watershed District, and with the permission of the property owners, the Anoka Conservation District (ACD) continues to study the wetland plant communities of the Sannerud wetland. The site is located in the Se ¼ of the Sw ¼ of Section 8 Township 32N, Range 23W, Ham Lake, Mn. Locally noted as the northwest of the intersection of Highway 65 and Constance Boulevard.

Study of this wetland has been two-fold. First, to measure the wetland hydrology on a continuous basis during the growing season, as part of the ACD's network of reference wetlands, which gives and indication of how the shallow water tables are reacting for jurisdictional purposes

The second goal, beginning in 2007, is to inventory the plant species and assign plant community boundaries. Then monitor the vegetation communities, observing hoe the species composition and boundaries change over time, with particular interest is the progression of invasive/exotic plant species as a result of changes in hydrology due to influence of various pressures upon this wetland. This wetland is likely to experience substantial changes at its periphery. These changes include increased traffic on the adjacent highway, potential road expansions, development, and increased impervious surface, Which leads to the possible expansion of the invasive species such as Reed Canary Grass.

Data Collection Methods

Data plots were established by two means. They were either along transects across multiple plant communities, or as a single plot within a small community. Each data plot collected plant species, and percent aerial coverage data by using 1-meter quadrants for the herbaceous layer, 15-foot radius for shrub/vine layers, and 30-foot radius for tree layers. Sample sites that over lapped into upland, or other plant communities were modified, while keeping the same square footage, to stay within the respective plant community.

Within each plot, vegetation was identified and cataloged to the species level with both common and scientific names, percent aerial coverage, indicator status and weather the species is native or invasive. These data were then used to establish plant community composition and aerial photograph interpretation was used to extrapolate the boundaries throughout the wetland. Due to seasonal vegetative variation, the community species composition is collected at the same time of year.

The boundary location and plot data were recorded with a hand held Garmin GPS unit with WAAS (Wide Area Augmentation System) correction and uploaded into Arc Map 9.1. These data were then used to create the community maps. In years past the community maps were categorized based on specific species resulting in ten communities. However, since these communities change in composition they are now grouped as either native or invasive. While the individual communities are still recognized and depicted on the map, the focus is on whether the community is native or invasive and if it is moving.

Collectively these data will serve to monitor plant community composition and boundaries over time. Listed below are brief narratives of each plant community along with a plant species table. Please note the sample sites are grouped with their respective plant community rather than in numeric order. For illustration of sample site locations, see the attached vegetation inventory figures.

Results

The data produced three plant communities types based on the percentage of native vs. invasive species composition. These three communities were further broken down into subcategories based on dominant species listed in descending order. Subsequently, the sample I.D. numbers will correlate with the plant communities, rather than numerical order.

Listed below are the main communities followed by the sub categories. Although there are 10 sub communities, for the purpose of this report, plant communities descriptions are of the main plant communities. The data plots identify species composition in each sub community and the Plant Community Maps depict each sub community along with sample plot locations.

- Native
  - ➢ Calamagrostis Canadensis, Carex lasiocarpa
  - ➢ Calamagrostis canadensis, Spirea tomentosa, Betula papyrifera
  - ➢ Rubus flagellaris, Carex lasiocarpa
  - ➢ Spirea tomentosa, Carex lasiocarpa, Rubus flagellaris
- Dominate Native/Invasive mix,
  - ➢ Carex lasiocarpa, Calamagrostis canadensis, Phalaris arundinacea, Rubus flagellaris, Spirea tomentosa, Populus tremulodies
  - ➢ Rubus flagellaris, Carex lacustris, Phalaris arundinacea
  - ➢ Spirea Tomentosa, Carex lasiocarpa, Phalaris arundinacea Rubus flagellaris
- Dominate Invasive/Native mix
  - ➢ Phalaris arundinacea, Acer rubrum, Populus tremulodies
  - ➢ Phalaris arundinacea, Carex lasiocarpa, Calamagrostis Canadensis
  - ➢ Phalaris arundinacea, Populus tremulodies

1. Native Plant Communities

This plant community encompasses 73% (13.8 acres) of the total wetland area, and is located mostly in the interior of the basin where the organic deposits are the thickest and the hydrology is the most stable.

By far the most dominant plant species are *Carex lasiocarpa* and *Calamagrostis Canadensis.* These communities are comprised of the following species data.

