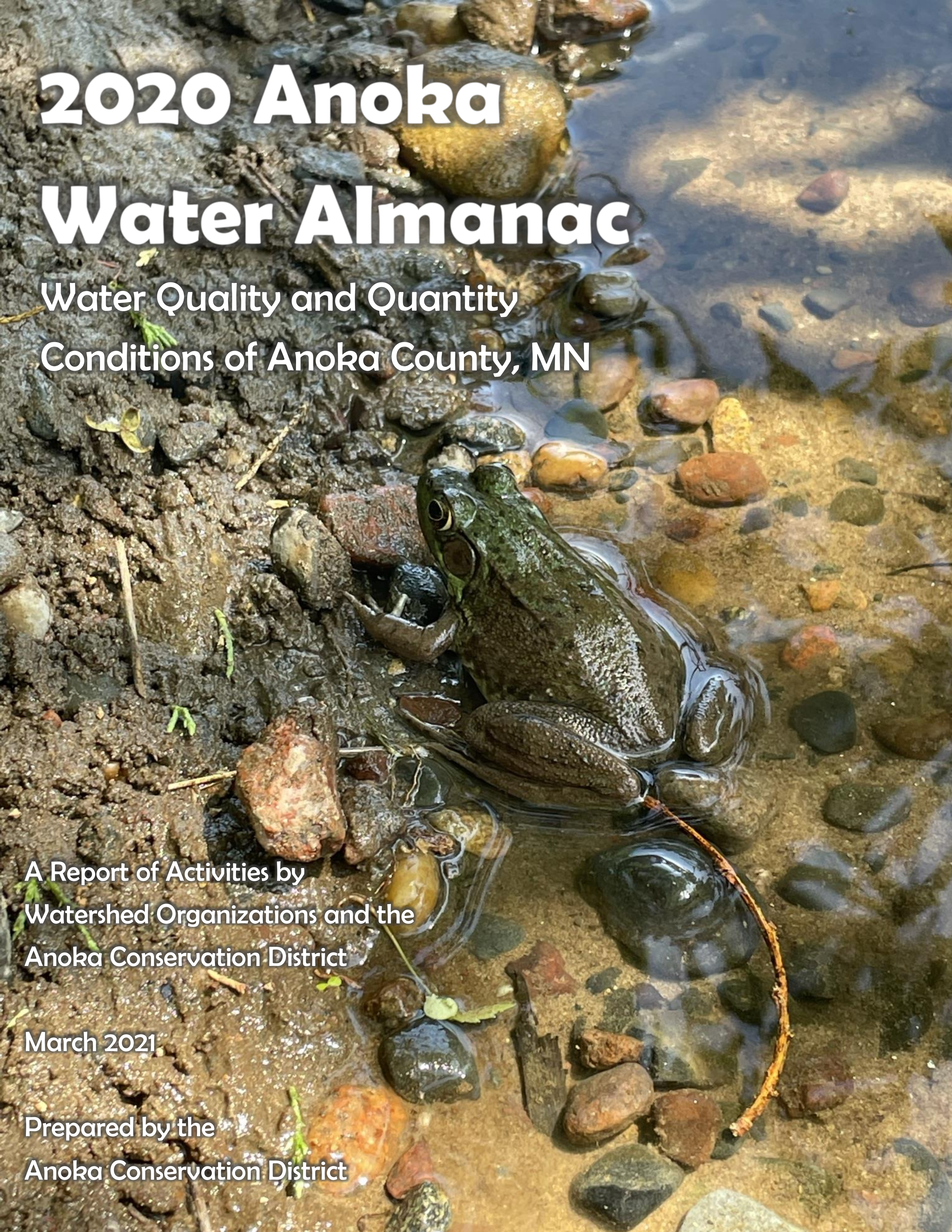

2020 Anoka Water Almanac

Water Quality and Quantity Conditions of Anoka County, MN

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

March 2021

Prepared by the
Anoka Conservation District

2020 ANOKA WATER ALMANAC

Water Quality & Quantity Conditions of Anoka County, Minnesota

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

March 2021

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EXECUTIVE SUMMARY AND ORGANIZATION OF THIS REPORT

This report summarizes water resources management and monitoring work done as a cooperative effort between the Anoka Conservation District (ACD) and watershed districts or watershed management organizations. 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 instruction on interpreting data.

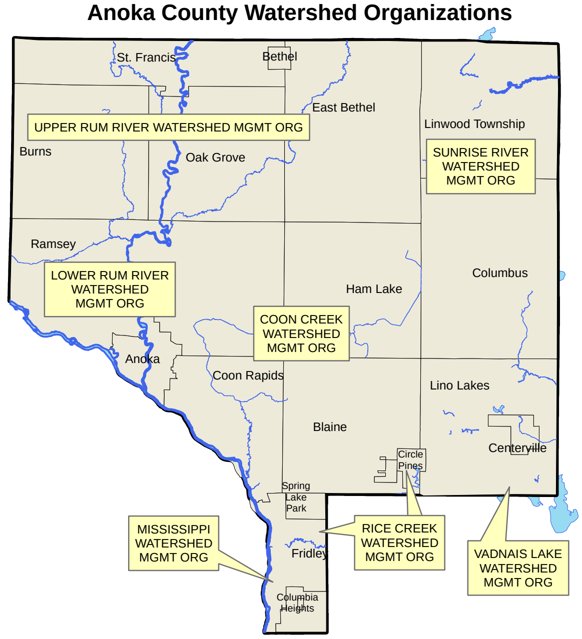
The water resource management and monitoring work reported here include:

- Monitoring
  - precipitation,
  - lake levels,
  - lake water quality,
  - stream hydrology,
  - stream water quality,
  - stream benthic macroinvertebrates,
  - shallow groundwater levels in wetlands, and
  - groundwater levels in observation wells.
- Water quality improvement projects
  - projects designed, installed, or planned are briefly discussed in this report,
  - cost share grants for erosion correction, lakeshore restorations, and rain gardens, and
  - promotion of available grants for water quality improvement projects.
- Studies and analyses
  - stormwater retrofitting assessments,
  - upstream to downstream water quality analyses,
  - water quality trend analyses and
  - reference wetland 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.

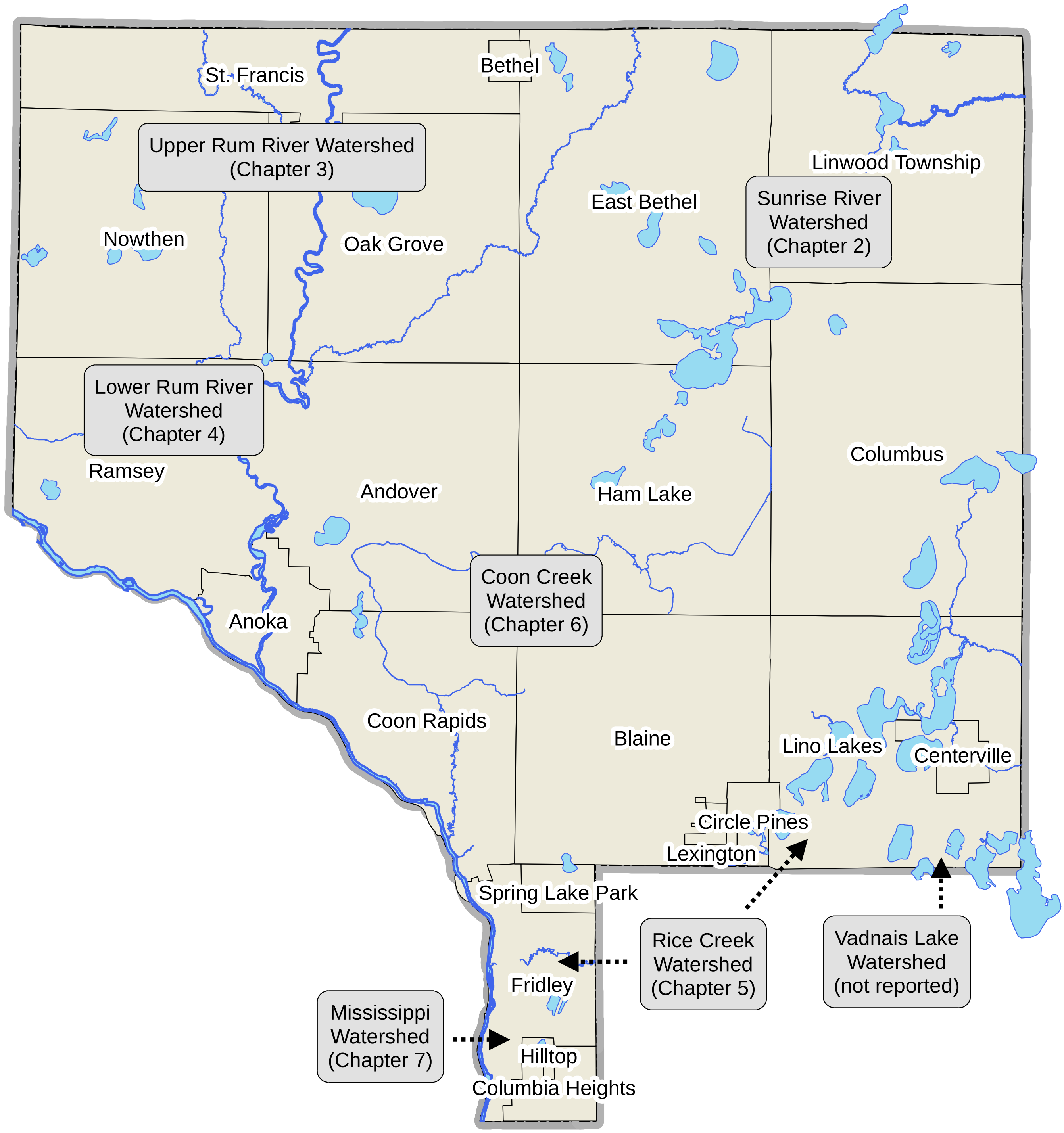
While this report is perhaps the most comprehensive source of monitoring data on lakes, stream, rivers, groundwater, and wetlands in Anoka County, it is not the only source; nor is this report a summary of all work completed throughout Anoka County in 2020. Rather, it is a summary of work carried out by the Anoka Conservation District in conjunction with watershed organizations within the county. Furthermore, only work conducted during 2020 is presented in this almanac (although trend and similar analysis also include previous years' data). For results of work completed in past years, readers should refer to previous Water Almanacs. All data collected in 2020 and prior is available in digital format from the Anoka Conservation District. All applicable data is also submitted to state databases for wider availability; these include the MPCA's EQuIS water quality database, the DNR's lakefinder tool for lake levels, the DNR's Cooperative Groundwater Monitoring (CGM) tool for observation wells, and the State Climatology Office online precipitation database.

Table of Contents

Anoka County Watershed Organizations



Chapter 1 – Primer

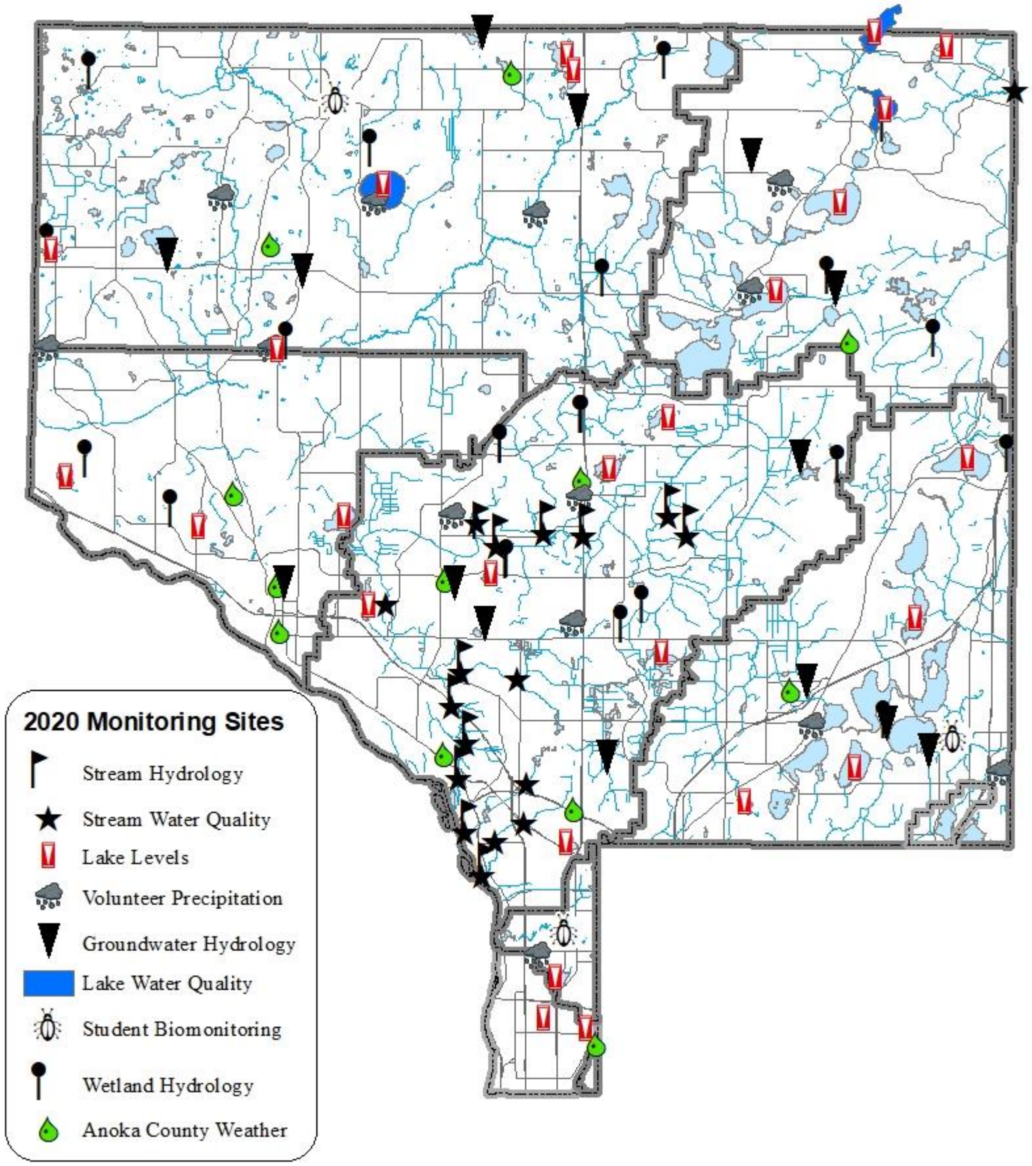


CHAPTER 1: WATER RESOURCE MONITORING PRIMER

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 reader 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.

2020 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 13 rain gauges countywide, which are monitored by volunteers, including one at the ACD office. The volunteer-operated stations are cylinder-style rain gauges located at the volunteer's home. Total rainfall is read daily. 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.

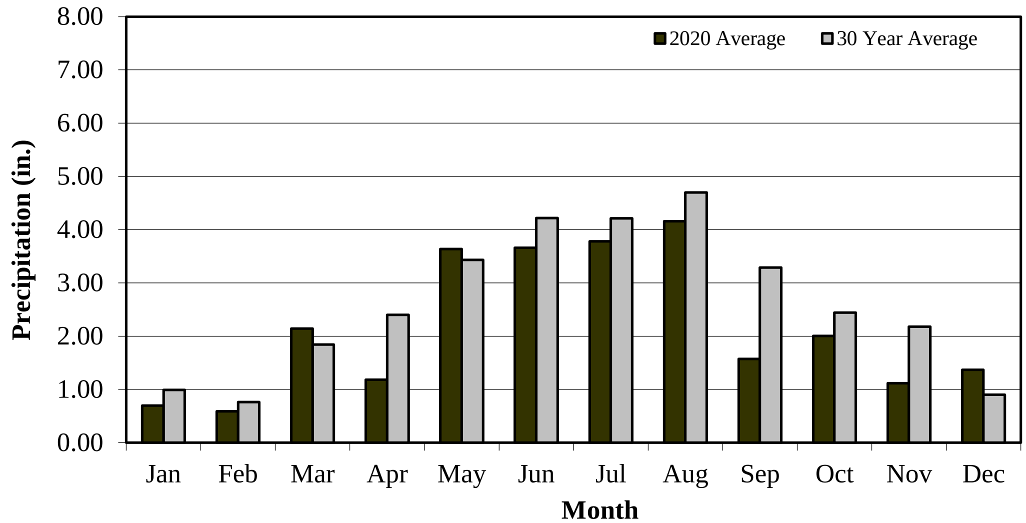
A summary of county-wide data is provided on the following page.

2020 Precipitation Monitoring Sites

Tipping bucket rain gauge.

Cylinder rain gauge.

2020 Anoka County Average Monthly Precipitation (average of all sites)



2020 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)**
BYRG, DNR, and NWS data															
30N 24W 3 DNR	Fridley	0.91	0.46	2.33	1.47	3.71	3.17	2.72	4.5	1.31	2.2	1.15		23.93	15.41
30 24 14 BYRG	Fridley	0.81	0.41	2.18	1.33	4.28	3.31	2.46	3.84	1.5	2.13	1.05		23.30	15.39
32 22 14 BYRG	Columbus	0.48	0.33	2.27	1.16	3.25	4.17	4.79	3.28	1.1	2.09			22.92	16.59
32 24 23 NWS	Andover	0.60	0.33	1.99	1.12	3.56	3.22	3.82	2.82	2.05	2.58	1.15	1.37	24.61	15.47
34N 23W 36 BYRG	East Bethel	0.73	0.44	1.71	1.28	4.12	3.44	4.46	3.87	1.76				21.81	17.65
Cylinder rain gauges (read daily)															
N. Myhre	Andover	0.75	0.75	1.90	1.04	4.26	4.03	4.05	4.09	2.45	1.33			24.65	18.88
J. Rufsvold	Burns				1.17	3.83	3.86	3.67	4.49	1.63	1.44			20.09	17.48
J. Arzdorf	Blaine				1.45	4.45	2.67	3.72	6.20	1.57	2.05			22.11	18.61
P. Arzdorf	East Bethel				1.43	3.96	3.34	4.11	4.81	1.73	2.19			21.57	17.95
A. Mercil	East Bethel	0.35	1.60		0.68	2.63	5.07	4.54	2.56	1.31	1.50			20.24	16.11
K. Ackerman	Fridley	0.79	0.49	2.76	1.50	3.97	3.48	2.42	3.64	1.59	2.50			23.14	15.10
B. Myers	Linwood				0.63	2.46	5.21	5.58	4.23	1.97	2.38			22.46	19.45
B. Barkhoff	Nowthen					4.11	2.95	3.94	4.53	1.28				16.81	16.81
D. Bauer	Lino Lakes	0.86	0.47	2.20	1.42	3.35	4.08	3.56	3.82					19.76	14.81
ACD Office	Ham Lake			1.92	1.17	3.73	4.43	4.48	3.94	1.02	2.03			22.72	17.60
Y. Lyrenmann	Ramsey				0.92	2.64	2.27	3.83	5.64	1.55	1.87			18.72	15.93
T. Isaacson						3.27	3.07	1.99	4.05					12.38	12.38
M. Hebaus	Lino Lakes					3.89	4.12	3.87	4.57	1.34	1.74			19.53	17.79
2020 Average	County-wide	0.70	0.59	2.14	1.18	3.64	3.66	3.78	4.16	1.57	2.00	1.12	1.37	25.91	16.81
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.

*Incomplete monthly data not included in averages

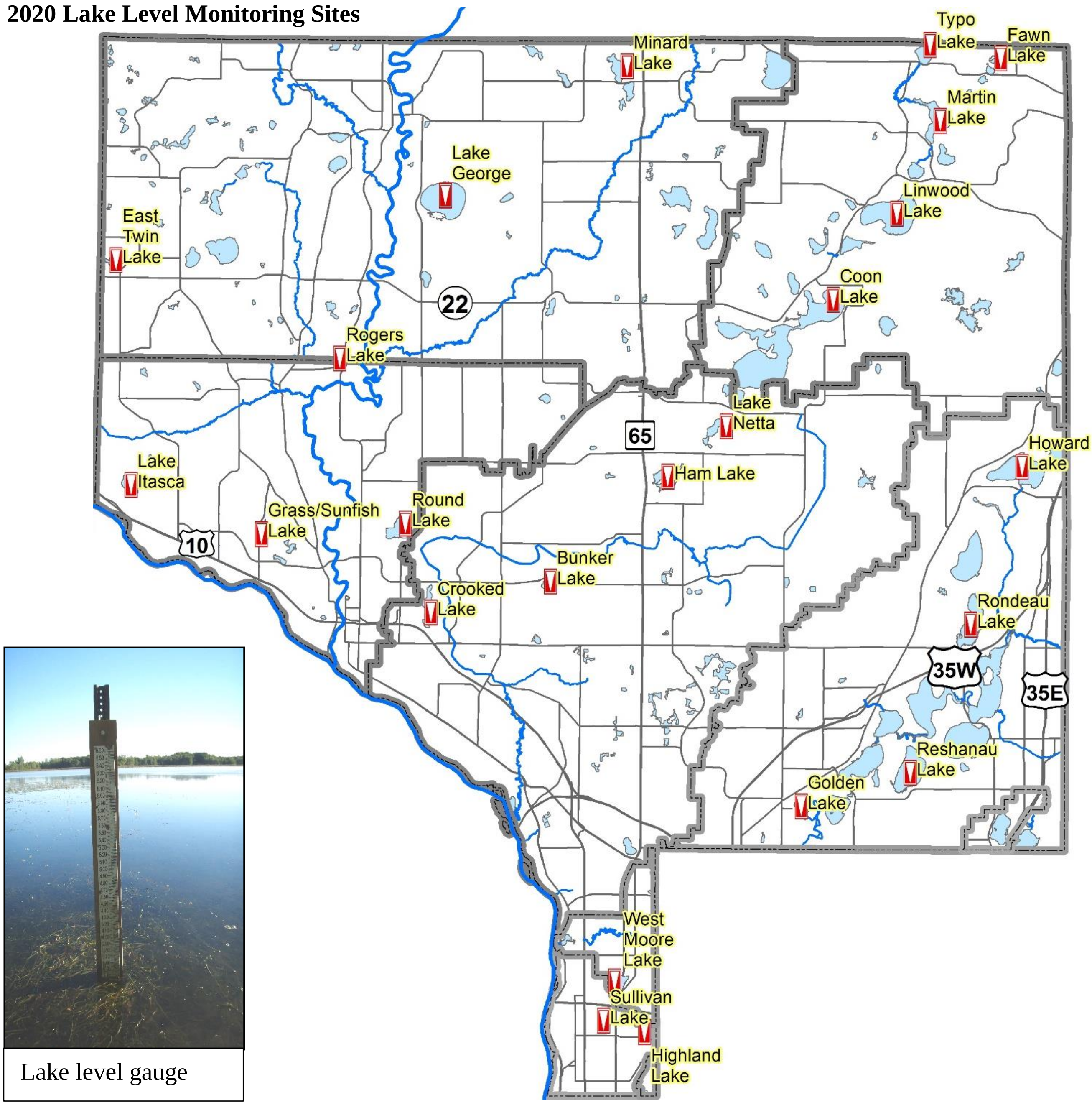
Lake Levels

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 25 lakes, with one additional lake monitored by continuous data logging equipment.

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.

2020 Lake Level Monitoring Sites



Lake level gauge

Stream Hydrology

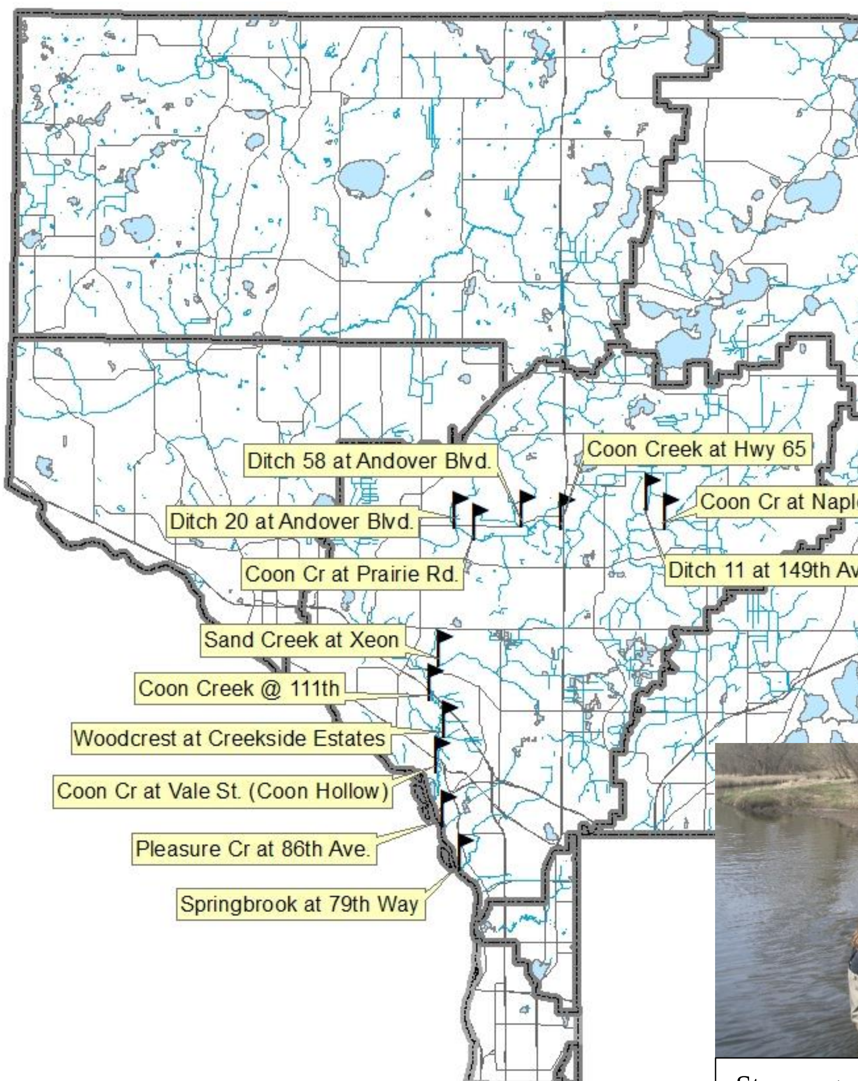
Hydrology is the study of water quantity and movement. Records of the quantity of water flowing in a stream helps engineers and natural resource managers better understand the effects of rain events, land development and storm water management. This information is also often paired with water quality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

The ACD monitored hydrology at 12 stream sites in 2020. Each site is equipped with an electronic gauge that records water levels ranging from every hour to every 15-minutes, depending on how fast the stream fluctuates. 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, including 3 new rating curves developed this year. 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.

2020 Stream Hydrology Monitoring Sites




Stream gauge setup.

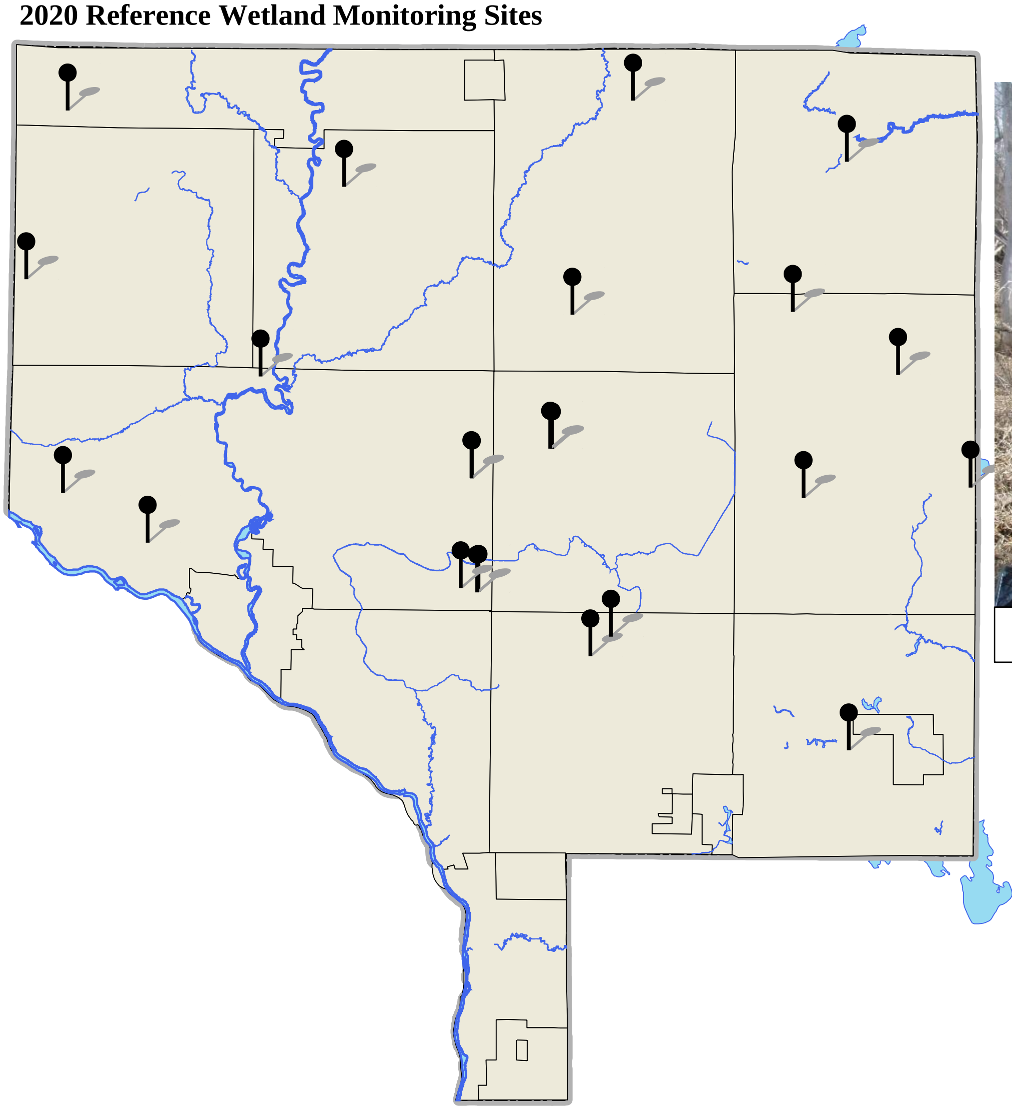
Wetland Hydrology

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, especially at the surface. In order to facilitate fair, accurate wetland determinations the ACD monitors 19 wetlands throughout the county that serve as a reference of conditions county-wide, and are thus called reference wetlands. Electronic monitoring wells are used to measure subsurface water levels at the wetland edge every four hours. 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 most have been monitored for 10+ years.

Reference wetland data provide 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 and wetland data can help speak to this.

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.

2020 Reference Wetland Monitoring Sites



Wetland gauge deploy.

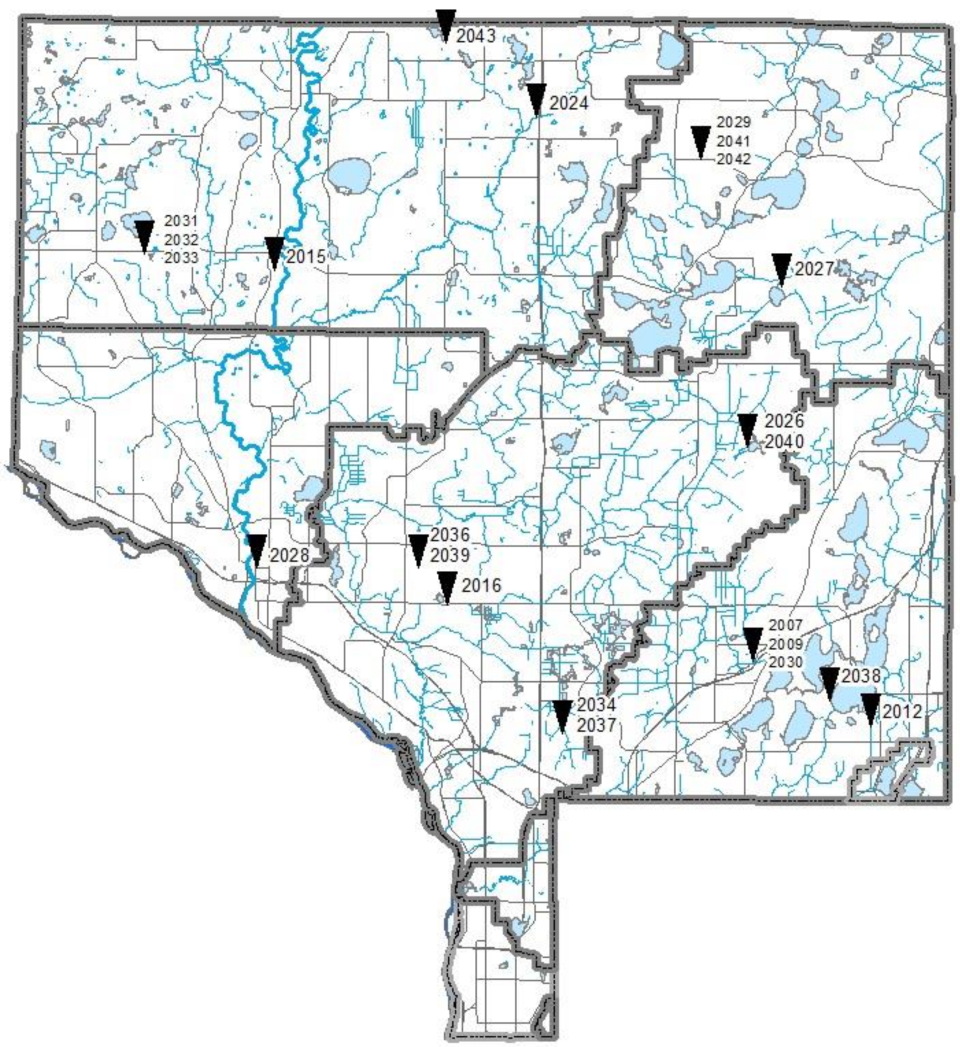
Groundwater Hydrology

The Minnesota Department of Natural Resources (MN DNR) and the 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 water level readings at 23 wells in Anoka County and to download continuous loggers quarterly. At most sites, the MN DNR now has automated devices taking continuous water level readings at more frequent intervals. The MN DNR incorporates these data into statewide and national databases that aid in groundwater mapping. The data are reported to the MN DNR and are available on their web site http://www.dnr.state.mn.us/waters/groundwater_section/obwell/index.html

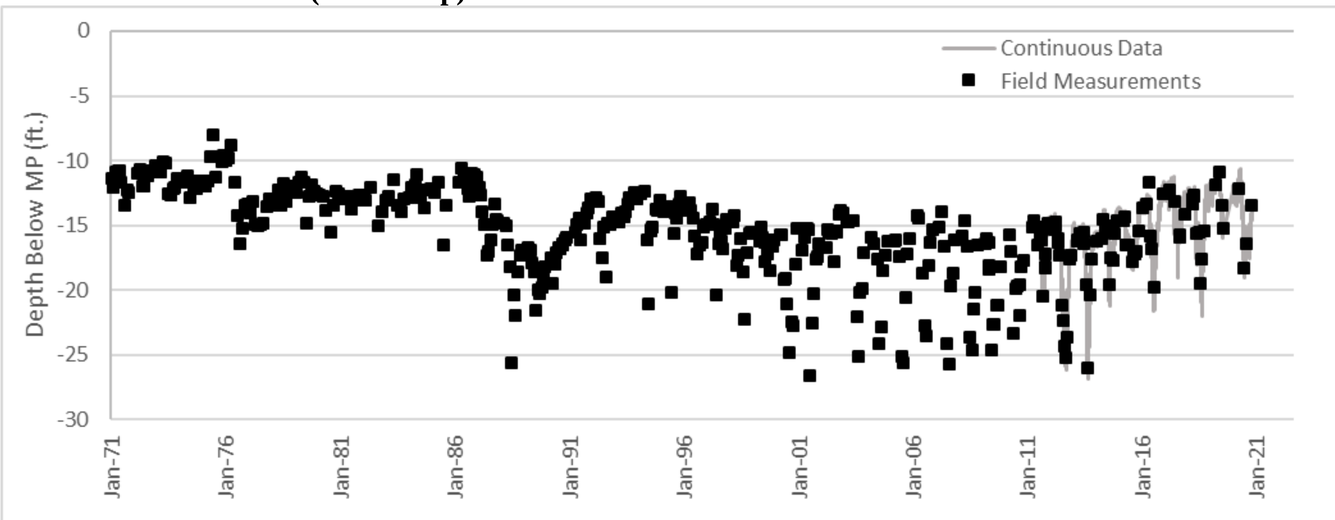
These deep groundwater wells are not as sensitive to precipitation as other hydrologic systems such as wetlands and streams, but rather respond to longer term trends.

The charts on the following pages show groundwater levels hand measured by ACD through 2020 for each well. These results are not presented elsewhere in this report. Raw data can be downloaded from the MN DNR website, as well as continuous data from wells with data loggers installed. ACD still hand measures wells with data loggers periodically to ensure accuracy.

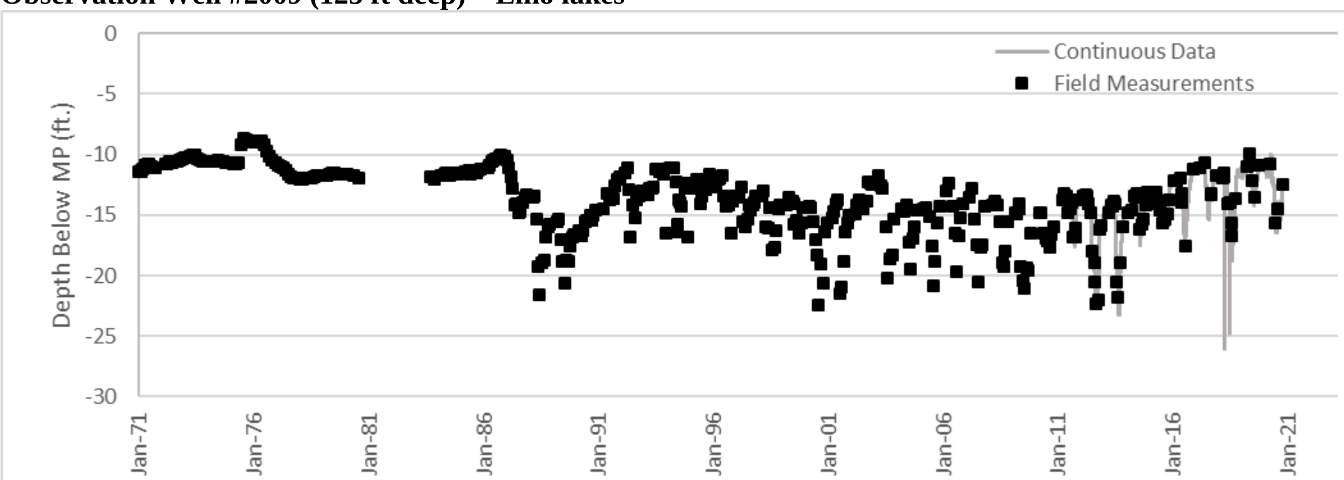
2020 Groundwater Observation Well Sites and Well ID Numbers



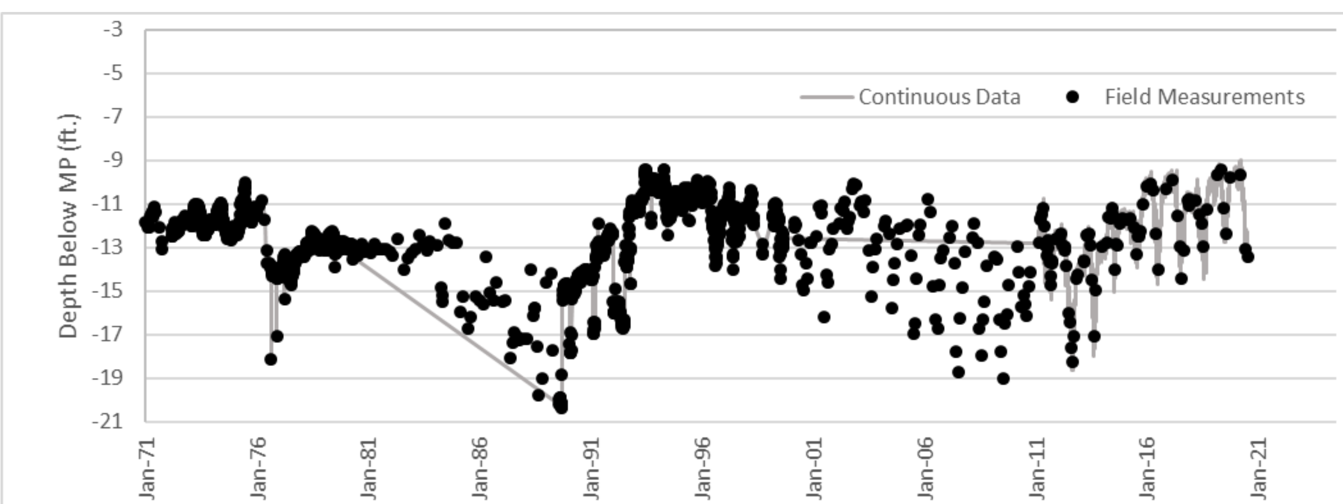
Observation Well #2007 (270 ft deep)—Lino Lakes



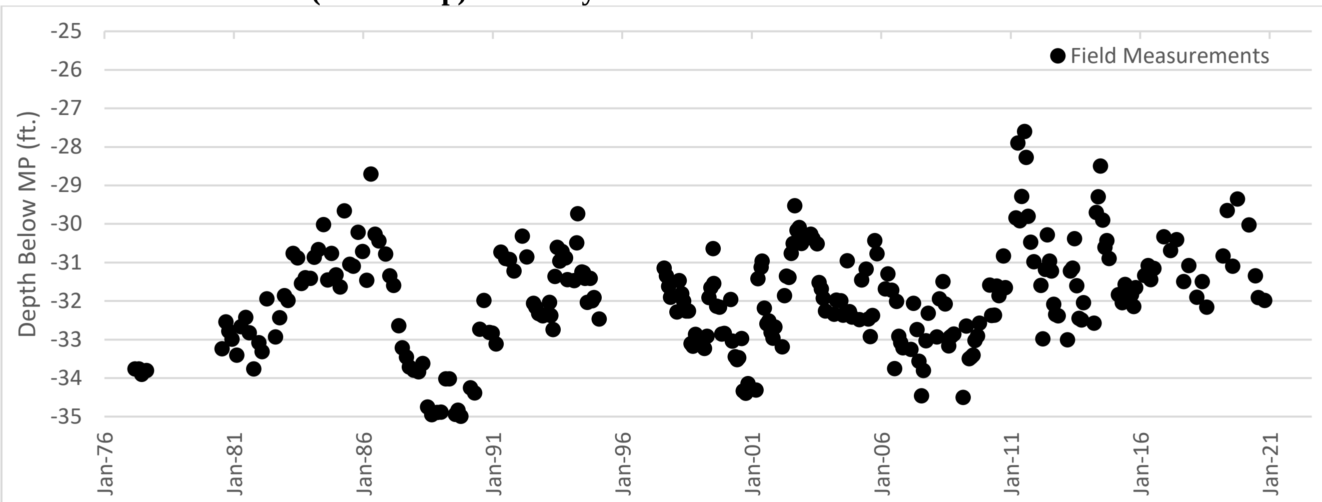
Observation Well #2009 (125 ft deep)—Lino lakes



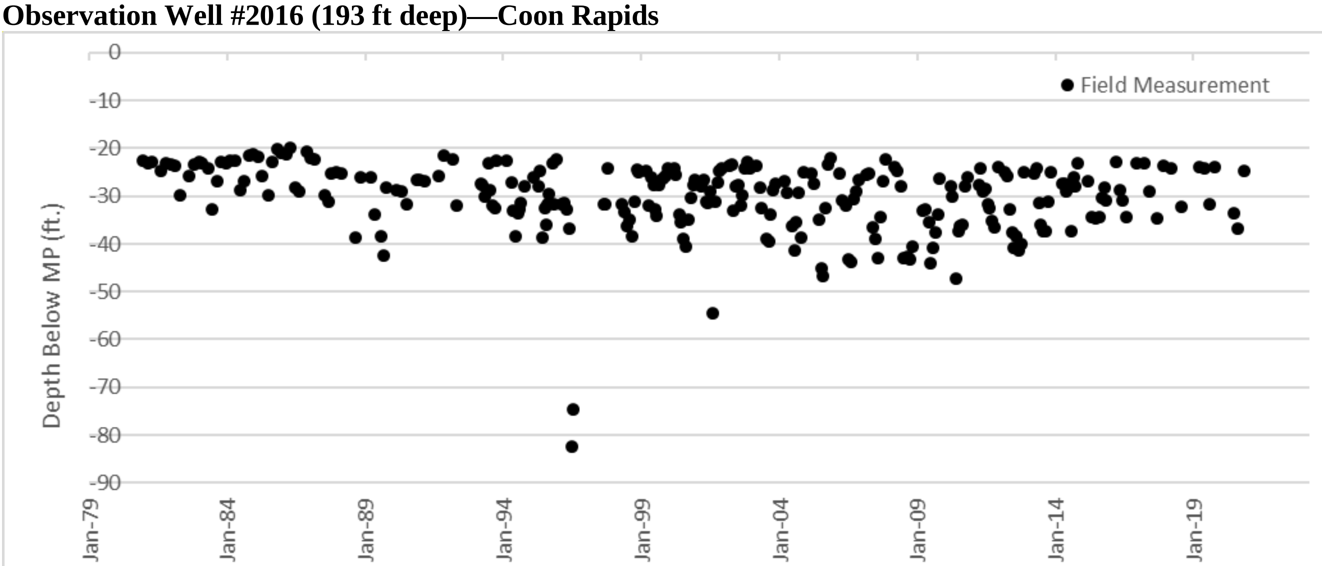
Observation Well #2012 (277 ft deep) – Centerville



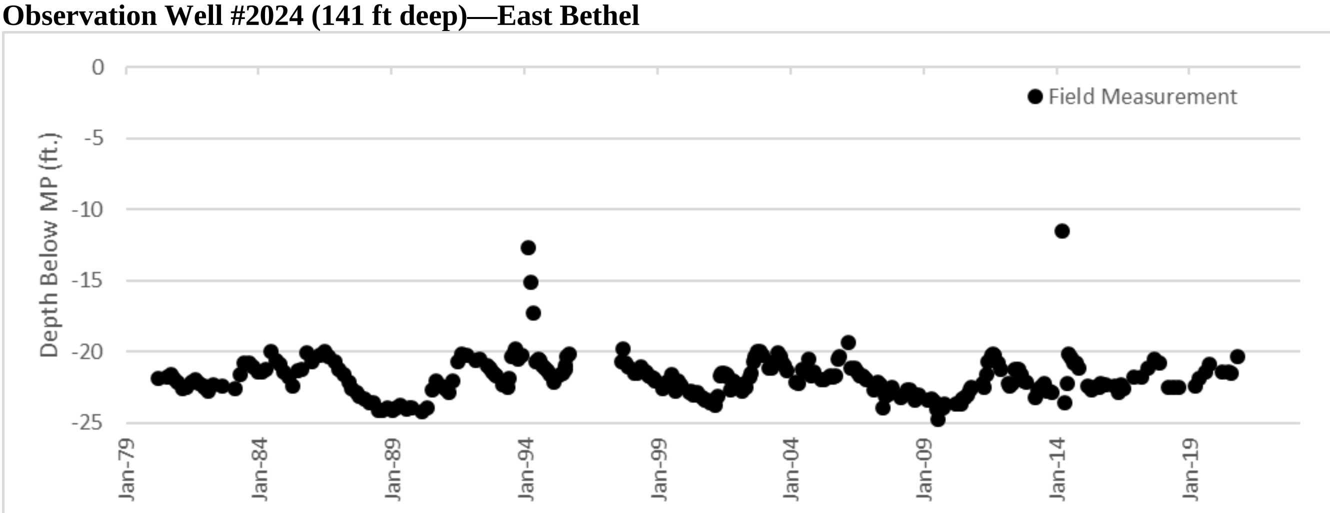
Observation Well #2015 (280 ft deep)—Ramsey



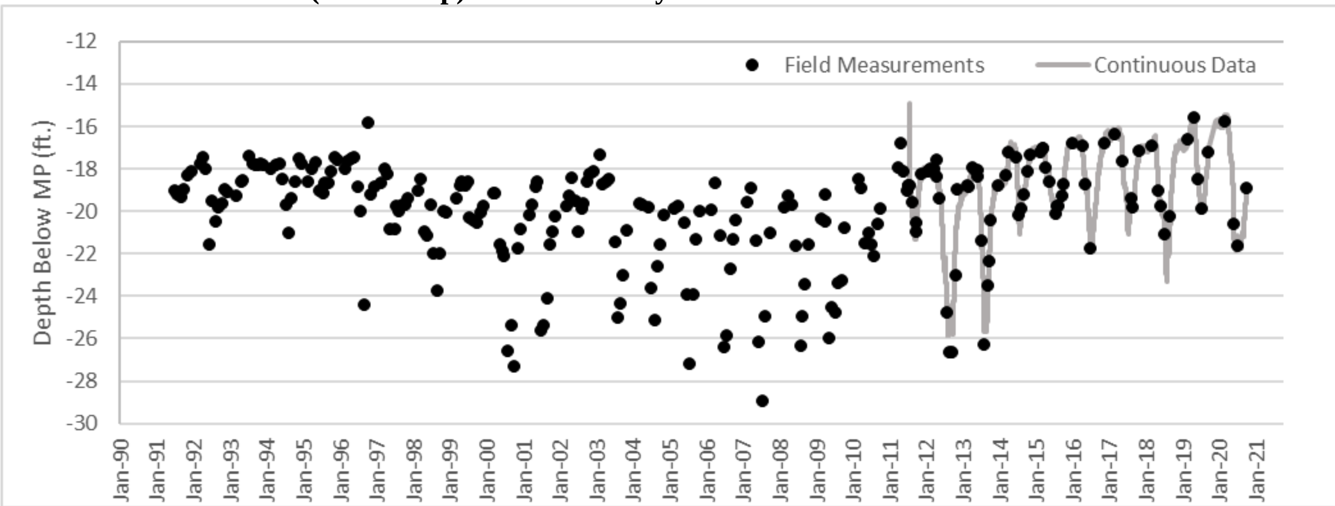
Observation Well #2016 (193 ft deep)—Coon Rapids



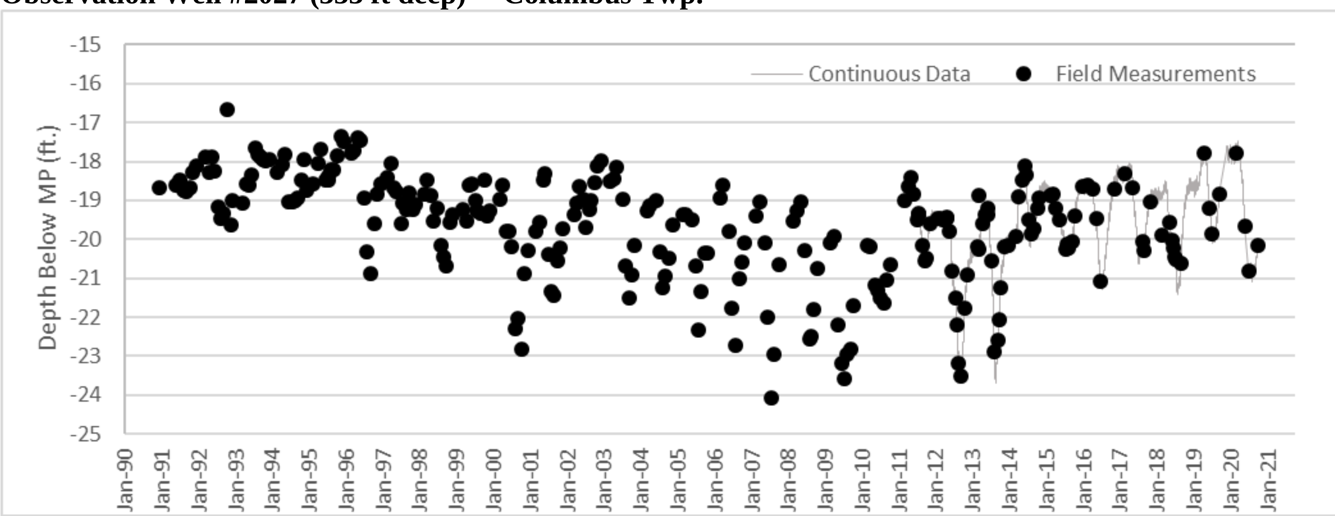
Observation Well #2024 (141 ft deep)—East Bethel



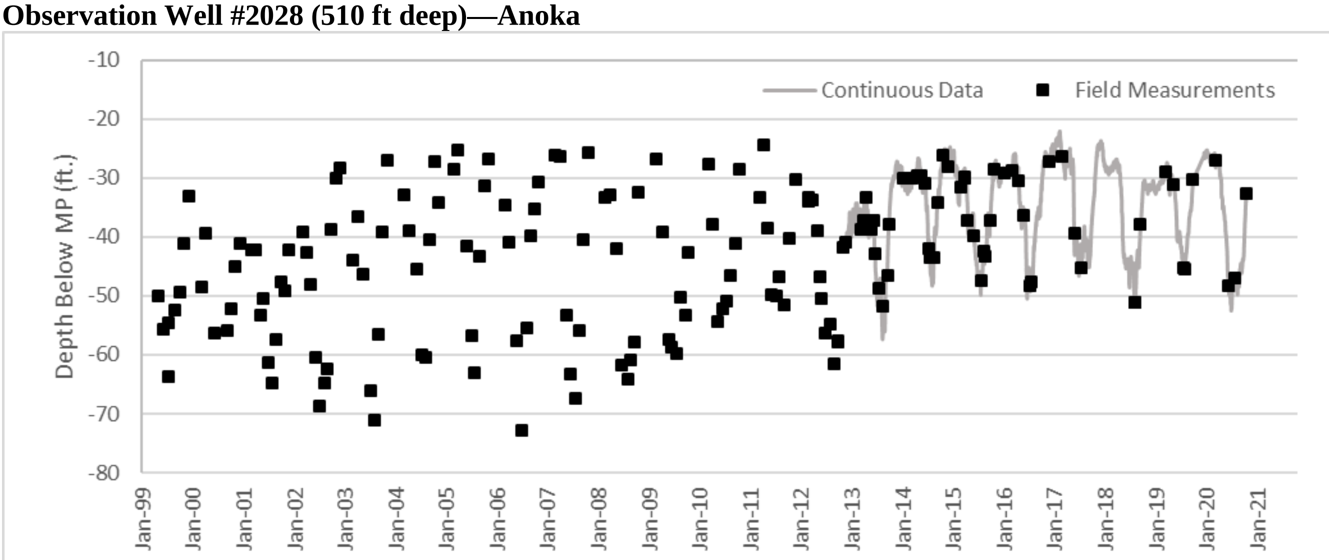
Observation Well #2026 (150 ft deep)— Carlos Avery #4



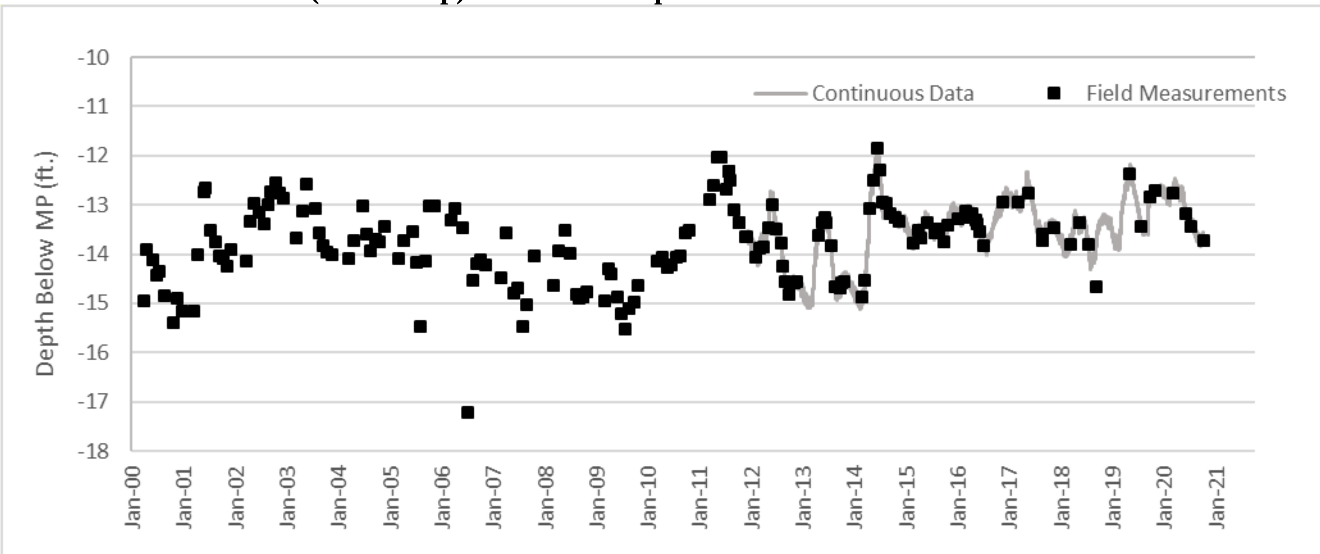
Observation Well #2027 (333 ft deep)— Columbus Twp.



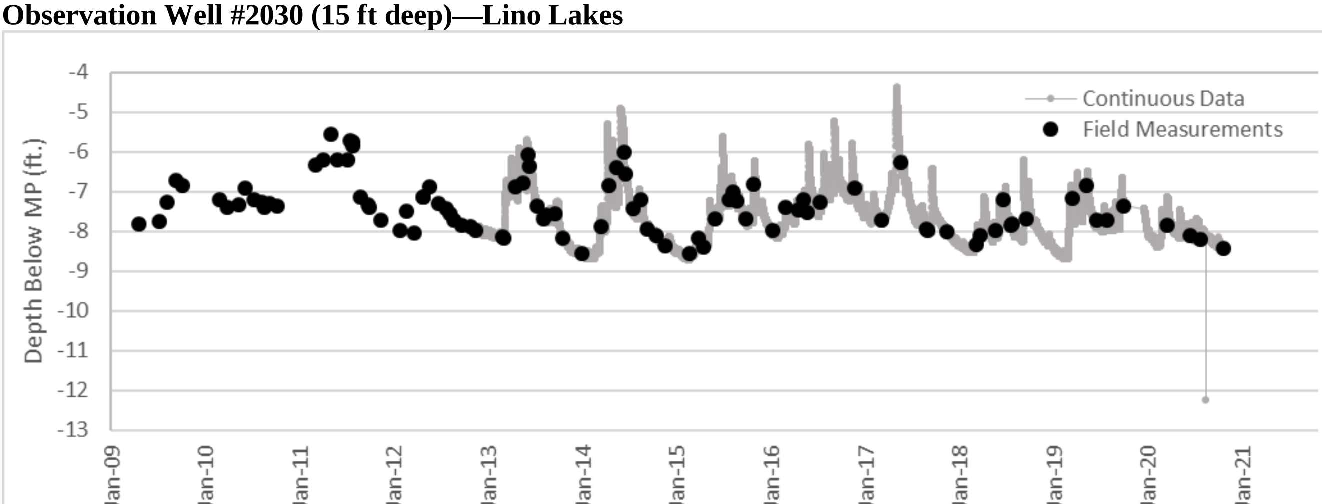
Observation Well #2028 (510 ft deep)—Anoka



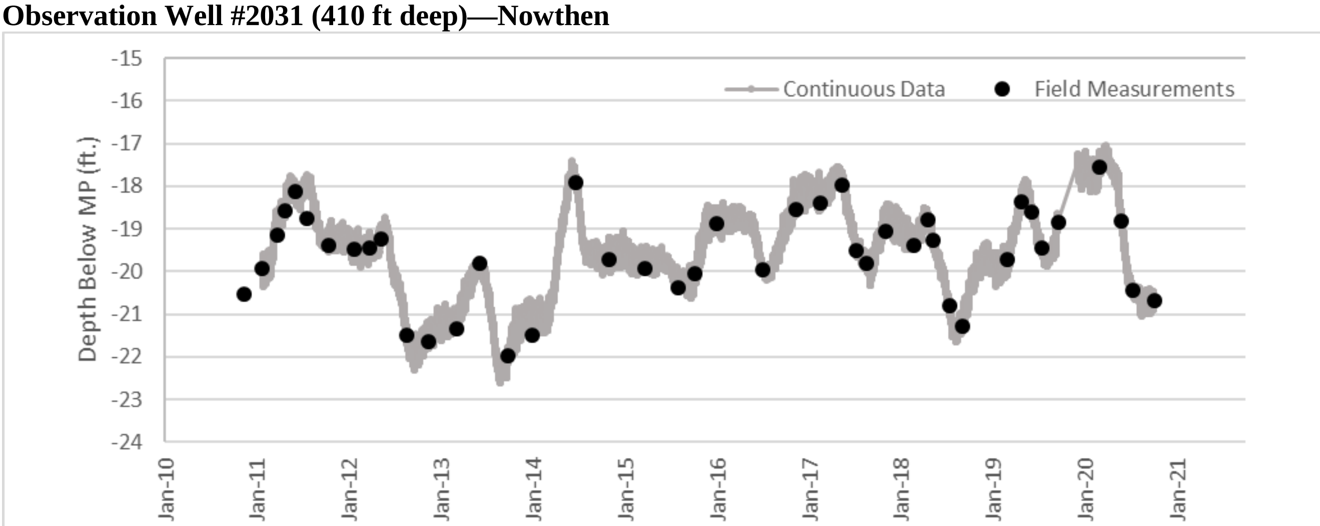
Observation Well #2029 (221 ft deep)—Linwood Twp.



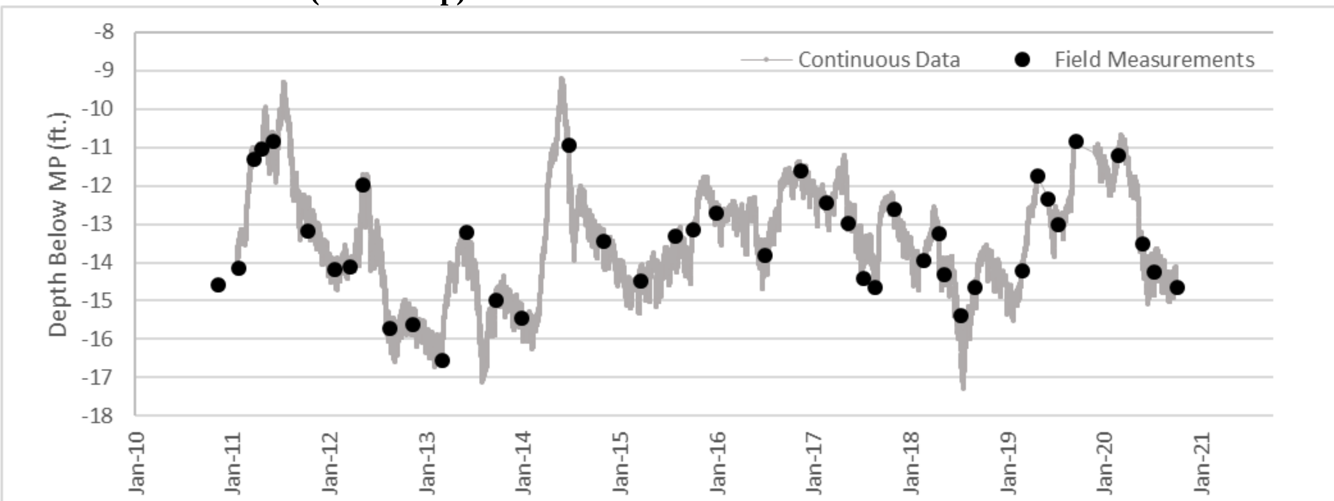
Observation Well #2030 (15 ft deep)—Lino Lakes



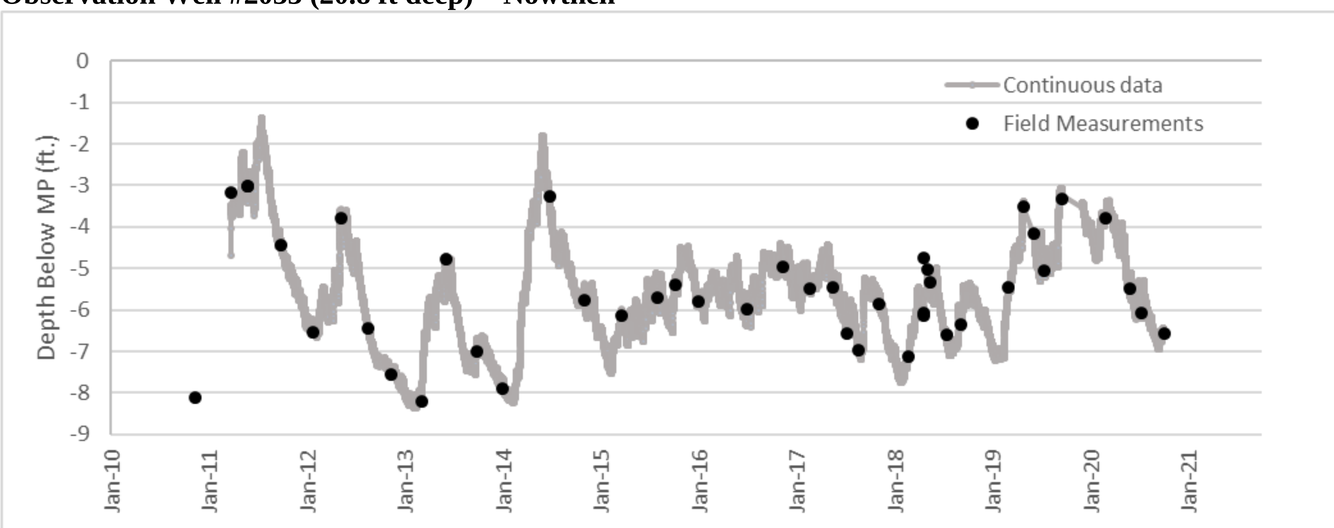
Observation Well #2031 (410 ft deep)—Nowthen



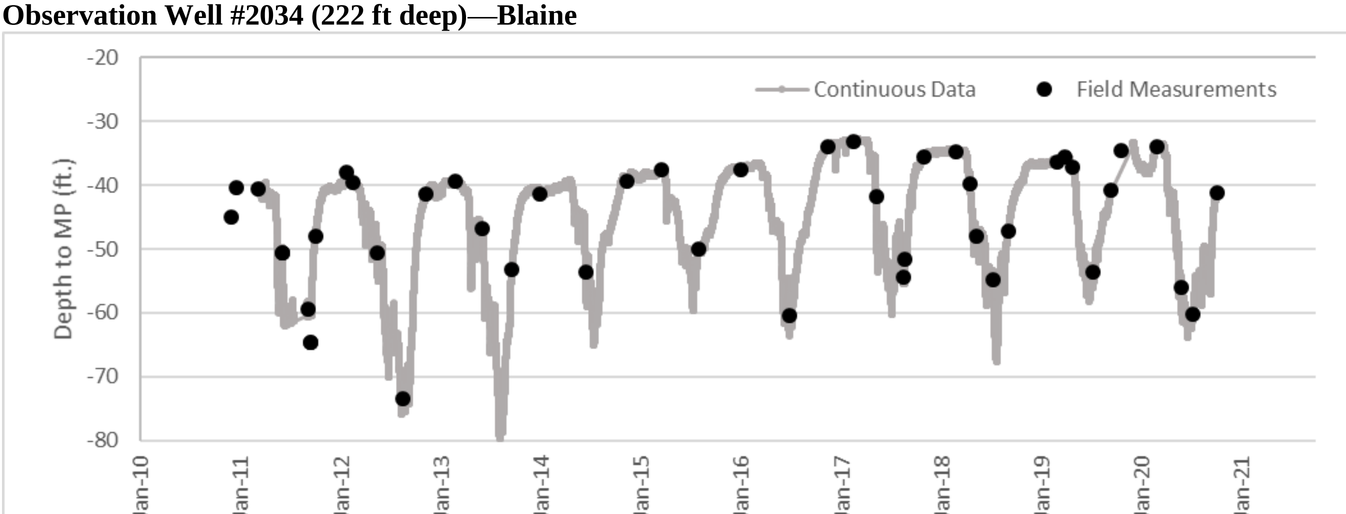
Observation Well #2032 (195 ft deep)—Nowthen



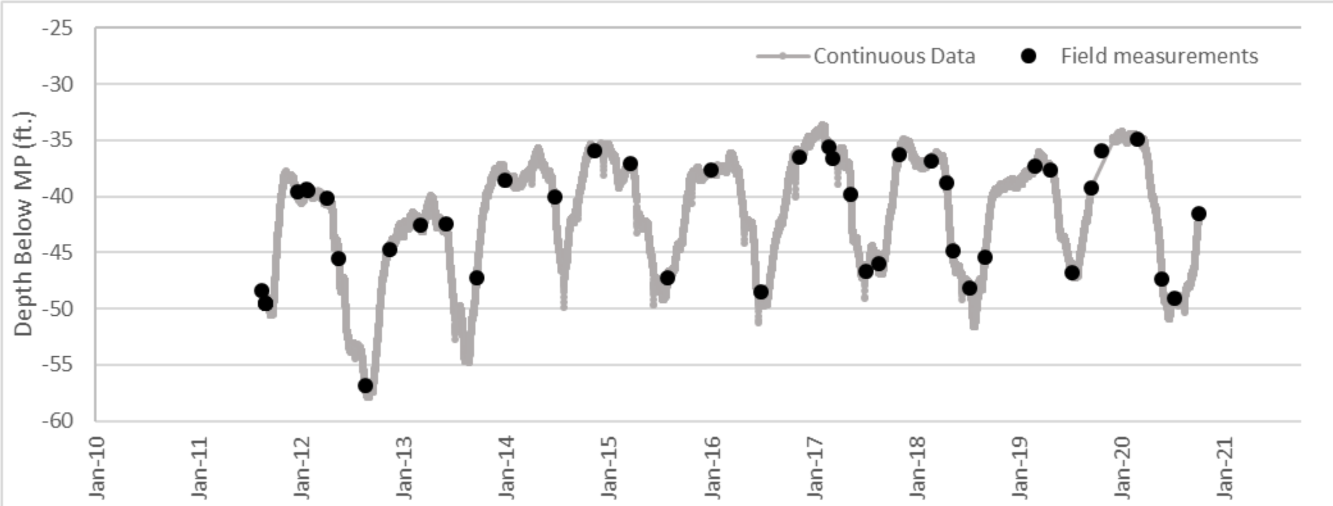
Observation Well #2033 (20.8 ft deep)—Nowthen



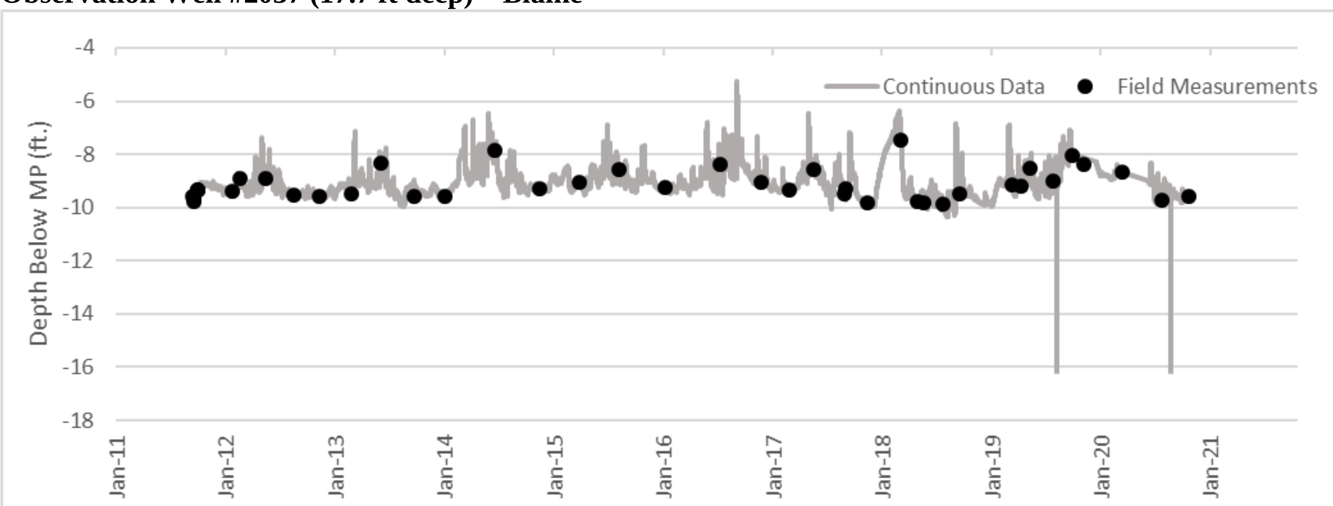
Observation Well #2034 (222 ft deep)—Blaine



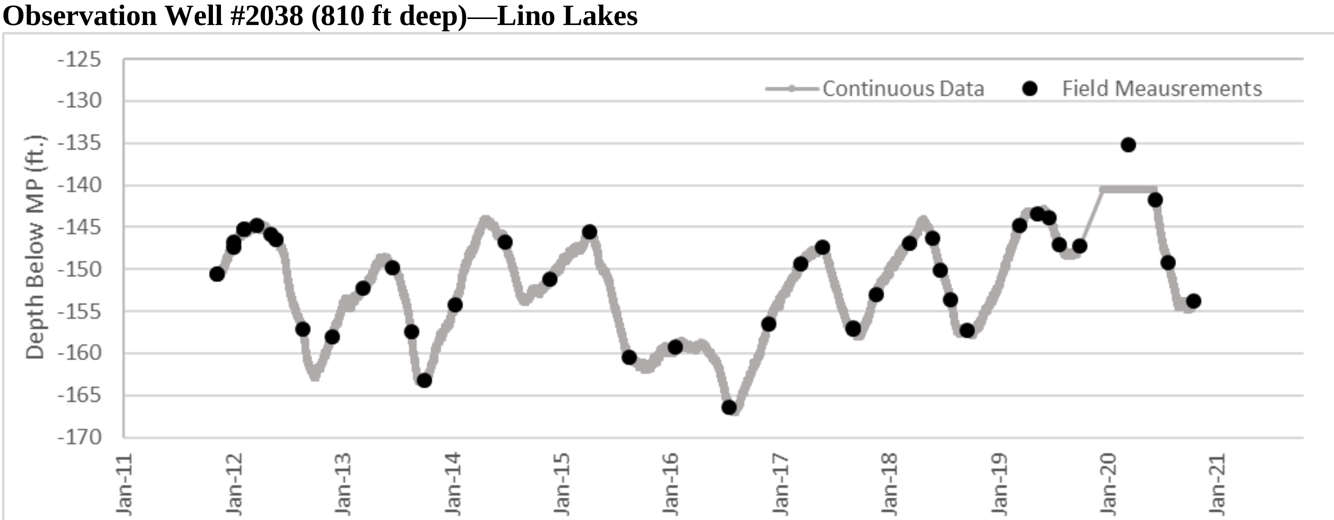
Observation Well #2036 (494 ft deep)—Andover



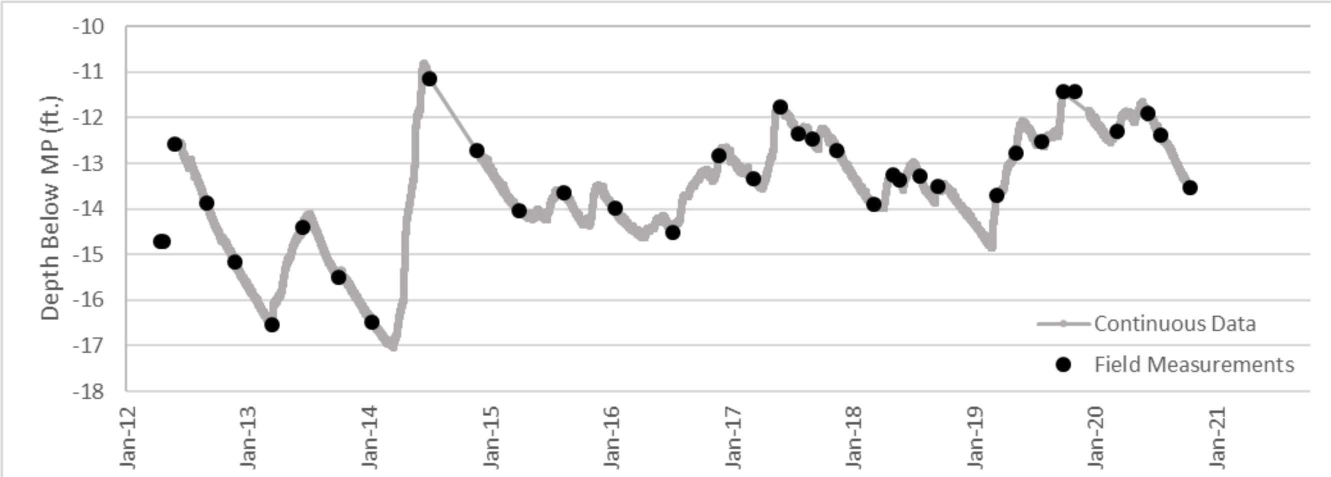
Observation Well #2037 (17.7 ft deep)—Blaine



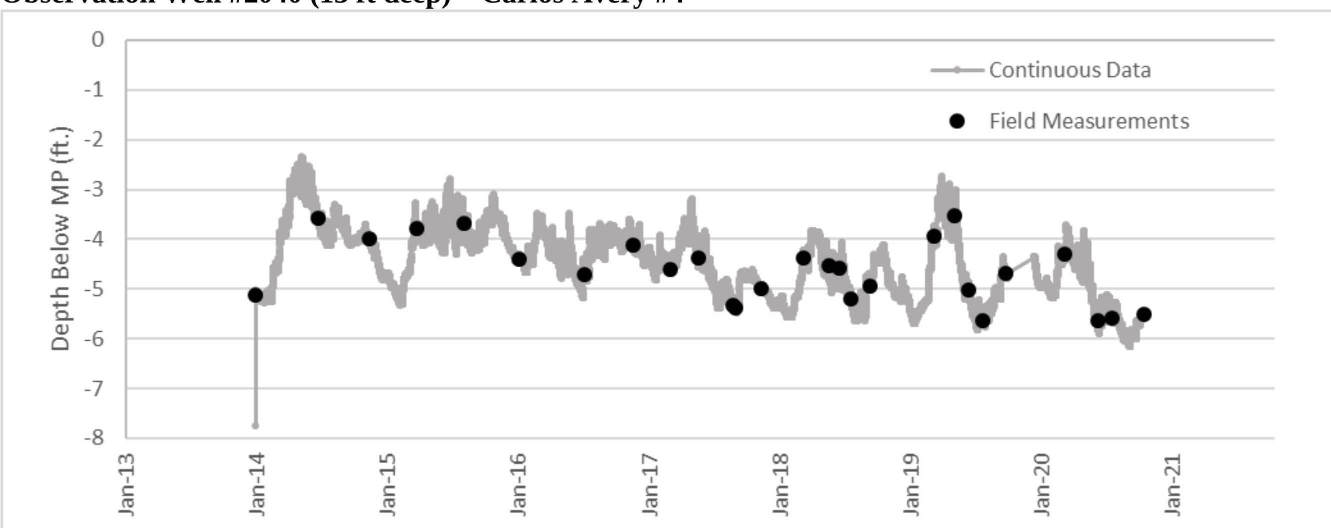
Observation Well #2038 (810 ft deep)—Lino Lakes



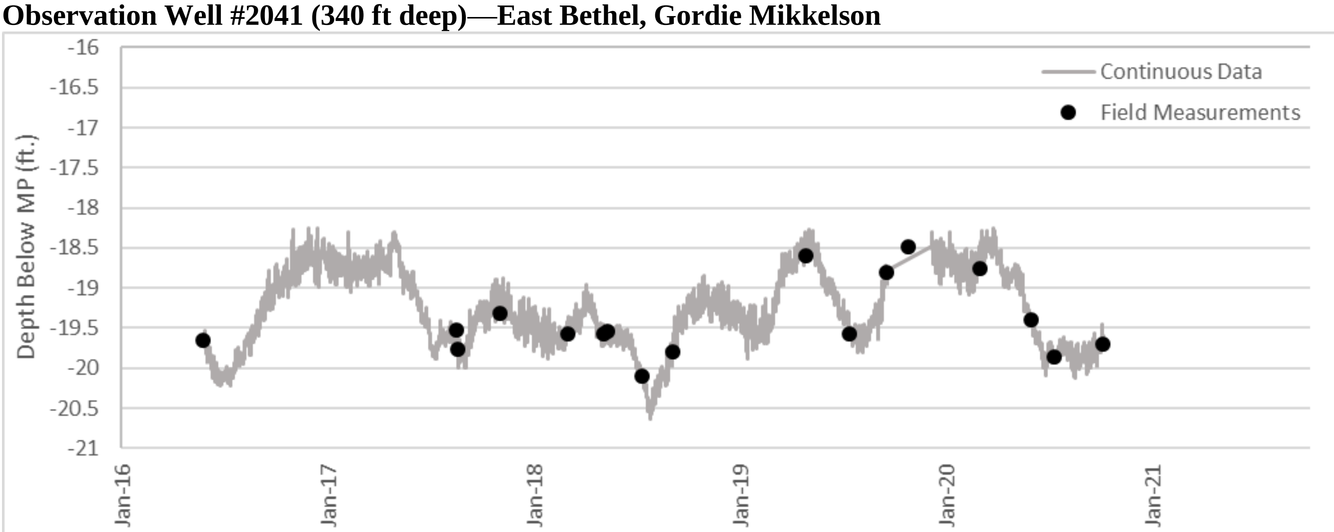
Observation Well #2039 (27.5 ft deep)—Andover



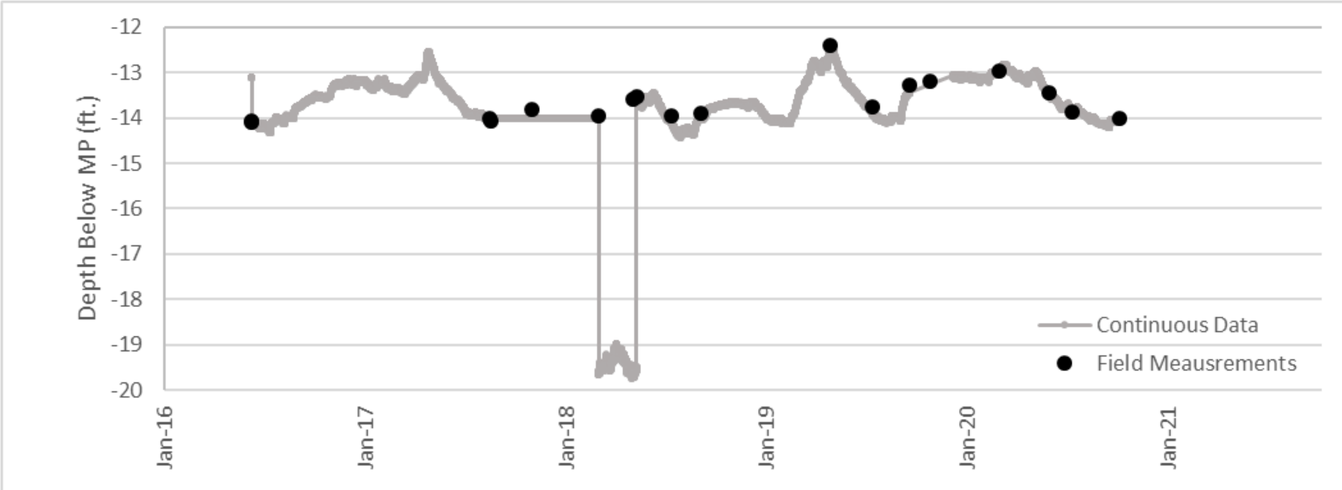
Observation Well #2040 (13 ft deep)—Carlos Avery #4



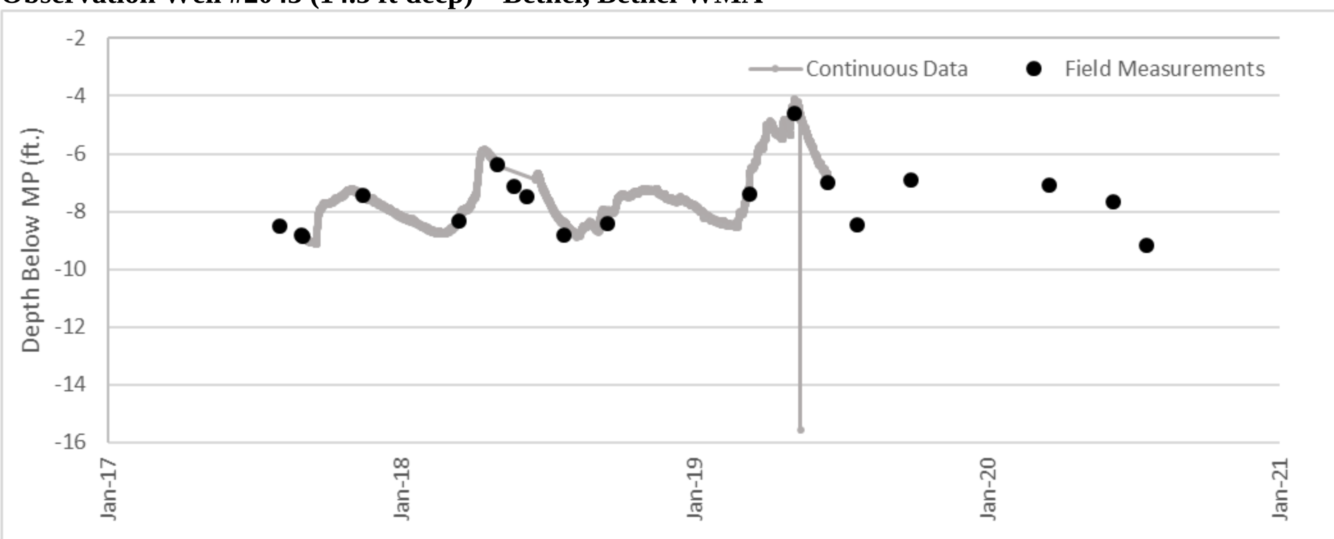
Observation Well #2041 (340 ft deep)—East Bethel, Gordie Mikkelson



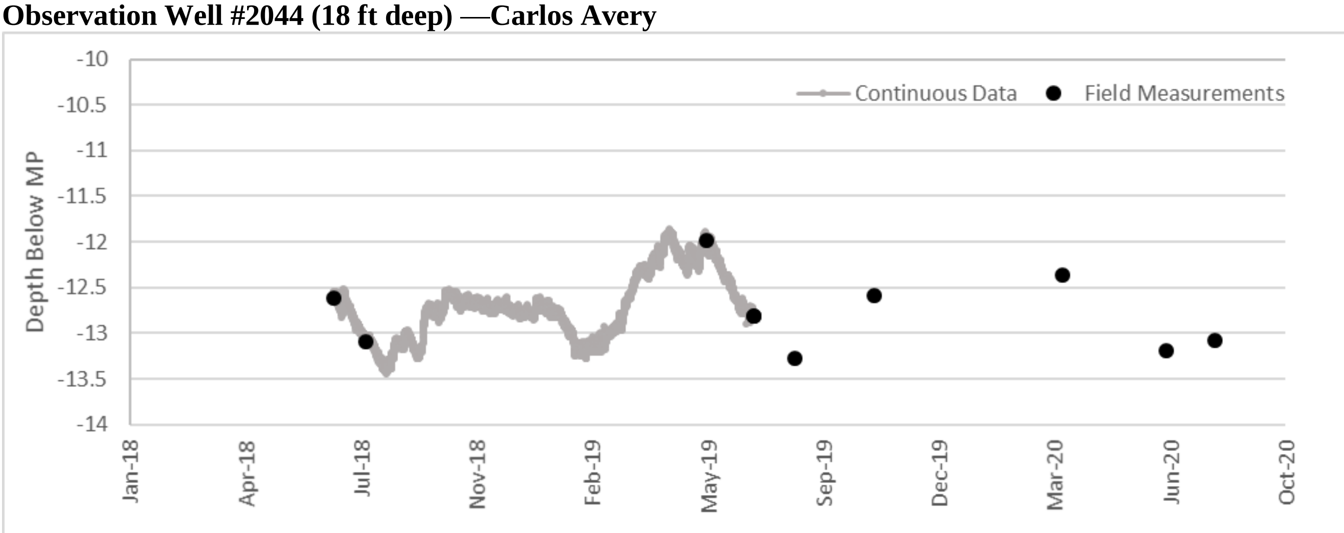
Observation Well #2042 (33.1 ft deep)—East Bethel, Gordie Mikkelson



Observation Well #2043 (14.5 ft deep)—Bethel, Bethel WMA



Observation Well #2044 (18 ft deep) —Carlos Avery

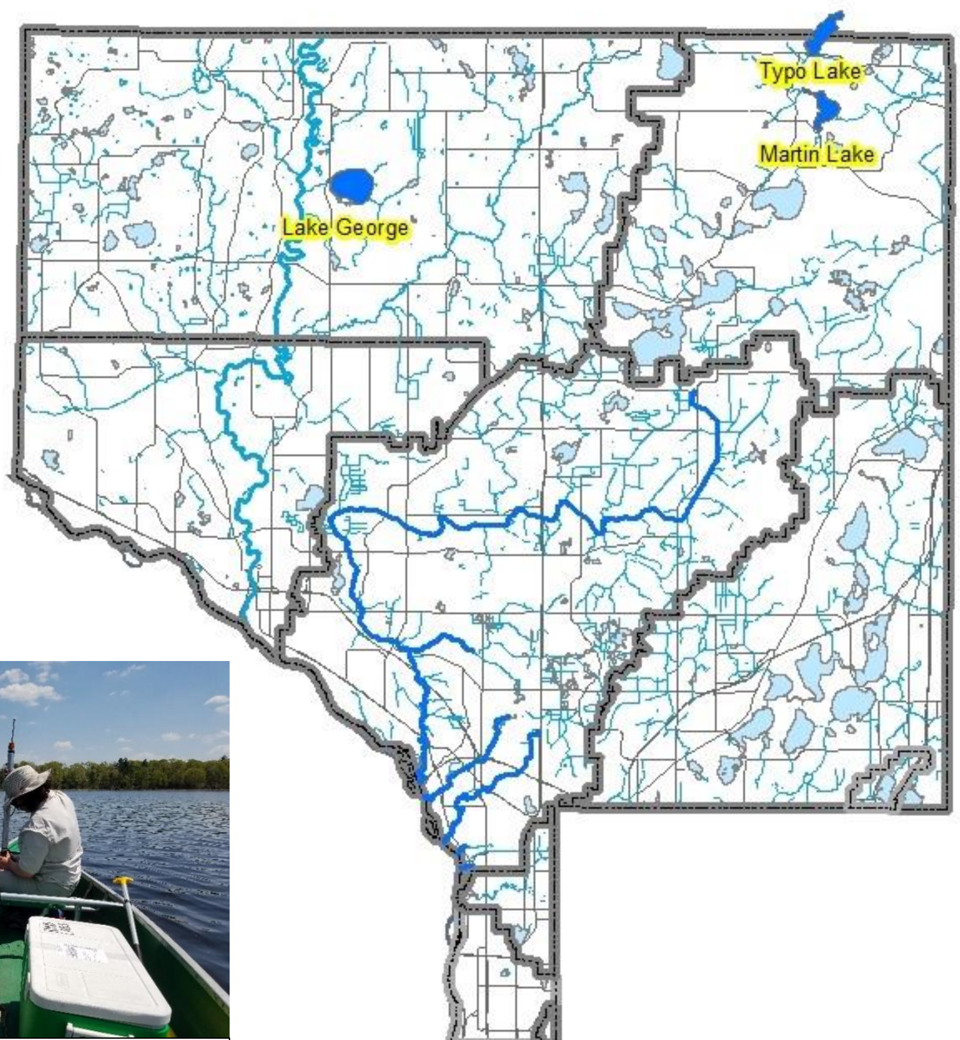


Lake Water Quality

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

In addition to this report, there are several sources of lake water quality data. For lakes monitored by the ACD, Met Council, or MPCA prior to the current year, see the letter grade table on page 23. Detailed analyses for the lakes shown in that table are in each respective year's Water Almanac Report. All data collected by the ACD and most other agencies can be retrieved through the MPCA's website Electronic Data Access tool, which draws data from their EQuIS database.

2020 Lake Water Quality Monitoring Sites



Lake water quality sample collection.

Lake Water Quality Monitoring Methods

The following parameters are tested at each lake:

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

Lakes are sampled every two weeks from May to September. Monitoring is conducted by boat at the deepest area of the lake. These sites are located using a portable depth finder or GPS. Conductivity, pH, turbidity, salinity, dissolved oxygen (DO), and temperature are measured using the Hydrolab Quanta multi-probe at a depth of one meter. Water samples are collected with a Kemmerer sampler from a depth of one meter, to be analyzed by an independent laboratory (Minnesota Valley Testing Labs) for total phosphorus and chlorophyll-a. Sample bottles are provided by the laboratory. Total phosphorus sample bottles contain the preservative sulfuric acid (H_2SO_4), while bottles for chlorophyll-a analysis do not require preservative. Brown bottles are used for chlorophyll-a to prevent light from entering the bottles. 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 Carlson's Trophic State Index and the Metropolitan Council's lake quality grading system 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 whether 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 $\geq$7). The pH of a lake will fluctuate daily and seasonally due to algal photosynthesis, runoff, and other factors.

Specific Conductivity- This is a measure of the degree to which the water can conduct electricity. It is caused by 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 (i.e. road salt), agricultural runoff, or failing septic systems.

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

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

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

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

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

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

Total Phosphorus (TP) - Phosphorus is an essential nutrient. Algal growth is commonly limited by phosphorous. High phosphorous in a lake can result in abundant algal growth. This, in turn, affects a variety of chemical and ecological factors including the lake's recreational suitability, fisheries, plants, and dissolved oxygen. A single pound of phosphorus can result in 500 pounds of algal growth. Minnesota Pollution Control Agency standards designate a lake in our ecoregion as "impaired" if average summertime phosphorus is >40 µg/L for deep lakes 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 waste, and stormwater runoff. The lake itself can also be a source of phosphorus. High levels of phosphorus contained in the bottom sediments of lakes can be released when the sediment is disturbed through recreation or animal activity, or when dissolved oxygen levels are low.

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

Lake water quality monitoring parameters

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

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

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

A- The Minnesota Pollution Control Agency has established a subjective ranking system that the ACD staff use during each lake visit (see table, below). Rankings 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 Carlson's Trophic State Index?

A- Carlson's Trophic State Index (see figure below) uses a number calculated with the lakes Secchi transparency, phosphorus, and chlorophyll-a readings 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 each for phosphorus, chlorophyll-a, and transparency, plus an overall trophic state index value which is a composite of the others. The indices are abbreviated as follows:

TSI- Overall Trophic State Index.

TSIP- Trophic State Index for Phosphorus.

TSIS- Trophic State Index for Secchi transparency.

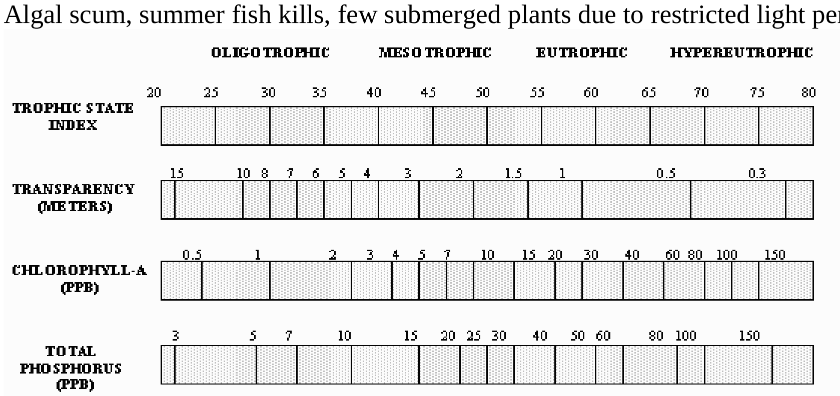
TSIC- Trophic State Index for the inorganic part of algae, Chlorophyll-a.

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

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- 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.

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 is set at < 40 μg/L in deep lakes and <60 μg/L in shallow lakes. For chlorophyll-a, the average concentrations range from 5 to 22 μg/L, with maximums ranging from 7 to 37 μg/L. Once these set limits have been reached or exceeded, excessive algae growth will be observed.

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

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

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

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

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

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

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

A- Because of inherent natural variation, lake water quality is not the same each year. Sorting out this natural variation from true trends is best accomplished with statistical tests that analyze the data objectively. When there is at least 5 years of monitoring data 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.

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

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	2012	2013	2014	2015	2016	2017	2018	2019	2020
Boot																																							C+	A	
Cenaiko																		B	A	A	A	B	A	A	A	A	A	A	B	B	B	B	B						A-		
Centerville		C		C					D												C	C		C	C	A															
Coon	C				C					C					C			C	B	A	B	C			C		C		C												
Coon (East Bay)					C					C	C	C		C	C	C		B	B	A	B	C	B		C	C	C	B	A	B	B	B	B	B+	A		B		A		
Coon (West Bay)																															A		A		B		A-		A-		
Crooked				C		C				C					B	C	B	B	B		B		B	B		B	B-		B	B		B	A-		A	A		B	A-		
East Twin	A	B		C						B						B		A	B	A	A		A			A			A			A		A				A			
Fawn									B									A	B	A	A	A			A		A		A		A		A			A			A		
Fish																																							A		
George	A	A	A		A					A								A	B	A	A		A			B			B			B		B	B	A	A	B	A-	A	A
George Watch		F	D	D		D		D	D	F	D	F					F	D	F	D	D	F	D	D	F	D	F	F	D	D	D	D	F					D			
Golden						D	C	D	F	F	F	F		D			C	D	C	C	C	D	D	D	D	C	C	C	C	C	C										
Ham					C									A	B		A	A	B		C	C			B	B		B	A		B	B		A	A		B	B		C	
Highland																				D	D	D	F	F	F	F	F	F									F			C	
Howard										F	F	F							F	D	D																				
Island				C																				B	B	C	C	B	B	C	C	C	C								
Itasca																			A	B	B																				
Laddie	D													A	B	B			B	B	B	B	B	B	B	B			B			B					A	B		B	
Linwood	B	C		C						C					C			C	C	C	C	C		C		C		C	C	C			C			C			C		
Lochness																												A	B		B	C	C					C			
Martin				D														D	D	C	D	D		D		D		D	D	D			D		C	C	C	C	C	D	C
Minard																																		A	A						
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-		A-	A		A	A		A	A	
Peltier				D										D	F	D	D	D	D	D	D	F	F	D	D	D	F	D													
Pickerel																B		A	A	B	C										A	C		B	A						
Reshanau																											D	D	D	D	D	D	D								
Rogers																			C		C			B			D		B	B											
Round																			B	A	B			A		B		C		C	C		A		A		A			A	
Sullivan (Sandy)														D	D	D		D	D	D	D	D	F	D	D	D								D			D			D	
Sunfish/Grass																																	B	B			B	A	B-		
Sunrise																																							B-	C	
Typo														F	F	F		F	F	F	F	F		F		F		F		F			F		D	F	F	F	F	D	F

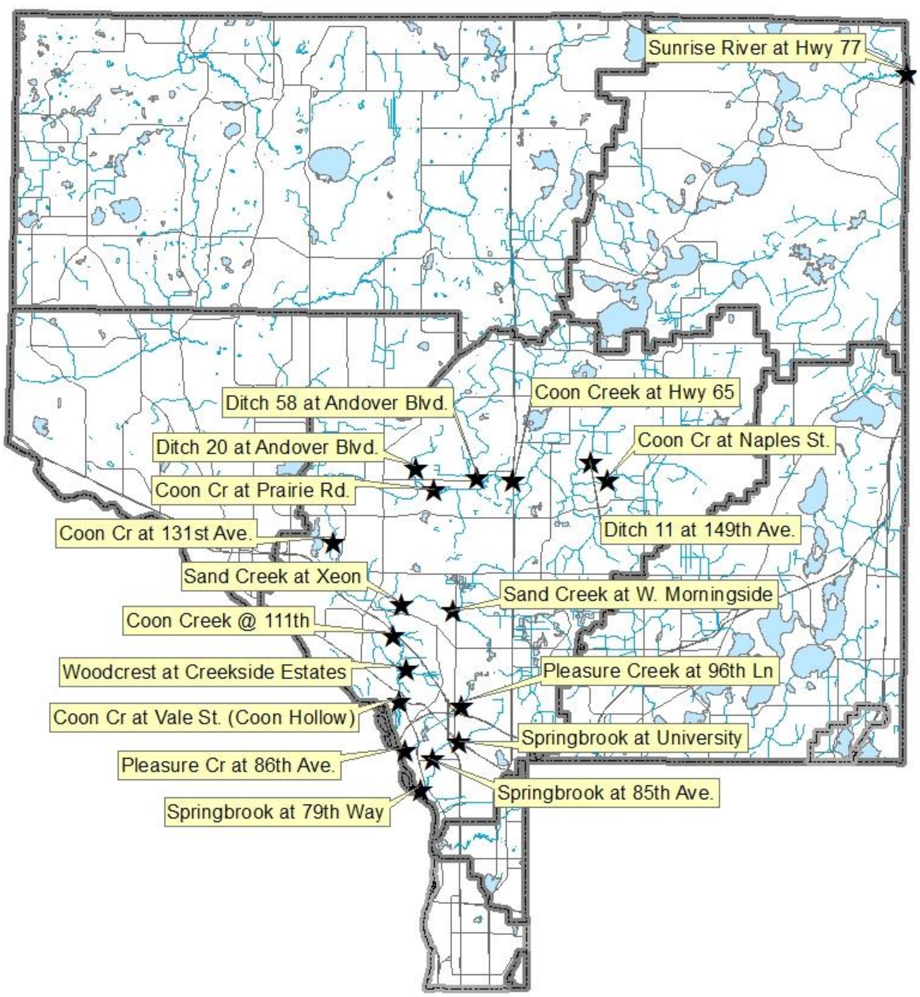
Stream Water Quality – Chemical Monitoring

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 2020 was conducted at nine Coon Creek system sites, two Sand Creek system sites, three Springbrook Creek sites, two Pleasure Creek sites, and one site each in the Sunrise River, and Woodcrest Creek. Additionally, the ACD continued a cooperative effort with the Metropolitan Council for monitoring of the Rum River at the Anoka Dam as part of the Metropolitan Council's Watershed Outlet Monitoring Program (WOMP). Those data are housed with the Metropolitan Council, and methodologies are available upon request from either organization.