Sample 1-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	100	Native
Calamagrostis canadensis	Canada Blue Joint	30	Native
Salaix nigra	Black Willow	5	Native
Spirea tomentosa	Steeple Bush	5	Native

Sample 1-3

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	100	Native
Calamagrostis canadensis	Canada Blue Joint	40	Native
Spirea tomentosa	Steeple Bush	5	Native

Sample 1-4

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	100	Native
Calamagrostis canadensis	Canada Blue Joint	20	Native
Typha angustifolia	Narrow-leaf Cattail	30	Native

Sample 2-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	100	Native
Carex lasiocarpa	Wooly-fruit sedge	40	Native
Salaix nigra	Black Willow	10	Native

Sample 2-3

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	100	Native
Carex lasiocarpa	Wooly-fruit sedge	30	Native

Sample 2-4

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	100	Native
Carex lasiocarpa	Wooly-fruit sedge	30	Native

Sample 3-3

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	100	Native
Carex lasiocarpa	Wooly-fruit sedge	30	Native

Sample 3-4

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	100	Native
Carex lasiocarpa	Wooly-fruit sedge	20	Native

Sample 4-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	100	Native
Carex lasiocarpa	Wooly-fruit sedge	20	Native
Salix exigia	Sandbar Willow	20	Native

Sample 4-3

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	100	Native
Carex lasiocarpa	Wooly-fruit sedge	20	Native
Polygonum amphibium	Water Smartweed	5	Native

Sample 4-4

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	100	Native
Calamagrostis canadensis	Canada Blue Joint	20	Native

This group of sample plots were taken in adjacent smaller native plant communities that necessitated their own boundaries due to species composition. Theses are native species commonly found along wetland edges.

Sample 5-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	60	Native
Rubus flagellaris	Raspberry	40	Native
Carex lasiocarpa	Wooly-fruit sedge	20	Native
Spirea tementosa	Steeple Bush	20	Native

Sample 10-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	60	Native
Rubus flagellaris	Raspberry	40	Native
Carex lasiocarpa	Wooly-fruit sedge	20	Native
Spirea tementosa	Steeple Bush	20	Native

Sample 5-3

Scientific Name	Common Name	% Coverage	Native/Invasive
Rubus flagellaris	Raspberry	60	Native
Calamagrostis canadensis	Canada Blue Joint	40	Native
Carex lasiocarpa	Wooly-fruit sedge	20	Native
Spirea tementosa	Steeple Bush	20	Native

Sample 3-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Spirea tementosa	Steeple Bush	40	Native
Carex lasiocarpa	Wooly-fruit sedge	40	Native
Rubus flagellaris	Raspberry	40	Native
Carex stricta	Uptight Sedge	5	Native

2. Dominant Native/Non-native invasive mix

This plant community encompassed 11%, (2.1 acres) of the wetland and is located either along the perimeter or between the perimeter and the interior basin. The dominate species in these plant communities are the Dew Berry and Canada Blue-joint Grass, with various trees and shrubs. This is where the organic soils were the thinnest, (4-16 inches) and the hydrology has the most bounce. Listed below are the sample data taken within these plant communities.

Sample Site 1-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Rubus flagellaris	Dew Berry	70	Native
Calamagrostis canadensis	Canada Blue Joint	30	Native
Phalaris arundinacea	Reed Canary Grass	20	Invasive
Populas trembeloidies	Quaking Aspen (S)	20	Native
Carex lasiocarpa	Wooly-fruit sedge	10	Native
Betula papyrifera	Paper Birch (s)	10	Native
Acer rubrum	Red Maple (T)	10	Native
Spirea tementosa	Steeple Bush	5	Native
Salix petiolaris	Meadow Willow	5	Native

Sample 4-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	40	Native
Rubus flagellaris	Dew Berry	30	Native
Salix exigia	Sandbar Willow	20	Native
Phalaris arundinacea	Reed Canary Grass	20	Invasive
Fraxinus pennsylvanicum	Green Ash	10	Native
Cornus stolonifera	Red-osier Dogwood (s)	10	Native
Acer rubrum	Red Maple (T)	10	Native
Ilex verticillata	Winterberry (S)	5	Native
Spirea tementosa	Steeple Bush	5	Native

Sample 9-2

Scientific Name	Common Name	% Coverage	Native/Invasive
Carex lasiocarpa	Wooly-fruit sedge	40	Native
Rubus flagellaris	Dew Berry	30	Native
Salix exigia	Sandbar Willow	20	Native
Phalaris arundinacea	Reed Canary Grass	20	Invasive
Acer rubrum	Red Maple	10	Native
Fraxinus pennsylvanicum	Green Ash	10	Native

Sample 6-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Rubus flagellaris	Dew Berry	80	Native
Carex lasiocarpa	Wooly-fruit sedge	30	Native
Phalaris arundinacea	Reed Canary Grass	15	Invasive

Sample 7-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Calamagrostis canadensis	Canada Blue Joint	80	Native
Carex lasiocarpa	Wooly-fruit sedge	30	Native
Phalaris arundinacea	Reed Canary Grass	10	Invasive

3. Dominant Non-native invasive/native mix

This non-native plant community encompassed 16%, (2.0 acres) of the wetland and is located along the perimeter of the wetland. The dominate species in these plant communities is Reed Canary Grass. This is also where the organic soils were the thinnest, (4-16 inches) and the hydrology has the most bounce.