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

2020 Chemical Stream Water Quality Monitoring Sites



Stream water quality sample collection.

STREAM WATER QUALITY MONITORING METHODS

Stream water is monitored four times during base flow conditions and four times 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. Stream sampling is performed using a Hydrolab Quanta multi-probe in the stream and concurrently collecting grab samples for laboratory analysis.

Each stream sample was tested for the following parameters:

- pH;
- Dissolved Oxygen (DO);
- Turbidity;
- Specific Conductivity;
- Temperature;
- Salinity;
- Total Phosphorus (TP);
- Total Suspended Solids (TSS);
- Secchi Tube Transparency
- others for some special investigations.

Conductivity, pH, turbidity, salinity, dissolved oxygen (DO), and temperature are measured in the field using a Hydrolab Quanta multi-probe. E. coli samples are analyzed by the independent laboratory Instrumental Research Inc. (IRI). Total phosphorus, chlorides, total suspended solids, sulfate, hardness, and any other parameters are analyzed by the independent laboratory RMB Environmental Laboratory. Sample bottles are provided by the laboratory, along with necessary preservatives. Water samples are kept on ice and delivered to the laboratory within 24 hours of collection, with the exception of E. coli samples, which are delivered to the laboratory no later than 7 hours after being collected. Stream water level is noted when the sample is 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 degree to which the water can conduct electricity. It is caused by 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 diffraction of light from solid material suspended in the water column, due to "muddiness" or algae.

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

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

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

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

Secchi Tube Transparency- Transparency is directly related to the amount of algae and suspended solids in the water column. A Secchi tube is a 1 m long tube marked at 1 cm intervals with a white and black disk on a string within it. The tube is filled with water and the disk is drawn upward until it is just visible than lowered until it just disappears. The midpoint between these points is the Secchi transparency

Total Phosphorus (TP) - Phosphorus is an essential nutrient. Algal growth is commonly limited by phosphorous. High phosphorous in a lake can result in abundant algal growth. This, in turn, affects a variety of chemical and ecological factors including the lake's recreational suitability, fisheries, plants, and dissolved oxygen. A single pound of phosphorus can result in 500 pounds of algal growth. Minnesota Pollution Control Agency standards designate a stream as impaired if it has >100 µg/L average summertime phosphorous.

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

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.

Analytical Limits for Stream Water Quality Parameters

Parameter	Unit of Measurement	Method Detection Limit	Reporting Limit	Analysis or Instrument Used
pH	pH units	0.01	0.01	Hydrolab Quanta
Conductivity	**mS/cm**	0.001	0.001	Hydrolab Quanta
Turbidity	NTU	0.1	0.1	Hydrolab Quanta
Dissolved Oxygen	mg/L	0.01	0.01	Hydrolab Quanta
Temperature	°C	0.1	0.1	Hydrolab Quanta
Salinity	%	0.01	0.01	Hydrolab Quanta
Total Phosphorus	µg/L	0.3	1.0	EPA 365.4
Total Suspended Solids	mg/L	5.0	5.0	EPA 160.2
Chloride	mg/L	0.005	0.01	EPA 325.1
Sulfate	mg/L	1.0	4.0	ASTM D516-02
Hardness	mg/L		na	2340.B
E. *coli*	MPN/100 mL	1.0	1.0	SM9223 B-97

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

A- We make up to three comparisons. First, with published water quality values for the ecoregion. Ecoregions are areas with similar soils, landform, potential natural vegetation, and land use. All of Anoka County is within the North Central Hardwood Forest (NCHF) Ecoregion. Mean values for our ecoregion, and for minimally impacted streams in our ecoregion, are in the table below. Secondly, we compare each stream to 48 other streams the Anoka Conservation District has monitored throughout the county. The county includes urban, suburban, and rural areas so this comparison incorporates water quality expectations in all these land uses.
Third, we compare levels of a pollutant observed to state water quality standards. These standards exist for some, but not all, pollutants.

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

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

RMB Environmental Laboratories (RMB) conducted the laboratory analysis. RMB has a comprehensive QA/QC program, which is available by contacting them directly. The ACD followed field protocols supplied by RMB including keeping samples on ice, avoiding sample contamination and delivering samples to the lab within 24 hours of sampling. Sample bottles are provided by RMB lab and include the necessary preservatives.

The hand held Hydrolab Quanta multi-probe used to conduct in-stream monitoring is 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	7.59
Conductivity	mS/cm	0.389	0.298	0.363
Turbidity	NTU		7.1	11.24
Dissolved Oxygen	mg/L	-	-	7.54
Temperature	°F		71.6	
Salinity	%		0	0.01
Total Phosphorus	µg/L	220	130	126
Total Suspended Solids	mg/L		13.7	13.66
Chloride	mg/L		8	13.3
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.

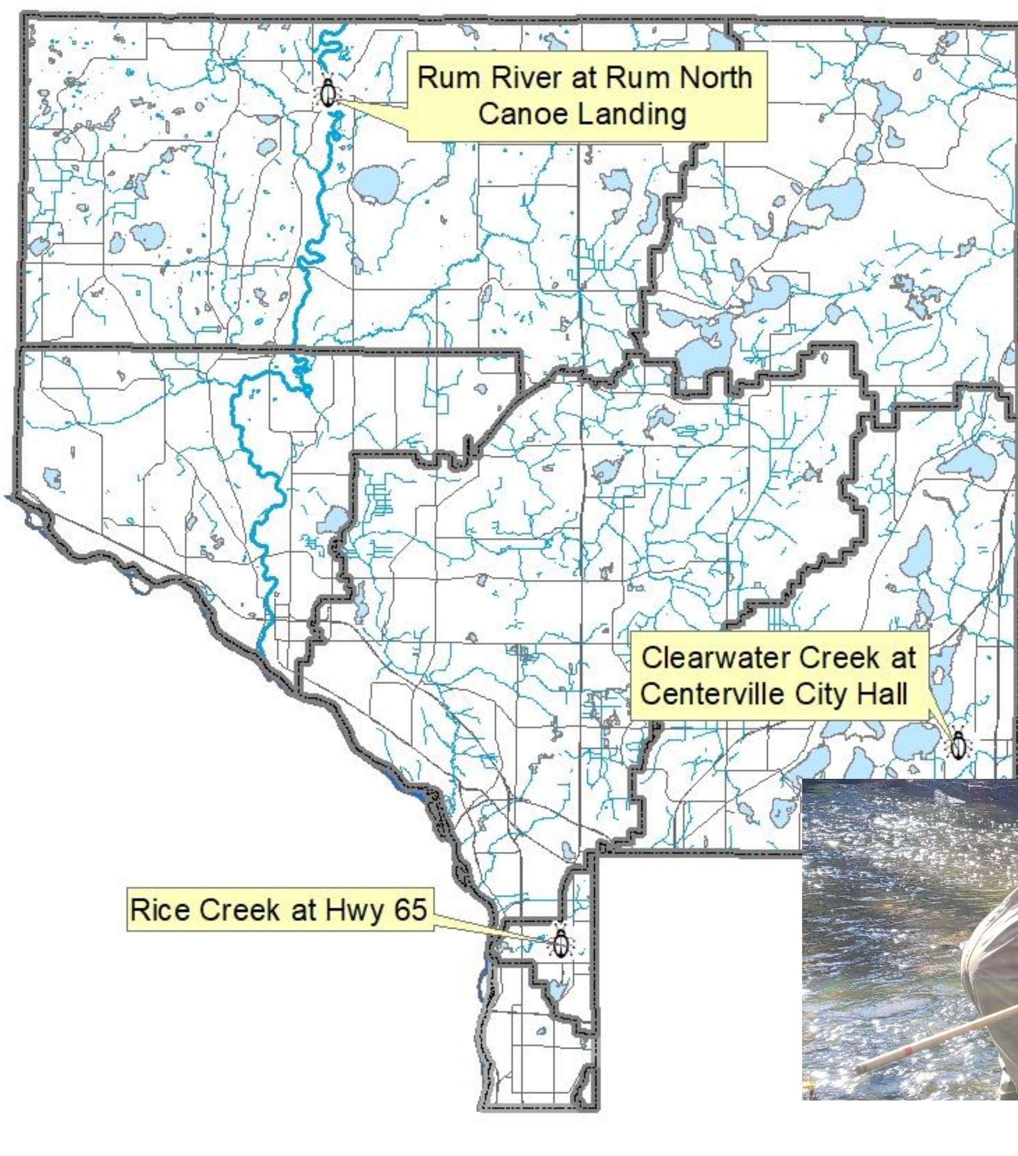
Stream Water Quality – Biological Monitoring

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 2019 there were approximately 190 students from four high schools who monitored four stream sites. Since 2000, over 5,372 students have participated. The experience affords students an opportunity to learn scientific methodologies and become involved in local natural resource management.

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

2020 Biological Stream Water Quality Monitoring Sites



Biomonitoring Methods

ACD biomonitoring is based on 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. For student biomonitoring, all habitat types are sampled but not in proportion. 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: <u>E</u>phemeroptera (mayflies), <u>P</u>lecoptera (stoneflies), and <u>T</u>richoptera (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.

% 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).

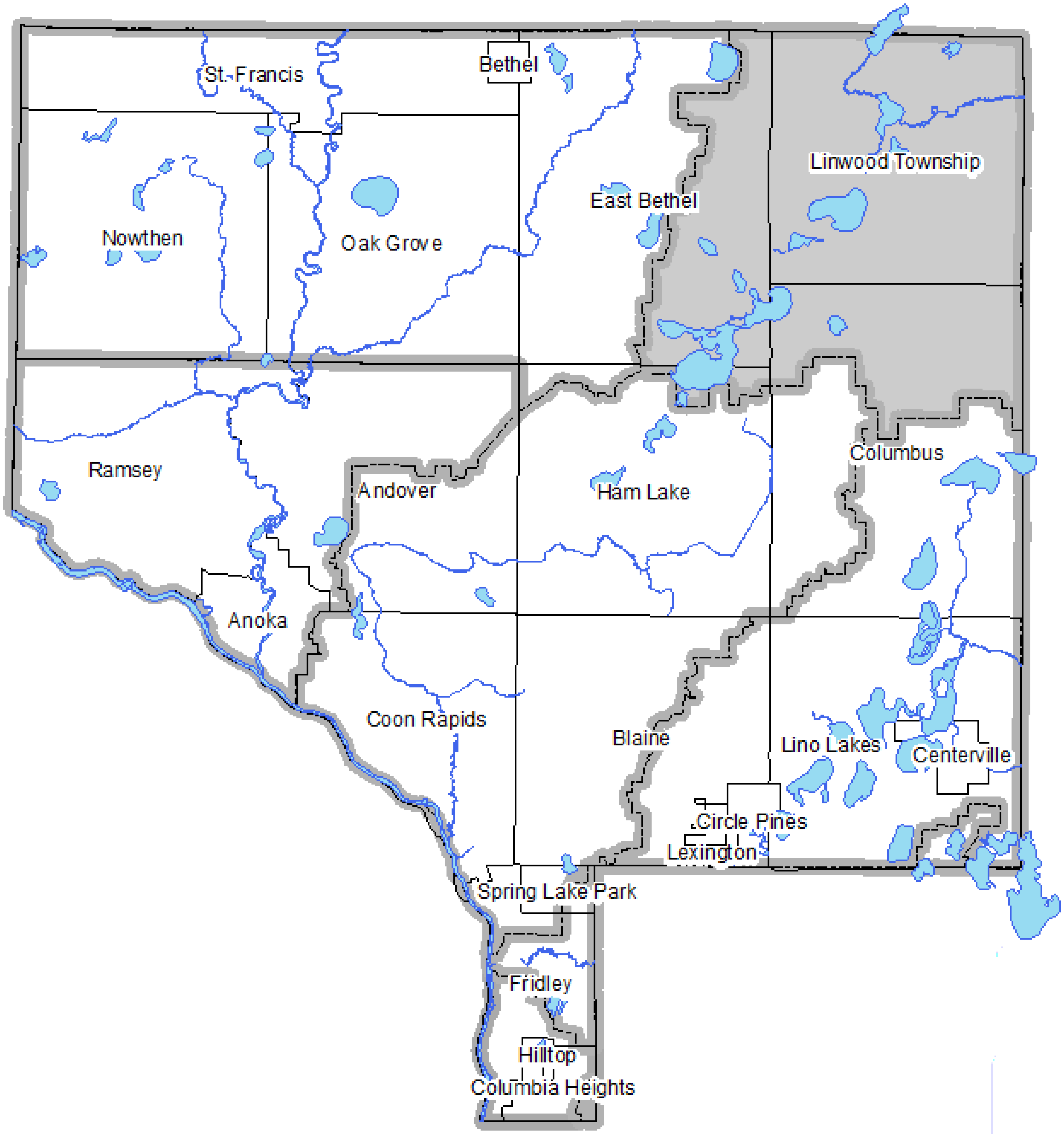
Sites

In 2020, high school classes from St. Francis, Totino Grace and Forest Lake ALC with ACD staff supervision sampled three sites for benthic macroinvertebrates and identified each organism captured to family level. Information on sampling results from individual sites can be found in the corresponding WMO chapter for that stream.

2020 Biomonitoring Sites and Corresponding Monitoring Groups

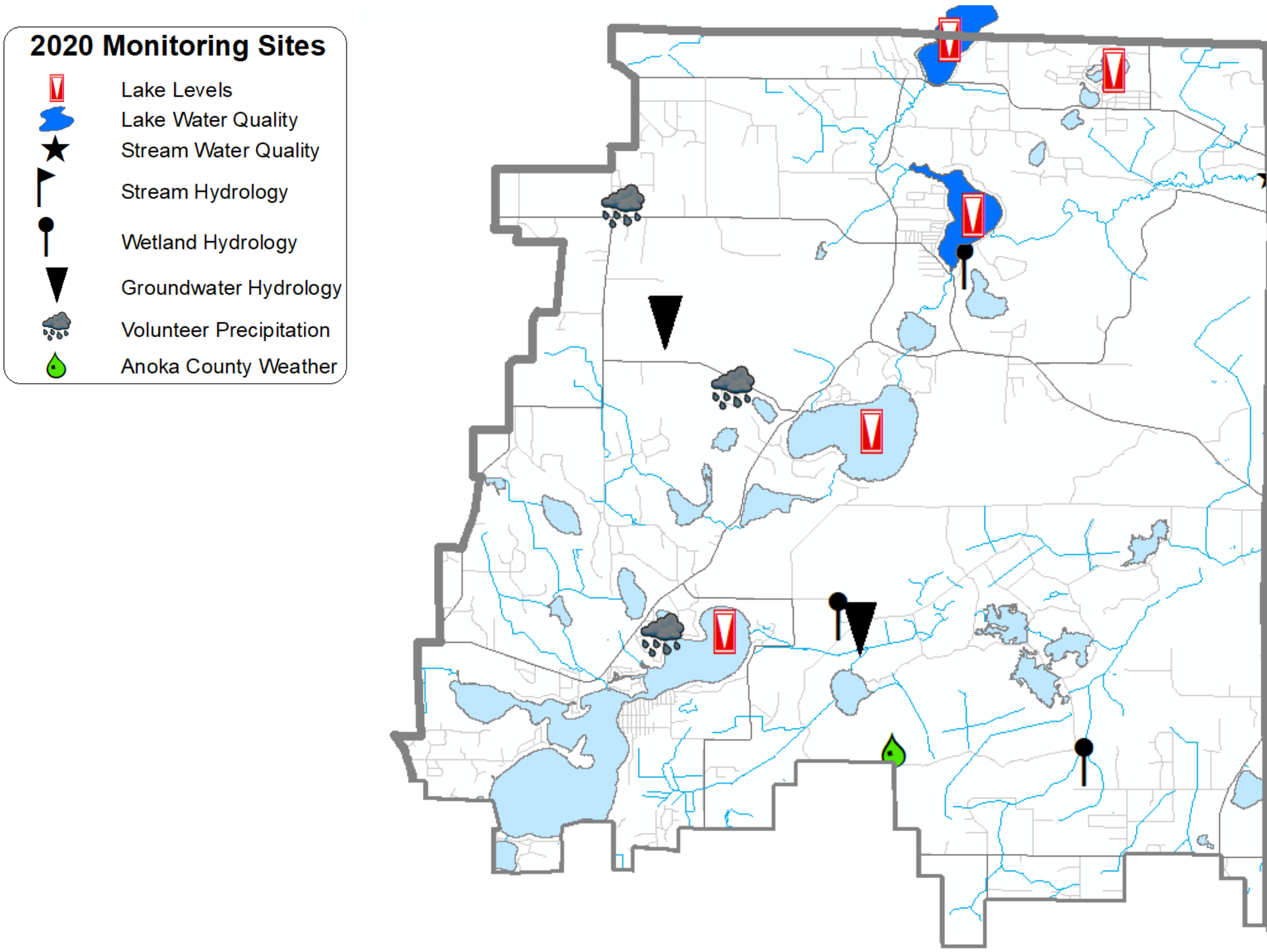
Monitoring Group	Stream
Forest Lake Area Learning Center	Clearwater Creek
Totino Grace High School	Rice Creek
St. Francis High School	Rum River (North)

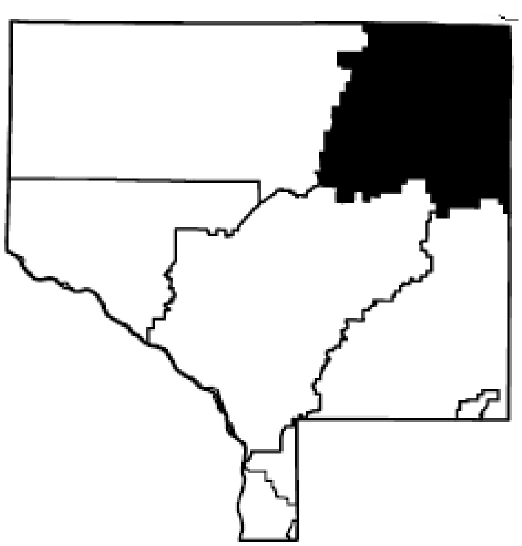
Chapter 2: Sunrise River Watershed



Prepared by the Anoka Conservation District

Chapter 2: Sunrise River Watershed





Lake Level Monitoring

Partners: SRWMO, ACD, MN DNR, local volunteers

Description: Weekly water level monitoring in lakes. The past five and twenty-five years of data for each lake are illustrated below, and all historical 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.

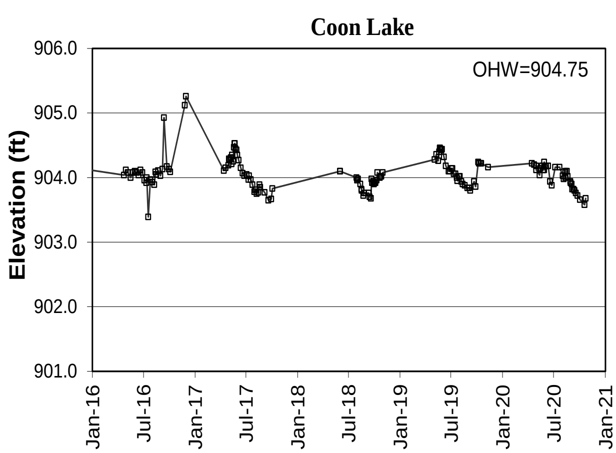
Locations: Coon, Fawn, Linwood, Martin, and Typo Lakes

Results: Lake gauges were installed by the Anoka Conservation District and surveyed by the MN DNR. In 2020, lake levels started near average and declined throughout the season. The rebound often seen in the fall was not observed. This is likely due to infrequent rain events throughout the season and the lowest annual total precipitation since 2012. All lakes recorded lower water levels on average than in 2019, and Coon Lake had its lowest average level since 2015.

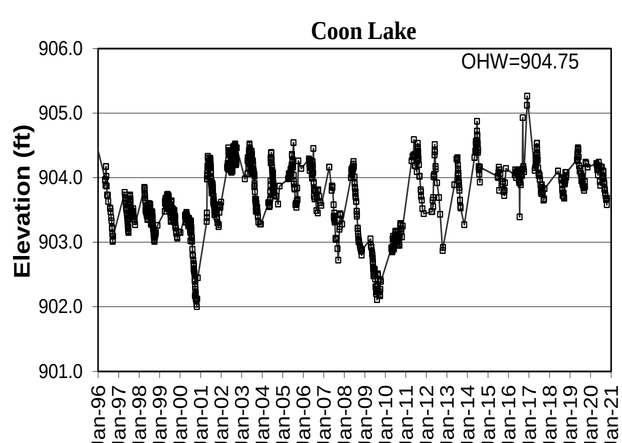
Lake levels fluctuated at a similar scale to previous years except for at Fawn Lake where levels fluctuated 1.33 ft. throughout the season. This was the largest range observed since 2014. The maximum elevation reached for the year (901.97) was the first seasonal reading taken for Fawn Lake in April, 2020 when lake levels were still elevated from the previous season. None of the lakes approached all-time highs or lows in 2020.

All lake level data can be downloaded from the MN DNR website's LakeFinder feature (https://www.dnr.state.mn.us/lakefind/index.html). Ordinary High Water Level (OHW), the elevation below which a DNR permit is needed to perform work, is listed for each lake on the corresponding graphs below.

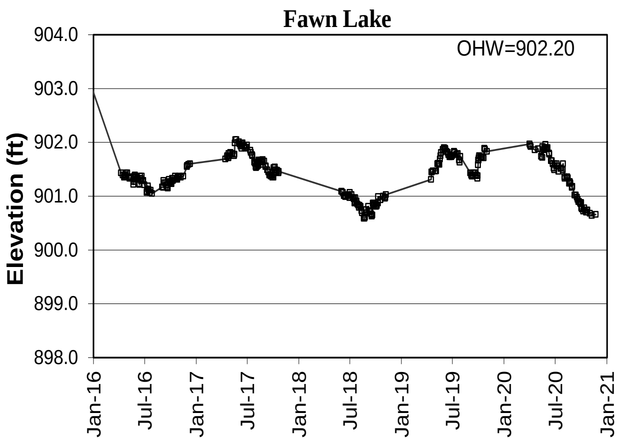
Coon Lake Levels – last 5 years



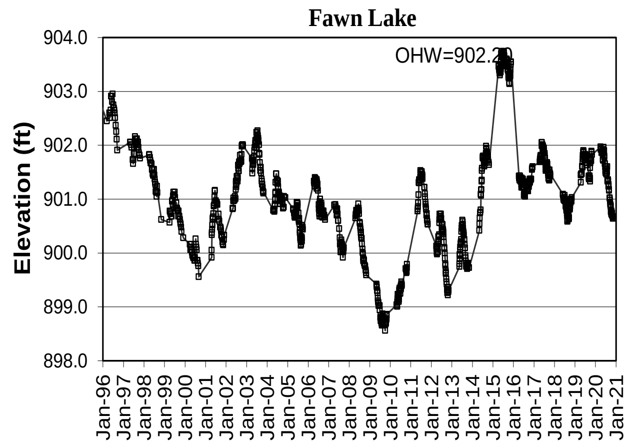
Coon Lake Levels – last 25 years



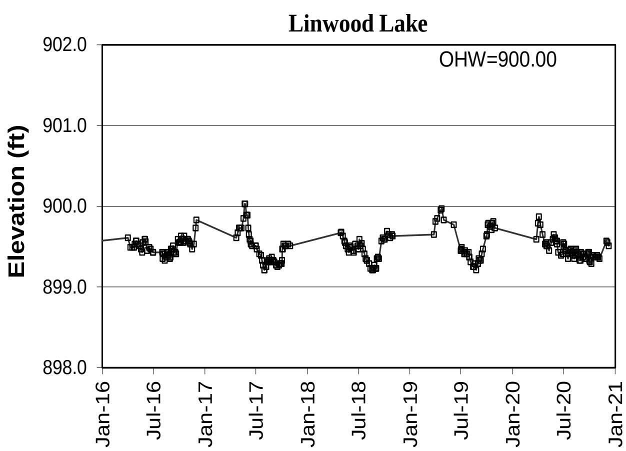
Fawn Lake Levels – last 5 years



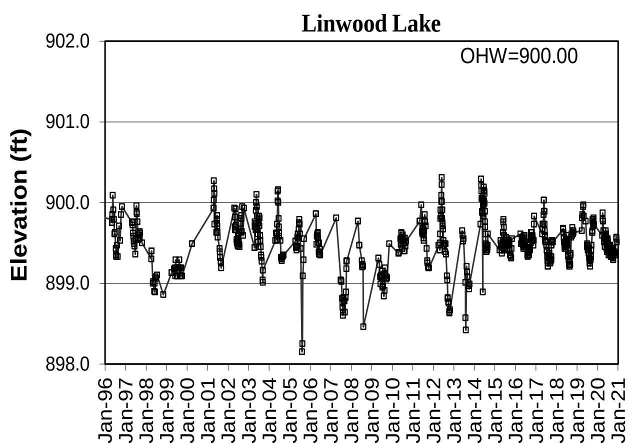
Fawn Lake Levels – last 25 years



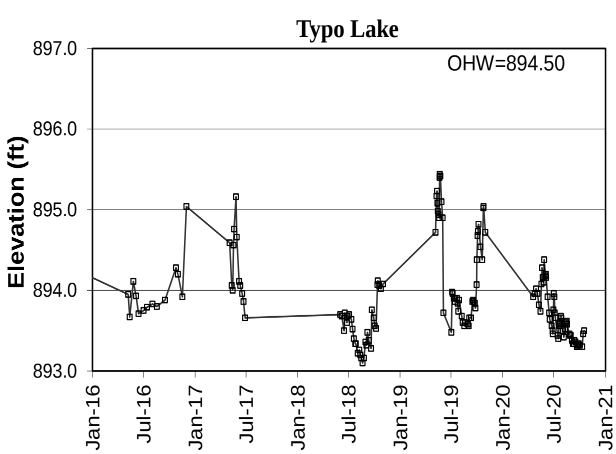
Linwood Lake Levels – last 5 years



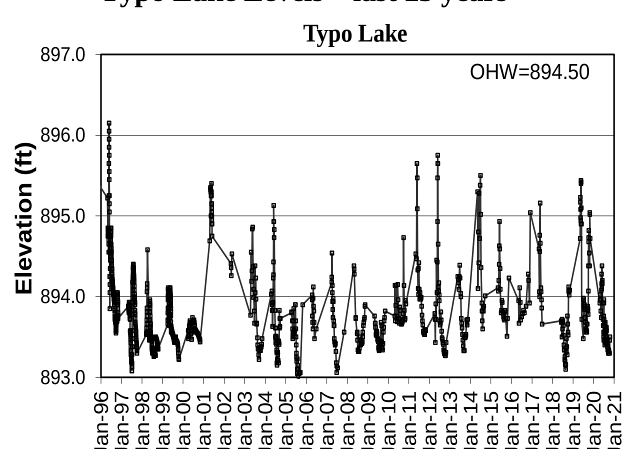
Linwood Lake Levels – last 25 years



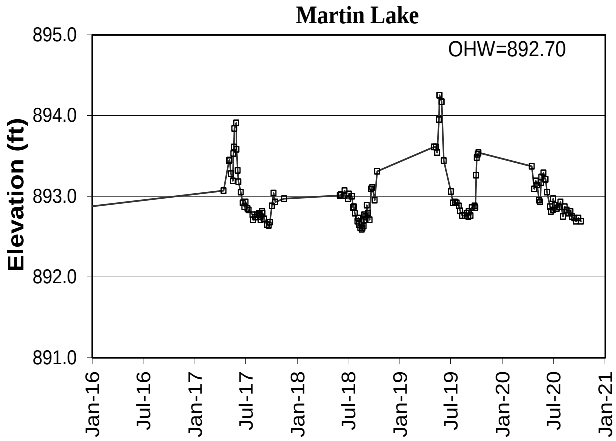
Typo Lake Levels – last 5 years



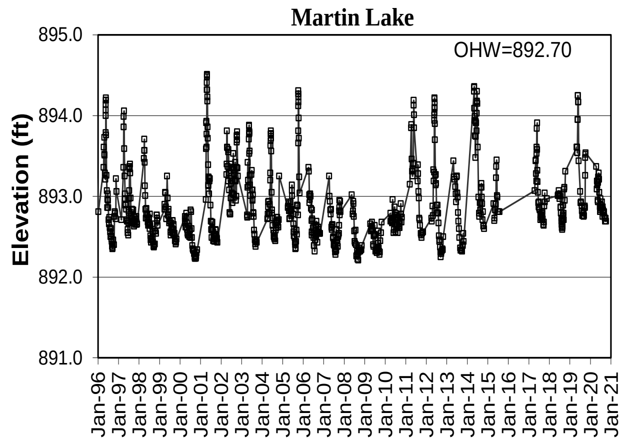
Typo Lake Levels – last 25 years



Martin Lake Levels – last 5 years



Martin Lake Levels – last 25 years



Lake	Year	Average	Min	Max
COON	2016	904.14	903.39	905.26
	2017	904.09	903.65	904.53
	2018	903.92	903.68	904.10
	2019	904.14	903.80	904.46
	2020	904.01	903.58	904.24

Lake	Year	Average	Min	Max
FAWN	2016	901.30	901.05	901.60
	2017	901.68	901.35	902.05
	2018	900.87	900.59	901.09
	2019	901.64	901.31	901.90
	2020	901.35	900.64	901.97

Lake	Year	Average	Min	Max
LINWOOD	2016	899.51	899.33	899.83
	2017	899.49	899.21	900.03
	2018	899.46	899.21	899.69
	2019	899.54	899.21	899.97
	2020	899.47	899.29	899.87

Lake	Year	Average	Min	Max
TYPO	2016	893.99	893.67	895.04
	2017	894.29	893.66	895.16
	2018	893.55	893.10	894.12
	2019	894.30	893.48	895.44
	2020	893.66	893.30	894.38

Lake	Year	Average	Min	Max
MARTIN	2015	892.96	892.70	893.45
	2017	893.03	892.64	893.91
	2018	892.85	892.59	893.31
	2019	893.32	892.75	894.25
	2020	892.95	892.69	893.37

Lake Water Quality

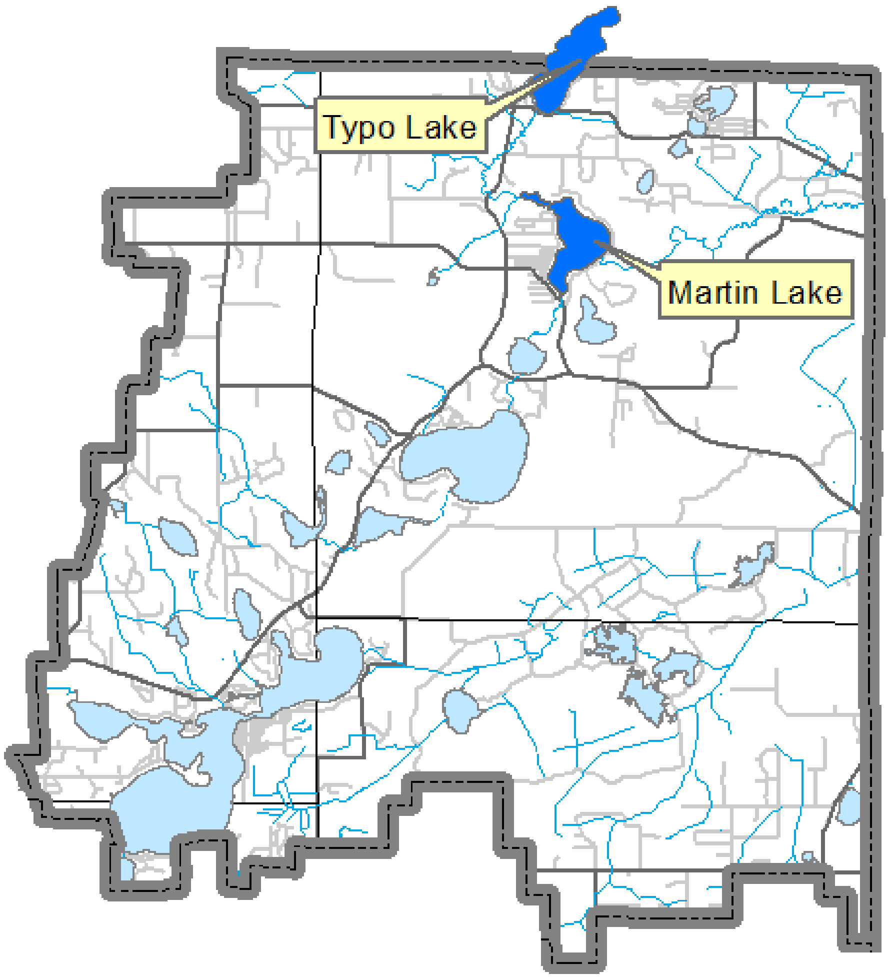
Description: May through September, every-other-week, monitoring is conducted for the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, specific conductivity, pH, and salinity.

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

Locations: Typo, and Martin Lakes

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 Minnesota Pollution Control Agency (MPCA) (https://cf.pca.state.mn.us/water/watershedweb/wdip/search_more.cfm) or from ACD. Refer to Chapter 1 for additional information on lake dynamics and interpreting the data.

2020 Sunrise River Watershed Lake Water Quality Monitoring Sites



TYPO LAKE

LINWOOD TOWNSHIP, LAKE ID # 30-0009

Background

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

2020 Results

In 2020 Typo Lake had poor water quality compared to other lakes in this region (NCHF Ecoregion), receiving an overall F letter grade. Average total phosphorus (TP) was 220.0 µg/L, which was an increase from the 2019 average of 175.0 µg/L and the highest recorded average since 2009. While total phosphorus levels continue to far exceed the 60 µg/L state standard, average concentrations appear to be staying well below averages from a decade ago (353.0 µg/L in 2009).

Chlorophyll-a (Cl-a) levels in 2020 averaged 73.5 µg/L. This is similar to 2019 and other previous years. It is below the historical average for the lake of 110.3 µg/L but still many times higher than the State standard for Cl-a in shallow lakes of 20 µg/L.

Average Secchi transparency in 2020 was 1.3 feet, which is the third-highest average on record. In 2007 and 2009 a Secchi disk could be seen only 5-6 inches below the surface, on average. Transparency has improved throughout the last decade, but still remains poorer than the state standard for shallow lakes transparency of 1 meter (3.3 feet).

Trend Analysis

Twenty years of water quality monitoring have been conducted by the MPCA (1993, '94, and '95) and the Anoka Conservation District (1997-2001, '03, '05, '07, '09, '12, 2014-2020). Overall, water quality has improved from 1993 to 2020 (excluding high nutrient outlier years 2007 and 2009) in a statistically significant way (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2, 15}=8.87$, $p<0.01$). When we tested these response variables individually with one-way ANOVAs, TP and Secchi depth still show no significant change across this time period. Cl-a, however, is showing a statistically significant decline ($p<0.001$). A superficial look at graphs of these parameters suggests that total phosphorus is generally stable between 150 µg/L and 250 µg/L without a long-term trend. Secchi transparency in recent years is similar to averages from the early 1990s, an improvement from the late 1990s-2010. Transparency in the lake seems to be improving, though at this point is not statistically significant. The major driver of improved water quality is decreasing Cl-a concentrations.

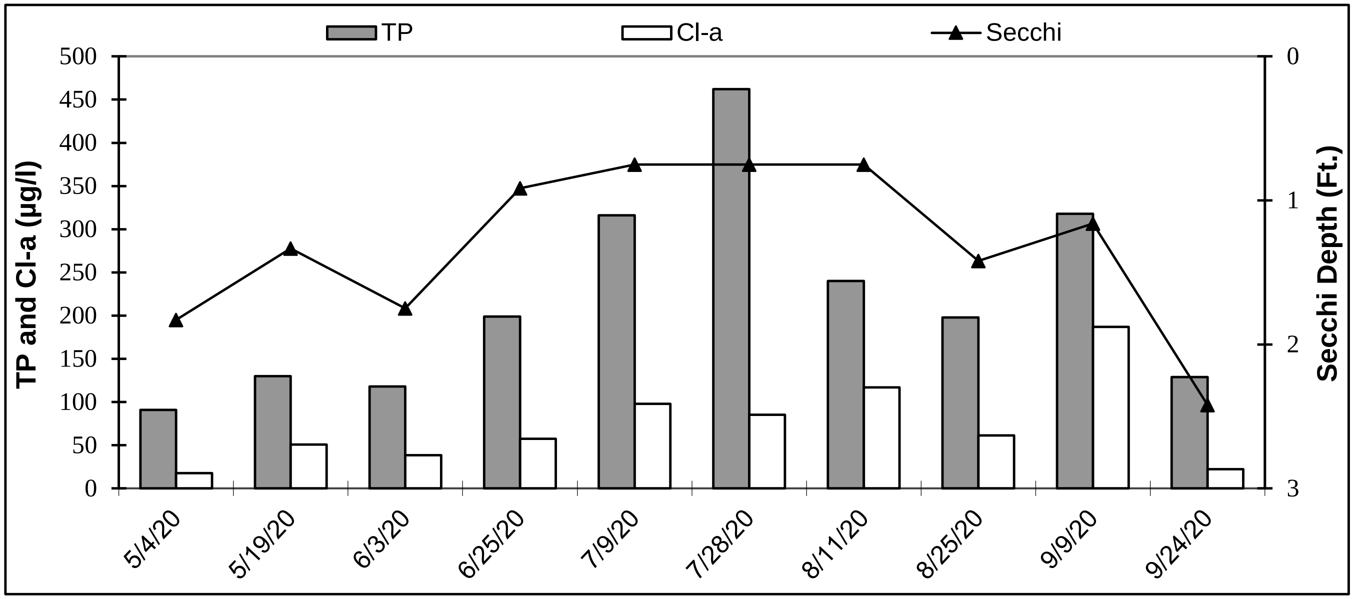
Discussion

Typo Lake, along with Martin Lake downstream was the subject of a Total Maximum Daily Load (TMDL) study by the Anoka Conservation District, which was approved by the State and EPA in 2012. This study documented the sources of nutrients to the lake, the degree to which each is impacting the lake, and put forth lake rehabilitation strategies. Some factors impacting water quality in Typo Lake include rough fish, ditched wetland west of the lake, and lake sediments. Recent work has included installation of carp barriers (completed in 2016), carp removals (2017-2019, to be continued through 2022), and a feasibility study of ditched wetland restorations upstream of Typo Lake (2018). The feasibility study identified 4 potential projects along Ditch 20 upstream of Type Lake. It also recommends that dredging of Ditch 20 not occur. Current shoreline conditions on Typo Lake were inventoried during a 2019/2020 shoreline survey. This inventory will assist in identifying future lakeshore projects. Recent water quality monitoring results suggest these management approaches are improving conditions in these lakes, but reaching goals will require additional effort and time.

TYPO LAKE

LINWOOD TOWNSHIP, LAKE ID # 30-0009

2020 Results



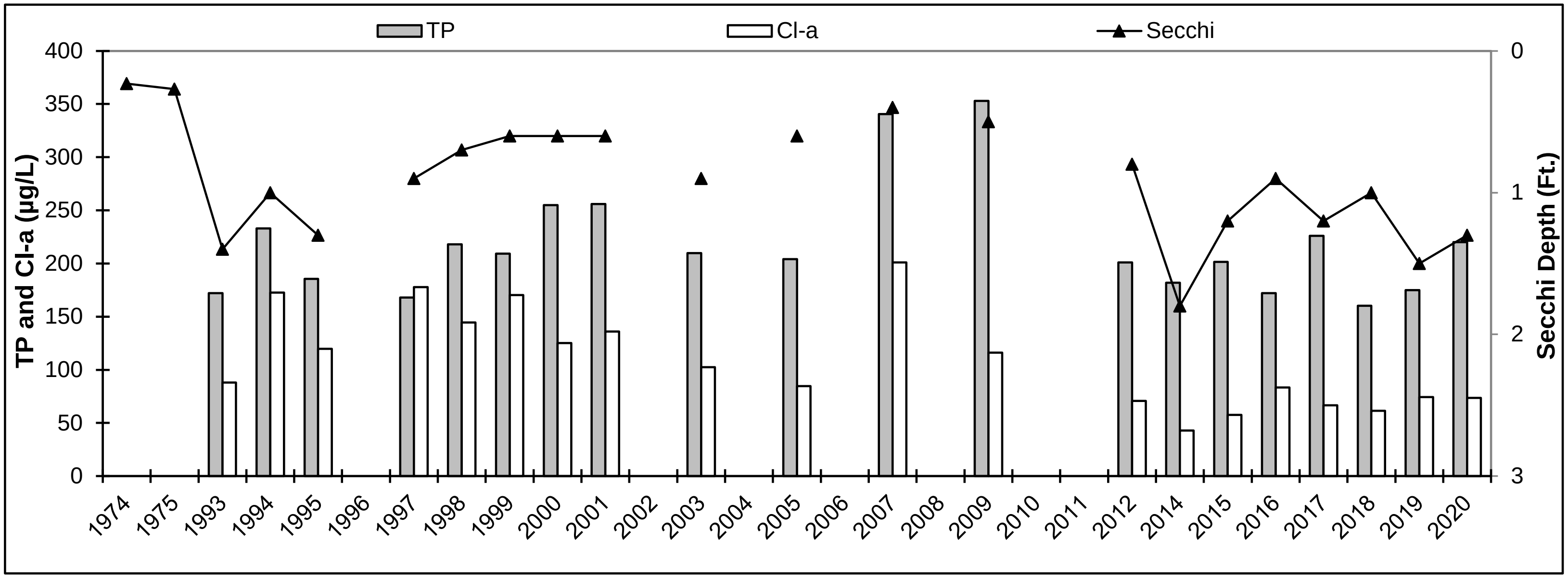
2020 Median Values

pH		8.61
Specific Conductivity	mS/cm	0.27
Turbidity	NTU	58.75
D.O.	mg/l	9.61
D.O.	%	105.53
Temp.	°F	73.59
Salinity	%	0.13
Cl-a	µg/L	59.35
T.P.	µg/l	198.5
Secchi	ft	1.25

Typo Lake **2020 Water Quality Data**	Units	Date / Time / R.L.*	5/4/2020 14:15	5/19/2020 11:30	6/3/2020 10:30	6/25/2020 10:24	7/9/2020 9:55	7/28/2020 10:20	8/11/2020 9:45	8/25/2020 9:55	9/9/2020 10:00	9/24/2020 9:50	Average	Min	Max
pH		0.1	8.79	8.61	8.58	8.43	8.07	8.88	9.14	9.13	8.53	8.61	8.68	8.07	9.14
Specific Conductivity	mS/cm	0.01	0.267	0.285	0.271	0.315	0.294	0.227	0.218	0.233	0.266	0.289	0.267	0.218	0.315
Turbidity	FNRU	1	35.00	57.20	65.70	72.40	109.00	106.00	12.1	43.60	60.30	20.40	64	12	109
D.O.	mg/l	0.01	10.99	10.80	11.23	8.41	5.72	6.75	12.22	9.91	7.60	9.30	9.29	5.72	12.22
D.O.	%	1	117.8	107.1	137.4	100.0	75.6	83.2	141.5	127.1	75.2	104.0	106.9	75.2	141.5
Temp.	°C	0.1	16.15	15.00	23.56	22.90	27.63	26.52	23.31	26.63	14.34	19.31	21.54	14.34	27.63
Temp.	°F	0.1	61.1	59.0	74.4	73.2	81.7	79.7	74.0	79.9	57.8	66.8	70.8	57.8	81.7
Salinity	%	0.01	0.13	0.13	0.13	0.15	0.14	0.11	0.11	0.11	0.12	0.14	0.1	0.1	0.2
Cl-a	µg/l	1	17.80	50.70	38.30	57.30	97.90	85.20	117.00	61.40	187.00	22.20	73.5	17.8	187.0
T.P.	mg/l	0.005	0.091	0.130	0.118	0.199	0.316	0.462	0.240	0.198	0.318	0.129	0.220	0.091	0.462
T.P.	µg/l	5	91	130	118	199	316	462	240	198	318	129	220	91	462
Secchi	ft	0.10	1.83	1.33	1.75	0.92	0.75	0.75	0.75	1.42	1.16	2.42	1.3	0.8	2.4
Secchi	m	0.10	0.56	0.41	0.53	0.28	0.23	0.23	0.23	0.43	0.35	0.74	0.4	0.2	0.7
Physical			2.0	1.0	3.0	2.0	3.0	3.00	3.00	2.0	3.0	2.0	2.4	1.0	3.0
Recreational			2.0	1.0	2.0	3.0	2.0	3.00	3.00	2.0	2.0	2.0	2.2	1.0	3.0

*reporting limit

Historic Annual Averages



Historical Report Card

Year	TP	Cl-a	Secchi	**Overall**
1974			F	**F**
1975			F	**F**
1993	F	F	F	**F**
1994	F	F	F	**F**
1995	F	F	F	**F**
1997	F	F	F	**F**
1998	F	F	F	**F**
1999	F	D	F	**F**
2000	F	F	F	**F**
2001	F	F	F	**F**
2003	F	F	F	**F**
2005	F	F	F	**F**
2007	F	F	F	**F**
2009	F	F	F	**F**
2012	F	D	F	**F**
2014	F	C	F	**D-**
2015	F	D	F	**F**
2016	F	F	F	**F**
2017	F	D	F	**F**
2018	F	D	F	**F**
2019	F	D	F	**F**
2020	F	D	F	**F**
State Standards	60 ug/L	20 ug/L	>3.3 ft	

Martin Lake

Linwood Township, Lake ID # 02-0034

Background

Martin Lake is located in northeast Anoka County. It has a surface area of 223 acres and maximum depth of 20 ft. The public access is located on the southern end of the lake. The lake is used moderately by recreational boaters and fishers, and would likely be used more if water quality improved. Martin Lake is almost entirely surrounded by private residences. The 5,402-acre watershed is 18% developed; the remaining 82% is vacant, agricultural, or wetlands. The non-native, invasive plant curly-leaf pondweed is present in Martin Lake but not at nuisance levels. Martin is on the MPCA's list of impaired waters for excess nutrients.

2020 Results

In 2020 Martin Lake had a C letter grade. During 2016-2018 the lake had a pattern of declining phosphorus levels, including a record low of 53.1µg/L in 2018. Total phosphorus levels were higher in 2019, but declined again in 2020 averaging 56.8 µg/L. Even though total phosphorus levels were higher in 2019, they were better than the average of 92.7 µg/L during 1997-2015. 2019 was the wettest year on record for the area, and increased runoff from the watershed may have played a role in higher 2019 phosphorus. Following that pattern, 2020 had below average rainfall, and we saw phosphorus levels in the lake recede.

In 2020, chlorophyll-a averaged 31.4 µg/L, a slight decrease increase from the 2019 average of 32.8 µg/L. Cl-a levels have been on a fairly steady incline since 2014 which had the lowest recorded average of 15.5 µg/L. While the 5-year (2016-2020) average (29.1 µg/L) has been much lower than the 2005-2009 average (108.3 µg/L), it remains above the impairment standard of 14 µg/L.

Average Secchi transparency was 3.0 feet in 2020, a slight decrease from 3.3 feet in 2019 but on par with the historical average of 2.9 feet for the lake. Secchi transparency remains about 30% below the State impairment threshold of 4.6 feet.

Trend Analysis

Twenty years of water quality data have been collected by the MPCA (1983), Metropolitan Council (1998, 2008), and the ACD (1997, 1999-2001, 2003, 2005, 2007, 2009, 2012-2020). Citizens monitored Secchi transparency 17 other years. Anecdotal notes from DNR fisheries data indicate poor water quality dating back to at least 1954. Although still poor, water quality in Martin Lake has shown an improvement from 1983 to 2020 that is statistically significant (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2, 16}=5.52$, $p < 0.05$). This is especially true for the last decade. Further examination of the data shows that while TP and Secchi transparency have not changed in the long-term since 1983, chlorophyll-a concentrations have shown a statistically significant decrease ($p < 0.01$) over this time. Water quality in Martin Lake declined through the late 1990s and reached its worst in 2007. In the nine years sampled since 2007, both TP and Secchi transparency have improved on a statistically significant basis ($p < 0.01$).

Discussion

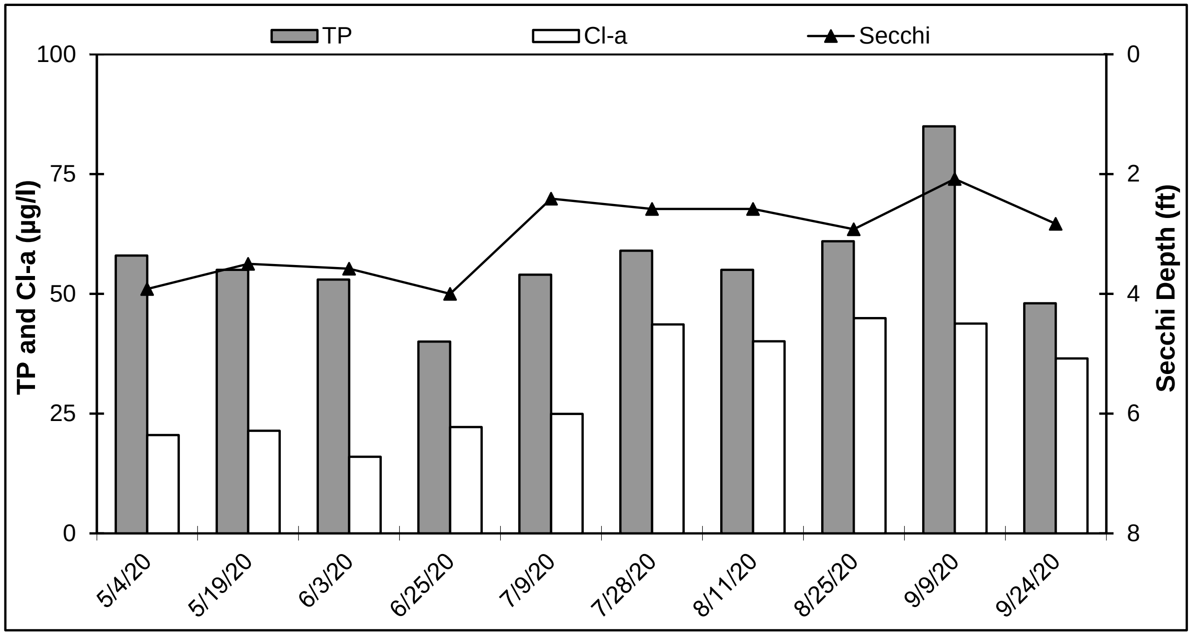
Martin Lake, along with Typo Lake upstream, was the subject of a TMDL study by the Anoka Conservation District that was approved by the State and EPA in 2012. This study documented the sources of nutrients to the lake, the degree to which each is impacting the lake, and put forward lake rehabilitation strategies. Water from Typo Lake and internal loading (carp, septic systems, sediments, etc.) are two of the largest negative impacts on Martin Lake water quality. Upstream of Typo Lake, a feasibility study was completed in early 2018 regarding restoration of ditched wetlands (Ditch 20). This study identified 4 potential projects and also recommends that dredging of Ditch 20 not occur.

Carp removals and restoration of two lake-adjacent stormwater ponds took place in 2020 and additional projects are planned in in the near future. Shoreline conditions on Martin Lake were inventoried during a 2019/2020 shoreline survey. This inventory will assist in identifying future lakeshore restoration projects. Recent water quality monitoring results suggest these management approaches are improving conditions in these lakes, but reaching goals will require additional effort and time.

Martin Lake

Linwood Township, Lake ID # 30-0009

2020 Results



2020 Median Values

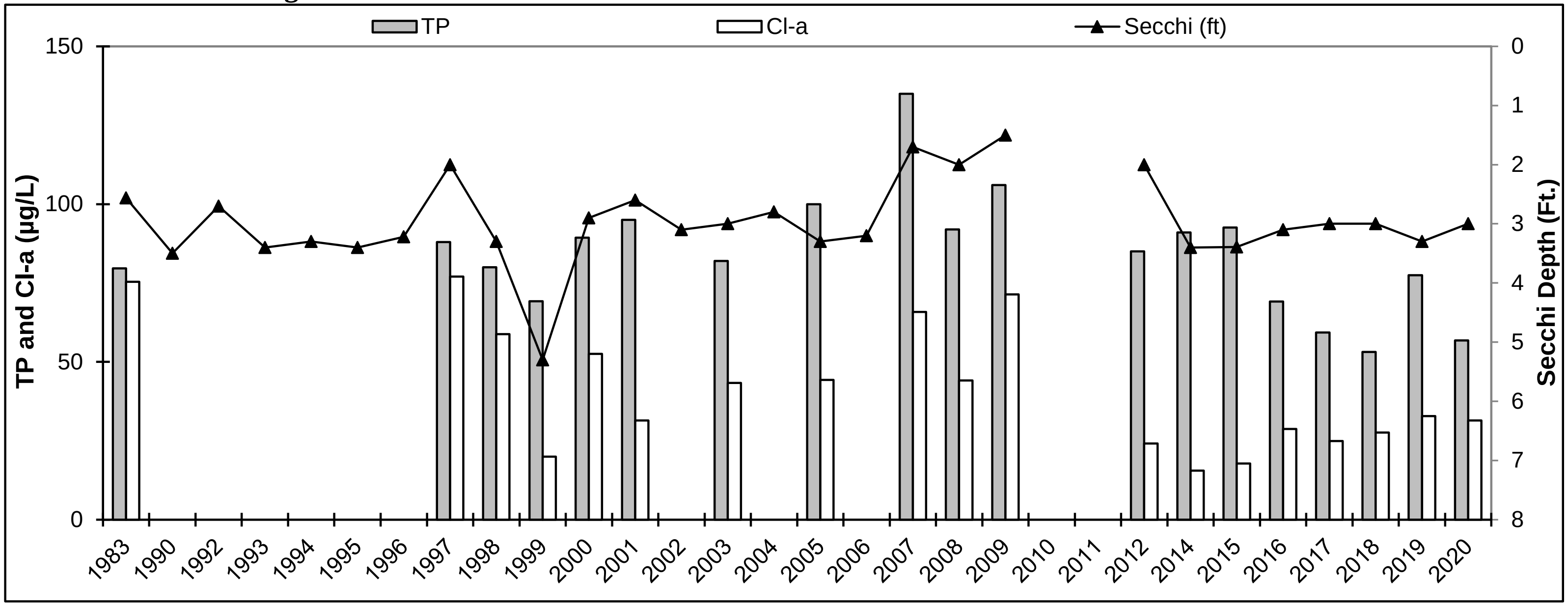
pH		8.56
Specific Conductivity	mS/cm	0.297
Turbidity	NTU	18.2
D.O.	mg/l	10.17
D.O.	%	121.35
Temp.	°F	73.85
Salinity	%	0.14
Cl-a	µg/L	30.7
T.P.	µg/l	55
Secchi	ft	2.8

Martin Lake
2020 Water Quality Data

	Units	R.L.*	5/4/2020	5/19/2020	6/3/2020	6/25/2020	7/9/2020	7/28/2020	8/11/2020	8/25/2020	9/9/2020	9/24/2020	Average	Min	Max
		Time:	13:42	12:00	12:00	11:00	10:30	10:55	10:30	10:20	10:30	10:15			
pH		0.1	8.92	8.45	8.41	8.61	8.50	8.62	8.47	8.87	8.21	8.86	8.59	8.21	8.92
Specific Conductivity	mS/cm	0.01	0.283	0.291	0.292	0.304	0.301	0.297	0.297	0.290	0.303	0.299	0.296	0.283	0.304
Turbidity	FNRU	1	8.30	7.20	13.30	4.80	25.10	19.10	33.60	18.20	34.90	17.50	16.34	4.80	34.90
D.O.	mg/l	0.01	11.42	10.01	13.30	10.27	8.24	10.07	9.67	11.48	8.27	12.60	10.53	8.24	13.30
D.O.	%	1	115.0	100.1	156.9	125.1	107.5	130.8	117.6	146.3	87.2	139.4	122.6	87.2	156.9
Temp.	°C	0.1	14.24	14.34	23.14	23.36	28.05	25.77	24.02	26.35	17.96	18.71	21.6	14.2	28.1
Temp.	°F	0.1	57.6	57.8	73.7	74.0	82.5	78.4	75.2	79.4	64.3	65.7	70.9	57.6	82.5
Salinity	%	0.01	0.13	0.14	0.14	0.15	0.14	0.14	0.14	0.14	0.14	0.15	0.14	0.13	0.15
Cl-a	ug/L	1	20.50	21.40	16.00	22.20	24.90	43.60	40.10	44.90	43.80	36.50	31.4	16.0	44.9
T.P.	mg/l	0.005	0.058	0.055	0.053	0.040	0.054	0.059	0.055	0.061	0.085	0.048	0.057	0.040	0.085
T.P.	ug/l	5	58	55	53	40	54	59	55	61	85	48	56.8	40	85
Secchi	ft	0.1	3.92	3.50	3.58	4.00	2.41	2.58	2.58	2.9	2.1	2.8	3.0	2.1	4.0
Secchi	m	0.1	1.19	1.07	1.09	1.22	0.73	0.79	0.79	0.89	0.63	0.86	0.9	0.6	1.2
Physical			2.0	2.0	2.0	1.0	1.0	3.0	2.0	2.0	2.0	2.0	1.9	1.0	3.0
Recreational			1.0	1.0	1.0	1.0	2.0	3.0	1.0	1.0	2.0	2.0	1.5	1.0	3.0

*reporting limit

Historic Annual Averages



Historical Report Card

Year	TP	Cl-a	Secchi	Overall
1996			D	**D**
1997	D	D	F	**D**
1998	D	D	D	**D**
1999	C	B	C	**C**
2000	D	C	D	**D**
2001	D	C	D	**D**
2002			D	**D**
2003	D	C	D	**D**
2004			D	**D**
2005	D	C	D	**D**
2006			D	**D**
2007	D	D	F	**D**
2008	D	C	F	**D**
2009	D	D	F	**D**
2012	D	C	F	**D**
2014	D	B	D	**C**
2015	D	B	D	**C**
2016	C	C	D	**C**
2017	C	C	D	**C**
2018	C	C	D	**C**
2019	C	C	D	**C**
2020	C	C	D	**C**
State Standards	40 ug/L	14 ug/L	>4.6 ft	

Stream Water Quality

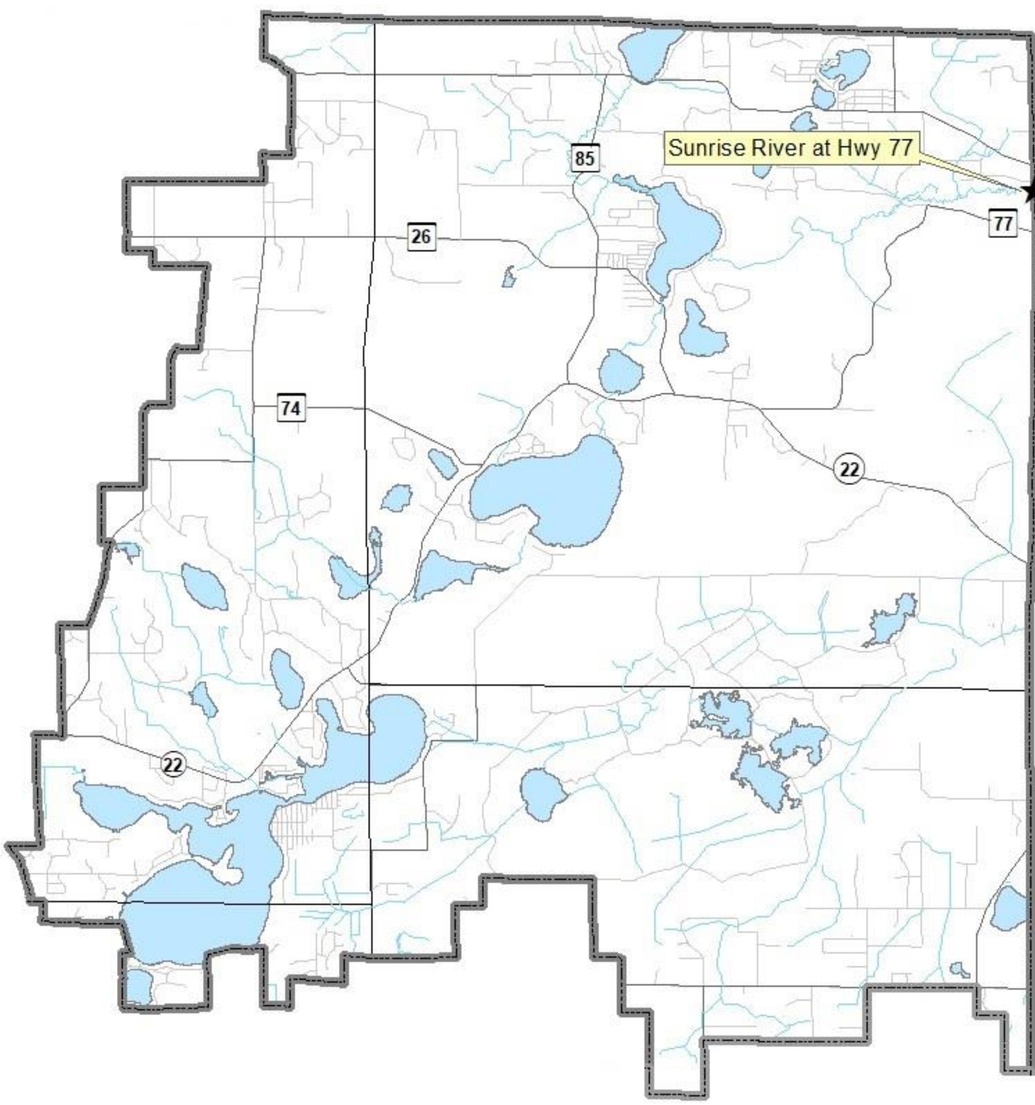
Description: In 2019 and 2020, the Sunrise River water quality monitoring site at Highway 77 was being monitored using funds from an MPCA Surface Water Assessment Grant (SWAG). Stream water quality was monitored on twelve occasions in 2020, including five grab samples. The selected site is at the furthest downstream limit of the Sunrise River Watershed Management Organization's jurisdictional area, and the Anoka County border. Parameters monitored include water level, pH, specific conductivity, turbidity, chlorides, transparency, dissolved oxygen, total phosphorus, and total suspended solids.

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

Location: Sunrise River at Hwy 77

Results: Results are presented on the following pages.

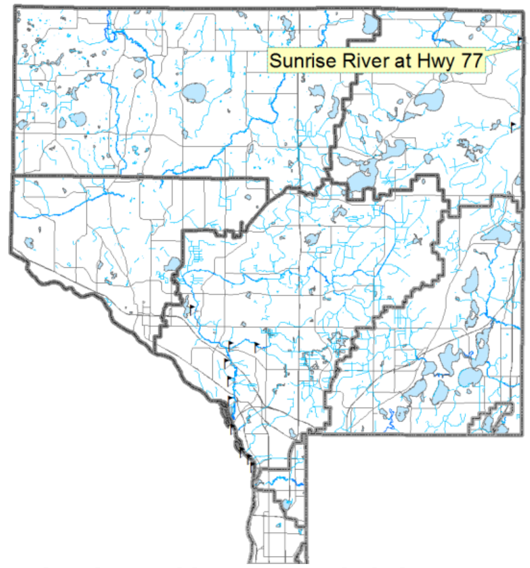
2020 Sunrise River Watershed Stream Water Quality Monitoring Sites



SUNRISE RIVER WEST BRANCH AT HWY 77

Near Fawn Lake Dr. NE, Linwood Township

STORET SiteID = S001-424



Years Monitored
2001, 2003, 2006, 2012, 2015, 2018-2020

Background
This monitoring site is near the downstream extent of the Sunrise River Watershed in Anoka County, at the Chisago County border. Upstream, this river drains through Rice, Boot, Linwood, Island, Martin, and Typo Lakes. The Sunrise River Watershed Management Organization historically monitors this site because it is where the river leaves their jurisdiction. Additionally, monitoring is considered important because this portion of the river is impaired for aquatic life with turbidity identified as a stressor. This site is included in the MN Pollution Control Agency's Cycle II Monitoring for the Lower St. Croix Watershed which began in 2019 and will run through 2020. A TMDL study was completed in 2013.

Methods
The river was monitored on 12 occasions in 2020. All monitoring during 2020 was completed during baseflow conditions. Parameters tested with portable meters included pH, specific conductivity, turbidity, temperature, dissolved oxygen, and salinity. Parameters tested by water quality grab samples sent to a state-certified lab included total phosphorus, chlorides, and total suspended solids. Grab samples were taken and analyzed by a laboratory at the beginning of each month monitored.

Summarized Results
Summarized water quality monitoring findings and management implications include:

- Specific conductivity was below the county median of 0.420 mS/cm. The median specific conductivity was 0.322 mS/cm. The median specific conductivity for all years at this site is 0.315 mS/cm. For management considerations see chlorides.
- Chlorides were measured at this site in all years, except 2015. In 2020, the median chloride concentration was 19.5 mg/L, a slight increase from 2019. The median for all years at this site is 16.5 mg/L and the countywide median is 13.29 mg/L which are both well below the state standard of 230 mg/L
  Management discussion: Road deicing salts are a concern region-wide. Chlorides are measurable in area streams year-round, including in the Sunrise River. While chloride levels may be low compared to state standards, excessive salt use should be avoided.
- Suspended solids and turbidity levels were similar in 2020 compared to other years monitored. The median for all years at this site is 17 mg/L TSS. These levels are higher than most other Anoka County streams, but still below the state standard of 30 mg/L TSS.
  Management discussion: Efforts to reduce suspended material in upstream lakes will likely help decrease turbidity and suspended solids throughout the Sunrise River.
- Phosphorus has fluctuated above and below the water quality standard for the Central River Nutrient Region of ≤100 µg/L. The 2020 median for TP was 67.0 ug/L, which was lower than previous years (2018 median of 101.5 ug/L). The median TP for all years at this site is 87 µg/L.
  Management discussion: Management in upstream lakes will help reduce phosphorus in the river.
- pH was within the range considered normal and healthy for streams in this area. The median pH was 7.56.
- Dissolved oxygen (DO) was typically within the range considered normal and healthy.

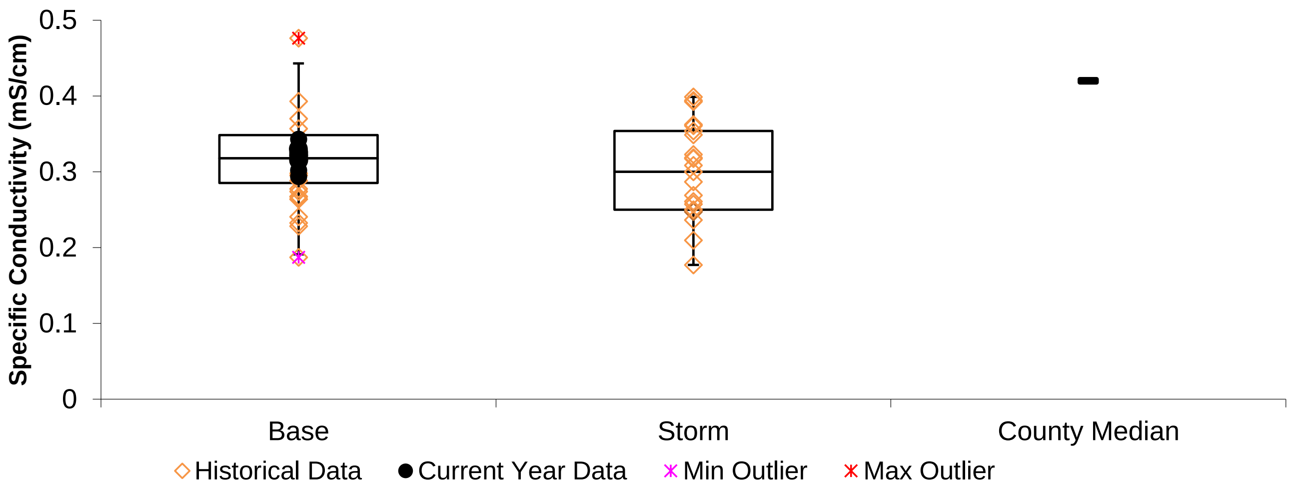
Below the data are presented and discussed for each parameter in greater detail. Management recommendations will be included at the conclusion of this report.

Specific conductivity

Specific conductivity and chlorides are measures of dissolved pollutants. Dissolved pollutant sources include urban road runoff, industrial chemicals, and others. Metals, hydrocarbons, and road salts are often of concern in a suburban environment. Specific conductivity is the broadest measure of dissolved pollutants we use. It measures electrical conductivity of water standardized for temperature; pure water with no dissolved constituents has zero specific conductivity.

Specific conductivity was acceptably low in the West Branch of the Sunrise River. Median specific conductivity for 2020 was 0.322 mS/cm. This is lower than the 2019 median which included some of the highest specific conductivity readings on record. The 2020 median for the site was also lower than the median for Anoka County streams (0.420 mS/cm). Specific conductivity has historically been lower during storms, suggesting that stormwater runoff contains fewer dissolved pollutants than the surficial water table that feeds the river during baseflow. Increased specific conductivity levels during baseflow conditions has been observed in many Anoka County streams. This has led to the determination that the largest contributor to rising specific conductivity levels is road deicing salts that have infiltrated into the shallow aquifer.

Specific conductivity during baseflow and storm conditions. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

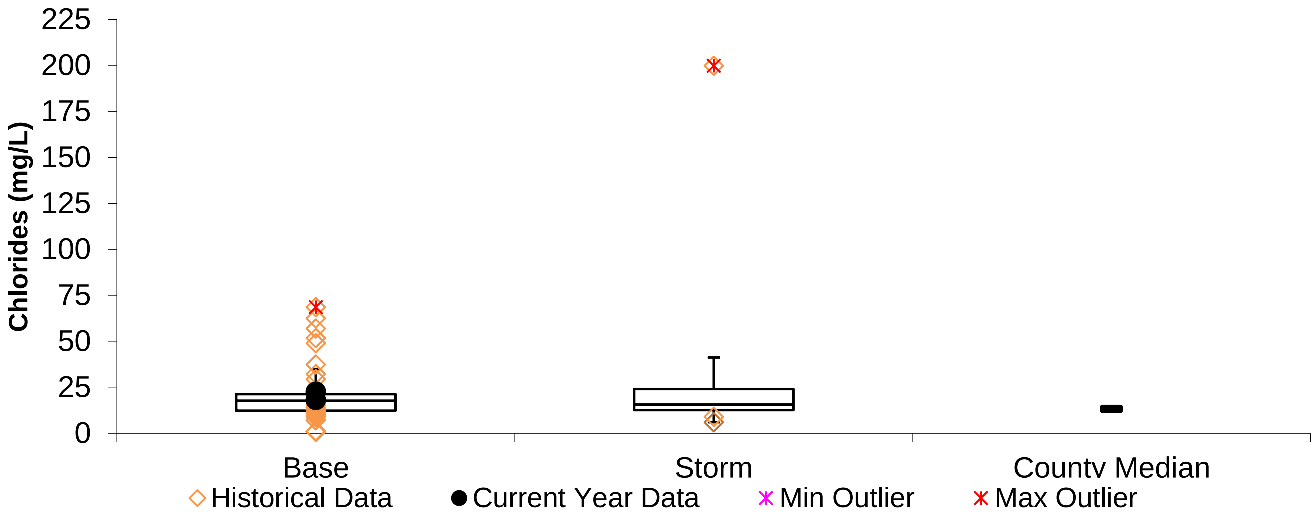


Chlorides

Chlorides are the measure of chloride salts, the most common of which are road de-icing chemicals and those used in water softening. Chlorides can also be present in other pollutant types, such as wastewater. These pollutants are of concern because of the effect they can have on the stream's biological community. Specific Conductivity data, reported above, is commonly used as an indicator for chlorides, with higher specific conductivity generally corresponding to higher chlorides.

Chloride concentrations in the West Branch of the Sunrise River are higher than the median for Anoka County (13.29 mg/L). In 2020 the median chloride concentration was 19.5 mg/L, slightly more than in 2019 but well below the state standard of 230 mg/L. A waterbody is considered impaired if two or more samples exceed the state standard in a three-year period. Only a couple of storm samples have been collected at this site for chlorides, but they have followed the pattern seen in specific conductivity with higher readings during baseflow conditions and further supports the finding that road deicing salts seeping into the shallow aquifer are a primary cause of higher baseflow chloride and specific conductivity readings.

Chlorides during baseflow and storm conditions. Orange diamonds are historical data from previous years and black circles are 2020 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 the refraction of a light beam passed through a water sample. It is most sensitive to large particles. Total suspended solids are 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.

It is important to note that suspended solids can come from sources within the river itself or outside of the river from the contributing watershed. Sources from the watershed include soil erosion, road sanding, and others. In-stream sources of TSS include riverbank erosion and movement of the river bottom. Finally, algae from the river and upstream lakes contribute to suspended solids.

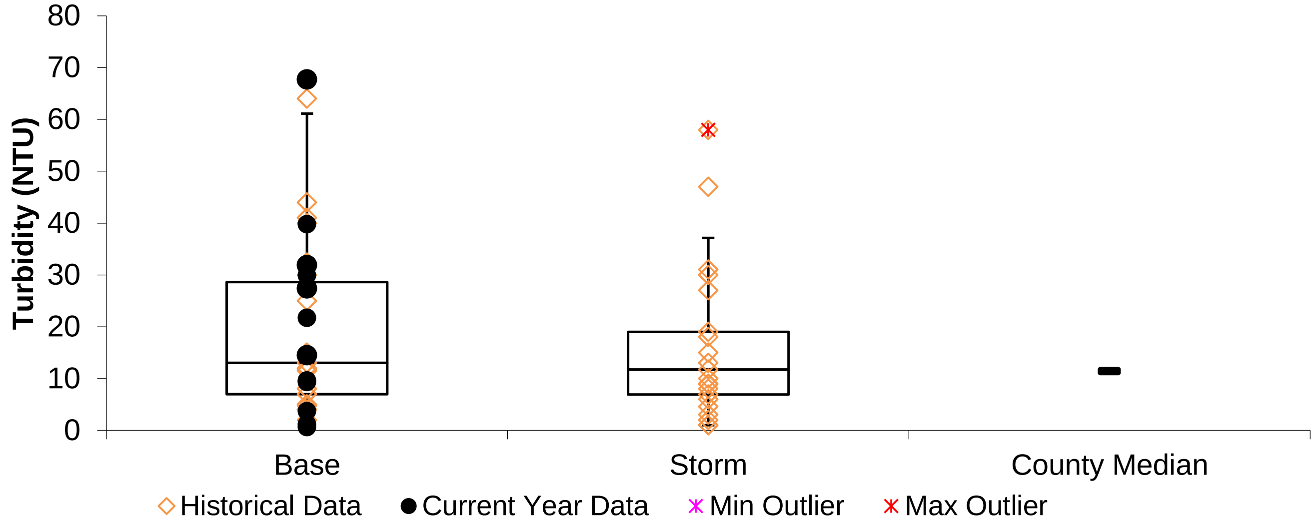
Turbidity is no longer used to determine if a stream is impaired. Instead, total suspended solids is used. Turbidity is still a helpful and easy to measure parameter. Generally, turbidity below 25 NTU is acceptable; previously this was the State's standard. When that standard was in place a stream was impaired if it exceeded this value on three occasions and at least 10% of all sampling events. Including all years of data, the West Branch of the Sunrise River has exceeded 25 NTU on 19 of 72 sampling occasions (26%). Turbidity increased in 2020, with five of twelve samples surpassing the state standard (42%).

The most obvious source of turbidity is algae from upstream lakes. Three upstream lakes are impaired for excess nutrients and high algae. They include Linwood, Martin, and Typo Lakes. The river sampling site is 3 miles downstream from Martin Lake. The area between the lake and sampling site is wide floodplain fringe and forest with little human impact that would not be expected to add much sediment to the river. Therefore, efforts to reduce suspended material in the river should focus on the upstream lakes. It is also worth noting that this section of the river has unconsolidated bottom material which can re-suspend and contribute to turbidity.

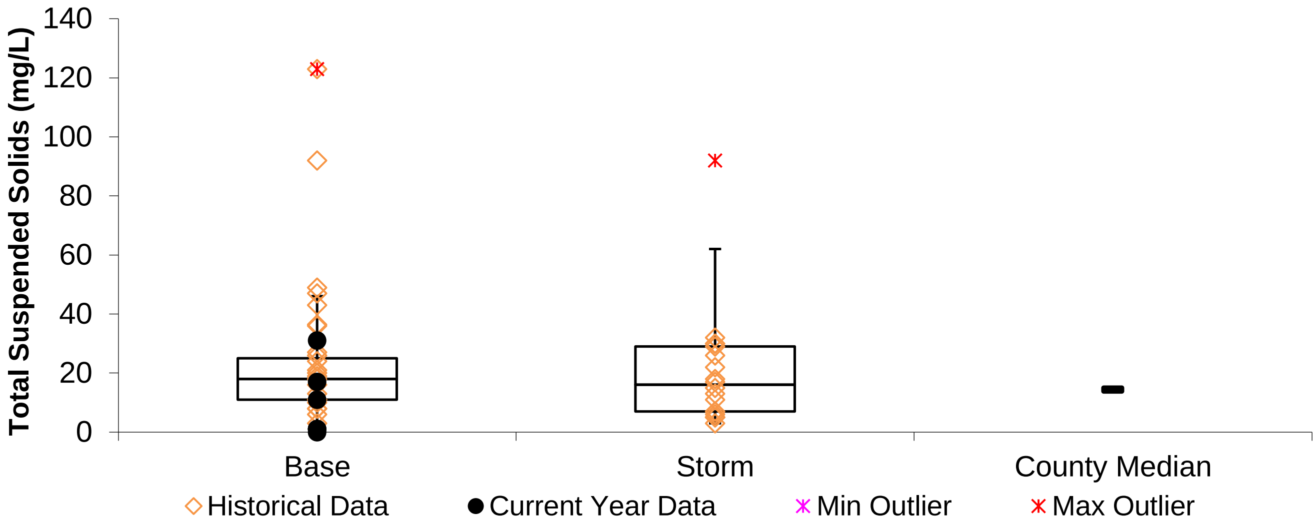
Total suspended solids in the West Branch of the Sunrise River has exceeded the State standard for this region. The standard is no more than 10% of samples exceeding 30 mg/L during April 1-September 30. Over all years monitored the West Branch exceeded the standard on 17% of sampling occasions (10 of 57).

In 2020 total suspended solid concentrations increased compared to 2019 with one sample exceeding 30 mg/L. In 2020, all samples were taken during baseflow. Other years of sampling included storm events. Higher concentrations of suspended solids may be from any combination of turbulence mobilizing sediment during higher stream flows, flushing of upstream lakes, and/or overland stormwater flow. Overland flow is relatively low in this subwatershed, which is largely forested and wetland.

Turbidity during baseflow and storm conditions Orange diamonds are historical data from previous years and black circles are 2020 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 Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

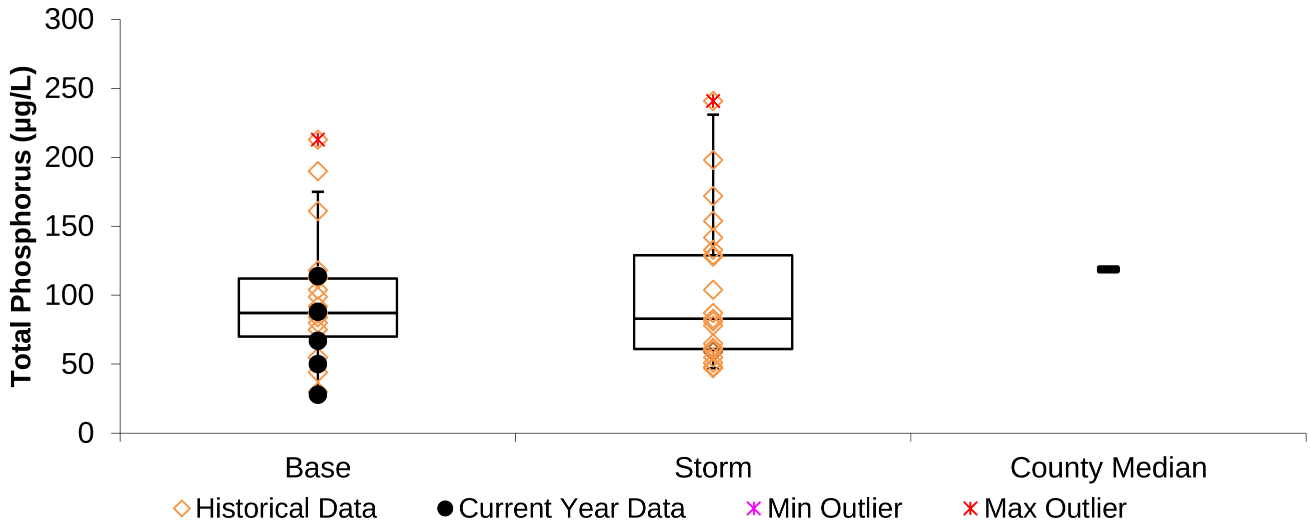


Total Phosphorus

The nutrient phosphorus is one of the most common pollutants in our region and can be associated with urban runoff, agricultural runoff, wastewater, and many other sources. Total phosphorus (TP) in the West Branch of the Sunrise River often exceeds the state standard of 100 µg/L. In 2020 the median phosphorus concentration was 67 ug/L but did exceed the state standard during one of the five sampling events. There was a decrease from the 2019 median of 72.0 ug/L, and a match of one exceedance of 100 µg/L. The median phosphorus concentration in the West Branch of the Sunrise River across all years monitored is 87.0 µg/L. Over all years sampled, 22 of 58 samples (38%) have exceeded the standard of 100 µg/L. These phosphorus concentrations are common for the area. There has generally not been a large difference between storm and baseflow TP concentrations during historical monitoring. All 2019 and 2020 sampling occurred during baseflow conditions.

In the case of the West Branch of the Sunrise River phosphorus levels are, at least in part, reflective of conditions of Martin Lake located 3 miles upstream from the sampling site. Martin Lake is impaired for excess phosphorus, with a summertime average of 79.2 µg/L over the last 10 years. Water quality improvements to Martin Lake will benefit the river downstream. Recent upstream projects including carp barriers, carp harvests, and stormwater retrofits, coincide with improved conditions in upstream lakes, but those benefits are not yet apparent in the West Branch of the Sunrise River.

Total phosphorus during baseflow and storm conditions. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



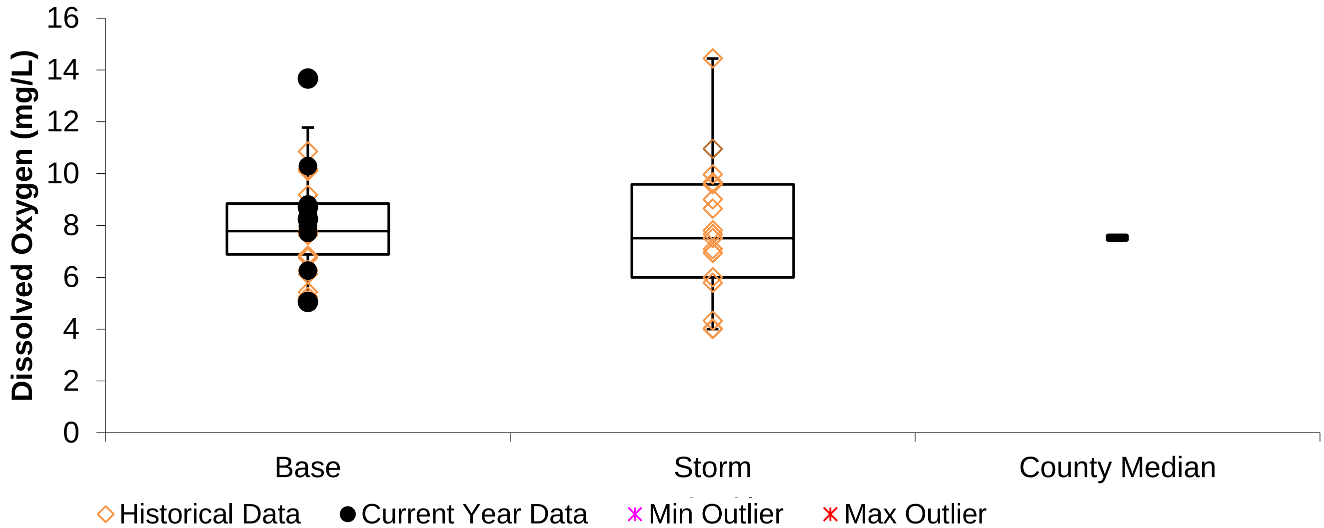
Dissolved Oxygen

Dissolved oxygen is necessary for aquatic life, including fish. Organic pollution causes oxygen consumption when it decomposes. If oxygen levels fall below 5 mg/L aquatic life begins to suffer, therefore the State water quality standard is a daily minimum of 5 mg/L. The stream is impaired if 10% of observations are below this level in the last 10 years. Dissolved oxygen levels are typically lowest in the early morning because of decomposition consuming oxygen at night without offsetting oxygen production by photosynthesis, which occurs during the day.

For the West Branch of the Sunrise River there are two datasets to consider. First, spot measurements were taken with the other water quality monitoring described in this report. Dissolved oxygen has been found at less than 5 mg/L on three out of 52 occasions. All were during storm events in prior years, occurring in 2003, 2012 and 2015. In 2020, there was one case in early July, where DO hit 5.05 mg/L, narrowly avoiding the daily minimum of 5 mg/L.

The second data set is around-the-clock DO measurements collected for eight days in by the MPCA in 2012. They found that DO dipped below 5 mg/L every morning. The river has been designated as impaired for poor fish and invertebrate communities. Although it is not listed as impaired for DO specifically, low DO concentration occurring each morning in this stream is a likely stressor on these organisms.

Dissolved oxygen results during baseflow and storm conditions Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

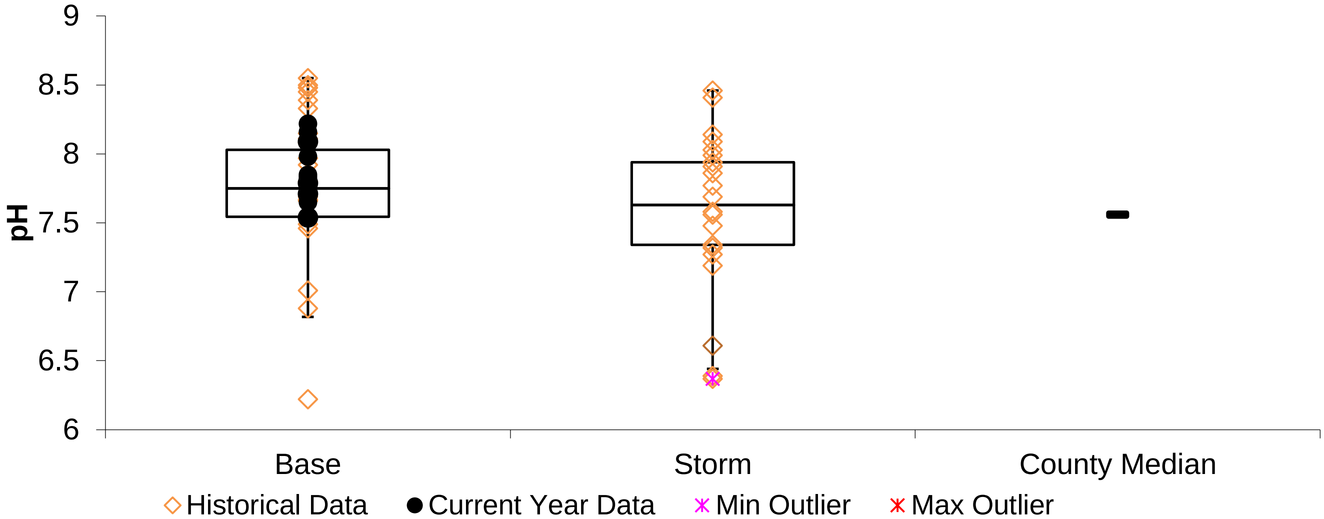


pH

pH refers to the acidity of the water. The MPCA's water quality standard is for pH to be between 6.5 and 8.5. The West Branch of the Sunrise River is regularly within this range (see figure below). It often has slightly higher pH than other streams because of the impact of algal production in upstream lakes.

It is interesting to note that pH is generally 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 in some areas, its effect on this aquatic system is small. In 2018, there was one occurrence of sub-standard pH in October when pH was 5.66. This is not overly concerning. pH was within the normal range (7.54 to 8.22) for all samples in 2020.

pH results during baseflow and storm conditions Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Recommendations

Water quality in the West Branch of the Sunrise River is poorer than ideal. A Total Maximum Daily Load (TMDL) study was completed in 2013 to determine impairments of this river. The study found that aquatic life in this river was struggling with turbidity identified as the main stressor. Low dissolved oxygen may also be a stressor contributing to aquatic life impairment. At this time, it appears that algae and nutrients in upstream lakes are a primary source of problems. Dissolved oxygen is not low in the lakes, however, and low nighttime levels in the river may be related to decomposition occurring in the large wetland floodplain. Future water quality management should be targeted at upstream lakes. Ongoing and upcoming projects include stormwater retrofits at Martin Lake and common carp management in the chain of lakes.

Wetland Hydrology

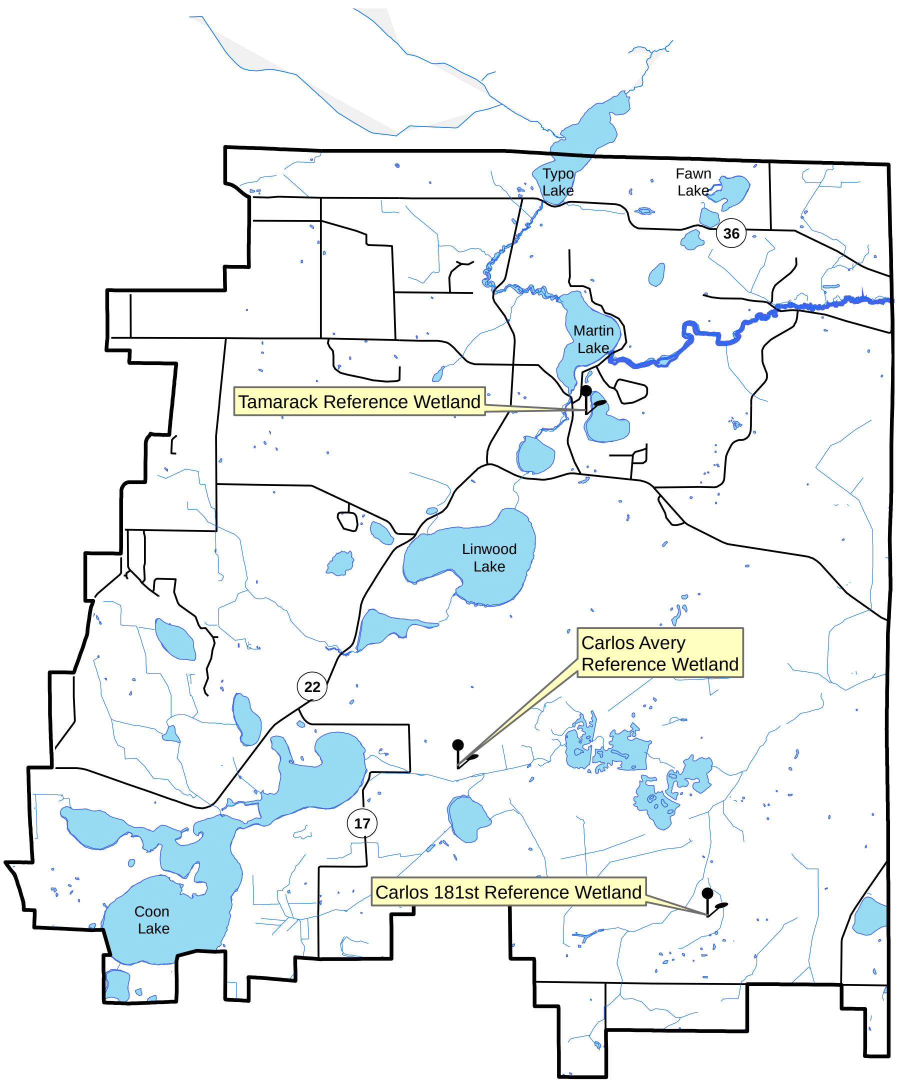
Description: Continuous groundwater level monitoring at a wetland boundary. Countywide, the ACD maintains a network of 23 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impacts 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.

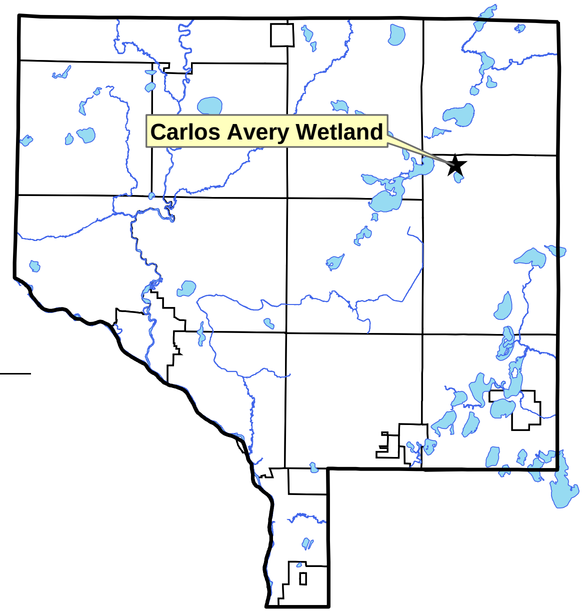
2020 Sunrise River Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

CARLOS AVERY REFERENCE WETLAND

Carlos Avery Wildlife Management Area, City of Columbus



Site Information

Monitored Since: 1997

Wetland Type: 3

Wetland Size: >300 acres

Isolated Basin? No

Connected to a Ditch? Yes

Soils at Well Location:

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

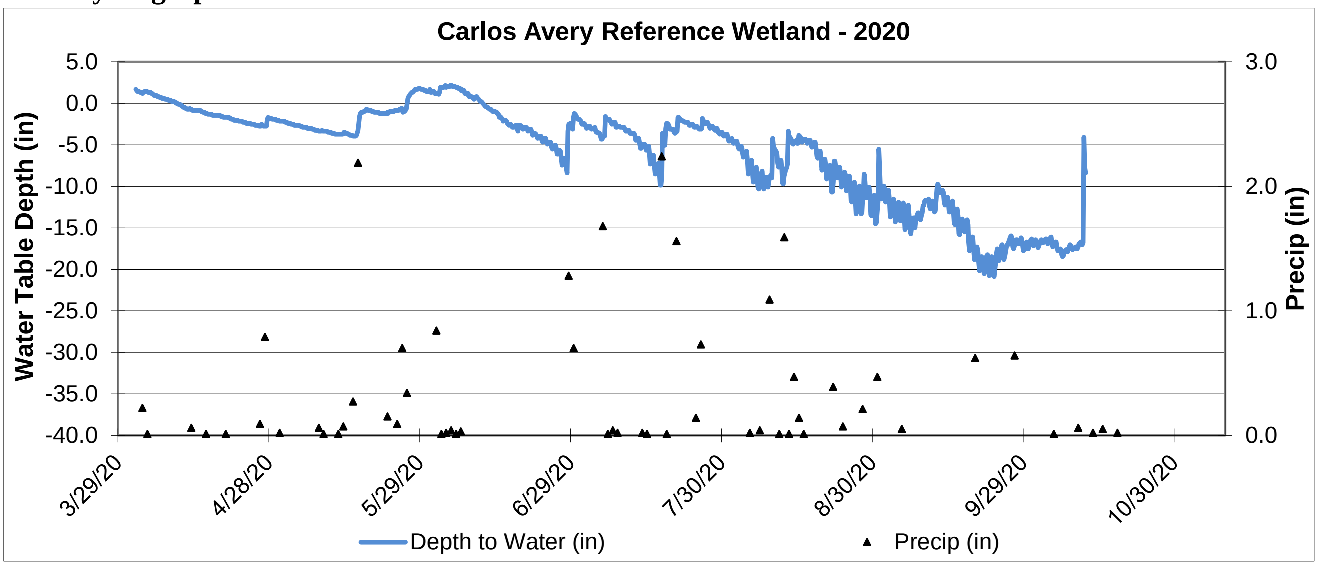
Surrounding Soils: Lino loamy fine sand

Vegetation at Well Location:

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

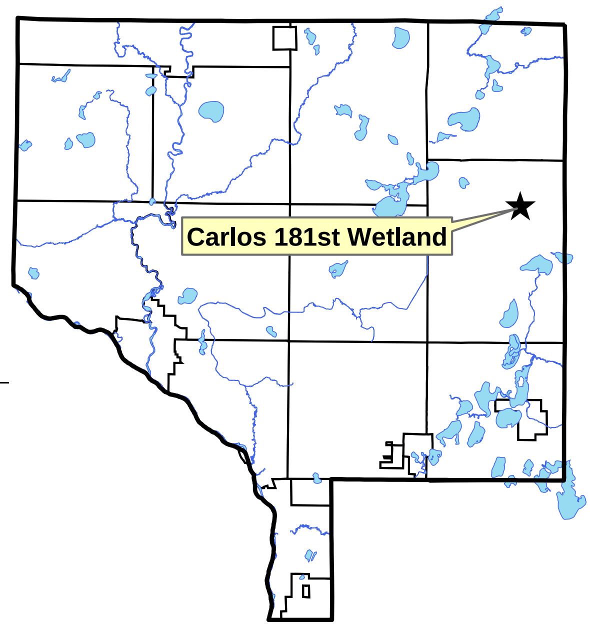
Other Notes: This is a broad, expansive wetland within a state-owned wildlife management area. Cattails dominate within the wetland.

2020 Hydrograph



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	-

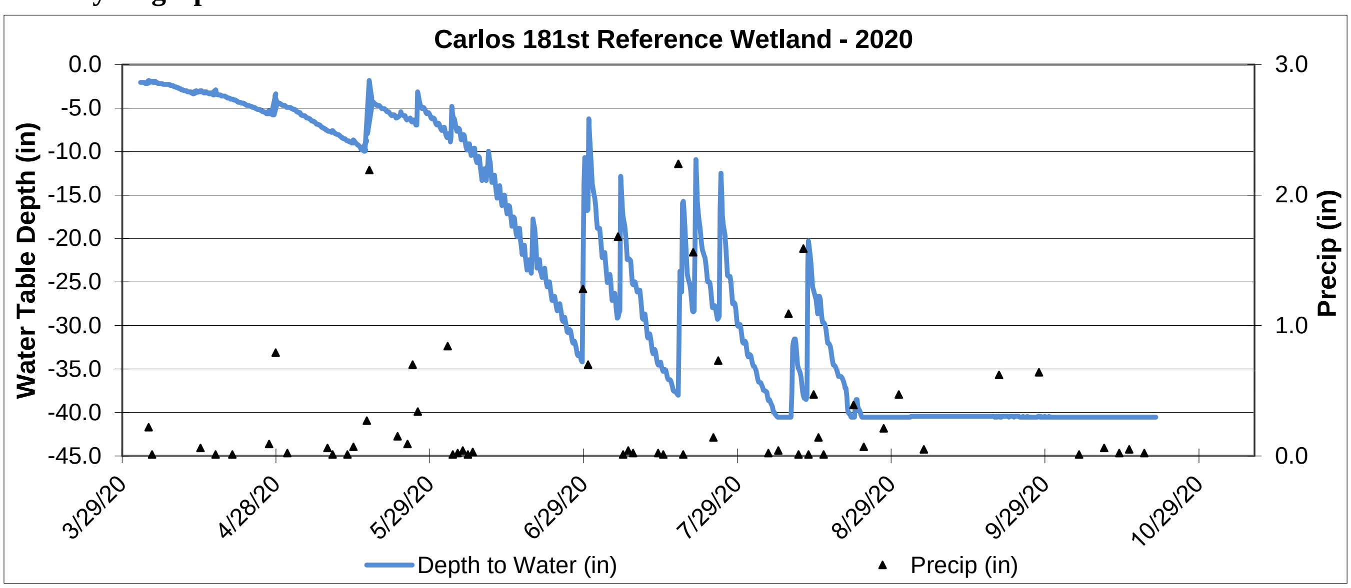
Surrounding Soils: Soderville fine sand

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

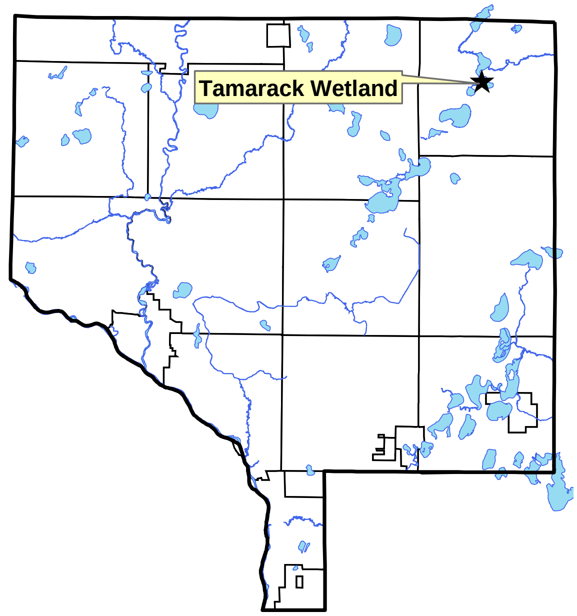
Other Notes: The site is owned and managed by the MN DNR. Access is from 181st Avenue.

2020 Hydrograph



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	-

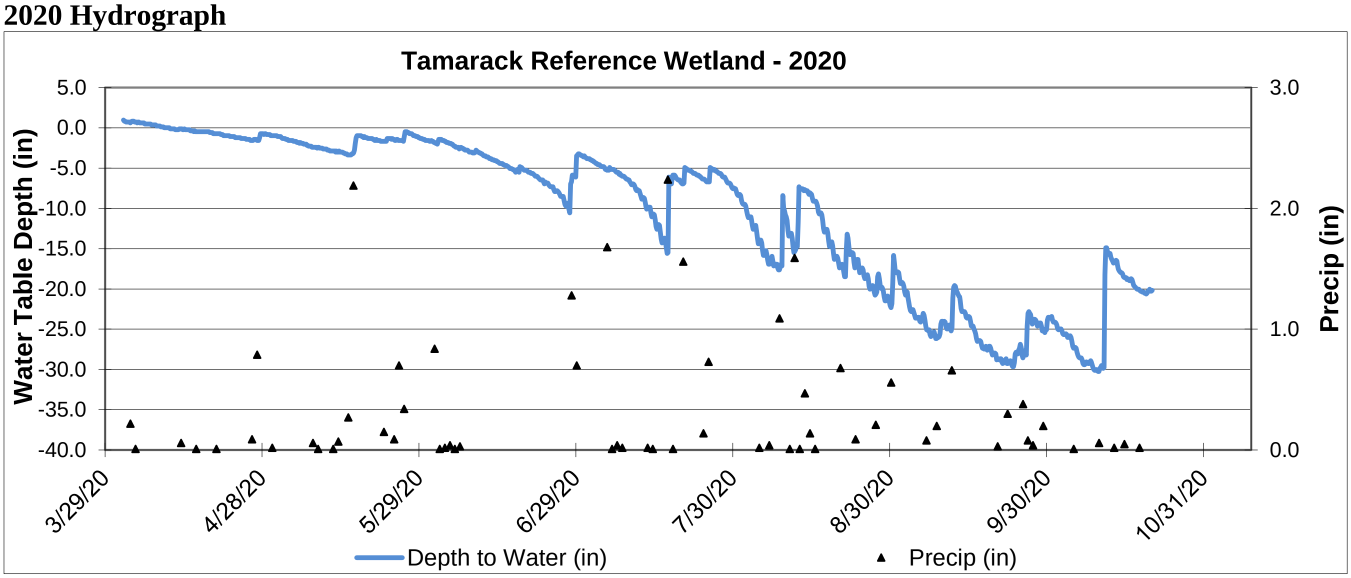
Surrounding Soils: Sartell fine sand

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.

2020 Hydrograph



Water Quality Grant Fund

Description: The Sunrise River Watershed Management Organization (SRWMO) offers cost share grants to 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 cost sharing of the materials needed for a project. The landowner is responsible for some expenses. The ACD assists interested landowners with design, materials acquisition, installation, and maintenance.

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

Locations: Throughout the watershed.

Results: Projects reported in the year they are installed.

SRWMO Cost Share Fund Summary

2005 SRWMO Contribution	+	$1,000.00
2006 SRWMO Contribution	+	$1,000.00
2006 Expense - Coon Lake, Rogers Property Project	-	$ 570.57
2007 – no expenses or contributions		$ 0.00
2008 SRWMO Contribution	+	$2,000.00
2008 Expense - Martin Lake, Moos Property Project	-	$1,091.26
2009 SRWMO Contribution	+	$2,000.00
2010 SRWMO Contribution	+	$1,840.00
2011 SRWMO Contribution	+	$2,000.00
2012 SRWMO Contribution	+	$2,000.00
2012 Expense – Linwood Lake, Gustafson Property Project	-	$ 29.43
2012 Expense – Transfer to Martin-Typo Lakes Carp Barriers	-	$4,300.00
2013 – no expenses or contributions		$ 0.00
2014 SRWMO Contribution	+	$2,000.00
2015 SRWMO Contribution		$ 0.00
2016 SRWMO Contribution		$ 0.00
2016 Expense – Voss Rain Garden	-	$1,229.31
2017 Expense – Voss Rain Garden Plants	-	$ 654.50
2017 SRWMO Contribution	+	$1,000.00
2018 Surplus Funds Returned from ACD to SRWMO Gen Fund	-	$2,000.00
2018 Expense – Gunnink Coon Lakeshore	-	$1,148.40
2019 SRWMO Contribution		$ 0.00
2020 SRWMO Contribution	+	$2,000.00
2020 Expense – Scheiderich Coon Lakeshore Restoration	-	$3,395.86
2021 Expense – Encumbered for Linwood Elementary rain garden	-	$1,030.00
Fund Balance		**$1,390.47**

Sunrise River Chain of Lakes Carp Removal Project

Description: Martin and Typo Lakes fail to meet state water quality standards due to excessive phosphorus, which fuels algae blooms. As a result, the lakes are often strongly green or brown, and the game fishery is depressed. Carp are a major cause of poor water quality in these lakes, diminishing their value for swimming, boating, and fishing. Efforts to manage and reduce carp are being undertaken to improve water quality, habitat, and the fishery.

Carp management efforts in 2020 were preceded by several actions. In 2015-2016 carp barriers were installed at four strategic locations near the inlets and outlets of both lakes to prevent carp migration, overwintering, and spawning. In 2017-2020 carp were actively removed from the lakes using an MN DNR Conservation Partners Legacy grant. Additionally, a detailed assessment of the carp population, age structure, and spawning history is being completed. A long-term management plan for carp was prepared in 2019.

A grant to continue removing carp was secured for 2020-2022 from the MN Board of Water and Soil Resources Clean Water Fund. The project goal is to remove carp down to a goal of 100 kg/ha. This is being accomplished through a variety of techniques including box netting and seining.

Purpose: To improve water quality in Typo and Martin Lakes, as well as downstream waterways.

Location: Sunrise River Chain of Lakes including Linwood, Island, Martin, and Typo Lakes.

Results: In 2020 the following work was completed:

- 739 carp were removed from Martin Lake. 5,967 carp have now been removed from this lake since 2018.
- 30 carp were removed from Linwood Lake. This was the first year of efforts at this lake. The spring seine that captured these carp had a number of radio-tagged carp in the net indicating a large catch until the net had to be lifted over obstacles.
- Planned carp removals for 2021 which will include Linwood, Martin and Typo Lakes.
- Presented results at the annual Martin Lakers Association meeting.

ACD staff, volunteers and Carp Solutions staff with carp removed from Martin Lake (left image) by box net (right). Carp were removed with box traps.

Coon and Martin Lakes Stormwater Retrofits Project

Description: Installation of projects to treat stormwater that is otherwise discharged into Coon or Martin Lakes with little or no treatment. Projects were identified and ranked in stormwater assessment studies.

Purpose: To improve lake water quality.

Location: Coon and Martin Lakes.

Results: Outreach to owners priority project locations was conducted. Of more than a dozen approached, three were interested in construction. Those projects were designed, bid and constructed. Two stormwater pond renovations will reduce 3.31 lbs of phosphorus and 2,240 pounds of sediment loading to Martin Lake. One rain garden will reduce 1.25 lbs of phosphorus and 379 pounds of sediment loading to Martin Lake.

Project funding is from a 2019 State Watershed Based Implementation Funding grant to the Sunrise River WMO. Funding remains to install additional projects in 2021.

Photos of stormwater retrofit projects constructed in 2021.


Stormwater pond rehabilitation—Martin Lake


Stormwater pond rehabilitation—Martin Lake


Rain garden —Coon Lake

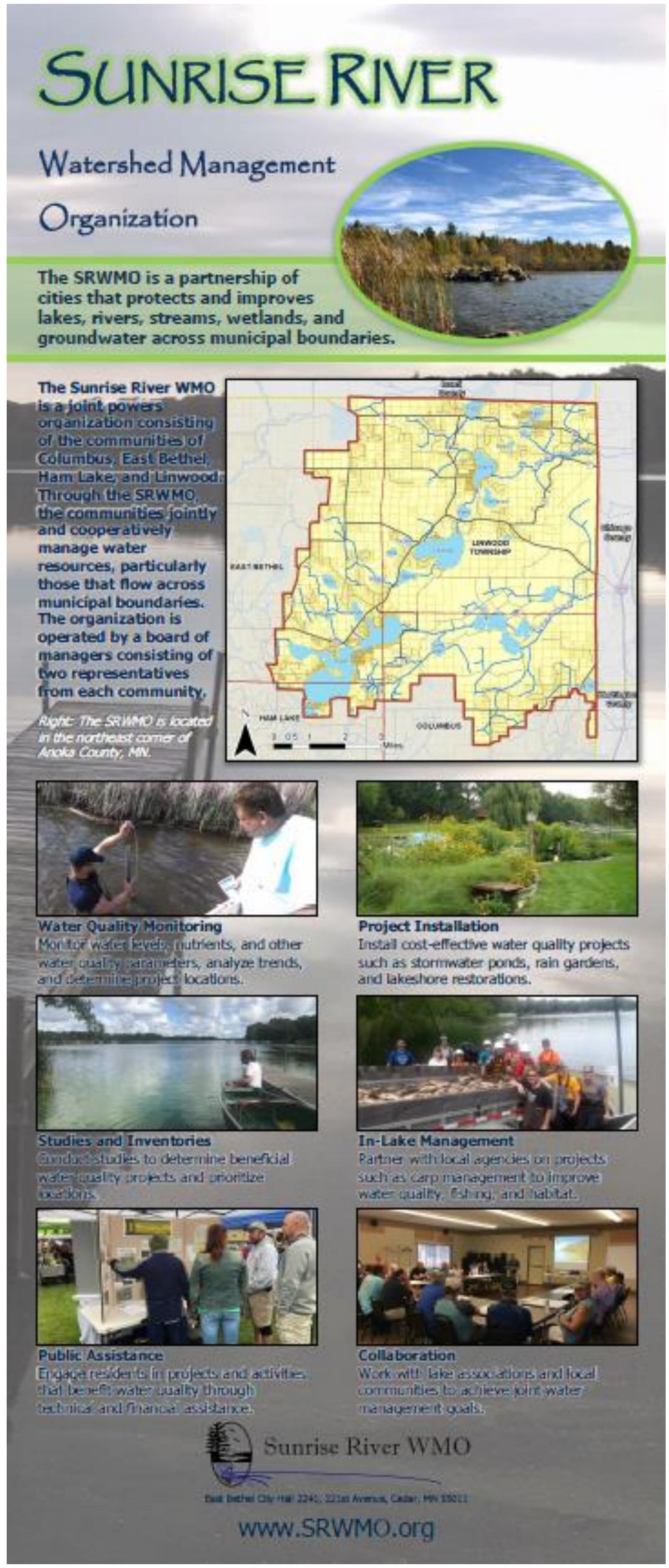
Booth/Display for Community Events

Description: Design a professional display with input from the SRWMO board.

Purpose: Highlight the SRWMO, projects and the types of natural resources found in the watershed.

Location: Watershed-wide

Results: ACD developed a professional display to be used at community events which showcases the SRWMO and the work being done in the watershed. Unfortunately, community events were cancelled in 2020 due to Covid-19, but the display is ready for subsequent use.



Secchi Transparency Lake Monitoring (Volunteer Coordination)

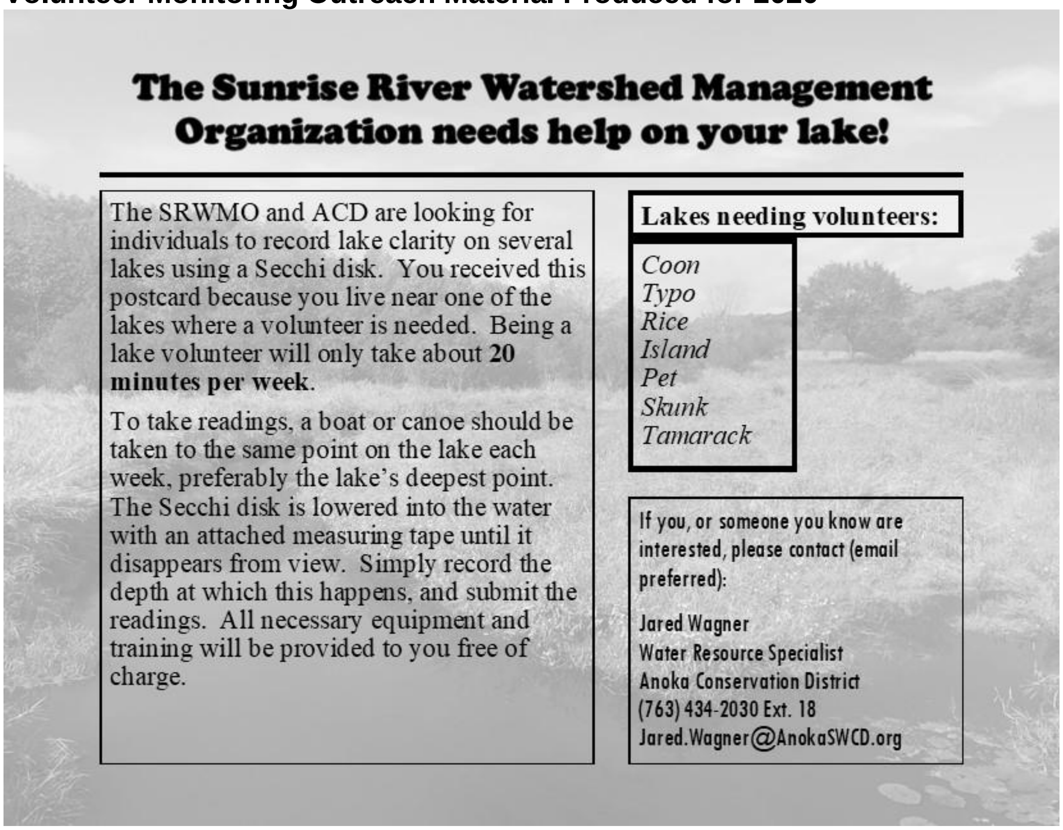
Description: Recruit local residents to participate in the State's volunteer Secchi monitoring program on lakes in the Sunrise Watershed.

Purpose: Get new volunteers enrolled in in the Citizen Monitoring Program.

Location: Coon, Typo, Rice, Island, Pet, Skunk, and Tamarack Lakes.

Results: ACD developed outreach material and conducted a targeted mailing based around 7 lakes in the watershed that are not currently enrolled in the Citizen Monitoring Program. Two new Secchi volunteers were established on Island and Typo Lake for the 2020 season, and both volunteers plan on participating through 2021. Additional outreach to secure volunteers at the remaining lakes is planned for 2021.

Volunteer Monitoring Outreach Material Produced for 2020



Annual Education Publications

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

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

Location: Watershed-wide

Results: In 2020 the SRWMO contracted with the ACD to prepare its annual education publications. Materials, shown below, were prepared for community newsletters, lake association newsletters and the local newspaper.

Articles for community newsletters

Sunrise River
Watershed Management Organization

The Sunrise River Watershed Management Organization and its partners are releasing a new video titled "Our Lakeshore Connection." The video explains the inner workings of lakes and what lakeshore owners can do on their own property to improve lake health.

To watch, visit the "videos" tab at www.SRWMO.org.

The SRWMO is partnering with the Anoka Conservation District to offer technical help and grants to homeowners wishing to do projects that benefit an area lake or stream, such as correct shoreline erosion or install native plant buffers. For more information contact Jamie Schurbon at 763-434-2030 ext. 21.

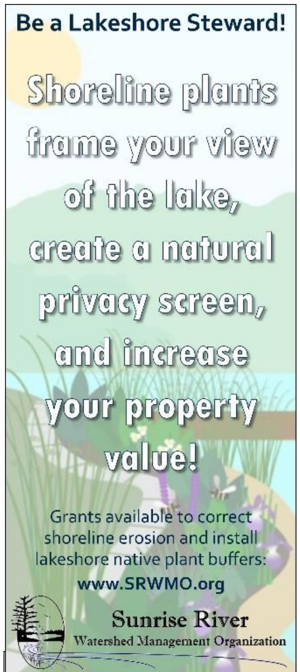
The SRWMO is a joint organization of the cities of East Bethel, Ham Lake, Columbus and Linwood Township for the purpose of managing local water issues. The SRWMO also participates in management of the larger Lower St. Croix Watershed (more info at www.lsc1w1p.org).

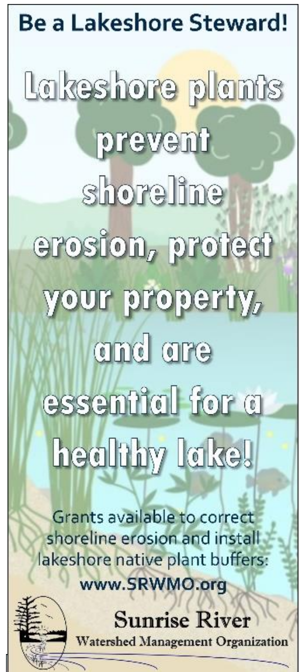
Septic System Fix Up Grants Available
Sunrise River Watershed Management Organization, www.SRWMO.org

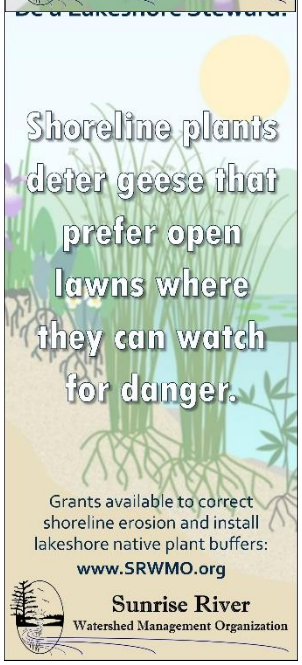
A properly functioning septic system provides effective treatment of wastewater, but if a system is neglected, it could cost thousands of dollars to repair and potentially contaminate local groundwater and surface water supplies, putting the health of your family and neighbors at risk.

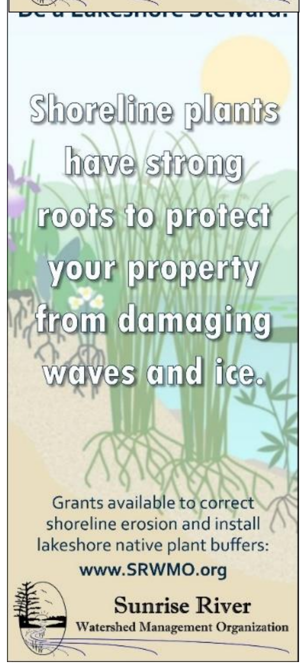
Septic system fix up grants are available that can pay for 80-90% of the cost of fixing or replacing a septic system. Applicants must meet low income criteria. To apply or learn more, contact Aaron Diehl at the Anoka Conservation District (763-434-2030 ext. 16 or aaron.diehl@anokaswcd.org).

Infographic series for lake association newsletters









Article for local newspapers

Who Owns the Water?

While paddling, my youngest son asked, "who owns the river?" As he has come to understand the world, everything is owned by someone. And that someone gets to say who else can enjoy it. And they may defend that thing from others. So who owns the water?

I emphatically replied, "you do!" And followed with the clarification, "not just you, but everyone. Can you believe all of this is partly yours?"

A lot of questions followed including "so I can go anywhere I want on the river?" Yes, pretty much. "What about lakes?" Yes, you are part owner of lakes too. You are completely welcome to enjoy them. "Can I do anything I want on the river?"

That last question is a little trickier, or perhaps a trick hoping I'll keep rolling with "yes" answers. The answer involves the word youngsters dread most: Sharing. Our waters are a shared resource. We care for them together. While we do have agencies that manage natural resources, they are in some large part trying guiding the rest of us "owners." Managing water is tricky because the waterbody can't be managed on its own. Lands drain to and affect the water.

It would seem that shoreline owners are the most important stewards of lakes and rivers based on proximity. Their actions can indeed make the shared resource better for all, or consume or degrade it. It's easy to find examples. We paddled past a shoreline full of trees and wildflowers along the bank – an owner that used what could have been manicured yard to add to the wildness and quietness of river.

I'm also reminded of another kid question, "where does the water go after it enters the gutter at the side of the street." Sometimes it goes to a stormwater pond or other place designed to at least partially clean it up, and then on to a river, stream or wetland. Or, sometimes it just goes straight to the waterbody. There are rural equivalents where water that starts far away reaches a lake or stream.

It turns out, we'll all shoreline owners in a sense. No matter where we live, water runs off to rivers, lakes, and groundwater. Responsible use of chemicals and fertilizers, preventing erosion, and improving habitat all add to, or detract from, our waters. Collectively, small actions make a big difference.

Many towns closely identify as being proudly in proximity to a waterbody. City of Forest Lake. Linwood Township (which contains Linwood Lake). Sunrise (on the Sunrise River). North Branch (on the North Branch of the Sunrise River). Cambridge (welcome signage says "City on the Rum River"). Taylors Falls. St. Croix Falls. You get the idea.

We identify with our waters. The quality and cleanliness of a waterbody is a mirror of our lands that drain to it. Seemingly accepting the lesson faster than most of us adults, during a brief stop on our paddling trip the youngest member of our group tossed some trash he found into his kayak. "If this is my river, I'd rather it be clean."

SRWMO Website

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

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

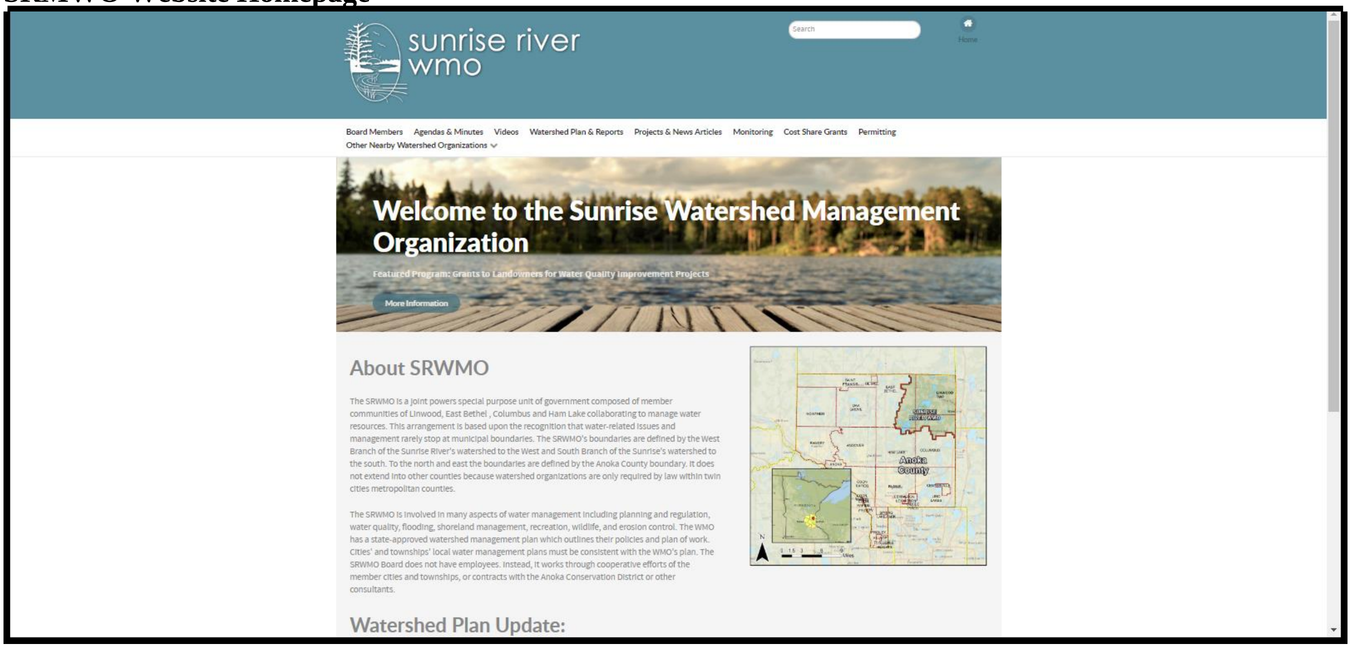
Location: www.SRWMO.org

Results: In 2020 routine SRWMO website updates were performed. The new website includes:

- Directory of board members,
- Meeting minutes and agendas,
- Watershed management plan and annual reports,
- Descriptions of work that the organization is directing,
- Highlighted projects,
- Informational videos,
- Maps of the URRWMO.

The website is regularly updated throughout the year.

SRMWO Website Homepage



Grant Searches and Applications

Description: The Anoka Conservation District (ACD) partners with the SRWMO for 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 2020 the SRWMO pursued several grants and positioned itself for others. They included:

1. **A MPCA grant for $25,447 was secured to fix up failing septic systems** for low-income homeowners. The Anoka Conservation District holds this grant, which must be used county-wide. In the SRWMO since 2018 this program fixed septic systems at Martin, Fawn, and Coon Lakes.
2. **Lower St. Croix 1W1P Watershed Based Funding for $1,236,531.** This non-competitive State grant funds projects in the SRWMO Watershed Management Plan, the Lower St. Croix One Watershed One Plan (1W1P) and a few other eligible plans. The SRWMO participated in developing the grant work plan that includes funding for subwatershed assessments studies (Linwood Lake is a candidate in the work plan), internal loading analysis (Martin & Linwood Lakes), wetland restoration (Ditch 20 draining to Typo Lake) and public outreach programming serving the SRWMO area. Exact project sites and funding amounts are still being determined.

Since 2014, the following grants have been secured for SRWMO projects though the assistance of the Anoka Conservation District:

2014 Martin and Typo Lake Carp Barriers, site 2	MN DNR CLP	$ 35,770
2014 Martin and Typo Lake Carp Barriers, sites 1,3,4	MN DNR CLP	$399,983
2014 Coon Lake Area Stormwater Retrofits	BWSR CWF	$ 42,987
2015 Ditch 20 Wetland Restoration Feasibility Study	BWSR CWF	$ 72,400
2017 Martin and Typo Lake Carp Harvests	MN DNR CLP	$ 99,000
2017 Septic System Fix Up Fund*	MPCA	$ 23,040
2018 Watershed Based Funding	BWSR WBF	$156,750
2018 Septic System Fix Up Fund*	MPCA	$ 27,055
2019 Septic System Fix Up Fund*	MPCA	$ 40,000
2019-20 Surface Water Monitoring Grant, Sunrise R	MPCA	$ 5,102
2019 Sunrise River Chain of Lakes Carp Mgmt	BWSR CWF	$148,000
2020 Septic System Fix Up Fund*	MPCA	$ 25,447
2020 Lower St. Croix Watershed Based Funding	BWSR WBIF	$ TBD
	TOTAL	$1,075,534

*Septic system fix up funds are available county-wide. Only the amount used in the SRWMO is reported.

SRWMO Annual Report to BWSR and State Auditor

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

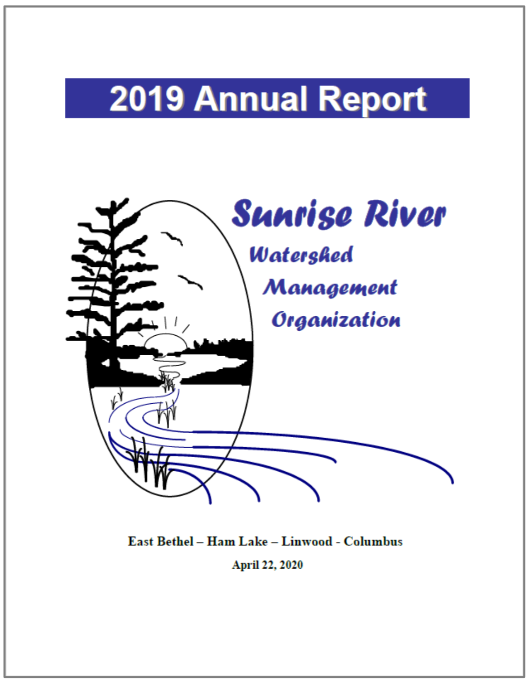
The SRWMO must also submit an annual financial report to the State Auditor. They accept unaudited financial reports for financial districts with annual revenues less than $185,000.

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

Locations: Watershed-wide

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

Cover



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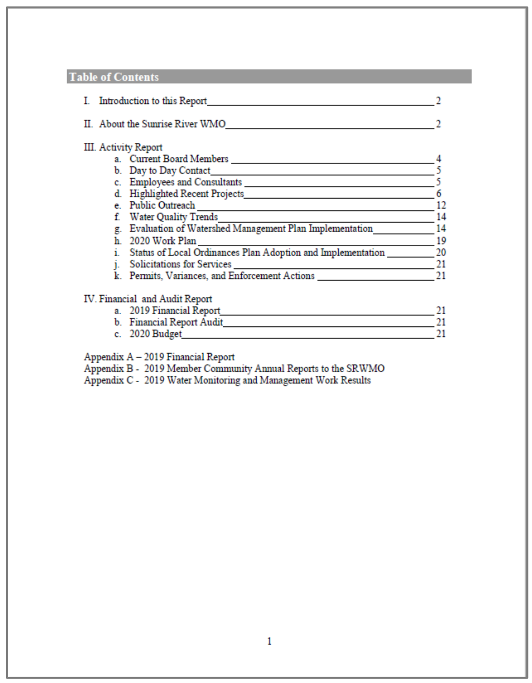

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On-call Administrative Services

Description: The Anoka Conservation District Watershed Projects Manager provides limited, on-call administrative assistance to the SRWMO. Tasks are limited to those defined in a contractual agreement.

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

Results: In 2020 administrative assistance provided to the SRWMO by the Anoka Conservation District included:

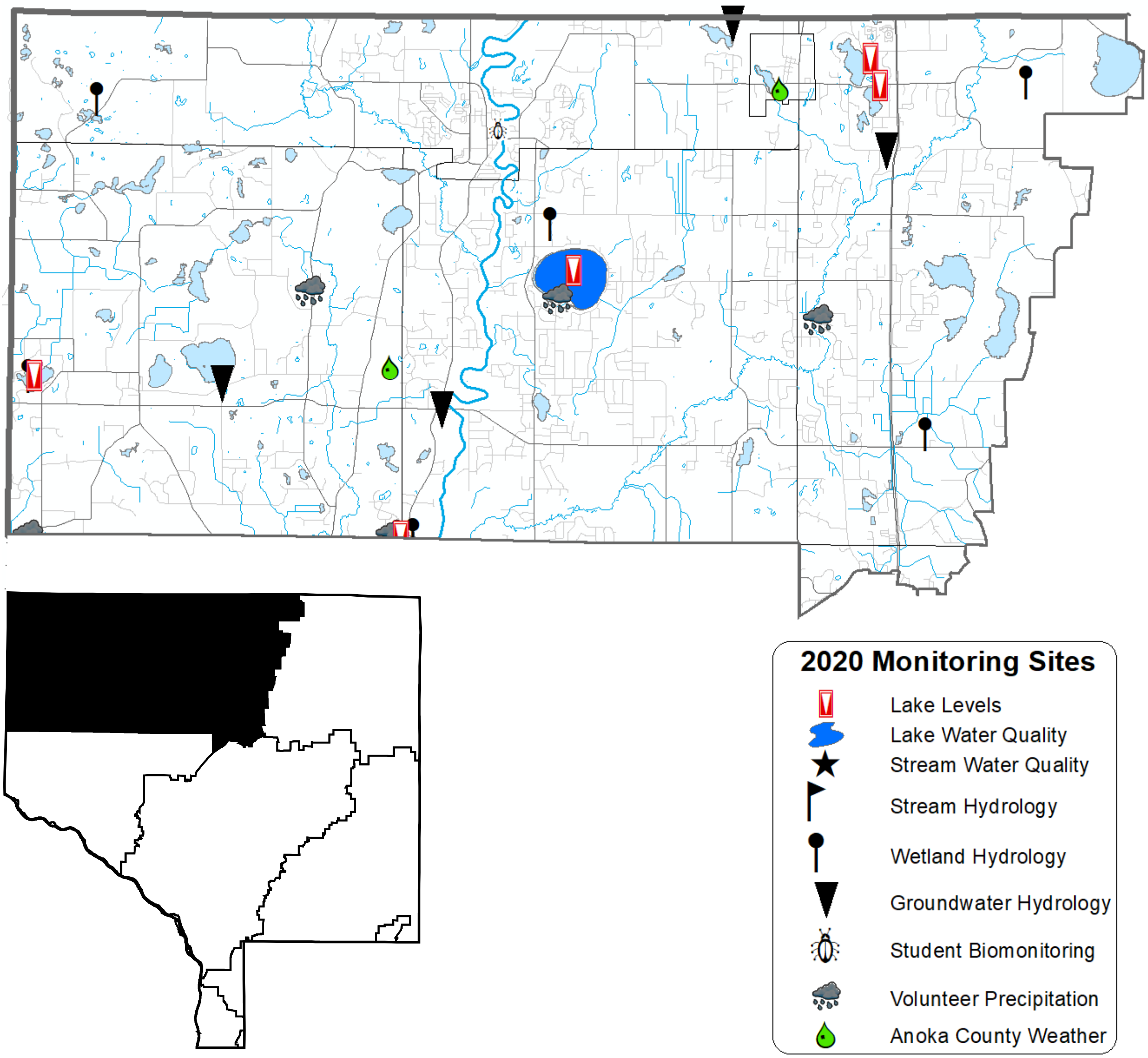
- Prepared board meeting packets. Facilitated meetings and meeting planning. Set up and hosted online meetings when necessary.
- Recruited a new Recording Secretary. Took meeting minutes during the interim. Reviewed each month's minutes.
- Prepared a draft 2021 budget for the SRWMO and subsequent revisions.
- Ordered and facilitated an audit-like agreed upon procedures review with an auditor.
- Prepared financial management policies for board approval, as recommended by the auditor.
- Addressed financial and budgeting concerns from Ham Lake, including multiple meetings.
- Provided Columbus with data for several different cost-splitting scenarios amongst member communities.
- Responded to a public information request for SRWMO finances from a company who apparently develops and sells marketing lists.
- Worked with the East Bethel Finance Director to update the SRWMO's ledger and incorporate tracking of an undesignated reserve fund.
- Brought two cost share grant applications to the SRWMO board for consideration – a Coon Lakeshore restoration and rain garden at Linwood Elementary School.
- Reviewed community ordinances for consistency with SRWMO standards. Follow-up continues in order to bring ordinances up to speed.
- Reviewed and provided recommended SRWMO actions on community local water plans.
- Reviewed a jurisdictional boundary adjustment proposal from the Rice Creek Watershed District.
- Created a new template for city reporting to the SRWMO. Solicited and received annual reports.
- Completed a risk assessment process with the SRWMO's insurer.
- Met with the DNR and County Highway Department to lobby for repair of the Linwood Lake outlet – a task in the SRMWO Plan.
- Fielded questions from board members on a variety of issues affecting the SRWMO.
- Represented the SRWMO at staff level meetings of the Lower St. Croix One Watershed One Plan. Reported back to the SRWMO board, including facilitating discussion about implementation organizational arrangements (JPC vs JPE).
- Fielded permitting questions from the county highway department and builders.

Recommendations

- **Implement the SRWMO Watershed Management Plan that was approved in 2019.** The plan reflects the latest science and includes schedules for various projects.
- **Request Watershed Based Funding from the Lower St. Croix One Watershed, One Plan group.** Highest priority projects for which there is funding include a Linwood Lake subwatershed assessment study, wetland restoration at Ditch 20, and internal loading study for Linwood or Martin Lake.
- **Continue carp removals at Martin and Typo Lakes and begin carp management at Linwood Lake.** A State Clean Water Fund grant will support this work in 2020-2022.
- **Collaborate with the Anoka County Outreach Coordinator.** Modest SRWMO funding can serve as match for WBIF or other funding which results in more work in the SRWMO.
- **Continue installation of stormwater retrofits around Coon and Martin Lakes** where completed studies have identified and ranked projects. The grant expires in Dec. 2021.
- **Update the SRWMO joint powers agreement** to address out of date material and the lack of a dispute resolution mechanism.
- **Continue prioritizing strategic water quality monitoring** to assess baseline conditions, diagnose problems and determine the effectiveness of new water quality projects. The data help with strategically implementing grant funds and local funds to provide the largest water quality benefit possible at the lowest cost.
- **Promote Septic System Fix-up Grants to landowners,** particularly in shoreland areas.
- **Bolster lakeshore landscaping education efforts.** The SRWMO Watershed Management Plan sets a goal of three lakeshore restorations per year. Lakeshores were mapped in 2019 and 2020 by the Anoka Conservation District so that future outreach can be targeted.
- **Replenish the SRWMO's cost share grant fund.** After two funded projects in 2020, approx. $1,300 remains.

Chapter 3: Upper Rum River Watershed

Prepared by the Anoka Conservation District


2020 Monitoring Sites
Lake Levels
Lake Water Quality
Stream Water Quality
Stream Hydrology
Wetland Hydrology
Groundwater Hydrology
Student Biomonitoring
Volunteer Precipitation
Anoka County Weather

Lake Levels

Partners: URRWMO, ACD, MN DNR, volunteers

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

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

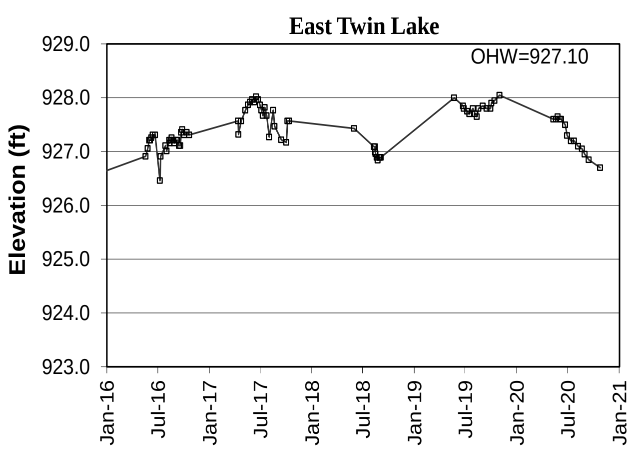
Locations: East Twin Lake, Lake George, Rogers Lake, Minard Lake

Results: Lake levels were measured by volunteers throughout the 2020 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. In 2020, lake levels started near average and declined throughout the season. The rebound often seen in the fall was not observed. This is likely due to infrequent rain events throughout the season and the lowest annual total precipitation since 2012.

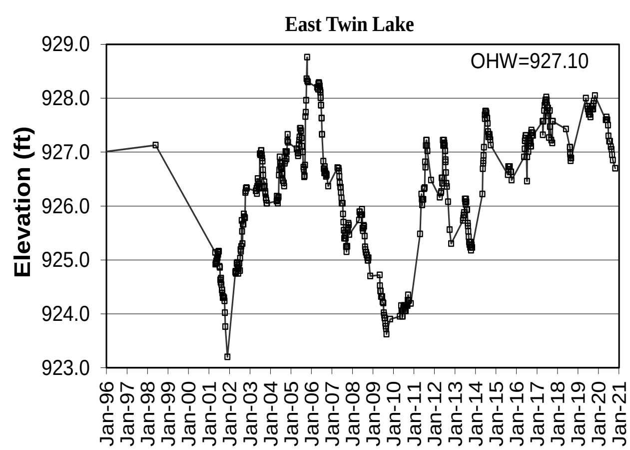
All lakes recorded lower water levels on average than in 2019 but were similar to averages observed throughout the past 5 years. Water levels on Lake George reached its lowest level since 2013 and Rogers Lake since 2015.

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

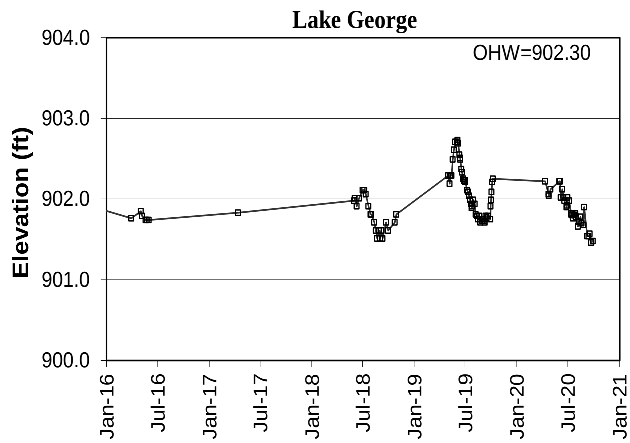
East Twin Lake Levels – last 5 years



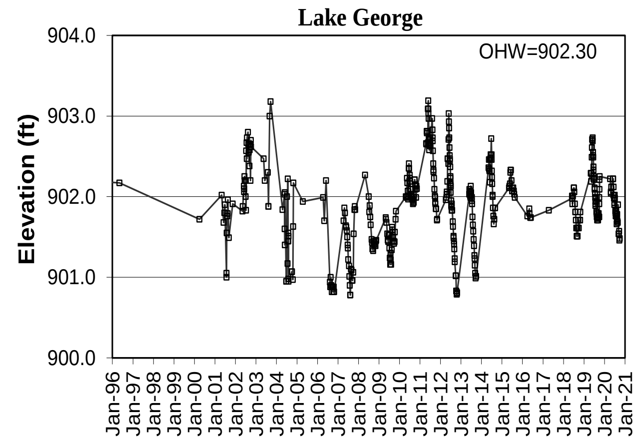
East Twin Lake Levels – last 25 years



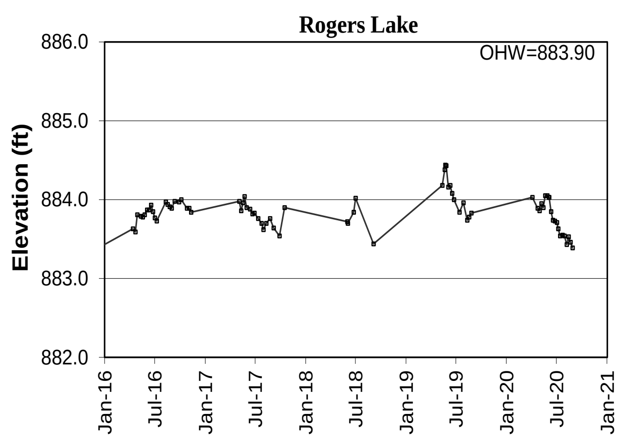
Lake George Levels– last 5 years



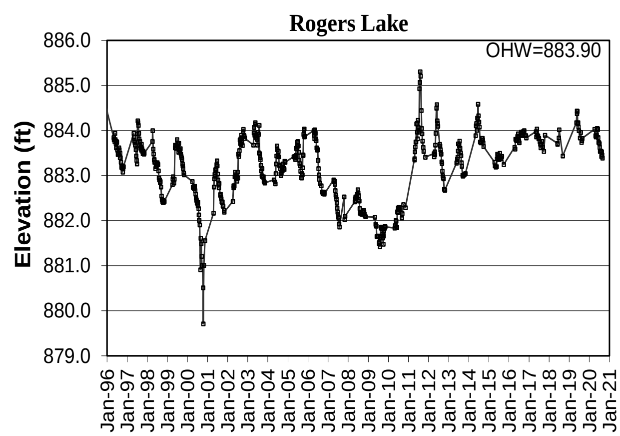
Lake George Levels – last 25 years



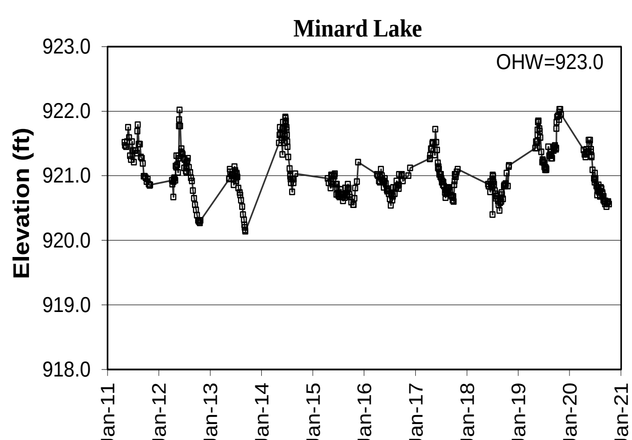
Rogers Lake Levels – last 5 years



Rogers Lake Levels – last 25 years



Minard Lake Levels – last 10 years



Lake	Year	Average	Min	Max
Rogers	2016	883.85	883.59	884.00
	2017	883.81	883.54	884.04
	2018	883.74	883.44	884.02
	2019	884.08	883.74	884.44
	2020	883.76	883.39	884.05

Lake	Year	Average	Min	Max
George	2015	902.14	901.99	902.33
	2016	901.77	901.74	901.85
	2018	901.79	901.51	902.11
	2019	902.12	901.71	902.73
	2020	901.86	901.46	902.22

Lake	Year	Average	Min	Max
East Twin	2016	927.17	926.46	927.41
	2017	927.67	927.17	928.02
	2018	927.00	926.84	927.43
	2019	927.83	927.65	928.05
	2020	927.28	926.70	927.65

Lake	Year	Average	Min	Max
Minard	2016	927.17	926.46	927.41
	2017	921.00	920.60	921.72
	2018	920.80	920.40	921.16
	2019	921.50	921.09	922.03
	2020	920.94	920.52	921.55

Lake Water Quality

Partners: ACD, Lake George LID and Conservation Club, URRWMO

Description: May through September, every-other-week, monitoring is conducted for the following parameters: total phosphorus, chlorophyll-a, Secchi transparency, dissolved oxygen, turbidity, temperature, Specific Conductivity, pH, and salinity.

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

Locations: Lake George

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

Upper Rum River Watershed Lake Water Quality Monitoring Sites

Lake George
City of Oak Grove, Lake ID # 02-0091

Background

Lake George is located in north-central Anoka County. The lake has a surface area of 535 acres with a maximum depth of 32 feet (9.75 m). Public access is from Lake George County Park on the lake's north side, where there is both a swimming beach and boat launch. About 70% of the lake is surrounded 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.

2020 Results

In 2020, Lake George had excellent water quality for this region of the state (NCHF Ecoregion), receiving an overall A letter grade for the third year in a row. Secchi transparency individually earned a B grade. These results are similar to what was recorded before 2009, when the majority of monitoring years scored an A. Since 2009 the majority of monitoring years have scored a B letter grade. The driving factor being declining secchi transparency.

Results for individual water quality parameters varied. Total phosphorus in 2020 averaged 20.3 µg/L, the lowest since 2005. Secchi transparency was high early in the season, but dropped to a low of 5.0 feet in early September. Average Secchi transparency was 9.24 feet, which was more than a half a foot improvement from 2019. Chlorophyll-a (Cl-a) averaged 8.0 µg/L, which was similar to the levels of previous years. Cl-a, TP and transparency were all poorest in early September, but throughout the season all three parameters were better than the State water quality standard for deep lakes in this region.

Although Lake George water quality remains better than State standards and is ranked good for a metro-county lake, simply adhering to these standards isn't the goal for such an important water body. Decline of Lake George's Secchi transparency has been a cause for concern in recent years with a now twenty-year trend of decline bearing out in statistical analyses. The last three years have shown improving clarity but these results are most likely linked to the below average precipitation occurring in 2018 and 2020. 2019 had the highest annual rainfall on record for the state, but secchi averages remained improved due to higher readings being recorded at the beginning of the season.

Trend Analysis

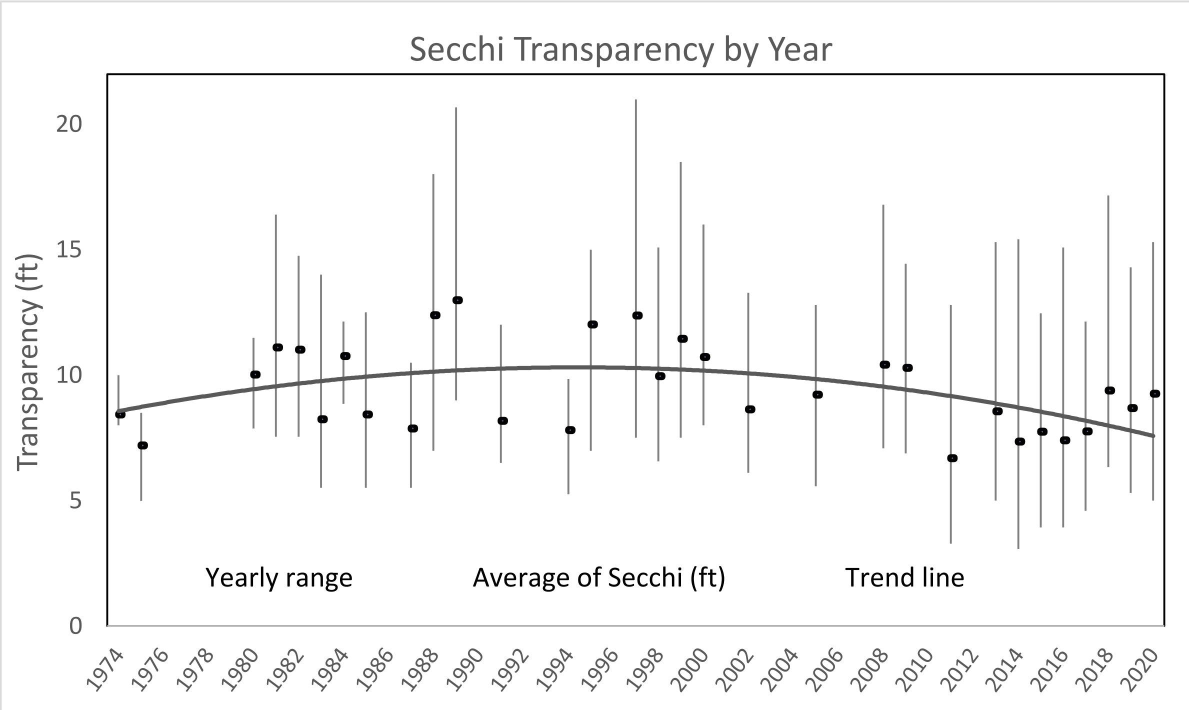
Over thirty years of water quality data have been collected by the Metropolitan Council (between 1980 and 2009) and the Anoka Conservation District (1997, 1999, 2000, 2002, 2005, 2008, 2011, 2013- 2020). A broad analysis of overall water quality that simultaneously considers TP, Cl-a and Secchi transparency did not find a statistically significant trend looking at all years of data (repeated measures MANOVA with response variables TP, Cl-a, and Secchi transparency, $p=0.46$). When parameters are isolated for individual analysis, there is no significant change in Cl-a or TP. However, during this same period there is a statistically significant trend of declining Secchi transparency ($p=<0.01$). When sampling years' 1995-2020 are isolated declining Secchi transparency again shows a statistically significant decline ($p<0.05$).

When we isolate just the last 10 years (2011-2020) we do see a statistical significant trend of improving water quality when looking at all parameters (repeated measures MANOVA with response variables TP, Cl-a, and Secchi transparency, $p<0.05$). When parameters are isolated for individual analysis both TP and Secchi transparency have improved on a statistically significant basis ($p<0.05$).

Lake George

CITY OF OAK GROVE, LAKE ID # 02-0091

Lake George Secchi transparency trend: Includes years with partial datasets not covering all open water months. Those years are excluded from ACD's statistical analysis and graphs later in the document.



Discussion

Lake George remains one of the clearest of the Anoka County lakes, but a trend of declining Secchi transparency from the mid-1990s through 2017 caused concern. Lake George is a highly valued lake due to its recreational opportunities and ecological quality. The lake has a large park, many lakeshore homes, and a notably diverse plant community (most metro area lakes have 10-12 different aquatic plant species; Lake George is home to 24).

In 2018 an intensive study of the lake and its watershed titled "Lake George Water Quality Improvement Assessment" was completed. Work from 2016-2018 included monitoring of tributaries, modeling, and evaluation of projects to correct the transparency decline. The work focused on the watershed, and a "phase 2" study of in-lake processes may occur in the future. The study was funded by the Lake George Improvement District, Lake George Conservation Club, Anoka Conservation District, and a State Clean Water Fund grant.

The aforementioned study provides some insight into the causes of transparency decline. While a number of factors may play a role, an increase in the average amount of precipitation falling is the most significant driver identified. Water Years (Oct. 1 – Sept. 30) that are wetter than the 100-year 90th percentile result in increased volumes of runoff and nutrients into the lake from surrounding tributaries, and the lake has poorer clarity in those years, or in immediately subsequent years.

These "wet" years were more frequent during the period that lake transparency has declined. Six out of sixteen years from 2001 to 2017 were "wet" with water year precipitation above the historical 90th percentile, with 1999 reaching just under the 90th percentile mark. Additionally, four of these six wet years occurred during the sustained low Secchi transparency period of 2010 through 2017.

Water year precipitation returned to normal levels in 2017 and 2018, causing a temporary rebound in average Secchi transparency during the most recently monitored years. The 2019 calendar year was the wettest on record. Secchi results in 2019 were only slightly poorer than the improved 2018 results, but that average was likely skewed by much higher readings earlier in the season, with poorer readings later. The correlation between precipitation and Secchi clarity was again observed in 2020. Total annual precipitation in 2020 was the lowest since 2012 which resulted in again improved Secchi clarity throughout the year. It is likely that a wet 2020 following the wet 2019 would have caused clarity to further decline.

There is concern that climate change and increased runoff from development in the watershed will drive poorer water quality in Lake George into the future. Among the recommendations of the 2018 study was replacing the deteriorating Ditch 19 weir just east of Lake George which is an important hydrological control for the lake. The weir was replaced in early 2020, and this project may have offered some additional clarity benefit right away. This replaced outlet structure should result in reduced nutrient delivery to the lake during wet years, and the broader benefits of restoring lake hydrology and enhancing game fish spawning opportunities. Other actions identified in the watershed study include agricultural best practices, an iron-enhanced sand filter, public education, lakeshore restorations, enhanced stormwater standards for new developments in the lakeshed and others. While certain tributary subwatersheds do generate more nutrients than others, and therefore deserve special consideration for projects, it is also noted that some of these subwatersheds drain through large wetlands with some apparent pollutant removal ability which must be considered when siting projects. Projects nearest the lake are favored because they treat a larger upstream area and don't duplicate treatment that might already be provided by certain wetlands.

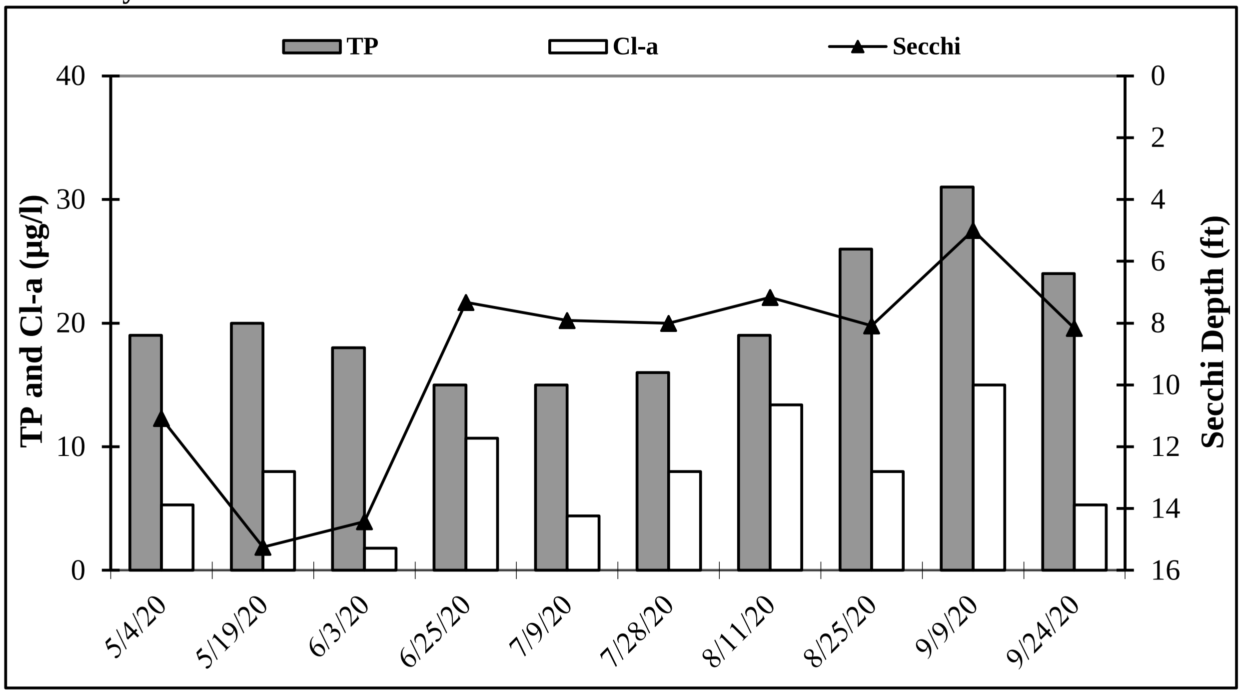
An additional concern for Lake George is noted in *the 2017 Rum River Watershed Fish-Based Lake IBI Stressor Identification Report* by the MN DNR. That report found Lake George's fish community was not impaired, but was one of special concern and deemed vulnerable. Lack of aquatic habitat and near-shore development disturbances were indicated as stressors. To help address this concern The Anoka Conservation District received a grant to implement lakeshore restoration projects on the lake in 2021-2022. These types of practices promote native lakeshore habitat while also reducing phosphorus loading into the lake.

Two exotic invasive plants are present in Lake George, curly-leaf pondweed and Eurasian water milfoil. The Lake George Improvement District and Lake George Conservation Club work to control these plants, and multiple years of localized treatments have occurred. In coordination with the MN DNR, the lake groups continually work to achieve control of these invasive plants without harming native plants or water quality. Water quality has been monitored immediately before and after herbicide treatments, and no obvious causal relationship between weed treatment and water quality was found.

Lake George

City of Oak Grove, Lake ID # 02-0091

2020 Daily Results



2020 Median Values

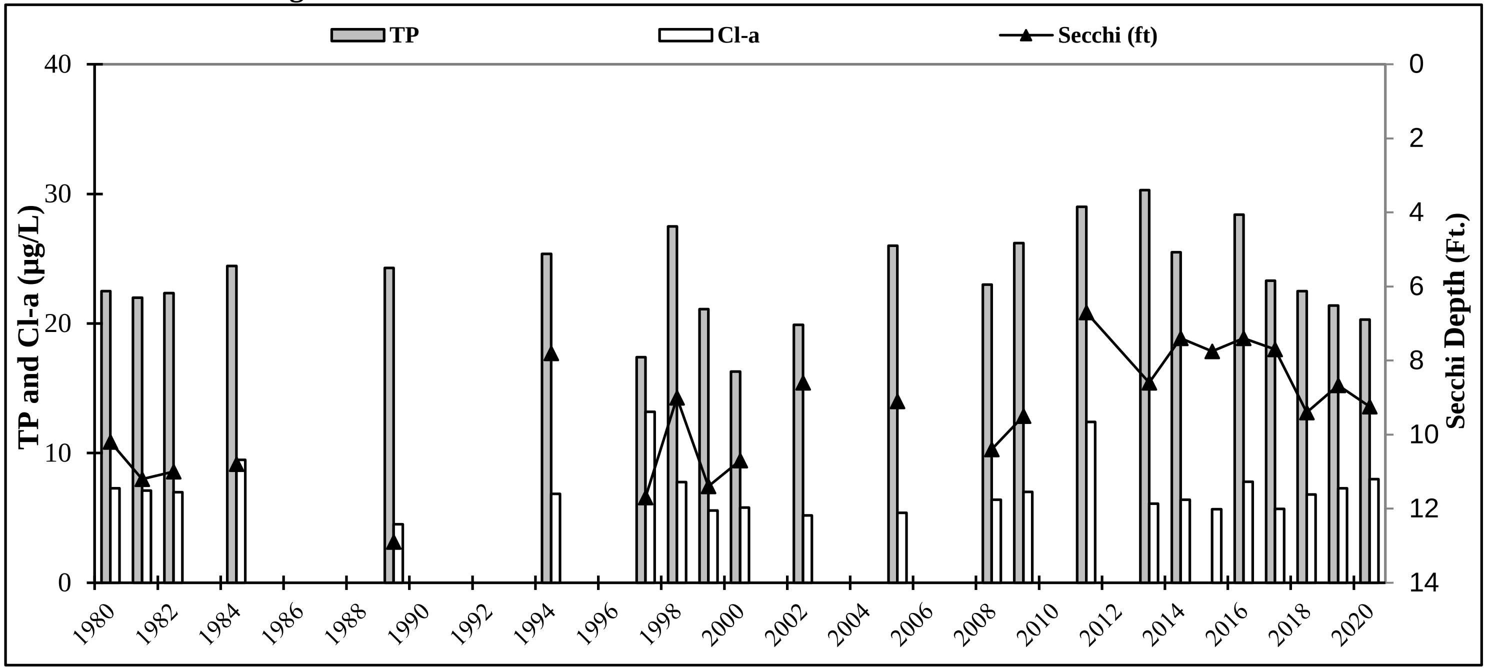
pH		8.25
Specific Conductivity	mS/cm	0.21
Turbidity	NTU	7.35
D.O.	mg/l	9.40
D.O.	%	109.5
Temp	°F	72.89
Salinity	%	0.10
Cl-a	µg/L	8.00
T.P.	µg/l	19.00
Secchi	ft	8.04

Lake George
2020 Water Quality Data

		Date:	5/4/2020	5/19/2020	6/3/2020	6/25/2020	7/9/2020	7/28/2020	8/11/2020	8/25/2020	9/9/2020	9/24/2020			
		Time:	12:25	10:15	9:00	9:15	9:15	9:30	8:55	9:10	9:15	9:05			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.98	8.29	7.83	8.32	8.19	7.82	8.20	8.71	7.98	8.43	8.28	7.82	8.98
Specific Conductivity	mS/cm	0.01	0.211	0.214	0.215	0.210	0.208	0.206	0.204	0.202	0.203	0.203	0.208	0.202	0.215
Turbidity	NTU	1	0.00	4.70	12.40	16.30	15.70	7.300	13.90	4.20	7.40	2.20	8.52	0	16
D.O.	mg/l	0.01	11.04	9.68	10.78	9.40	7.95	8.22	9.28	9.40	8.17	10.14	9.41	7.95	11.04
D.O.	%	1	109.8	96.1	127.0	114.0	109.1	103.5	108.0	119.1	87.7	110.8	108.5	87.7	127.0
Temp.	°C	0.1	13.76	13.95	21.94	23.49	28.55	25.98	23.95	25.81	18.26	18.13	21.4	13.8	28.6
Temp.	°F	0.1	56.8	57.1	71.5	74.3	83.4	78.8	75.1	78.5	64.9	64.6	70.5	56.8	83.4
Salinity	%	0.01	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Cl-a	µg/L	1	5.30	8.0	1.8	10.7	4.4	8.0	13.4	8.0	15.0	5.3000	8.0	1.8	15.0
T.P.	mg/l	0.005	0.019	0.020	0.018	0.015	0.015	0.016	0.019	0.026	0.031	0.024	0.020	0.015	0.031
T.P.	µg/l	5	19	20	18	15	15	16	19	26	31	24	20.30	15	31
Secchi	ft		11.08	15.25	14.42	7.33	7.91	8.00	7.17	8.08	5.00	8.17	9.24	5.0	15.3
Secchi	m		3.38	4.65	4.40	2.23	2.41	2.44	2.19	2.46	1.52	2.49	2.8	1.5	4.6
Physical			1.0	1.0	2.0	2.0	1.0	2.0	2	2.0	1	1.0	1.5	1.0	2.0
Recreational			1.0	1.0	1.0	1.0	1.0	1.0	1	1.0	1	1.0	1.0	1.0	1.0

*reporting limit

Historic Annual Averages



Historical Report Card

Year	TP	Cl-a	Secchi	**Overall**
1980	A	A	A	**A**
1981	A	A	A	**A**
1982	A	A	A	**A**
1984	B	A	A	**A**
1989	B	A	A	**A**
1994	B	A	B	**B**
1997	A	B	A	**A**
1998	B	A	B	**B**
1999	A	A	A	**A**
2000	A	A	B	**A**
2002	A	A	B	**A**
2005	B	A	B	**B**
2008	B	A	A	**A**
2009	B	A	B	**B**
2011	B	B	C	**B**
2013	B	A	B	**B**
2014	B	A	B	**B**
2015	A	A	B	**A**
2016	B	A	B	**B**
2017	B	A	B	**B**
2018	A	A	B	**A**
2019	A	A	B	**A**
2020	A	A	B	**A**
State standards	40 µg/L	14 µg/L	1.4 meters	

2020 Aquatic Invasive Vegetation Mapping

Lake George
City of Oak Grove, Lake ID # 02-0091

Partners: Lake George LID, Lake George Conservation Club, MNDNR

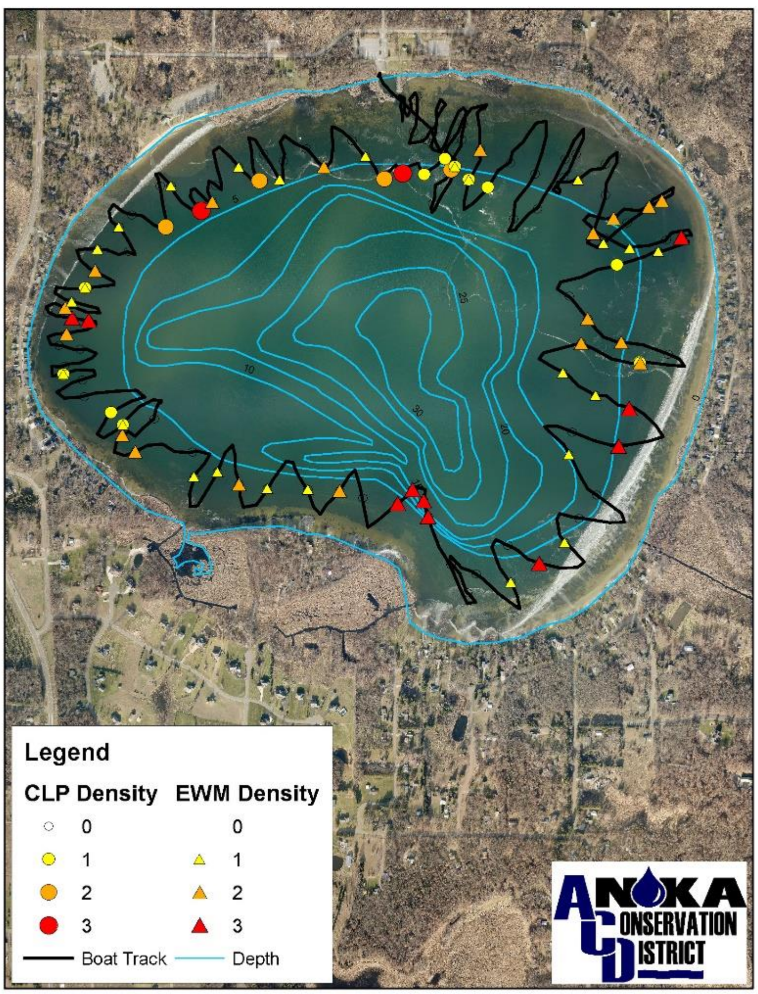
Description: The Anoka Conservation District (ACD) was contracted by the Lake George Lake Improvement District (LID) to conduct an aquatic invasive vegetation delineation.

Purpose: To map out the presence of Curly Leaf Pondweed (CLP) and Eurasian Water Milfoil (EWM) as required for MN DNR herbicide treatment permits. A goal was to map these invasive species as early as possible in the growing season to allow for herbicide treatment as early as possible for reduced impacts on native plants and lessened possible impacts on water quality.

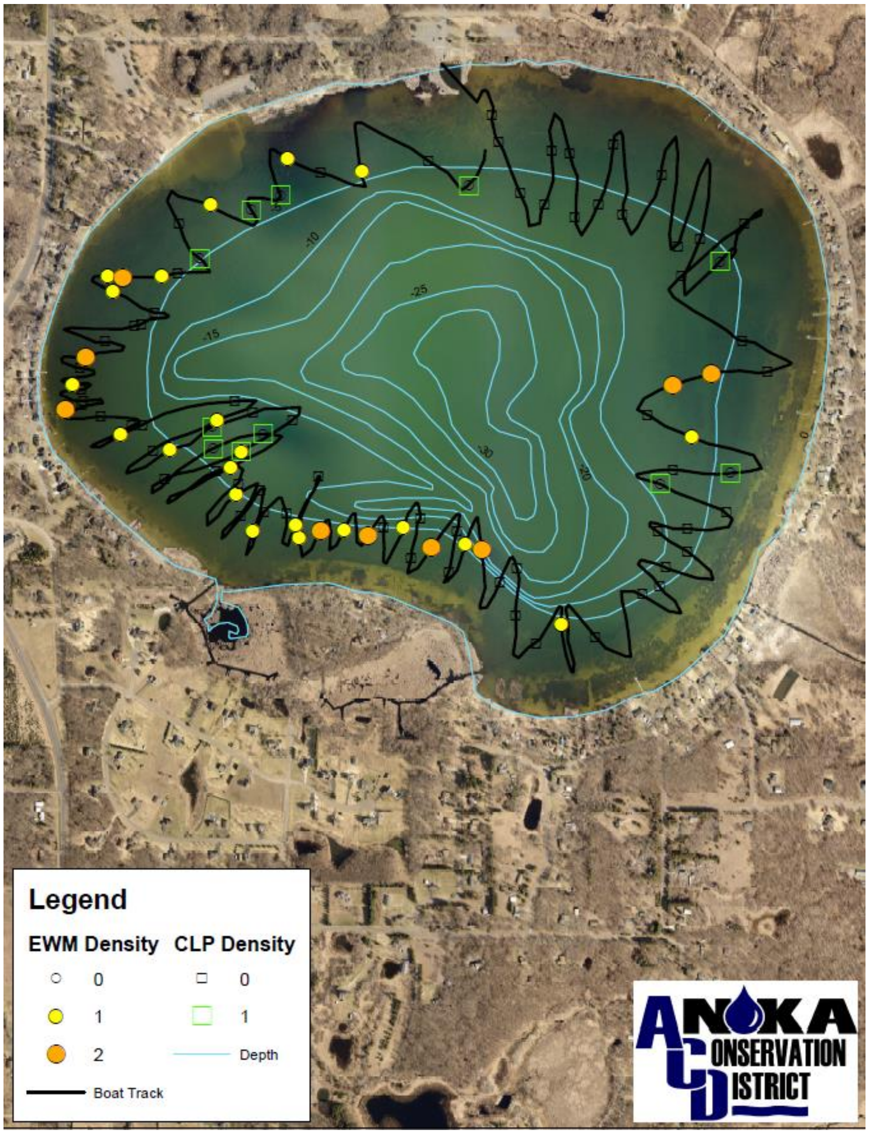
Locations: Lake George

Results: Maps presented below were delivered to the MN DNR and Lake George Improvement District within 48 hours of the field surveys. These survey points were reviewed by the MNDNR and helped direct herbicide treatment efforts.

May 4, 2020 Lake George Curly Leaf Pondweed (CLP) and Eurasian Water Milfoil (EWM) Survey



July 10, 2020 Lake George Curly Leaf Pondweed (CLP) and Eurasian Water Milfoil (EWM) Survey



Stream Water Quality – Biological Monitoring

Partners: St. Francis American Legion Post #622

Description: This program combines environmental education and stream monitoring. Under the supervision of the 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 generally 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.

Location: Rum River at Rum River North County Park

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

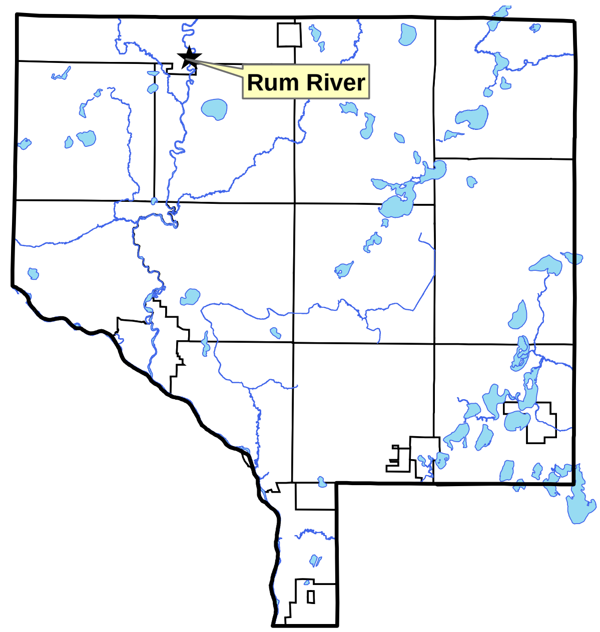
Population Attributes Metrics

% 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.

% 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).

RUM RIVER

at Rum River North County Park, St. Francis



Last Monitored

By St. Francis High School in 2020

Monitored Since

2000

Student Involvement

150 students in 2020, approximately 1,500 since 2000

Background

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

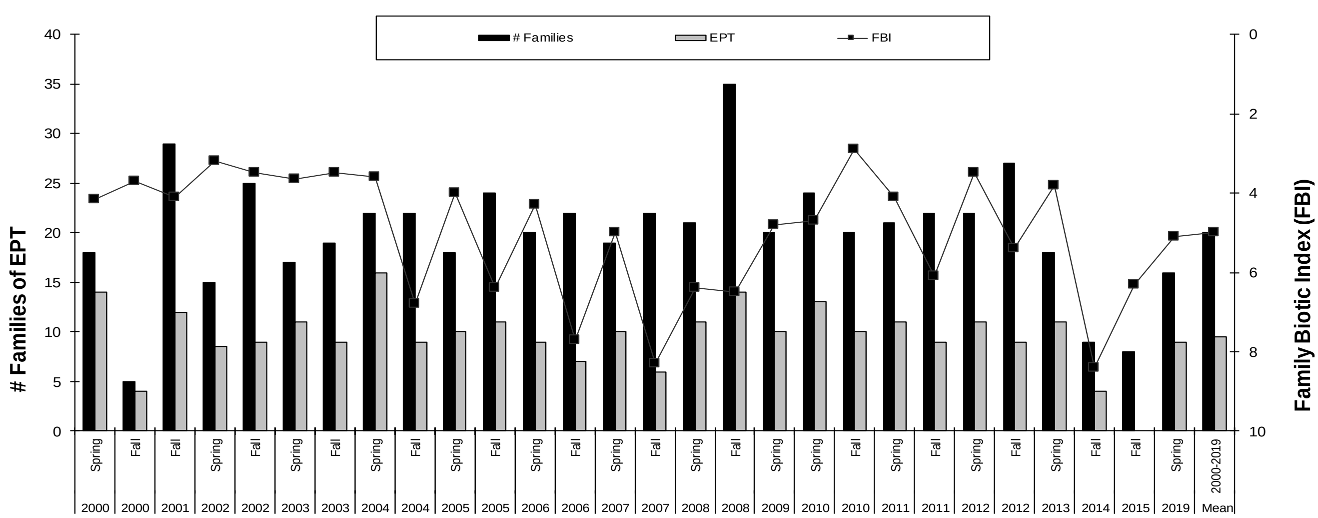
The sampling site is in Rum River North County Park. This site is typical of the Rum in northern Anoka County, having a rocky bottom with numerous pool and riffle areas.

Results

St. Francis High School classes monitored the Rum River in the spring of 2020, with ACD oversight and funding from the St. Francis American Legion. In, 2020 general biology classes performed a rapid bio-assessment activity of the River where we looked at types of organisms captured and gave a score based on general pollution sensitivity. Because there were so many classes, we did not collect the invertebrates for lab identification. Many of the student groups captured numerous EPT taxa, which are indicators of good water quality. Next year, we are planning to return to lab identification of invertebrates with college biology classes. Below are data from previous years.

Last year, in 2019, captures indicated a moderate-to-healthy ecological condition despite high water levels and fast flows which typically lower sampling success the students. Multiple years should cumulatively be considered when interpreting biomonitoring data. Water levels, weather, site conditions and differences in class sizes and student capabilities can all contribute to different results in any one year. Based on the multi-year dataset it appears that Rum River ecological health at this site is good.

Summarized Biomonitoring Results for Rum River North County Park, 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.

Table of most recent five years

Year	2012	2013	2014	2015	2019	Mean
Season	Fall	Spring	Fall	Fall	Spring	2000-2019
FBI	5.4	3.8	8.4	6.3	5.1	5.0
# Families	27	18	9	8	16	20.0
EPT	9	11	4	0	9	9.6
Date	27-Sep	20-May	24-Oct	22-Jul	19-May	
Sampled By	SFHS	SFHS	SFHS	4-H	SFHS	
Sampling Method	MH	MH	MH	MH	MH	
Mean # Individuals/Rep.	333	247.5	219	23	139	
# Replicates	1	2	1	1	1	
Dominant Family	veliidae	Baetiscida	Corixidae	Cambaridae	Siphlonuridae	
% Dominant Family	13.8	34.7	86.3	34.8	32.4	
% Ephemeroptera	34.2	54.1	3.7	0	46	
% Trichoptera	4.2	6.3	0.5	0.0	0	
% Plecoptera	11.1	30.3	2.3	0	18	

Discussion

Historically, both chemical and biological monitoring indicate the good water quality of this river. Poorer results in 2014 and 2015 may reflect varying site and sampling conditions rather than a shift in the biological community. Habitat is ideal for a variety of stream life, and includes a variety of substrates, plenty of woody snags, riffles, and pools. Taxa that are extremely sensitive to pollution are still being collected. Water chemistry monitoring done at various locations on the Rum River throughout Anoka County indicates that water quality is also good. Continued biological monitoring is recommended both as an education program and for long-term ecological condition monitoring.

Wetland Hydrology

Partners: URRWMO, ACD

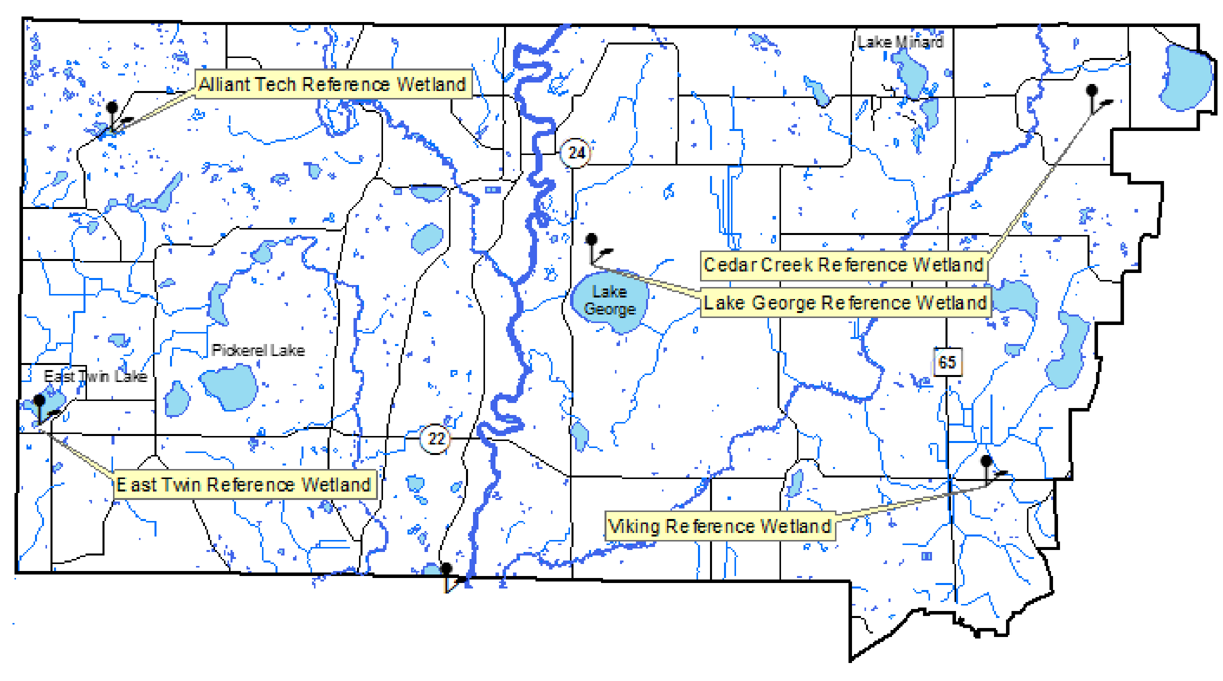
Description: Continuous groundwater level monitoring at a wetland boundary to a depth of 40 inches. Countywide, the ACD maintains a network of 23 wetland hydrology monitoring stations.

Purpose: To provide understanding of wetland hydrology, including the impacts 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

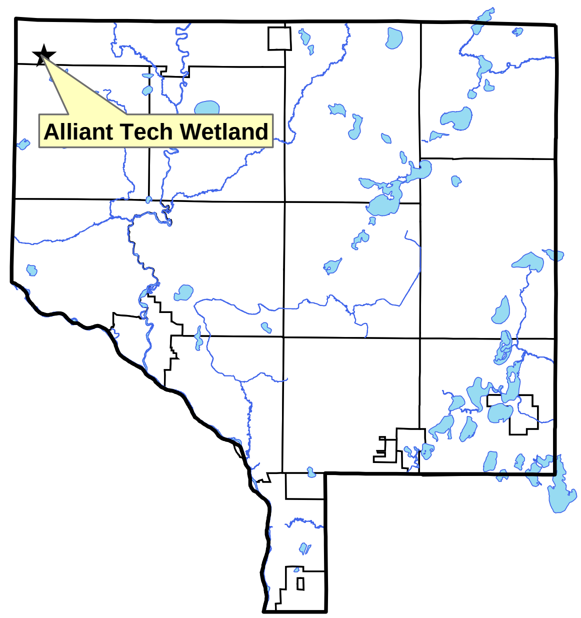
Results: See the following pages. Raw data and updated graphs can be downloaded from www.AnokaNaturalResources.com using the Data Access Tool.

2020 Upper Rum River Watershed Wetland Hydrology Monitoring Site



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	-

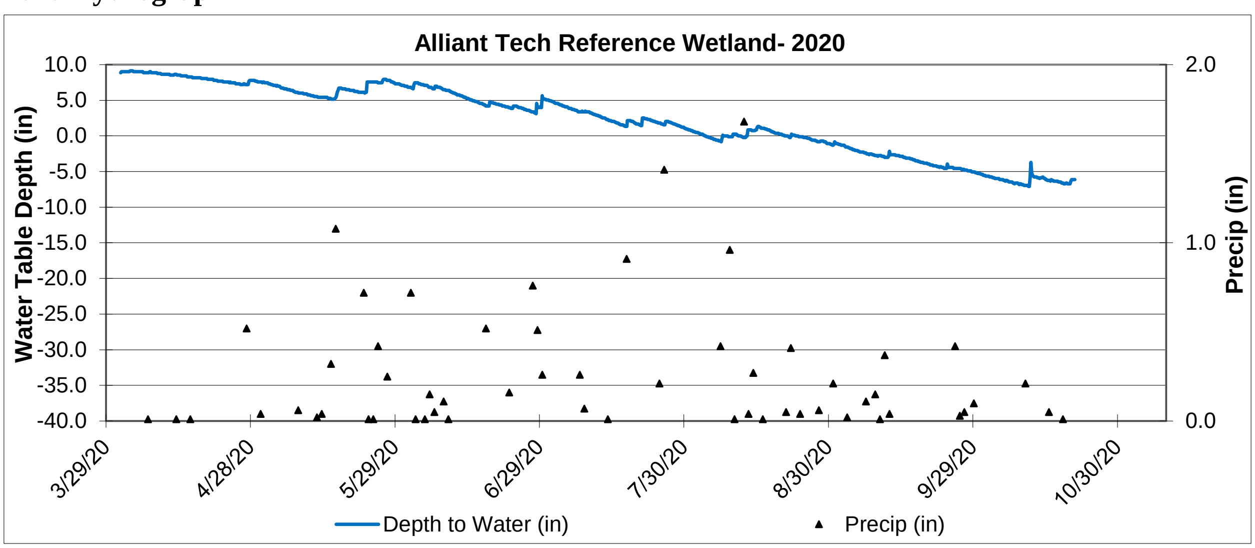
Surrounding Soils: Emmert

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.

2020 Hydrograph



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

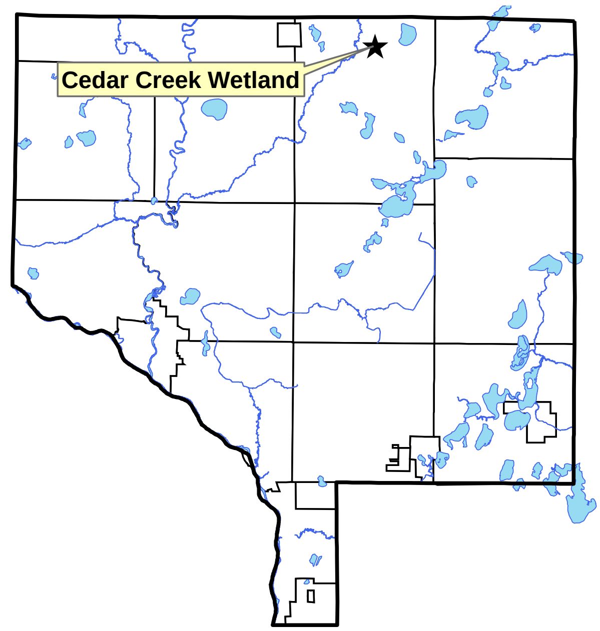
Isolated Basin? No

Connected to a Ditch? No

Soils at Well Location: not yet available

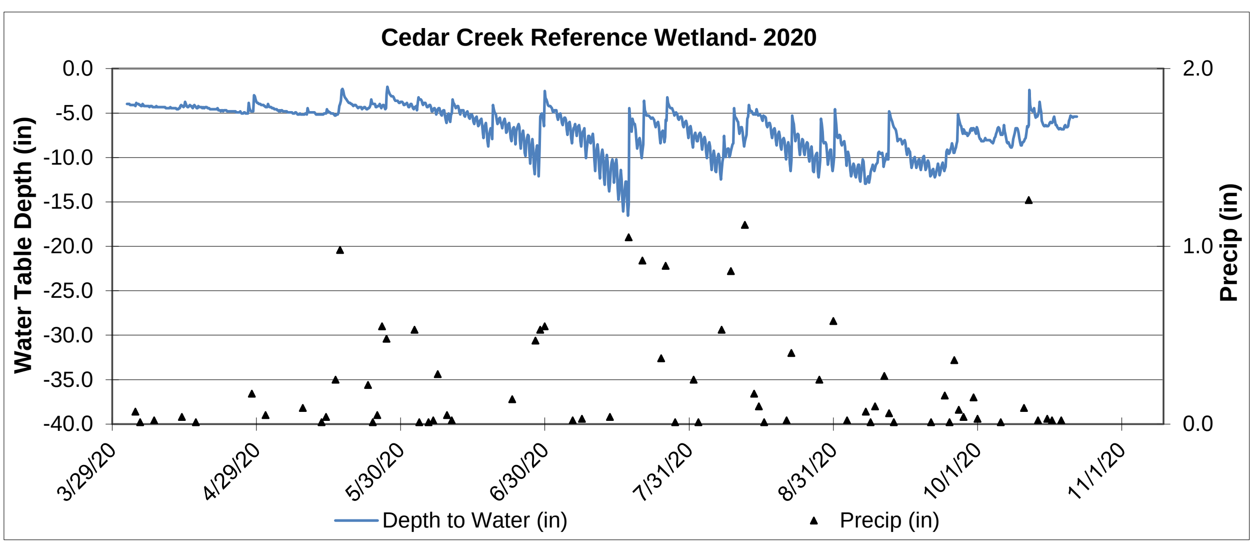
Surrounding Soils: Zimmerman

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.

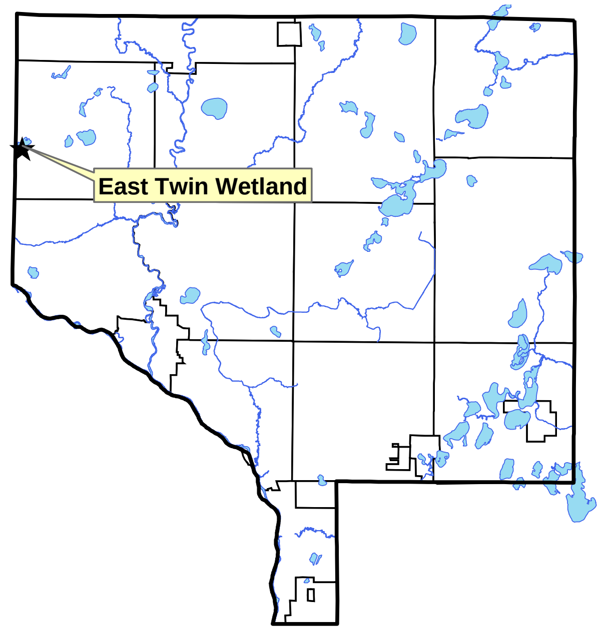
2020 Hydrograph



EAST TWIN REFERENCE WETLAND

Twin Lake City 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	-

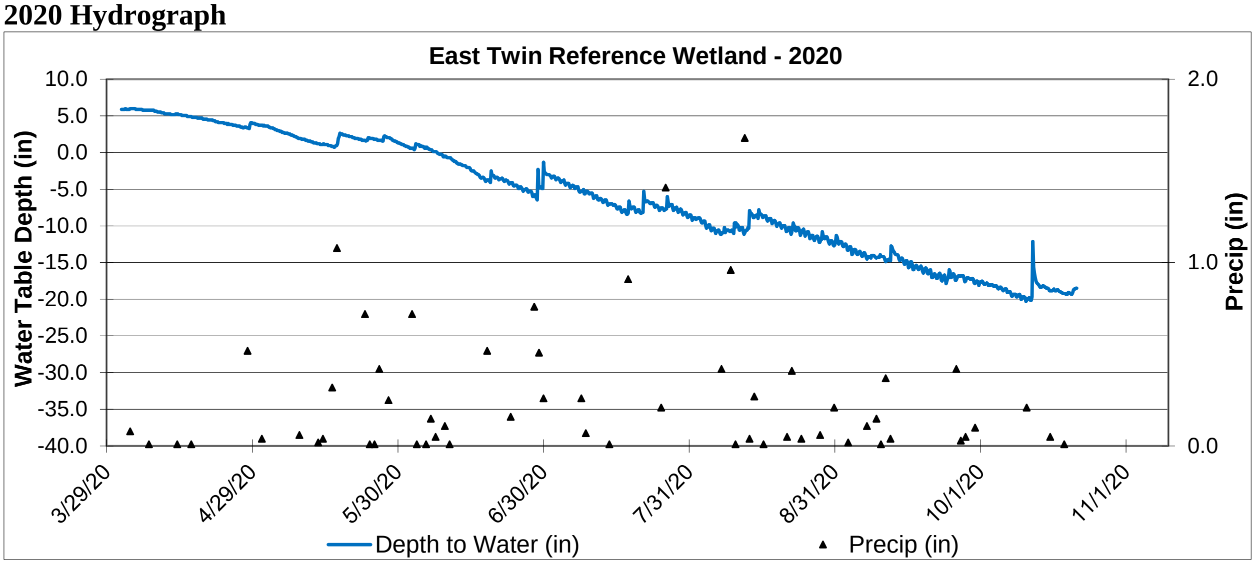
Surrounding Soils: Lake Beach, Growton and Heyder fine sandy loams

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 Twin Lakes City Park, and is only 180 feet from the lake itself. Water levels in the wetland are influenced by lake levels.

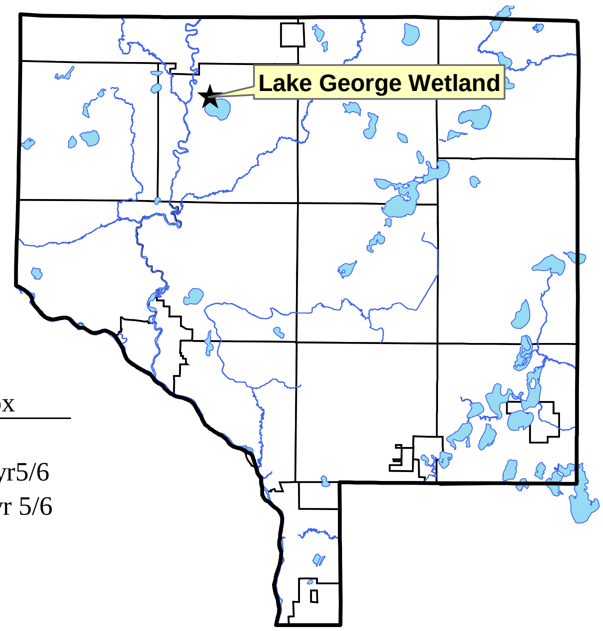
2020 Hydrograph



Wetland Hydrology Monitoring

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

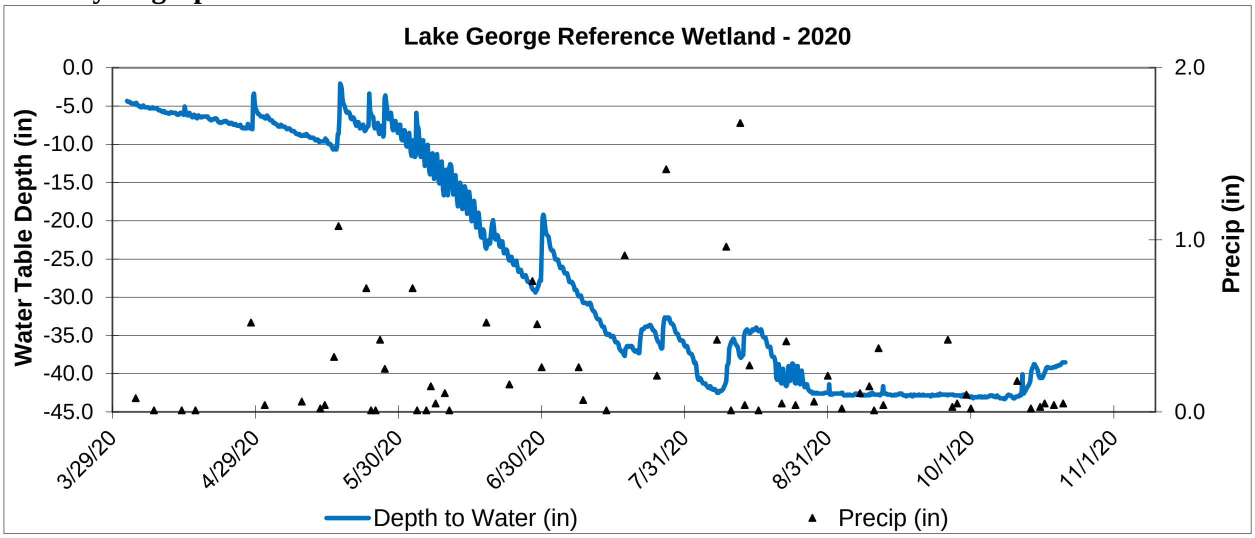
Surrounding Soils: Lino loamy fine sand and Zimmerman fine sand

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.

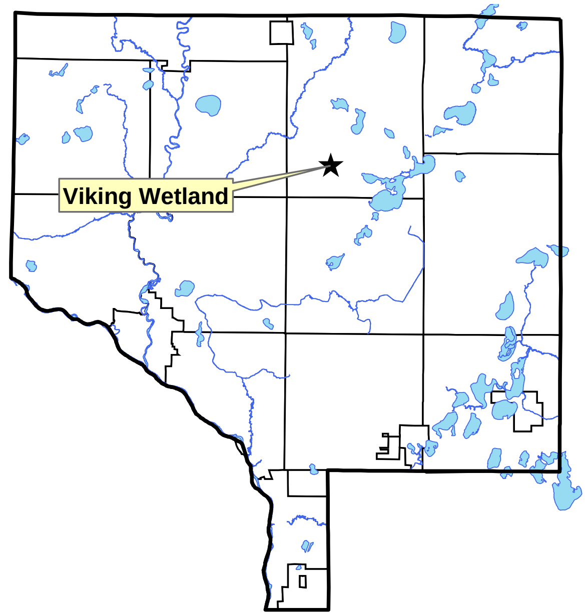
2020 Hydrograph



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

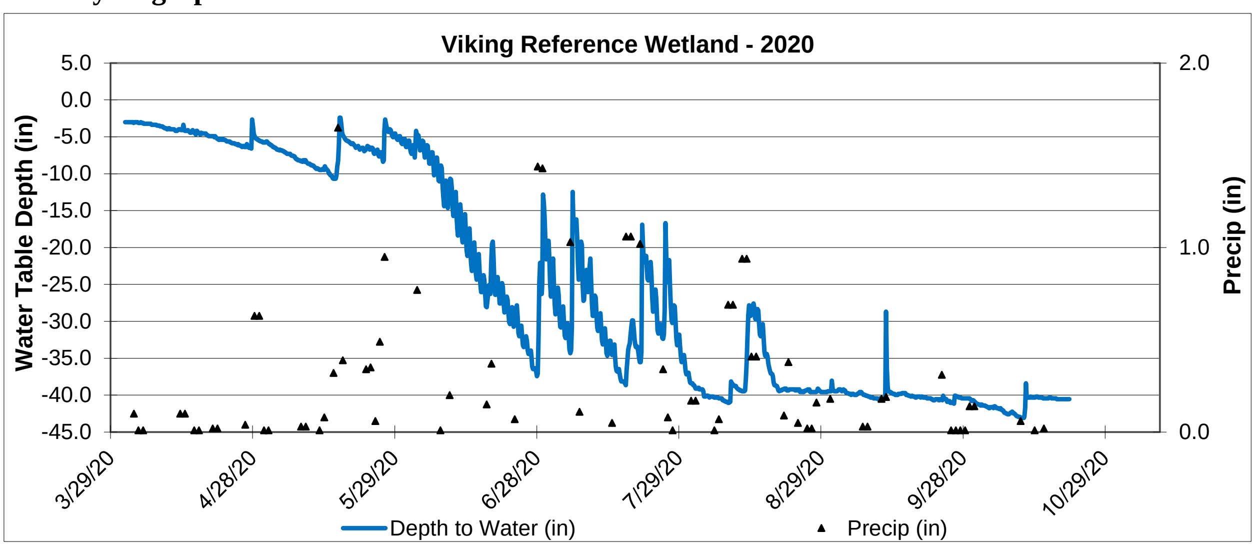
Surrounding Soils: Zimmerman fine sand

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).