Sample 2-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	60	Invasive
Carex lasiocarpa	Wooly-fruit sedge	40	Native
Calamagrostis canadensis	Canada Blue Joint	30	Native
Typha angustifolia	Narrow-leaf Cattail	10	Native

Sample 3-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	100	Invasive
Rubus flagellaris	Dew Berry	40	Native
Populas trembeloidies	Quaking Aspen (S)	30	Native
Betula papyrifera	Paper Birch (s)	30	Native
Solidago gigantia	Giant Goldenrod	10	Native

Sample 5-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	80	Invasive
Calamagrostis canadensis	Canada Blue Joint	10	Native
Carex lasiocarpa	Wooly-fruit sedge	10	Native

Sample 8-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	80	Invasive
Populus trembeloidies	Quaking Aspen (S)	50	Native
Calamagrostis canadensis	Canada Blue Joint	20	Native

Sample 9-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	80	Invasive
Populus trembeloidies	Quaking Aspen (S)	50	Native
Calamagrostis canadensis	Canada Blue Joint	20	Native

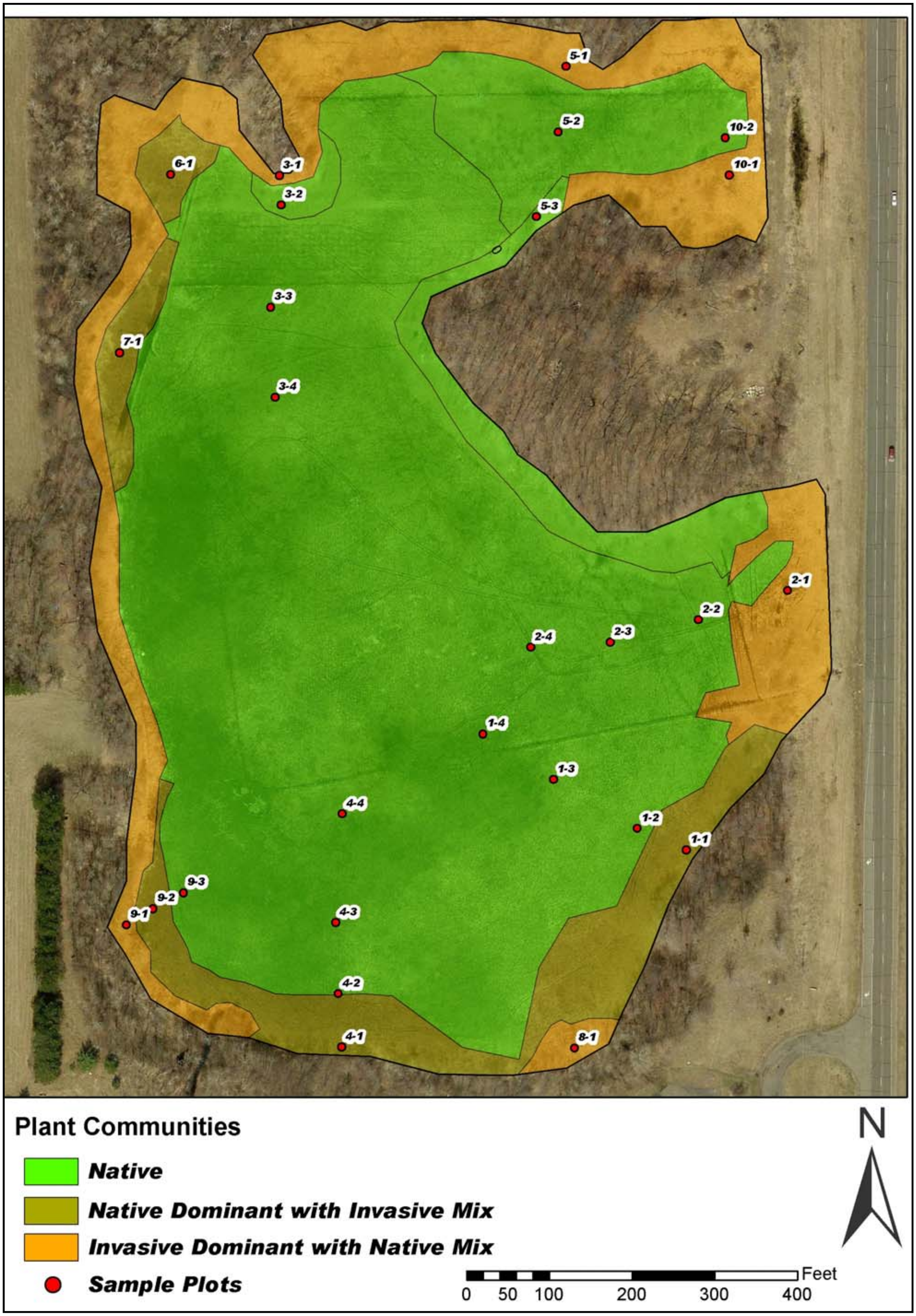
Sample 10-1

Scientific Name	Common Name	% Coverage	Native/Invasive
Phalaris arundinacea	Reed Canary Grass	80	Invasive
Populus trembeloidies	Quaking Aspen (S)	50	Native
Calamagrostis canadensis	Canada Blue Joint	20	Native