2020 Hydrograph



Rum River Bank Erosion Grants

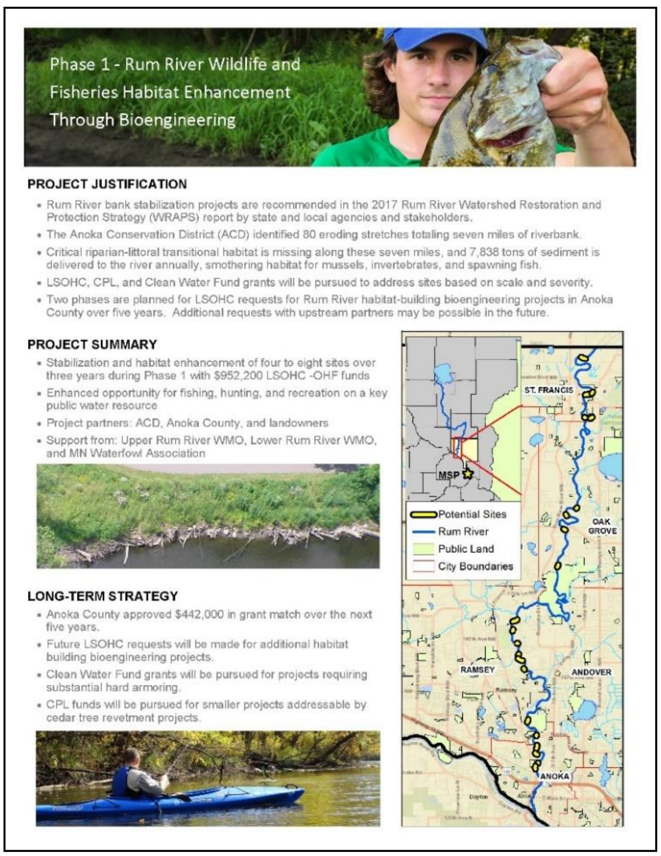
Partners: ACD, Anoka County Parks, LRRWMO, URRWMO

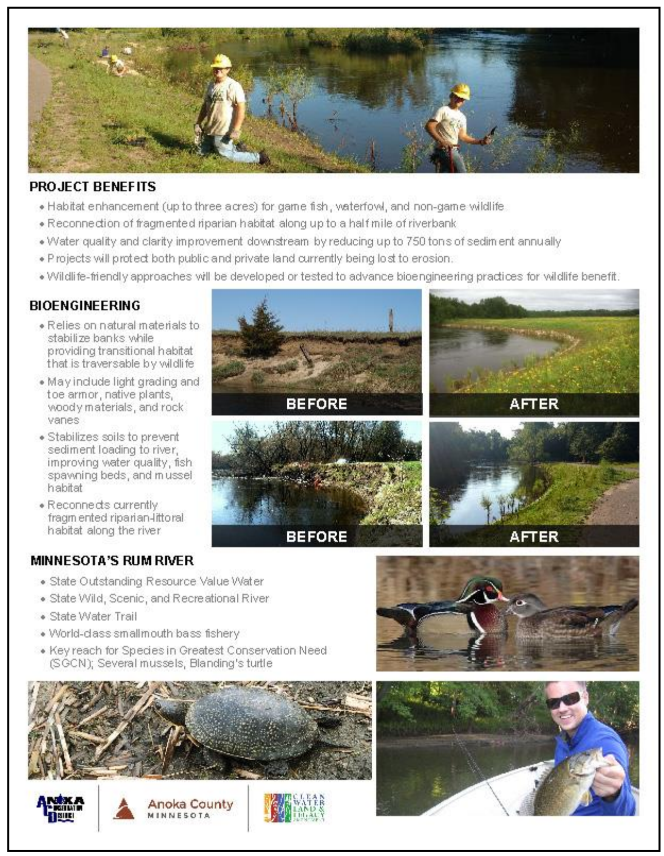
Description: The Anoka Conservation District (ACD) prepared an inventory of Rum River bank erosion using 360° photos of the riverbanks of the Rum throughout Anoka County. The photos are available through Google Maps using the Street View feature. An inventory report identifying 80 stretches of riverbank with moderate to very severe erosion is available on ACD's website. Estimated project cost and annual sediment load reduction to the river were calculated. ACD used this inventory to apply for grant funding for stabilization projects to correct some of these eroding banks. These applications, and matching money from Anoka County and the Rum River WMOs resulted in $1.4 Million to be used over the next three years for stabilization projects. This funding comes from the Outdoor Heritage Fund (OHF) and Clean Water Fund (CWF) of the Clean Water Land and Legacy Amendment.

Purpose: To identify and prioritize riverbank stabilization sites and be used by ACD and other entities to pursue grant funds to restore or stabilize eroding stretches of Rum Riverbank.

Location: Rum River conveyance throughout Anoka County

Results: Inventory of 80 stretches of moderate to very severe erosion on banks of the Rum River. $1.4 Million has been secured in grant and matching funds to implement stabilization projects.





Application illustration for the Lessard-Sams Outdoor Heritage Council to do Rum River stabilization projects utilizing bioengineering approaches. The LSOHC reccomended funding these projects at $816,000 over the next three years, which will be matched with $205,000 in local funds from Anoka County and the Upper and Lower Rum River WMOs.

URRWMO Website

Partners: URRWMO, ACD

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 watershed.

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

Location: www.URRWMO.org

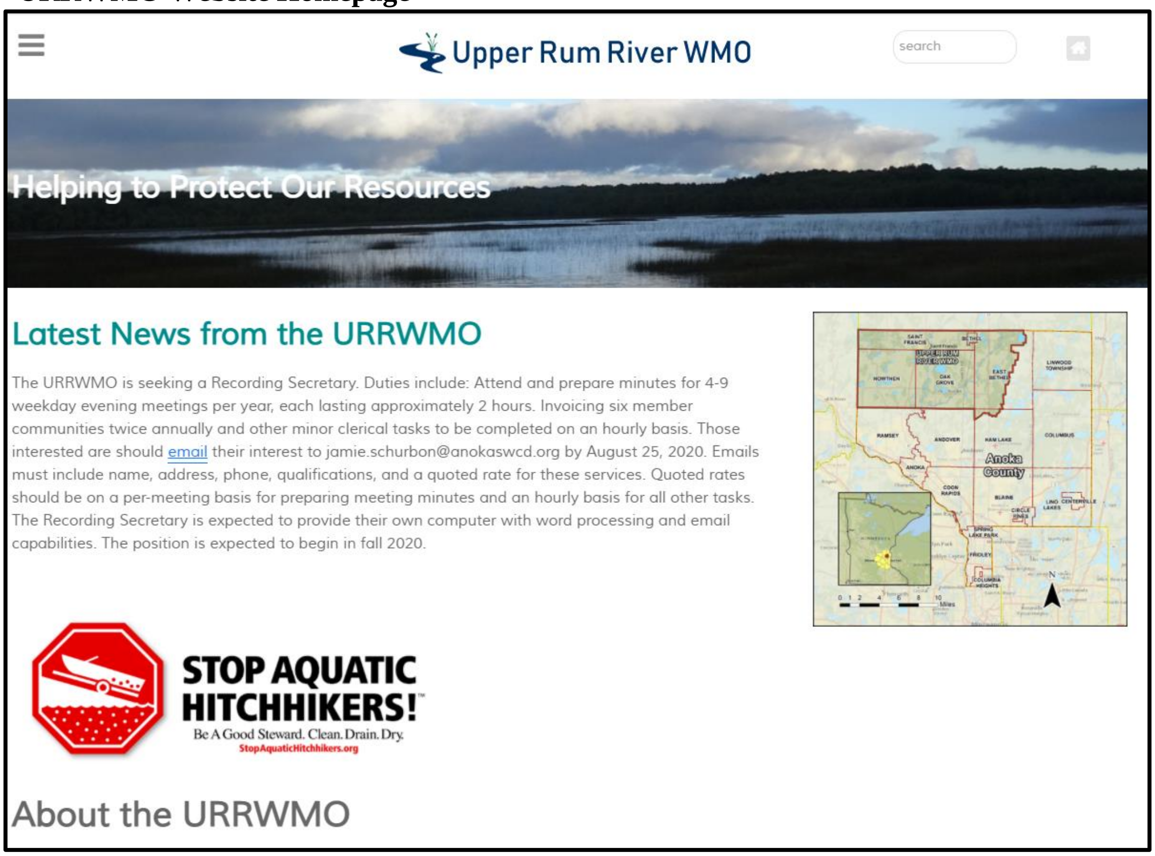
Results:

In 2020 routine URRWMO website updates were performed. The new website includes:

- Directory of board members,
- Meeting minutes and agendas,
- Watershed management plan and annual reports,
- Descriptions of work that the organization is directing,
- Highlighted projects,
- Informational videos,
- Maps of the URRWMO.

The website is regularly updated throughout the year.

URRWMO Website Homepage



URRWMO Annual Newsletter

Partners: URRWMO, ACD

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

Purpose: To increase public awareness of the URRWMO and its programs as well as receive input.

Locations: Watershed-wide.

Results: The Anoka Conservation District (ACD) assisted the URRWMO by drafting the annual newsletter article about new partnerships for student water quality monitoring on the Rum River. The URRWMO Board reviewed and edited the draft article.

2020 URRWMO Newsletter Article

Upper Rum River Watershed Management Organization

MEDIA RELEASE

Contact person: Jamie Schurbon 763-434-2030 ext. 21
Date: April 17, 2020

Rum River Gets Attention from Local Watershed Organization, Students

The Rum River is one of six State Wild, Scenic and Recreational Rivers. Quaint and quiet along much of its length, the river is a recreational hotspot for fishing and canoeing. Its waters, after they join with the Mississippi River, are also a drinking water source for the Twin Cities. This important river has a local entity, the Upper Rum River Watershed Management Organization (URRWMO) that cares for it.

The URRWMO has found partnerships with St. Francis High School science classes and the American Legion. Science classes have visited the river across the street from the school to inventory invertebrates (bugs, crawfish, snails, etc) living in the river. They were accompanied by professionals from the Anoka Conservation District, who set the scientific protocols and used the resulting data. Because each invertebrate has a unique pollution tolerance and habitat requirement, the students could calculate metrics of river health. They found the Rum River in northern Anoka County is in good health, and has remained so over the years.

The program to combine education and data collection is ongoing thanks to support from the American Legion. While over 1,000 high school students monitored the river's health 2000 to 2015, the program's funding source faltered thereafter. The program shut down for three years. In 2019 the program was restarted, thanks to financial help from the American Legion. That year 40 students again entered the river with nets. The funding and work is planned to continue in 2020.

Leadership for this and other river stewardship is provided by the URRWMO. The URRWMO is a special purpose unit of government formed by the cities of Bethel, East Bethel, Ham Lake, Oak Grove, Nowthen and St. Francis. Its purpose is to manage the area's waters, particularly those that flow across city boundaries. For more information visit www.URRWMO.org.

Photo provided as separate image file.

Annual Mini-Report to Member Cities

Partners: URRWMO, ACD

Description: The Upper Rum River Watershed Management Organization (URRWMO) provides a brief annual report to its member communities. This is in addition to, and shorter than, reports to the State that are also shared with the member cities.

Purpose: To improve communication between member cities, especially city councils, and the URRWMO.

Locations: Watershed-wide

Results: The Anoka Conservation District assisted the URRWMO with preparation of a 2020 mini-report to member cities. The report highlighted recent accomplishments and upcoming work.

April 2020 Report to Member Cities

Upper Rum River WMO Annual Mini-Report to Cities

APRIL 2020

INFORMATION FOR CITY COUNCILS ABOUT THE UPPER RUM RIVER WATERSHED MANAGEMENT

URRWMO BOARD

City of Bethel
David Olsrud
Ryan Sequin

City of East Bethel
Tim Harrington
Radja Lohse

City of Ham Lake
Sandy Flaherty (Treasurer)

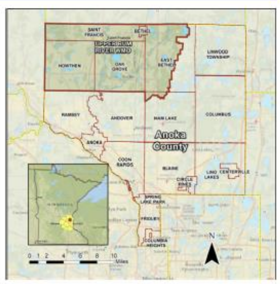
City of Nowthen
Dan Breyen (V. Chair)
Joel Greenberg

City of Oak Grove
John West (Chair)
Dan Denno

City of St. Francis
Lan Tornes
Vacant

New URRMWO Watershed Mgmt Plan Approved!

The URRWMO's new 10-year watershed management plan was approved by the MN Board of Soil and Water Resources (BWSR) and adopted by the URRWMO in summer 2019. The plan will guide the URRWMO's work and expenditures, including community contributions. Congrats to all who worked to get this plan approved.



Map of the URRWMO

$1.4M in Grants for Eroding Rum Riverbanks

Partners in the Anoka County portion of the Rum River watershed have secured over $1.4 million dollars in state grant funds for stabilizing Rum Riverbanks and improving near-shore habitat. The effort was led by the Anoka Conservation District, with grant matching funds from the URRWMO, Lower Rum River WMO, and Anoka County. This project is one of three high priority projects in the URRWMO plan.

The Anoka Conservation District (ACD) has created an inventory of Rum Riverbanks from St. Francis to Anoka. That inventory identifies 80 stretches of moderate to severe erosion. Owners of those properties will be invited to work with ACD on riverbank erosion control. Work will only be done where there are willing landowners.

The grant term is three years. Work begins in 2020. Funds are from the Outdoor Heritage Fund and the MN DNR Conservation Partners Legacy Program. Both use funds from the Clean Water, Land and Legacy Amendment.

Riverbank erosion sites

2019 Accomplishments

- Watershed plan approved— Adopted our URRWMO 10-year plan draft.
- Lake George Connections—The URRWMO took a pontoon tour of Lake George with the two lake groups, building relationships and collaboration.
- High school biomonitoring—We restarted the Rum River biomonitoring program with St. Francis High School, with funding assistance from the American Legion. 40 students participated.
- Technical Advisory Committee (TAC)—Assembled a TAC, primarily of city staff, to prioritize projects, develop a culvert inventory methods, and update URRWMO wetland and stormwater standards.
- Participated in One Watershed One Plan (1W1P)—Joined with other watershed organizations, counties, and soil and water conservation districts to create a plan that coordinates our local activities to achieve regional goals. URRWMO board member Matt Downing is the vice-chair of the Policy Committee that oversees the planning.

2020 Plans

- Water condition monitoring—Continue routine monitoring at East Twin, George, Rogers and Minard Lakes.
- TAC—Reconvene our TAC to guide development of a standardized stormwater treatment practice inspection process, ensure city ordinances are consistent with URRWMO standards, and other tasks.
- Watershed Based Implementation Funding—Participate in a new non-competitive grant program from the State (see article below). $366,000 in funding is available and will recur every two years. It is a major opportunity to accomplish URRWMO priorities that are otherwise financially difficult.
- High school biomonitoring—Continue the Rum River biomonitoring program with St. Francis High Schools. The American Legion, has renewed its financial support for students to catch macroinvertebrates (bugs) and use them as a gauge of river health.
- Riverbank stabilizations—The Anoka Conservation District will begin design and construction planning for riverbank stabilizations (article on page 1 of this report).

Watershed Based Funding

The URRWMO and its cities are participating in a major new funding collaboration called Watershed Based Implementation Funding (WBIF). This state grant is not competitive. $366,000 is available for the metro Rum River Watershed (i.e. the Anoka County portions of the Rum River watershed).

Eligible projects must be in WMO plans, 1W1P or the Anoka Conservation District's annual plan. It Projects must improve water quality. It is more important than ever that cities incorporate their priority water quality projects into the URRWMO plan. Cities are eligible to directly receive grant funds.

The grant is not competitive, but is collaborative. How the funds are used is decided by representatives from cities, the Lower and Upper Rum River WMO's, and the Anoka Conservation District. Chuck Schwartz is the representative for URRWMO cities. Matt Downing is the representative for the URRWMO.

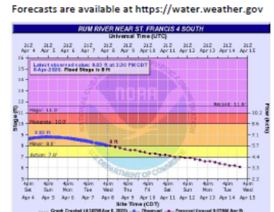
The meetings to decide how funding is allocated begin in April 2020. Two to three meetings are anticipated.

The MN Board of Water and Soil Resources is administering the funds and overseeing the funding allocation process.

New Flood Forecasting

The National Weather Service has begun flood forecasting for the Rum River at Viking Boulevard. This new service was prompted by a request from communities throughout the Rum River watershed. Forecasts were already put into action during high water of spring 2020.

Forecasts are available at https://water.weather.gov



Example Rum River flood forecast

www.URRWMO.org

Annual Reports to the State

Partners: URRWMO, ACD

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

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

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

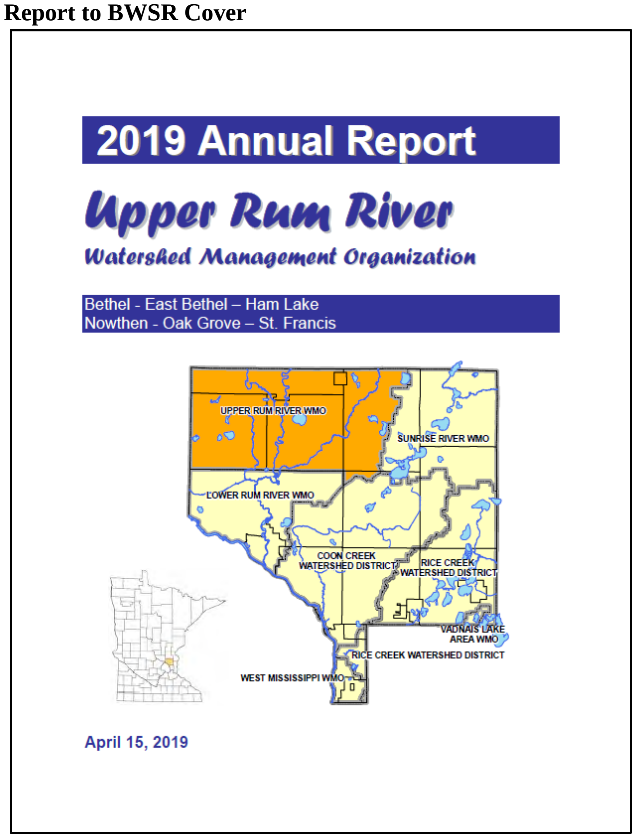
Locations: Watershed-wide

Results: The Anoka Conservation District assisted the URRWMO with preparation of a 2020 Upper Rum River WMO Annual Report to BWSR and reporting to the State Auditor. This included:

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

All were completed by the end of April 2021. The report to BWSR and financial report are available on the URRWMO website.

Report to BWSR Cover



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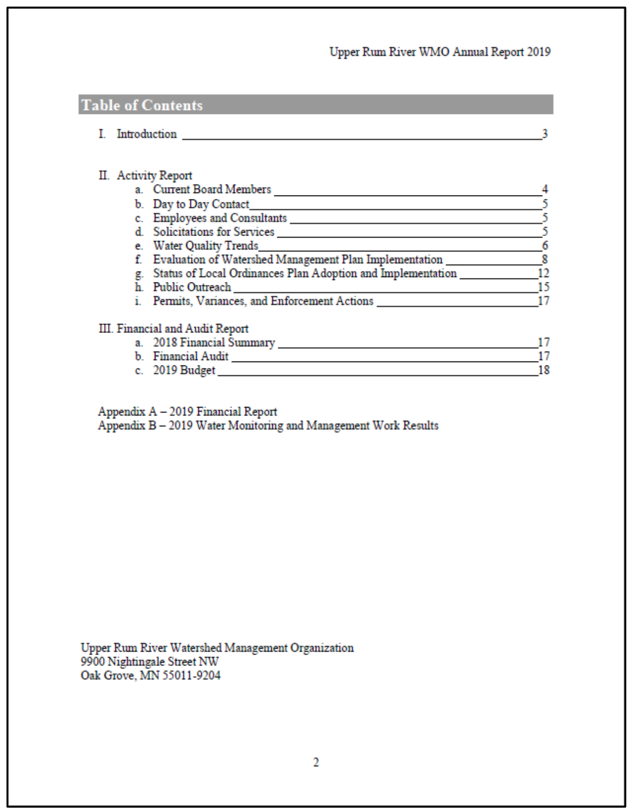

Upper Rum River WMO Annual Report 2019

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Appendix A – 2019 Financial Report
Appendix B – 2019 Water Monitoring and Management Work Results

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

2

Watershed Coordinator Services

Description: The Anoka Conservation District serves as URRWMO Watershed Coordinator. This includes providing a variety of administrative services. Tasks are limited to those defined in a contractual agreement.

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

Results: In 2020 administrative assistance provided to the URRWMO by the Anoka Conservation District included:

- Prepared board meeting packets. Facilitated meetings and meeting planning. Set up and hosted online meetings when necessary.
- Recruited a new Recording Secretary. Took meeting minutes until during the interim. Reviewed each month’s minutes.
- Prepared a draft 2021 budget for the URWMO and subsequent revisions.
- Ordered and facilitated an audit-like agreed upon procedures review with an auditor.
- Represented the URRWMO at staff level meetings of the Rum River One Watershed One Plan. Reported back to the URRWMO board, including facilitating discussion about implementation organizational arrangements (JPC vs JPE).
- Assisted with represented the URRWMO on the metro Rum Watershed Based Implementation Funding convene group, resulting in funding for the following in the URRWMO area: Rum Riverbank stabilizations, stormwater retrofits, Lake George shoreline stabilizations, outreach/education, and a Ford Brook subwatershed assessement study.
- Facilitated the URRWMO’s technical advisory committee resulting in five board-approved items (wetland & stormwater standards, culvert inventory protocols, landlocked basins standards, and project prioritization). All were required under the URRWMO Watershed Management Plan.
- Completed an amendment to the URRWMO Watershed Management Plan.
- Addressed financial and budgeting concerns from Ham Lake, including multiple meetings.
- Worked with member cities who are required to ensure their ordinances are consistant with URRWMO standards.
- Reviewed and provided recommended URRWMO actions on community local water plans.
- Created a new template for city reporting to the URRWMO. Solicited and received annual reports.
- Requested and received biomonitoring funding from the American Legion.
- Fielded permitting questions from the county highway department and builders.
- Created a new URRWMO logo.

Recommendations

- **Participate in the Rum River One Watershed One Plan** process, resulting in prioritized management across the entire Rum River watershed.
- **Fund and install projects identified in the URRWMO Watershed Management Plan**. This prioritized list was created by the URRWMO Technical Advisory Committee (TAC):
  1. Rum Riverbank stabilizations*
  2. Anoka County Water Resources Outreach Collaborative*
  3. (Tied) Stormwater retrofits for the Rum River and subwatershed assessments*. Prioritized subwatershed assessment areas are: a) Pickerel Lake b) East Twin Lake c) Rum River direct drainage and d) City of Bethel periphery
  4. Lake George shoreline stabilizations*
  5. Lake George iron-enhanced sand filter feasibility study
  6. Ditch 19 connector dredging

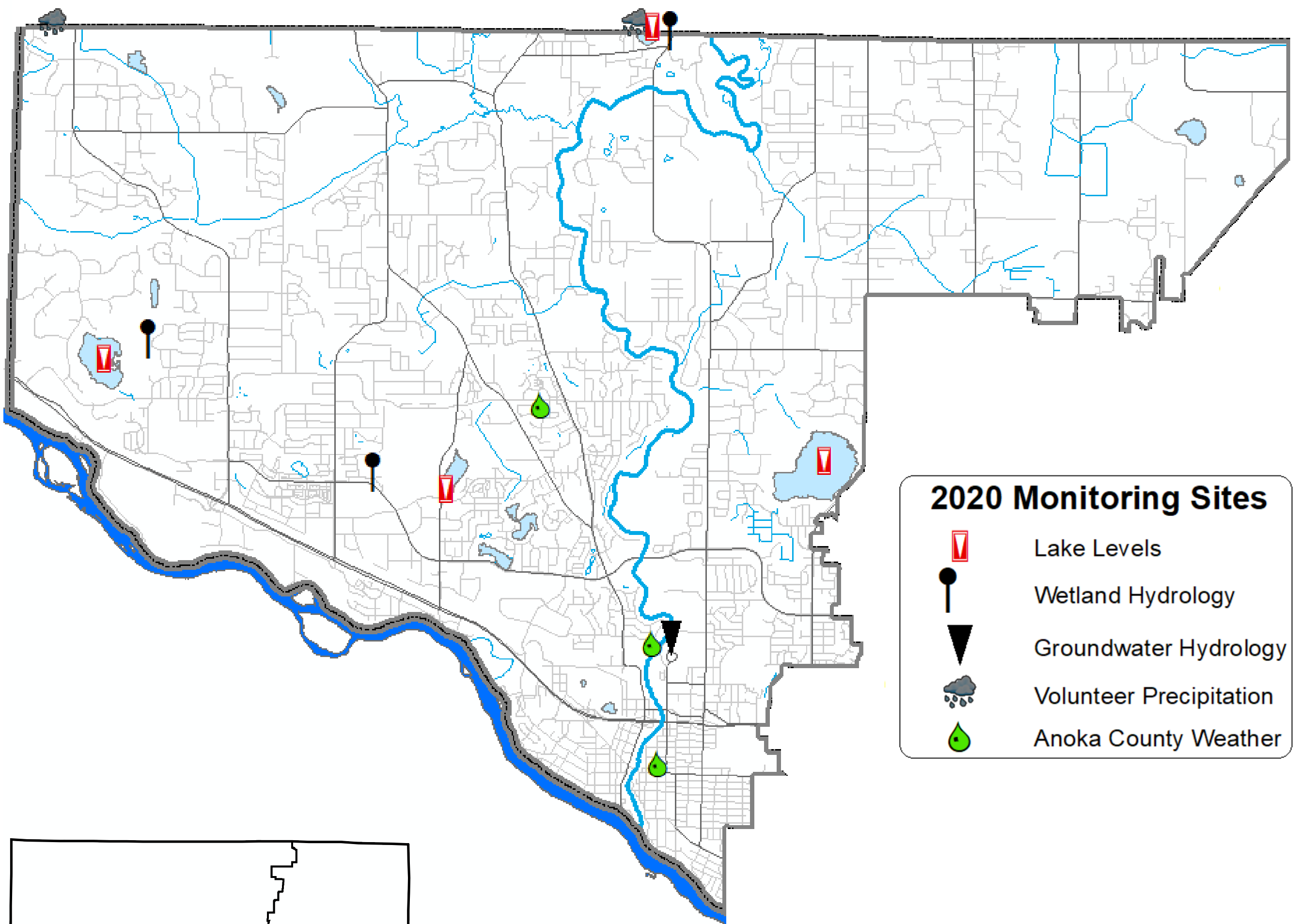
* Indicates projects that have been initiated using State grant funds and URRWMO matching funds.

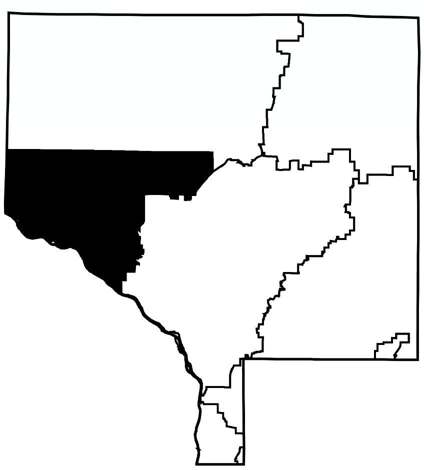
- **Bring projects to a construction-ready status** so they are positioned for State Watershed Based Implementation Funds. 10% match is needed for these grants.
- **Monitor Lake George water quality at least every other year.** The lake has had a declining clarity trend in recent years. The Lake Improvement District has taken up monitoring every other year when the URRWMO has not funded that work, but would prefer to put their dollars into projects.
- **Promote practices that limit road deicing salt applications** while keeping roads safe. Streams throughout the URRWMO have increasing specific conductivity. Requiring municipal plow drivers to become certified through MN Pollution Control Agency deicing courses is recommended.
- **Periodically monitor chlorides in streams**. Monitoring every 3 years minimum is recommended.
- **Promote groundwater conservation and protection.** Metropolitan Council models predict 3+ ft. drawdown of surface waters in parts of the URRWMO by 2030, and 5+ ft. by 2050. This indicates conservation actions will be required to ensure the groundwater supply stays sufficient. Infiltration practices should be highly prioritized, and unused wells on private/public lands should be sealed to prevent contamination.

Chapter 4: Lower Rum River Watershed

Prepared by the Anoka Conservation District

Chapter 4: Lower Rum River Watershed





Lake Level Monitoring

Partners: LRRWMO, ACD, MN DNR, volunteers

Description: Weekly water level monitoring in lakes. The past five and twenty-five years of data are illustrated below, and all historical 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 impacts of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

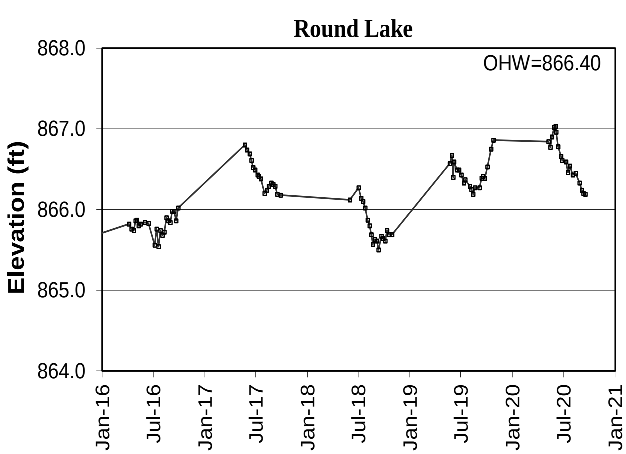
Locations: Round, Rogers, Itasca, and Sunfish/Grass Lakes

Results: Lake levels were measured by volunteers throughout the 2020 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. In 2020, lake levels started near average and declined throughout the season. The rebound often seen in the fall was not observed. This is likely due to infrequent rain events throughout the season and the lowest annual total precipitation since 2012.

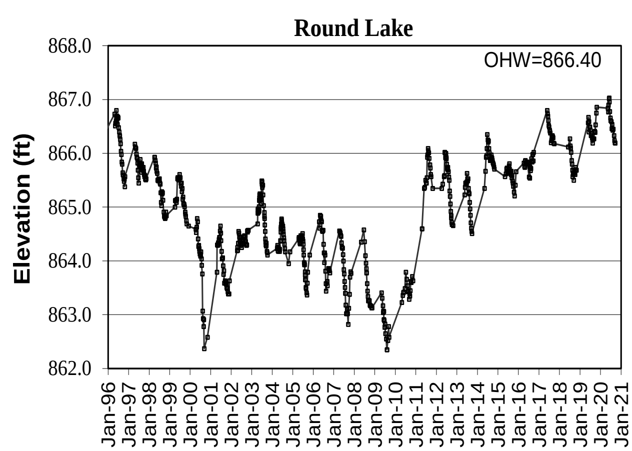
Rogers Lake reached its lowest water level since 2015, while Lake Itasca had its highest average level since 2006. Sunfish Lake appears to be rising over the past 25 years with all of 2020 staying above the OHW (860.01). Round Lake has rebounded to the levels it had in the mid-nineties after dropping almost five feet 1996-2010. In 2020 Round Lake reached its highest level since 1986 (867.03).

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

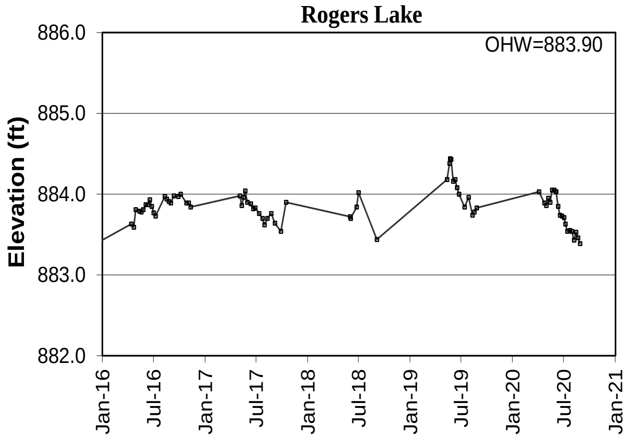
Round Lake Levels – last 5 years



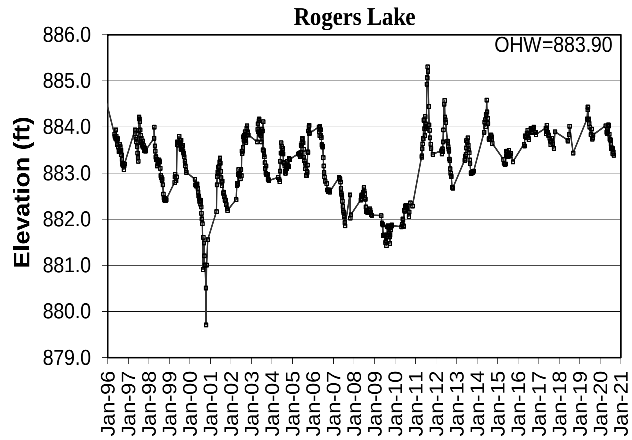
Round Lake Levels – last 25 years



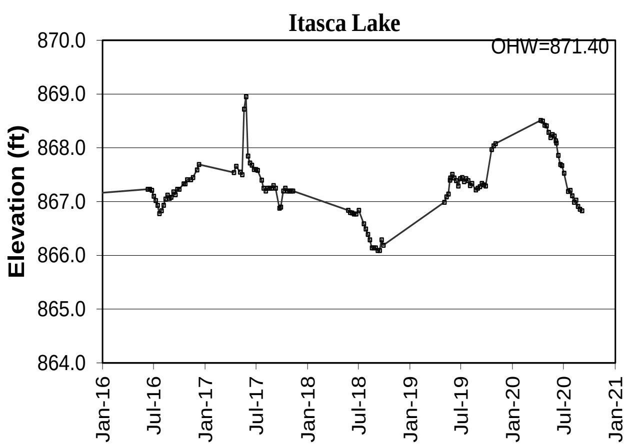
Rogers Lake Levels – last 5 years



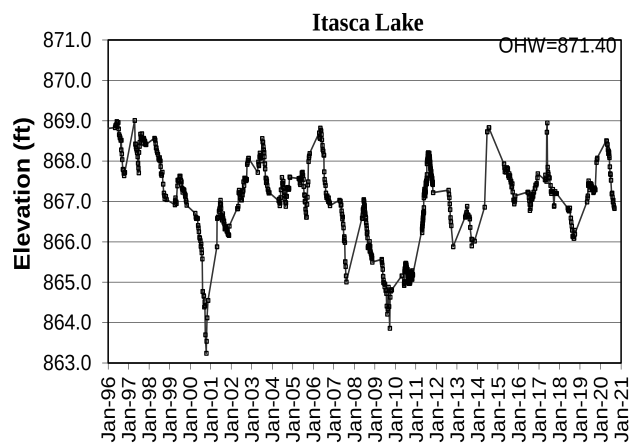
Rogers Lake Levels – last 25 years



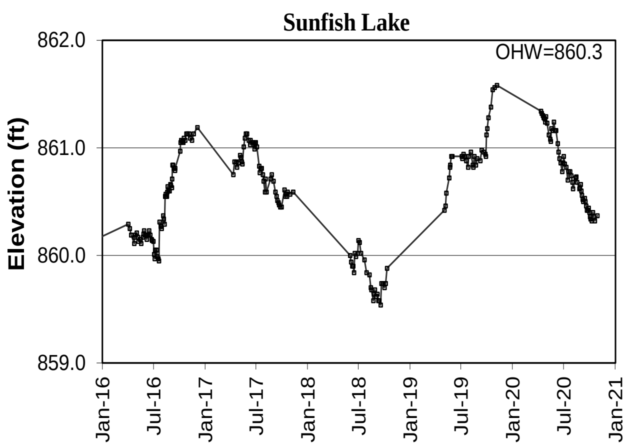
Itasca Lake Levels – last 5 years



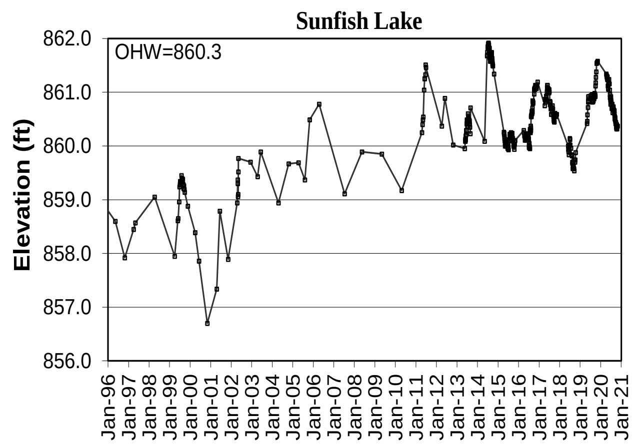
Itasca Lake Levels – last 25 years



Sunfish/Grass Lake Levels – last 5 years



Sunfish/Grass Lake Levels – last 25 years



Lake Itasca	Year	Average	Min	Max
	2016	867.19	866.78	867.69
	2017	867.47	866.88	868.95
	2018	866.45	866.09	866.84
	2019	867.41	866.99	868.08
	2020	867.72	866.83	868.51

Rogers Lake	Year	Average	Min	Max
	2016	883.85	883.59	884.00
	2017	883.81	883.54	884.04
	2018	883.74	883.44	884.02
	2019	884.08	883.74	884.44
	2020	883.76	883.39	884.05

Round Lake	Year	Average	Min	Max
	2016	865.81	865.54	866.02
	2017	866.42	866.18	866.80
	2018	865.80	865.50	866.27
	2019	866.45	866.19	866.86
	2020	866.61	866.19	867.03

Sunfish/ Grass Lake	Year	Average	Min	Max
	2016	860.48	859.95	861.19
	2017	860.79	860.45	861.13
	2018	859.81	860.14	860.14
	2019	860.94	860.42	861.58
	2020	860.80	860.32	861.34

Wetland Hydrology

Partners: LRRWMO, ACD

Description: Continuous groundwater level monitoring at a wetland boundary. Countywide, the ACD maintains a network of 23 wetland hydrology monitoring stations.

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

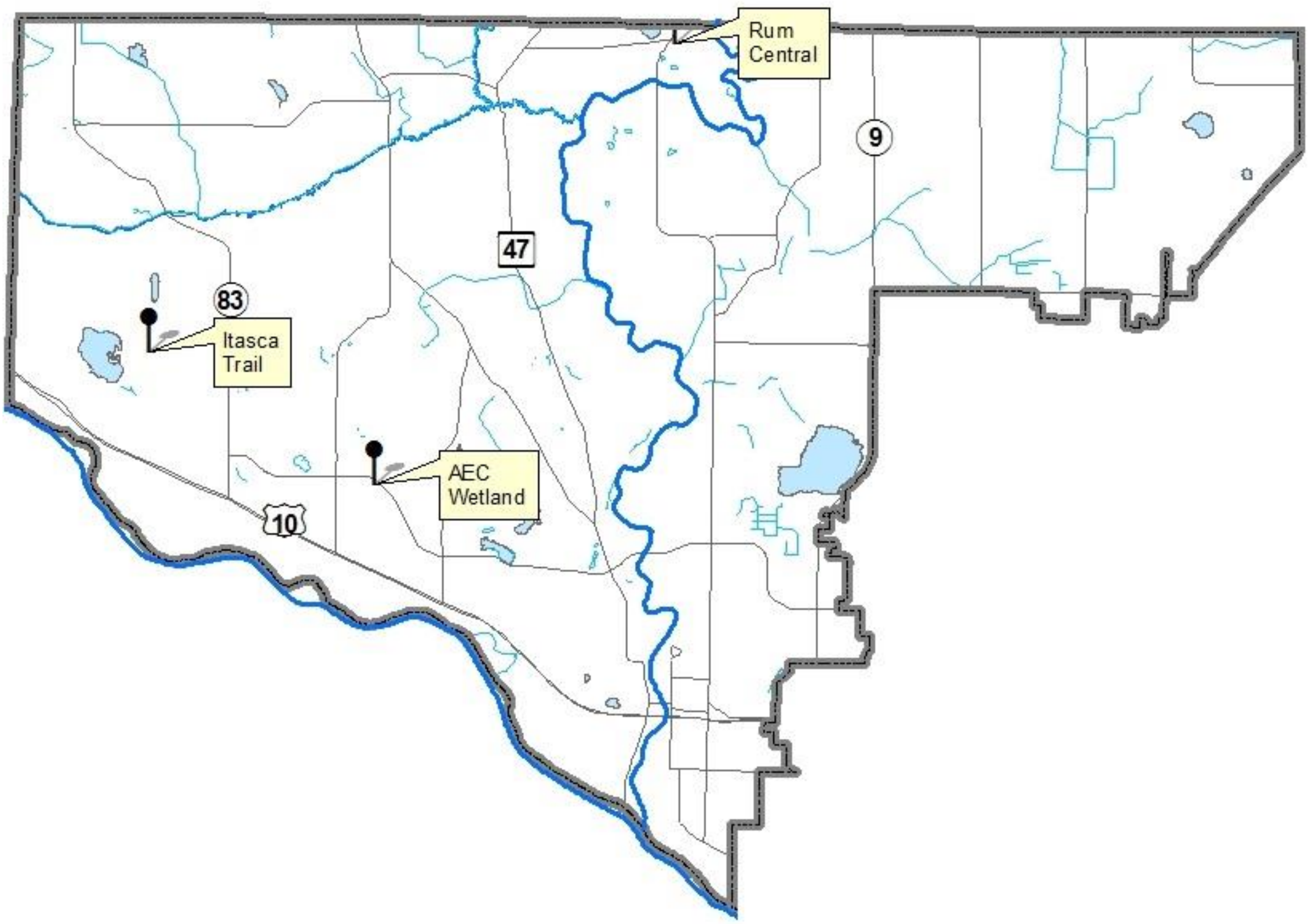
Locations: AEC Reference Wetland, Connexus Energy Property on Bunker Lake Blvd, Ramsey

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

Lake Itasca Trail Reference Wetland, Lake Itasca Park, Ramsey

Results: Depicted on the following pages.

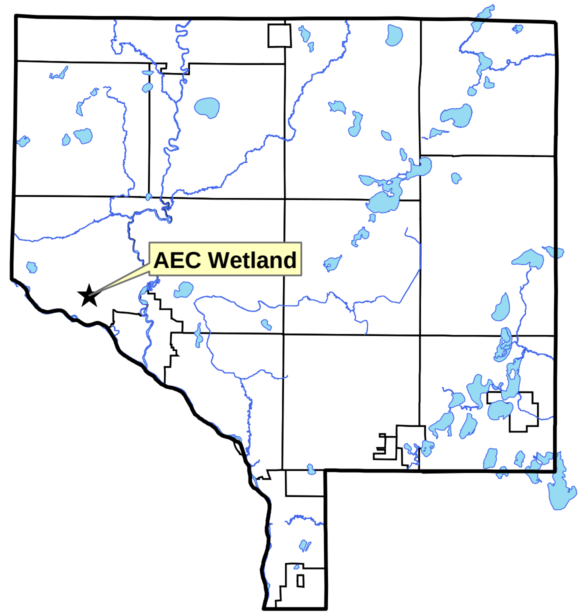
Lower Rum River Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

AEC Reference Wetland

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



Site Information

Monitored Since: 1999

Wetland Type: 3

Wetland Size: ~18 acres

Isolated Basin? No, probably receives storm water

Connected to a Ditch? No

Soils at Well Location:

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

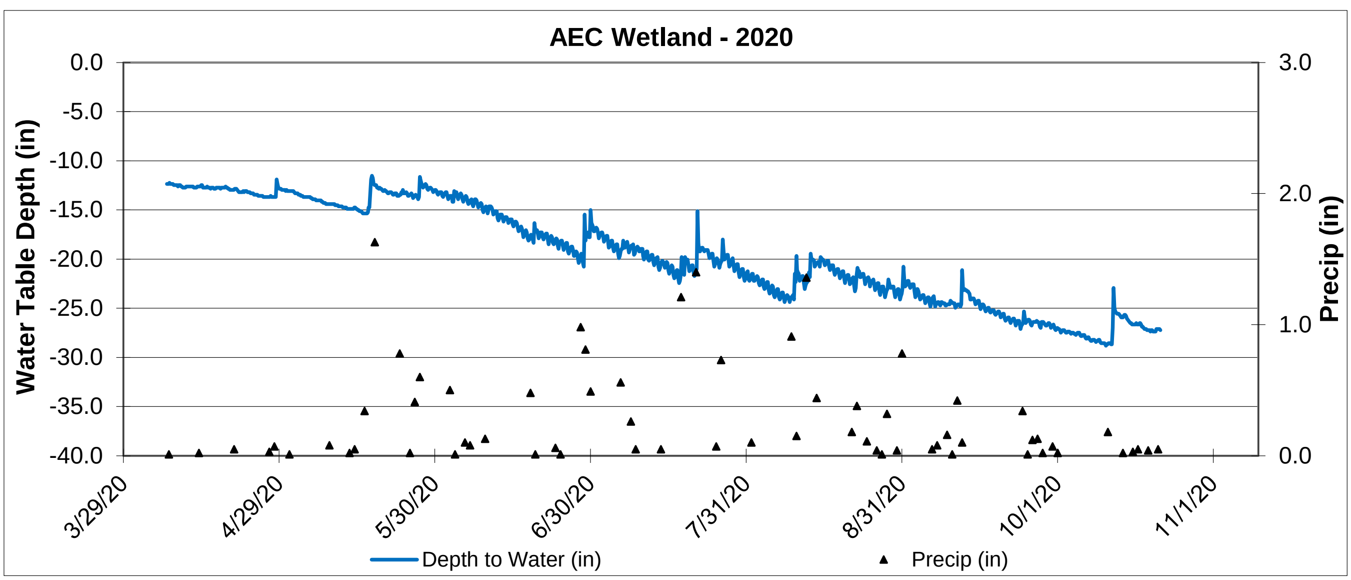
Surrounding Soils: Hubbard coarse sand

Vegetation at Well Location:

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

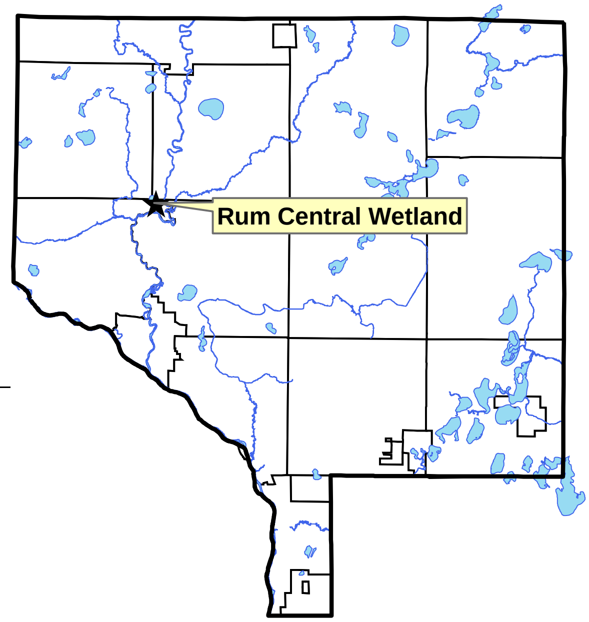
Other Notes: Well is located at the wetland boundary.

2020 Hydrograph



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	-

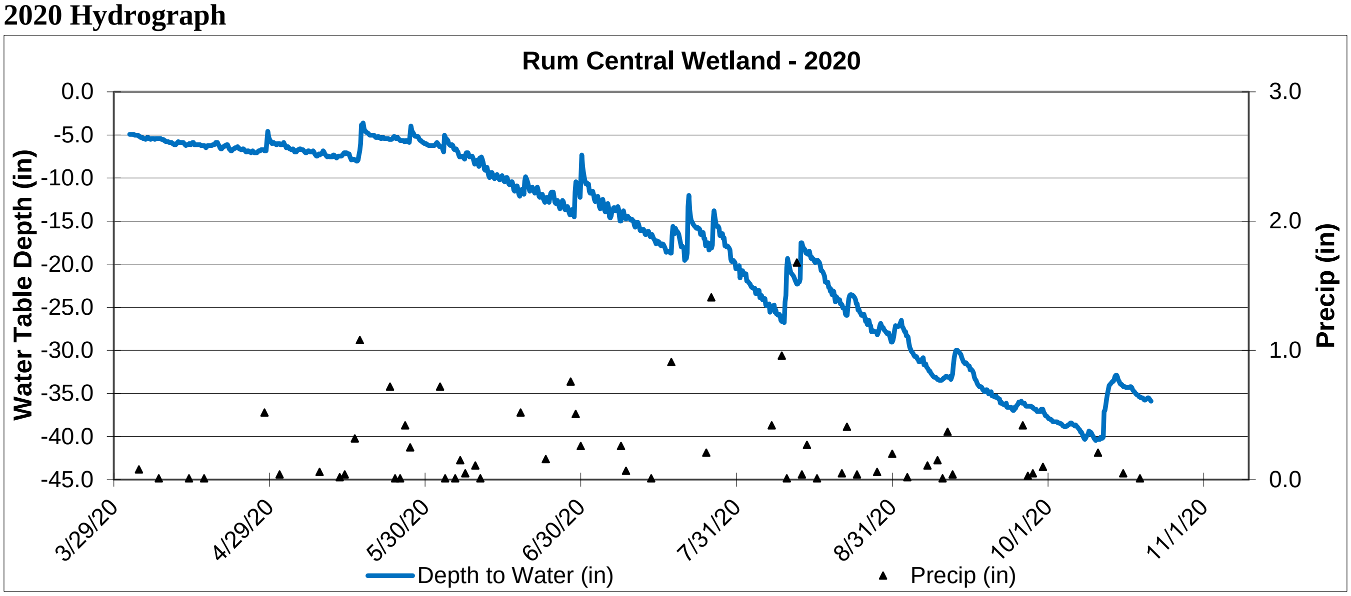
Surrounding Soils: Zimmerman fine sand

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.

2020 Hydrograph



Wetland Hydrology Monitoring

LAKE ITASCA TRAILS REFERENCE WETLAND

Lake Itasca Trails Park, Ramsey

Site Information

Monitored Since: 2013

Wetland Type: 2/6

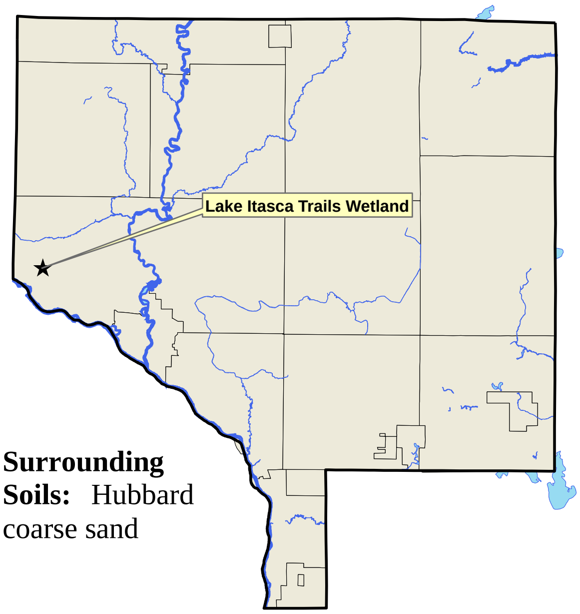
Wetland Size: ~10 acres

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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



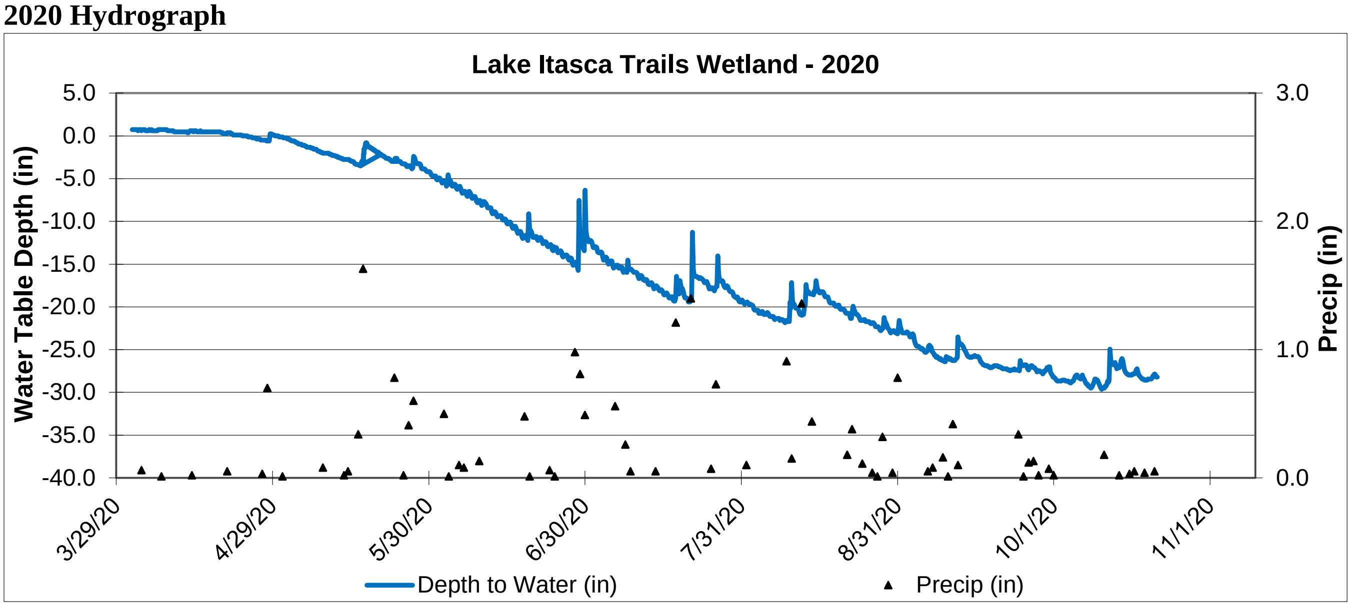
Surrounding Soils: Hubbard coarse sand

Vegetation at Well Location:

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

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

2020 Hydrograph



Water Quality Grant Fund

Partners: LRRWMO, ACD

Description: The LRRWMO provides cost share grants 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 is administered by the Anoka Conservation District. Projects affecting the Rum River are given the 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.

LRRWMO Cost Share Fund Summary

2006 LRRWMO Contribution	+	$1,000.00
2008 Expense – Herrala Rum Riverbank stabilization	-	$ 150.91
2008 Expense – Rusin Rum Riverbank stabilization	-	$ 225.46
2009 LRRWMO Contribution	+	$1,000.00
2009 Expense – Rusin Rum Riverbank bluff stabilization	-	$ 52.05
2010 LRRWMO Contribution	+	$ 0
2010 LRRWMO Expenses	-	$ 0
2011 LRRWMO Contribution	+	$ 0
2011 Expense - Blackburn Rum riverbank	-	$ 543.46
2012 LRRWMO Contribution	+	$1,000.00
2013 LRRWMO Contribution	+	$1,000.00
2013 Expense – Geldacker Mississippi Riverbank	-	$1,000.00
2014 LRRWMO Contribution	+	$2,050.00
2006-14 Expense – Smith Rum Riverbank stabilization	-	$ 2,561.77
2015 LRRWMO Contribution	+	$1,000.00
2016 LRRWMO Contribution	+	$1,000.00
2016 Expense – Brauer Rum Riverbank	-	$1,150.00
2018 LRRWMO Contribution	+	$2,000.00
2014-16 Expense – Anoka rain garden plants	-	$ 916.59
2019 LRRWMO Contribution	+	$2,000.00
2020 LRRWMO Contribution	+	$2,000.00
Fund Balance		**$7,449.76**

Rum River Bank Erosion Grants

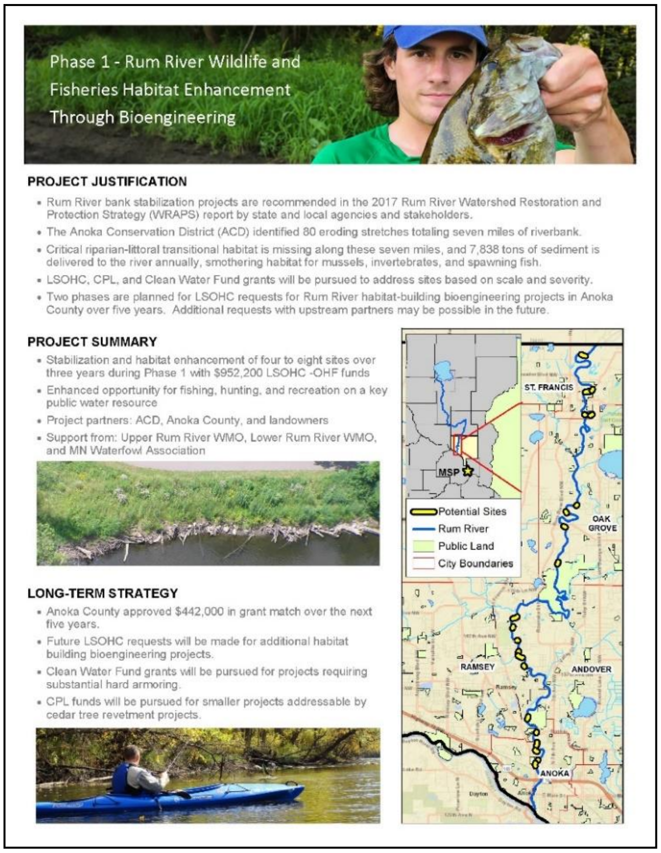
Partners: ACD, Anoka County Parks, LRRWMO, URRWMO

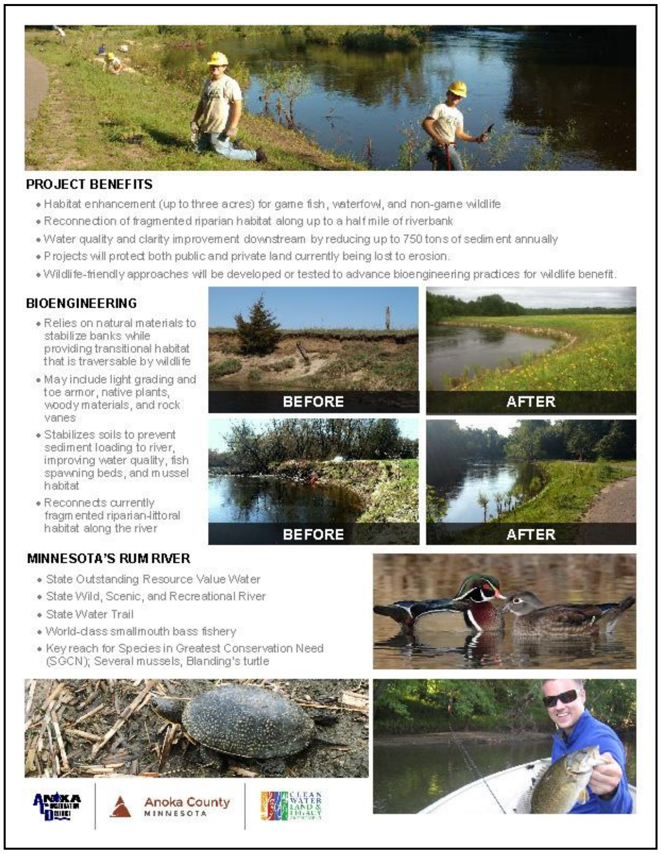
Description: The Anoka Conservation District (ACD) prepared an inventory of Rum River bank erosion using 360° photos of the riverbanks of the Rum throughout Anoka County. The photos are available through Google Maps using the Street View feature. An inventory report identifying 80 stretches of riverbank with moderate to very severe erosion is available on ACD's website. Estimated project cost and annual sediment load reduction to the river were calculated. ACD used this inventory to apply for grant funding for stabilization projects to correct some of these eroding banks. These applications, and matching money from Anoka County and the Rum River WMOs resulted in $1.4 Million to be used over the next three years for stabilization projects. This funding comes from the Outdoor Heritage Fund (OHF) and Clean Water Fund (CWF) of the Clean Water Land and Legacy Amendment.

Purpose: To identify and prioritize riverbank stabilization sites and be used by ACD and other entities to pursue grant funds to restore or stabilize eroding stretches of Rum Riverbank.

Location: Rum River conveyance throughout Anoka County

Results: Inventory of 80 stretches of moderate to very severe erosion on banks of the Rum River. $1.4 Million has been secured in grant and matching funds to implement stabilization projects.





Application illustration for the Lessard-Sams Outdoor Heritage Council to do Rum River stabilization projects utilizing bioengineering approaches. The LSOHC reccomended funding these projects at $816,000 over the next three years, which will be matched with $205,000 in local funds from Anoka County and the Upper and Lower Rum River WMOs.

Rum River Bank Stabilizations

Partners: ACD, Conservation Corps MN, Anoka County Parks, landowners

Description: One large-scale riverbank stabilization project was installed on the Rum River in 2020. A cedar tree revetment practice was used to stabilize 650 linear feet of eroding bank. The project was installed with labor from Conservation Corps Minnesota (CCM) work crews and ACD staff. Funding for the revetment project came from the Conservation Partners Legacy Grant Program and a Clean Water Fund CCM crew labor grant.

Purpose: To stabilize areas of riverbank with mild to moderate erosion in order to reduce sediment loading in the Rum River, as well as to reduce the likelihood of much larger and more expensive corrective projects in the future.

Location: Rum River Central Regional Park

Results: Stabilized 650 linear feet of riverbank on the Rum River within Rum Central Regional Park

2020 Rum Central Regional Park Revetment Project

Anoka High School Campus Groundwater Conservation Plan (CGCP)

Partners: Anoka High School staff, ACD

Description: For this project, the Metro Conservation Districts (MCD) is working to provide groundwater conservation planning protocols to member districts for implementation on large-acreage, public campuses (e.g. public schools and government facilities). These areas are targeted due to their educational benefits, likelihood of stakeholder buy in and implementation, magnitude of potential impact, and opportunity for school district-wide implementation. Funding for the project is provided by a Clean Water Fund grant. The grant recipient is MCD and Anoka Conservation District is serving as the grant host.

Purpose: To identify all possible groundwater conservation practices on the Anoka High School Campus and rank them by cost-effectiveness for prioritization of installation.

Location: Anoka High School Campus – Anoka, MN

Results: The Campus Groundwater Conservation Planning (CGCP) protocol was implemented on the Anoka High School Campus in 2020 for the purpose of identifying and ranking water conservation project opportunities. Of the 224 projects identified for conserving municipal water, 113 have an estimated payback period shorter than their estimated lifespan, which makes them feasible from a financial perspective. Implementation of these 113 potential water conservation projects would result in an annual reduction in water use of 1,502,297 gallons, which corresponds to a reduction of $7,968.18 in annual costs associated with water and energy.

Payback Period Criteria	Number of Projects	Installation Cost ($)	Savings (Water + Energy) over Life of Projects ($)	Net Savings (Water + Energy) over Life of Projects ($)	Annual Water Savings (gallons)	Water Savings over Life of Projects (gallons)	Cost per 1,000 gallons saved over Life of Projects
< 1 year	11	$550.00	$7,813.52	$7,263.52	154,672	1,394,568	$0.39
< 2 years	29	$2,850.00	$20,991.01	$18,141.01	415,828	3,809,687	$0.75
< 5 years	79	$15,450.00	$57,051.68	$41,601.68	1,132,321	10,799,304	$1.43
All projects with positive net savings ($)	113	$26,950.00	$75,656.59	$48,706.59	1,502,297	14,470,805	$1.86
All projects, including negative net savings ($)	224	$47,750.00	$82,445.16	$34,695.16	1,636,702	15,687,024	$3.04

Anoka Rain Gardens

Partners: City of Anoka, ACD

Description: The City of Anoka completed a street resurfacing project in the 38th Lane neighborhood in summer of 2020. The City hired ACD to design three rain gardens in this neighborhood which were installed in conjunction with the street resurface project. This neighborhood already contained two rain gardens that were performing well, and protecting water quality in the Rum River by treating stormwater that was otherwise piped through the storm sewer system to the river. Collectively, these new rain gardens will remove about 76% of the pollutant load from 4.7 acres in this neighborhood. Design work was completed in January of 2020, and installation took place during the summer.

Purpose: To improve water quality in the Rum and Mississippi Rivers.

Location: 38th Lane Neighborhood, Anoka

Results: Three rain gardens were designed and installed in 2020.

Map of installed and previously installed rain gardens

Newsletter Articles

Partners: LRRWMO, ACD

Description: The Lower Rum River Watershed Management Organization (LRRWMO) contracts the Anoka Conservation District (ACD) to create public education materials. The LRRWMO is required to distribute an annual publication under State Rules. This requirement is met through newsletters or infographics in city newsletters. This method ensures wide distribution at minimal cost.

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

Location: Watershed-wide

Results: In 2020, the Anoka Conservation District (ACD) drafted two newsletter infographics and sent them to cities for inclusion in their newsletters. The two brief articles are shown below.

2020 Newsletter Articles

Lower Rum River
Watershed Management Organization

MEDIA RELEASE

Contact person: **Jamie Schurbon 763-434-2030 ext. 21**
Date: **April 17, 2020**

Local Watershed Organization Tackles Riverbank Erosion

Riverbank erosion causes problems for both property owners and the river's health. Recent inventories of Rum and Mississippi of river conditions found dozens of stretches of eroding riverbank in Anoka County. The Lower Rum River Watershed Management Organization (LRRWMO) and its partners will soon begin work to correct a number of those eroding riverbanks.

Grants totaling $2M have been secured from the MN Board of Water and Soil Resources, Lessard-Sams Outdoor Heritage Council, and the MN DNR. All these funding sources get money from the Clean Land, Water and Legacy Amendment passed by voters in 2008. Grants for Rum Riverbank stabilization projects are being received by the Anoka Conservation District in collaboration with the LRRWMO, Upper Rum River WMO, The Nature Conservancy and Anoka County Parks. Grants for Mississippi River Community Park in Anoka are being received by the City of Anoka in collaboration with the LRRWMO. Work begins in 2020, with most construction in 2021.

Stabilizing even just 10 eroding riverbanks will decrease sediment entering the river by over 750 tons. That sediment makes the water brown, carries nutrients and other pollutants, and smothers fish spawning habitat. Every project will include habitat improvements in and next to the water.

[This paragraph is optional – cut if required to fit available space] Riverbank erosion varies in size and type of solution. Amongst locally eroding riverbanks, some are tall banks of bare, collapsing sand. These locations, including Mississippi River Community Park require re-grading, rock or other robust engineering to fix. Other eroding riverbanks are just a few feet tall. These can be corrected with "softer" materials such as armoring with cut cedar trees and planting for long-term stability. In either case, work is done with an eye toward improving habitat.

The Lower Rum River Watershed Management Organization is a special purpose unit of government made up of three cities: Andover, Anoka and Ramsey. Its purpose is to manage the area's waters, particularly those that flow across city boundaries. More information is at www.LRRWMO.org.

Photos below are also provided as separate image files.

Grants for water quality projects

The Lower Rum River Watershed Management Organization is offering small grants to residents wishing to do projects that will benefit lakes, streams and groundwater. Common project types are lakeshore stabilization or vegetation buffers, rain gardens, and streambank stabilization. Applications are accepted on a first-come, first-serve basis. Commonly, grant awards are for $500 to $3,000 or 50-75% of the project cost, however every project is considered on its own merits.

Applications are accepted through the Anoka Conservation District, which hosts several grant programs in an effort to be a one-stop-shop. The Anoka Conservation District also offers free technical help to residents wishing to address a water quality or habitat issue. Applications are found at www.AnokaSWCD.org/financial-support.html or contact Jamie Schurbon (jamie.schurbon@anokaswcd.org or 763-434-2030 ext. 21).

Funding provided by the Lower Rum River Watershed Management Organization (LRRWMO). The LRRWMO is a joint effort of the cities of Anoka, Andover and Ramsey.

Lower Rum River WMO www.LRRWMO.org

LRRWMO Website

Description: The Lower Rum River Watershed Management Organization (LRRWMO) contracts the Anoka Conservation District (ACD) to design and maintain a website about the LRRWMO and the Lower Rum River watershed. The website has been in operation since 2003.

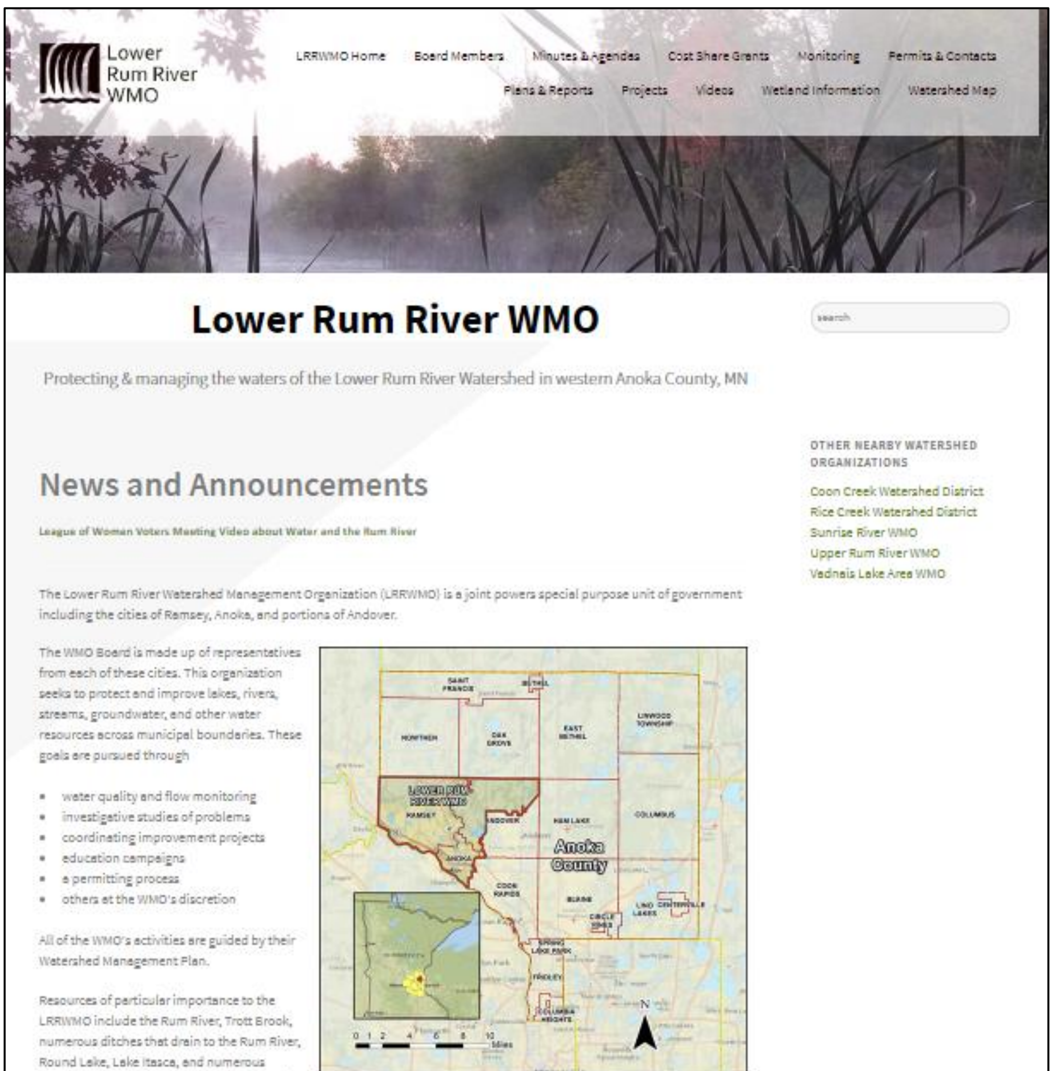
Purpose: To increase awareness of the LRRWMO and its programs. The website also provides tools and information that helps users better understand water resources issues in the area.

Location: LRRWMO.org

Results: In 2020 the LRRWMO's new website, which was launched in 2018, was maintained. The website includes:

- Directory of board members,
- Meeting minutes and agendas,
- Watershed management plan and annual reports,
- Descriptions of work that the organization is directing,
- Highlighted projects,
- Informational videos,
- Maps of the LRRWMO.

LRRWMO Website Homepage



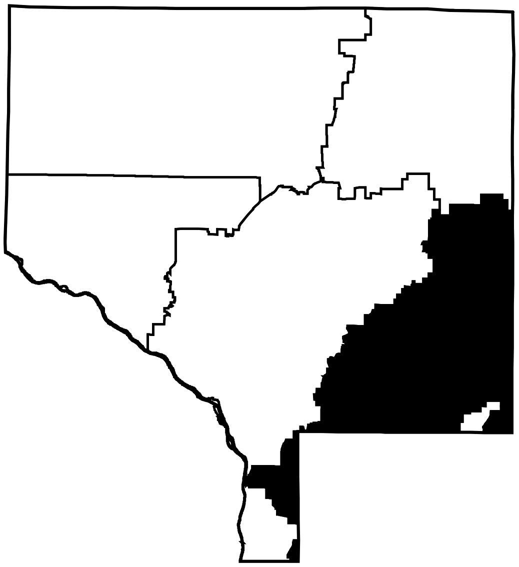
Recommendations

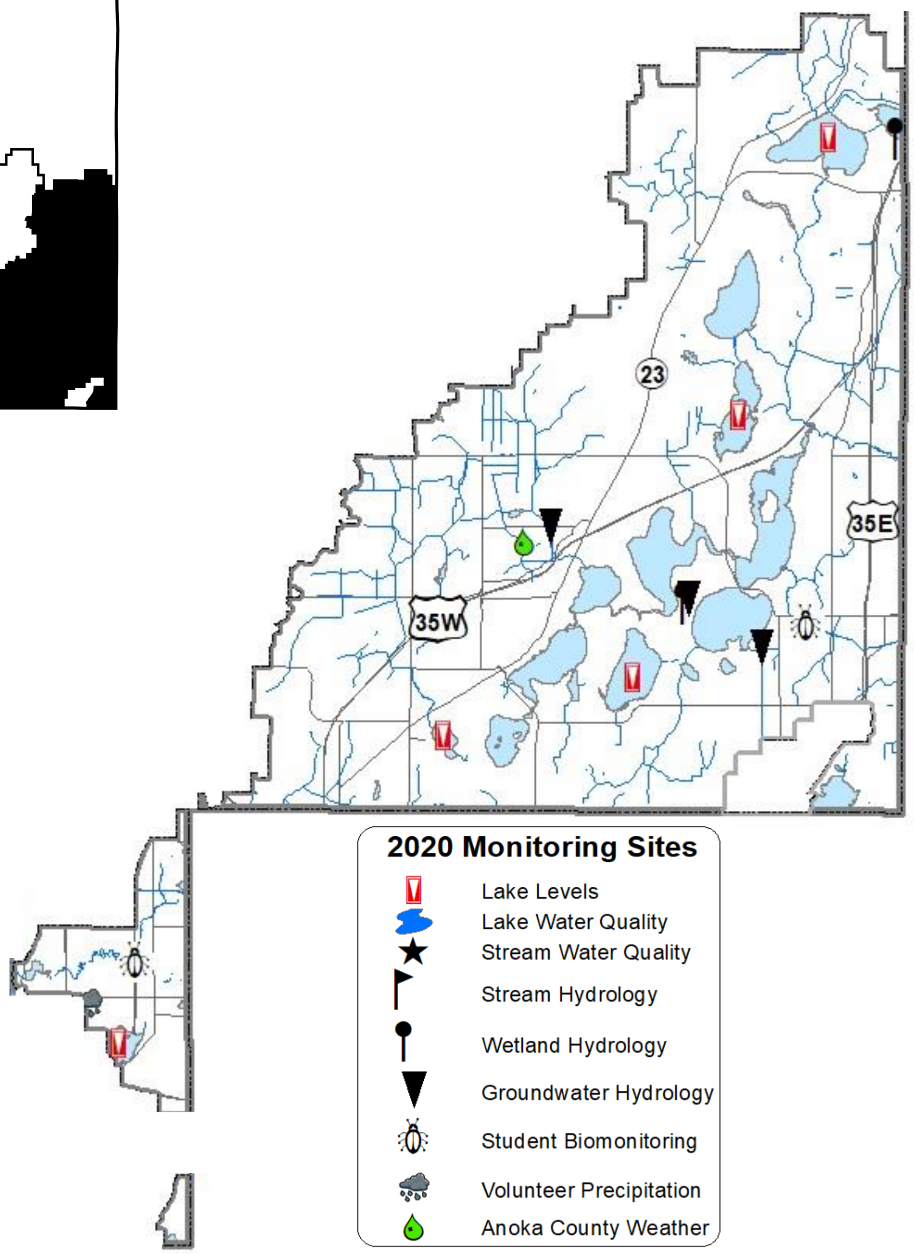
- **Install projects identified the new LRWRMO Watershed Management Plan**, currently under review. New non-competitive State Watershed Based Funding may be used for these projects, as well as competitive grants.
- **Continue to install projects identified in the stormwater retrofit studies for the Cities of Anoka and Ramsey.** Projects have been identified and ranked that would improve stormwater runoff before it is discharged to the Rum or Mississippi River. Metropolitan Council grant funds were used to construct three projects in 2017-2018. Three more projects were installed by the City of Anoka and ACD in 2020. Additional cost-effective projects exist.
- **Engage with upstream entities creating a collaborative Rum River One Watershed, One Plan** (1W1P). As the receiving entity at the bottom of the watershed for all water flowing downstream, it is especially important to collaborate on, and prioritize, projects benefitting the river. 1W1P development continues through 2021.
- **Implement the MPCA Rum River WRAPP (Watershed Restoration and Protection Plan).** This WRAPP included an assessment of the entire Rum River watershed. It outlines regional priorities and management strategies, and attempts to coordinate them across jurisdictions. The primary project type identified in Anoka County is the stabilization of eroding banks along the Rum River.
- **Maintain or reduce Rum River phosphorus.** Phosphorus levels are close to State water quality standards. It may be appropriate to review development and stormwater discharge ordinances to ensure phosphorus does not increase in coming years.
- **Implement groundwater conservation measures** throughout the watershed and promote them metro-wide. Depletion of shallow groundwater is a concern region-wide.
- **Continue surveillance water monitoring** at a frequency sufficient to detect changes and trends.
- **Continue chloride sampling at all sites on a rotating basis.** Chloride sampling was conducted at County Road 7 in 2018 and 2019. Because this pollutant can have such a profound impact on aquatic life and drinking water, continuing to periodically include it in the monitoring regime is prudent.

Chapter 5: Rice Creek Watershed

Prepared by the Anoka Conservation District

Chapter 5 - Rice Creek Watershed





Lake Levels

Partners: RCWD, ACD, volunteers

Description: Weekly water level monitoring in lakes. Graphs for the past five years as well as historical data from the last 25 years are shown below. All data are available on the Minnesota DNR website using the “LakeFinder” feature (www.dnr.mn.us.state\lakefind\index.html).

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

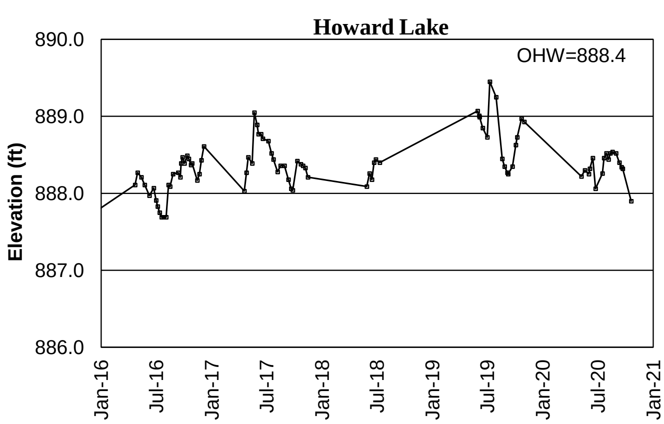
Locations: Howard Lake, Moore Lake, Reshanau Lake, and Rondeau Lake

Results: Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. In 2020, lake levels started near average and declined throughout the season. The rebound often seen in the fall was not observed. This is likely due to infrequent rain events throughout the season and the lowest annual total precipitation since 2012.

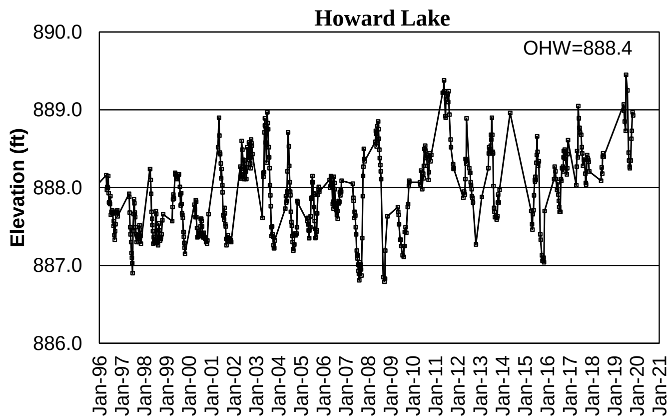
Water levels on Moore Lake had its lowest average level since 2009. Rondeau Lake had its lowest average since 2013 and only reached a maximum elevation of 886.07 which is the lowest annual peak elevation since 2000. Howard Lake levels were similar to previous years and water levels on Reshanau Lake had its highest average since 2014. All four lakes fluctuated less in 2020 than in 2019.

All lake level data can be downloaded from the MN DNR website’s LakeFinder feature (https://www.dnr.state.mn.us/lakefind/index.html). 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.

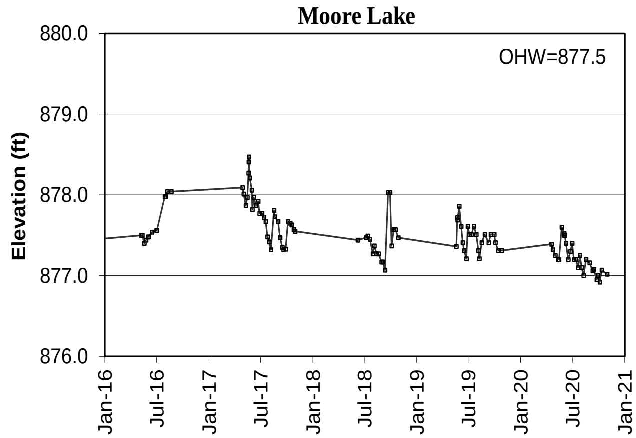
Howard Lake Levels- Last 5 Years



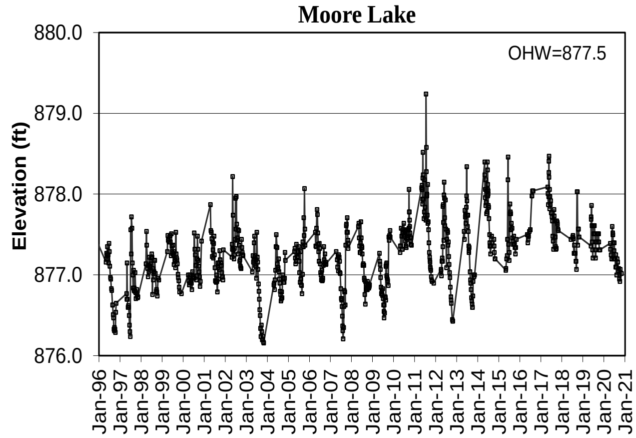
Howard Lake Levels- Last 25 Years



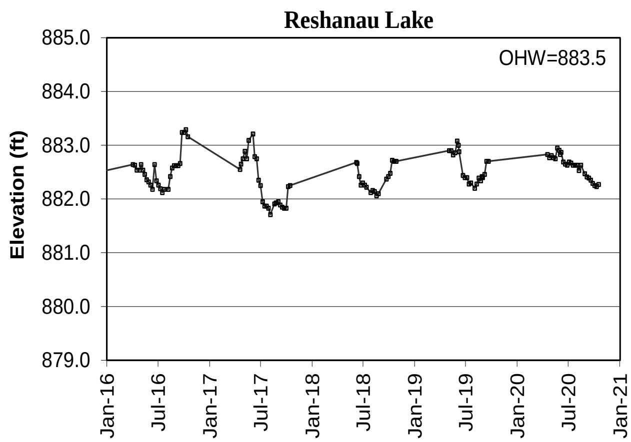
Moore Lake Levels- Last 5 Years



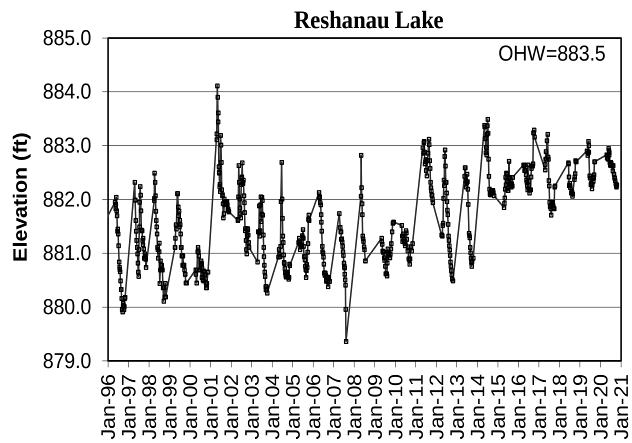
Moore Lake Levels- Last 25 Years



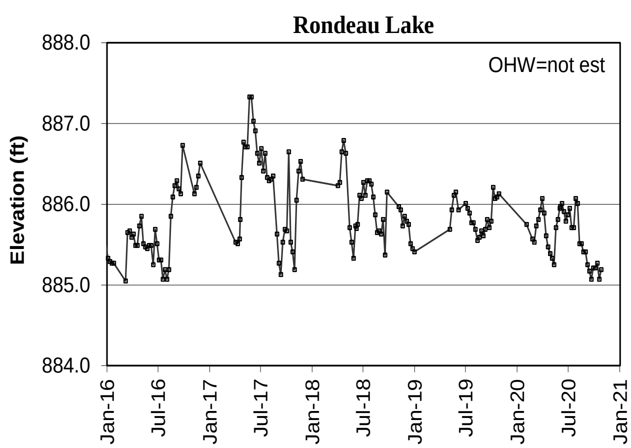
Reshanau Lake Levels- Last 5 Years



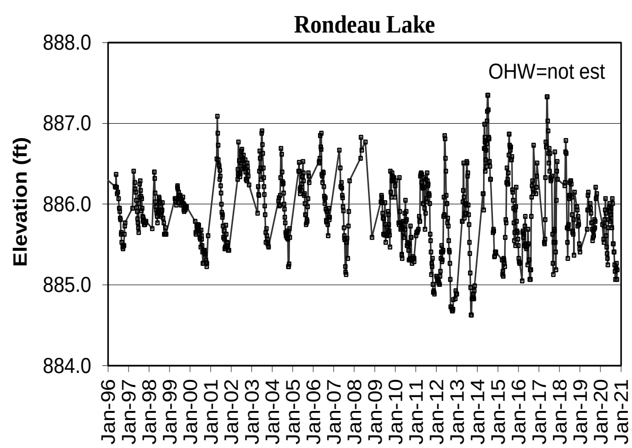
Reshanau Lake Levels- Last 25 Years



Rondeau Lake Levels- Last 5 Years



Rondeau Lake Levels- Last 25 Years



Lake	Year	Average	Min	Max
Howard	2016	888.17	887.69	888.61
	2017	888.43	888.03	889.05
	2018	888.30	888.09	888.44
	2019	888.77	888.25	889.45
	2020	888.34	887.90	888.54

Lake	Year	Average	Min	Max
Rondeau	2016	885.66	885.05	886.73
	2017	886.19	885.13	887.33
	2018	885.92	885.33	886.79
	2019	885.86	885.55	886.21
	2020	885.61	885.07	886.07

Lake	Year	Average	Min	Max
Moore	2016	877.65	877.40	878.04
	2017	877.77	877.32	878.47
	2018	877.44	877.07	878.03
	2019	877.47	877.21	877.86
	2020	877.22	876.92	877.60

Lake	Year	Average	Min	Max
Reshanau	2016	882.55	882.12	883.29
	2017	882.28	881.71	883.21
	2018	882.38	882.06	882.72
	2019	882.58	882.20	883.08
	2020	882.61	882.23	882.95

Wetland Hydrology

Partners: RCWD, ACD

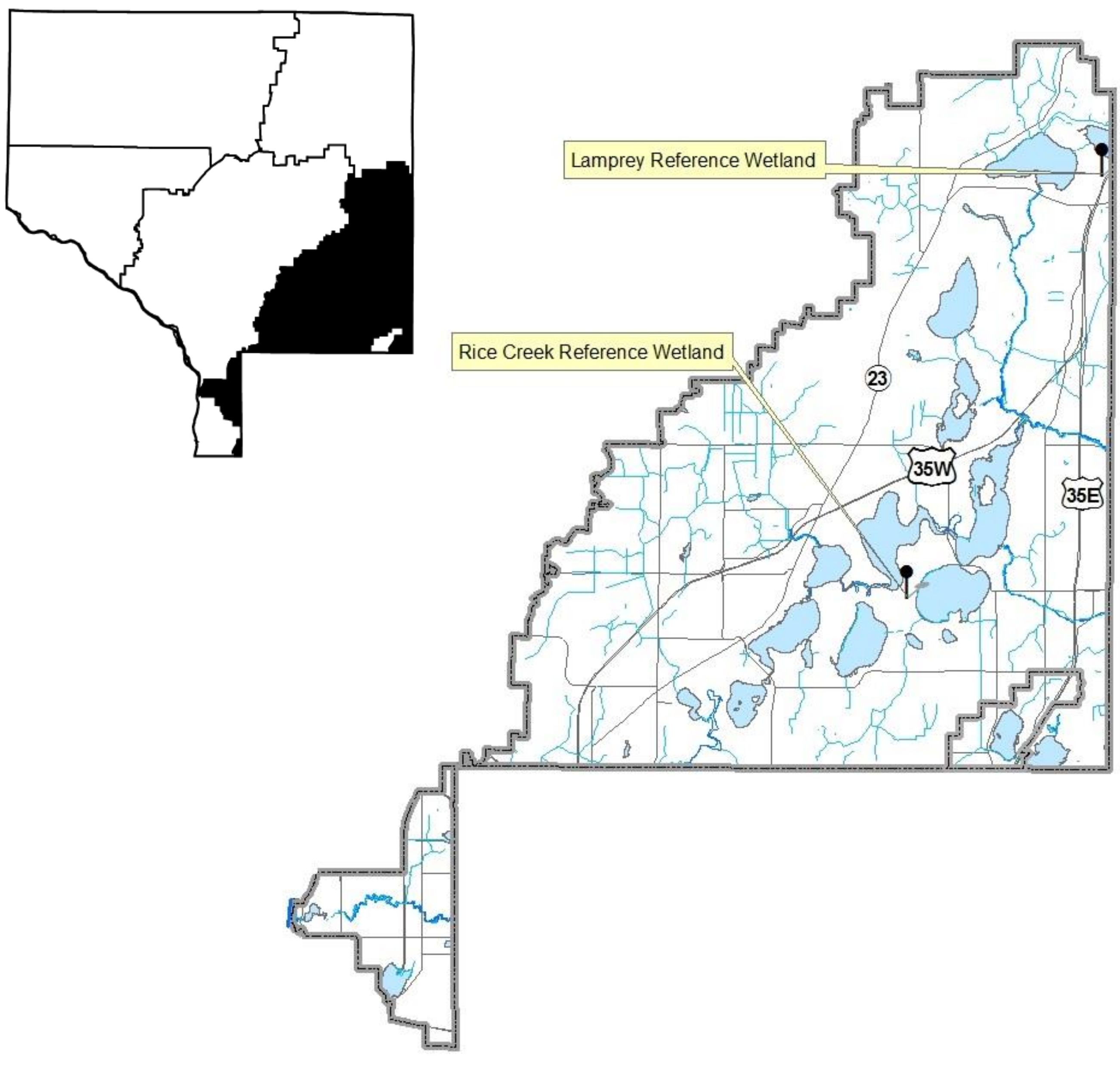
Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 23 wetland hydrology monitoring stations.

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

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

Results: See the following pages.

Rice Creek Watershed Wetland Hydrology Monitoring Sites



Wetland Hydrology Monitoring

LAMPREY REFERENCE WETLAND

Lamprey Pass Wildlife Mgmt Area, Columbus

Site Information

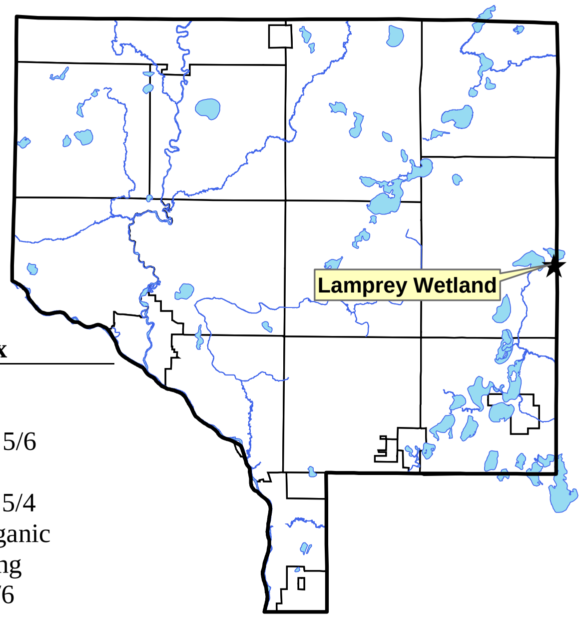
Monitored Since: 1999

Wetland Type: 4

Wetland Size: ~0.5 acres

Isolated Basin? Yes

Connected to a Ditch? No



Soils at Well Location:

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

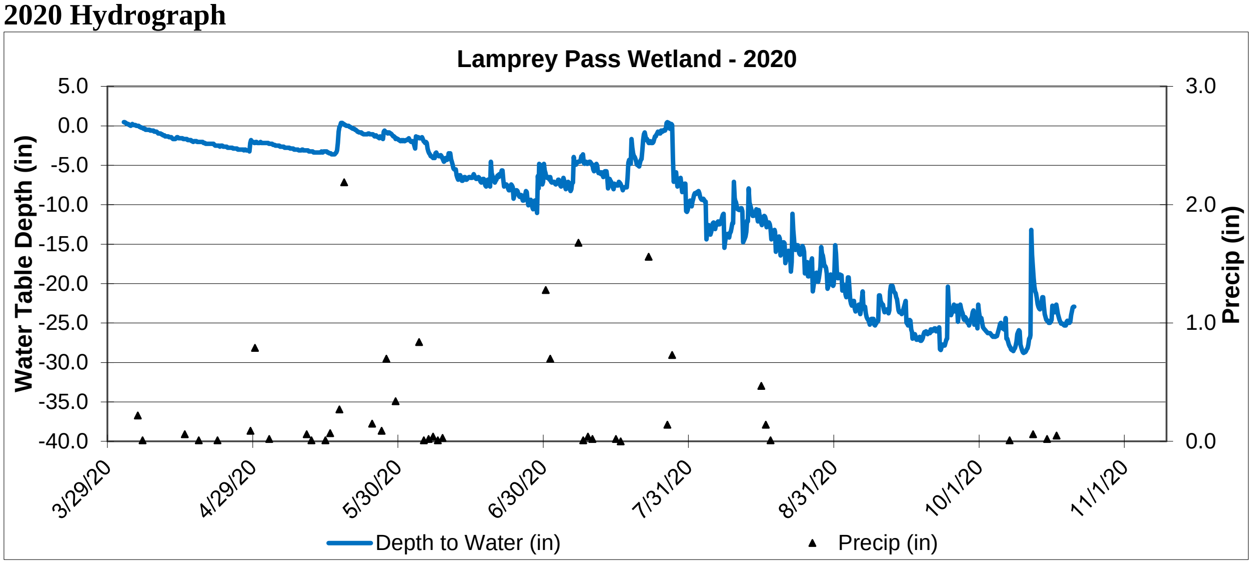
Surrounding Soils: Braham loamy fine sand

Vegetation at Well Location:

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

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

2020 Hydrograph

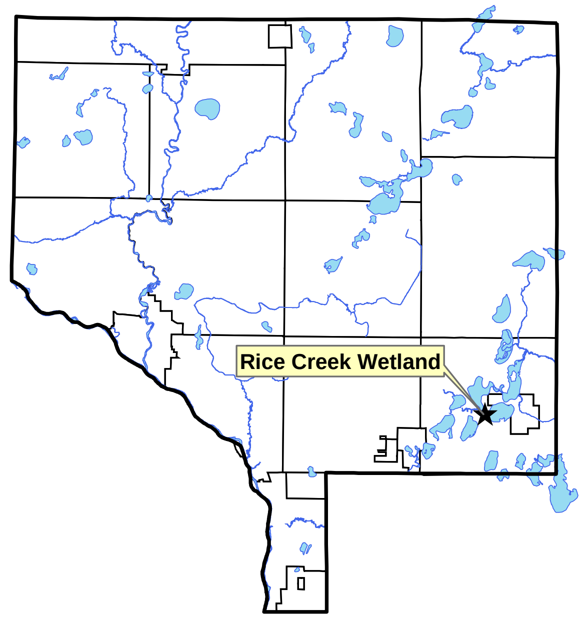


Wetland Hydrology Monitoring

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

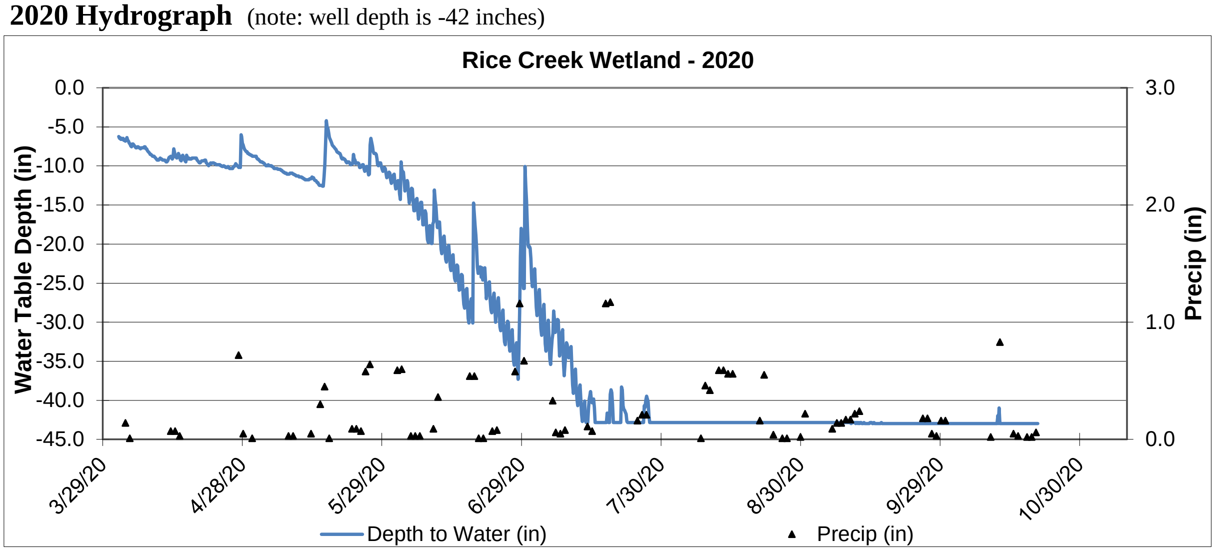
Surrounding Soils: Nessel fine sandy loam and Blomford loamy fine sand

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. During the months August and September the surrounding wetland area was dry.

2020 Hydrograph (note: well depth is -42 inches)



Stream Water Quality – Biological Monitoring

Description: This program combines environmental education and stream monitoring. Under the supervision of the ACD staff, high school science classes collect aquatic macroinvertebrates from a stream, identify their collections 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 generally 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.

Location: Clearwater Creek at Centerville City Hall

Rice Creek at Locke Park, upstream of Highway 65

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

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.

% 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).

Biomonitoring

CLEARWATER CREEK

at Centerville City Hall, Centerville

Last Monitored

By FLALC in fall 2020

Monitored Since

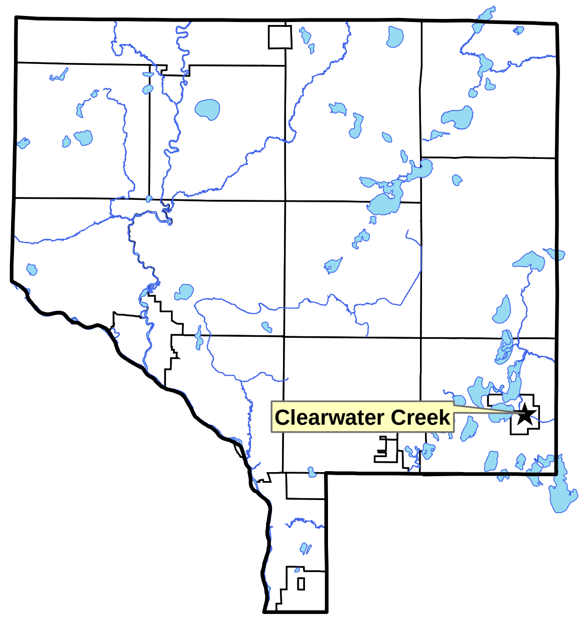
1999

Student Involvement

8 students in 2020, approximately 653 since 1999

Background

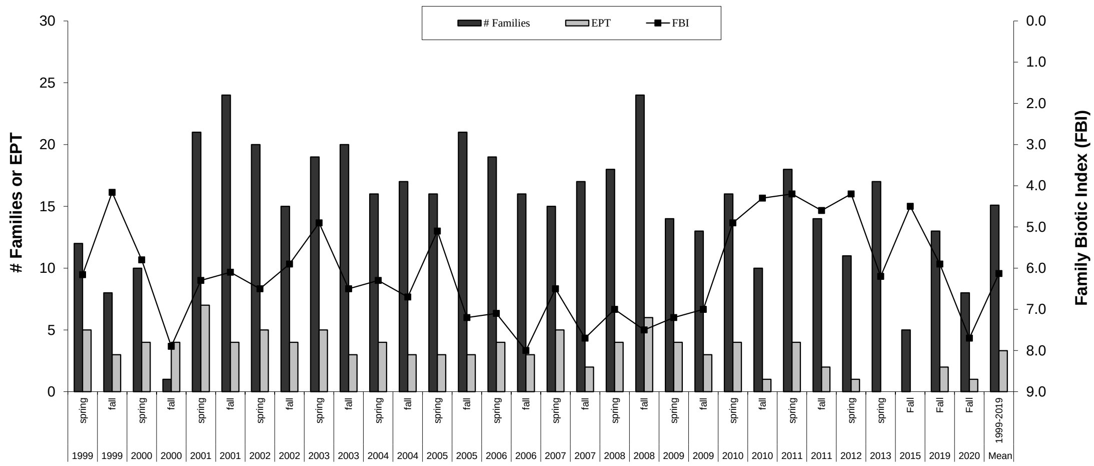
Clearwater Creek originates in Bald Eagle Lake in northwest Ramsey County and flows northwest into Peltier Lake. Land use is an approximately equal mix of residential and agricultural, with some small commercial sites. The land use immediately surrounding the sampling site is entirely residential and developed. The stream banks are steep and eroding in spots. The streambed at the sampling site is gravelly or sandy with larger boulders. The stream is 6-12 inches deep at baseflow and approximately 10-15 feet wide.