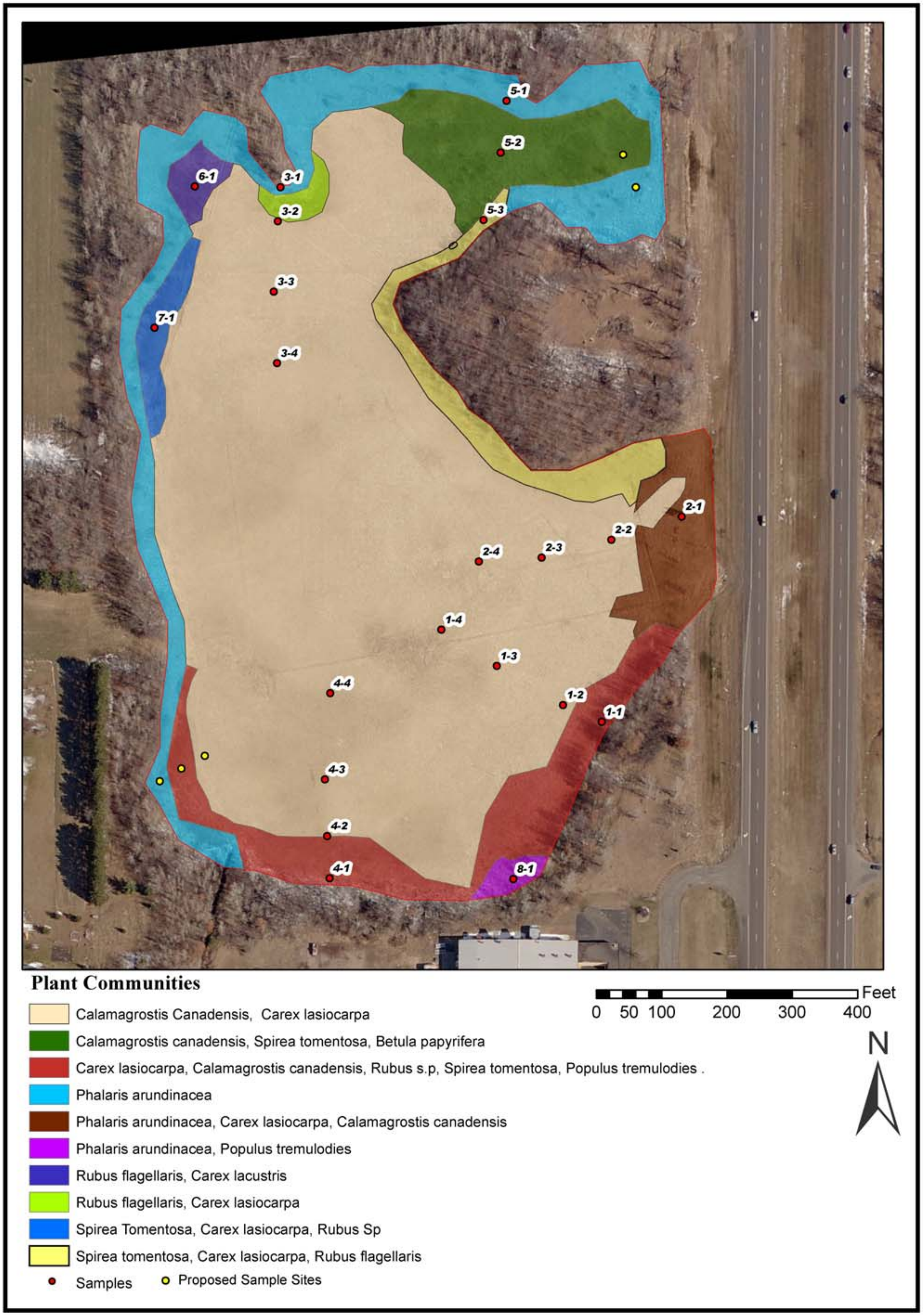
Conclusions

Though four years have eclipsed since the plant community survey began, we have yet to see any appreciable change. There has been changes in species composition, leading to changes in plant community names, but not enough to alter boundary changes. The invasive species boundary appears stable, most likely due to the hydrological patters of the basin. Therefore, The question of whether the invasive species, will invade in to the interior will rest on how the hydrology changes over time.