Results

Centennial High School classes monitored Clearwater Creek through 2012. In 2013, ACD monitored the creek, and in 2015 and 4-H group monitored it. A Forest Lake Area Learning Center class picked monitoring back up at this site in 2019 and 2020. Overall, this stream has average or slightly below average conditions based on the invertebrate data. Since 2010, the FBI score has been lower than in most previous years. The lower FBI value suggests an increase in pollution tolerant species. This change may be driven by the dominance of the invertebrate community by Gammaridae and Hyallelidae amphipods since that time, which have moderate tolerance values. The Amphipod families had not been dominant before 2009, and EPT taxa were much more prevalent before that time, averaging about 4 unique EPT families present each year. Since 2010, less than 2 EPT families are present on average, and amphipods have dominated. Invertebrate data in 2020 showed only a small percentage from the Trichoptera family and the dominant family by large being Hyallelidae.

Summarized Biomonitoring Results for Clearwater Creek in Centerville



Biomonitoring Data for Clearwater Creek in Centerville
Data presented from the most recent monitored five years. Contact the ACD to request archived data.

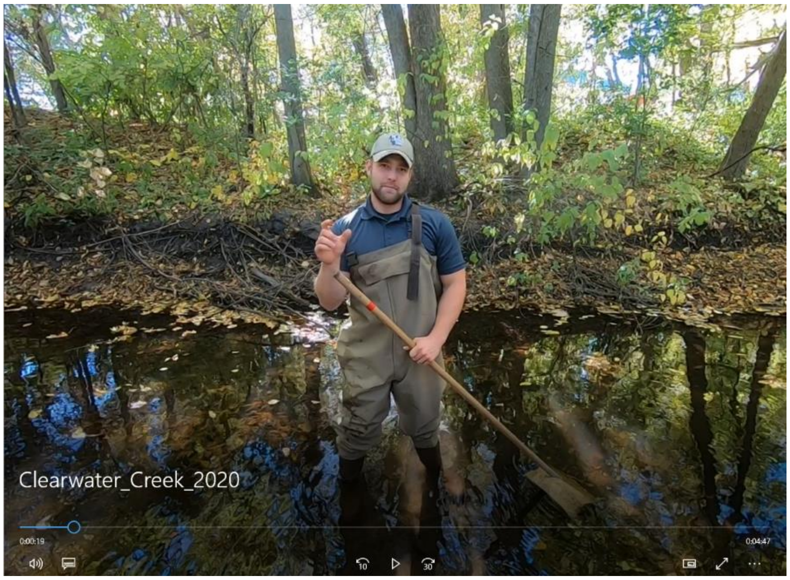
Year	2012	2013	2015	2019	2020	Mean
Season	spring	spring	Fall	Fall	Fall	1999-2020
FBI	4.2	6.2	4.5	5.9	7.7	6.1
# Families	11	17	5	13	8	15.2
EPT	1	0	0	2	1	3.3
Date	17-May	28-May	31-Aug	10-Oct	7-Oct	
Sampled By	CHS	CHS	Anoka 4-H	FLALC	FLALC	
Sampling Method	MH	MH	MH	MH	MH	
Mean # Individuals/Rep.	273	228	152	133	255	
# Replicates	1	1	1	1	1	
Dominant Family	Gammaridae	Hyalellidae	Gammaridae	Hyalellidae	Hyalellidae	
% Dominant Family	87.9	34.2	65.7	36.1	90.2	
% Ephemeroptera	2.2	0	0.0	1.5	0	
% Trichoptera	0.0	0.0	0.0	26.3	0.4	
% Plecoptera	0.0	0.0	0.0	0.0	0.0	

Discussion

This creek's biological community is probably limited by a combination of habitat, hydrology, and water chemistry factors. This creek has been highly modified and primarily turned into a straightened ditch throughout much of its flow path. Clearwater Creek is listed as impaired for dissolved oxygen as well as both fish and invertebrate biota. It's likely that Bald Eagle Lake, which is impaired for nutrients and serves as the Creek's headwaters, is contributing to the low oxygen concentrations. However it is worth noting that Bald Eagle Lake had an alum treatment in 2014 and 2016 to reduce phosphorus levels, which may reduce oxygen demand in Clearwater Creek.

Due to COVID-19, 2020 sampling of Clearwater Creek was completed by ACD along with the class teacher and his sons. The teacher put together an educational video on sampling for the students, and the collected samples were identified in the lab by students.

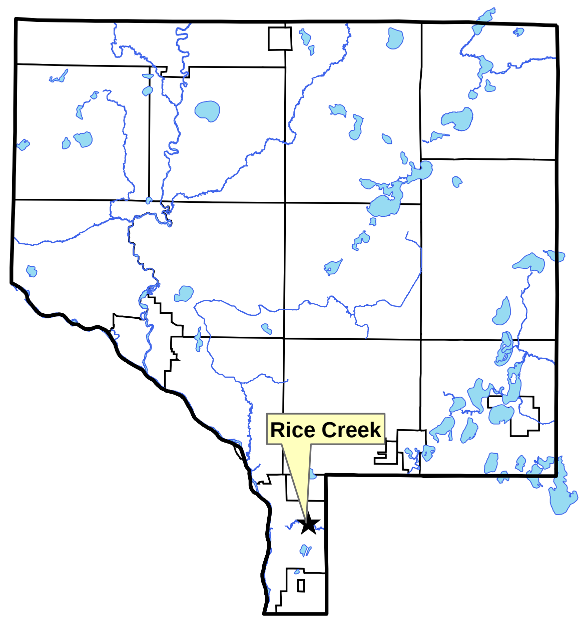
ACD Staff at Clearwater Creek



Biomonitoring

RICE CREEK

at Hwy 65, Rice Creek West Regional Trail Corridor, Fridley



Last Monitored

By Totino Grace High School in fall 2020

Monitored Since

1999

Student Involvement

25 students in 2020, approximately 1,325 since 1999

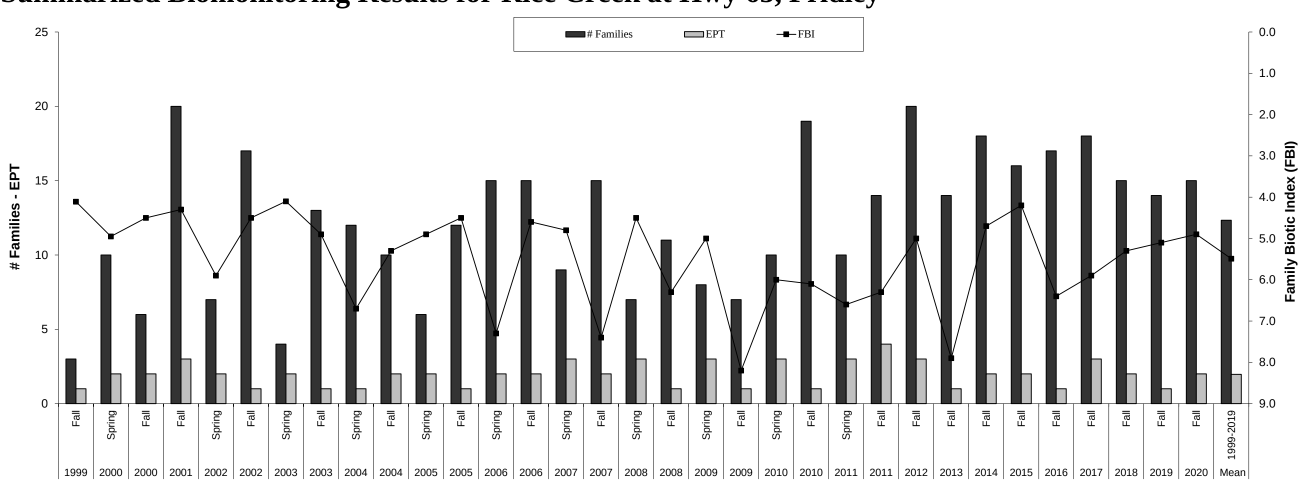
Background

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 the Rice Creek West Regional Trail Corridor, which encompasses a large portion of the stream's riparian zone in Fridley. This site is forested. Outside of this forested buffer, the watershed is urbanized and the stream receives runoff from a variety of urban sources. The stream has a rocky bottom with pools and riffles.

Results

Totino Grace High School monitored this stream in fall of 2020, facilitated by the Anoka Conservation District. At this site, Rice Creek has a macroinvertebrate community indicative of poor stream health. While the number of families present has been similar to, or above the long-term average for Anoka County streams on several occasions, most of these are generalist species that can tolerate polluted conditions. The most dominant family six of the past seven years in a generalist family of the Trichopera order, Hydropshychidae. The number of EPT families present has been below the county average in all years. EPT are generally pollution-sensitive, but the caddisfly family Hydropsychidae, is an exception to that rule. It thrives in relatively poor environmental conditions. Hydropsychidae was the large majority of EPT taxa collected in 2020 along with a small number of Baetidae.

Summarized Biomonitoring Results for Rice Creek at Hwy 65, Fridley



Biomonitoring Data for Rice Creek at Highway 65

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

Year	2016	2017	2018	2019	2020	Mean
Season	Fall	Fall	Fall	Fall	Fall	1999-2020
FBI	6.4	5.9	5.3	5.1	4.9	5.5
# Families	17	18	15	14	15	12.3
EPT	1	3	2	1	2	2.0
Date	18-Oct-16	17-Oct-17	15-Oct-18	15-Oct-19	12-Oct-20	
Sampled By	TGHS	TGHS	TGHS	TGHS	TGHS	
Sampling Method	MH	MH	MH	MH	MH	
# Individuals	272	545	509	322	240	
# Replicates	1	1	1	1	1	
Dominant Family	Hydropsychidae	Simuliidae	Hydropsychidae	Hydropsychidae	Hydropsychidae	
% Dominant Family	41.5	65.2	24.6	48.4	63.8	
% Ephemeroptera	0	2	14.5	0	4.6	
% Trichoptera	41.5	12.3	24.6	48.4	63.8	
% Plecoptera	0	0	0	0	0	
% EPT	41.5	14.3	39.1	48.4	68.4	

Discussion

The poor macroinvertebrate community in this creek is likely due to poor water quality and flashy flows during storms, not poor habitat. Habitat at the sampling site and nearby is good, in part because of past stream habitat improvement projects. The stream has riffles, pools, and runs with a variety of snags and rocks. The area immediately surrounding the stream is wooded, with walking trails. However, outside of this natural corridor around the stream, the watershed is urbanized and storm water inputs are likely the cause of degraded water quality. During storms, water levels in the creek can rise sharply. This portion of Rice Creek is impaired for both fish and invertebrate biota.

Totino Grace High School students at Rice Creek.

Water Quality Grant Administration

Description: RCWD contracted ACD to provide technical assistance for the RCWD Water Quality Grant Program. Tasks could include landowner outreach and education, site reviews, site visits, project evaluations, BMP design, cost-share application assistance, contractor selection assistance, construction oversight, long-term project monitoring, and other services as needed.

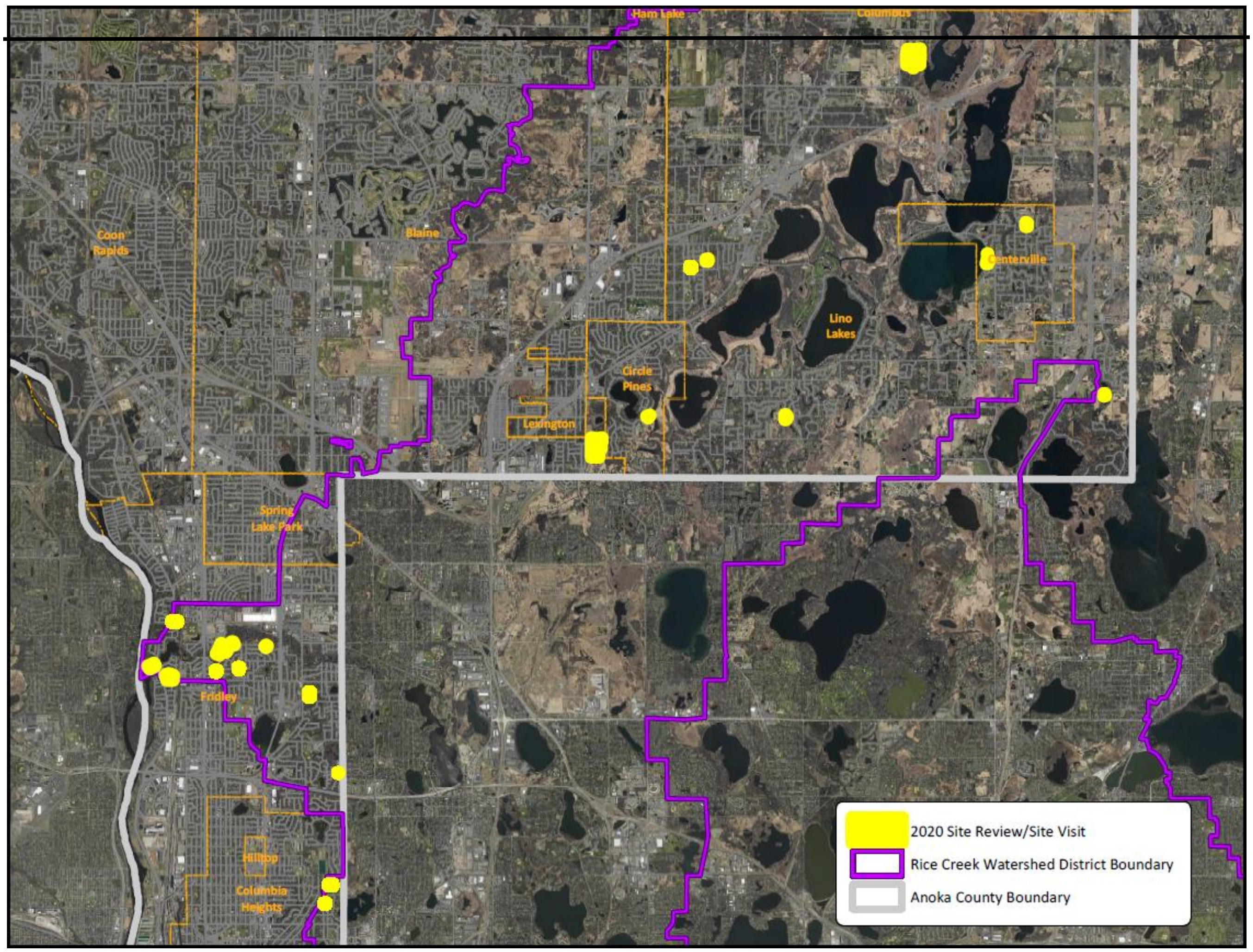
Purpose: To assist property owners within the Rice Creek watershed with the design and installation of water quality improvement BMPs.

Results: Below is a summary of technical assistance provided in 2020.

2020 Summary

Formal property reviews/site visits were conducted at 26 sites throughout the Rice Creek watershed in Anoka County (see overview map below for specific locations). Project types included fourteen rain gardens, three lakeshore stabilizations, four streambank stabilizations, and five backyard drainage or habitat projects.

Sites within the Rice Creek watershed at which ACD provided technical assistance in 2020.



Recommendations

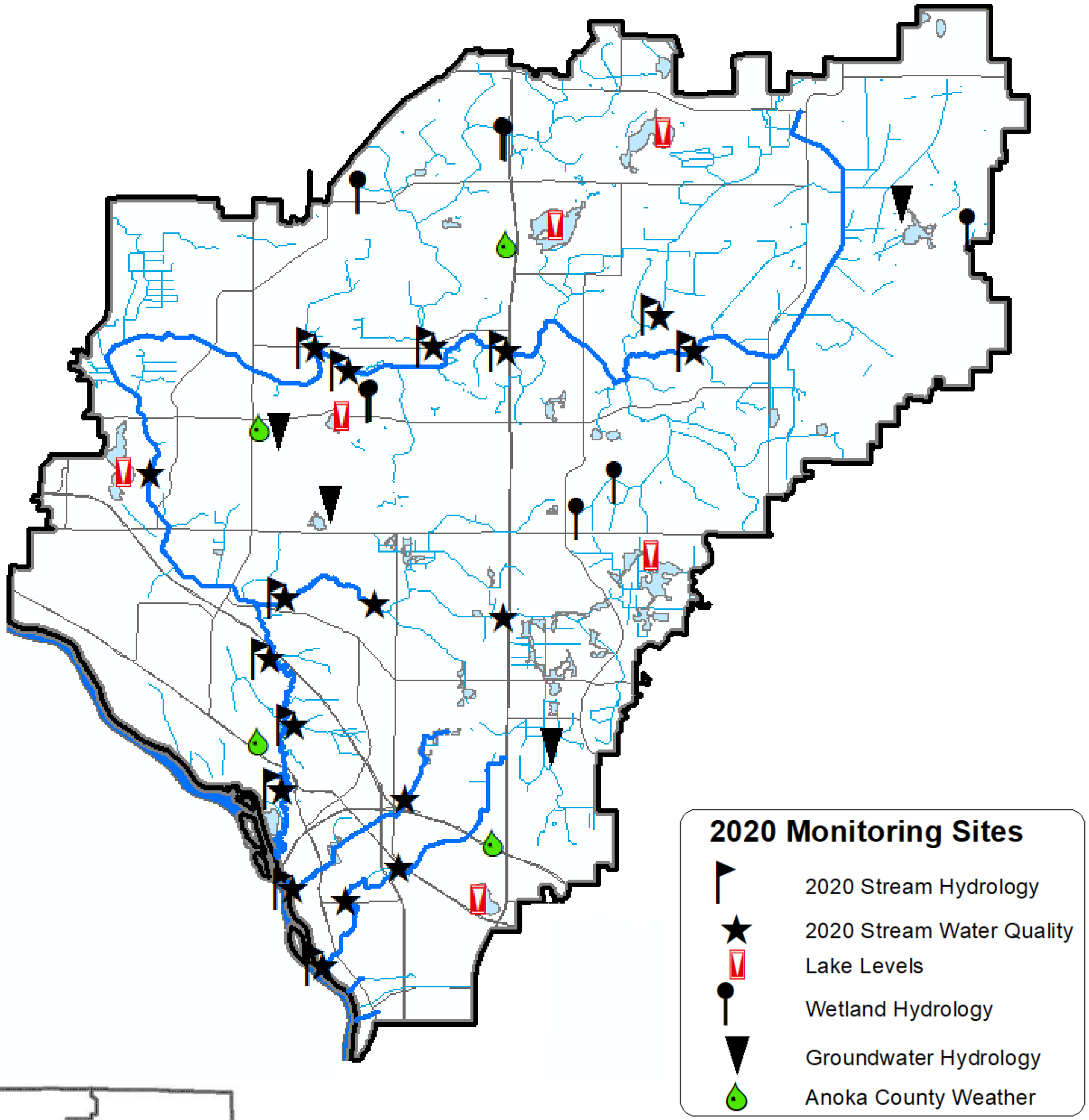
- **Continue to install cost effective projects** identified in previously completed Subwatershed Retrofit Analyses. Projects identified in these studies would be ideal candidates for targeted outreach about available cost share funds. In many cases, projects are already sited, and the water quality benefits of potential projects have already been modelled.

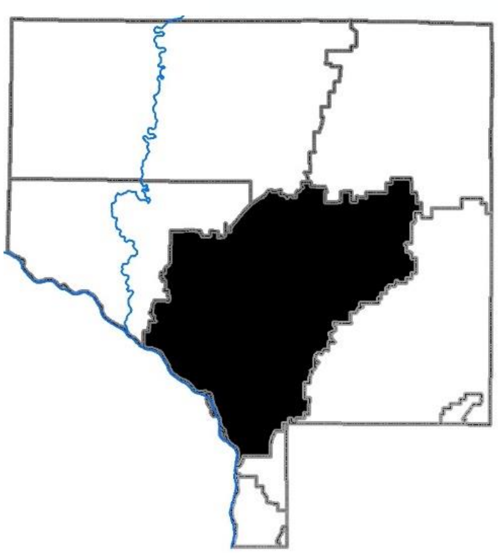
- **Continue the biomonitoring program** with area schools at Rice Creek and Clearwater Creek. This program provides dual benefits in contributing to a long-term bio-indicator dataset as well as educating local youth on their natural resources. Clearwater Creek was monitored again in 2020 in lieu of the difficult to access Hardwood Creek. Clearwater Creek provides a much easier sampling location for the classes.

Chapter 6: Coon Creek Watershed

Prepared by the Anoka Conservation District

Coon Creek Watershed





SUMMARY OF FINDINGS

Description:

This is a brief summary of new findings and notable results from 2020. Detailed analyses for all individual sites can be found below in the appropriate section of the work results.

Precipitation:

- Volunteer data and online resources showed a below average precipitation year. The state had the lowest annual precipitation totals since 2012.

Lake Levels:

- In 2020, lake levels started near average and declined throughout the season, but remained within the normal range. The rebound often seen in the fall was not observed. This is likely due to infrequent rain events throughout the season and the lowest annual total precipitation since 2012.

Stream Hydrology:

- Ditches and streams saw less fluctuation in stage and recorded some of the lowest maximum elevations on record at many of the monitoring sites.
- Development of rating curves was attempted for three sites in the Coon Creek system (Coon Creek at Naples St., Ditch 11 at 149th Ave., and Ditch 20 at Andover Blvd). Abnormal flow, possibly caused by damming or dense vegetation growth, was documented at Ditch 11 and the Naples St. sites, preventing the development of usable rating curves and necessitating further review.

Stream Water Quality:

- In general, elevated phosphorus concentrations, especially during storms, are an issue throughout the watershed and Anoka County as a whole.
- Woodcrest Creek observed positive water quality results. In recent years several treatment practices were implemented in the area including; a streambank stabilization throughout the channel, rain garden installations, and a large scale iron–enhanced sand filter. These practices seem to be effective with treating stormwater runoff in Woodcrest.
- New monitoring sites at some tributaries revealed high concentrations of phosphorus loading into the system Occurring in the upper reaches of the watershed. Ditch 11 and Ditch 58 drain nearby agriculture fields and poor practices and may be contributing to high TP levels. Targeted AgBMP's implemented into the current practices occuring in the fields upstream of these sites could benefit overall water quality in Coon Creek.
- High *E. coli* levels persist throughout the watershed.

Wetland Hydrology:

- Many reference wetland sites experienced low levels which resulted in some equipment bottoming out at a few of the monitoring sites. Equipment will be adjusted in the 2021 season.

RECOMMENDATIONS

- **Shorten the stage reading interval for smaller, flashier creeks** in the lower portions of the watershed with new equipment now being used that can better handle the volume of readings. A 15-minute interval should be used at all creek sites.

- **Update dated stream rating curves.** Changes in stream morphology necessitate periodic updates by manually measuring flow and stage under a variety of water levels, especially in sandy systems. For the past couple of years, and continuing into 2021, we have been developing new rating curves at streams and tributary ditches where none exists. It is important to also keep existing curves updated, especially ones that were developed 10 years ago.

- **Continue implementing water quality monitoring at new sites,** or sites not monitored for a number of years, where upstream to downstream analysis indicates an influx of pollutants. In 2020, two new water monitoring sites were developed at Woodcrest Creek and Ditch 20, just upstream of where ditch each enters Coon Creek. In 2021, 6 new monitoring sites will be established. This will help to further the investigation into the water quality decline of Coon Creek as it flows through the upper portion of its watershed.

- **Continue monitoring chlorides regularly.** Samples collected in 2019 offered a valuable update to results collected from 2007-2012. Sand Creek at Xeon in particular had higher storm event chloride concentrations than ever before measured at this site. Streams in developed watersheds are at especially high risk of elevated and increasing chloride concentrations.

- **Investigate phosphorus loading to Springbrook Creek**. During baseflow, total phosphorus concentrations decrease moving downstream in Springbrook Creek. During storms however, concentrations at the downstream site, 79th Way, increase greatly and often exceed state standards. Investigation into potential loading of TP from the Nature Center wetland complex or neighborhoods in the vicinity of East River Rd may help guide future work in this system.

- **Survey existing reference wetland sites** to determine any changes to wetland boundaries and document any changes to vegetation and soil profiles for wetland regulatory personnel as well as consultants as a means for efficient, accurate wetland determinations.

- **Promote the availability of reference wetland data** among wetland regulatory personnel as well as consultants as a means for efficient, accurate wetland determinations. We are finding these data to be more and more helpful in developing areas and have seen demand for data increase accordingly. ACD has developed an online database to store and organize all historical and future monitoring data.

- **Implement stormwater treatment practices** in the upper portions of the watershed that is less developed and contains more agricultural land uses. Tributary ditches appear to be high sources of pollutant loading into the main stem and reducing pollutant loading in these areas will need to be addressed.

COON CREEK WATERSHED LAKE LEVELS

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

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

Locations:

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

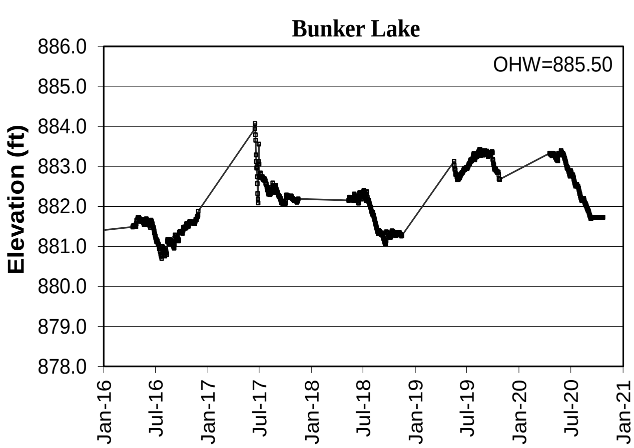
Results: In 2020, lake levels were measured by volunteers 81 times at Ham Lake, 30 times at Lake Netta, 38 times at Crooked Lake, 29 times at Laddie Lake and 15 times at Sunrise Lake. Water levels at Bunker Lake were monitored May through November using an electronic gauge, which reported the daily average of six readings each day.

Lake levels were measured by volunteers throughout the 2020 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. In 2020, lake levels started near average to above average and declined throughout the season. The rebound often seen in the fall was not observed. This is likely due to infrequent rain events throughout the season, and the lowest annual total precipitation since 2012.

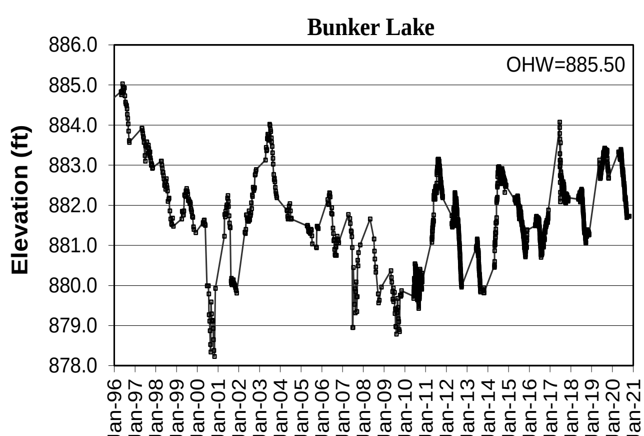
Most lakes had similar 2020 average levels to the averages observed each of the past 5 years. Lake Netta reached its lowest level since 2017, and Bunker Lake its lowest since 2016. Sunrise Lake levels averaged the lowest since monitoring began in 2018.

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. All lakes monitored were lower than the OHW for much of the monitoring season. Levels above OHW were only recorded early in the year.

Bunker Lake Levels – last 5 years

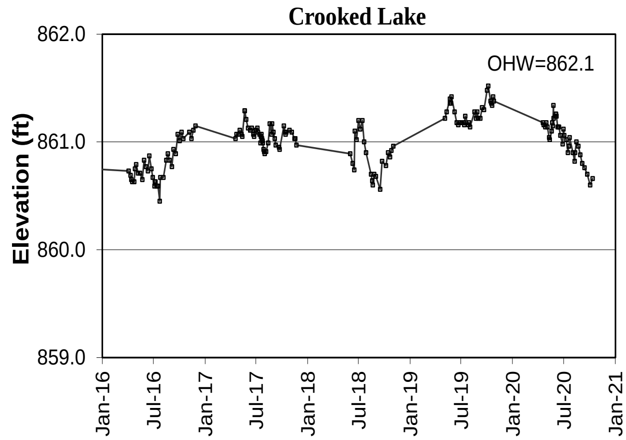


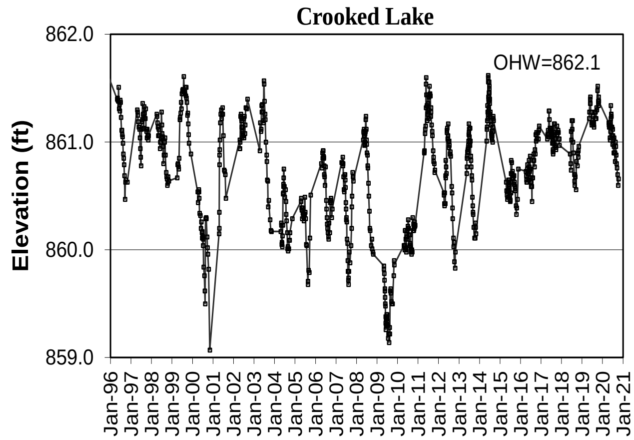
Bunker Lake Levels- last 25 years



Crooked Lake Levels- last 5 years

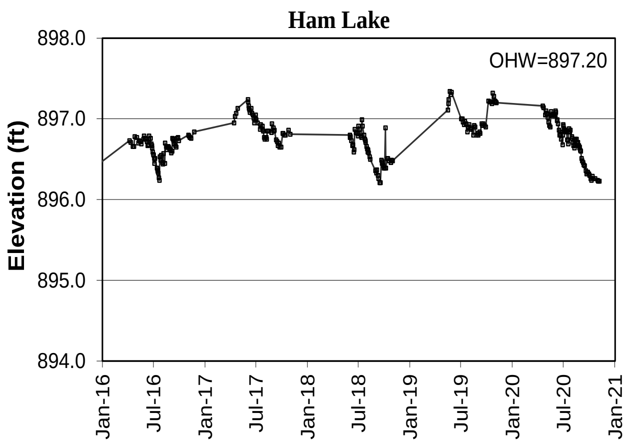
Crooked Lake Levels- last 25 years

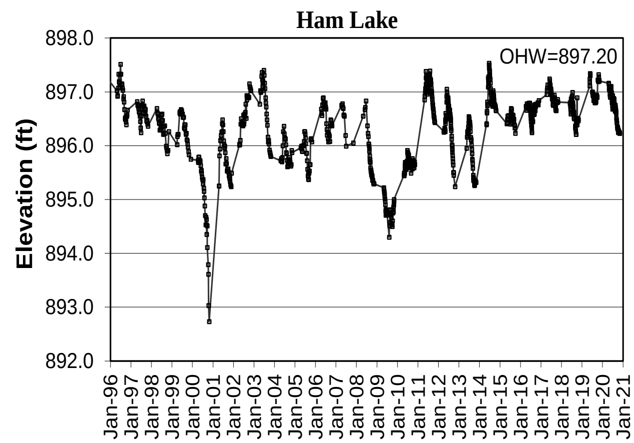




Ham Lake Levels- last 5 years

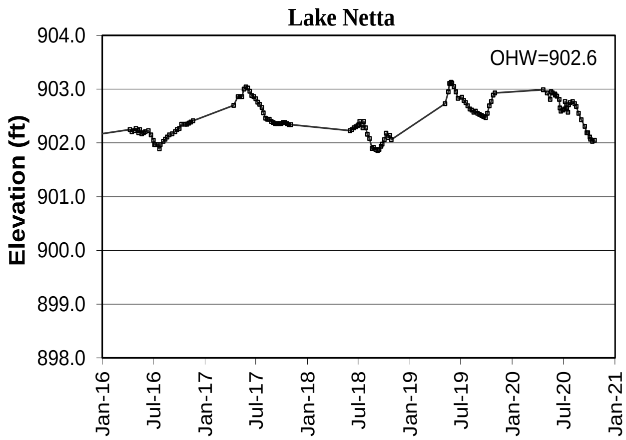
Ham Lake- Last 25 years



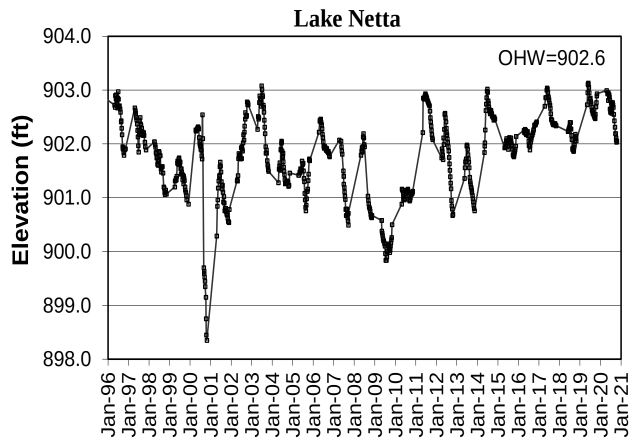


Lake Netta Levels- last 5 years

Lake Netta Levels- last 25 years

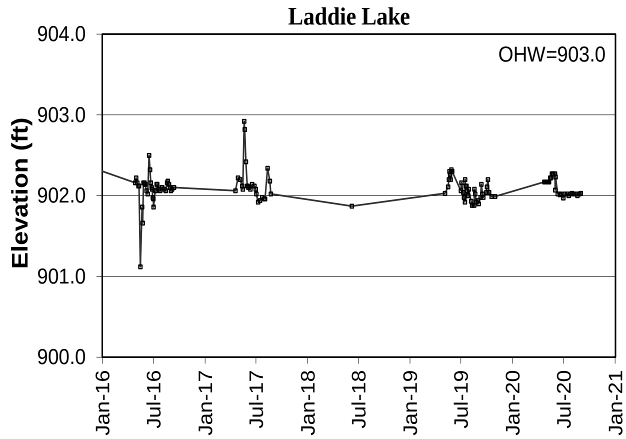


Lake Netta
OHW=902.6
Elevation (ft)
904.0
903.0
902.0
901.0
900.0
899.0
898.0
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21

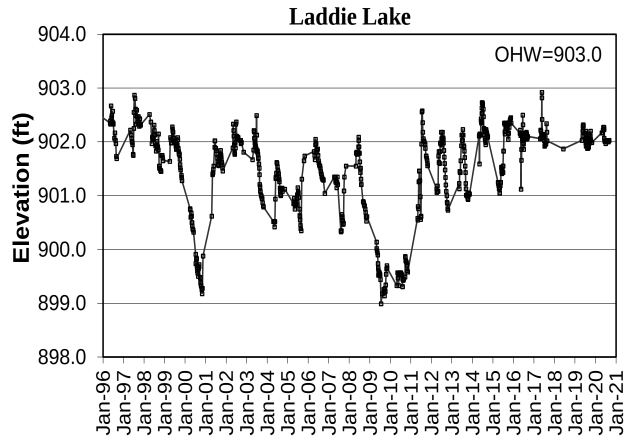


Lake Netta
OHW=902.6
Elevation (ft)
904.0
903.0
902.0
901.0
900.0
899.0
898.0
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21

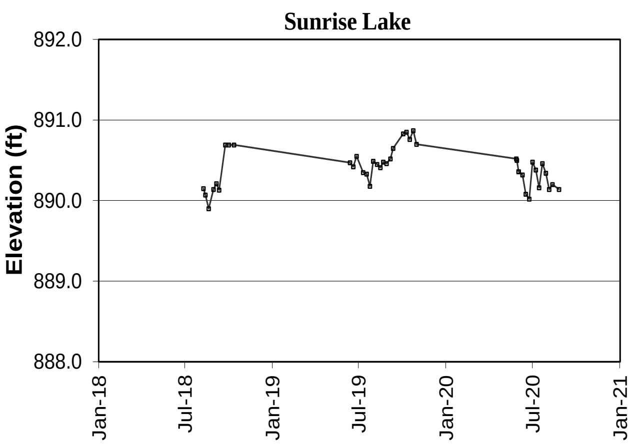
Laddie Lake Levels- last 5 years



Laddie Lake Levels- last 25 years



Sunrise Lake Levels- 2018-2020



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

Lake	Year	Average	Min	Max
Bunker Lake	2016	881.37	880.70	881.88
	2017	882.42	882.05	884.07
	2018	881.07	881.73	882.40
	2019	883.09	882.67	883.43
	2020	882.52	881.70	883.39

Lake	Year	Average	Min	Max
Crooked Lake	2016	860.77	860.45	861.09
	2017	861.06	860.89	861.29
	2018	860.87	860.56	861.20
	2019	861.28	861.14	861.52
	2020	861.04	860.60	861.34

Lake	Year	Average	Min	Max
Laddie Lake	2015	901.83	901.05	902.45
	2016	902.07	901.12	902.50
	2017	902.16	901.92	902.92
	2019	902.05	901.88	902.32
	2020	902.11	901.97	902.27

Lake	Year	Average	Min	Max
Ham Lake	2016	896.64	896.24	896.84
	2017	896.91	896.65	897.24
	2018	896.60	896.21	896.99
	2019	897.02	896.80	897.34
	2020	896.80	896.32	897.16

Lake	Year	Average	Min	Max
Netta Lake	2016	902.16	901.89	902.35
	2017	902.62	902.34	903.04
	2018	902.13	901.86	902.40
	2019	902.93	902.47	903.13
	2020	902.60	902.03	902.99

Lake	Year	Average	Min	Max
Sunrise Lake	2018	890.30	889.90	890.69
	2019	890.54	890.18	890.87
	2020	890.29	890.02	890.52

Stream Water Quality and Hydrology Monitoring

Description: Water chemistry grab sampling, continuous stage, and storm event water quality monitoring

Purpose: To detect water quality trends and changes, collect continuous stage data over time, and inform pollutant loading and flood modeling.

Locations: Throughout the watershed

Methods: See Below

Water Chemistry Grab Sampling

Grab samples are collected during both storm and baseflow conditions throughout the open water season and sent to a certified laboratory for analysis. Parameters analyzed by the lab include total phosphorus (TP), total suspended solids (TSS), *E.coli* bacteria, and periodically, chlorides. Eight samples are collected at each site; four during baseflow conditions and four following storm events. Storms are generally defined as one-inch or more of rainfall in 24 hours. In some years, smaller storms were sampled because of a lack of larger storms. All storms sampled were significant runoff-producing events.

Physical and chemical water parameters are also measured with portable meters during each sampling event. Parameters measured include; pH, specific conductance, turbidity, temperature, salinity, and dissolved oxygen (DO). Transparency tube water clarity readings are also collected at each visit, as is water level (stage) using a staff gauge surveyed to mean sea level elevation, or by measuring down from a known tape-down point (e.g. culvert).

This report includes data from all years and all sites for each subwatershed to provide a broad view of a stream's water quality under a variety of conditions. Water quality assessments are based on upstream-to-downstream comparisons, a comparison of baseflow conditions and post-storm conditions, and an overall assessment compared to other Anoka County streams and State water quality standards. Mean and median results for each parameter at the furthest downstream site are tabulated for comparison to State standards. All results are graphed in box and whisker style plots.

Continuous Stage

Continuous stage data is recorded using water level logging equipment deployed in the stream for the duration of the open water season. These readings are converted to elevation using readings collected from the surveyed staff gauge or tape-down point also installed at each location. Stage readings are collected at regular intervals ranging from 15 minutes to 1 hours, depending on the flashiness of the particular site. During download activity stage is recorded manually at each site and referenced to the current reading on the data logger. This allows for calibration throughout the season.

Storm Event Continuous Water Quality

Each year, certain sites are selected for more intensive monitoring over the course of storm events. A water quality sonde is deployed in the stream shortly before a storm is forecasted and left in the stream until after the storm has ceased and the site has returned to baseflow condition. Parameters collected during storm event sampling include pH, salinity, specific conductance, temperature, dissolved oxygen, and turbidity. Sondes are left in place for a period of several days. This data provides a picture of the change in water quality over the duration of various sized storms, rather than a single snapshot of water quality at the time of grab sample collection.

Precipitation

Precipitation data is provided alongside water quality results. Precipitation totals were recorded daily from eleven Anoka County EMS Weather Stations, or long-standing precipitation volunteers with proven reliability in readings. The closest reliable precipitation record for each site was used.

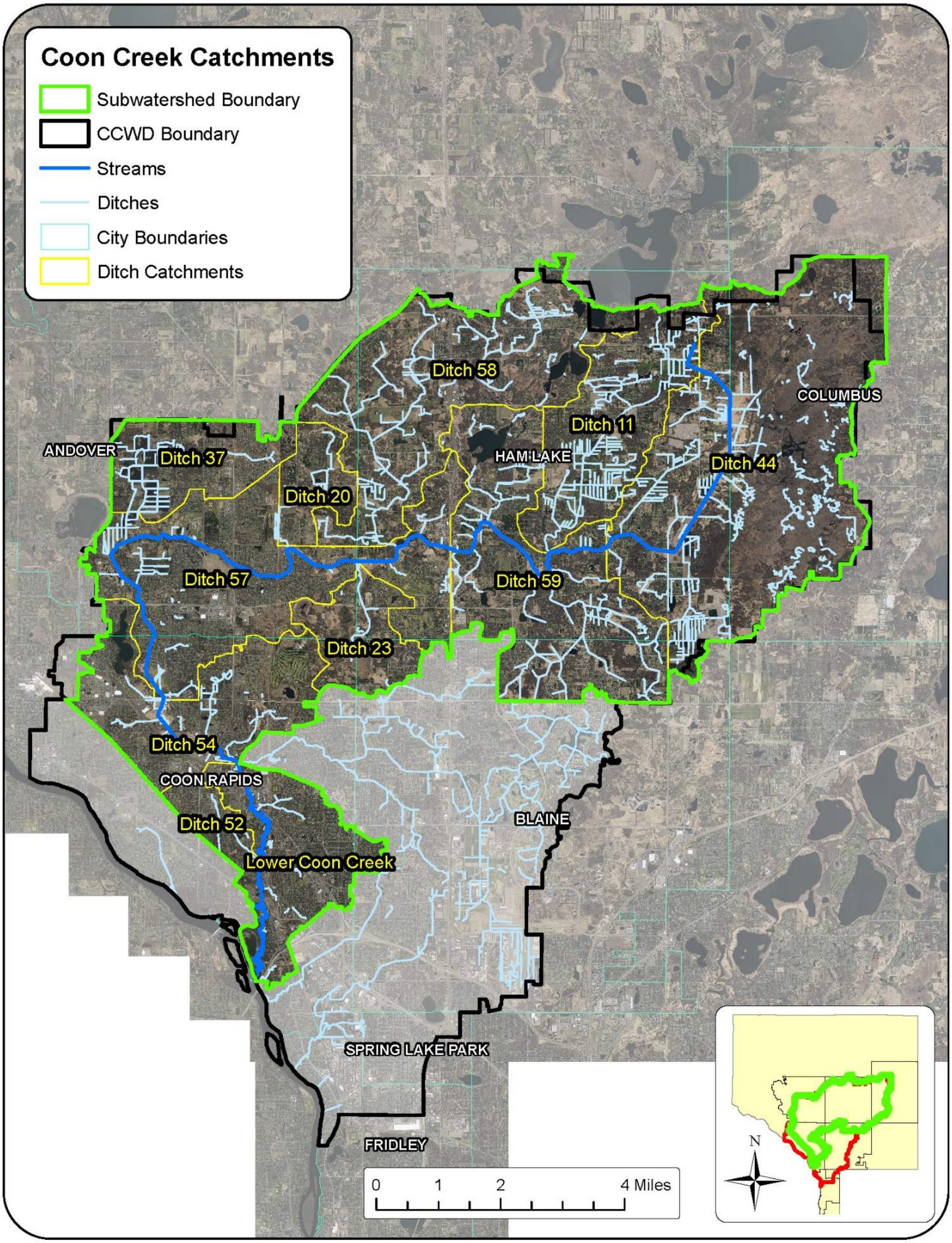
Water Quality Monitoring – Coon Creek Main Stem and Tributary Ditches

Coon Creek Main Stem and Tributary Ditches Monitoring Sites		
Site Name/ SiteID	**Years Monitored**	**2020 Data Collected**
Coon Cr at Lexington Blvd S007-539	2013-2016	
Ditch 11 at 149st Ave (tributary) S007-541	2013-2017, 2020	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Coon Cr at Naples St S007-057	2012-2020	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Coon Cr at Hwy 65 S005-259	2018-2020	Water Chemistry Grab Samples, Continuous Stage
Ditch 58 at Andover Blvd (tributary) S005-830	2013-2018, 2020	Water Chemistry Grab Samples, Continuous Stage
Coon Cr at Shadowbrook Townhomes S004-620	2007-2016	
Ditch 20 at Andover Blvd) (tributary) S016-392	2020	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Coon Cr at Prairie Rd. S007-540	2013, 2017, 2018, 2020	Water Chemistry Grab Samples, Continuous Stage
Coon Cr at 131st Ave S005-257	2010-2020	Water Chemistry Grab Samples
Coon Cr at Lions Park (Hanson Blvd) S004-171	2007-2017	
Coon Creek at 111th S007-559	2018-2020	Water Chemistry Grab Samples, Continuous Stage
Ditch 52 at Robinson (tributary) S015-117	2018	
Woodcrest Creek at Creekside Estates S016-393	2020	Water Chemistry Grab Samples, Continuous Stage, Storm Event Water Quality
Coon Cr at Vale St S003-993	2005-2020	Water Chemistry Grab Samples, Continuous Stage

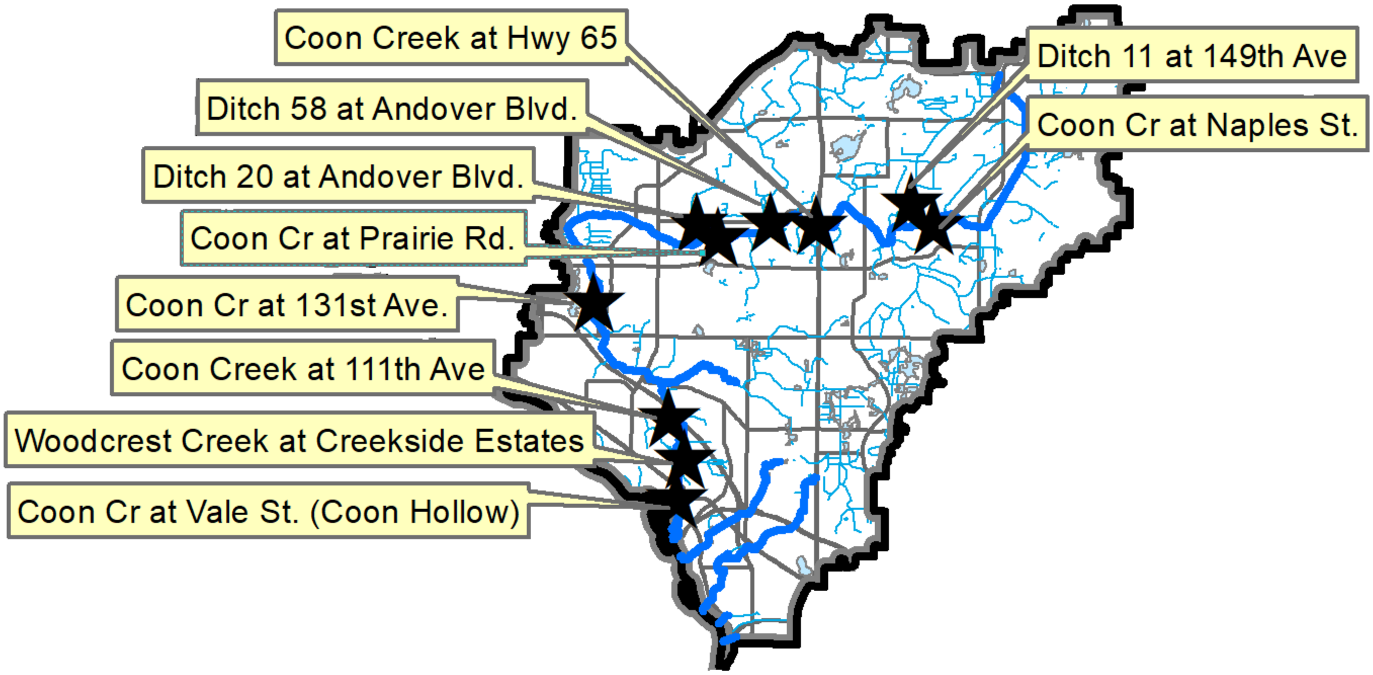
Background

Coon Creek and its tributaries (excluding the Sand Creek subwatershed discussed separately) drain approximately 49,000 acres through central Anoka County. The main stem of Coon Creek starts as a ditched channel (Ditch 44) near the intersection of Crosstown Blvd and Lexington Ave in northeastern Ham Lake. The channel continues south and east approximately 27 miles, draining Ham Lake, southern Andover, western Blaine, and much of Coon Rapids, before emptying into the Mississippi River between the Coon Rapids Dam and Highway 610. Many tributary ditch systems join with Coon Creek throughout the system. These ditch systems, and Coon Creek itself, drain a mixture of rural agriculture and residential, suburban residential, and commercial land usage. Land usage shifts from primarily rural agriculture and residential in the northern portions of Ham Lake, which primarily drain through open channel ditch systems, to denser suburban residential and commercial usage through Andover and Coon Rapids, which primarily drains through subsurface stormwater infrastructure before outletting to the creek itself.

The rural ditch systems that drain agricultural and residential lands to Coon Creek, primarily in the northern portions of the watershed include the Ditch 44, 11, 59, 58, 20, 23 and 37 systems. The ditch systems draining primarily suburban residential and commercial lands in the lower reaches of the watershed include the Ditch 52 and Ditch 41 (Sand Creek) systems. The central portions of the main channel of Coon Creek make up the Ditch 57 drainage area, and the lower portions of the main channel make up the Ditch 54 drainage area. Coon Creek is listed as an impaired water for aquatic recreation due to elevated levels of *E. coli* bacteria and aquatic life due to poor invertebrate communities. Coon Creek also exceeds state standards for TSS and TP, two pollutants that have been identified as primary stressors to the local invertebrate and fish communities. New standards for aquatic life (Tiered Aquatic Life Use Standards) may take into consideration the fact that the creek is part of a public ditch system and, therefore, may lower aquatic life expectations and affect the impairment standards for this waterbody.


Coon Creek Catchments
Subwatershed Boundary
CCWD Boundary
Streams
Ditches
City Boundaries
Ditch Catchments
Ditch 58
COLUMBUS
Ditch 11
ANDOVER
Ditch 37
HAM LAKE
Ditch 44
Ditch 20
Ditch 57
Ditch 59
Ditch 23
Ditch 54
COON RAPIDS
Ditch 52
BLAINE
Lower Coon Creek
SPRING LAKE PARK
FRIDLEY
0 1 2 4 Miles
N

Coon Creek Main Stem and Tributary Ditch Monitoring Sites



Results and Discussion

Coon Creek is listed as impaired for aquatic recreation (*E. coli*) and invertebrate biota, with total phosphorus and total suspended solids (TSS) identified as the primary stressors along with poor habitat and altered hydrology. Total phosphorus levels throughout the watershed often exceed state water quality standards, as do TSS levels during storms. Coon Creek water quality declines significantly upstream to downstream, though that decline primarily occurs in the upper portions of the watershed. Water quality in Coon Creek is compromised by a number of factors, but it appears that efforts by the CCWD to improve stormwater treatment are making a difference in areas where this work is occurring, primarily in the developed areas in the downstream portions of the watershed. Modern stormwater treatment in newer developed areas paired with investments from the CCWD towards improving the stormwater treatment in underserved areas and maintaining the channel appear to be holding the line and preventing further decline of water quality. There is no significant change in total phosphorus or TSS concentrations from the monitoring site at 131st Ave to Vale St Additionally, there is no significant change at the Vale St long-term stream outlet monitoring site over time since 2005 for these parameters.

Unfortunately, based on phosphorus concentration data, the ditch systems in the upper portions of the watershed appear to be degrading Coon Creek water quality to levels that will prevent it from ever having good water quality downstream if new management measures are not implemented in these areas. A significant decline in water quality is documented through the main channel in the upper reaches, namely from Naples St. to 131st Ave. Many ditch systems that drain rural and agricultural areas join Coon Creek throughout this portion of the watershed. These ditch systems are not all monitored, but the ditches that are monitored appear to have poor water quality. Additionally, the primary source of *E. coli* bacteria in Coon Creek as identified by the TMDL, is livestock (cattle and horses). These are far more prevalent in the upper reaches of the watershed, and sometimes immediately adjacent to the creek itself. Domestic pets are listed as the next largest source after livestock. Another likely source of *E. coli* throughout the watershed is waterfowl, which congregate throughout much of the drainage area and in the creek itself. A shift in focus and resources to the upstream reaches of the Coon Creek watershed may be the most beneficial next step to improving water quality through the entirety of the system. A more in-depth analysis of individual parameters can be found below.

Specific conductance and Chlorides

Dissolved pollutant concentrations are higher in downstream reaches of Coon Creek, where there is more impervious area with denser development (see figures below). Median specific conductance increases gradually from upstream (0.437 mS/cm) to downstream (0.730 mS/cm) during baseflow conditions. Median specific conductance (all years) following storm events shows a smaller difference between upstream and downstream, ranging from 0.410 to 0.529 mS/cm, but at a lower concentration than during baseflow. The median specific conductance concentration in Coon Creek at Vale St. is higher during both baseflow conditions and post storm event than the composite countywide median for Anoka County streams of 0.420 mS/cm

This lends some insight into the pollutant sources. If dissolved pollutants were only elevated after storms, stormwater runoff would be suspected as the primary driver. Because dissolved pollutants are highest during baseflow conditions, pollution of the shallow groundwater which feeds the stream during baseflow is suspected to be a primary contributor. In Coon Creek, especially further downstream, specific conductance is higher during baseflow conditions, meaning the local groundwater feeding the stream at baseflow is likely a significant source of dissolved pollutants.

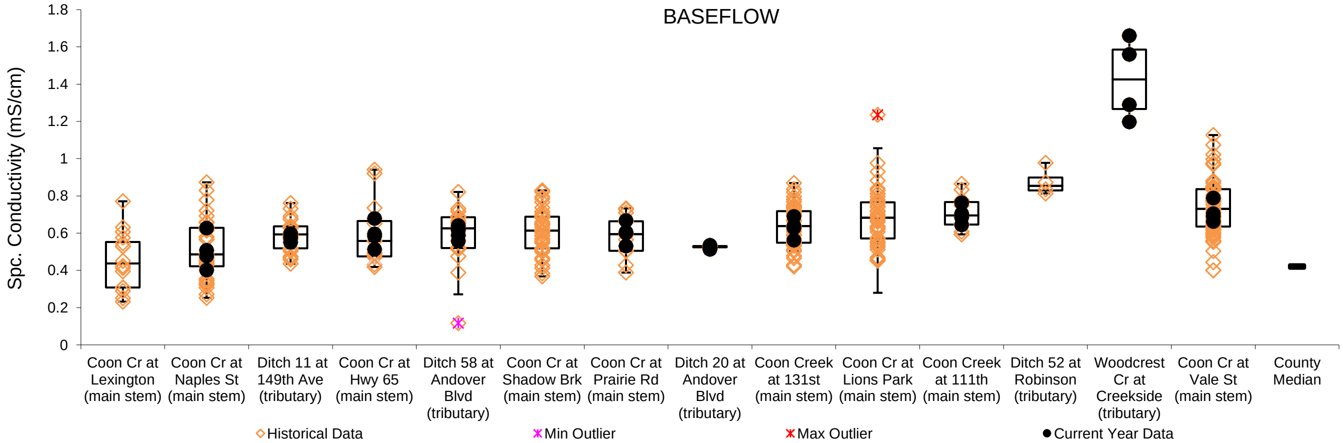
Storms help dilute some of the pollutant load, making the increase from upstream to downstream smaller. However, upstream median values during all conditions are still above average in Coon Creek compared to other Anoka County streams. Prevention measures to reduce specific conductance (such as reduced road salting) should be a focus of management.

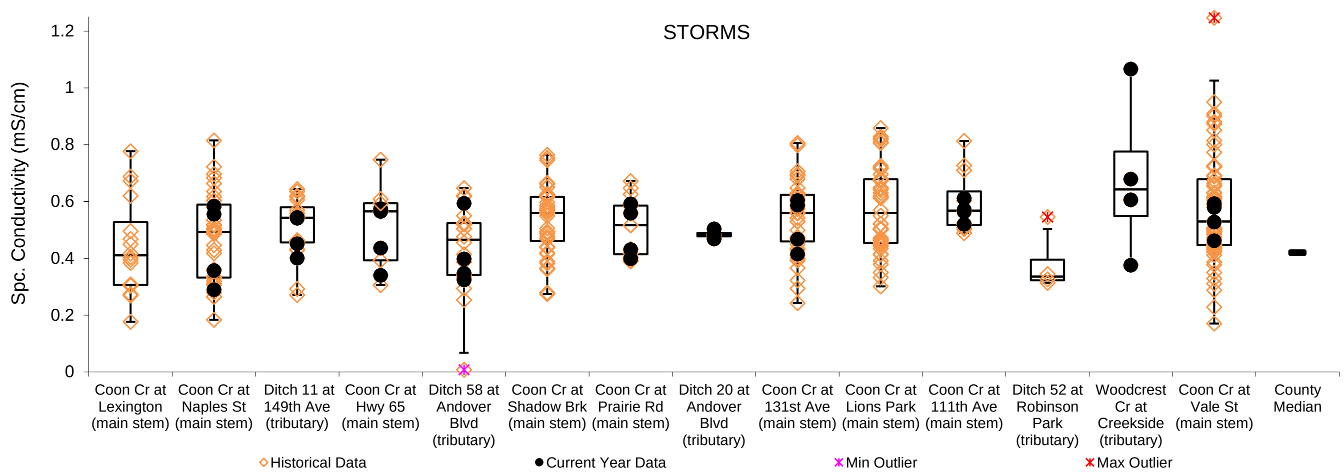
Chloride sampling has not occurred enough in Coon Creek for statistical analysis, but a cursory look at the box plots of chloride concentrations below shows an increase in chloride moving downstream through Coon Creek. As the creek progresses through its watershed, road and housing densities increase dramatically. This is likely causing additional loading of chlorides in these reaches through road salting, and potential industrial inputs. Although the concentrations of chlorides increase dramatically moving downstream, the concentrations in grab samples have not approached state standard concentrations (230 mg/L chronic and 860 mg/L acute). Chlorides were not sampled in 2020.

Median specific conductance in Coon Creek Data is from Vale St for specific conductance all years through 2020.

	Specific conductance (mS/cm)	**State Standard**	**N**
Baseflow	0.730	Specific conductance – none	64
Storms	0.530		64
All	0.655		128
Occasions > state standard			0

Specific conductance at Coon Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Phosphorus

The State water quality standard for Total Phosphorus (TP) for streams in this region is 100 µg/L, and Coon Creek eventually may be designated as impaired as it often exceeds the standard, especially during storms. Coon Creek does have a TMDL in place for TP even without the impaired designation for this pollutant because it is identified as a stressor for aquatic macroinvertebrates, which the creek is impaired for. Best management practices to address stormwater phosphorus loading would be beneficial along the entire stream length, but especially in the upper ditched portions of the watershed. ANOVA analyses at three sites moving upstream to downstream (Coon Creek at Naples St, 131st Ave, and Vale St.) show a significant increase in TP concentrations from the upstream portions of the watershed to the approximate mid-point of the watershed (Naples St. to 131st Ave.) during both baseflow and stormflow conditions. In both scenarios, no additional significant increase is present from 131st Ave. to the downstream monitoring site at Vale St.

Focusing on the upper portions of the watershed, the monitoring sites along mainstem Coon Creek at Lexington Ave. and Naples St. both generally have baseflow concentrations below the state standard, and often are below that standard during post-storm sampling as well. However, the two monitored ditch systems that join with Coon Creek downstream of these sites (Ditch 11 and Ditch 58) generally have higher phosphorus concentrations than mainstem Coon Creek. Ditch 11, where phosphorus concentrations are generally high in all conditions, appears to be contributing to the downstream degradation of Coon Creek water quality. The average concentration of TP samples collected in Ditch 11 at 149th Avenue from 2013-2017 and 2020 was 135 µg/L for baseflow events and 292 µg/L for storm events, both higher than the state standard of 100 µg/L. Similarly, at Ditch 58 average concentration of TP during baseflow was 97.08 µg/L and 197.5 µg/L during storm events. A new monitoring site at Ditch 20 at Andover Blvd averaged higher than the State standard during both baseflow (132 µg/L) and storm events (217 µg/L) as well. Other ditch systems with similar land use that join with Coon Creek in these upper reaches are also likely contributing to the increases in phosphorus concentration moving downstream through the watershed. This is supported by ANOVA results indicating significant increases in average baseflow and stormflow TP concentrations between Naples St (headwaters) and 131st Ave ($p= <0.01$ & $P= <0.05$, respectively)

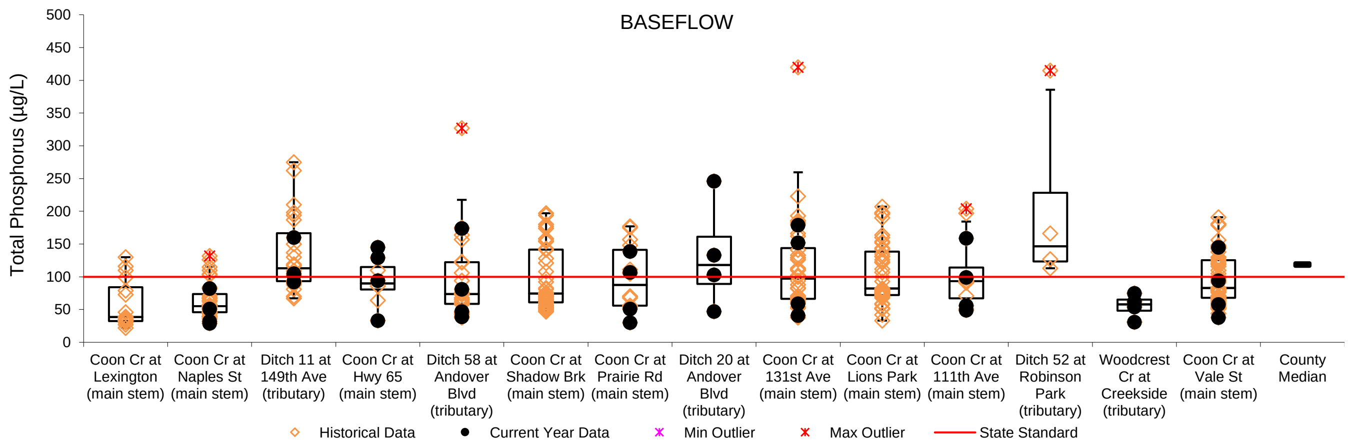
Of particular note in the middle and lower reaches of the watershed, there is no significant difference in average baseflow or stormflow TP concentrations between 131st Ave and Vale St For all samples collected at these sites during baseflow , TP concentrations at 131st Ave average 113.27 µg/L, while concentrations at Vale St. average 96.60 µg/L. Average storm flow concentrations are 195.81 µg/L and 194.70 µg/L, respectively. These results indicate there is no further degradation of Coon Creek downstream of 131st Ave. When analyzing change over time at Vale St., no significant change is found for either baseflow or post-storm total phosphorus concentrations from 2005-2020, although post-storm flow conditions have improved during this period of record ($p=.07$). The Coon Creek Watershed District has invested a lot of money and effort into stormwater treatment practices and stream improvement projects in this portion of the watershed. Stormwater management in this portion of the watershed appears to have quantifiable impacts towards improving phosphorus concentrations in the creek during storm events. However, the concentrations in these lower watershed reaches often still exceed state standards.

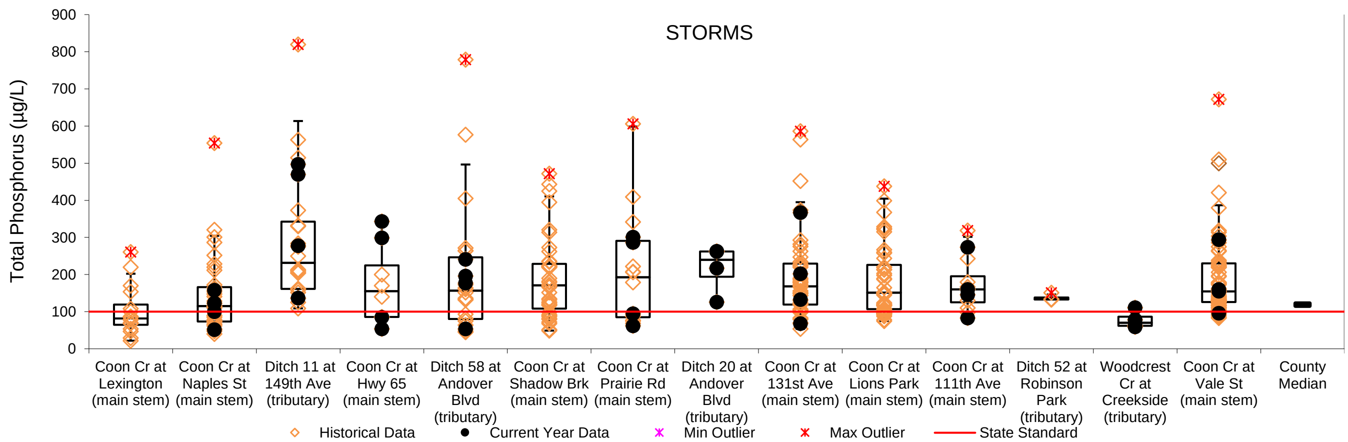
The Coon Creek TMDL, approved in 2016, delegates acceptable loads of pollutants in Coon Creek on a load duration curve (LDC) instead of a fixed daily or annual load in pounds. The LDC for Coon Creek is graphed on a plot with flow-weighted daily loads for phosphorus samples collected at Vale Street from 2005-2014 (CCWD TMDL Report; Page 47, Figure 16). This plot shows that the creek exceeds its LDC for TP during high and very high flows almost 100% of the time, while often maintaining acceptable loads during low and very low flows. Pairing the results shown on this curve with our grab sample concentration analysis indicates that additional treatment of stormwater in the upper reaches of the watershed should be a high priority for management in Coon Creek. It is likely that the ditch systems joining Coon Creek in its upper reaches are flushing phosphorus into the creek during storm events that cannot be diluted or settle out attached particles before travelling through the entire system. Ditch 20 at Andover Blvd had high total phosphorus as well as high TSS concentrations throughout 2020.

Average and median total phosphorus in Coon Creek Data is from Vale St for all years through 2020.

	Average Total Phosphorus (µg/L)	Median Total Phosphorus (µg/L)	State Standard	N
Baseflow	96.60	83.00	100 µg/L	63
Storms	194.70	154.50		64
All	146.03	127.0		127

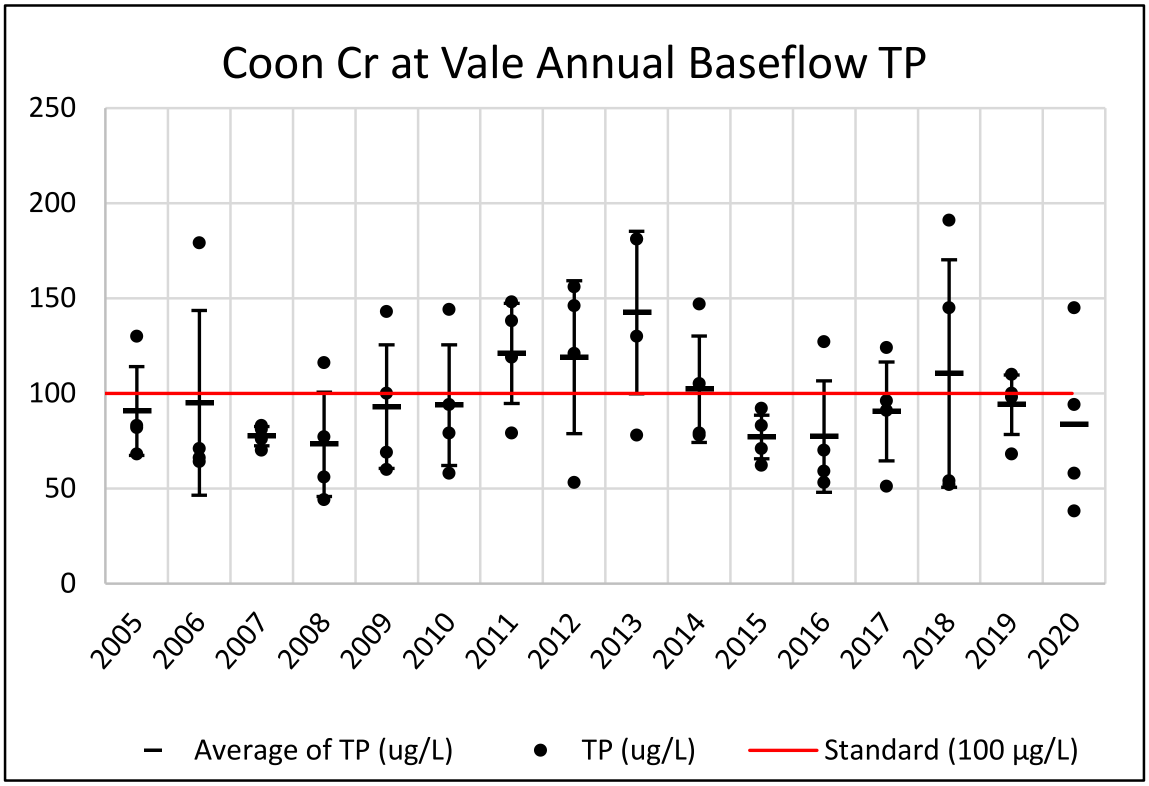
Total Phosphorus at Coon Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

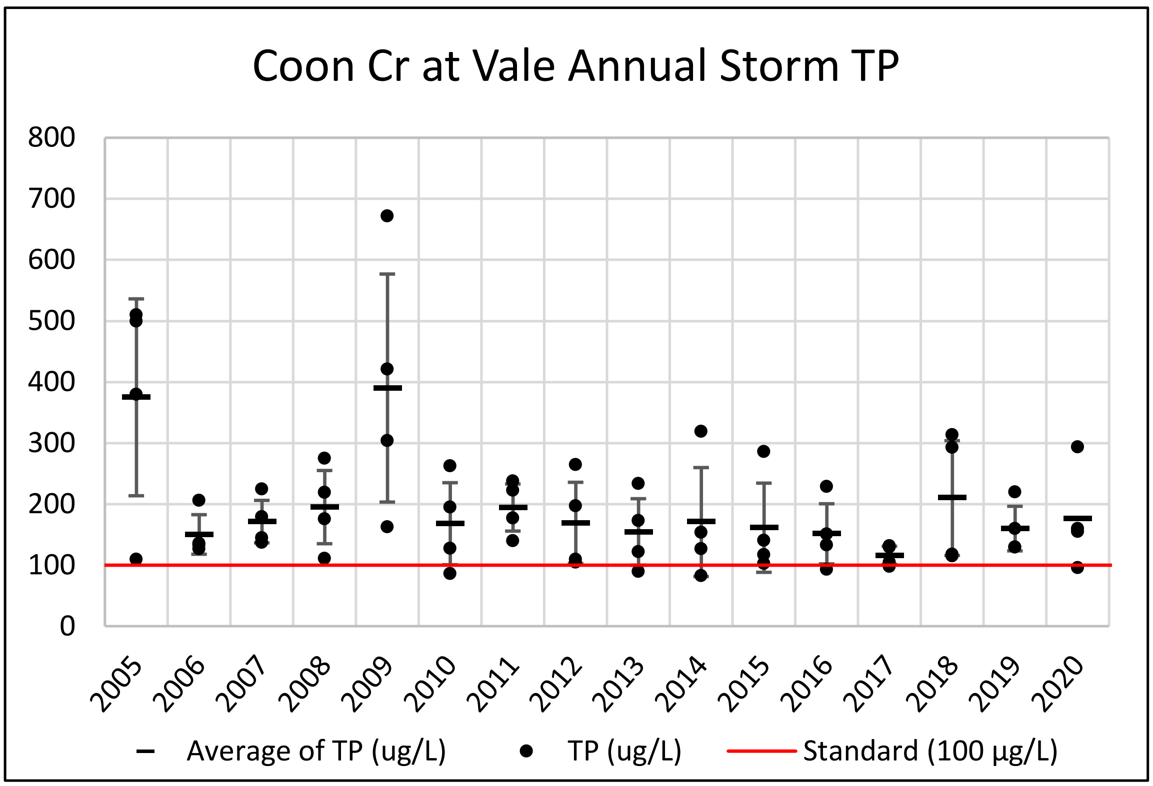




Coon Creek at Vale St. - Annual average TP Concentration - ANOVA regression 2005-2020

Parameter	**Significant Change in Annual $\overline{X}$ (2005-2020)**	**p=**	**Standard Error of Means**
Total Phosphorus - Baseflow	None	0.81	19.53
Total Phosphorus - Storm	None	0.07	70.54


Coon Cr at Vale Annual Baseflow TP
250
200
150
100
50
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Average of TP (ug/L)
TP (ug/L)
Standard (100 µg/L)


Coon Cr at Vale Annual Storm TP
800
700
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Average of TP (ug/L)
TP (ug/L)
Standard (100 µg/L)

ANOVA Matrix for Baseflow Total Phosphorus	Coon Creek at Naples St. (2012-2020) 36 Samples Total	Coon Creek at 131^{st} Ave. (2010-2020) 44 Samples Total	Coon Creek at Vale St. (2005-2020) 63 Samples Total
Coon Creek at Naples St.		Significant Increase Naples $\bar{X}$= 64.33µg/L 131^{st} $\bar{X}$= 113.27 µg/L p= < 0.01	Significant Increase Naples $\bar{X}$= 64.33µg/L Vale $\bar{X}$= 96.60 µg/L p= < 0.01
Coon Creek at 131^{st} Ave.			No Sig. Change 131^{st} $\bar{X}$= 113.27 µg/L Vale $\bar{X}$= 96.60 µg/L p= 0.109
Coon Creek at Vale St.			

ANOVA Matrix for Storm Total Phosphorus	Coon Creek at Naples St. (2012-2020) 36 Samples Total	Coon Creek at 131^{st} Ave. (2010-2020) 44 Samples Total	Coon Creek at Vale St. (2005-2020) 64 Samples Total
Coon Creek at Naples St.		Significant Increase Naples $\bar{X}$=142.55µg/L 131^{st} $\bar{X}$= 195.81 µg/L p= < 0.05	Significant Increase Naples $\bar{X}$= 142.55 µg/L Vale $\bar{X}$= 194.70 µg/L p= <0.01
Coon Creek at 131^{st} Ave.			No Sig. Change 131^{st} $\bar{X}$= 195.81 µg/L Vale $\bar{X}$= 194.70 µg/L p= 0.96
Coon Creek at Vale St.			

Total Suspended Solids and Turbidity

Similar to TP, Coon Creek has a TMDL for TSS because it is identified as a stressor for aquatic macroinvertebrates in the creek, not because the creek is impaired for TSS. TSS concentrations in Coon Creek follow a very similar pattern to TP concentrations, but are generally at levels below the State standard. The state water quality standard for TSS in the Central River Nutrient Region is 30 mg/L. The stream occasionally exceeds the state standard concentration during storm events in its middle and lower reaches.

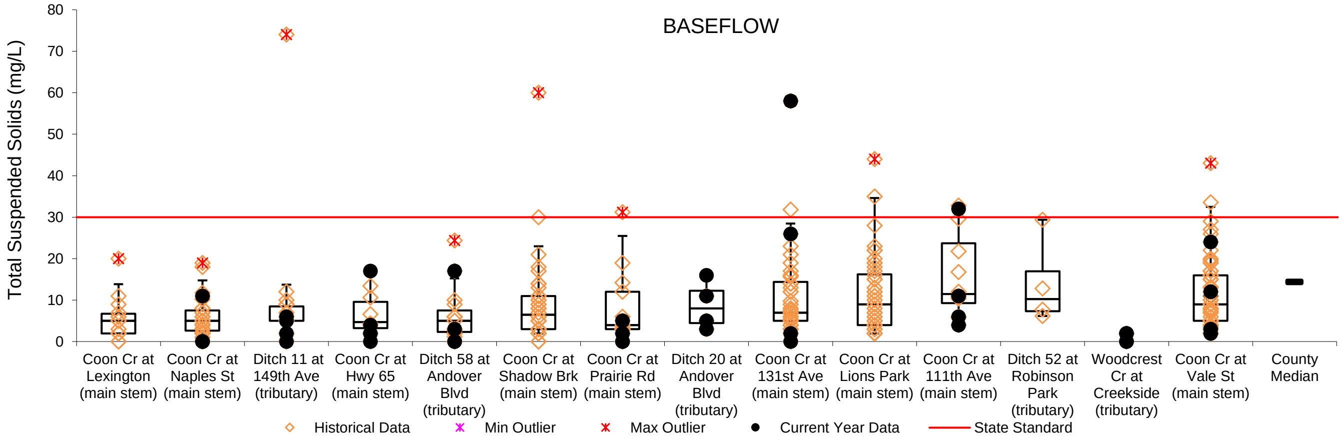
ANOVA analyses at three sites moving upstream to downstream (Coon Creek at Naples St, 131st Ave, and Vale St.) show a significant increase in TSS concentrations from the upstream portions of the watershed to the approximate mid-point of the watershed (Naples St. to 131st Ave.) during both baseflow and stormflow conditions. In both scenarios, no additional significant difference is present from 131st Ave to the downstream monitoring site at Vale St, indicating that degradation of Coon Creek is largely occurring upstream of 131st Ave. There is also no significant change in TSS over time at Vale St. from 2005 through 2020 although long-term stormflow averages show a declining trend (p=.06). The LDC plot for TSS in Coon Creek from the TMDL (Page 42, Figure 13) shows that allowable TSS loads are generally only exceeded during high flows at Vale Street. Grab samples also indicate that concentrations remain below state standards most of the time, and only exceed the standard occasionally following storm events. Although one sampling event during baseflow in late-July revealed turbidity and suspended solid levels that matched historical maximums for several of the Coon Creek sites, nothing out of the ordinary was observed during that day.

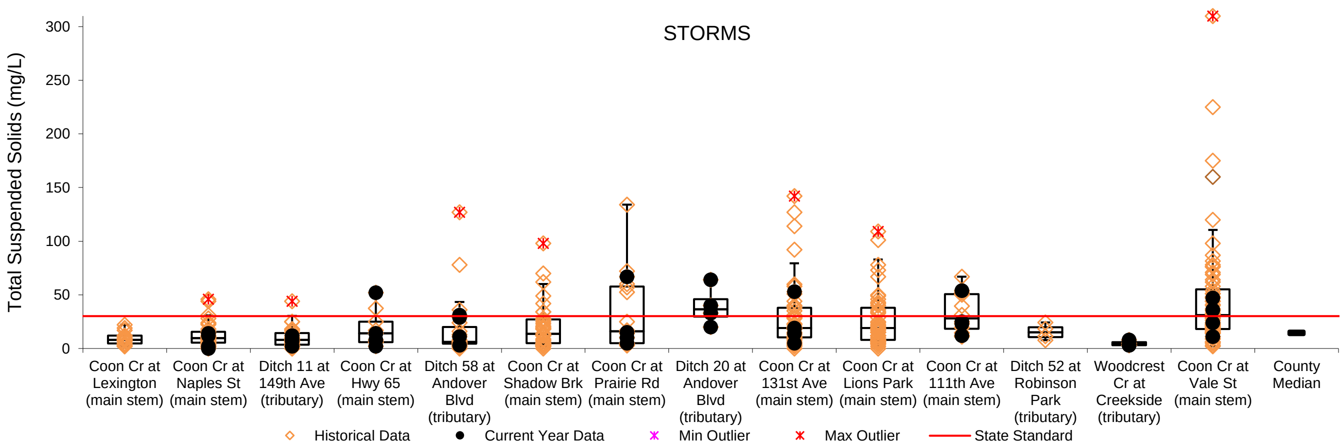
While TSS concentrations and daily flow-weighted loads generally conform to state standards in Coon Creek at Vale Street, it should be noted that significant increases in concentrations moving from the upstream reaches to more central monitoring sites mirror the trends observed for TP and should be a high priority for management of Coon Creek's water quality. In the TMDL report, it is estimated that 63% of all TSS loading to Coon Creek is due to streambank erosion. If this is the case, that erosion may be more severe in upper reaches of the watershed where TSS concentrations are increasing. These unstable banks may offer a good starting point for the reduction of both TSS and TP in Coon Creek through stabilization efforts, or efforts to reduce the rapid increase in flow and erosive energy from water rushing through the ditch systems during storm events. Any efforts to reduce TSS loading to Coon Creek in these upper reaches will also reduce phosphorus loading to the creek as well as improve the water quality of the entire creek downstream of the implemented projects. Additionally, as the northern portion of the subwatershed develops, it is important to continue enforcing stringent stormwater regulations and compliance with construction site best practices.

Average and median total suspended solids in Coon Creek Data is from Vale St for all years through 2020.

	Average TSS (mg/L)	Median TSS (mg/L)	State Standard	N
Baseflow	11.61	9.0	30 mg/L	64
Storms	47.59	31.0		64
All	29.60	17.0		128
Occasions > state TSS standard				34 (26%) (32 during storm flows)

Total Suspended Solids at Coon Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

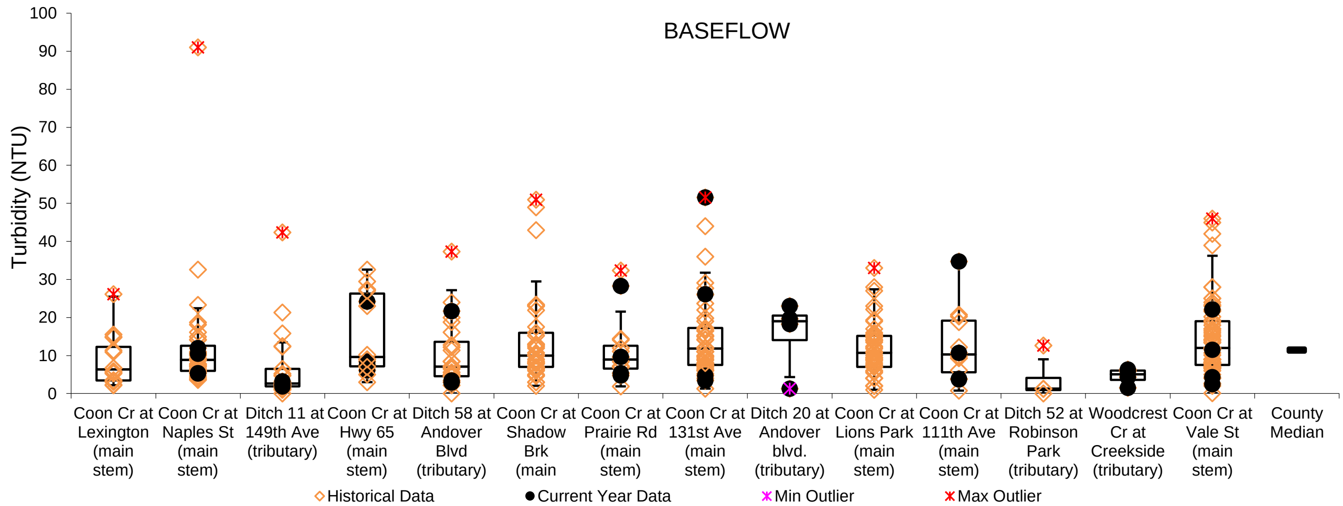


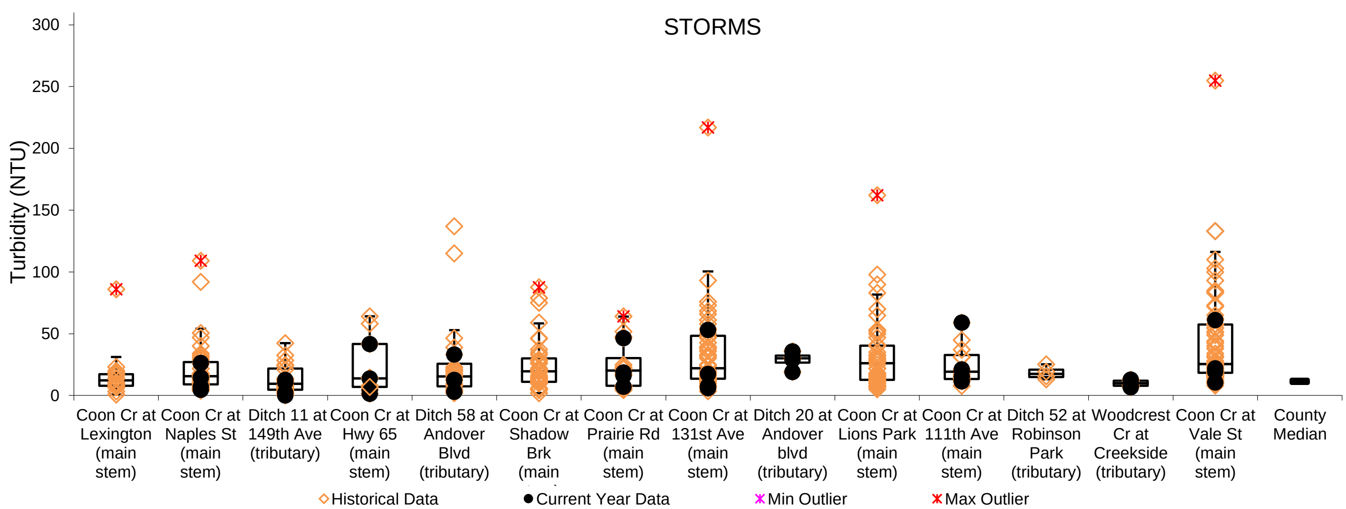


Average and median turbidity in Coon Creek Data is from Vale St for all years through 2020

	Average Turbidity (NTU)	Median Turbidity (NTU)	State Standard	N
Baseflow	14.57	12.0	N/A	63
Storms	43.48	25.50		64
All	29.14	18.7		127

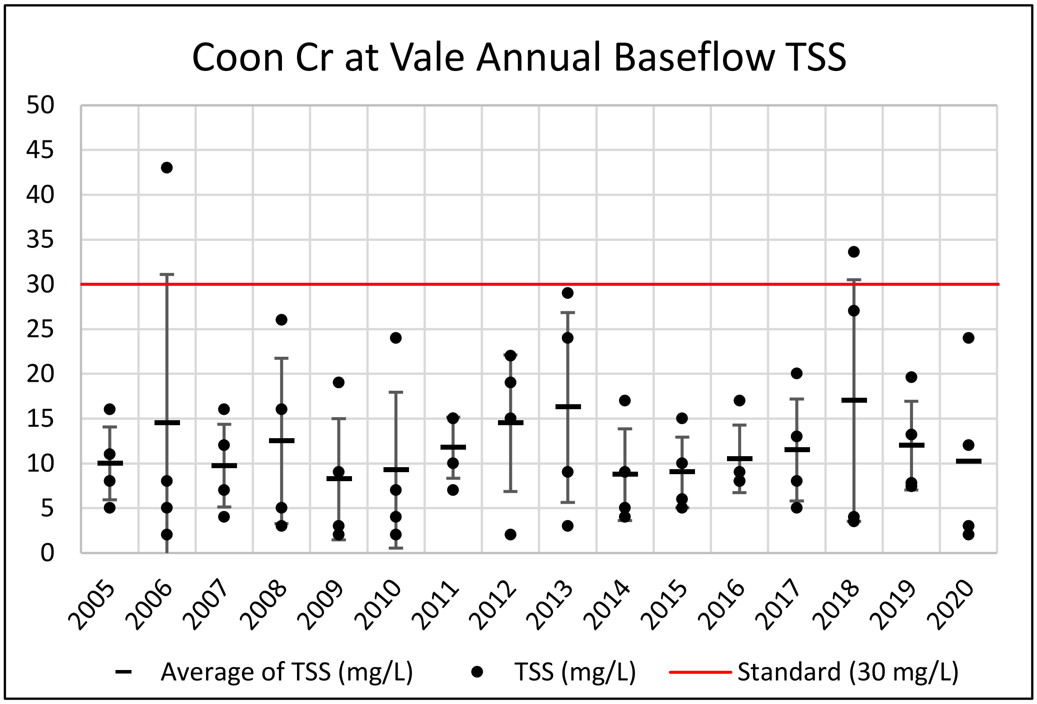
Turbidity at Coon Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

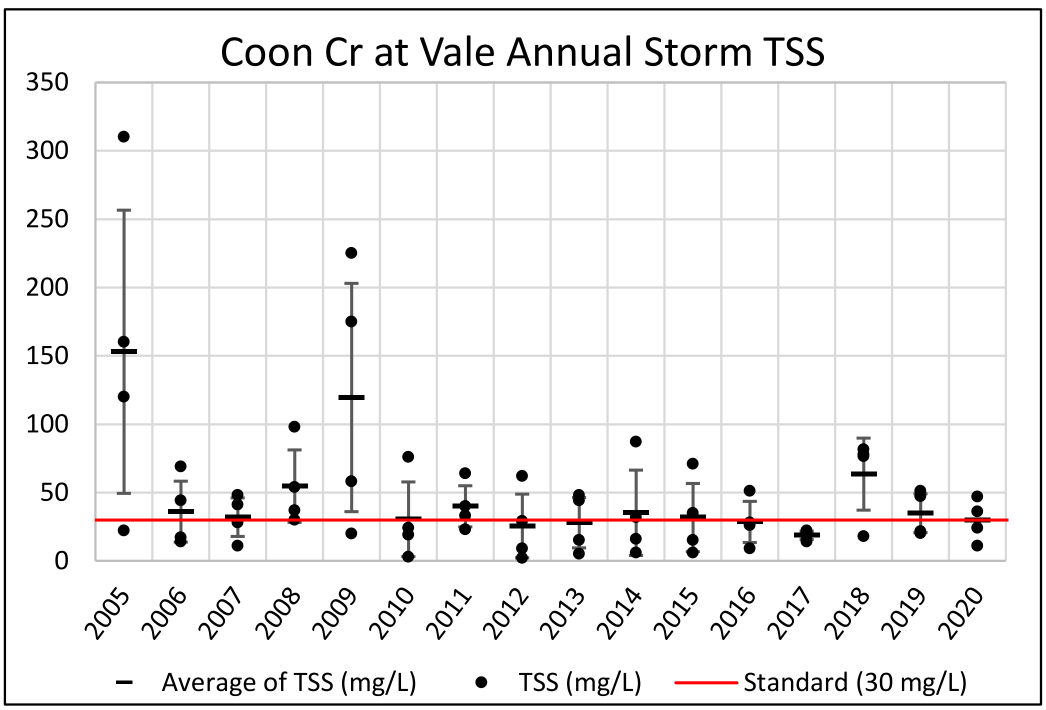




Coon Creek at Vale St. - Annual average ANOVA regression TSS 2005-2020

Parameter	Significant Change in Annual $\bar{X}$ (2005-2020)	p=	Standard Error of Means
Total Suspended Solids - Baseflow	None	0.63	2.77
Total Suspended Solids - Storm	None	0.06	33.51





ANOVA Matrix for Baseflow Total Suspended Solids	Coon Creek at Naples St. (2012-2020) 36 Samples Total	Coon Creek at 131st Ave. (2010-2020) 46 Samples Total	Coon Creek at Vale St. (2005-2020) 64 Samples Total
Coon Creek at Naples St.		Significant Increase Naples $\overline{X}$= 5.43 mg/L 131st $\overline{X}$= 10.63 mg/L p= < 0.01	Significant Increase Naples $\overline{X}$= 5.43 mg/L Vale $\overline{X}$= 11.61 mg/L p= < 0.01
Coon Creek at 131st Ave.			No Sig. Change 131st $\overline{X}$= 10.63 mg/L Vale $\overline{X}$= 11.61 mg/L p= 0.58
Coon Creek at Vale St.			

ANOVA Matrix for Storm Total Suspended Solids	Coon Creek at Naples St. (2012-2020) 36 Samples Total	Coon Creek at 131st Ave. (2010-2020) 44 Samples Total	Coon Creek at Vale St. (2005-2020) 64 Samples Total
Coon Creek at Naples St.		Significant Increase Naples $\overline{X}$= 11.98mg/L 131st $\overline{X}$= 30.17 mg/L p= < 0.001	Significant Increase Naples $\overline{X}$= 11.98mg/L Vale $\overline{X}$= 47.59 mg/L p= <0.001
Coon Creek at 131st Ave.			No Sig. Change 131st $\overline{X}$= 30.17 mg/L Vale $\overline{X}$= 47.59 mg/L p= 0.054
Coon Creek at Vale St.			

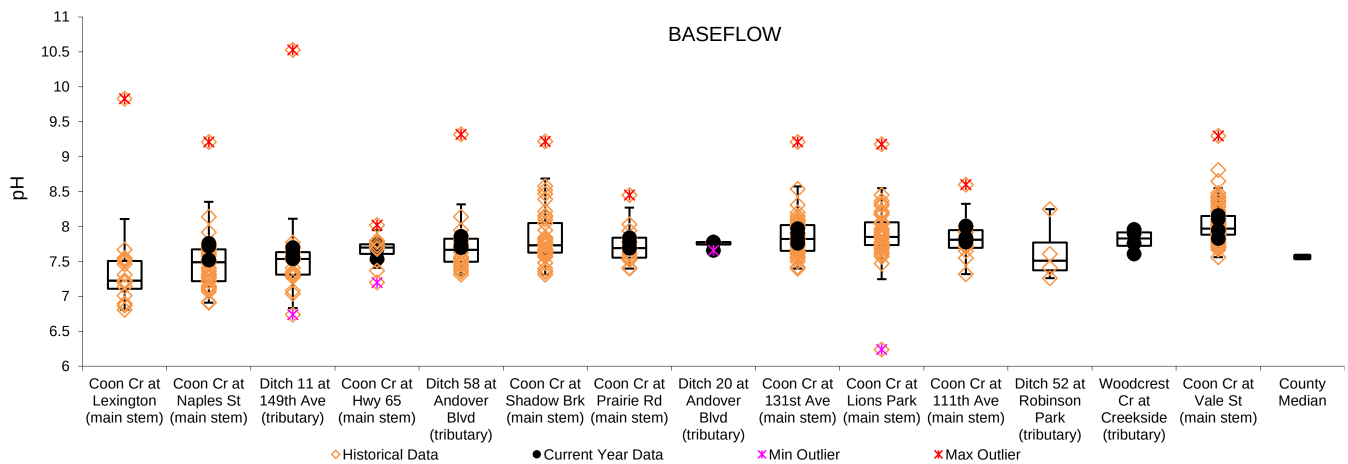
pH

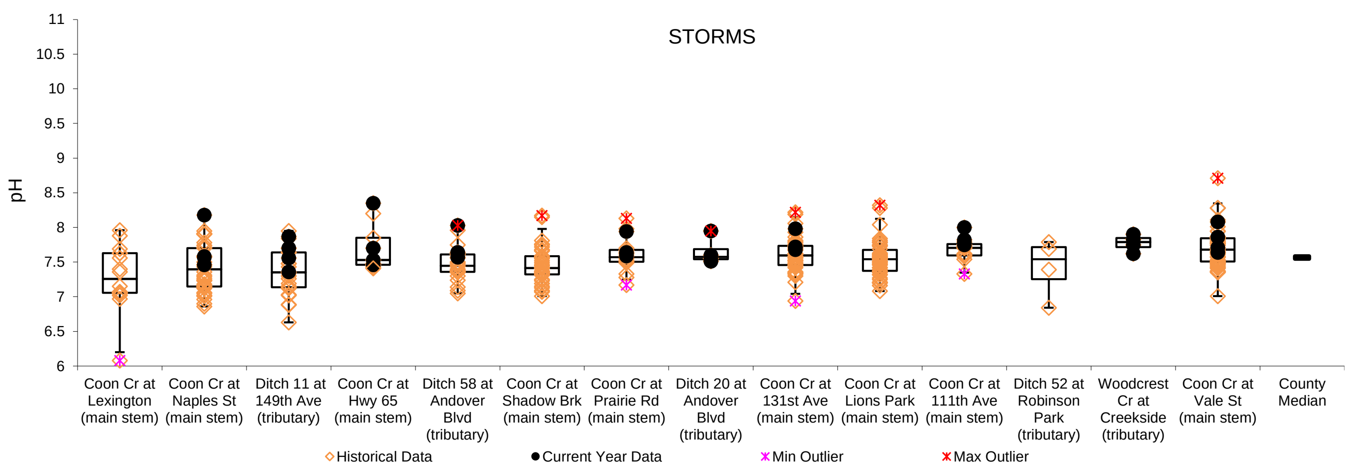
pH levels in Coon Creek are normally within the state standard range of 6.5-8.5. Typically, pH is lower during storm events because rainfall is more acidic. Exceedances of state standards have occurred, but they are rare and are not currently a concern within the creek.

Average and median pH in Coon Creek Data is from Vale St for all years through 2020.

	Average pH	**Median pH**	**State Standard**	**N**
Baseflow	8.04	7.97	6.5-8.5	63
Storms	7.70	7.68		60
All	8.04	7.86		123
Occasions outside state standard				4 (3 during baseflow)

pH at Coon Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





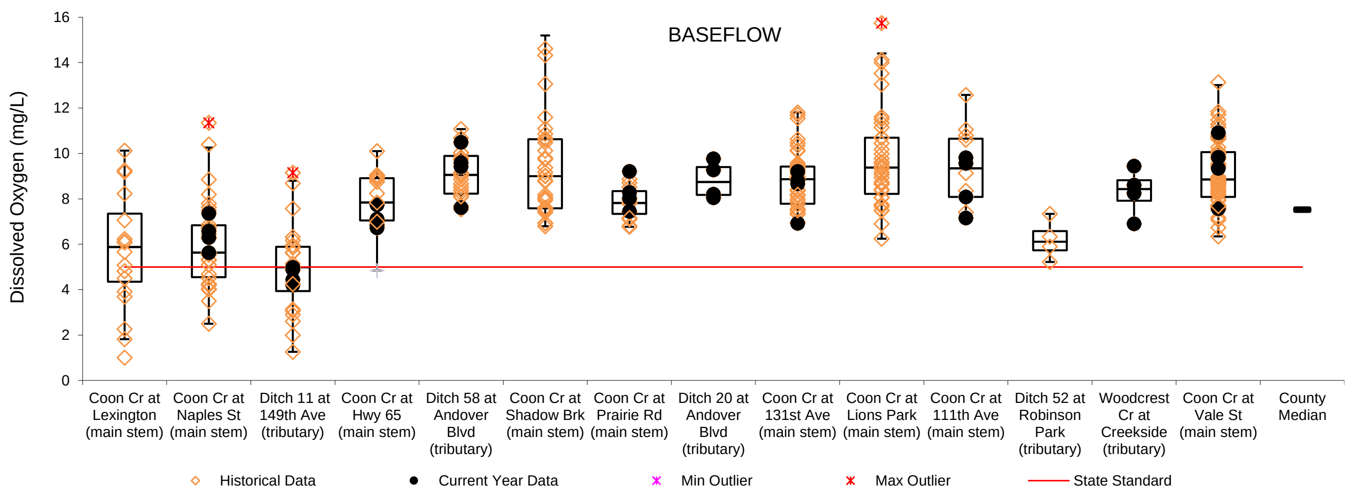
Dissolved Oxygen

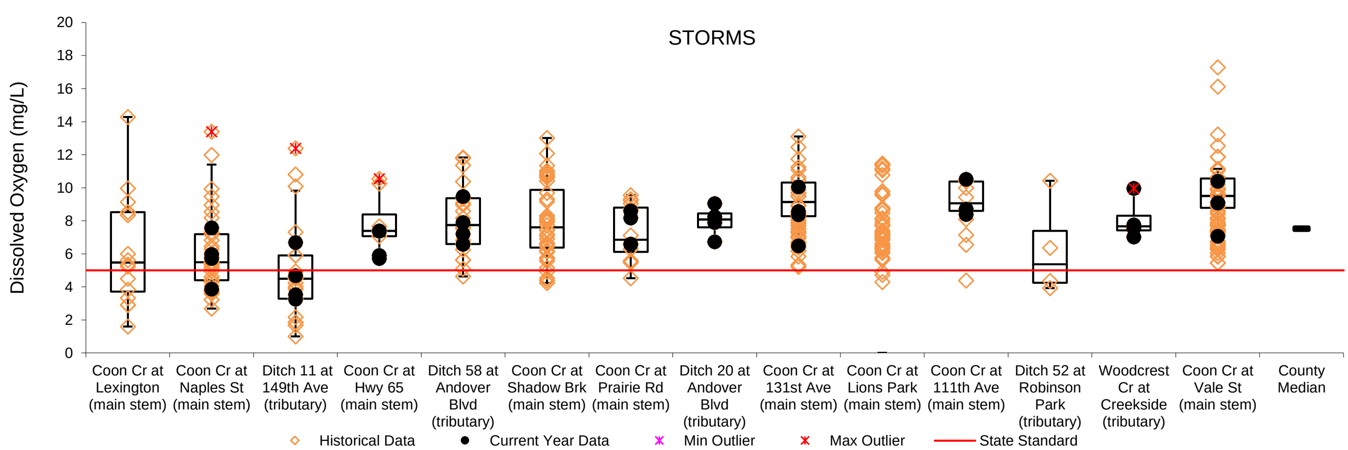
Low dissolved oxygen (DO) levels are generally not an issue in Coon Creek, especially in the downstream reaches of the creek, but have been identified as a stressor to aquatic life in the headwaters. In past years, low DO readings all occurred in the upstream reaches of the main stem and in Ditch 11. There is an apparent increase in DO levels between these upstream sites and the site located near the Shadowbrook housing development. Higher DO levels are present in the larger and more natural channel found further downstream than the levels observed in the small ditched channels upstream.

Average and median dissolved oxygen in Coon Creek Data is from Vale St for all years through 2020.

	Average Dissolved Oxygen (mg/L)	Median Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	9.27	8.85	5 mg/L daily minimum	59
Storms	8.65	8.00		62
All	8.96	8.66		121
Occasions <5 mg/L				0

Dissolved oxygen at Coon Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





E. coli

The chronic state water quality standard for *E. coli* in streams is based on a calculated geometric mean of not less than five samples in any given calendar month. This mean should not exceed 126 MPN. An additional acute standard of not more than 10% of all samples in a given month should not exceed 1260 MPN is also listed. Because we monitor streams throughout the year, only collecting eight samples total, we do not have sufficient numbers of samples for any given calendar month to calculate geometric means or percentage-based exceedances comparable to these standards. It is however acceptable to group monthly data across years for impairment determinations and progress reporting.

During baseflow conditions, *E. coli* concentrations are generally lower in the upper reaches of the Coon Creek system and higher downstream. Median *E. coli* for all years at sites moving upstream to downstream ranges from 82.0 MPN at Naples St. to 146.5 MPN at Vale St during baseflow conditions. Though the sampling frequency requirements were not met for comparison to state standards, bacteria levels during baseflow generally are below the 126 MPN chronic state water quality standard benchmark in the upper watershed.

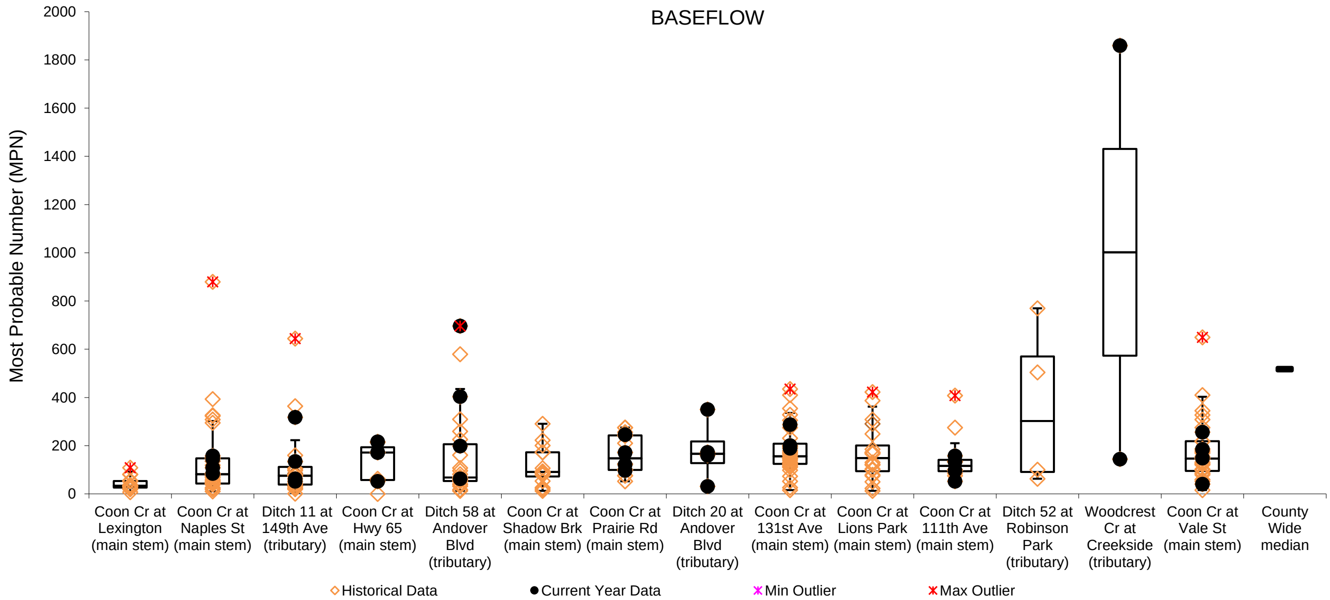
During baseflow conditions, all sites downstream of Naples St. exceeded 126 MPN on at least one occasion in 2020. Although *E. coli* concentrations were lower than previous years monitored, median *E. coli* for all years suggest that concentrations are likely close to exceeding the state standard most of the time in the lower reaches of the watershed. During storms, *E. coli* concentrations were significantly higher and more variable (note the order of magnitude difference in Y-axis scales in the graphs below). Median *E. coli* during storms from upstream to downstream ranges from 433.5 MPN at Naples St to 945.5 MPN at Vale St. In 2020, all samples collected at all sites post-storm exceeded 126 MPN. Although the sampling frequency requirements are again not met, *E. coli* levels in Coon Creek grab samples during storms in 2020 exceeded 1,260 MPN on seven occasions (17.5% of samples). *E. coli* concentrations were high at the newly monitored Woodcrest Creek site during baseflow conditions.

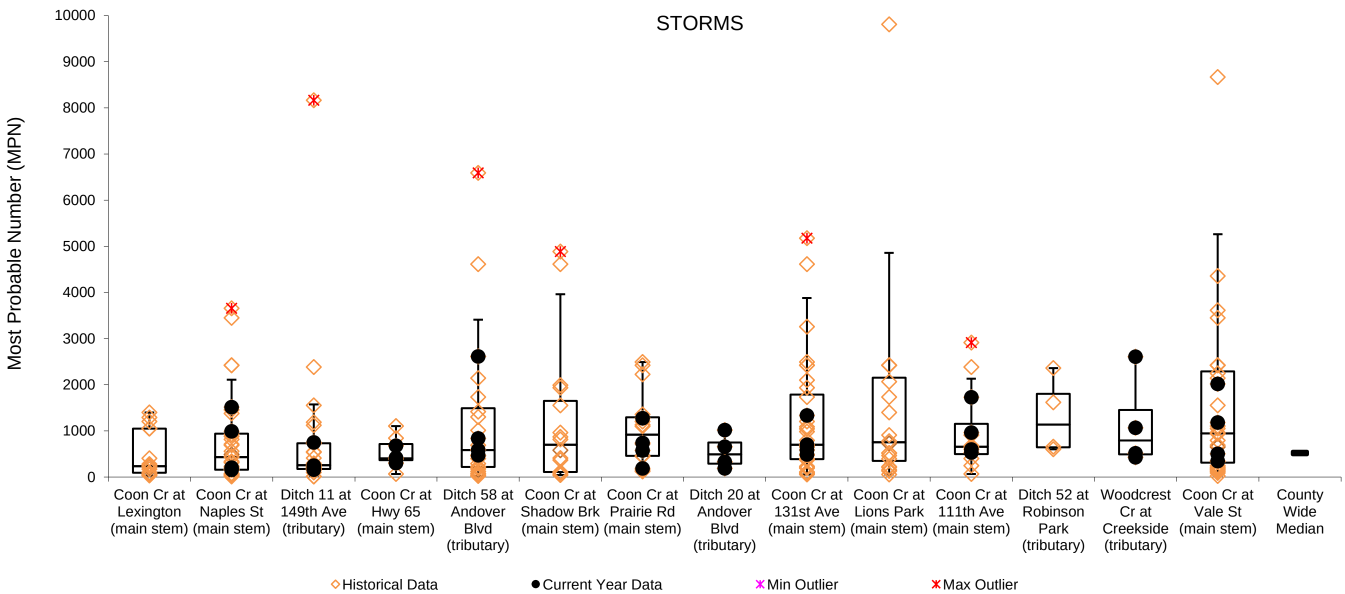
Coon Creek is listed as impaired for aquatic recreation due to *E. coli* and the *E. coli* LDC in the Coon Creek TMDL (Page 51, Figure 20) shows that the creek often exceeds acceptable loads during all flow levels, low to very high. *E. coli* sources can be harder to pinpoint than sources of other pollutant loading because concentrations fluctuate wildly up or down without additional input due to this particular pollutant being a living organism. The TMDL estimates that livestock (51%) and domestic dogs (37%) contribute most of the *E. coli* load to Coon Creek. Most of the livestock, which are primarily identified as horses, occur in the upstream portions of the watershed. Domestic dogs likely exist throughout the watershed. Horses as point sources near the creek should be easy to identify in the upper portions of the watershed. An education campaign, and potentially some monetary incentives, could help address these sources. It is also possible that waterfowl have a larger *E. coli* footprint in Coon Creek than road surveys conducted for the TMDL may suggest. Potential human sources of E. coli loading such as failing septic systems or leaky sanitary sewer infrastructure should also be inventoried. Additionally, implementation strategies to address TSS and TP loading by reducing soil erosion and organic debris will also reduce particle-bound sources of *E. coli*.

Average, Geomean and median *E. coli* in Coon Creek Data is from Vale St. 2013-2020.

	Average *E. coli* (MPN)	**Geomean *E. coli* (MPN)**	**Median *E. coli* (MPN)**	**State Standard**	**N**
Baseflow	175.37	135.80	146.5	Monthly Geometric Mean >126	32
Storms	1,823.58	790.92	945.5		32
All	999.48	328.14	233.5	Monthly 10% average >1260	64
Occasions >126 MPN					19 baseflow (59%), 29 storm (91%)
Occasions >1260 MPN					0 baseflow, 12 storm (37%)

***E. coli* at Coon Creek** Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Continuous Stream Water Quality Monitoring – Coon Creek Tributary

WOODCREST CREEK

at Creekside Estates, Coon Rapids

Background

Continuous stream water quality monitoring in conducted as select sites each year; Woodcrest Creek was chosen for analysis in 2020. On the following pages, results from each storm monitored in 2020 are shown. This includes eight storm events in total. The graphs show daily precipitation totals as well as the stream hydrograph for the duration of the storm. Separate graphs show each water quality parameter graphed with water elevation. The text below summarizes findings across all storms for each parameter. This was the first year of monitoring at the Woodcrest Creek site. Equipment was installed in a deeper pool before flowing through a box culvert under the railroad track. It is recommended that more continuous stream water quality monitoring be completed at this site to properly document existing conditions and how the system reacts to storm events.

Results and Discussion

Turbidity

- In general, turbidity rises rapidly at the beginning of storms, usually rising along with stage at the site. Maximum turbidity readings for individual storms typically reached levels between 50 and 300 NTU.
- Turbidity was quick to return to normal levels observed during baseflow conditions, usually returning to baseflow conditions within a 12-hour window.
- At baseflow, Woodcrest Creek runs quite clear with typical turbidity readings between 0 and 10 NTU.

Specific Conductance

- Specific conductance decreases during storm events in Woodcrest Creek. When creek stage rises due to storm runoff, conductance drops. During brief, intense rainfall stream conductance drops sharply. This relationship indicates that the shallow groundwater that feeds the stream during baseflow conditions has higher specific conductance than stormwater runoff.
- Infiltration of road deicing salts is a likely source of dissolved pollutants in streams at baseflow, year round due to contamination of the surficial groundwater that feeds the streams.
- At baseflow, specific conductance in Woodcrest Creek generally remains between 1,400 and 1,600 µS/cm.

Dissolved Oxygen

- Dissolved oxygen concentrations in Woodcrest Creek were overall healthy with dissolved oxygens rebounded quickly after dropping below 5.0 mg/L, the threshold considered healthy for aquatic organisms.. The lowest reading recorded was in late June when dissolved oxygen levels dropped below 2.0 mg/L. On this occasion, water temperatures were greater than 73° F.
- 4 out of 8 sampling events in 2020 had conditions where dissolved oxygen went below the state standard of 5.0 mg/L
- Diel fluctuations in dissolved oxygen concentrations in Woodcrest Creek are also typically less than 3.5 mg/L, the state standard for maximum diel oxygen flux in this region.

Temperature

- Water temperature is generally not considered a concern in Woodcrest Creek because there are no trout or other temperature sensitive organisms.

pH

- When water levels rise due to storm runoff, pH in Woodcrest Creek declines. Rainwater is more acidic than the local shallow groundwater feeding the creek.
- pH stayed within the desired range of 6.5 to 8.5 that is specified in State water quality standards.

Precipitation

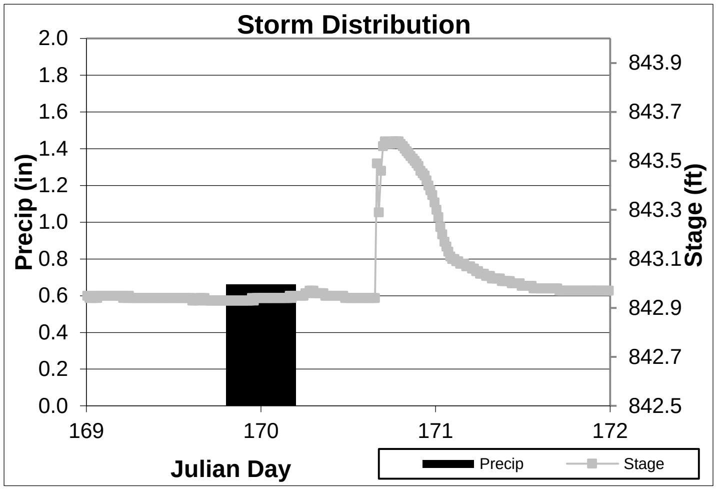
- Storm totals for Woodcrest Creek ranged from 0.08 inch to 1.08 inches.
- Most rain events took place over a 24-hour period with a couple extending over multiple days.
- Precipitation was well below average in 2020 and larger more intense rain events did not occur with any frequency.

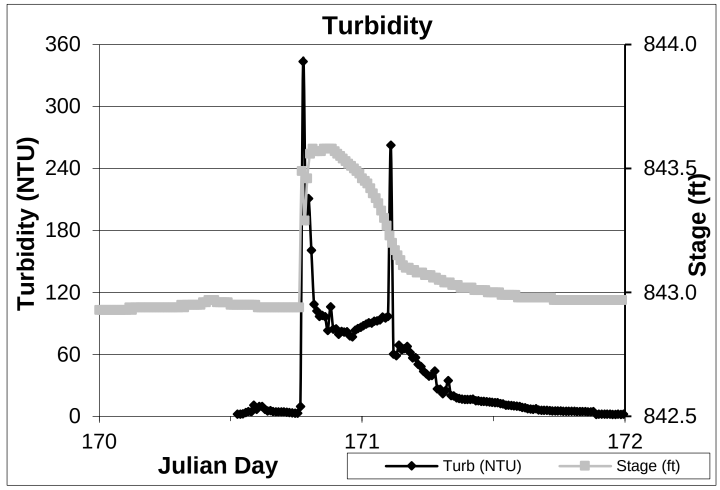
Continuous Monitoring – <u>Woodcrest Creek at Creekside Estates</u>
Storm 1 – June 18th to June 20th

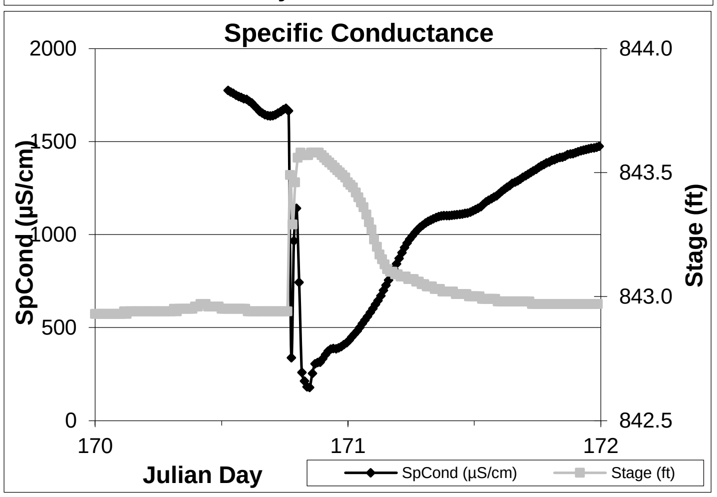
<u>Storm Summary:</u>

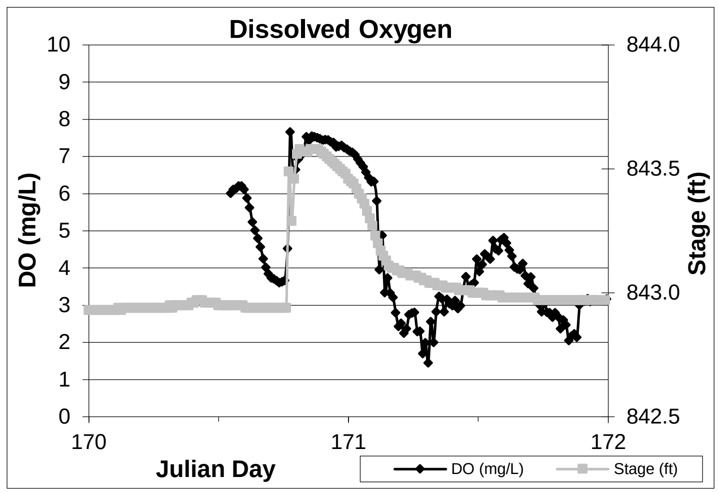
Dates: June 18 2020 (Day 170) to June 20 2020 (Day 172)

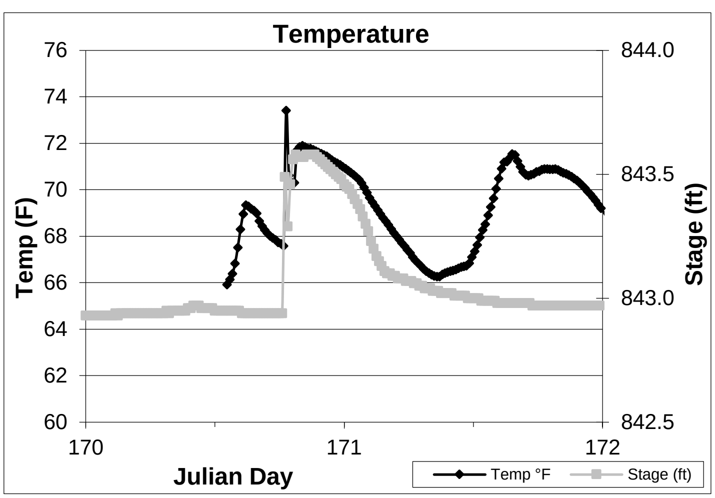
Precipitation: 0.66 in.

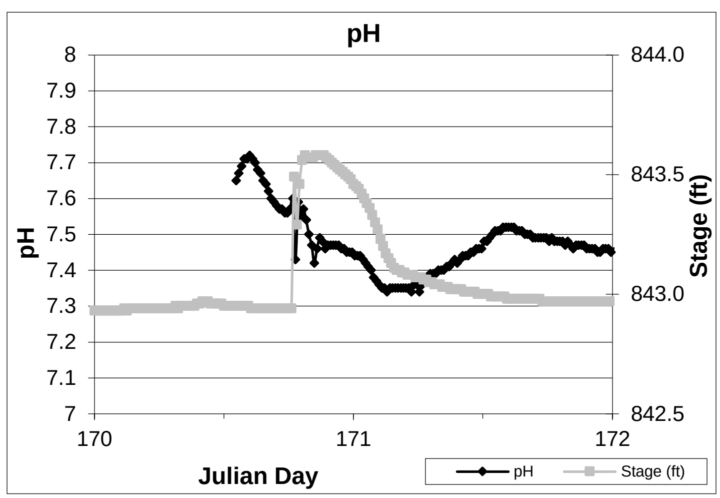










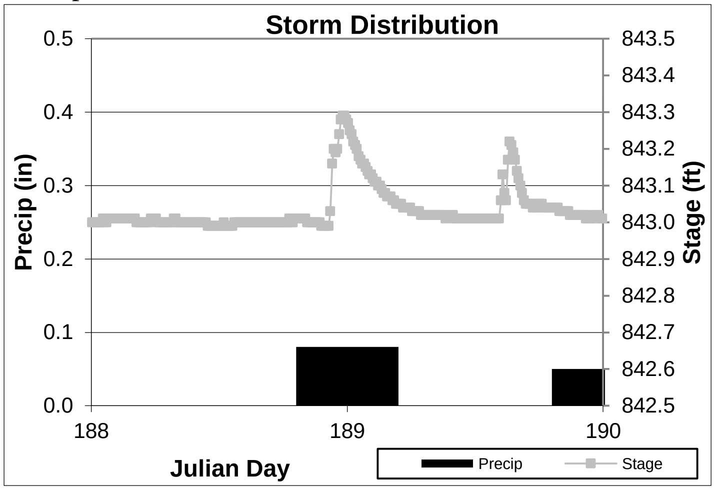


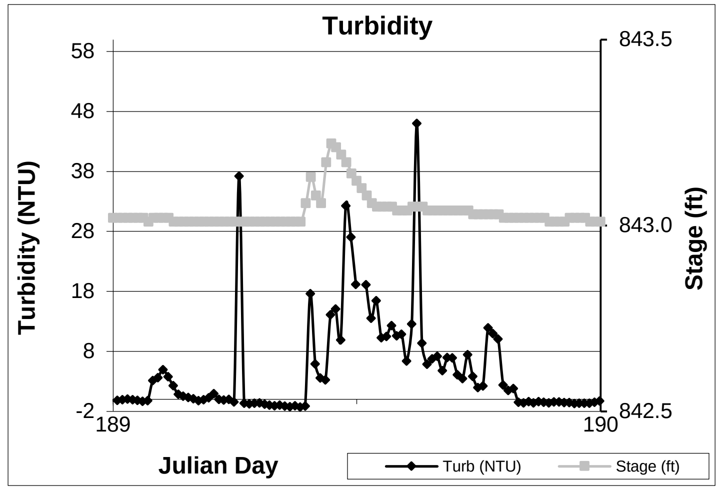
Continuous Monitoring – <u>Woodcrest Creek at Creekside Estates</u>
Storm 2 – July 7th to July 8th

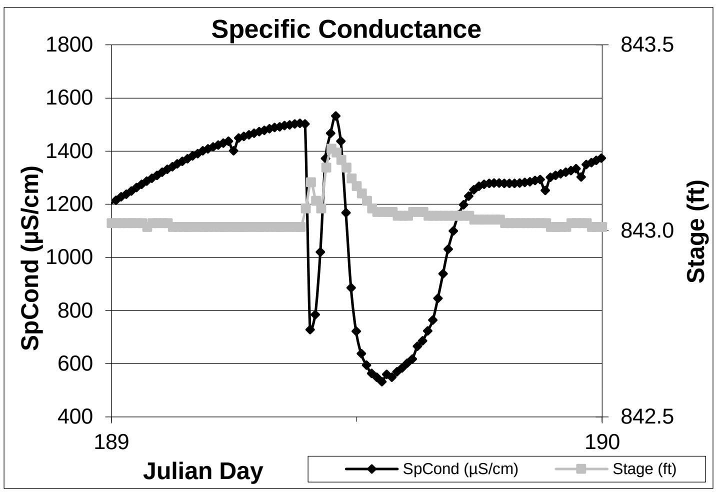
<u>Storm Summary:</u>

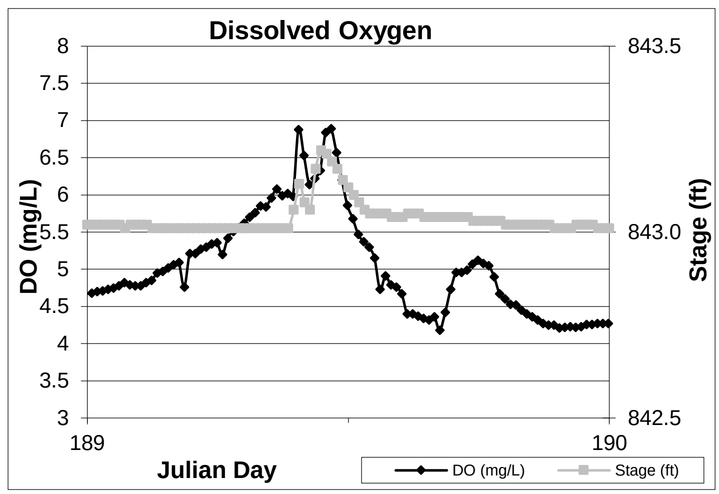
Dates: 7 July 2020 (day 189) to 8 July 2020 (day 190)

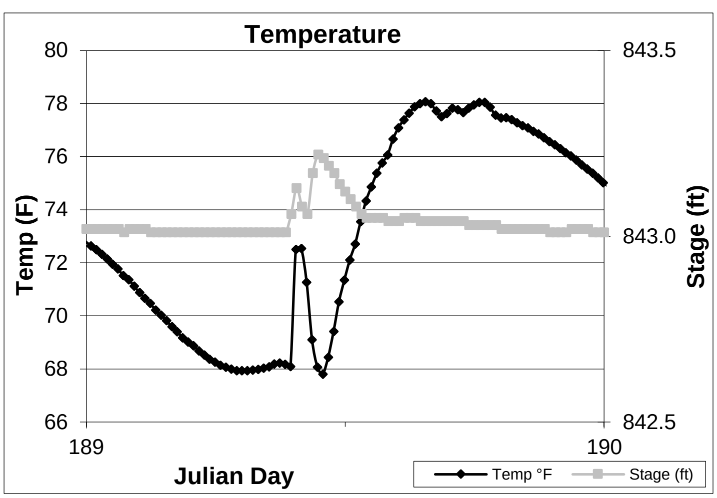
Precipitation: 0.08 in.

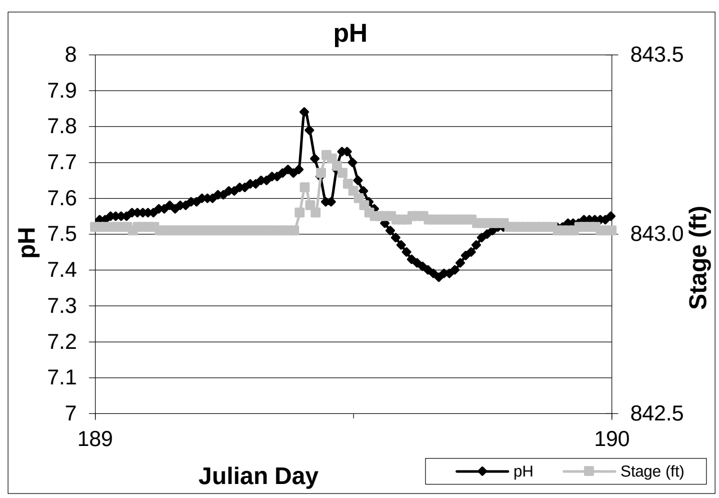






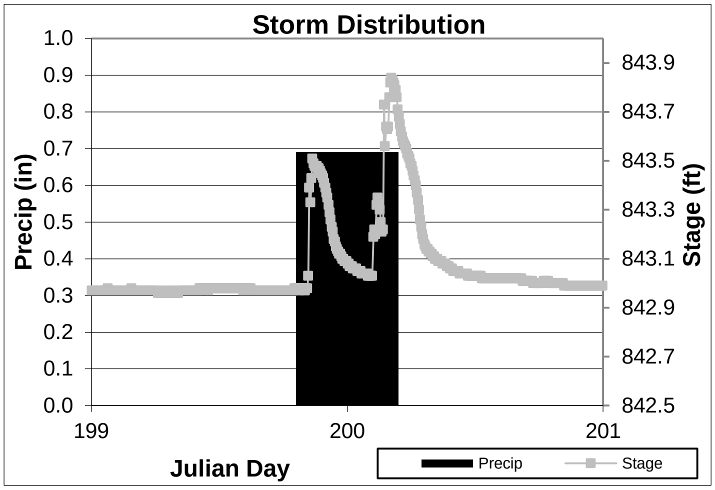


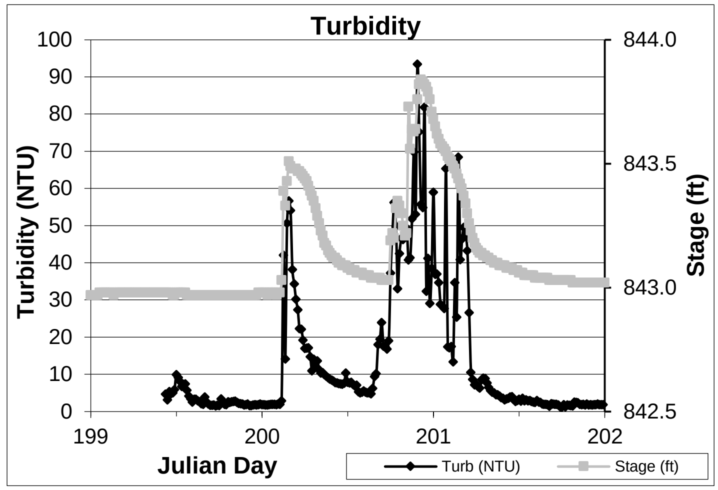


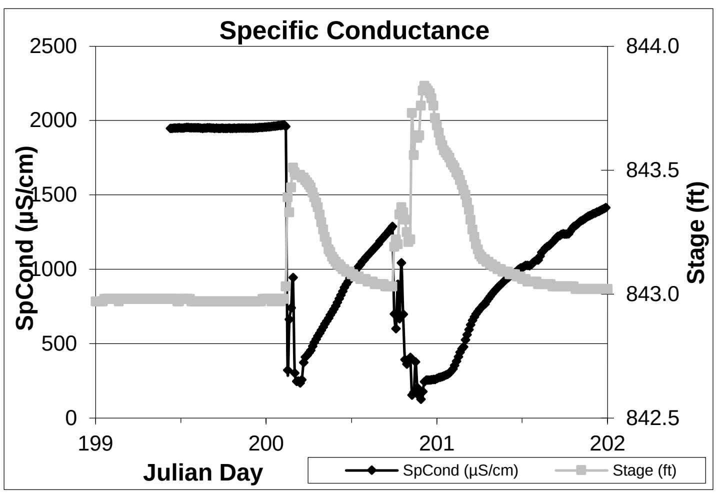


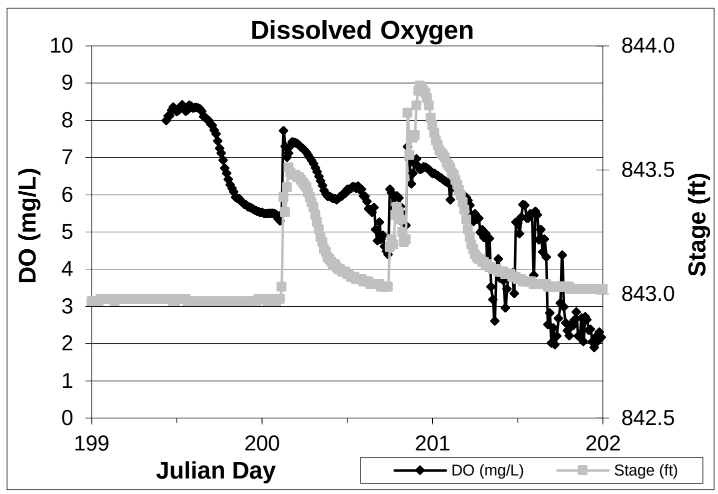
Continuous Monitoring – <u>Woodcrest Creek at Creekside Estates</u>
Storm 3 – July 17th to 20th

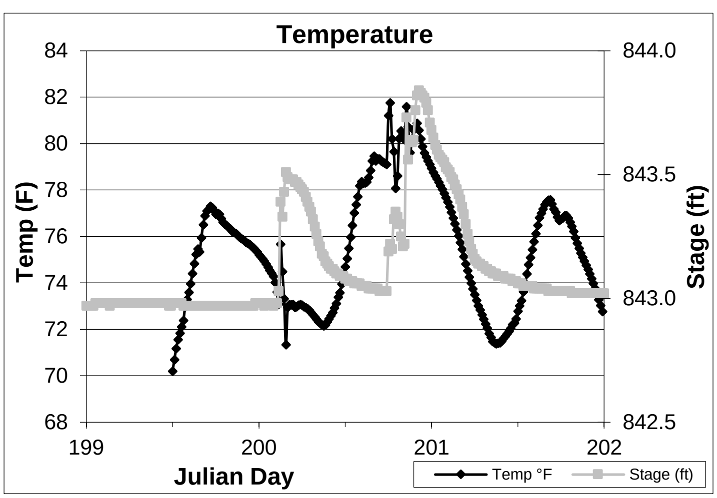
<u>Storm Summary:</u>
Dates: 17 July 2020 (day 199) to 20 July 2020 (day 202)
Precipitation: 0.69 in.

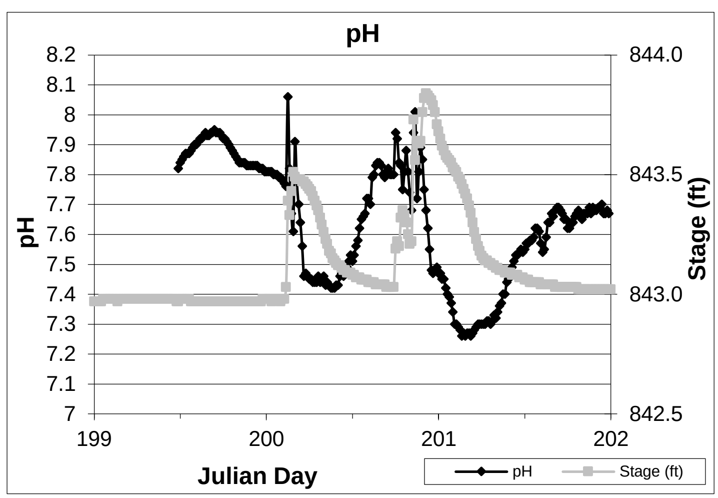






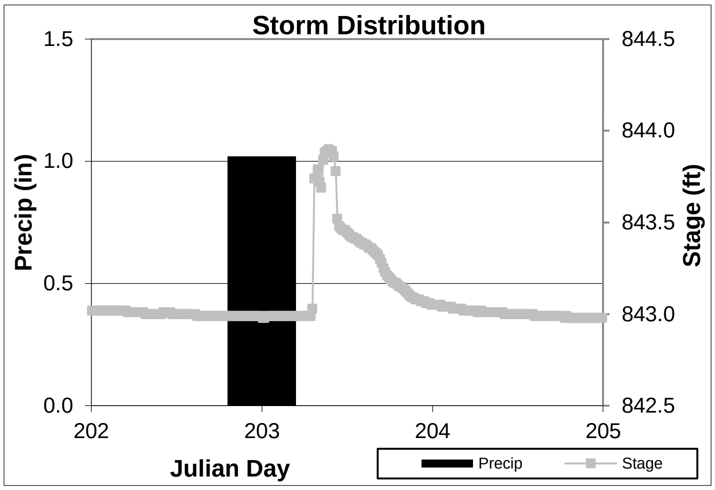


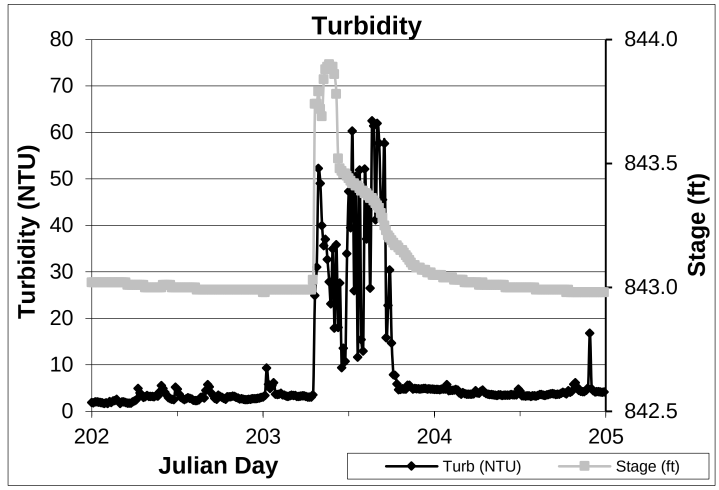


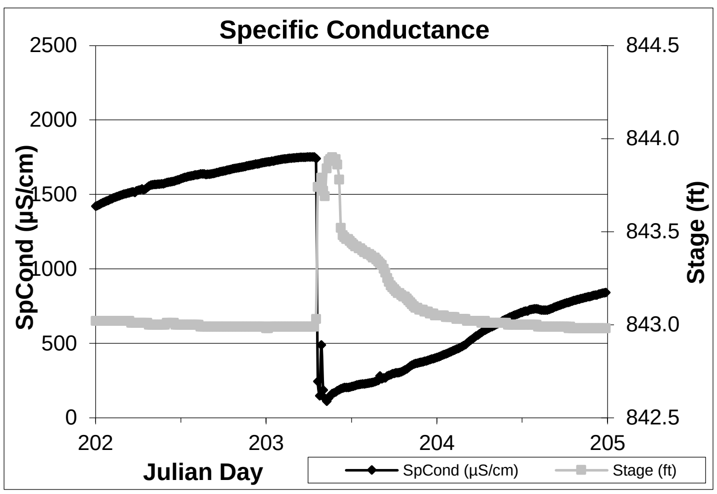


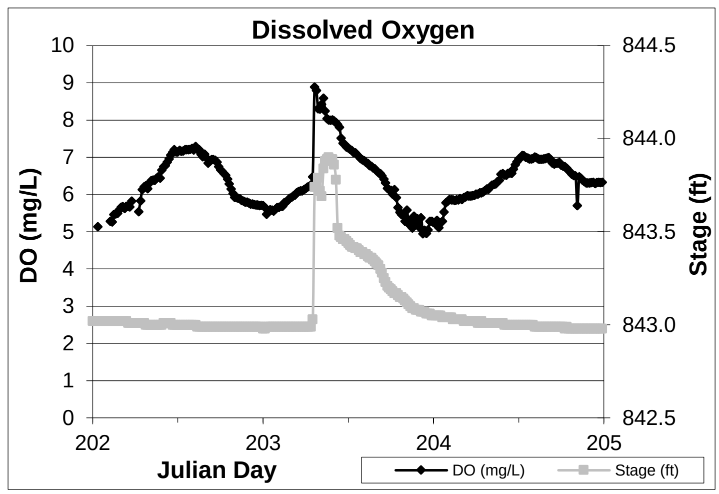
Continuous Monitoring – Woodcrest Creek at Creekside Estates
Storm 4 – July 20th to 23rd

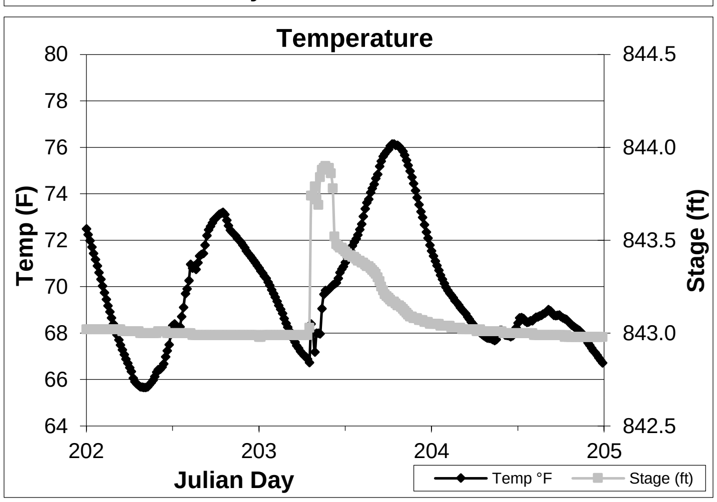
Storm Summary:
Dates: 20 July 2020 (day 202) to 23 July 2020 (day 205)
Precipitation: 1.02

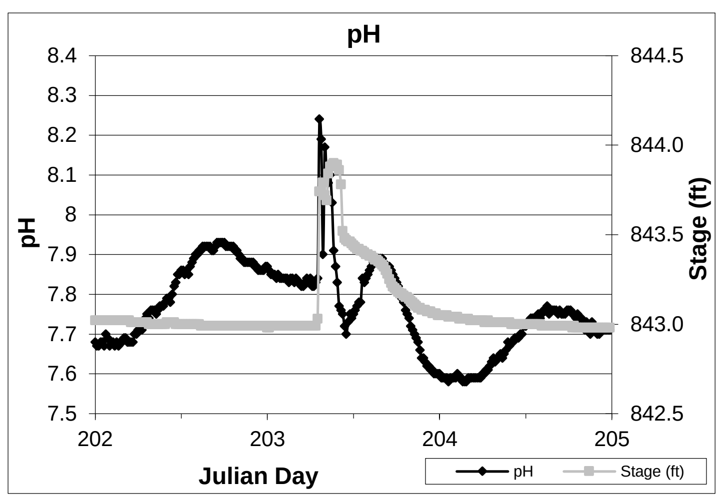






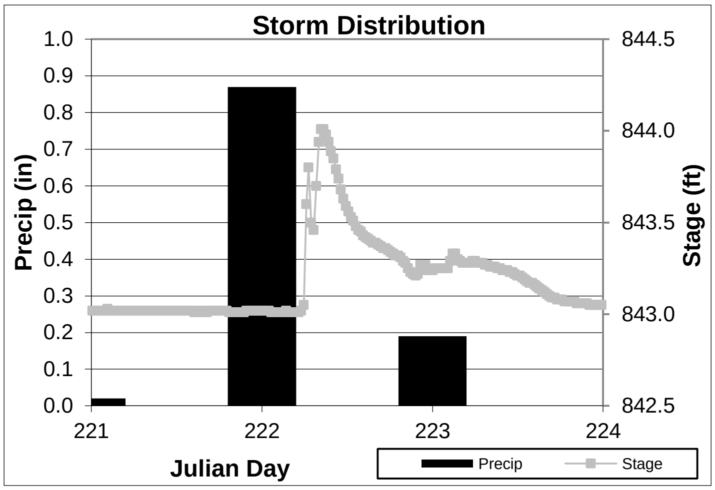


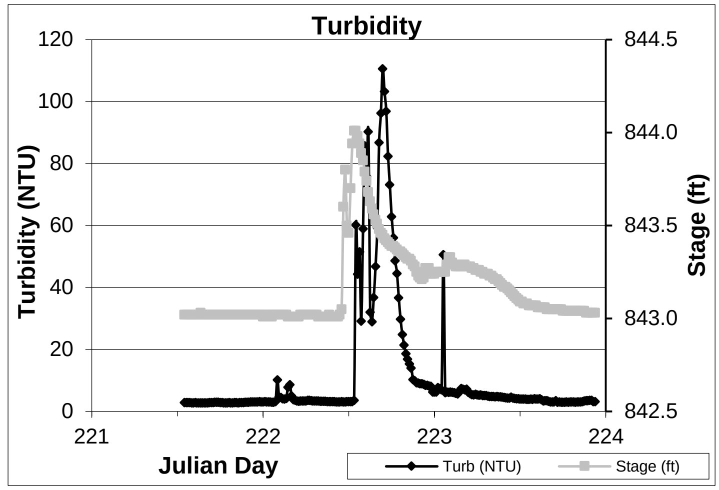


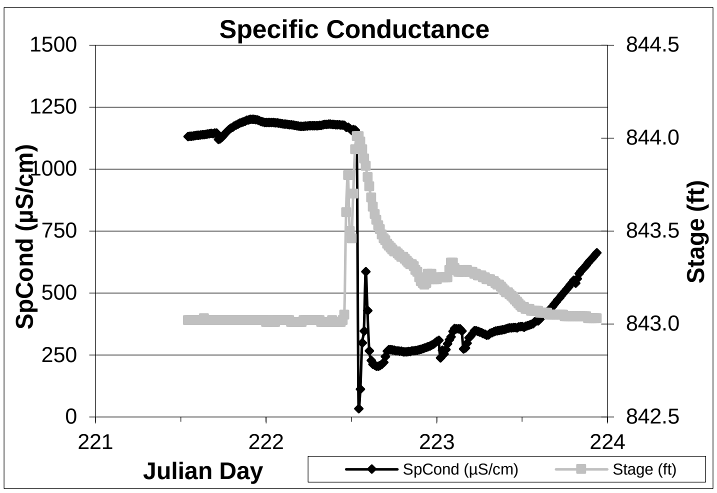


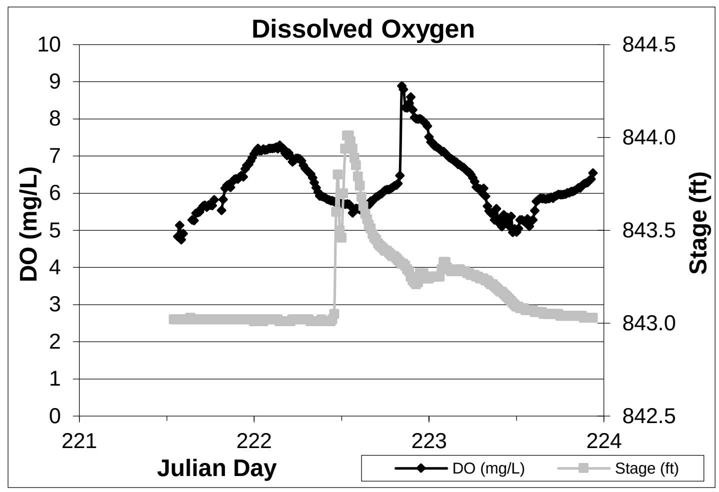
Continuous Monitoring – <u>Woodcrest Creek at Creekside Estates</u>
Storm 5 – August 8th to 11th

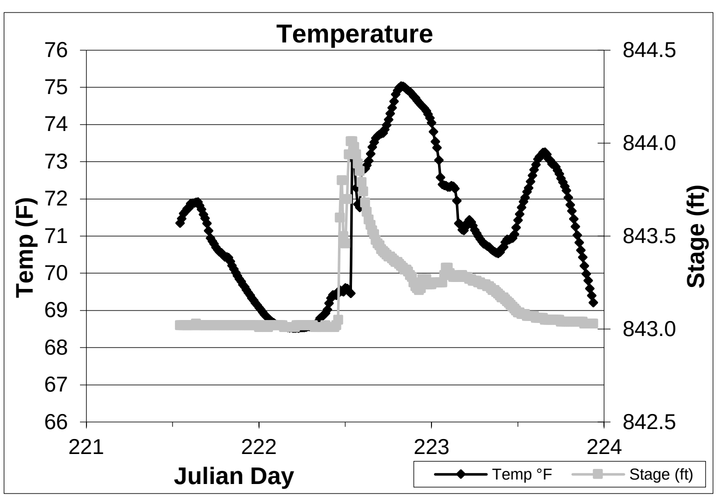
<u>Storm Summary:</u>
Dates: 8 August 2020 (day 221) to 11 August 2020 (day 224)
Precipitation: 1.08 in.

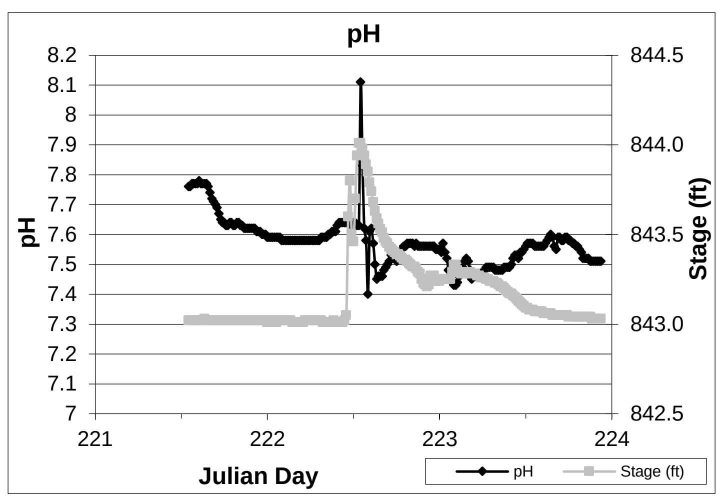










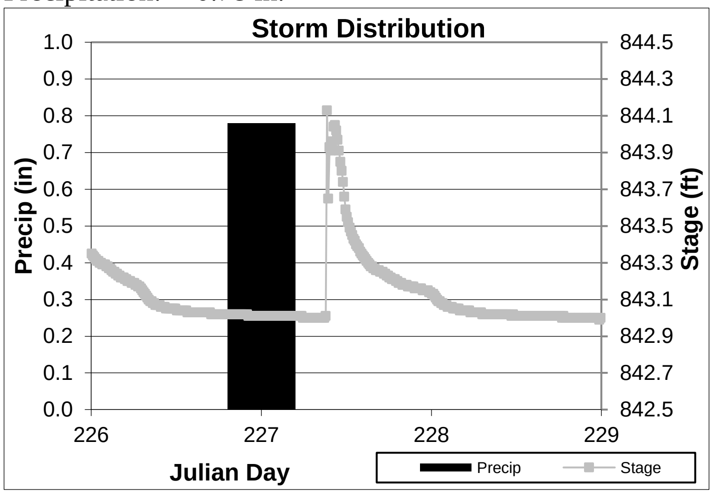


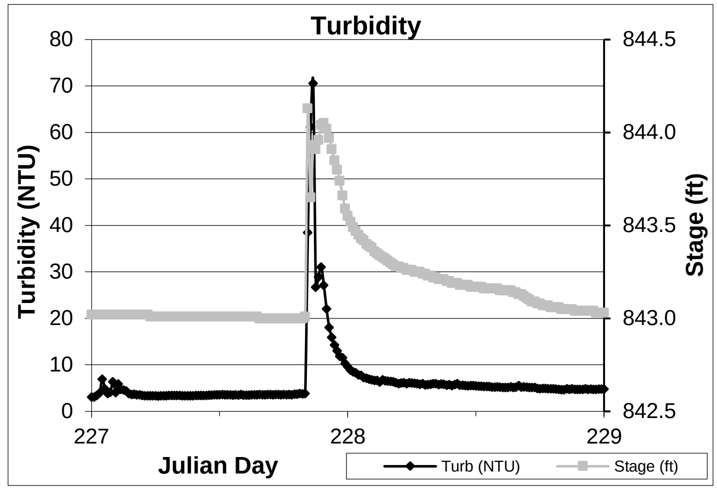
Continuous Monitoring – Woodcrest Creek at CreeksideEstates
Storm 6 – August 14th to August 16th

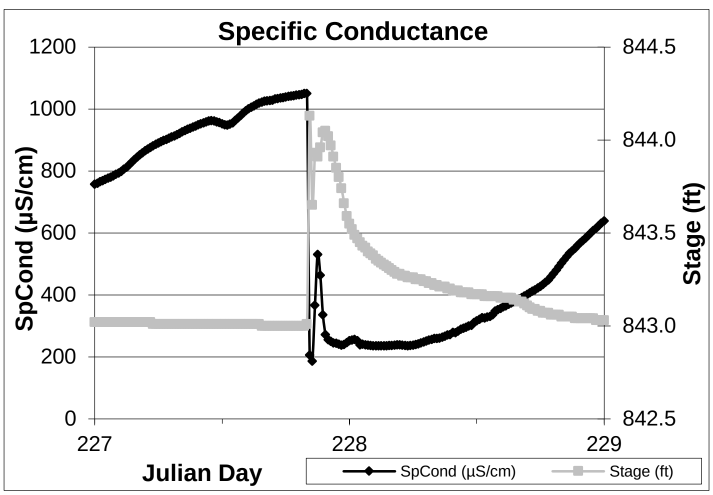
Storm Summary:

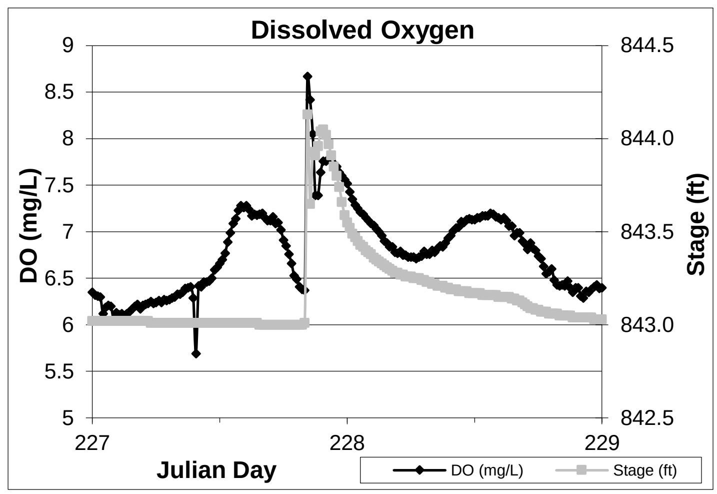
Dates: 14 August 2020 (day 227) to 16 August 2020 (day 229)

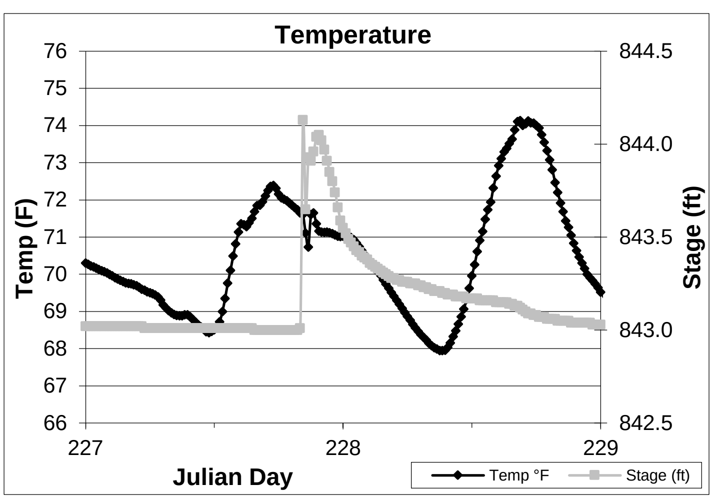
Precipitation: 0.78 in.

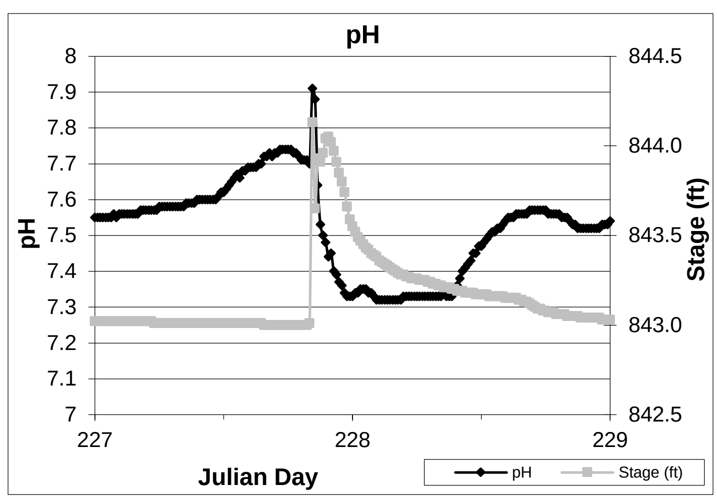










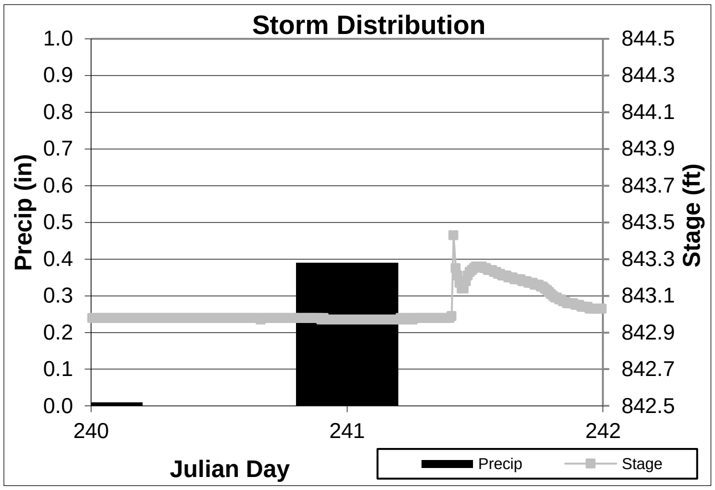


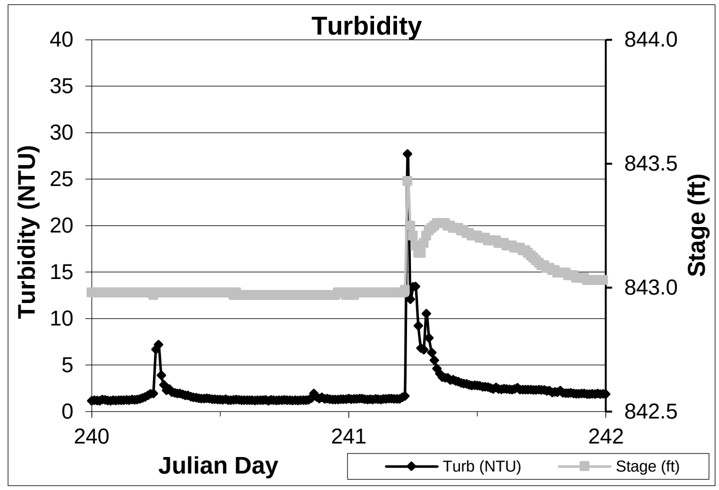
Continuous Monitoring – <u>Woodcrest Creek at Park Estates</u>
Storm 7 – August 27th to 29th

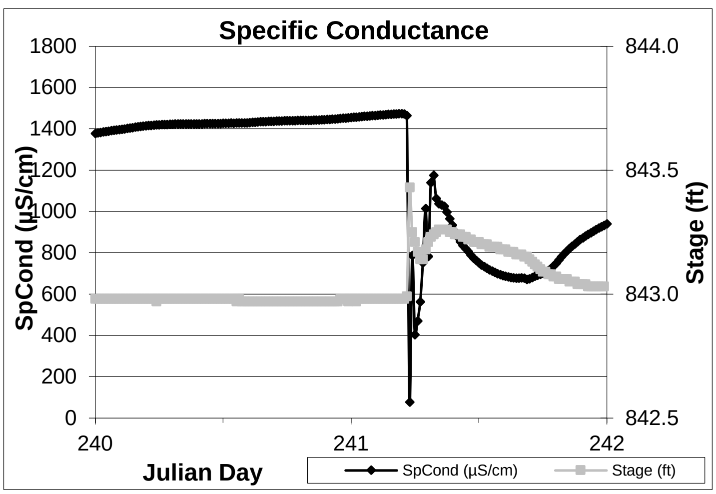
<u>Storm Summary:</u>

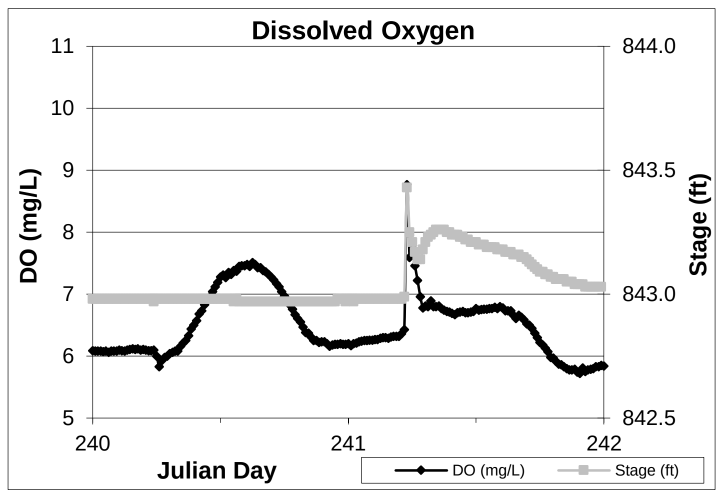
Dates: 27 August 2020 (day 240) to 29 August 2020 (day 242)

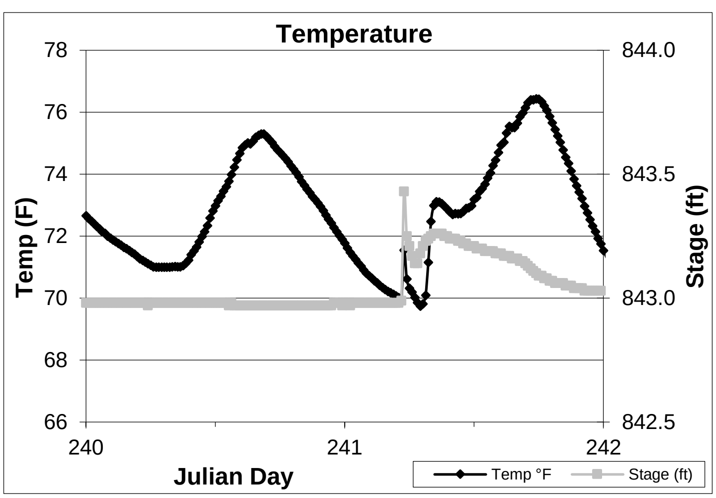
Precipitation: 0.40 in.

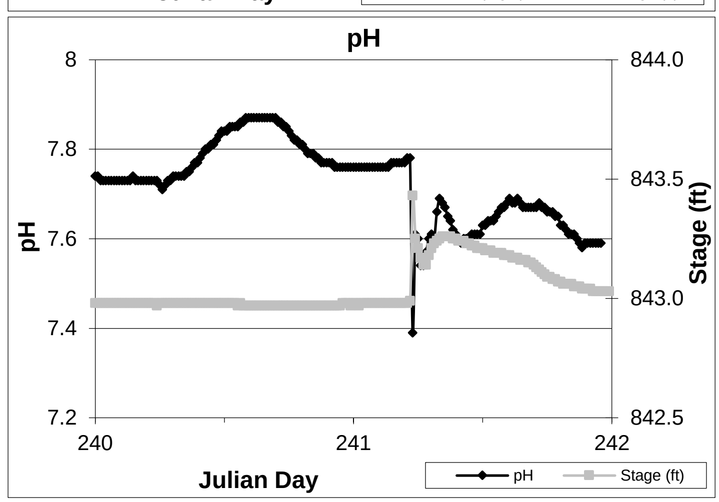










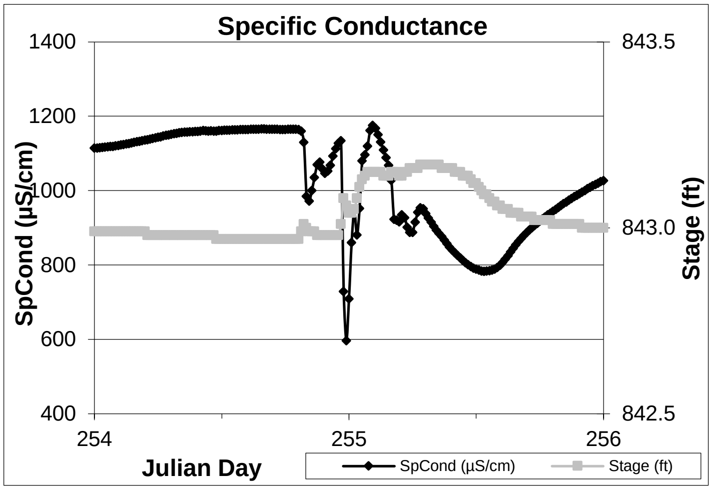


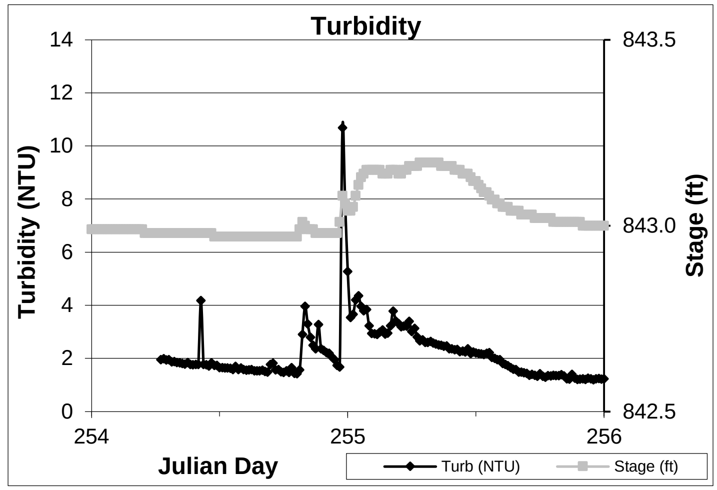
Continuous Monitoring – Woodcrest Creek at Park Estates
Storm 8 – September 11th to 13th

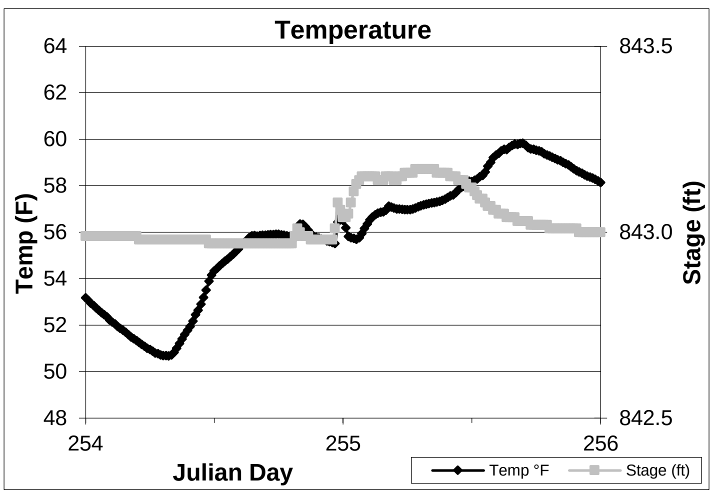
Storm Summary:

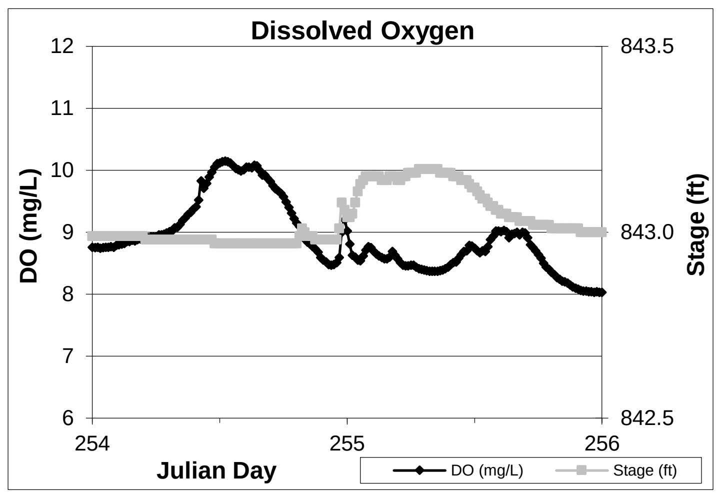
Dates: 11 September 2020 (day 254) to 13 September 2020 (day 256)

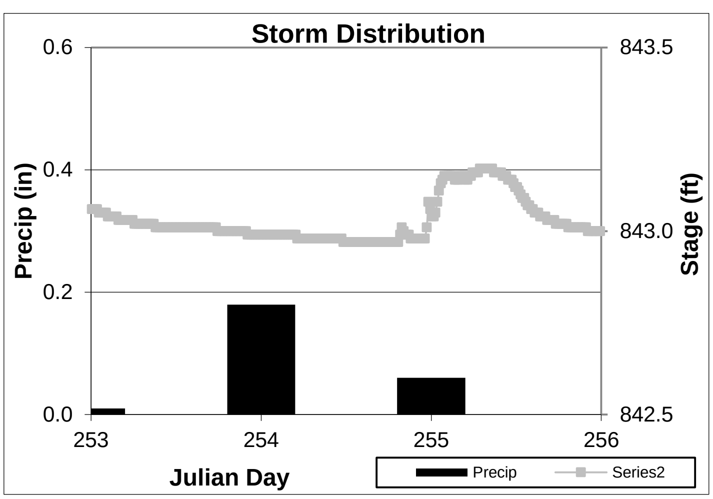
Precipitation: 0.26 in.

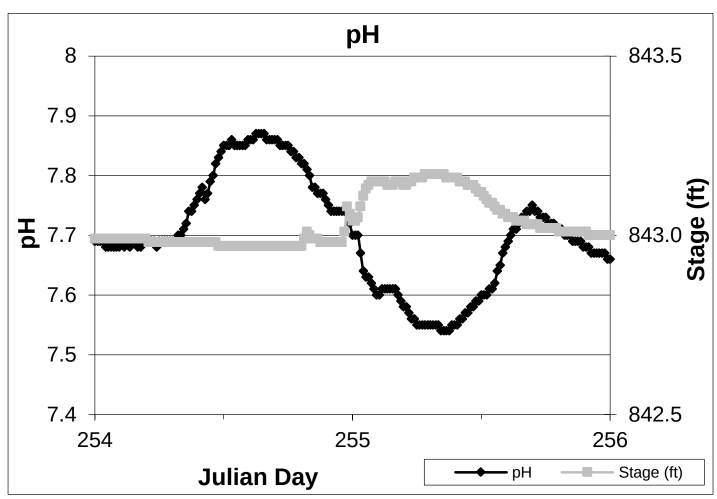








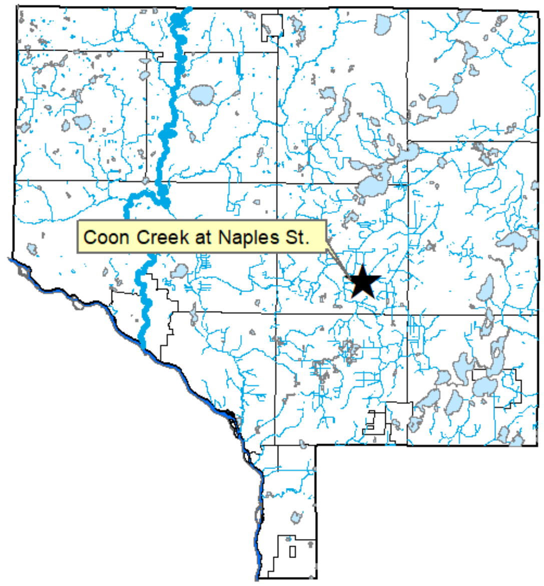




COON CREEK

at Naples St, Ham Lake

Notes



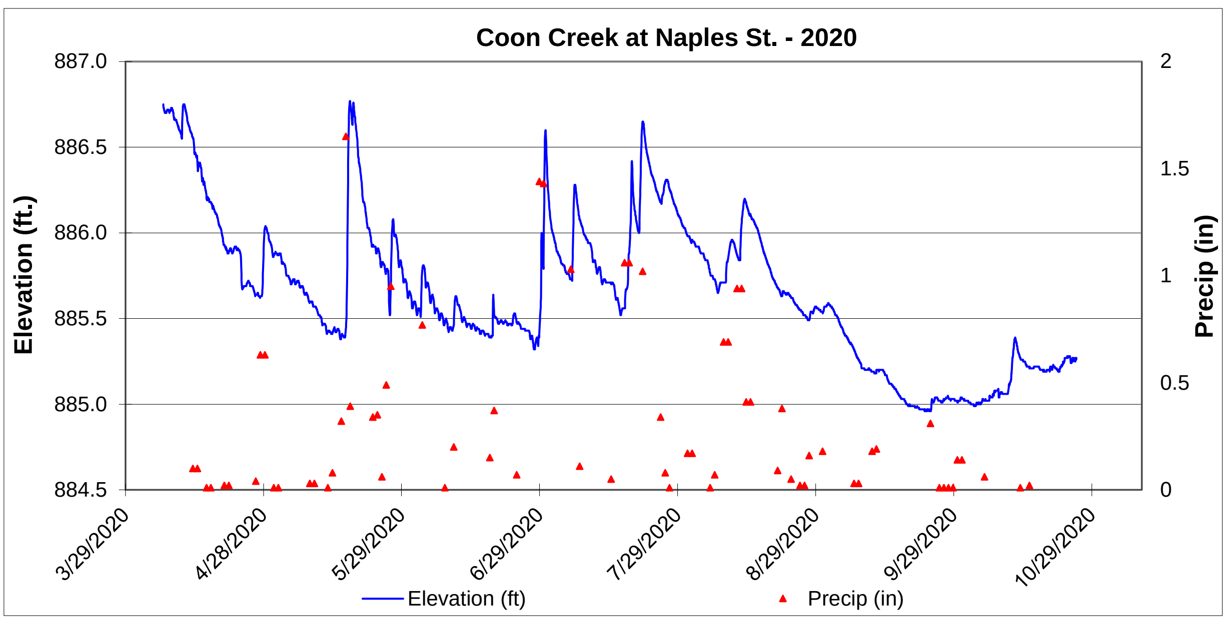
Stage at this site was flashy but fluctuated less than previous years. Throughout the monitoring season, the baseflow stage elevation at this site steadily decreased.

During the 2020 season, the creek at Naples St. only fluctuated 1.81 ft. between its minimum and maximum-recorded stage. This was the smallest range of stage fluctuation on record. The recorded range was 1.45 ft. less than the average range for this site. This was likely due to the infrequent and less intense rain events. This site fluctuated less in 2020 than other Coon Creek sites. During a 1.65-inch storm on May 17, stage only rose 1.33 ft. in a 24-hour span.

It seemed that damming occurred at this site, which may have affected flow throughout the season, but this could not be confirmed. The average stage in 2020 was similar to other monitoring years.

A rating curve was first established for this site in 2013 and another was developed in 2020, which is displayed below. When compared to the 2013 rating curve, the 2020 model showed much higher stage correlating with less discharge.

2020 Hydrograph

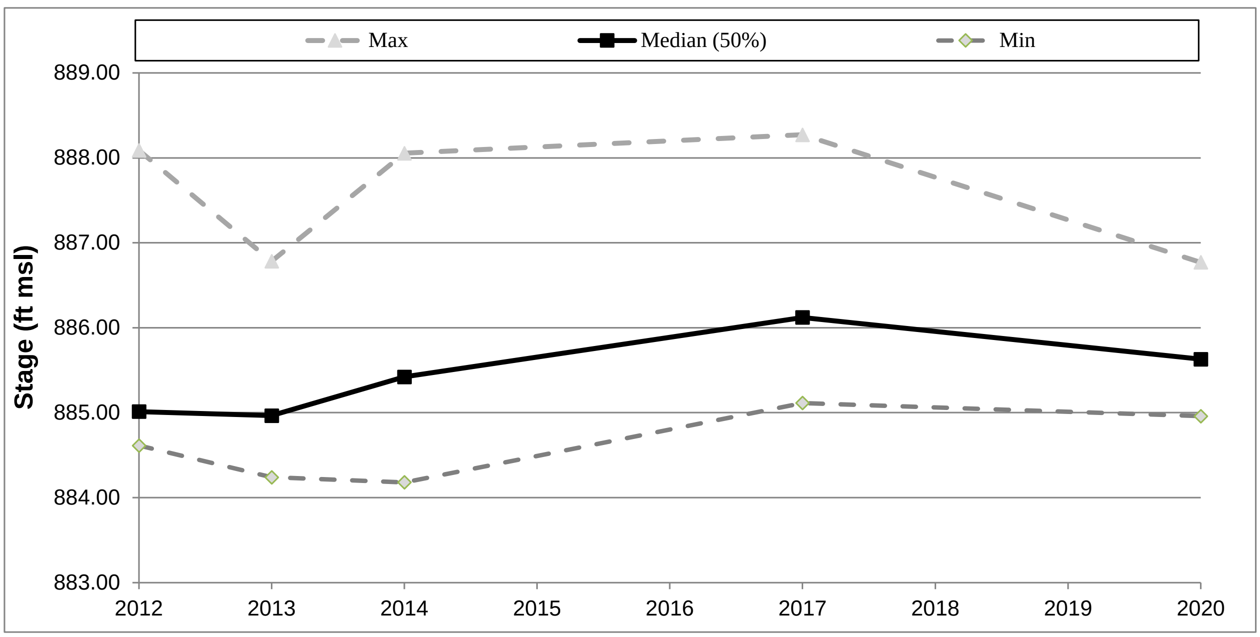


COON CREEK

at Naples St, Ham Lake

Summary of All Monitoring Years

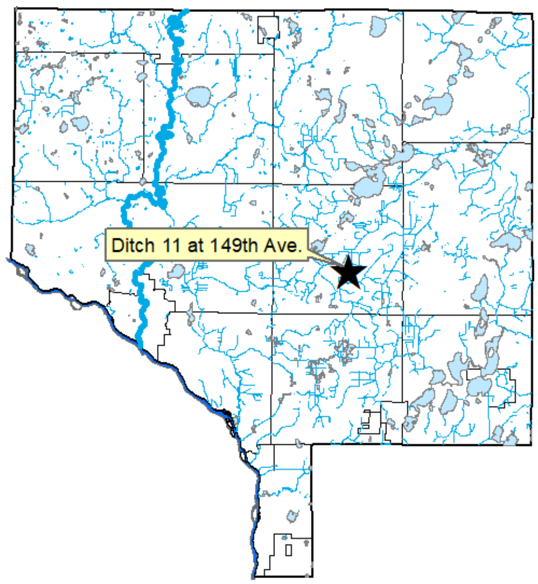
Percentiles	2012	2013	2014	2017	2020
Min	884.61	884.24	884.18	885.11	884.96
2.5%	884.71	884.41	884.69	885.26	884.99
10.0%	884.81	884.46	884.88	885.65	885.04
25.0%	884.89	884.55	885.06	885.78	885.36
Median (50%)	885.01	884.97	885.42	886.12	885.63
75.0%	885.49	885.42	886.38	886.42	885.92
90.0%	885.89	885.84	887.76	886.92	886.23
97.5%	887.78	886.22	888.01	888.09	886.66
Max	888.09	886.78	888.06	888.27	886.77



DITCH 11

at 149th Ave, Ham Lake

Notes



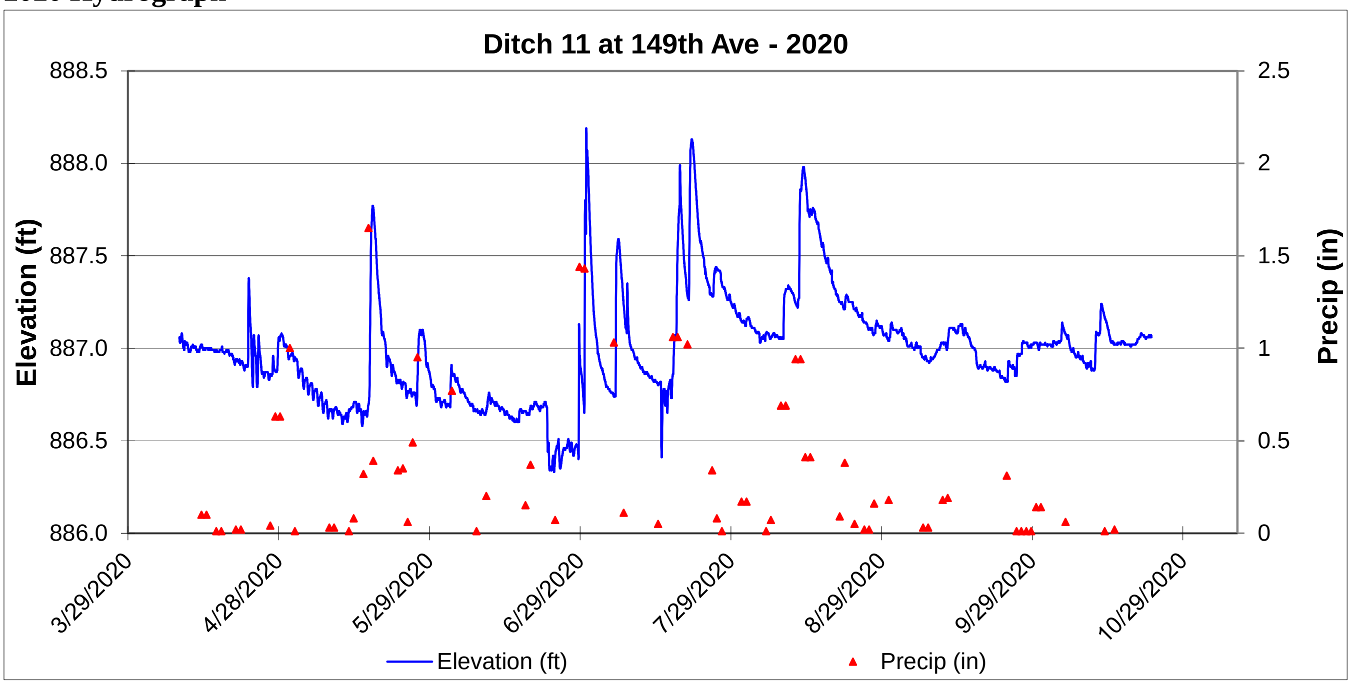
Stage at this site is flashy in response to storms, reacting quickly to rainfall events. This was the first year stage was monitored at this site.

During the 2020 season, the ditch at the 149th Ave site fluctuated 2.10 ft. between its minimum and maximum-recorded stage. During a 1.43-inch storm on June 30, stage rose 1.15 ft. in four hours.

Damming occurred at this site. This elevated high stage may have been due to excessive vegetation, damming activity by local farmers, or fluctuations in local groundwater levels. This can be seen in the higher base flow stage in August, September, and October even with minimal rainfall occurring.

A rating curve was established for this site in 2020 and is displayed below. This rating curve could benefit from continued refinement.

2020 Hydrograph

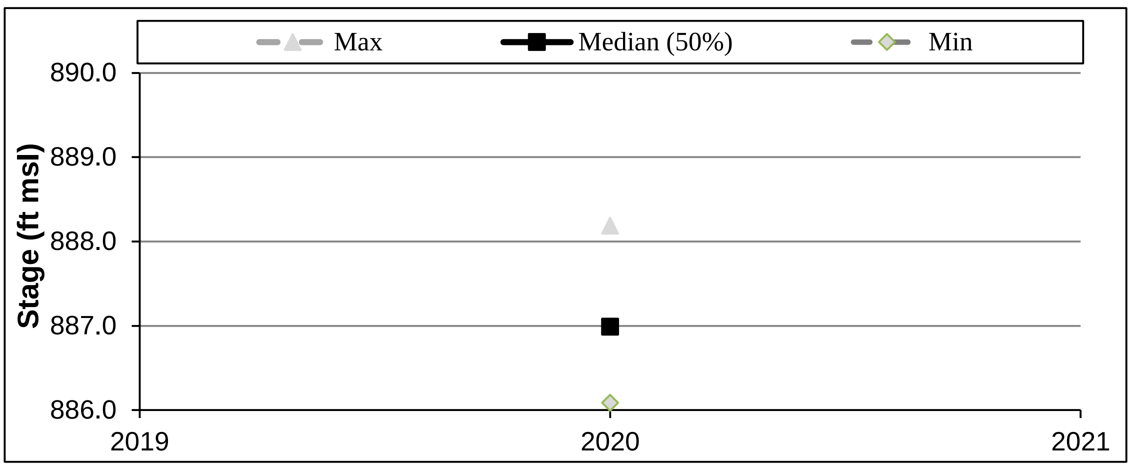


DITCH 11

at 149th Ave, Ham Lake

Summary of All Monitoring Years

Percentiles	2020
Min	886.09
2.5%	886.36
10.0%	886.66
25.0%	886.79
Median (50%)	886.99
75.0%	887.09
90.0%	887.33
97.5%	887.75
Max	888.19



COON CREEK

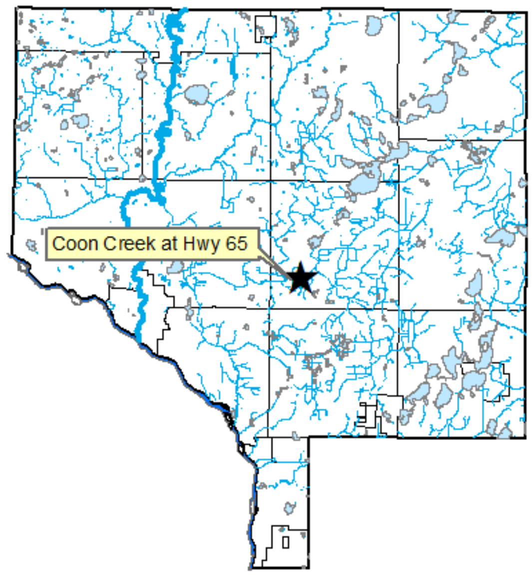
at Highway 65, Ham Lake

Notes

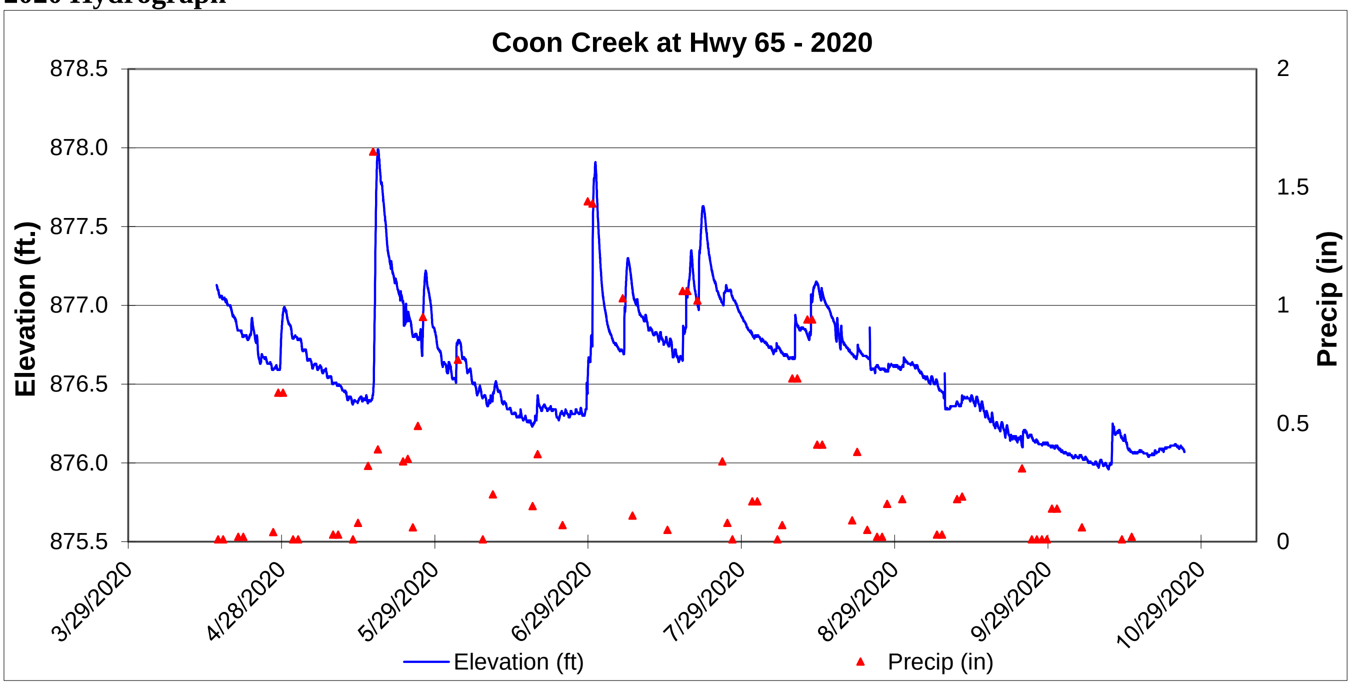
Stage at this site is flashy, reacting quickly to rainfall and returning to baseflow conditions quickly. Throughout the monitoring season, the baseflow stage elevation at this site steadily decreased.

2020 is the first year of monitoring stage at the Highway 65 site. During the season, the creek only fluctuated 2.03 ft. between its minimum and maximum-recorded elevations. 2020 was a below average year for precipitation and resulted in less fluctuation throughout the Coon Creek system. More monitoring should be done at this site to examine how stage fluctuates throughout the season.

Following a 1.65-inch rainfall, stage rose 1.60 ft. in a 10-hour span.



2020 Hydrograph



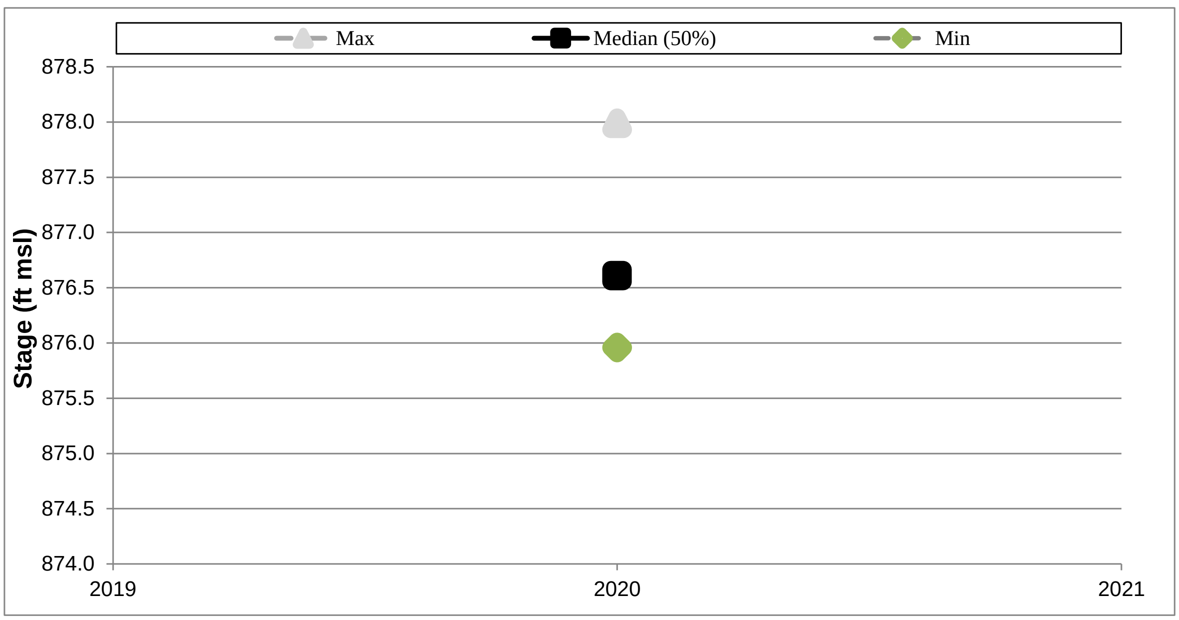
Stream Hydrology Monitoring

COON CREEK

at Highway 65, Ham Lake

Summary of All Monitoring Years

Percentiles	2020
Min	875.96
2.5%	876.02
10.0%	876.10
25.0%	876.32
Median (50%)	876.61
75.0%	876.83
90.0%	877.07
97.5%	877.42
Max	877.99



DITCH 58

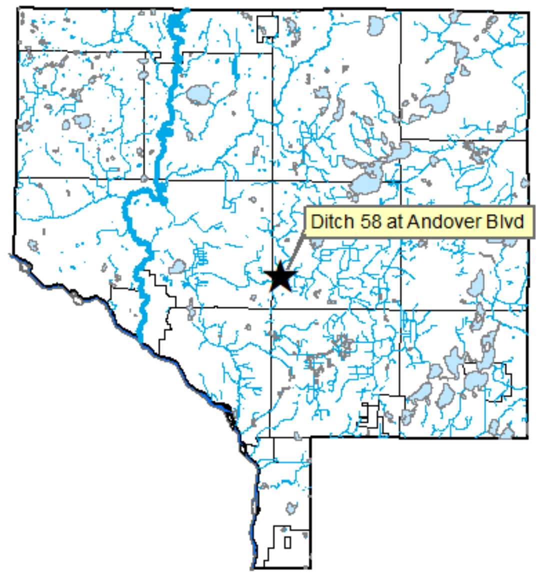
at Andover Blvd, Ham Lake

Notes

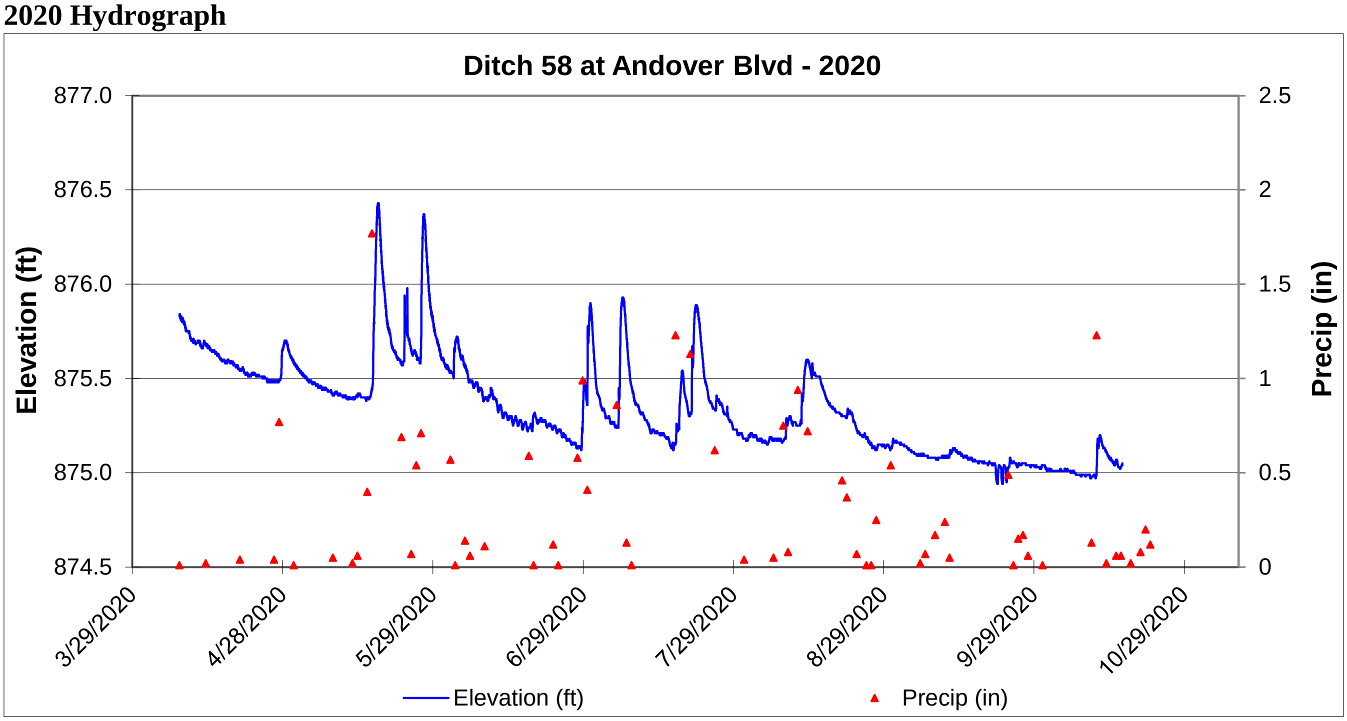
During the 2020 season,Ditch 58 at the Andover Blvd site only fluctuated 1.49 ft. between its minimum and maximum-recorded stage. This was the smallest range of stage fluctuation since 2001 when the site was first monitored. This small range is due to the lowest maximum elevation on record occurring in 2020.

Rainfall in 2020 was infrequent and storms were less intense. Total annual precipitation was the lowest since 2012. Baseflow elevation at this site steadily decreased throughout the year.

The logger at this site took readings in 15-minute intervals. Stage was quick to react to storm events. During a 0.77-inch storm on May 26, stage rose 0.44 ft. over a 5-hour span.



2020 Hydrograph

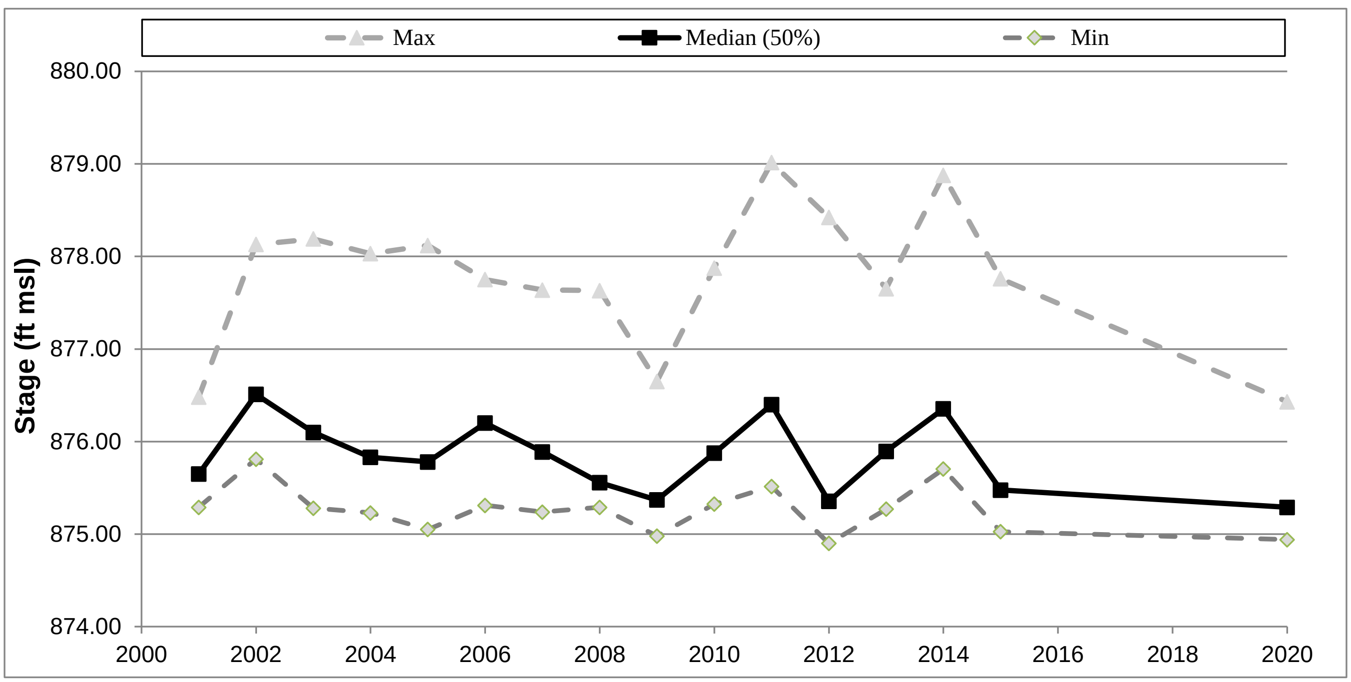


DITCH 58

at Andover Blvd, Ham Lake

Summary of All Monitoring Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	2008
Min	875.29	875.81	875.28	875.23	875.05	875.31	875.24	875.29
2.5%	875.35	876.18	875.57	875.63	875.54	875.91	875.29	875.33
10.0%	875.48	876.33	875.64	875.51	875.37	875.66	875.37	875.36
25.0%	875.58	876.41	875.74	875.63	875.54	875.91	875.49	875.39
Median (50%)	875.65	876.51	876.10	875.83	875.78	876.20	875.89	875.56
75.0%	875.77	876.73	876.59	876.05	876.04	876.35	876.16	876.06
90.0%	876.23	877.42	877.01	876.45	876.22	876.47	876.40	876.28
97.5%	876.30	878.13	878.16	877.04	876.98	876.89	876.90	876.61
Max	876.48	878.13	878.19	878.03	878.12	877.75	877.64	877.63
Percentiles	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2020**
Min	874.98	875.33	875.52	874.90	875.27	875.70	875.03	874.94
2.5%	875.01	875.39	875.62	875.02	875.52	876.07	875.19	874.99
10.0%	875.16	875.48	875.65	875.06	875.57	876.10	875.28	875.04
25.0%	875.29	875.58	875.79	875.12	875.64	876.16	875.36	875.12
Median (50%)	875.37	875.88	876.40	875.36	875.90	876.35	875.48	875.29
75.0%	875.46	876.25	876.92	875.51	876.24	877.05	875.63	875.51
90.0%	875.54	876.49	877.67	875.79	876.48	878.30	875.92	875.67
97.5%	875.79	877.13	878.55	877.02	877.00	878.80	876.77	875.88
Max	876.65	877.88	879.02	878.42	877.65	878.88	877.76	876.43



Stream Hydrology Monitoring

Coon Creek

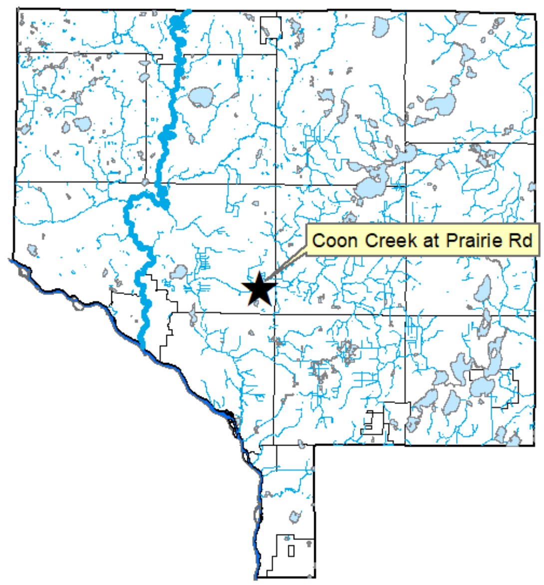
at Prairie Rd, Coon Rapids

Notes

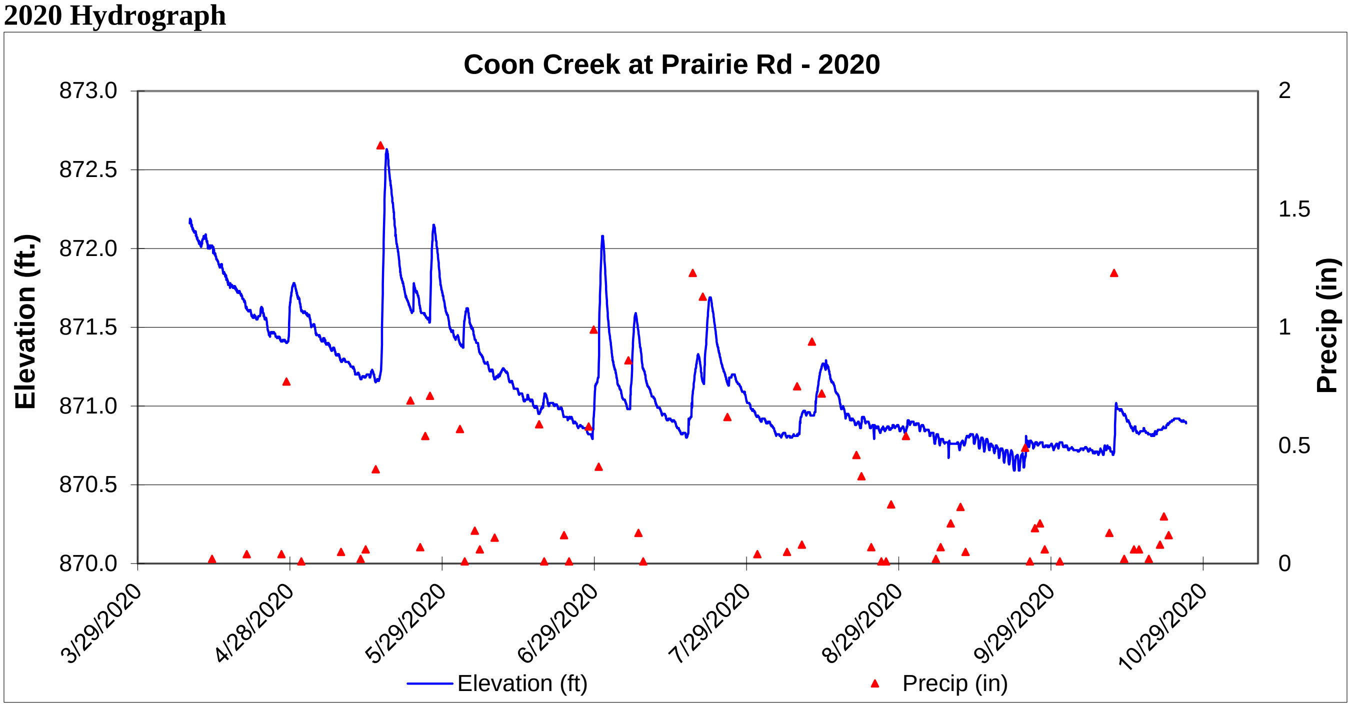
Stage at this site is quick to respond to rainfall. 2020 was only the second season stage has been monitored at this site. During the 2020 season, the creek at the Prairie Rd site fluctuated 2.04 ft. between its minimum and maximum-recorded elevation. This was nearly a foot less of range than what was observed in 2019.