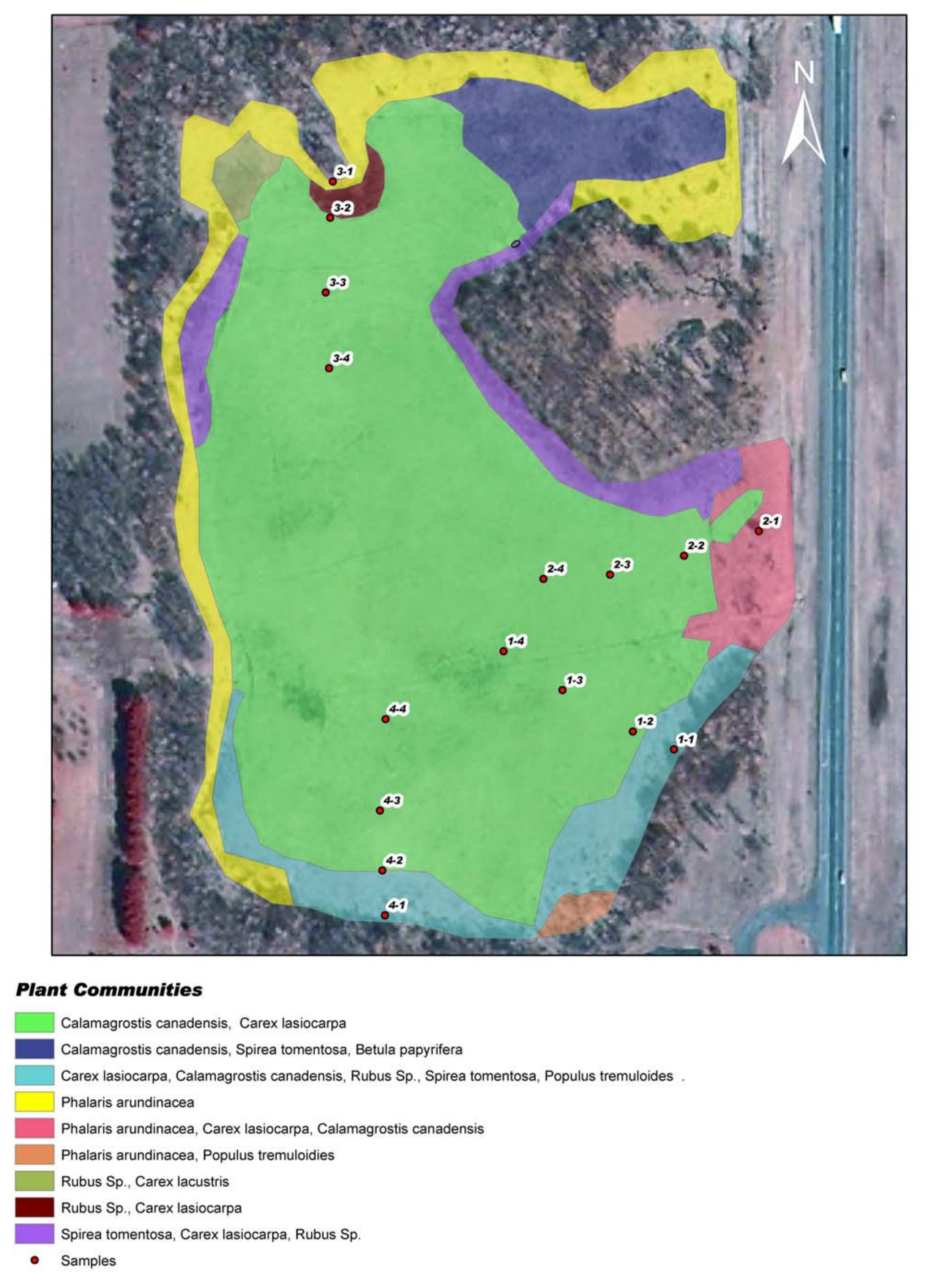
2011 PLANT COMMUNITIES MAP WITH DATA PLOT LOCATIONS



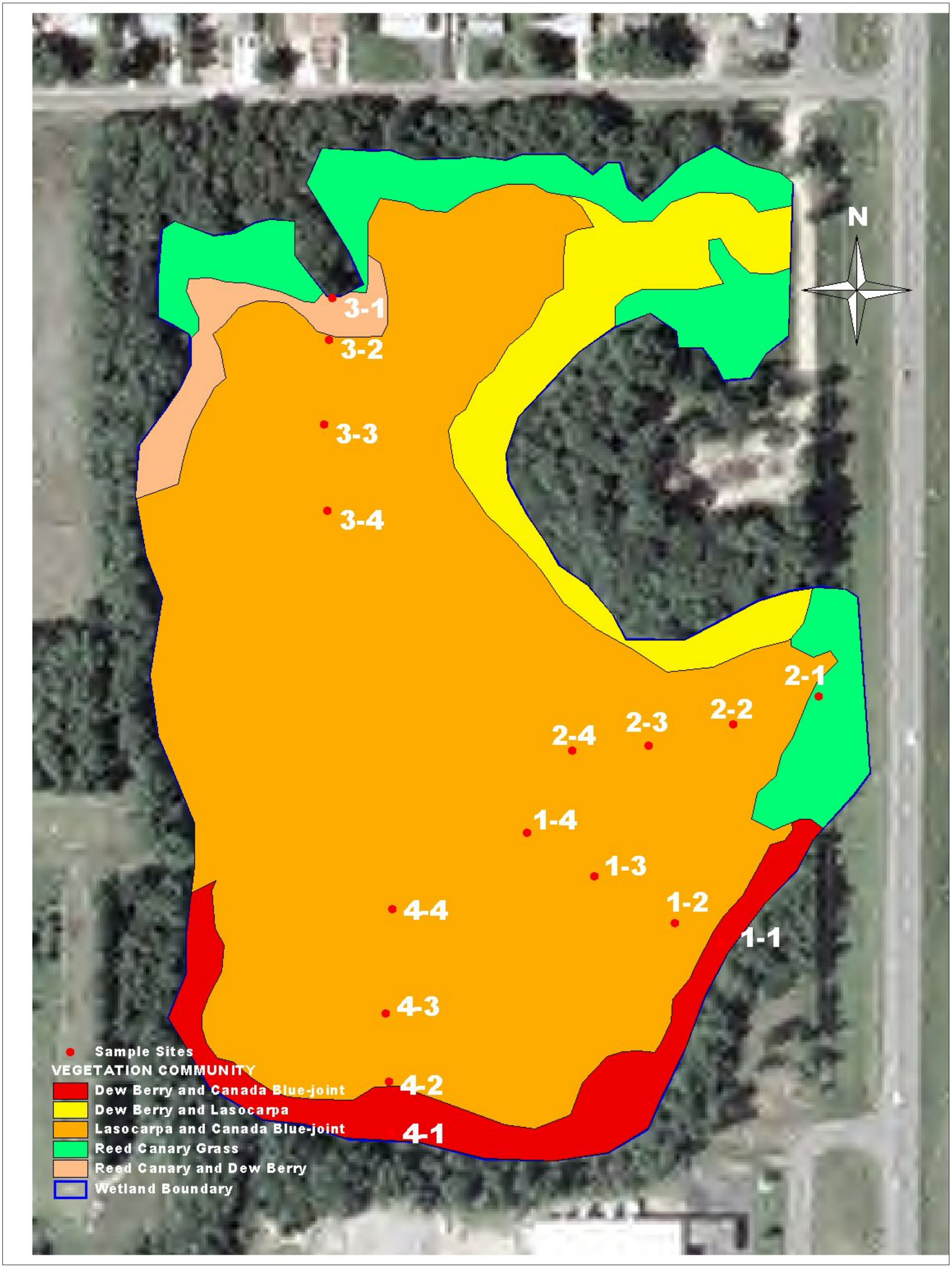
20101 PLANT COMMUNITIES MAP WITH DATA PLOT LOCATIONS



2008 PLANT COMMUNITIES MAP WITH DATA PLOT LOCATIONS



2007 PLANT COMMUNITIES MAP WITH DATA PLOT LOCATIONS



Stormwater Retrofit Assessment – Lower Coon Creek

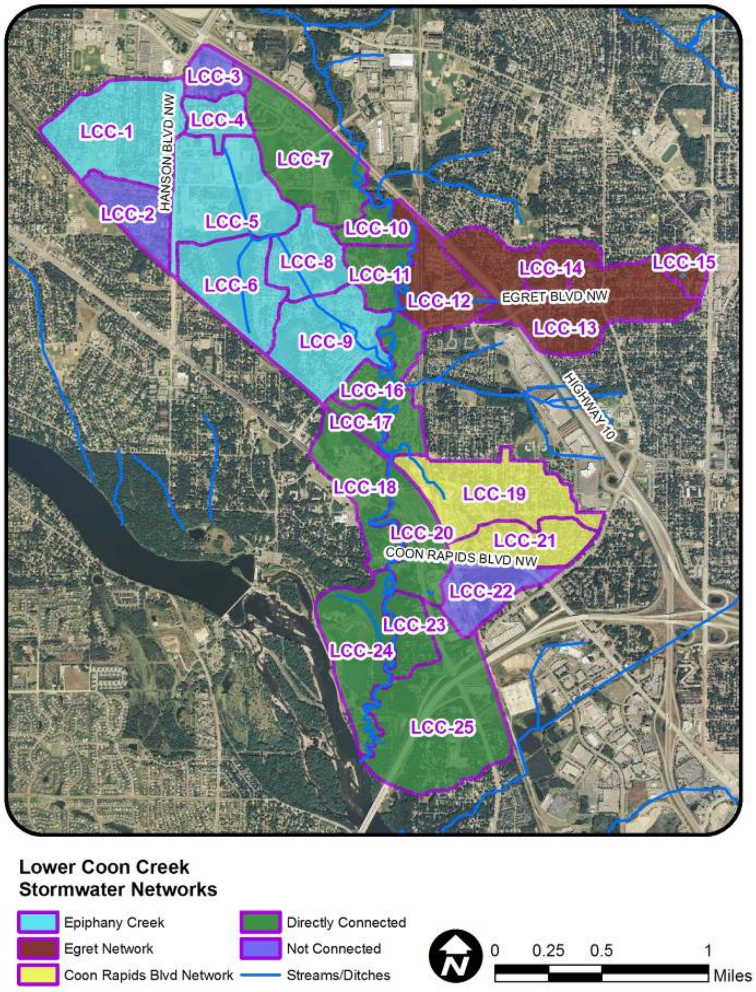
Description: This stormwater retrofit assessment takes a systematic approach to identifying and prioritizing water quality improvement projects that provide the greatest amount of stormwater treatment per dollar spent. Lower Coon Creek was chosen because water quality is known to deteriorate in this section of the creek before the confluence with the Mississippi River. The subwatershed is approximately 2,313 acres and is located entirely in the City of Coon Rapids.