The maximum elevation observed in 2020 was also nearly a foot less than the last maximum elevation recorded in 2015. Storm events were less frequent in 2020 with annual total precipitation being the lowest since 2012.

During a 1.77-inch storm on May 17, stage rose 1.4 ft. over a 14-hour span.



2020 Hydrograph

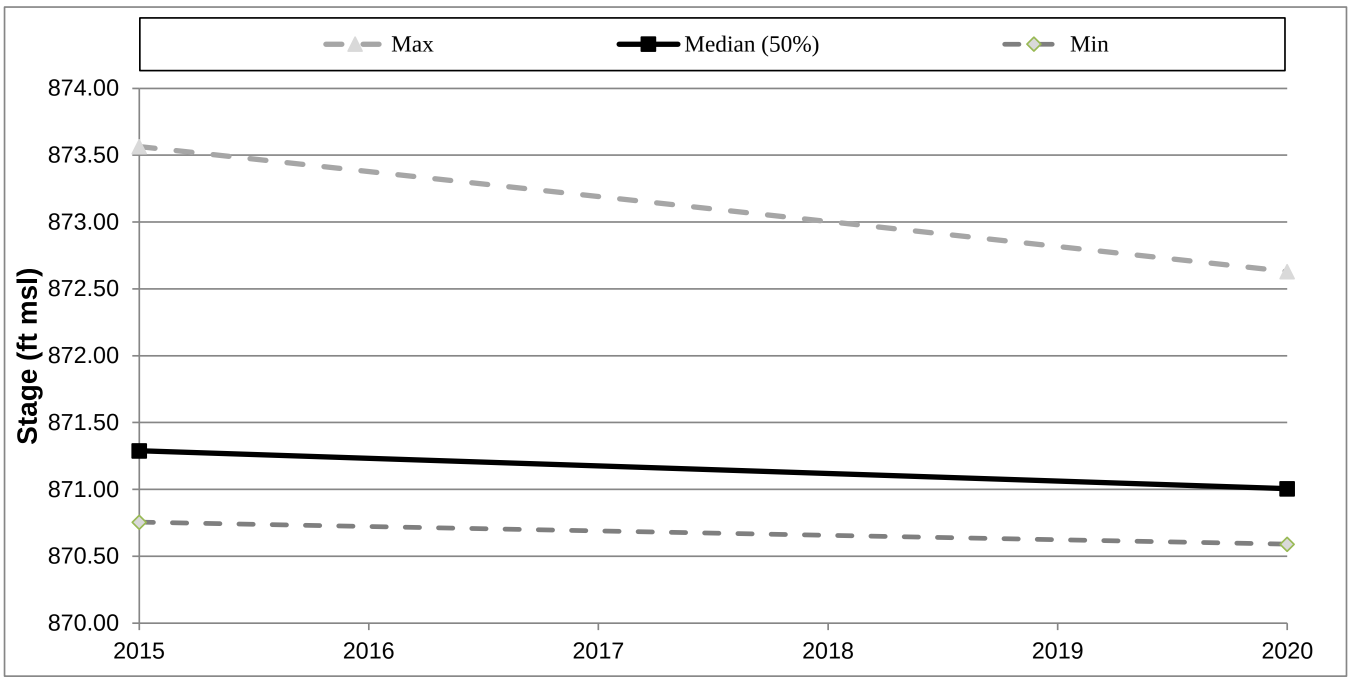


COON CREEK

at Prairie Rd, Coon Rapids

Summary of All Monitoring Years

Percentiles	2015	2020
Min	870.76	870.59
2.5%	870.84	870.70
10.0%	870.92	870.75
25.0%	871.06	870.84
Median (50%)	871.29	871.01
75.0%	871.63	871.41
90.0%	871.98	871.72
97.5%	872.63	872.07
Max	873.56	872.63



Stream Hydrology Monitoring

DITCH 20

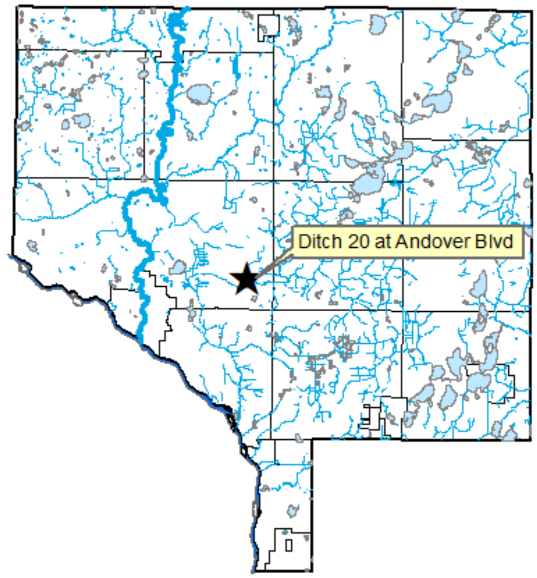
at Andover Blvd, Coon Rapids

Notes

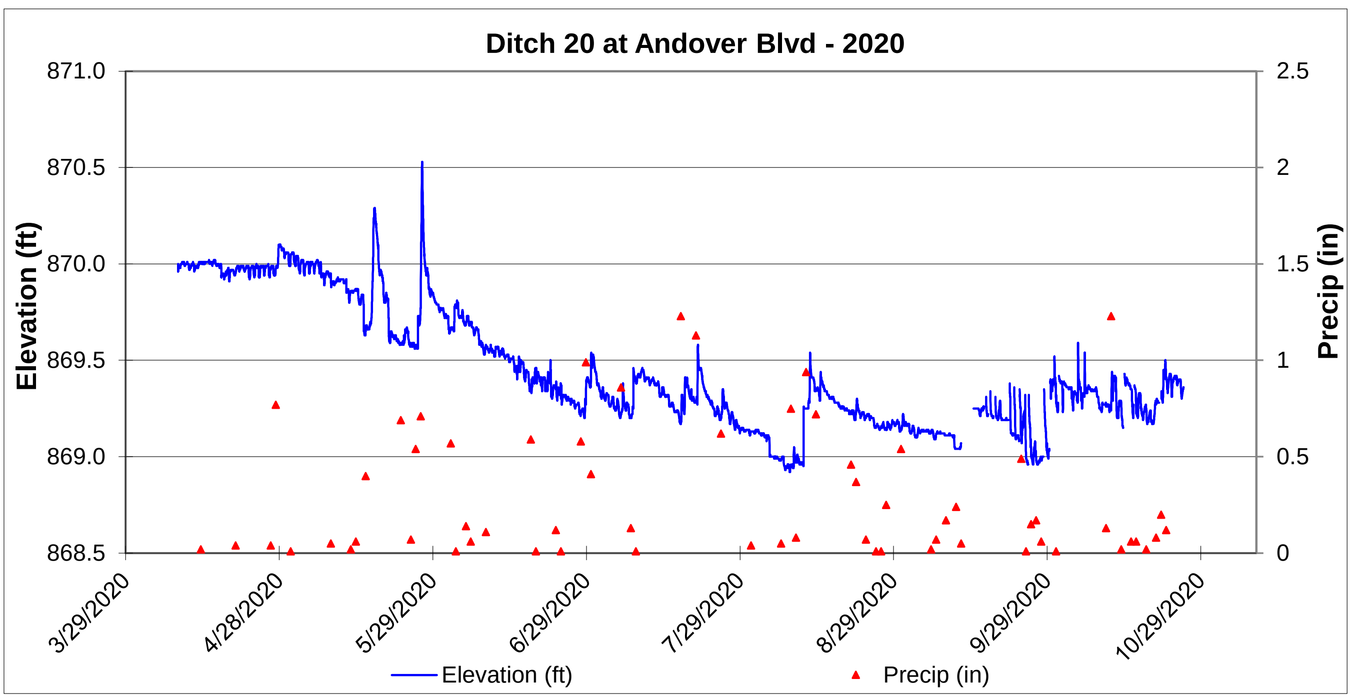
Stage at this site responded very little to rain events.

2020 was the first year stage was monitored at this site. During the 2020 season, Ditch 20 at Andover Blvd only fluctuated 1.80 ft. between its minimum and maximum-recorded stage. During the season, the site experienced very low flow occasionally causing the equipment to malfunction and give inaccurate readings. Equipment will be installed in a different area in 2021.

Based on a rating curve developed in 2020, estimated discharge ranged from 0.001 to 3.14 cfs in 2020, with a 50th percentile discharge of 0.20 cfs. The 2020 rating curve is displayed below.



2020 Hydrograph

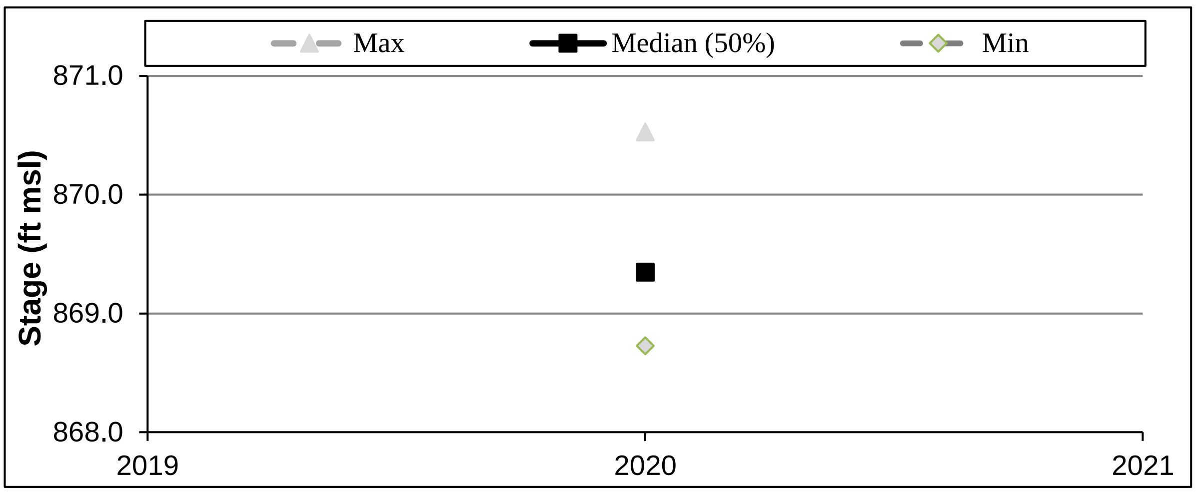


DITCH 20

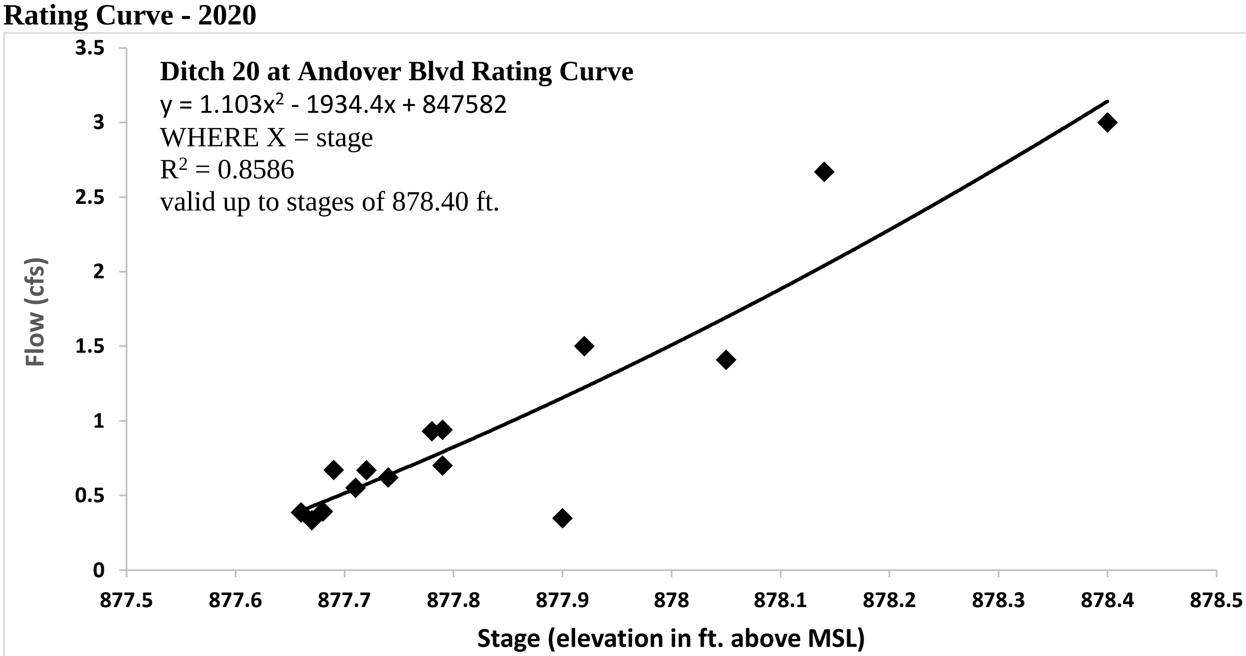
at Andover Blvd, Coon Rapids

Summary of All Monitoring Years

Percentiles	2020
Min	868.73
2.5%	868.97
10.0%	869.11
25.0%	869.21
Median (50%)	869.35
75.0%	869.70
90.0%	869.99
97.5%	870.03
Max	870.53



Rating Curve - 2020



COON CREEK

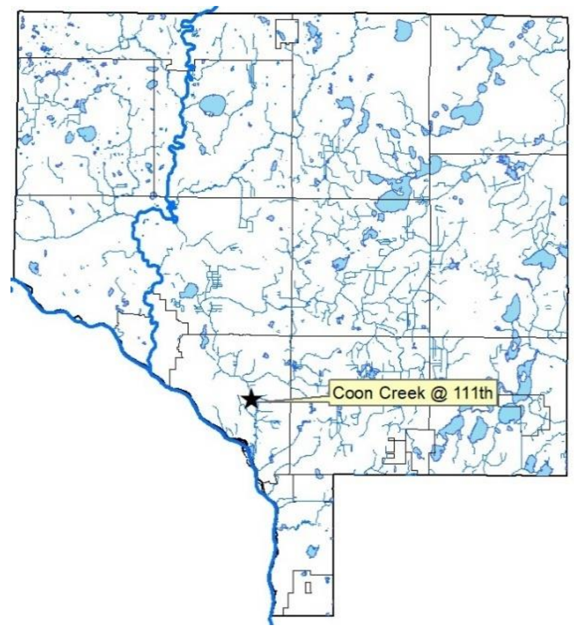
at 111th Ave. NW, Coon Rapids

Notes

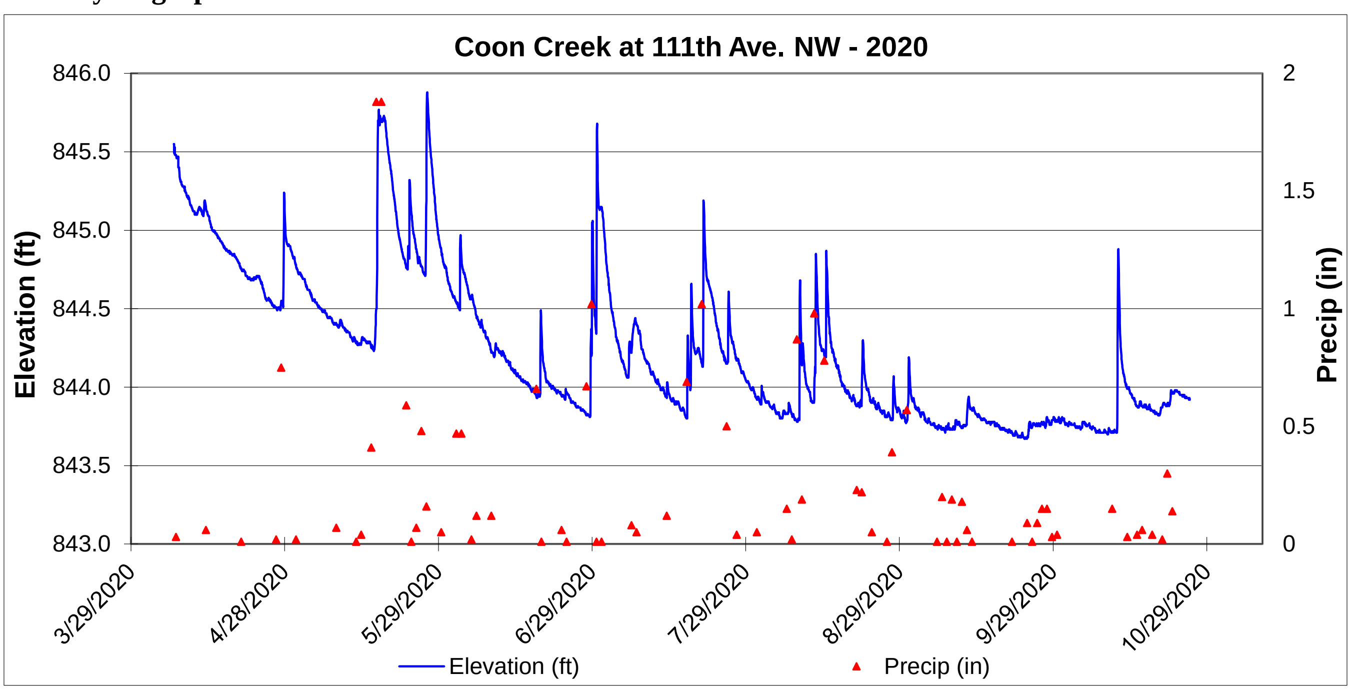
Stage at this site was flashy in response to storms, with stage rising quickly after rainfall but receding slowly back to baseflow.

During the 2020 season, the creek at the 111th Ave site only fluctuated 2.21 ft. between its minimum and maximum-recorded stage. This was the smallest range of stage fluctuation recorded at the three Coon Creek sites. During a 1.02-inch storm on July 29, stage rose 1.01 ft. in just a two-hour span.

Based on a rating curve developed in 2018, estimated discharge ranged from 23.68 cfs to 93.89 cfs in 2020, with a 50th percentile discharge of 25.22 cfs. The 2018 rating curve is displayed below.



2020 Hydrograph

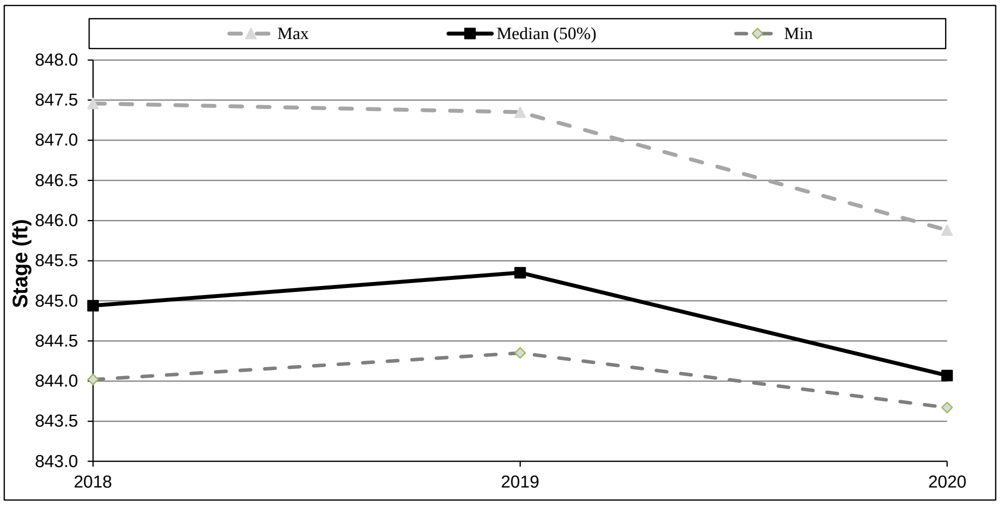


COON CREEK

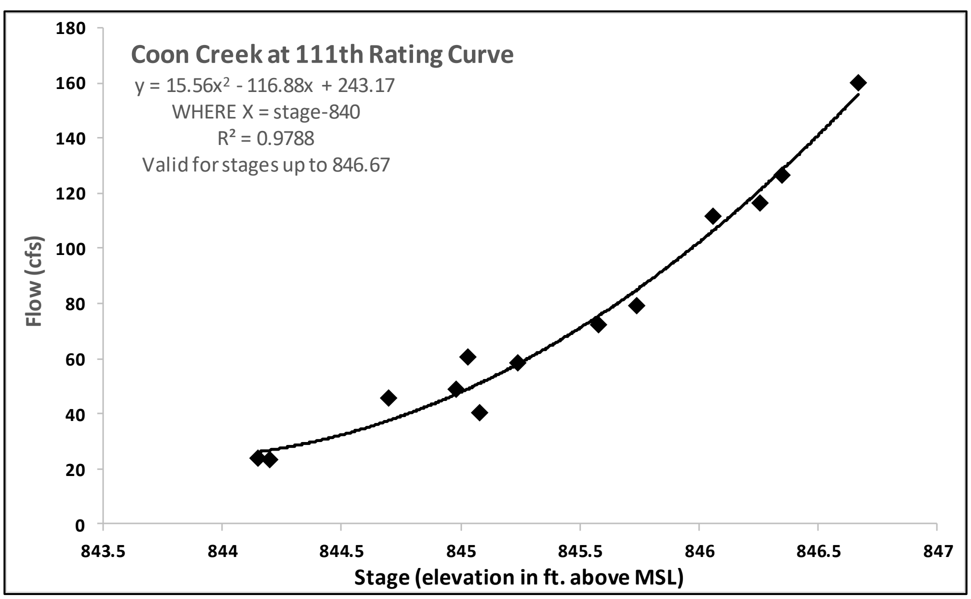
at 111th Ave. NW, Coon Rapids

Summary of All Monitoring Years

Percentiles	2018	2019	2020
Min	844.02	844.35	843.67
2.5%	844.08	844.48	843.71
10.0%	844.24	844.58	843.76
25.0%	844.50	844.81	843.85
Median (50%)	844.94	845.35	844.07
75.0%	845.51	846.09	844.55
90.0%	845.88	846.75	844.93
97.5%	846.45	847.20	845.39
Max	847.46	847.35	845.88



Rating Curve - 2018



WOODCREST CREEK

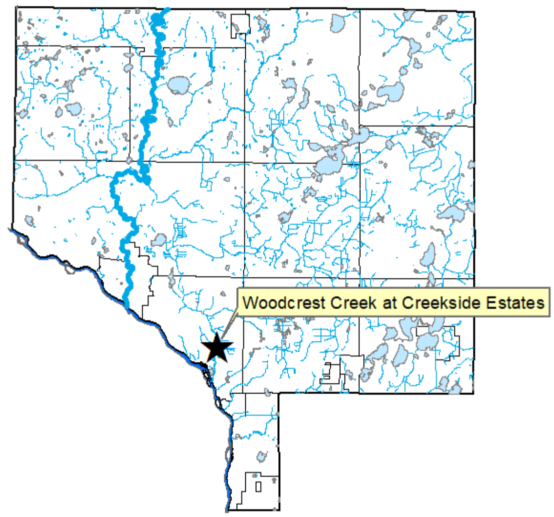
at Creekside Estates, Coon Rapids

Notes

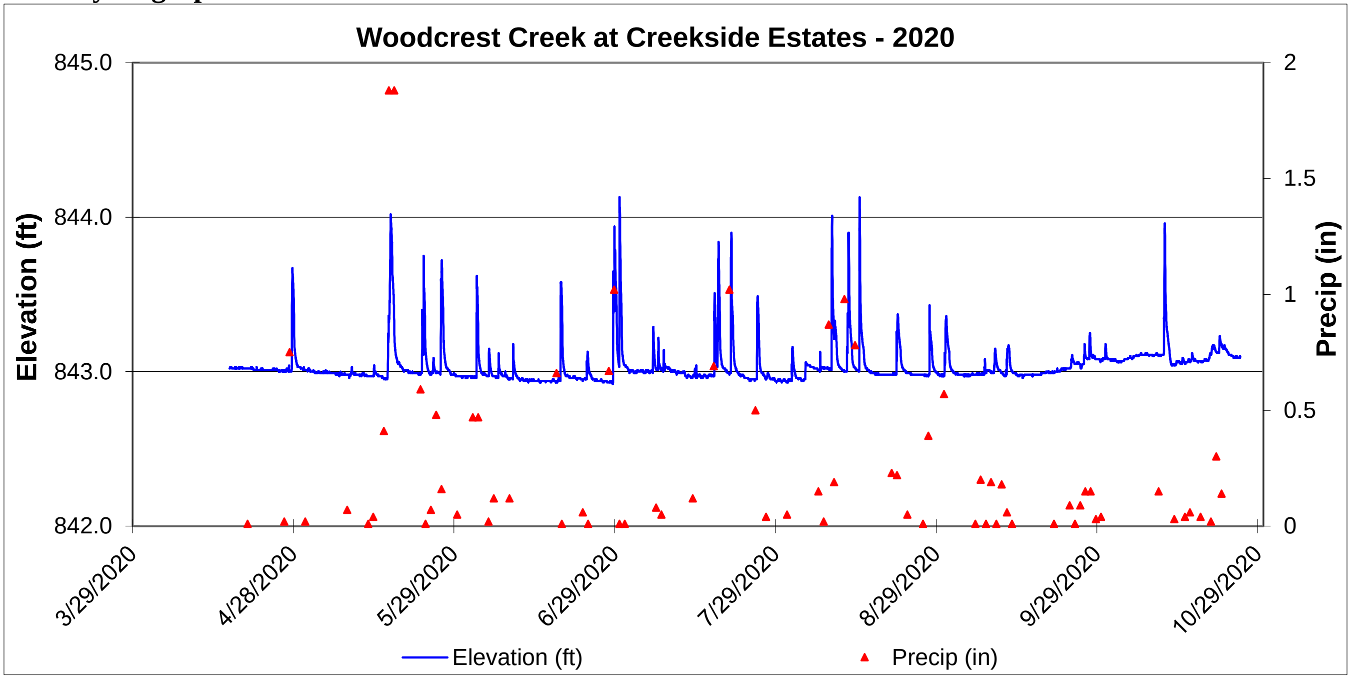
Stage at this site is extremely flashy in response to rainfall storms and quick to return to baseflow elevations. Equipment logged readings in 15-minute intervals.

2020 was the first season stage was monitored at this site. During the 2020 season, Woodcrest Creek at the Creekside site fluctuated 1.21 ft. between its minimum and maximum-recorded stage.

During a 0.78-inch rain event on August 14, stage rose 1.13 ft. in only a 15-minute span. The creek at this site would consistently rise a half foot or more in response to any amount of rainfall.



2020 Hydrograph

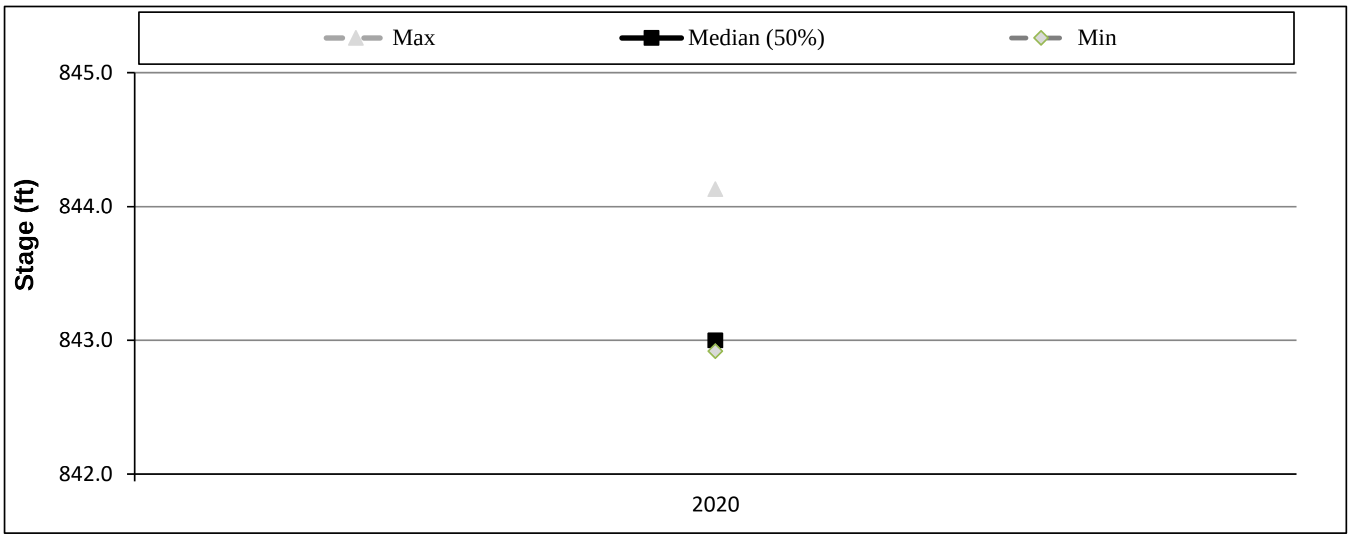


WOODCREST CREEK

at Creekside Estates, Coon Rapids

Summary of All Monitoring Years

Percentiles	2020
Min	842.92
2.5%	842.94
10.0%	842.95
25.0%	842.98
Median (50%	843.00
75.0%	843.05
90.0%	843.12
97.5%	843.44
Max	844.13



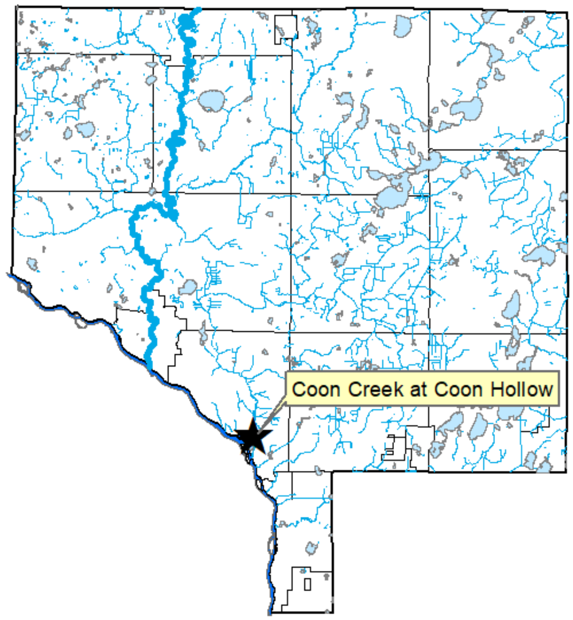
Stream Hydrology Monitoring

Coon Creek

at Coon Creek Hollow, Vale Street, Coon Rapids

Notes

In 2020, water levels at Vale St. fluctuated 2.45 ft. This was the smallest range recorded at this site since stage was first monitored back in 2005. This is due to the maximum stage also being the lowest on record. Stage remained lower than average throughout the year in 2020, with sustained periods with no rainfall.

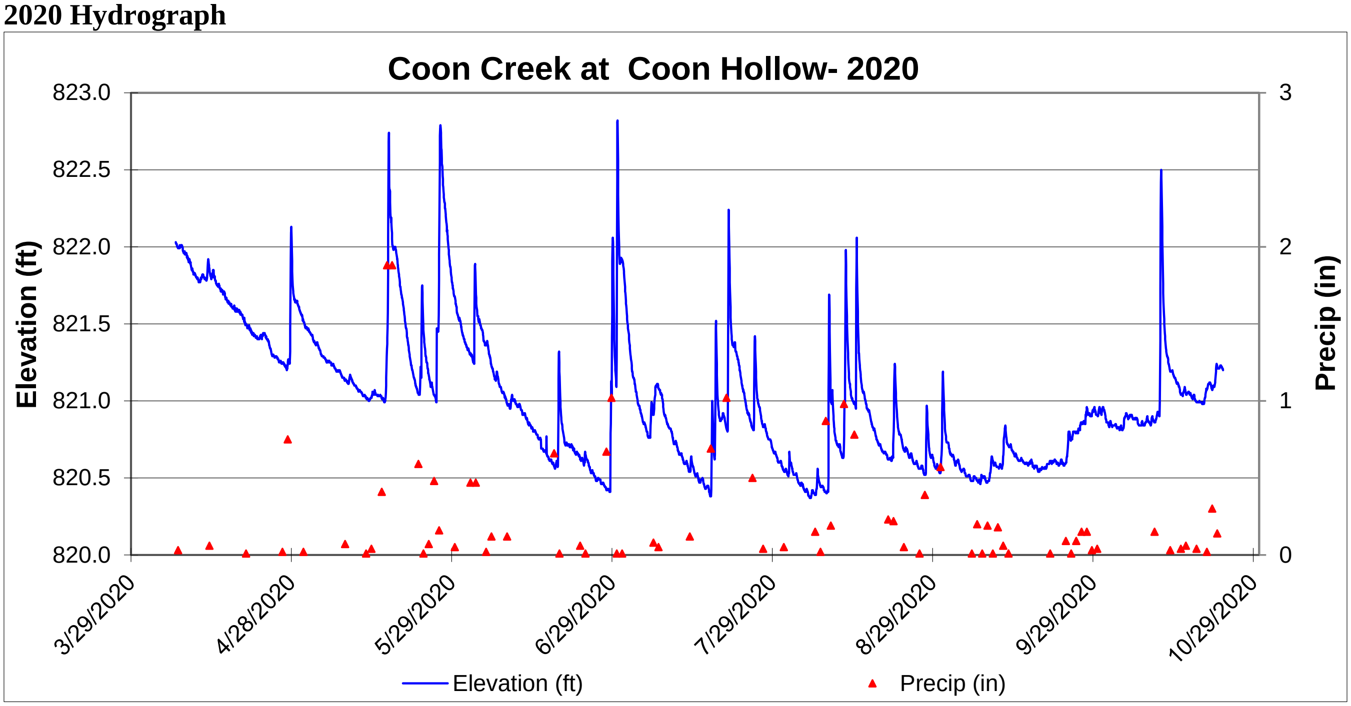


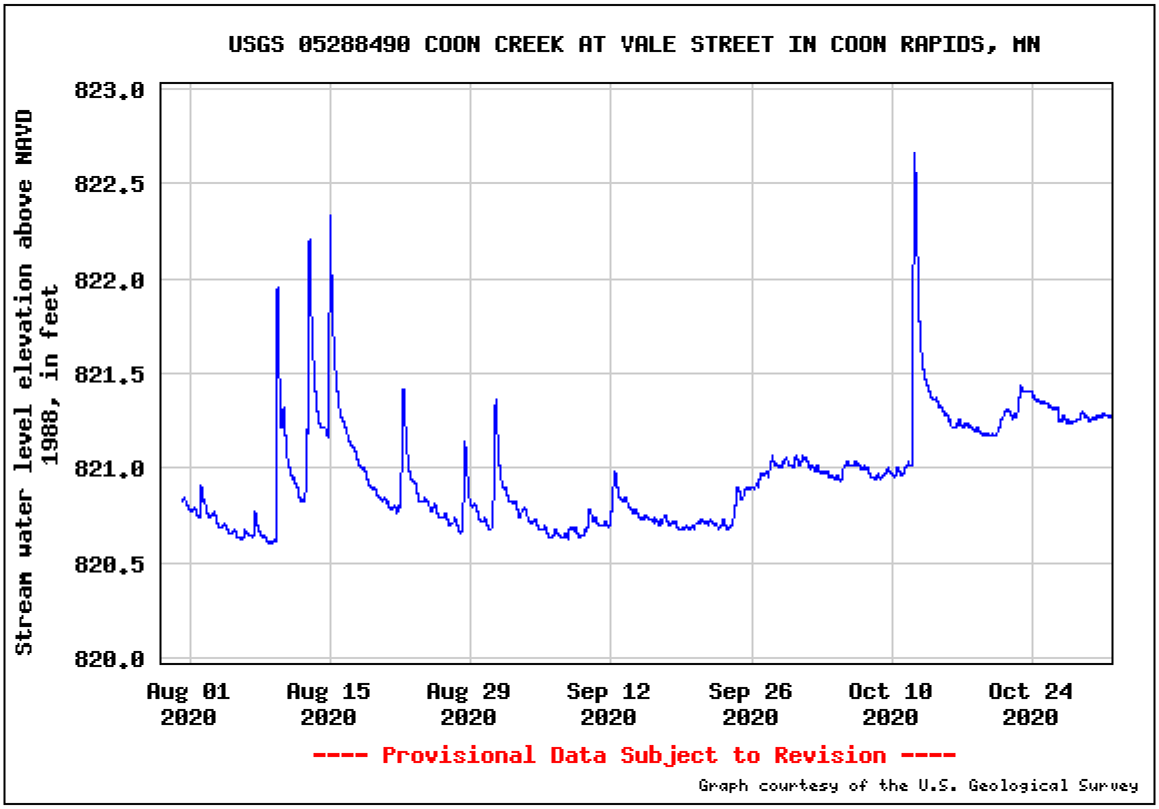
Coon Creek has flashy responses to rain events, water levels rise quickly in response to precipitation, but return to baseflow conditions slowly. The quick, intense response to rainfall is likely due to a large amount of stormwater infrastructure input from the urbanized portions of the lower watershed. The Vale St. site was less flashy in 2020 because of infrequent and less intense rainfall.

During a 1.02-inch rain event on June 29, the creek rose 1.53 ft. in three hours. Similarly, a storm of 1.02 inches on July 21 caused stage in the creek to rise 1.38 ft. in three hours.

Based on a rating curve developed in 2010, estimated discharge ranged from 53.46 cfs to 144.19 cfs in 2020, with a 50th percentile discharge of 82.88 cfs. The 2010 rating curve is displayed below.

2020 Hydrograph

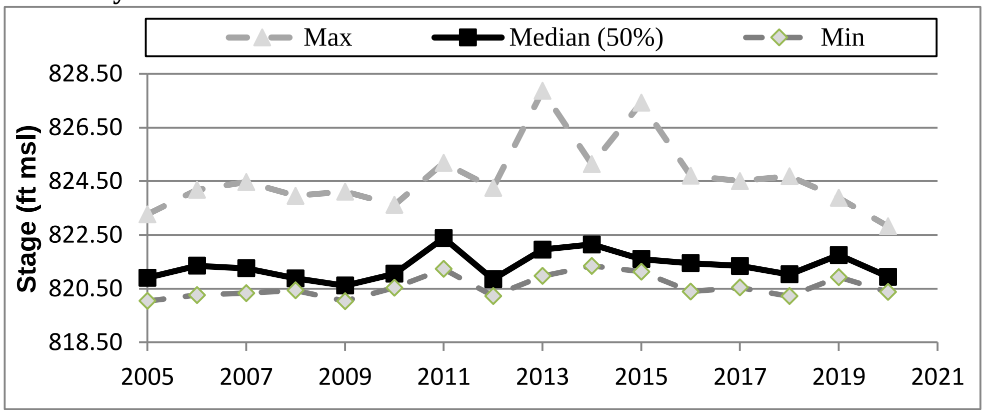



USGS 05288490 COON CREEK AT VALE STREET IN COON RAPIDS, MN
Stream water level elevation above NAVD 1988, in feet
823.0
822.5
822.0
821.5
821.0
820.5
820.0
Aug 01 2020
Aug 15 2020
Aug 29 2020
Sep 12 2020
Sep 26 2020
Oct 10 2020
Oct 24 2020
---- Provisional Data Subject to Revision ----
Graph courtesy of the U.S. Geological Survey

COON CREEK

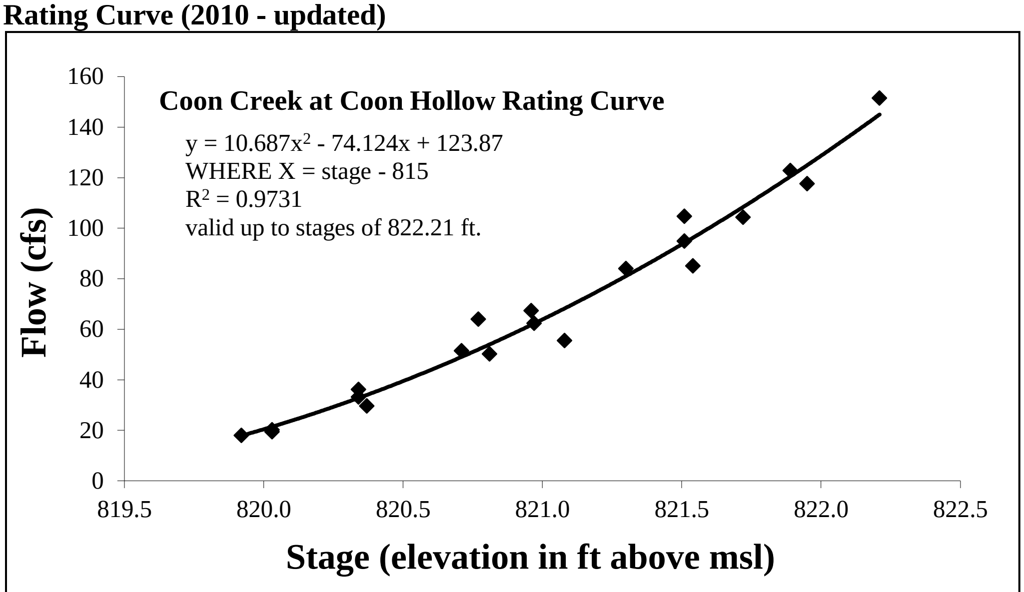
at Coon Creek Hollow, Vale Street, Coon Rapids

Summary of All Monitored Years



Percentiles	2005	2006	2007	2008	2009	2010	2011	2012
Min	820.04	820.26	820.33	820.43	820.03	820.54	821.23	820.22
2.5%	820.06	820.42	820.40	820.52	820.12	820.64	821.27	820.28
10.0%	820.19	820.53	820.53	820.57	820.20	820.73	821.31	820.33
25.0%	820.57	820.78	820.73	820.63	820.35	820.85	821.83	820.45
Median (50%)	820.91	821.35	821.25	820.88	820.61	821.05	822.38	820.85
75.0%	821.26	821.78	821.88	821.78	820.93	821.32	822.99	821.28
90.0%	821.77	822.27	822.63	822.26	821.31	821.68	823.70	821.89
97.5%	822.92	822.76	823.21	822.79	822.05	822.33	824.56	823.60
Max	823.26	824.18	824.47	823.96	824.11	823.62	825.18	824.25
Percentiles	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Min	820.97	821.35	821.13	820.39	820.54	820.22	820.93	820.37
2.5%	820.99	821.47	821.19	820.58	820.70	820.28	821.05	820.44
10.0%	821.00	821.51	821.31	820.78	820.84	820.40	821.16	820.54
25.0%	821.20	821.67	821.41	820.99	821.08	820.60	821.37	820.65
Median (50%)	821.95	822.15	821.60	821.44	821.34	821.03	821.75	820.94
75.0%	827.87	823.33	821.92	821.91	821.72	822.21	822.49	821.27
90.0%	827.87	824.38	822.30	822.24	822.25	822.56	823.19	821.66
97.5%	827.87	824.87	823.08	822.76	823.84	823.33	823.52	822.00
Max	827.87	825.13	827.42	824.70	824.51	824.69	823.88	822.82

Rating Curve (2010 - updated)



Water Quality Monitoring – Sand Creek System

Sand Creek System Monitoring Sites		
Site Name/ SiteID	**Years Monitored**	**2020 Data Collected**
Ditch 41 at Radisson Rd, Blaine S006-421	2010-2017	
Ditch 41 at Highway 65, Blaine S005-639	2009-2020	Water Chemistry Grab Samples
Ditch 41 at Happy Acres Park, Blaine S005-641	2009	
Ditch 60 at Happy Acres Park, Blaine S005-642	2009, 2019	
Ditch 41 at University Avenue, Coon Rapids S005-264	2008	
Ditch 39 at University Avenue, Coon Rapids S005-638	2009, 2019	
Sand Cr at Morningside Mem. Gardens, Coon Rapids S006-420	2010-2020	Water Chemistry Grab Samples
Sand Cr at Xeon Street, Coon Rapids S004-619	2007-2020	Water Chemistry Grab Samples, Continuous Stage

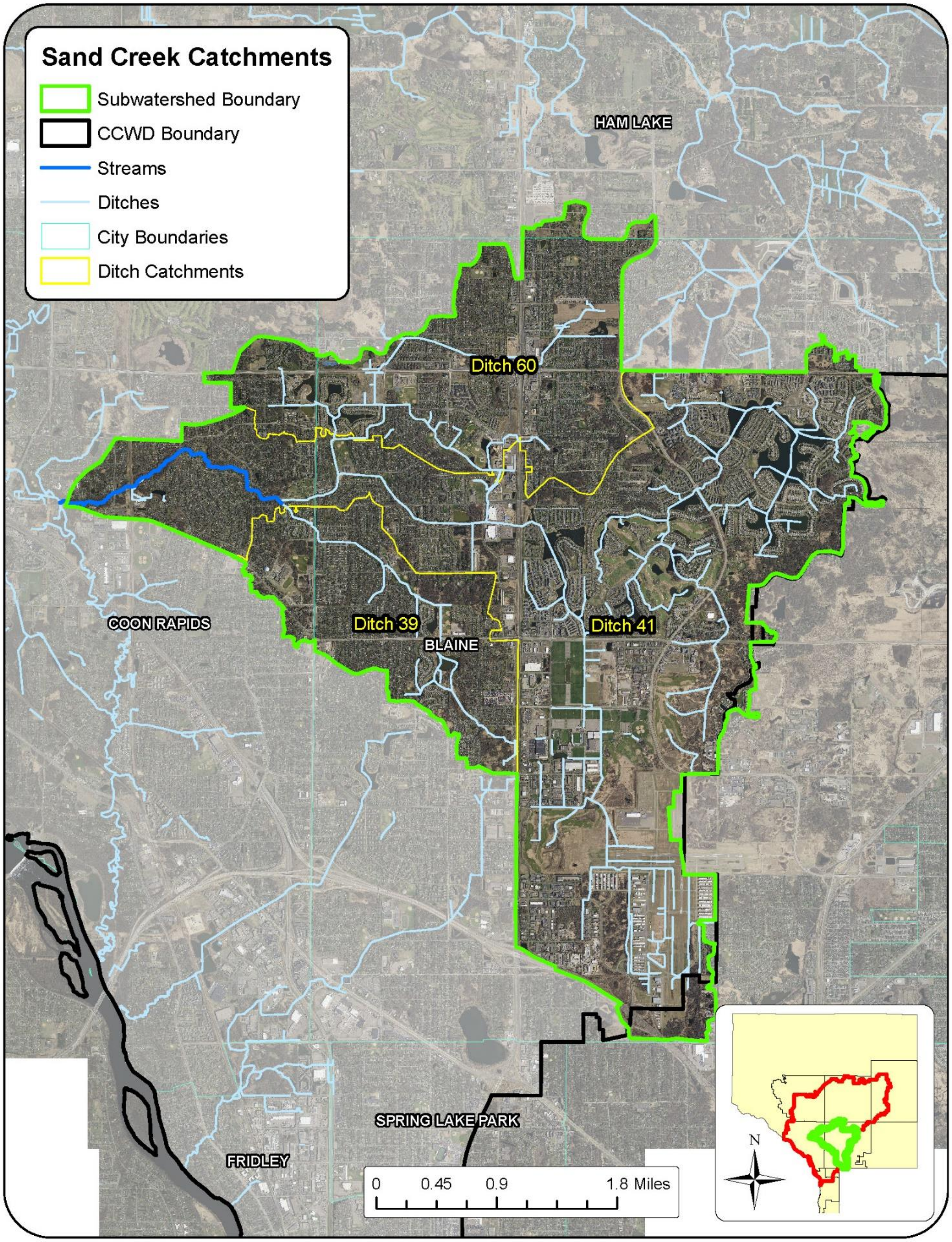
Background

Sand Creek is the largest tributary to Coon Creek. It is comprised of three major ditch systems that join near University Avenue on the border of Blaine and Coon Rapids. The primary ditch system comprising the Sand Creek subwatershed is Ditch 41. Ditch 41 drains 6,658 acres of suburban residential, commercial, and retail areas throughout western Blaine. In the upstream portions of this system (upstream of Highway 65), the system is comprised of a complex network of ditch tributaries and man-made ponds and lakes which serve as stormwater treatment practices and as aesthetic landscape features. The northern portion of this network is comprised primarily of the Lakes of Radisson Development, which includes dense single family “lakeshore” homes built around five man-made basins. After flowing through these lakes, the ditch system continues through a series of ponds through the golf course ponds of the TPC Twin Cities golf course, and finally through another network of ponds in the Club West Development.

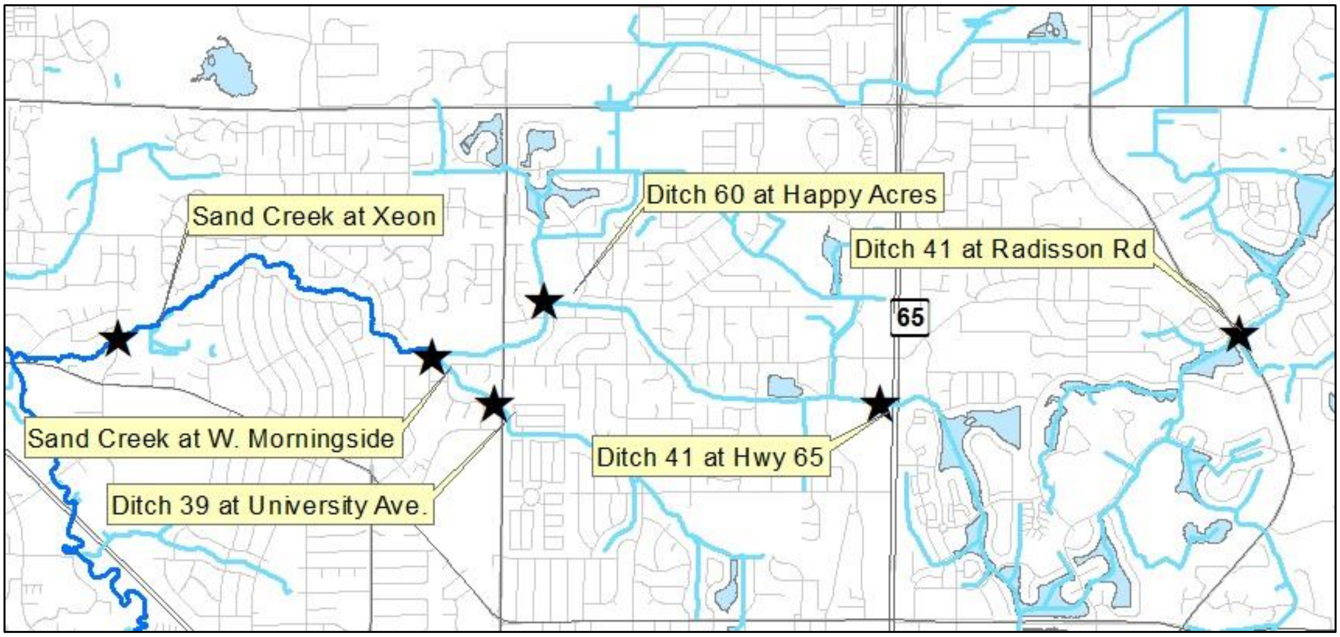
The upstream-most, southern portion of the Ditch 41 system drains primarily commercial areas of the eastern Highway 65 corridor, including large shopping centers, athletic complexes, schools, and small businesses. It also drains a significant portion of the Anoka County Airport in Blaine. These drainageways combine and join with the rest of the Ditch 41 system at the Club West ponds before crossing under Highway 65.

A couple of small tributaries join with Ditch 41 shortly after crossing Highway 65 before it reaches Happy Acres Park, about a quarter-mile east of University Avenue, and joins with Ditch 60 from the north. The Ditch 60 system drains 2,279 acres of primarily residential housing in northwestern Blaine before consolidating into a large stormwater pond in the Crescent Ponds development. This pond then outlets via a short ditch channel that joins with Ditch 41 at Happy Acres Park before continuing under University Avenue. Ditch 39 joins with Ditch 41 from the south about a quarter-mile west of University Avenue. Ditch 39 drains 1,395 acres of primarily residential usage before crossing University Ave and emptying into a stormwater pond in the 116th Ave Loop. This stormwater pond outlets via a culvert that connects with Ditch 41 in the southwest corner of the West Morningside Memorial Gardens property.

In this report, the reach of stream from the confluence of these three ditch systems in West Morningside memorial Gardens to its outfall to Coon Creek at Lions Coon Creek Park will be called Sand Creek. Sand Creek flows west approximately two miles through residential neighborhoods, paralleled by a narrow, wooded parkland trail corridor for much of this reach. At its confluence with Coon Creek, Sand Creek is about 15 ft. wide and 2.5-3 ft. deep during baseflow conditions. Recently, the creek has undergone a corridor restoration project between Olive St and Xeon Blvd, including re-meandering .4 miles of previously straightened channel to a more natural meandered state, stabilizing actively eroding stream banks via vegetated riprap and bioengineering, stabilizing channel incision via cross vanes and rock riffles, installing woody habitat features, reconnecting floodplain, and restoring native riparian vegetation. This project reduces pollutant loading from eroding streambanks, allows for sediment deposition, and enhances wildlife habitat along 1.1 miles of Sand Creek before its confluence with Coon Creek. Sand Creek is listed as impaired for *E. coli* and invertebrate biota downstream of West Morningside Memorial Gardens. New standards for aquatic life (Tiered Aquatic Life Use Standards) currently under development may take into consideration the fact that the creek is part of a public ditch system and, therefore, may lower aquatic life expectations and affect the impairment standards for this waterbody.


Sand Creek Catchments
Subwatershed Boundary
CCWD Boundary
Streams
Ditches
City Boundaries
Ditch Catchments
HAM LAKE
Ditch 60
COON RAPIDS
Ditch 39
BLAINE
Ditch 41
SPRING LAKE PARK
FRIDLEY
0 0.45 0.9 1.8 Miles
N

Sand Creek Monitoring Sites



Results and Discussion

Sand Creek's water quality generally meets state standards for most parameters, other than *E. coli*. Sand Creek is listed as impaired for aquatic recreation due to *E. coli* and for aquatic life due to invertebrate biota. It has load duration curves and pollutant reduction targets for total phosphorus and TSS in the Coon Creek TMDL due to these parameters being listed as stressors to aquatic life. Loading of these different pollutants into the Sand Creek system seems to be happening in different areas of the watershed for each.

Based on pollutant concentrations, Ditch 60 and Ditch 39 are degrading Sand Creek's water quality for phosphorus, with higher concentrations measured in each during both baseflow and storm conditions than in Ditch 41 at Hwy 65, or at Morningside Memorial Gardens after all three ditches combine, indicating dilution by Ditch 41. Total phosphorus concentrations have not increased in the main channel of Sand Creek over time at Xeon St, nor do they increase moving upstream to downstream from Morningside Memorial Gardens to Xeon St. TSS, however, does increase significantly between Morningside memorial Gardens and Xeon St for post-storm samples. The TMDL attributes only 13% of TSS loading in Sand Creek to bank erosion, but that factor may be underestimated in the lower portion of the Creek between Morningside and Xeon St. A 2018-21 stream restoration project along Sand Creek between Olive St and Xeon Blvd should help stabilize banks in these lower reaches, as well as help dissipate erosive energy during high flow events, which is when the creek exceeds state TSS standards.

E. coli loading happens throughout the Sand Creek watershed, with dog waste identified in the TMDL as the primary source of the bacteria. The TMDL may be underestimating the effect that waterfowl are having on *E. coli* in this stream due to the transient nature of waterfowl through migration and daily feeding routines. ACD staff have witnessed waterfowl by the hundreds in many areas of Sand Creek periodically during sampling.

Management strategies for each of these pollutants may be harder to consolidate into projects that will improve all of these pollutant types. Targeting phosphorus loading from stormwater should occur in the upper portions of the tributary ditch subwatersheds, namely Ditch 60 and Ditch 39. Targeting TSS loading should occur in the lower reaches of the stream channel, potentially through the further stabilization of eroding banks and additional re-meandering or rate control projects. Targeting of *E coli* bacteria cannot likely be accomplished in any single location, but may be best done through educational resources and offering dog-waste disposal resources to users of the Sand Creek Trail system.

Specific conductance and Chlorides

Sand Creek's dissolved pollutant levels as measured by specific conductivity are higher than levels found in Coon Creek, which Sand Creek drains into. The long-term median under all conditions for specific conductance in Sand Creek at Xeon St is 0.773 mS/cm compared to the median for all Coon Creek monitoring sites upstream of this confluence at Lions Coon Creek Park and at 131st Ave, each of which has a longer-term median near 0.592 mS/cm.

Sand Creek's watershed is primarily suburban residential with the unique characteristic of many man-made and densely developed basins at the headwaters. The watershed 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 dissolved pollutants. Stormwater treatment practices such as catch basins and settling ponds are relatively ineffective at removing dissolved pollutants

From upstream to downstream in Sand Creek there is little change in concentrations of dissolved pollutants (see figures below), although there is a slight decline in long-term median values moving upstream to downstream. This suggests dissolved pollutant concentrations in all parts of the watershed are similar with upstream portions contributing slightly higher concentrations.

Dissolved pollutants can easily infiltrate into shallow groundwater that feeds streams during baseflow conditions. This causes continuous high levels of specific conductance that actually decline during storm events when dilution occurs. If stormwater runoff was the primary source of dissolved pollutants in the creek, one indicator would be higher conductivity during storm events. Specific conductivity monitored at Xeon Street during baseflow conditions had median levels 10%-15% higher than during storms. This is not to say that storm runoff is free of dissolved pollutants, rather the concentration is lower than what is found in shallow groundwater feeding Sand Creek. From a management standpoint, it is important to remember that the sources of dissolved pollutants generated from both stormwater and baseflow are generally the same, and preventing the pollutants' initial release into the environment should be a high priority.

High concentrations of dissolved pollutants in Sand Creek are contributing to the degradation of Coon Creek. Both creeks were monitored at sites just before they join (Coon Cr at Lions Park and Sand Cr at Xeon). Across all years monitored, Sand Creek's median specific conductance is approximately 20% higher than Coon Creek (0.840 vs 0.682 mS/cm) before this junction.

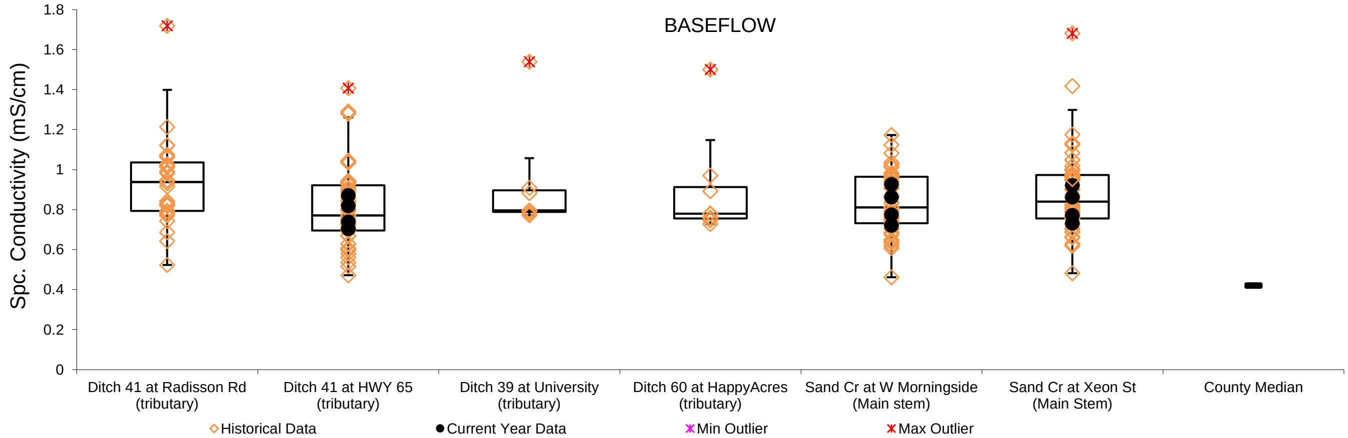
Chloride salts are a primary driver of conductivity levels in urban streams. Median chloride concentrations are also higher in Sand Creek than in Coon Creek. Chloride samples were collected in 2019 in each of Sand Creek's individual contributing ditch systems as well as the Creek itself. Concentrations were very similar during both baseflow conditions and following storm events, with storm events causing slightly increased concentrations. Of the contributing ditch systems, Ditch 60 consistently had the highest concentration of chlorides. In such a densely developed watershed, de-icing salts used for roadways, parking lots, and private driveways are a likely contributor of much of the chlorides entering the creek system.

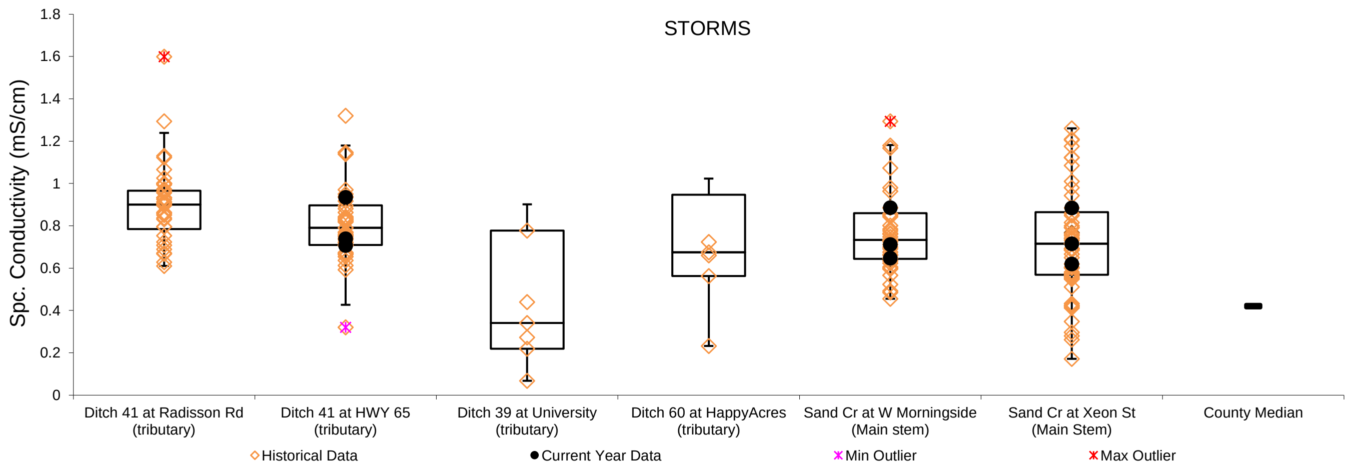
Seven years of chloride sample collection have occurred at the downstream site at Xeon St, 2007-2012 and 2019. While this is not a large enough record to assess trends over time, looking at annual averages for these samples offers insight into any potential changes in the system. These averages are generally lower than the baseflow averages for the same year. Storm samples in 2019, however, exceeded all of these annual averages. This was the first year that the average storm flow concentration exceeded the baseflow concentration during the same monitoring year, and is the highest average on record for either condition over any monitored year. These elevated storm event chloride concentrations are worth tracking in future monitoring years. No individual samples on record have approached the 230 mg/L chronic state standard for chlorides. Chlorides were not sampled in 2020.

Average and median specific conductance in Sand Creek Data is from Xeon St for specific conductance and all years through 2020.

	Average Specific conductance (mS/cm)	Median Specific conductance (mS/cm)	State Standard	N (Sp Cond.)
Baseflow	0.874	0.840	Specific conductance – none	56
Storms	0.721	0.716		56
All	0.798	0.773		112
Occasions > state standard				0

Specific conductance at Sand Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Phosphorus

Similar to Coon Creek, Sand Creek is not listed as impaired for total phosphorus, but it does have an approved TMDL for the nutrient as a result of the aquatic life impairment. Our grab sample monitoring shows TP concentrations generally remain below the state standard of 100 µg/L in Sand Creek (see table and figures below). The long-term median for TP in Sand Creek at Xeon St (all years) is 60.5 µg/L during baseflow and 89 µg/L during storm events. However, Sand Creek at Xeon St samples during storm events average 105.5 µg/L, slightly higher than the state standard. Since 2007, post-storm samples collected at Xeon St. have exceeded the state standard 34% of the time.

Phosphorus loading occurs throughout the Sand Creek watershed, but the Ditch 39 and Ditch 60 systems seem to degrade Sand Creek water quality more than Ditch 41. At the Ditch 41 Highway 65 site, upstream of both lateral ditch confluences, total phosphorus levels are generally low during both baseflow and storm events. Prior to 2019, Ditch 39 and Ditch 60 were only monitored in 2009, so very limited information was available to assess their impact on the Sand Creek system as a whole. It appears that these ditches both have relatively poor water quality compared to Ditch 41 and contribute to the degradation of Sand Creek downstream. Both of these ditches exceeded 100 µg/L during baseflow and storm sampling events in both 2009 and 2019.

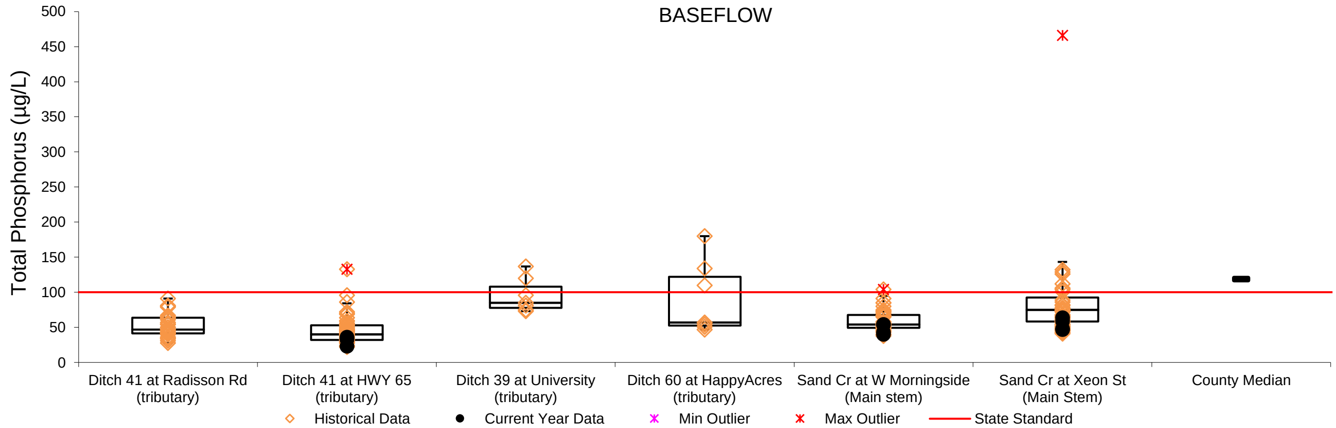
After the confluence of all three ditch systems, TP concentrations at the Morningside Memorial Gardens site still generally fall below the state standard 100 µg/L, though exceedances during storm events are common. All 2020 readings at the Memorial Gardens site remained below 100 µg/L during both baseflow and storm events. Continuing to move downstream to Xeon Street, Sand Creek flows as a more natural meandering channel with a protective park system adjacent to it. Total phosphorus concentrations do not significantly increase through this stretch during either baseflow or storm conditions. Recent work in this portion of the subwatershed includes construction of a new stormwater pond, many rain garden installations that treat stormwater runoff from residential neighborhoods draining to Sand Creek, as well as large channel restoration and re-meander projects that stabilized eroding banks and will provide additional habitat for aquatic biota.

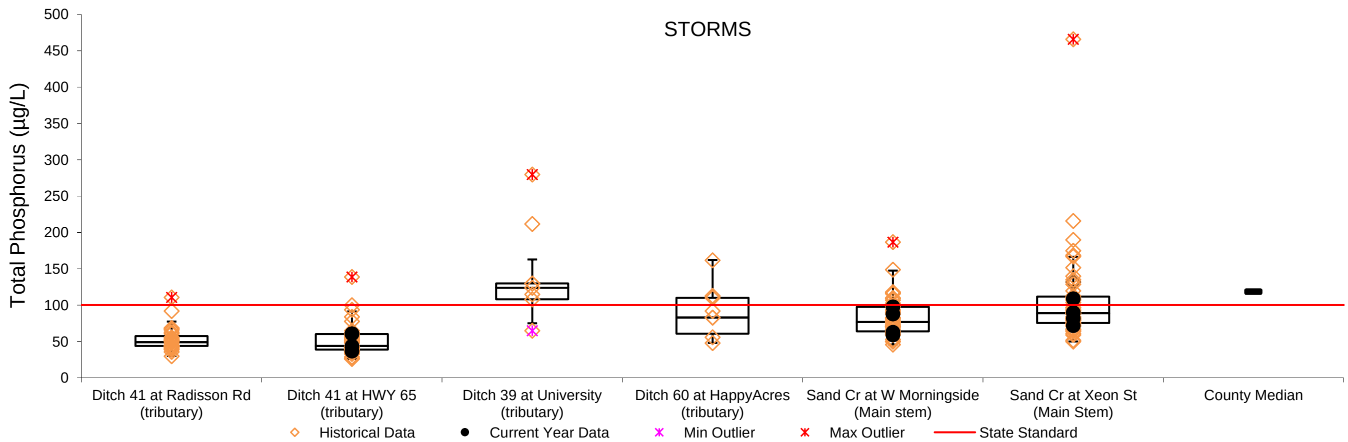
The Coon Creek TMDL, approved in 2016, also delegates acceptable levels of pollutants in Sand Creek using a load duration curve (LDC) approach. The LDC for Sand Creek is graphed on a plot with flow-weighted daily loads for phosphorus samples collected at Xeon Street (Page 48, Figure 17). This plot shows that Sand Creek exceeds its LDC for TP occasionally, and at all flow levels from low to very high. Average TP concentrations only exceed the LDC during very high flows. Pairing the results shown on this curve with our grab sample concentration analysis indicates that additional treatment of stormwater, especially in the individual catchments of Ditch 39 and Ditch 60, should be a high priority for management in Sand Creek.

Average and median total phosphorus in Sand Creek Data is from Xeon St for all years through 2020.

	Mean Total Phosphorus (µg/L)	Median Total Phosphorus (µg/L)	State Standard	N
Baseflow	64.23	60.50	100	56
Storms	105.56	89.00		55
All	84.71	75.0		111
Occasions > state standard				19 (34%) storm 5 (9%) baseflow

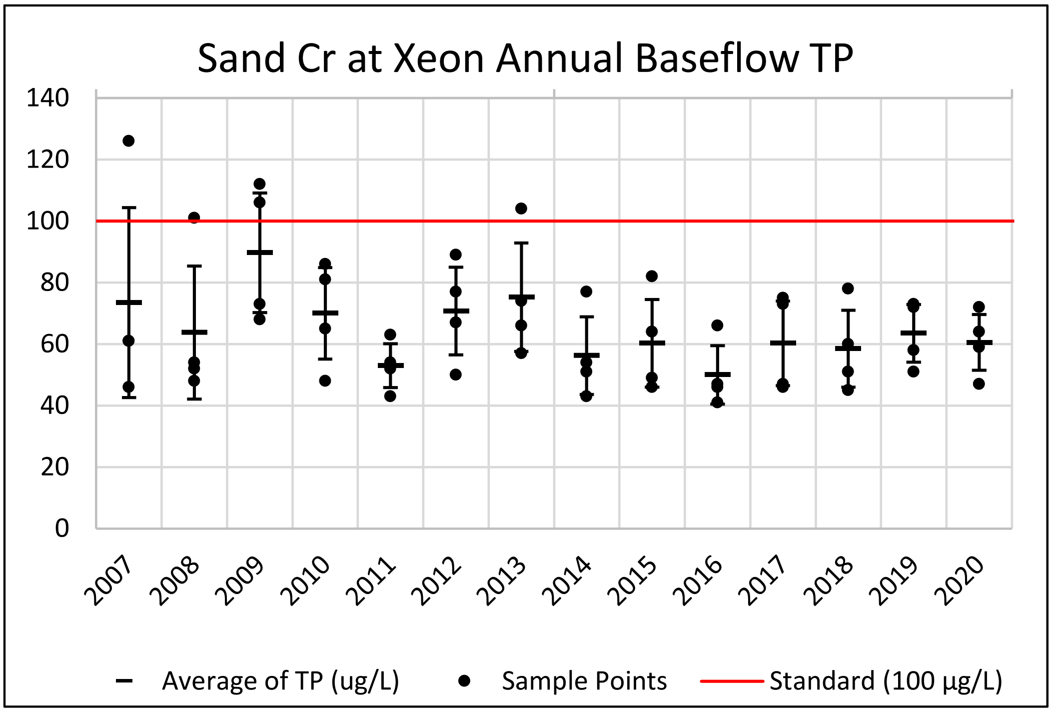
Total phosphorus at Sand Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

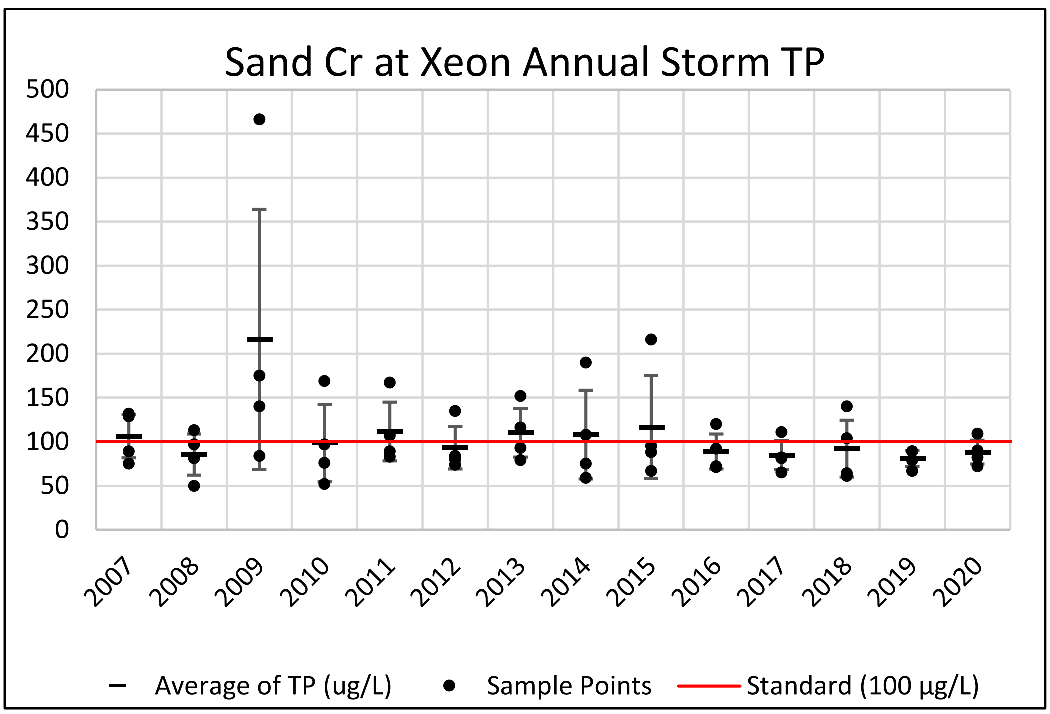




Parameter	Significant Change in Annual $\overline{X}$ (2007-2020)	p=	Standard Error of Means
Total Phosphorus - Baseflow	None – But very close to an improving trend	0.057	9.24
Total Phosphorus - Storm	None	0.13	31.93

Sand Creek at Xeon St. - Annual average ANOVA regression TP 2007-2020





ANOVA Matrix for Baseflow Total Phosphorus	Sand Cr at West Morningside Memorial Gardens (WMMG) (2010-2020) - 44 Samples	Sand Cr at Xeon St. (2007-2020) – 56 Samples
Sand Cr at Morningside Memorial Gardens (2010-2020) - 44 Samples		No Sig. Change WMMG $\bar{X}$= 58.38 µg/L Xeon $\bar{X}$= 64.23 µg/L p= 0.09
Sand Cr at Xeon St. (2007-2020) – 56 Samples		

ANOVA Matrix for Storm Total Phosphorus	Sand Cr at West Morningside Memorial Gardens (WMMG) (2010-2020) – 43 Samples	Sand Cr at Xeon St. (2007-2020) – 55 Samples
Sand Cr at Morningside Memorial Gardens (2010-2020) – 43 Samples		Significant Increase WMMG $\bar{X}$= 83.53 µg/L Xeon $\bar{X}$= 105.56 µg/L p= <0.05
Sand Cr at Xeon St. (2007-2020) – 55 Samples		

Total Suspended Solids and Turbidity

TSS concentrations are generally low in Sand Creek, although storm flow concentrations are elevated in the downstream portions of the creek and appear to not follow the same loading pattern as TP does through the system. Unlike TP, TSS concentrations are generally low during all conditions in each of the three individually monitored ditch tributaries before their confluences. At baseflow, TSS concentrations remain low through the remainder of the Sand Creek channel, averaging 11.2 mg/L for all baseflow samples at Xeon St. The state standard concentration for TSS for streams in this region is 30 mg/L, a mark only exceeded once at Xeon St. during baseflow conditions. During storms, however, TSS concentrations are elevated starting at West Morningside Memorial Gardens and continuing to Xeon St. downstream, where the state standard has been exceeded in 9% of storm samples. Additionally, storm flow TSS concentrations increase significantly between Morningside and Xeon St, though no increase is present at Xeon St over time. Interestingly, storm flow TSS concentrations remain low in all three of the individual ditches upstream of their confluences, likely the result of large stormwater basins that allow for particle settling.

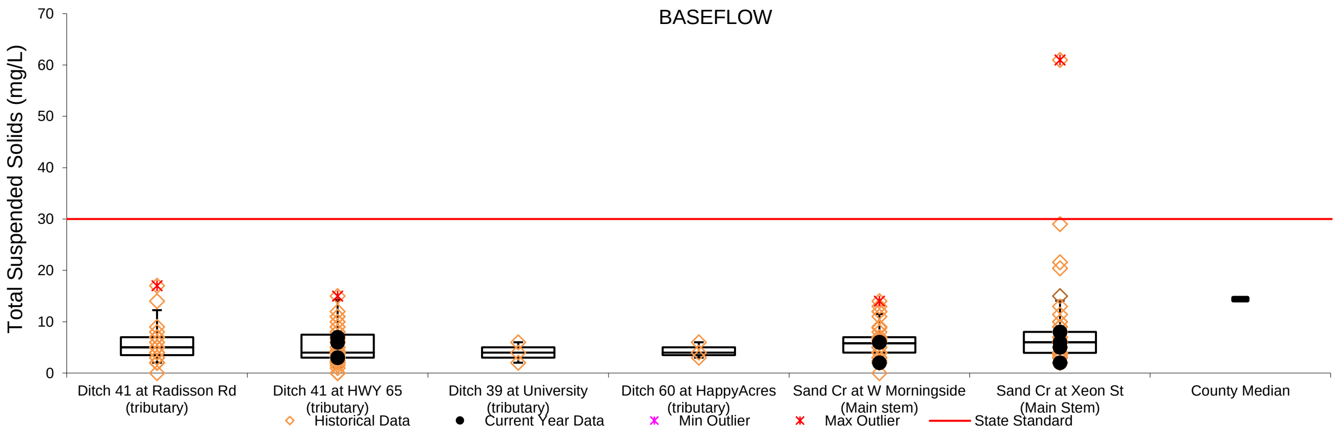
The approved Coon Creek TMDL contains a Load Duration Curve for TSS in Sand Creek at the Xeon St monitoring station (Page 43, Figure 14). The results graphed on this curve show only a couple of exceedances for TSS, and only at high to very high flows. In contrast to total phosphorus loading, which appears to be highest from the Ditch 39 and Ditch 60 tributaries, TSS loading in Sand Creek appears to be occurring in the main channel after the confluence of the three ditches, and primarily during larger storm events that cause high flows. This may suggest that high flows are causing excessive erosion of unstable banks in the lower Sand Creek channel, increasing the TSS load through this portion of the system. The recent stabilization and re-meander projects near Xeon and Olive Streets should help stabilize this portion of the creek. Since 2016, zero exceedances of the 30 mg/L standard, even post-storm events, at Xeon St have occurred. If these results continue through future monitoring, it would make a strong case that the re-meander and bank stabilization projects are reducing loading of TSS in the lower reaches of the creek.

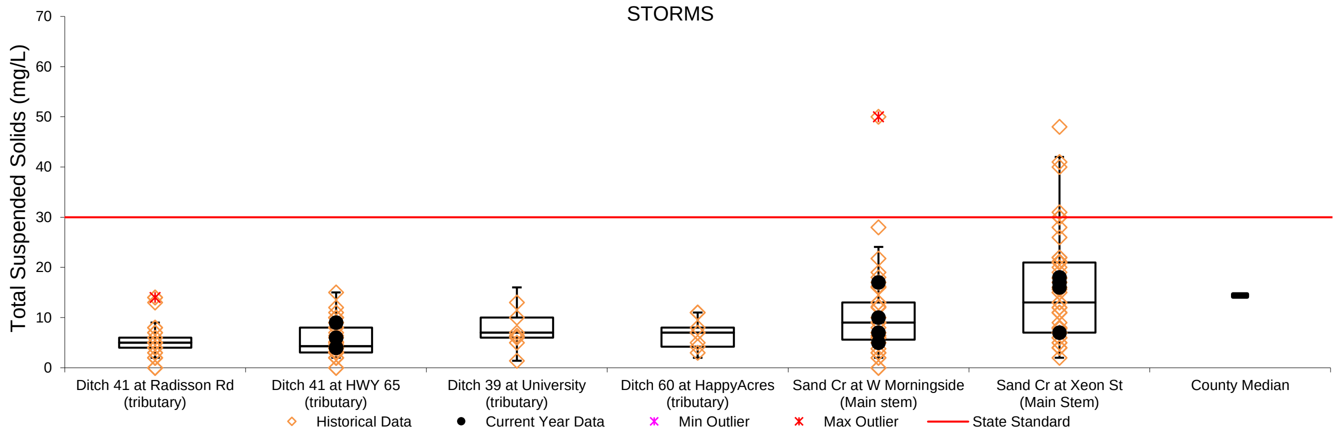
Additionally, while the Coon Creek TMDL identified bank erosion as a major contributor of TSS to Coon Creek (63%), it is considered only a minor factor in Sand Creek accounting for just 13% of the total TSS load. If this is the case, there may be some large source(s) of TSS washing into the Creek in the lower portion of the watershed during storm events that is not contributing additional phosphorus in an equivalent manner. Any sources contributing these large loads of particulates into the creek may be identifiable by large swaths of deposited material near storm drain inlets or other direct drainage sources of stormwater to the creek. If no large sources of sediment can be identified on the landscape, the TMDL may be vastly underestimating bank erosion in Sand Creek. In many streams, management of TP and TSS sources on the landscape is best accomplished through stormwater practices that will capture and treat both before they enter the stream system. In the Sand Creek system, it appears that the sources of loading for these pollutants may be different, and management of each may be best accomplished with separate strategies.

Average and median total suspended solids in Sand Creek Data is from Xeon St for all years through 2020.

	Average Total Suspended Solids (mg/L)	Median Total Suspended Solids (mg/L)	State Standard	N
Baseflow	11.21	6.1	30 mg/L TSS	56
Storms	17.0	13.0		56
All	12.34	8.0		112
Occasions > state TSS standard				1 (1%) storm 5 (9%) baseflow

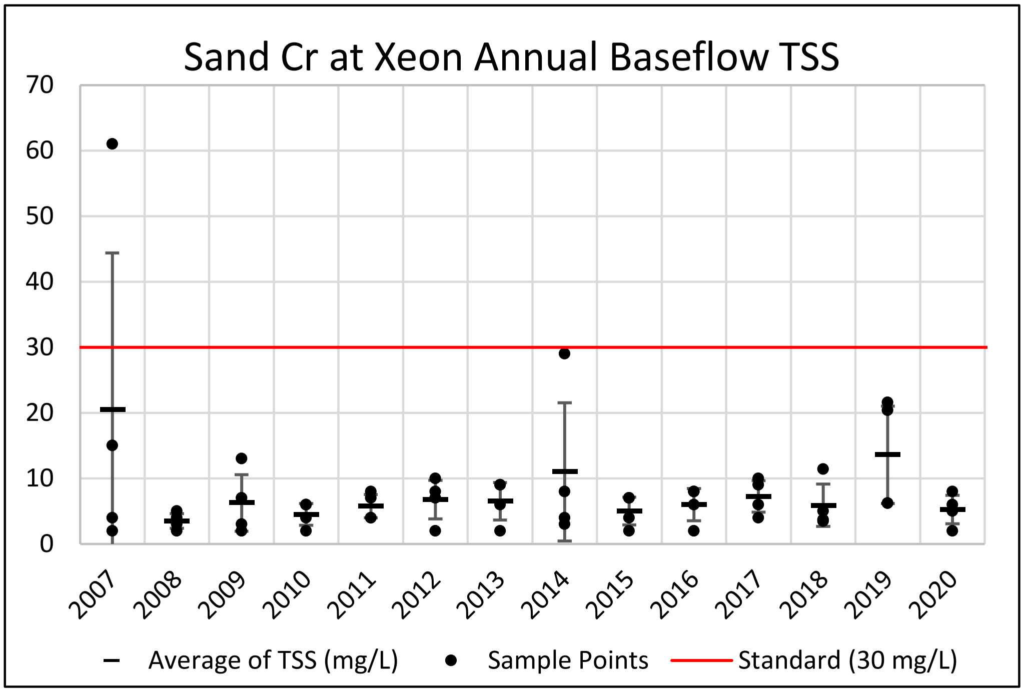
Total suspended solids at Sand Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

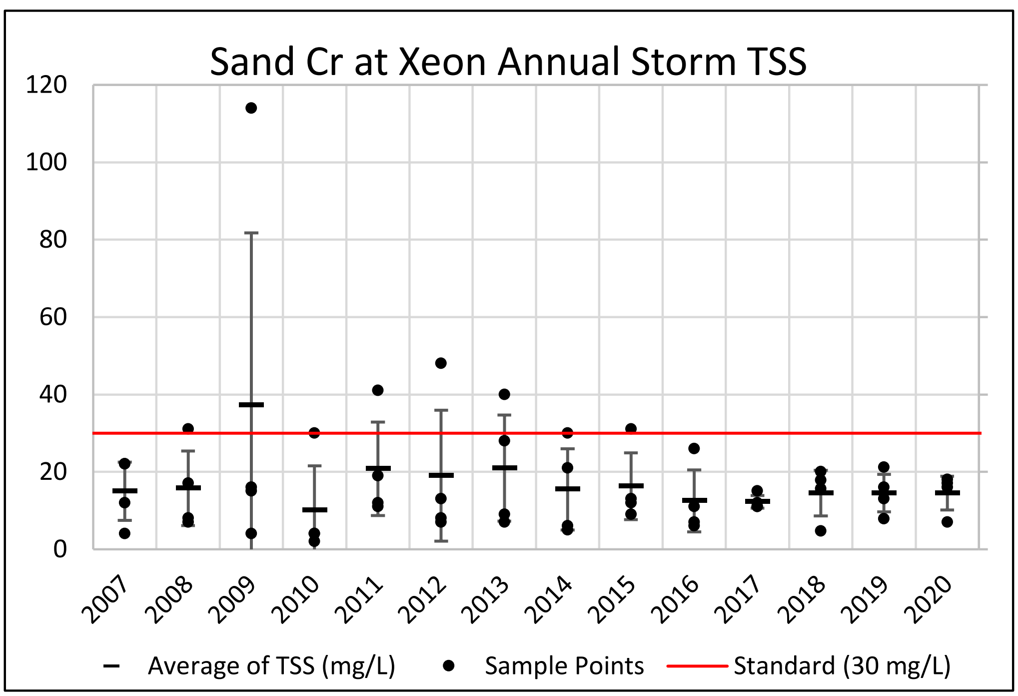




Parameter	Significant Change in Annual $\bar{X}$ (2005-2020)	p=	Standard Error of Means
Total Suspended Solids - Baseflow	None	0.13	31.93
Total Suspended Solids - Storm	None	0.19	6.36

Sand Creek at Xeon St. - Annual average ANOVA regression TSS 2007-2020





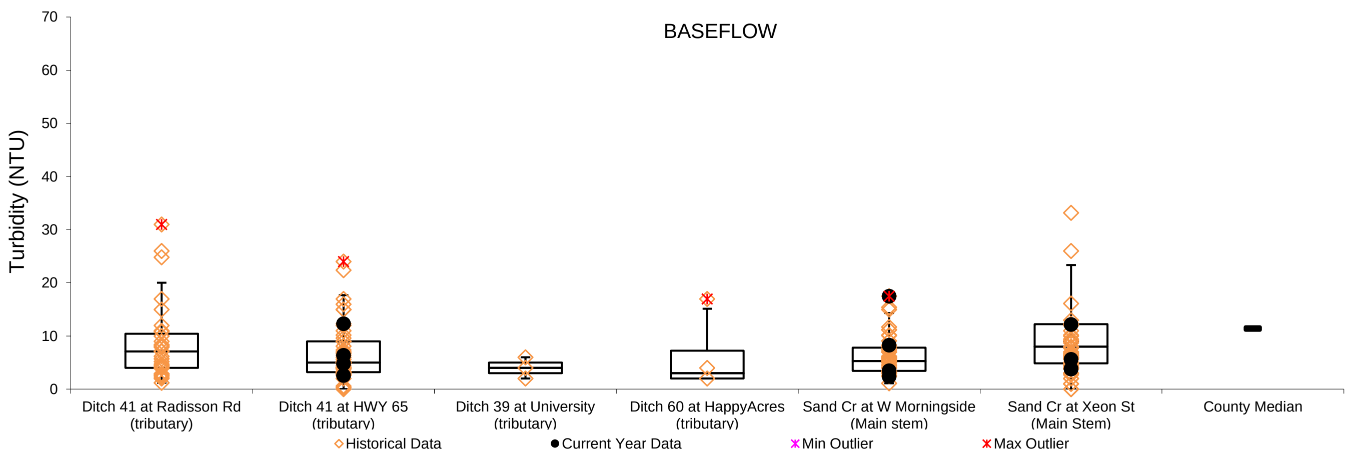
ANOVA Matrix for Baseflow Total Suspended Solids	Sand Cr at West Morningside Memorial Gardens (WMMG)	Sand Cr at Xeon St. (2007-2020) – 56 Samples
Sand Cr at Morningside Memorial Gardens (2010-2020) 44 – Samples		No Sig. Change WMMG $\bar{X}$= 6.1 mg/L Xeon $\bar{X}$= 11.21 mg/L p= 0.61
Sand Cr at Xeon St. (2007-2020) – 55 Samples		

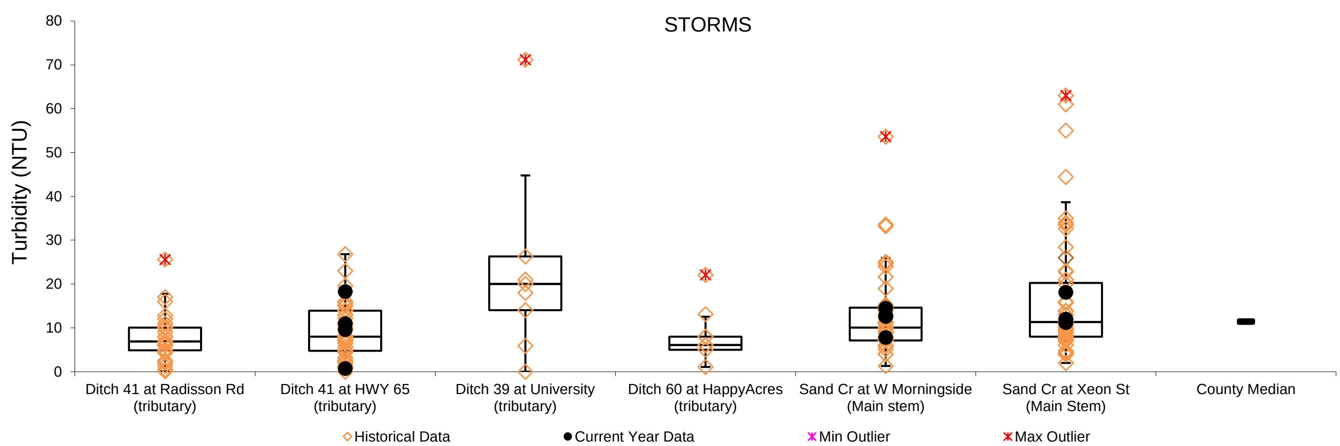
ANOVA Matrix for Storm Total Suspended Solids	Sand Cr at West Morningside Memorial Gardens (WMMG)	Sand Cr at Xeon St. (2007-2020) – 56 Samples
Sand Cr at Morningside Memorial Gardens (2010-2020) 44 – Samples		Significant Increase WMMG $\bar{X}$= 10.27 mg/L Xeon $\bar{X}$= 17.00 mg/L p= <0.05
Sand Cr at Xeon St. (2007-2020) – 56 Samples		

Average and median turbidity in Sand Creek Data is from Xeon St for all years through 2020.

	Average Turbidity (NTU)	Median Turbidity (NTU)	State Standard	N
Baseflow	9.36	5.8	n/a	55
Storms	16.54	11.3		56
All	12.98	8.0		111

Turbidity at Sand Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





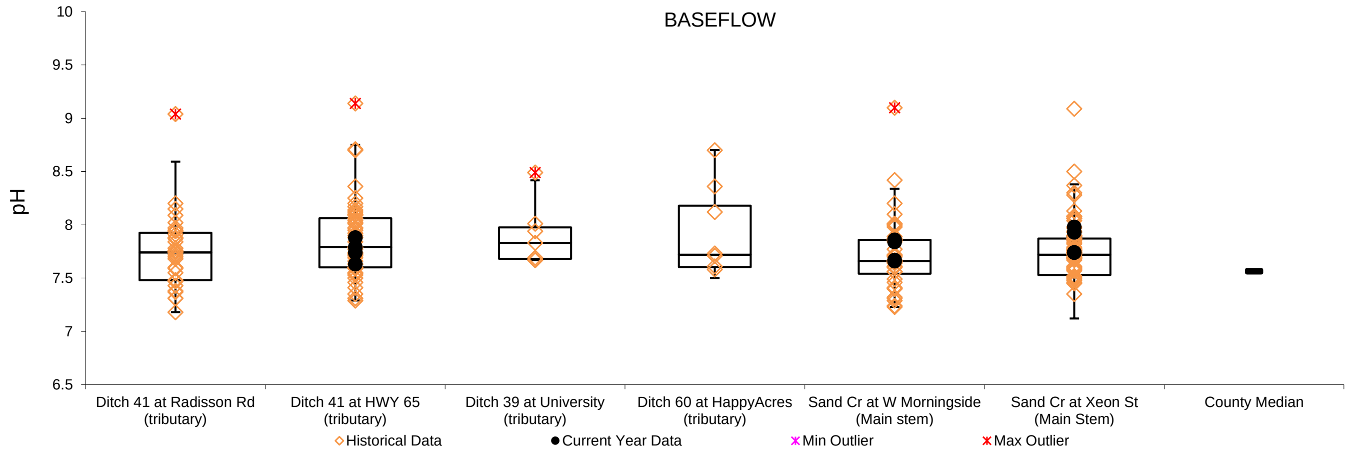
pH

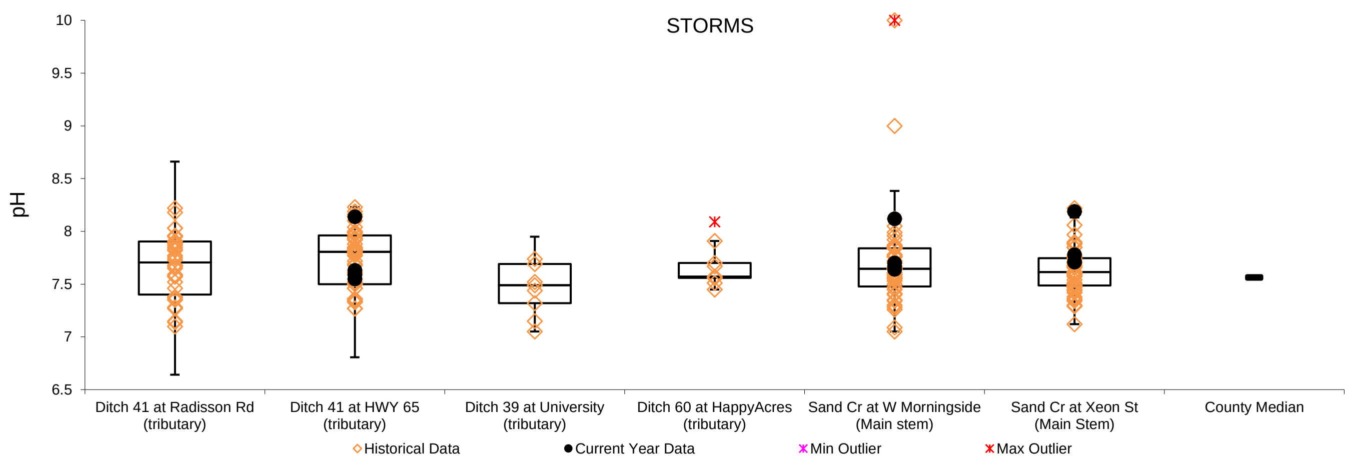
Sand Creek pH remained within the acceptable range in 2020. Historically, individual outliers have caused a couple high readings in excess of 9.0. These may be due to a poor calibration of the sampling equipment. The median for all conditions at Xeon is 7.72. The state standard for pH is for the parameter to remain between 6.5 and 8.5. In general, pH is lower during storms because rainwater is more acidic.