Purpose: To improve stormwater quality and reduce the volume of runoff entering the stormwater system from neighborhoods that most greatly contribute to the degradation of Coon Creek and its tributaries.

Results: In 2011, major steps of the assessment were completed including retrofit scoping, desktop analysis, field reconnaissance, and project identification. The subwatershed was divided into 25 catchments grouped into five categories based on their drainage system and connectedness to Coon Creek (see map below). Over 400 potential stormwater retrofit projects have been identified. Potential projects include rain gardens, new stormwater ponds, modifications to existing ponds, iron-enhanced sand filters, and permeable asphalt. Work on this assessment will continue in 2012 as projects are modeled and ranked according to cost-effectiveness.

Due to the extensive nature of this work, a separate report will be prepared. That report will be available at www.anokaswcd.org or from the Anoka Conservation District.

Map of the Lower Coon Creek Stormwater Retrofit Assessment Area



Sand Creek Rain Garden Promotion and Design

Description: This rain garden promotion and design effort is part of a grant project with CCWD. In 2010, CCWD received a grant from the MPCA to construct a new stormwater pond and install a series of residential rain gardens to improve the water quality in Sand Creek. ACD was contracted to manage the promotion and design portion of the rain garden project.

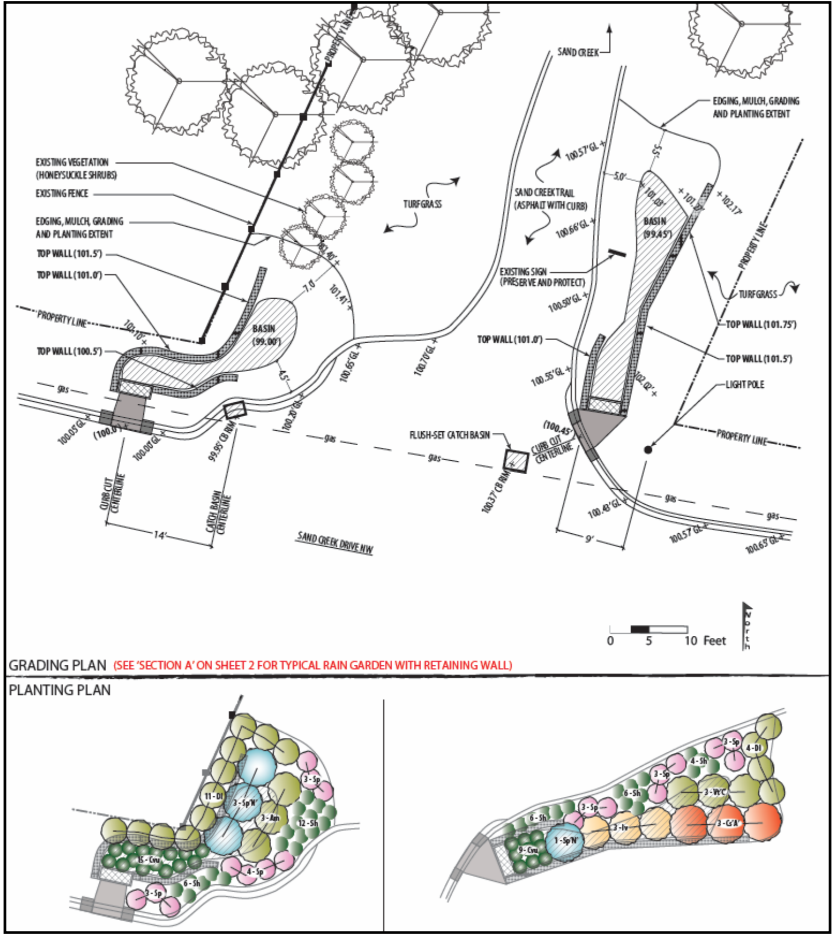
Purpose: To improve stormwater quality and reduce the volume of runoff entering the stormwater system from neighborhoods that contribute to degradation of Sand Creek and Coon Creek.

Results: In fall 2011, ACD staff approached over 30 properties in a residential neighborhood to the south of Sand Creek looking for landowners interested in participating in the rain garden program. Interested landowners then attended an information meeting lead by ACD staff at Sand Creek Elementary. The meeting covered the basics of rain gardens, why their property was important, as well as project funding and contract requirements. Seven rain garden designs were developed for six interested property owners. Two additional gardens were designed for a city-owned parcel near the creek. Construction on the gardens is scheduled to be completed in 2012.

Funding breakdown for this project

Coon Cr Watershed District – promotion, education, designs	$5,110
Anoka Conservation District – in-kind contribution	$6,255
Total	**$11,365**

Example rain garden design - Two of the nine rain garden designs were developed for the Sand Creek Trail access point at the intersection of Sand Creek Drive and Kumquat Street.



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	CCWD Rain	Reference Wetland	Lake Level	Stream Level	Lake WQ	Stream WQ	Student Biomon	ProBiomon	Lower Coon Cr Assess	Woodcrest Retro Assess	Sand Cr Retro Promo	CCWD Hydrolab	CCWD Veg Survey	Total
Revenues														
CCWD	4120	4175	480	2725	2150	10775	800	7650	14280		5110	1330	760	54355
State														
Anoka Conservation District					1156		25		5988	6106	6255	430		19960
County Ag Preserves							731							731
Regional/Local														
Other Service Fees														
Local Water Planning	1363		272	1461			763							3859
TOTAL	5483	4175	752	4186	3306	10775	2319	7650	20268	6106	11365	1760	760	78904
Expenses-														
Capital Outlay/Equip	21	8	1	22	4	23	3	5		80		8	3	179
Personnel Salaries/Benefits	4683	2836	658	3531	2151	3560	2000	6177	18141	4968	10665	1452	415	61237
Overhead	428	219	49	320	988	4559	136	351	1115	670	332	146	35	9348
Employee Training	17	17	4	18	6	13	15	60	142	17	60	3	3	377
Vehicle/Mileage	80	44	11	51	43	57	29	77	275	48	83	26	5	828
Rent	223	116	25	169	102	183	71	187	595	322	185	75	19	2273
Program Participants														
Program Supplies	30	18	5	75	11	205	65	152			39	50		650
Equipment Maintenance														
TOTAL	5483	3258	752	4186	3306	8600	2319	7009	20268	6106	11365	1760	479	74892

Recommendations

- **Install water quality improvement projects identified in the Sand and Woodcrest Creek stormwater assessments.** Potential projects have been ranked by cost effectiveness; most cost effective projects should be done first.
- **Conduct subwatershed assessments for lower Coon Creek that locate and prioritize water quality improvement opportunities.** The Anoka Conservation District and Coon Creek Watershed District are planning an assessment for lower Coon Creek in 2011. Based on monitoring data, areas of focus should be total phosphorus, total suspended solids, and storms >1-inch.
- **Install continuous water quality monitoring of Coon Creek at Vale Street** during storms to better understand variability in nutrients and suspended solids throughout the storm. This should also aid in understanding pollutant sources so they can be addressed.
- **Ensure that future stream monitoring is done in such a way that it can be incorporated into future total maximum daily load (TMDL) studies.** Coon Creek is presently listed as impaired for biota, but may also be failing to meet turbidity standards.
- **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.
- **Secure funding for Blaine High School biomonitoring** of Coon Creek at Egret Street.
- **Integrate stream hydrology, precipitation, and water quality data into watershed-wide computer models.**
- **Expand the number of quadrats in the Sannerud wetland vegetation studies** to improve our ability to detect small changes.
- **Scrutinize monitoring and water quality improvement needs for Pleasure and Springbrook Creeks**, which will likely become part of the Coon Creek Watershed District. Past work on these waterbodies has been limited, but substantial problems are known to occur.
- **Reduce road salt use.** Elevated chlorides are pervasive throughout shallow aquifers and the streams that feed them.
- **Continue hydrolab continuous water quality monitoring of Coon Creek.** A variety of storms should be sampled and storm monitoring should continue more than 2 days after a storm because monitoring has found water quality has not recovered from the storm within that time. Monitoring during few baseflow periods would be useful for comparison purposes.