Average and median pH in Sand Creek Data is from Xeon St for all years through 2020.

	Average pH	Median pH	State Standard	N
Baseflow	7.84	7.77	6.5-8.5	55
Storms	7.81	7.61		56
All	7.83	7.72		111
Occasions outside state standard				1 baseflow (2%) 2 storm (4%)

pH at Sand Creek Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





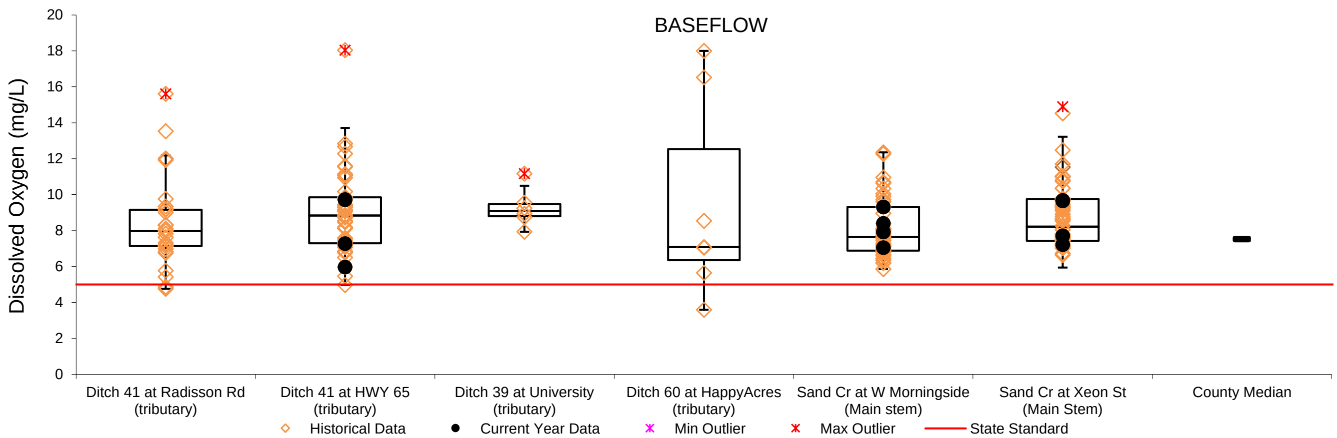
Dissolved Oxygen

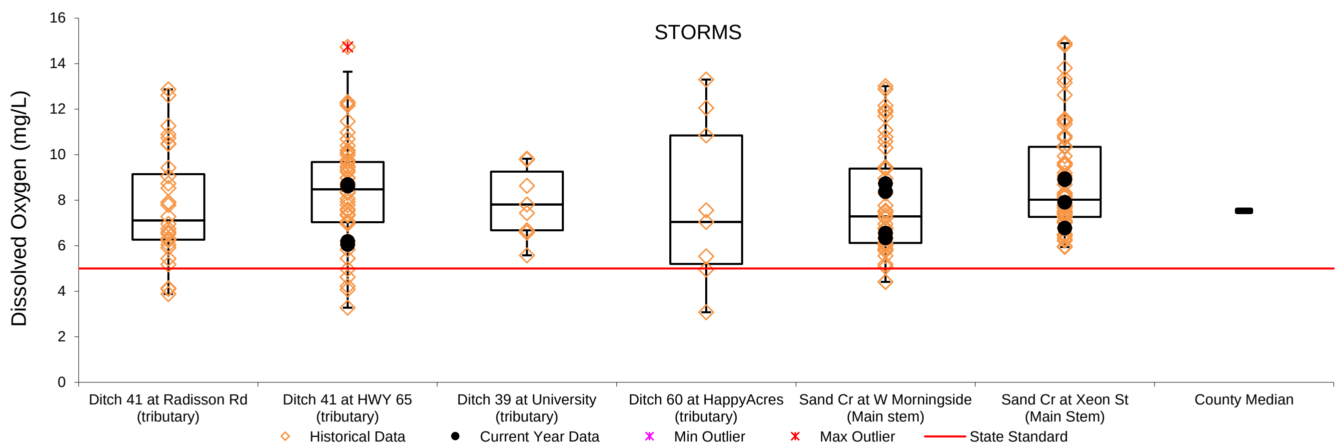
Dissolved oxygen is healthy in lower reaches of Sand Creek, and has never been recorded below 5 mg/L at Xeon St. However, on 13 of 208 (6%) sampling occasions across all monitored years at other upstream sites, DO dropped below 5 mg/L. Overall, there are no significant management concerns about dissolved oxygen levels in Sand Creek, but it should continue to be monitored with an invertebrate biota impairment in place. It is also possible that low oxygen levels in the headwater systems could be contributing to phosphorus loading if select ponds are not functioning as designed and are instead leaching phosphorus under some conditions.

Average and median dissolved oxygen in Sand Creek. Data is from Xeon St for all years through 2020.

	Average Dissolved Oxygen (mg/L)	Median Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	8.83	8.57	5 mg/L daily minimum	52
Storms	8.89	8.01		56
All	8.86	8.22		100
Occasions <5 mg/L				0 at Xeon St., 13 at other sites

Dissolved Oxygen at Sand Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating lines).





E. coli

The chronic state water quality standard for *E. coli* in streams is based on a calculated geometric mean of not less than five samples in any given calendar month. This mean should not exceed 126 MPN. An additional acute standard of not more than 10% of all samples in a given month should not exceed 1260 MPN is also listed. Because we monitor streams throughout the year, only collecting eight samples total, we do not have sufficient numbers of samples for any given calendar month to calculate geometric means or percentage-based exceedances comparable to these standards. It has been determined, however, that *E. coli* levels in Sand Creek are high enough to warrant an impairment listing for the bacteria, and subsequently, a TMDL load duration curve exists for *E. coli* in Sand Creek. We will examine the *E coli* levels observed in our grab samples, the LDC for *E. coli* in Sand Creek, as well as source analysis from the Coon Creek TMDL.

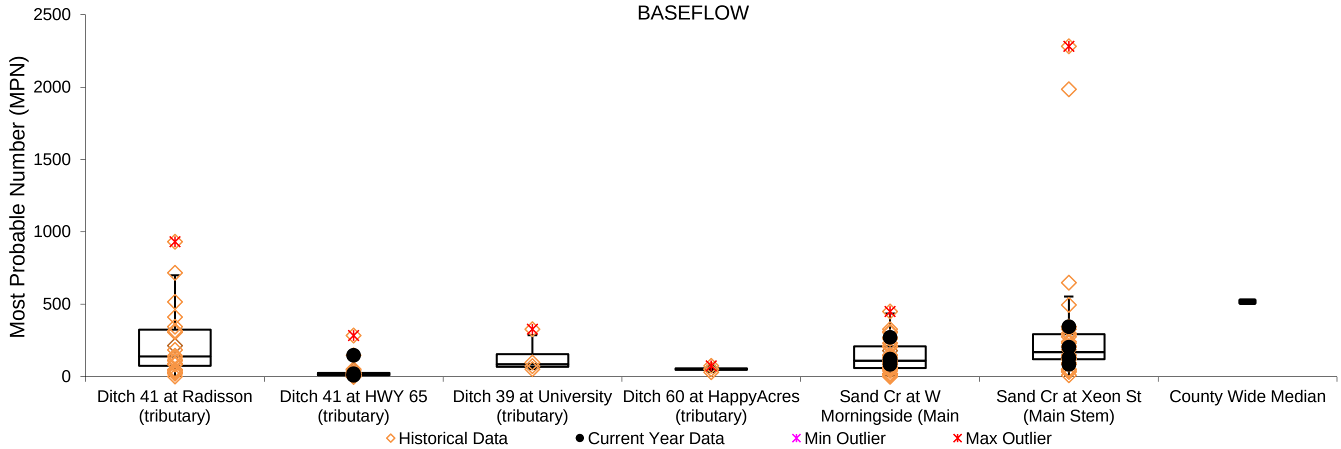
Looking to each of the contributing ditches as potential sources of *E. coli* in Sand Creek, it appears that Ditch 41 is contributing high levels of *E. coli* during both baseflow and storms at the furthest upstream monitoring site at Radisson Road during past monitoring years (this site was not monitored in 2020), followed by a consistently sharp decline at the monitoring site at Highway 65. Again in 2020, Ditch 41 at Highway 65 had very low levels of *E. coli*. This may be due to chemical treatment in the TPC and/or Club West ponds just upstream of Highway 65 Ditch 60 had fairly low levels of *E. coli* while Ditch 39 saw higher levels, especially after storm events.

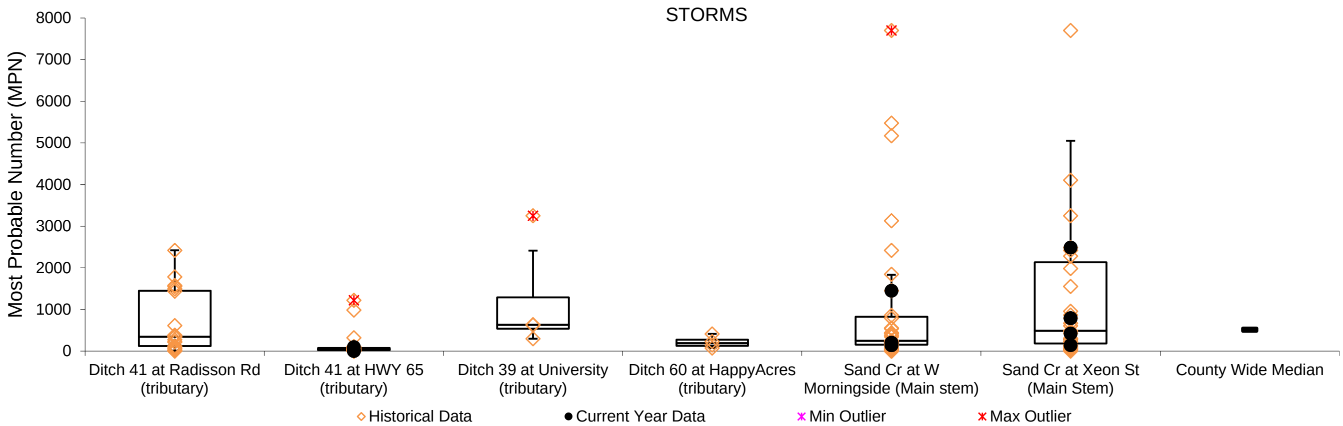
The Coon Creek TMDL offers more insight into *E. coli* loading into Sand Creek. The Load Duration Curve plot (Page 51, Figure 21) shows exceedances of acceptable flow-weighted loads of *E. coli* in most samples and across all flow ranges at Xeon St. The TMDL lists domestic pets as the primary source of *E. coli* to Sand Creek, accounting for 89% of all input. Considering the entire Sand Creek system drains primarily suburban residential neighborhoods, identifying hot zones and target areas for addressing *E. coli* could be a challenge. Perhaps a more widespread outreach and education effort, paired with resources such as dog-waste bag stations and trash receptacles along the popular trail system would be good starting points.

Average, Geomean and median *E. coli* in Sand Creek. Data is from Xeon St. for all years through 2020.

<table>
<tr><th></th><th>Average E. coli (MPN)</th><th>Geomean E. coli (MPN)</th><th>Median E. coli (MPN)</th><th>State Standard</th><th>N</th></tr>
<tr><td>Baseflow</td><td>316.28</td><td>171.45</td><td>168.50</td><td rowspan="3">Monthly Geometric Mean >126</td><td>32</td></tr>
<tr><td>Storms</td><td>1,906.95</td><td>570.52</td><td>487.0</td><td>31</td></tr>
<tr><td>All</td><td>1,098.99</td><td>309.97</td><td>243.0</td><td>63</td></tr>
<tr><td>Occasions >126 MPN
Occasions >1260 MPN</td><td></td><td></td><td></td><td>Monthly 10% average >1260</td><td>18 (56%) baseflow, 25 (81%) storm
2 (6%) baseflow, 10 (32%) storm</td></tr>
</table>

***E. coli* at Sand Creek.** Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating lines).





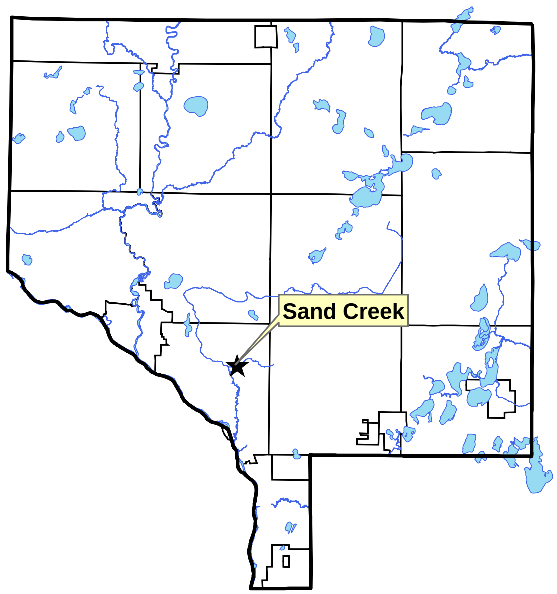
SAND CREEK

at Xeon Street, Coon Rapids

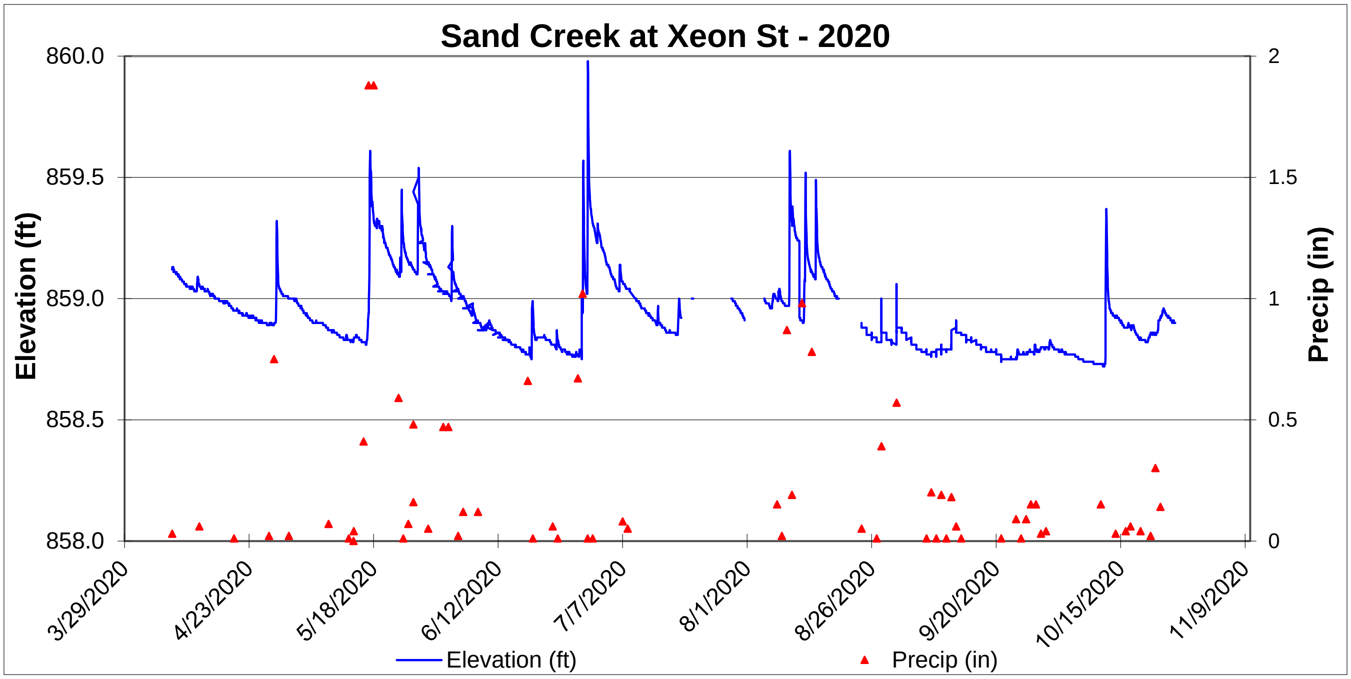
Notes

Stage at this site fluctuates less compared to the Morningside site located further upstream. This is likely because the channel of Sand Creek widens considerably between these two sites which helps mitigate bounce. Occasionally, large storms will cause water levels to rise up to a foot or more in a matter of hours.

In 2020 water levels at this site fluctuated 1.26 feet throughout the season, the smallest range since 2002. The lowest maximum elevation on record was also observed in 2020. Rainfall was infrequent and average annual precipitation was the lowest since 2012. During the season, equipment malfunctioned and had to be replaced, resulting in small data gaps. A streambank stabilization was completed at this site in recent years.



2020 Hydrograph



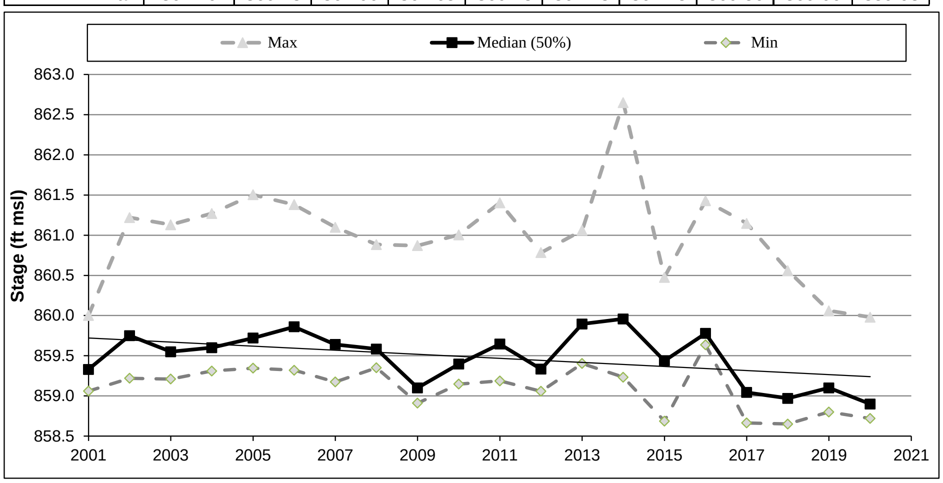
SAND CREEK

at Xeon Street, Coon Rapids

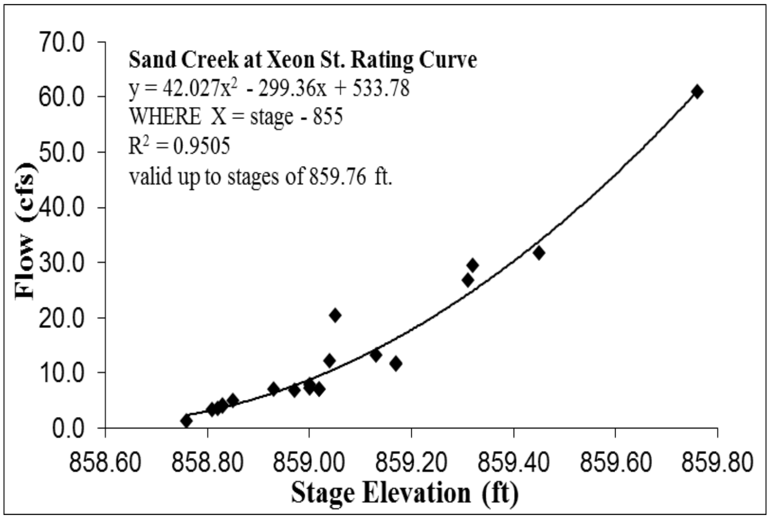
Summary of All Monitored Years

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

Percentiles	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Min	859.19	859.06	859.40	859.23	858.69	859.64	858.66	858.65	858.80	858.72
2.5%	859.22	859.07	859.53	859.42	858.96	859.67	858.69	858.69	858.85	858.75
10.0%	859.28	859.11	859.60	859.61	859.03	859.70	858.84	858.80	858.91	858.77
25.0%	859.47	859.18	859.70	859.79	859.16	859.73	858.94	858.85	858.98	858.82
Median (50%)	859.65	859.33	859.90	859.96	859.44	859.78	859.04	858.97	859.10	858.90
75.0%	859.89	859.53	860.04	860.28	859.66	859.84	859.36	859.11	859.23	859.02
90.0%	860.08	859.76	860.18	861.08	859.82	860.00	859.57	859.26	859.36	859.14
97.5%	860.33	860.11	860.37	861.93	860.04	860.38	859.96	859.47	859.50	859.31
Max	861.40	860.78	861.06	862.65	860.48	861.43	861.15	860.56	860.06	859.98



Rating Curve – 2013



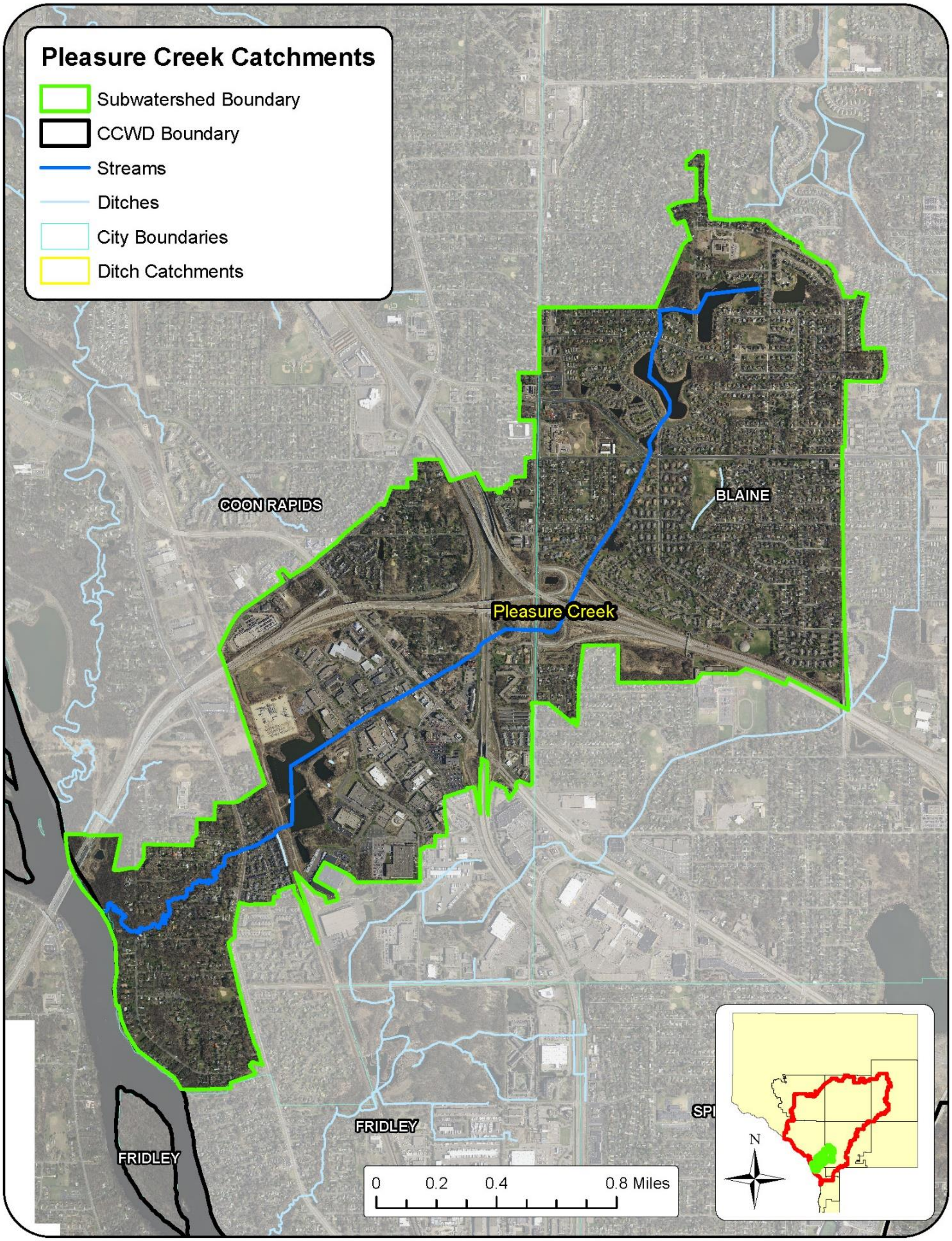
Water Quality Monitoring – Pleasure Creek

Pleasure Creek (Ditch 17) Monitoring Sites		
Site Name/ SiteID	**Years Monitored**	**2020 Data Collected**
Pleasure Cr at Pleasure Cr Parkway S005-636	2009	
Pleasure Cr at 99th Ave S005-637	2009	
Pleasure Cr at 96th Lane S005-263	2008, 2018-2020	Water Chemistry Grab Samples
Pleasure Creek at 86th Avenue S003-995	2006-2020	Water Chemistry Grab Samples, Continuous Stage

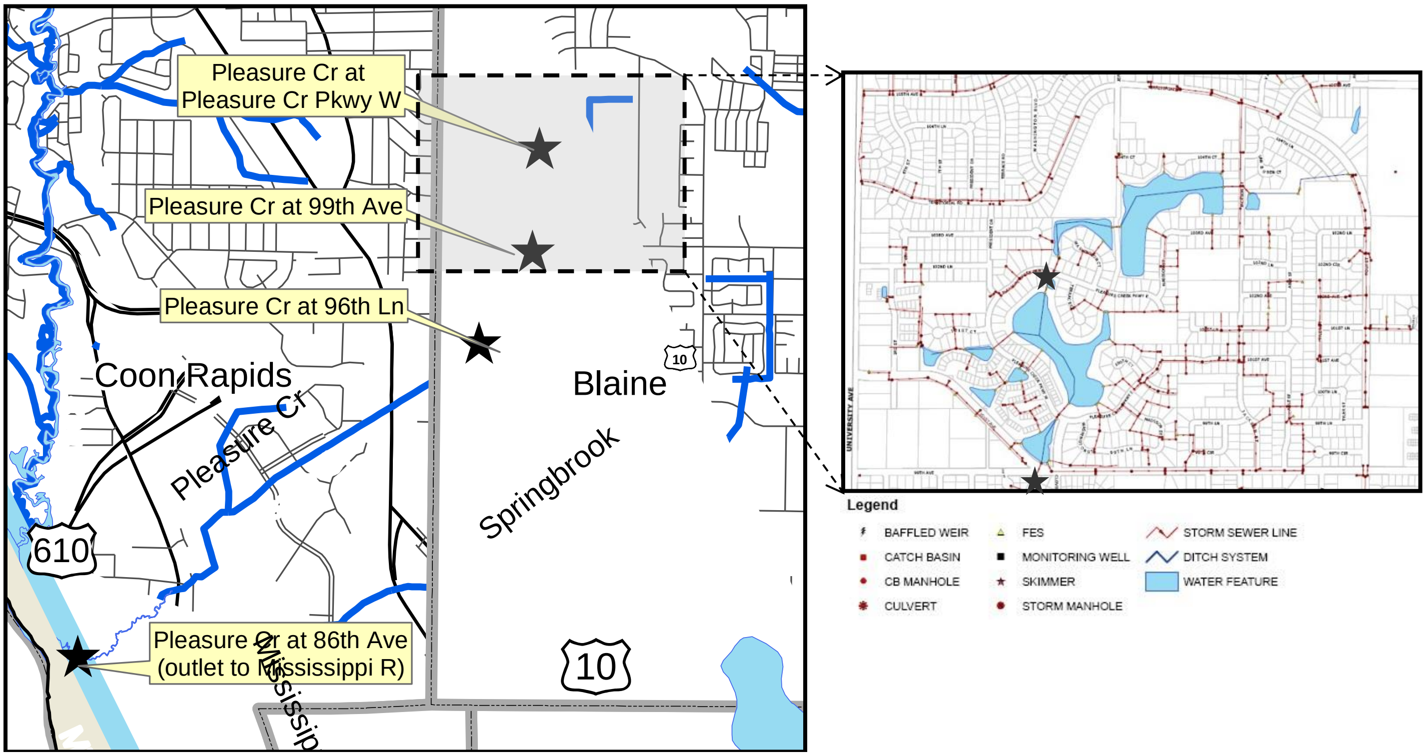
Background

Pleasure Creek drains 1,880 acres through southwestern Blaine and southern Coon Rapids. The watershed consists primarily of suburban residential and commercial land use. Pleasure Creek begins as the outlet channel for a series of stormwater ponds in the Blaine Haven development. The creek flows as a straightened ditch channel for about 1.5 miles before emptying into a large stormwater pond in the commercial area between East River Road and Coon Rapids Boulevard in southern Coon Rapids. This pond outlets through about a quarter-mile of culvert under railroad tracks and East River Road before Pleasure Creek continues as a meandering channel for its final 1.5 miles to its confluence with the Mississippi River. The creek is about 8-10 ft. wide and 0.5-1.0 ft. deep near its outlet at baseflow.

Pleasure Creek is listed as impaired for invertebrate biota and *E. coli* bacteria. New standards for aquatic life (Tiered Aquatic Life Use Standards) currently under development may take into consideration the fact that the creek is part of a public ditch system and, therefore, may lower aquatic life expectations and affect the impairment standard for this waterbody.


Pleasure Creek Catchments
Subwatershed Boundary
CCWD Boundary
Streams
Ditches
City Boundaries
Ditch Catchments
COON RAPIDS
BLAINE
Pleasure Creek
FRIDLEY
FRIDLEY
N
0
0.2
0.4
0.8 Miles

Pleasure Creek Monitoring Sites



Results and Discussion

Pleasure Creek is currently listed as impaired for poor invertebrate biota and high *E. coli*. The Coon Creek TMDL also contains load duration curves (LDC) for TSS and total phosphorus in Pleasure Creek because these pollutants are identified as stressors for aquatic life in this stream.

Neither total phosphorus nor TSS are especially problematic in Pleasure Creek, only exceeding state standard concentrations occasionally, and primarily during storm events. Exceedances of the LDC for each of these parameters in Pleasure Creek are also rare and typically only occur at very high flows.

E. coli levels are very high in Pleasure Creek. The chronic standard concentration of 126 MPN is exceeded 71% of the time at baseflow and 84% of the time during storms at 86th Ave. Additionally, the Pleasure Creek LDC for *E. coli* in the Coon Creek TMDL is exceeded in the majority of sample events plotted at all flow levels. Similar to Sand Creek, the TMDL attributes over 90% of *E. coli* loading in Pleasure Creek to domestic dogs, but this assumption may be underrepresenting the contribution of waterfowl into this creek.

Chlorides were sampled in CCWD streams in 2019, with Pleasure Creek having higher concentrations than other streams in the watershed. The chronic state standard for chlorides is 230 mg/L. Pleasure Creek near its outlet at 86th Ave. exceeded that concentration in two of four storm samples in 2019, and averaged 185.5 mg/L over all eight samples collected that growing-season. Pleasure Creek has not exceeded the acute standard of 860 mg/L in any sample. While these concentrations do comply with state standards, they are higher than other streams monitored in the county and in the watershed. Chlorides are a particularly problematic pollutant to aquatic life and in drinking water. Pleasure Creek flows into the Mississippi River, and its water quality has implications for both. Chlorides were not sampled for in 2020.

Specific conductance

Specific conductance in Pleasure Creek is high. The long-term median for specific conductance during baseflow conditions at the 86th Av. site is 1.096 mS/cm. By comparison, the median for all Anoka County streams is 0.420 mS/cm. The long-term median for specific conductance post-storms in Pleasure Creek is even higher at 1.170 mS/cm at 86th Ave. There is a notable increase in specific conductance from 96th lane to 86th Ave. 96th lane also has a much more consistent and smaller range of concentrations than does 86th Ave, which fluctuates to a far greater degree.

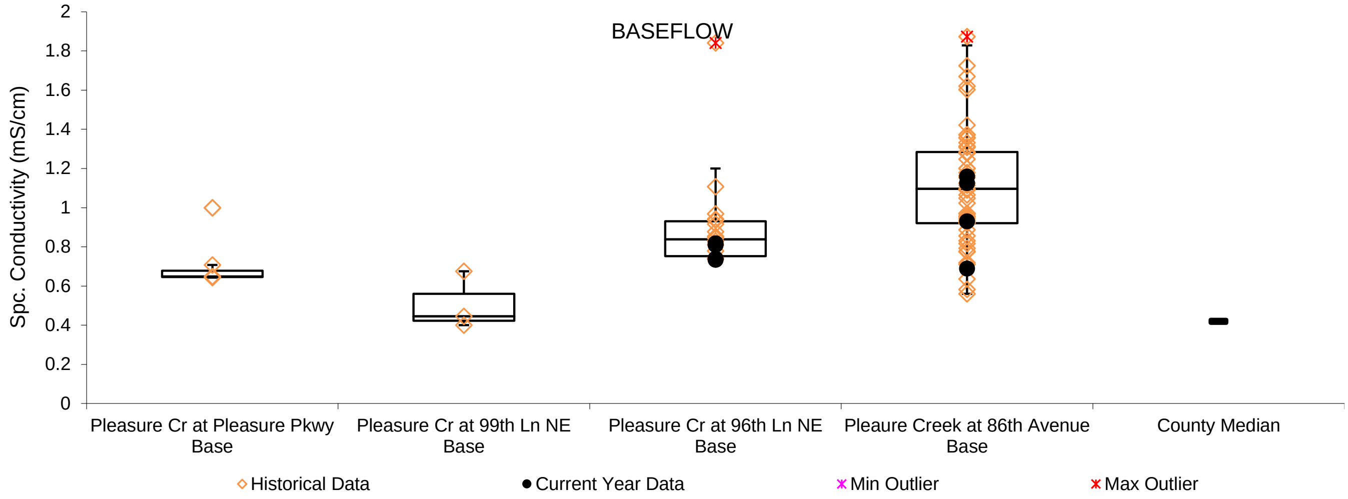
Specific conductance is slightly higher post-storm than during baseflow conditions. This is the opposite of most other area streams. At the majority of streams road deicing salt infiltration to the shallow water table that feeds stream base flows is an often-suspected source of pollutants. This is still probably occurring at Pleasure Creek, based on high baseflow specific conductance. However, higher specific conductance observed post-storms indicates that stormwater runoff directly to Pleasure Creek also has very high levels of dissolved pollutants. There is likely a large amount of dissolved pollutants on the landscape contributing to high specific conductance during storms as well as high levels during baseflow conditions due to contaminated shallow ground water.

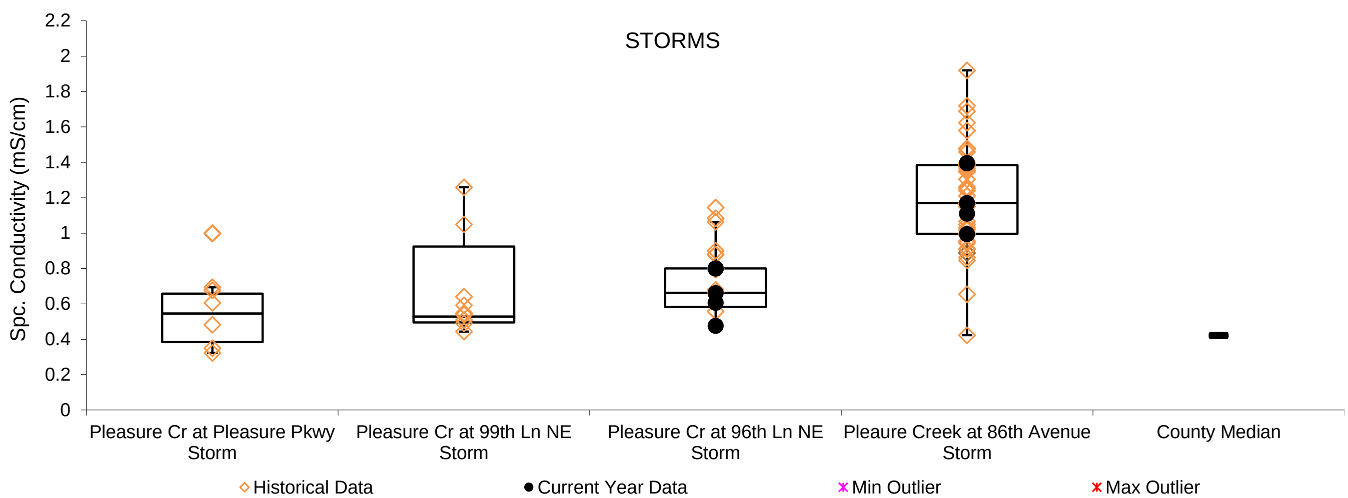
Dissolved pollutants are especially difficult to manage once in the environment. They are not readily removed by stormwater settling ponds. Infiltration practices can provide some treatment through biological processes in the soil, but also risk contaminating groundwater. The first approach to dissolved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

Average and median specific conductance in Pleasure Creek at 86th Ave. for specific conductance and chlorides all years through 2020.

	Average specific conductance (mS/cm)	Median specific conductance (mS/cm)	State Standard	N
Baseflow	1.1.03	1.096	Specific conductance – none	53
Storms	1.197	1.170		47
All	1.154	1.145		100

Specific conductance at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Phosphorus

Total phosphorus (TP) is generally low in Pleasure Creek during baseflow conditions and slightly higher post-storms. In all conditions, TP concentrations in Pleasure Creek are lower than other streams in Anoka County with a composite median of 67.0 µg/L compared to the overall countywide median of 118.8 µg/L. Pleasure Creek has however exceeded the state standard of 100 µg/L during 27% of storm samples taken at 86th Ave. The TP concentration at 96th lane also exceeded 100 µg/L on eight occasions since 2018, four during baseflow and four post-storms. One reading in late July at the 96th Lane site was abnormally high with a reading of 372 µg/L. Nothing else observed that day explained why phosphorus levels were so elevated. During the same sampling event TSS and Turbidity levels were also high. Phosphorus loading into this system seems to be occurring primarily in the upstream portions of the drainage area, unlike chlorides and dissolved pollutants. ANOVA results indicate a significant decrease in average TP concentrations during baseflow conditions between the 96th Ln site and outlet monitoring site at 86th Ave ($p < 0.05$). It is possible that one or more ponds in the headwaters are loading phosphorus to the system under some conditions.

The Pleasure Creek LDC for TP in the Coon Creek TMDL (Page 48, Figure 18) shows that Pleasure Creek does not often exceed acceptable TP loads, and generally only does so at very high flows. This indicates that stormwater infrastructure in this creek's watershed is doing a good job of treating stormwater for TP during all but the largest storm events.

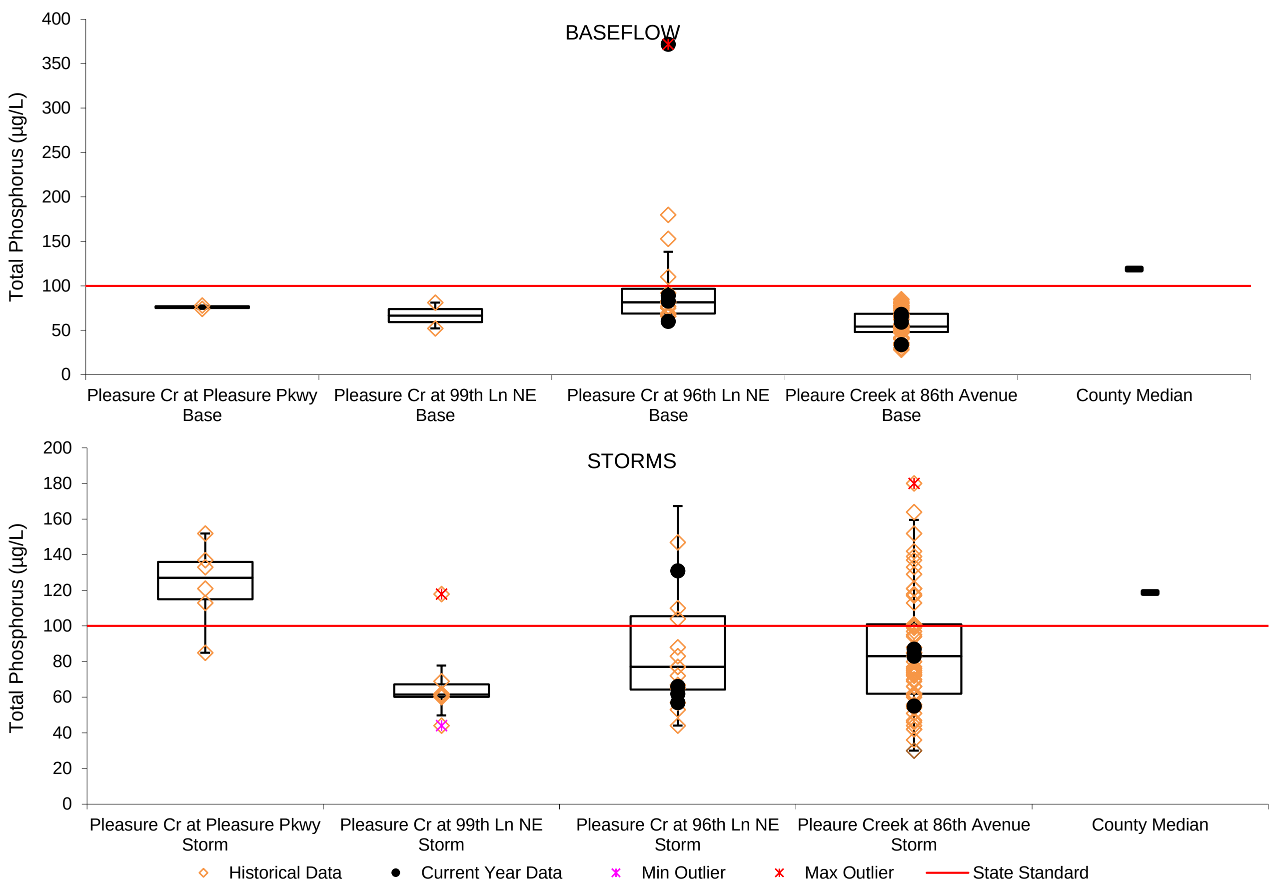
Median TP in Pleasure Creek. Data is from the 86th Avenue site and all years through 2020.

	Average Total Phosphorus (µg/L)	**Median Total Phosphorus (µg/L)**	**State Standard**	**N**
Baseflow	56.7	54.0	100	48
Storms	86.5	83.0		56
All	72.78	67.0		104
Occasions > state standard				0 baseflow 15 (27%) storms

ANOVA Matrix for Baseflow Total Phosphorus	Pleasure Creek at 96th Lane	Pleasure Creek at 86th Ave
Pleasure Creek at 96th Lane		Significant Decrease 96th Ln X= 107.68 µg/L 86th Ave X= 56.77 µg/L p= <0.05
Pleasure Creek at 86th Ave		

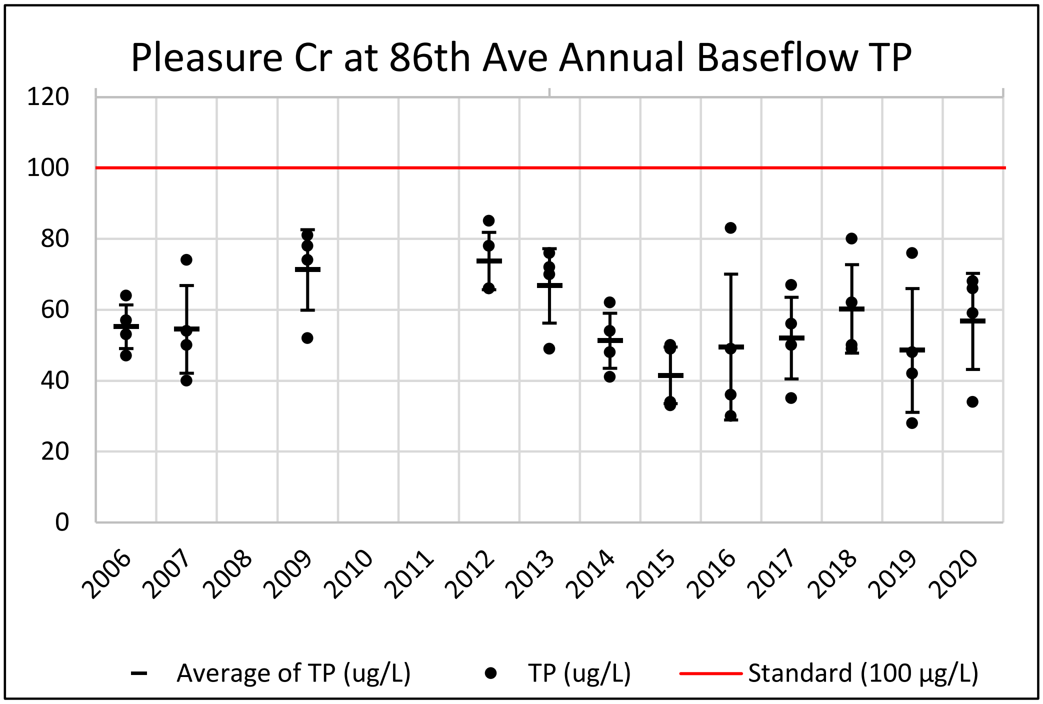
ANOVA Matrix for Storm Total Phosphorus	Pleasure Creek at 96th Lane	Pleasure Creek at 86th Ave
Pleasure Creek at 96th Lane		No Sig. Change 96th Ln X= 112.56 µg/L 86th Ave X= 86.53 µg/L p= 0.15
Pleasure Creek at 86th Ave		

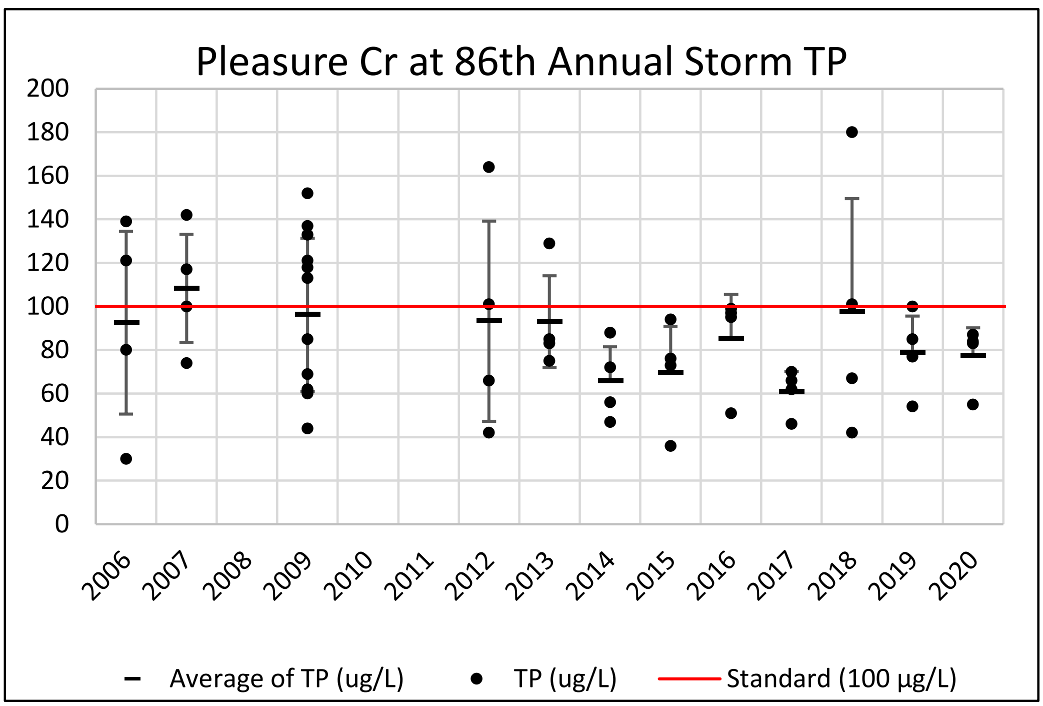
Total phosphorus at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines)



Parameter	Significant Change in Annual $\bar{X}$ (2006-2020)	p=	Standard Error of Means
Total Phosphorus - Baseflow	None	0.29	9.56
Total Phosphorus - Storm	None-Very Close	0.053	12.42

Pleasure Creek at 86th Ave - Annual average ANOVA regression TP 2006-2020





Total Suspended Solids and Turbidity

TSS and turbidity are both generally low during baseflow conditions. However, during storm events, TSS (all years) has exceeded the state standard of 30 mg/L 34% of the time. No samples collected in 2019 or 2020 exceeded the state standard concentration. The LDC for TSS in Pleasure Creek in the Coon Creek TMDL (Page 43, Figure 15) shows that Pleasure Creek does exceed acceptable TSS loads periodically, but again, usually only during periods of very high flow. ANOVA results indicate a significant increase in average post-storm TSS concentrations between the 96th ln monitoring site and 86th ave site downstream, indicating that TSS degradation is occurring downstream of Hwy 10. Notably, this is opposite of the pattern observed for TP where degradation is occurring upstream of 96th ln.

The generally low turbidity and TSS, as well as TP, likely reflect the effectiveness of a system of stormwater ponds located just upstream of East River Road. Increases in both parameters during some storms, particularly larger storms, is not unexpected for any stream. Additional stormwater treatment near and downstream of, East River Road would likely be the most effective with improving water quality in Pleasure Creek because treatment upstream is already robust.

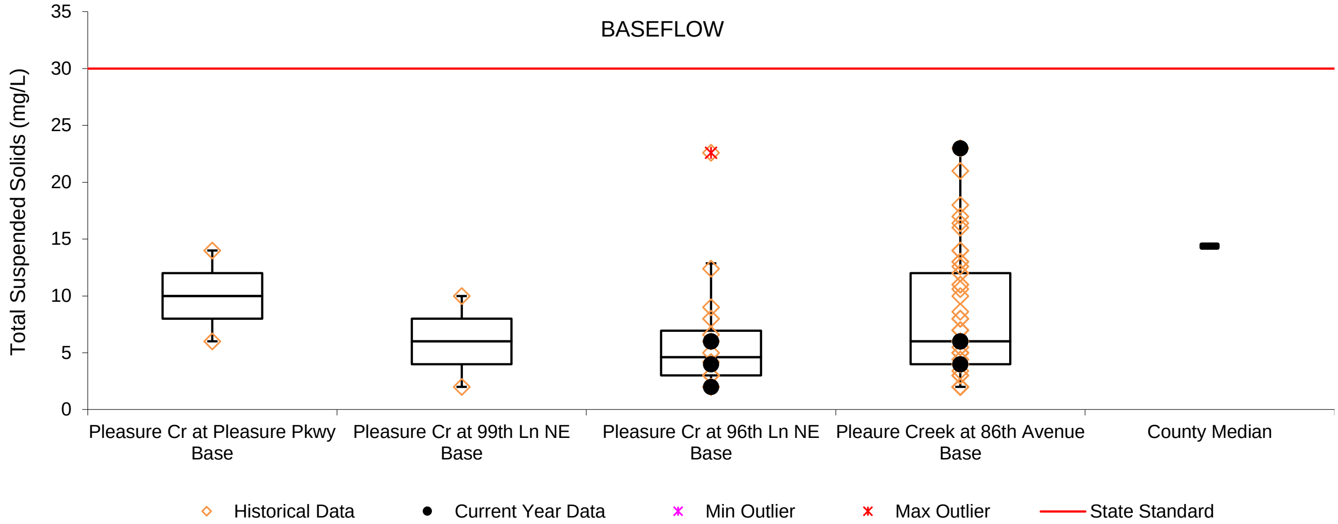
Average and median total suspended solids in Pleasure Creek. Data is from the 86th Avenue site and all years through 2020.

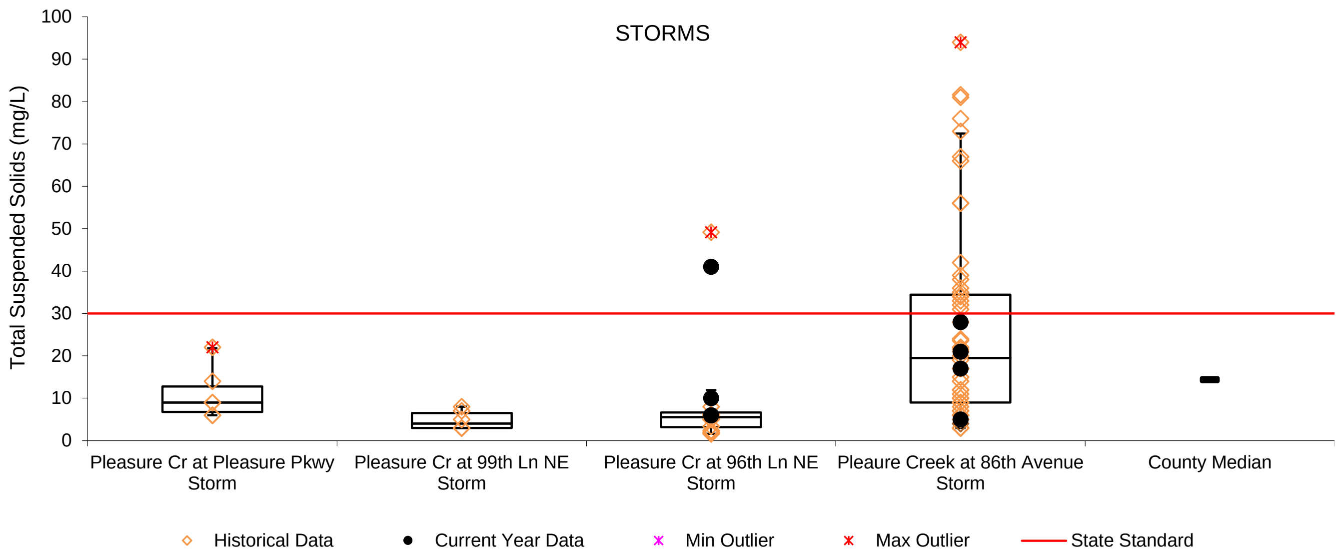
	Average Total Suspended Solids (mg/L)	Median Total Suspended Solids (mg/L)	State Standard	N
Baseflow	8.24	6.0	30 mg/L TSS	48
Storms	26.30	19.5		56
All	17.96	10.8		104
Occasions > state TSS standard				0 baseflow 19 (34%) storm

ANOVA Matrix for Baseflow TSS	Pleasure Creek at 96th Lane	Pleasure Creek at 86th Ave
Pleasure Creek at 96th Lane		No Sig. Change 96th Ln X= 6.17 mg/L 86th Ave X= 8.23 mg/L p= 0.18
Pleasure Creek at 86th Ave		

ANOVA Matrix for Storm TSS	Pleasure Creek at 96th Lane	Pleasure Creek at 86th Ave
Pleasure Creek at 96th Lane		Significant Increase 96th Ln X= 9.91 mg/L 86th Ave X= 26.30 mg/L p= <0.01
Pleasure Creek at 86th Ave		

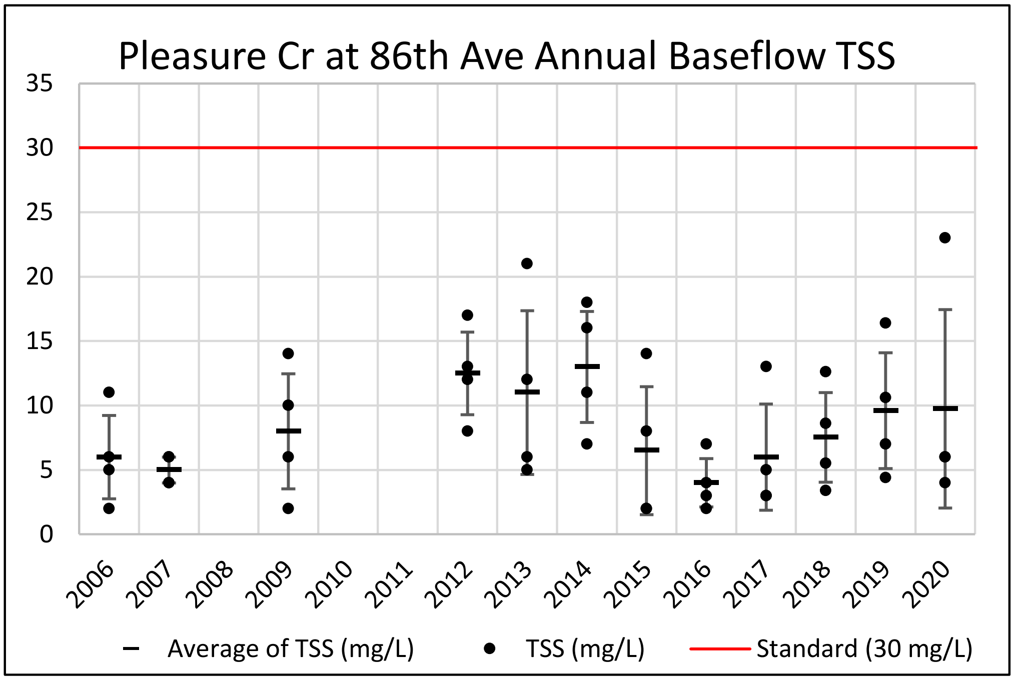
Total suspended solids at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

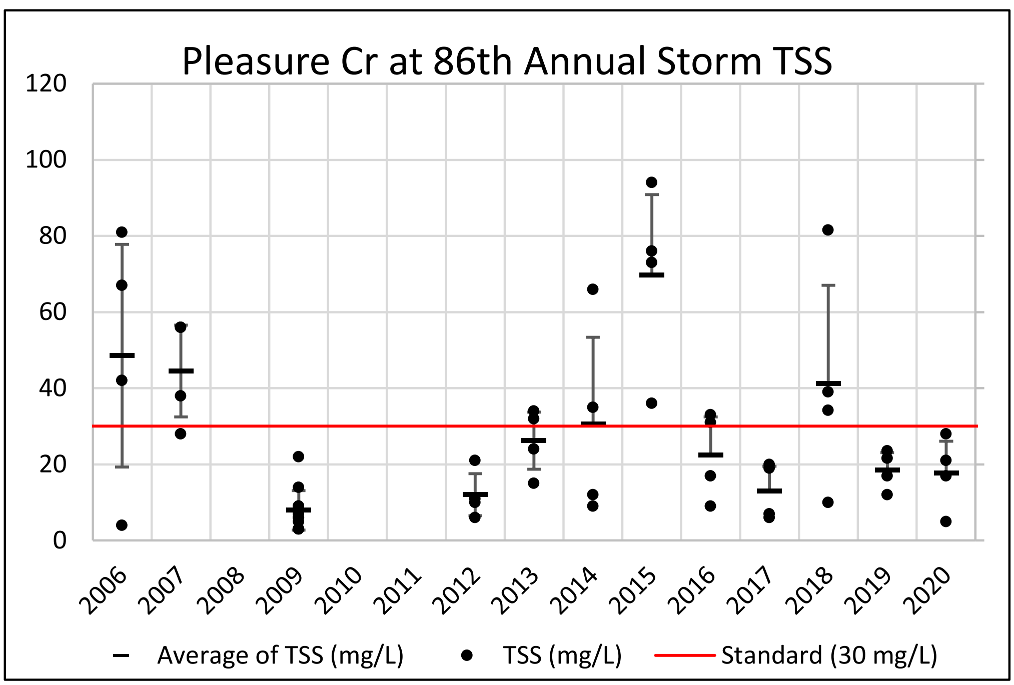




Parameter	Significant Change in Annual $\overline{X}$ (2006-2020)	p=	Standard Error of Means
Total Suspended Solids - Baseflow	None	0.57	3.027
Total Suspended Solids - Storm	None	0.47	18.73

Pleasure Creek at 86th Avenue - Annual average ANOVA regression TSS 2006-2020

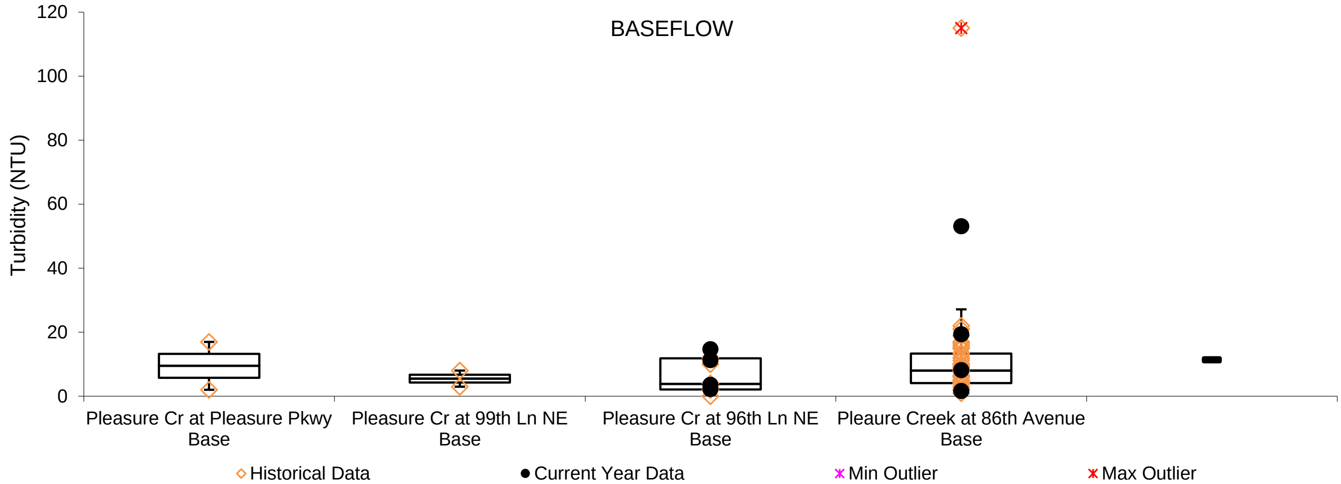


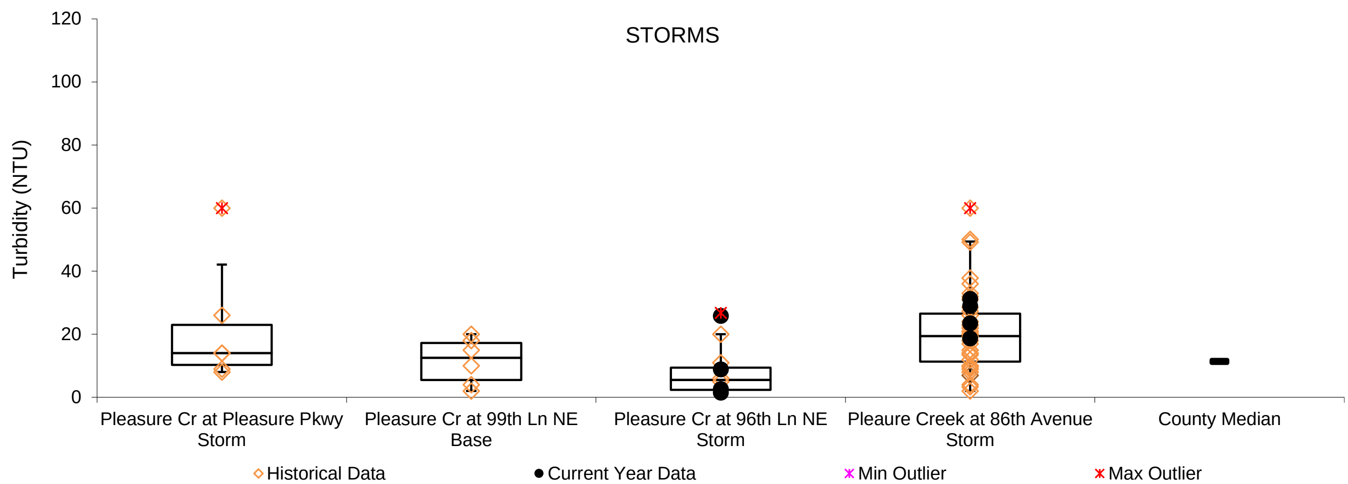


Average and median turbidity in Pleasure Creek. Data is from the 86th Avenue site and all years through 2020.

	Average Turbidity (NTU)	Median Turbidity (NTU)	State Standard	N
Baseflow	11.0	8.0	n/a	59
Storms	20.8	19.4		59
All	15.9	12.2		118
Occasions > state TSS standard				

Turbidity at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





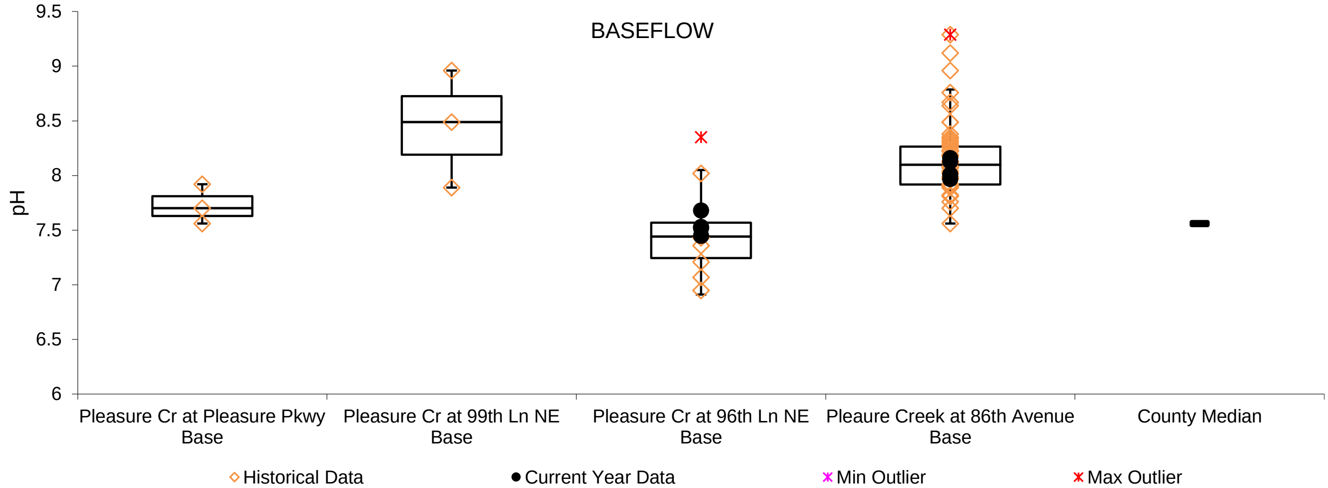
pH

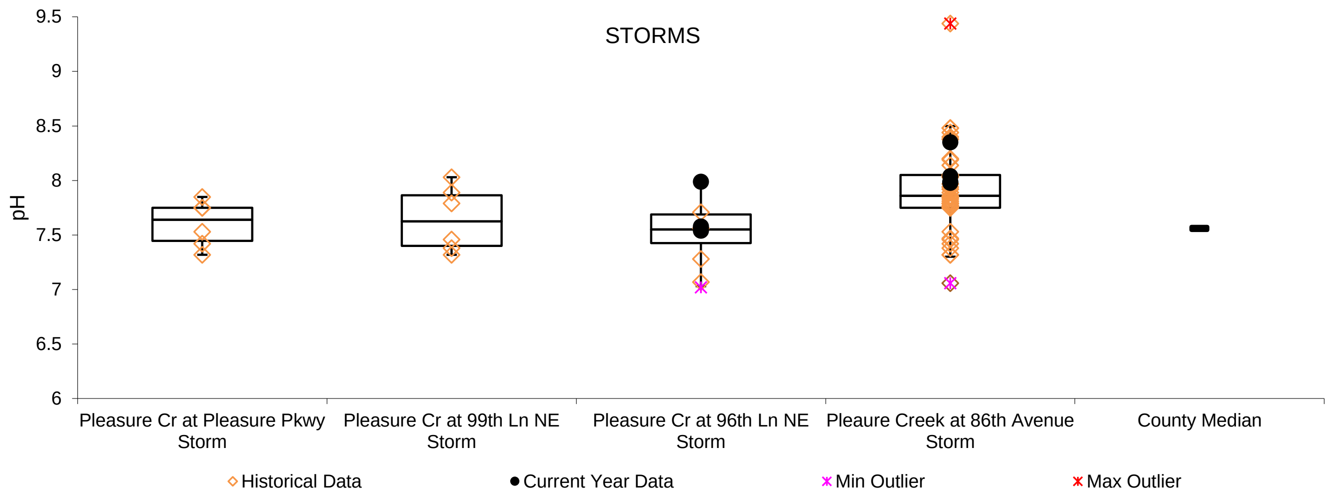
Pleasure Creek pH levels have generally remained within the state water quality standard range of 6.5-8.5, but median and average values are at the higher end of that range and higher than the long-term median for all Anoka County streams (7.56). Eight exceedances of the healthy range have occurred in the 117 samples collected since 2002. Seven of these eight exceedances occurred during baseflow conditions. This is not surprising given that rain is typically more acidic that water on the landscape and often reduces pH during storms.

Average and Median pH in Pleasure Creek. Data is from the 86th Avenue site and all years through 2020.

	Average pH	Median pH	State Standard	N
Baseflow	8.15	8.10	6.5-8.5	60
Storms	7.92	7.86		57
All	8.04	8.01		117
Occasions outside state standard				7 (12%) baseflow 1 (2%) storm

pH at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





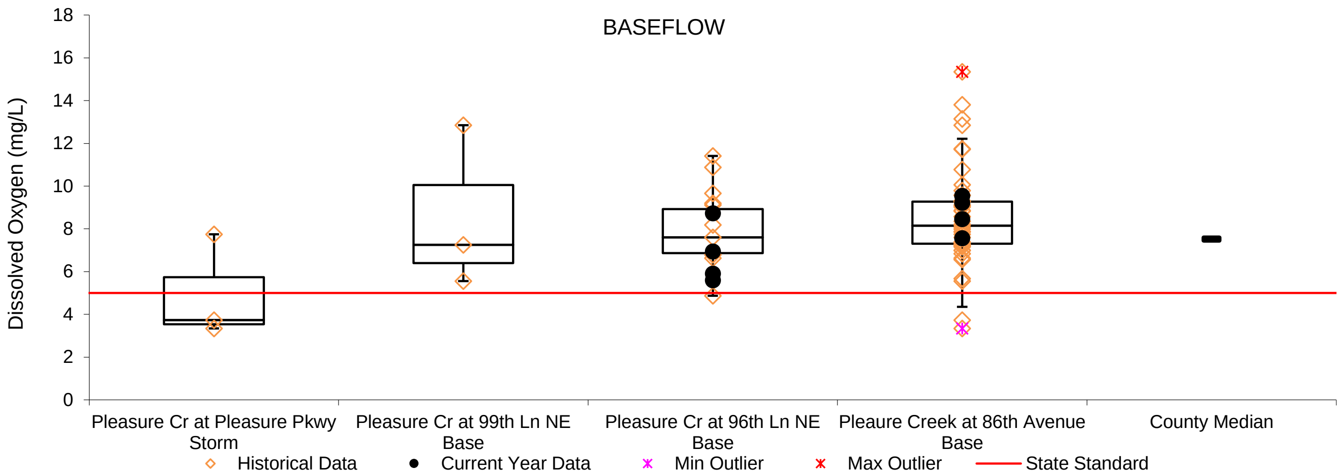
Dissolved Oxygen

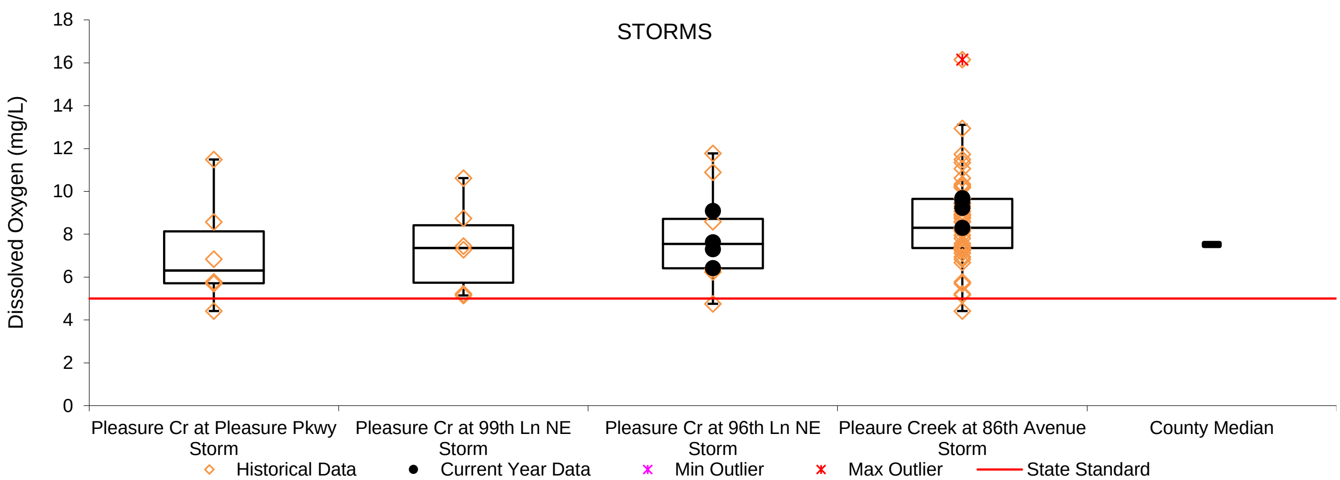
Dissolved oxygen (DO) levels in Pleasure Creek are generally within the acceptable range, only falling below the state standard 5 mg/L daily minimum in three of 113 samples collected since 2001 at 86th Ave. Overall, there does not appear to be an issue with this parameter in Pleasure Creek.

Average and Median dissolved oxygen in Pleasure Creek. Data is from the 86th Avenue site and all years through 2020.

	Average Dissolved Oxygen (mg/L)	Median Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	8.51	8.15	5 mg/L daily minimum	55
Storms	8.64	8.30		58
All	8.57	8.21		113
Occasions <5 mg/L				3

Dissolved Oxygen at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





E. coli Bacteria

The chronic state water quality standard for *E. coli* in streams is based on a calculated geometric mean of not less than five samples in any given calendar month. This mean should not exceed 126 MPN. An additional acute standard of not more than 10% of all samples in a given month should not exceed 1260 MPN is also listed. Because we monitor streams throughout the year, only collecting eight samples total, we do not have sufficient numbers of samples for any given calendar month to calculate geometric means or percentage-based exceedances comparable to these standards

Pleasure Creek is listed as impaired for aquatic recreation due to excessive *E. coli*, and the Coon Creek TMDL contains a Load Duration Curve for this parameter (Page 52, Figure 22). The LDC chart shows exceedances of acceptable levels for the majority of samples collected. High *E. coli* still persists today, so people should be wary about contact with, and inadvertent consumption of, Pleasure Creek water. The TMDL attributes 92% of Pleasure Creek *E. coli* input to domestic dogs. Similar to the other streams in the Coon Creek TMDL, it is possible that waterfowl are underrepresented in the report.

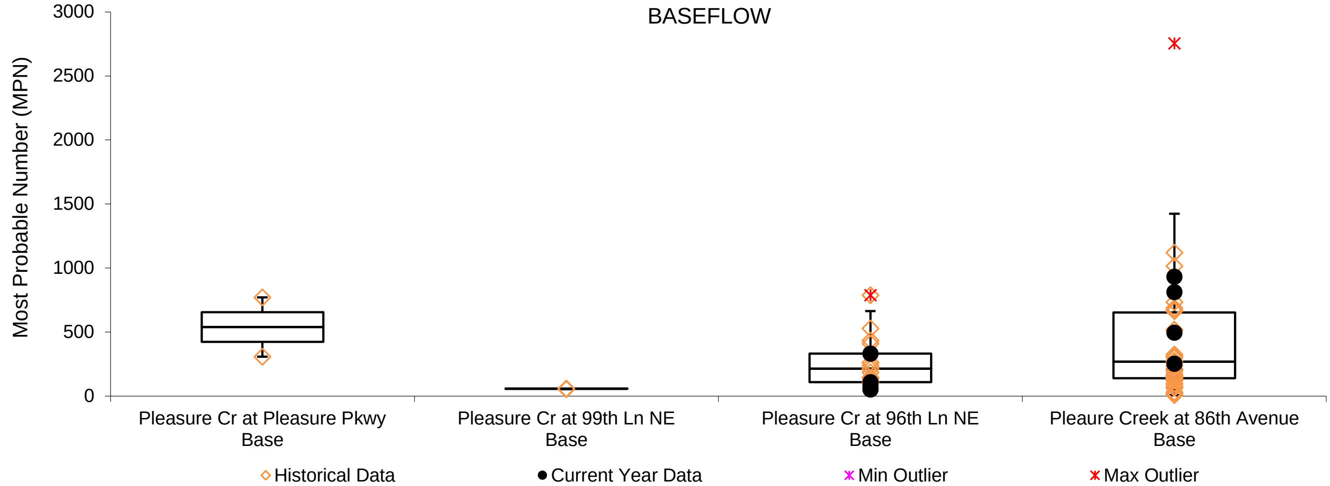
While current sampling frequency does not allow calculations based on state standards, *E. coli* measurements collected in 2020 are still informative. All eight samples collected during at 86th Ave during baseflow and post-storm events, exceeded the chronic standard of 126 MPN. *E. coli* concentrations seem to rise upstream to downstream during baseflow conditions and decrease upstream to downstream after storm events.

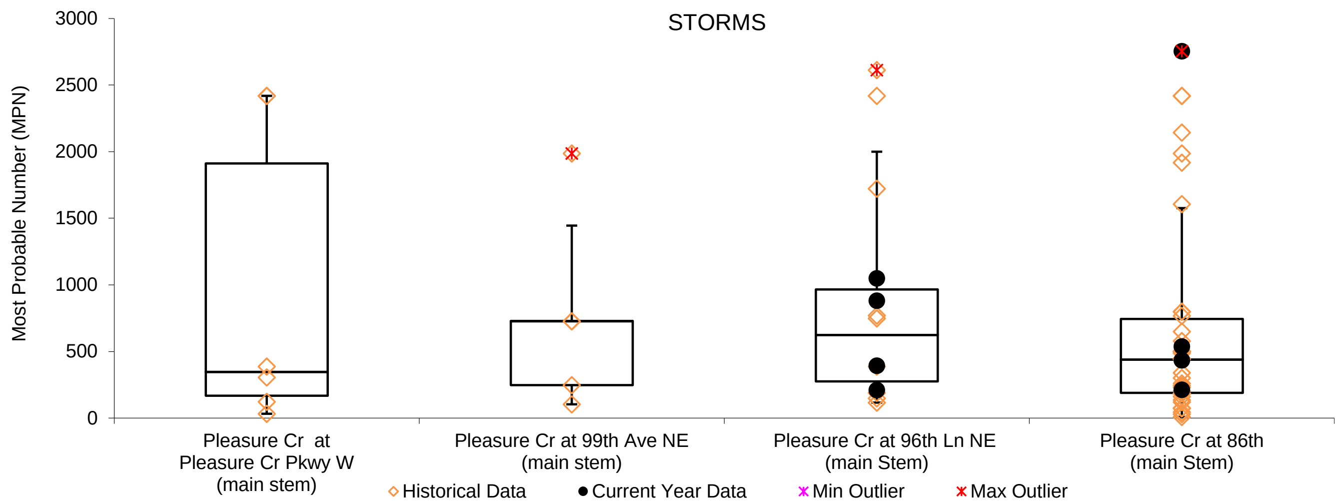
Average and median *E. coli* in Pleasure Creek. Data is from the 86th Avenue site only, all data through 2020.

<table>
<tr><th></th><th>Average E. coli (MPN)</th><th>Median E. coli (MPN)</th><th>Geometric Mean</th><th>State Standard</th><th>N</th></tr>
<tr><td>Baseflow</td><td>324.39</td><td>203.0</td><td>197.34</td><td rowspan="4">Monthly Geometric Mean >126

Monthly 10% average >1260</td><td>38</td></tr>
<tr><td>Storms</td><td>685.01</td><td>438.0</td><td>364.15</td><td>38</td></tr>
<tr><td>All</td><td>504.70</td><td>268.65</td><td>268.12</td><td>76</td></tr>
<tr><td>Occasions >126 MPN
Occasions >1260 MPN</td><td></td><td></td><td></td><td>27 (71%) baseflow, 32 (84%) storm
0 baseflow, 7 (18%) storm</td></tr>
</table>

***E. coli* at Pleasure Creek.** Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





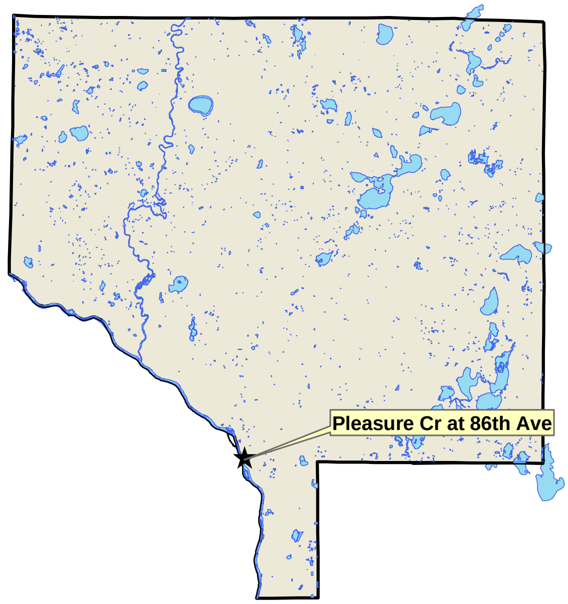
PLEASURE CREEK

at 86th Ave, Coon Rapids

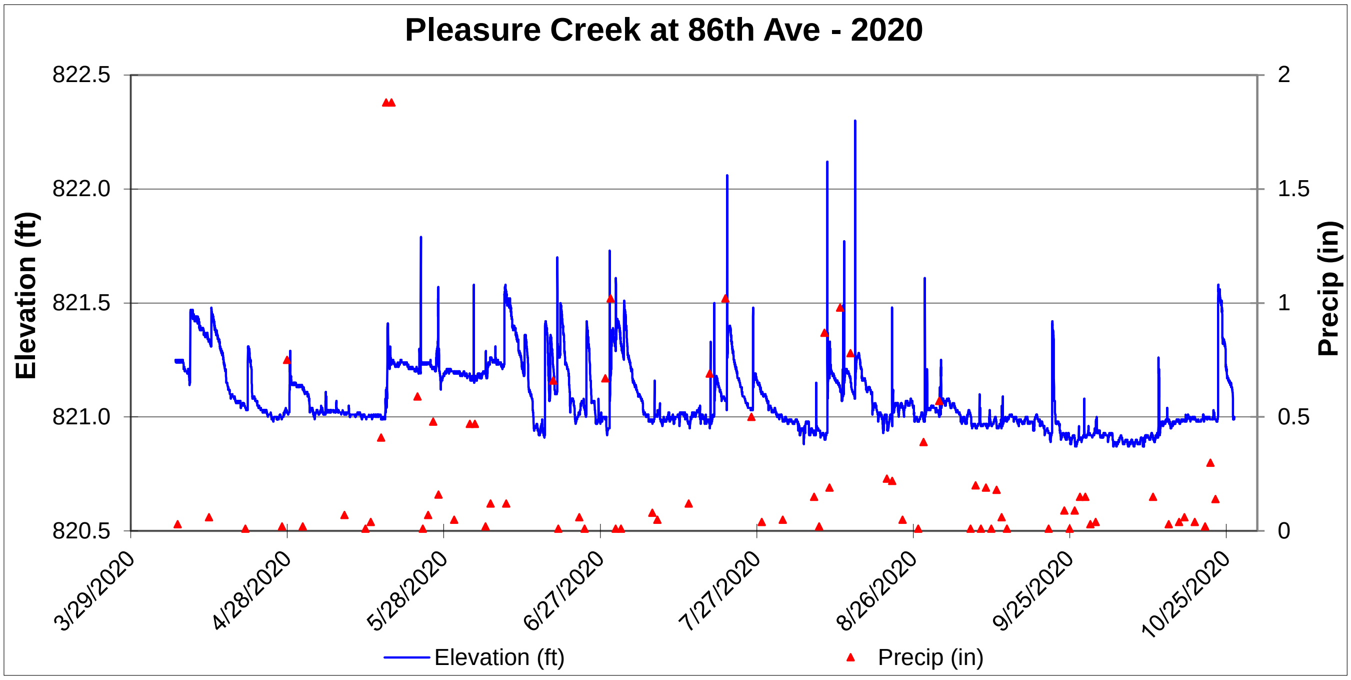
Notes:

Pleasure Creek at 86th fluctuated 1.43 feet throughout 2020. Stage reading frequency was shortened to 15-minute intervals instead of one hour for 2020 due to the potential flashiness of the site. Based on the hydrograph, the new 15-minute intervals were better able to capture most the storm surge fluctuations. The site is sometimes flashy, with a 0.78-inch storm on August 14 causing an increase of 1.22 feet in only a half-hour span.

There was a streambank stabilization project installed at this site in 2019. The banks and creek bed were both regraded during the project, changing the characteristics of the channel. The rating curve, which was developed for this site in 2013, must be reestablished.



2020 Hydrograph

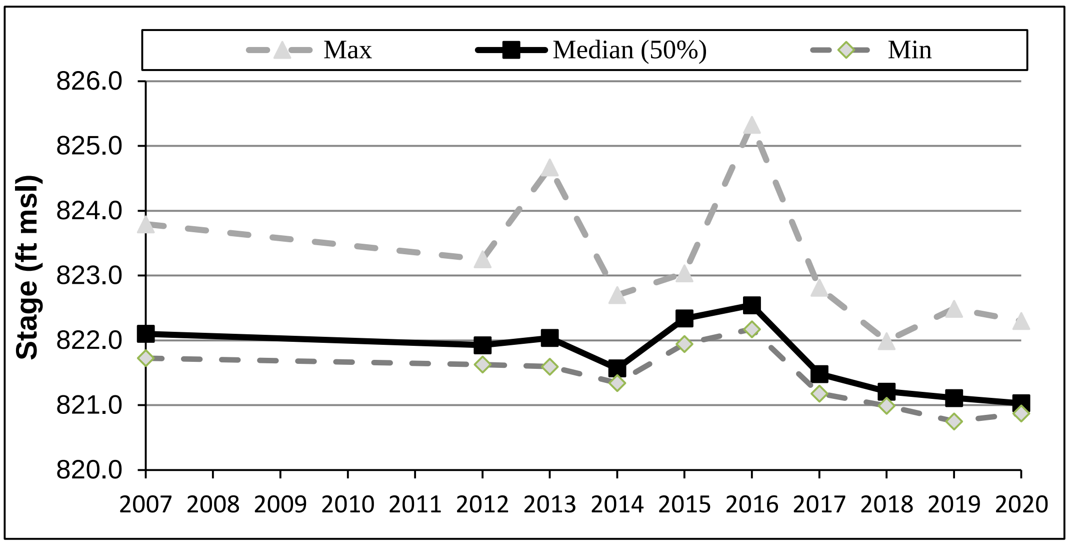


PLEASURE CREEK

at 86th Ave, Coon Rapids

Summary of All Monitored Years

Percentiles	2007	2012	2013	2014	2015	2016	2017	2018	2019	2020
Min	821.73	821.63	821.60	821.34	821.95	822.17	821.18	820.99	820.75	820.87
2.5%	821.77	821.69	821.63	821.38	821.98	822.20	821.26	821.01	820.91	820.89
10.0%	821.84	821.77	821.73	821.42	822.02	822.27	821.31	821.06	820.97	820.93
25.0%	821.95	821.80	821.78	821.45	822.26	822.46	821.40	821.13	821.03	820.98
Median (50%)	822.10	821.93	822.04	821.57	822.34	822.54	821.48	821.21	821.11	821.03
75.0%	822.32	822.04	824.67	821.82	822.46	822.61	821.59	821.29	821.20	821.18
90.0%	822.49	822.19	824.67	821.98	822.56	822.70	821.69	821.43	821.27	821.27
97.5%	822.63	822.33	824.67	822.19	822.61	822.81	821.82	821.52	821.69	821.43
Max	823.79	823.25	824.67	822.70	823.04	825.33	822.81	821.99	822.49	822.30



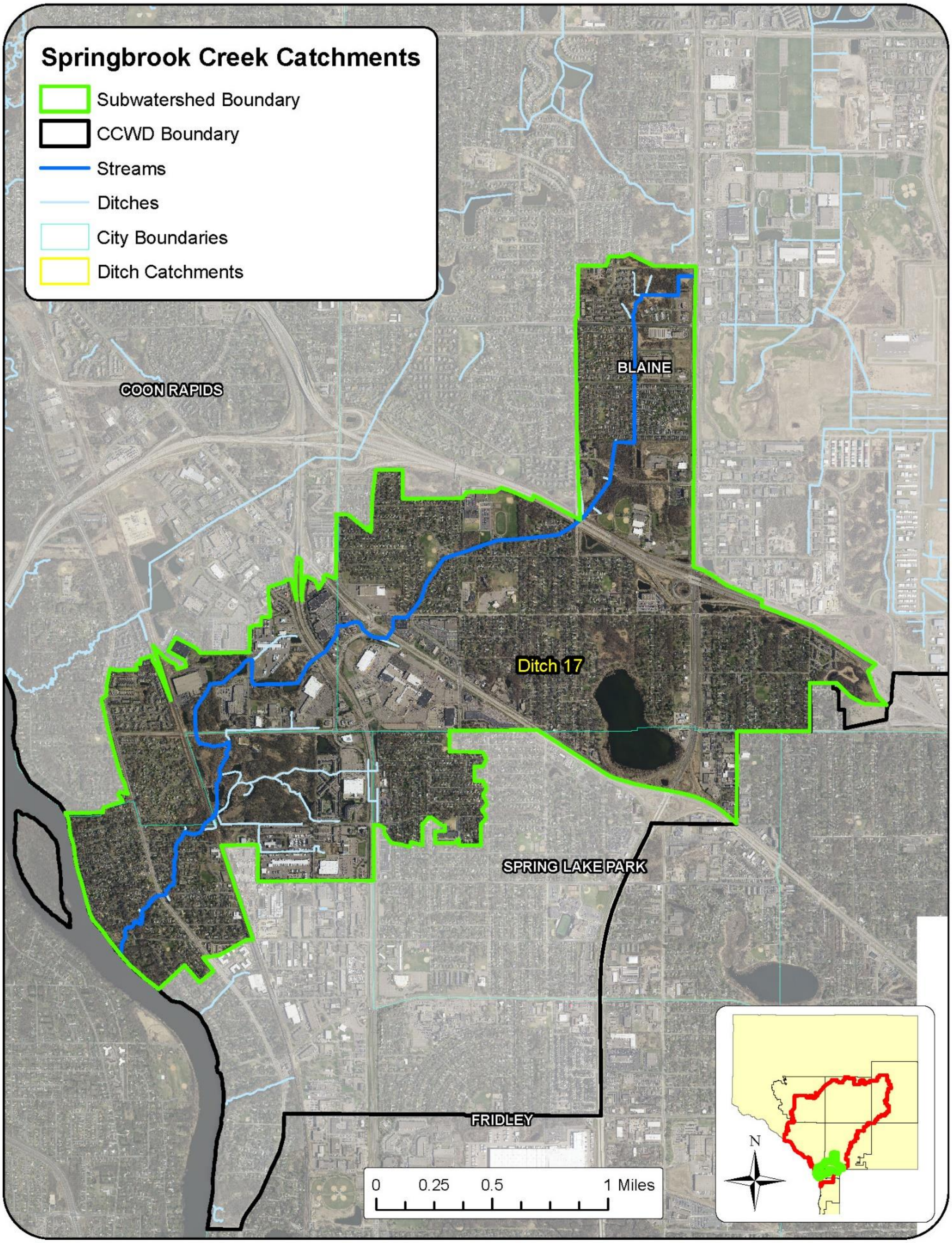
Water Quality Monitoring – Springbrook Creek

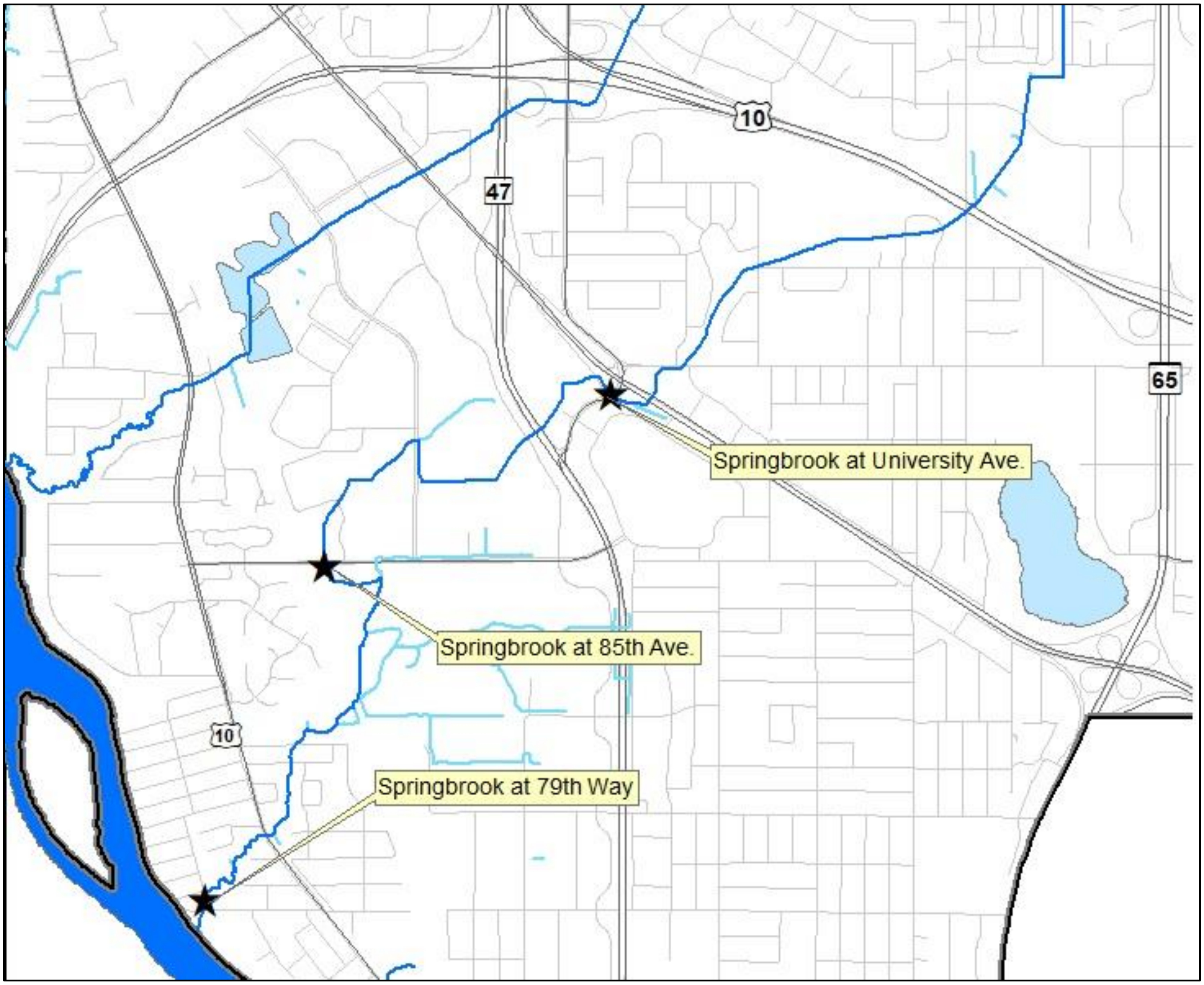
Springbrook Creek (Ditch 17) Monitoring Sites		
Site Name/ SiteID	**Years Monitored**	**2020 Data Collected**
Springbrook at University, Blaine S007-542	2013-2020	Water Chemistry Grab Samples
Springbrook at 85th Avenue, Fridley S007-543	2013-2020	Water Chemistry Grab Samples
Springbrook at 79th Way, Fridley S006-140	2012-2020	Water Chemistry Grab Samples, Continuous Stage

Background

Springbrook Creek (Ditch 17) is a small waterway draining an urbanized and highly modified watershed. This watershed does not drain to Coon Creek, but is included in the Coon Creek Watershed District jurisdictional boundary as well as the Coon Creek TMDL. The watershed includes portions of the Cities of Blaine, Coon Rapids, Spring Lake Park and Fridley. The primary channel flows approximately 5 miles from a small ditched wetland north of 99th Ave. in Blaine, through the southeastern corner of Coon Rapids, through the wetland impoundment in Springbrook Nature Center in northern Fridley, and finally to the Mississippi River. Several small ditch tributaries and numerous subsurface stormwater conveyance systems contribute to the creek, with many branches joining at the Springbrook Nature Center impoundment. From the outlet of the nature center, the creek flows approximately one mile to its confluence with the Mississippi River in a single, meandering channel. At its outlet, Springbrook Creek is about 10 ft. wide and 1 ft. deep at baseflow. The stream is flashy, with water levels that increase dramatically following rainfall and quickly recede thereafter.

In the early 2000s Springbrook Creek was the subject of a multi-partner project focused on monitoring and improving water quality through the implementation of capital improvement projects. Funding support for the project came from a MN Pollution Control Agency grant and from the City of Fridley. During that effort, several projects to improve stormwater treatment and also rehabilitate the nature center impoundment were implemented. Water quality monitoring during this time produced only a small amount of usable data, but enough was collected to indicate water quality and hydrology problems in the system. More regular monitoring of this creek has taken place since 2012 at the three monitoring sites mapped below.


Springbrook Creek Catchments
Subwatershed Boundary
CCWD Boundary
Streams
Ditches
City Boundaries
Ditch Catchments
COON RAPIDS
BLAINE
Ditch 17
SPRING LAKE PARK
FRIDLEY
0
0.25
0.5
1 Miles
N



Results and Discussion

Springbrook Creek, like other creeks in the watershed, is impaired for aquatic recreation (due to elevated *E. coli* concentrations) and invertebrate biota (with TP identified as a main stressor). Unlike the other streams in the Coon Creek TMDL, Springbrook Creek does not have TSS identified as a stressor to stream biota and so does not have a load duration curve (LDC) for that parameter.

Total Phosphorus concentrations are high in Springbrook Creek, especially during storms. The average concentration of all TP samples collected at 79th way exceeds the state standard of 100 µg/L at 102 µg/L. The average concentration for storm samples collected at this site is 132 µg/L. The LDC plot for TP in Springbrook Creek in the Coon Creek TMDL (Page 49, Figure 19) shows that acceptable TP loads are exceeded in each grab sample collected during all but the lowest flow conditions. Springbrook Creek has an LDC for TP because the parameter is identified as a stressor for aquatic macroinvertebrates, but it is not beyond reason that the creek could also carry a TP impairment of its own.

E. coli levels are high in Springbrook Creek. The chronic standard concentration of 126 MPN is exceeded over 50% of the time at baseflow and 90% of the time during storms at 79th Way. Additionally, the Springbrook Creek LDC for *E. coli* in the Coon Creek TMDL is exceeded in the majority of sample events plotted at all flow levels. Once again, the TMDL attributes the majority (89%) of *E. coli* loading in Pleasure Creek to domestic dogs, but this assumption may be underrepresenting the contribution of waterfowl in this creek.

Chlorides were sampled in CCWD streams in 2019, with Springbrook Creek having higher concentrations than other streams in the watershed. The chronic state standard for chlorides is 230 mg/L. While Springbrook Creek near its outlet at 79th Way has not exceeded that concentration in any grab samples, it averaged 156 mg/L in eight grab samples collected in 2019. Springbrook Creek has not exceeded the acute standard of 860 mg/L in any sample. While these concentrations do comply with State standards, they only represent growing-season conditions, and they are much higher than other streams monitored in the county, and higher than Coon Creek and Sand Creek in the watershed. Chlorides are a particularly problematic pollutant to aquatic life and in drinking water. Springbrook Creek flows into the Mississippi River, and its water quality has implications for both. Chlorides were not sampled for in 2020.

Specific conductance and Chlorides

Springbrook Creek dissolved pollutant levels as measured by specific conductance are higher than other streams in the watershed. The long-term median for specific conductance in Springbrook at 79th Way during all conditions is 0.905 mS/cm. By contrast, the median for Coon Creek at Vale St. is 0.655 mS/cm. Median specific conductance at 79th Way (all years) is lower during storm events (0.849 mS/cm) compared to baseflow conditions (0.996 mS/cm).

Chloride sampling was conducted in Springbrook Creek in 2019 for the first time since 2012. The median chloride concentration at 79th Way was 156 mg/L, which matches the composite median with 2012 data included. In 2019, concentrations during baseflow vs post-storm events were similar at 79th Way, but the relationship moving upstream to downstream was not. At baseflow, chloride concentrations upstream were higher, and declined moving downstream. During post-storm sampling, the opposite was true. The same relationship is true in the specific conductance data. One post-storm sample at 85th Ave. resulted in a chloride concentration of 254 mg/L, which exceeds the Minnesota Pollution Control Agency's chronic water quality standard of 230 mg/L. No monitoring occurred during snowmelt when chlorides tend to be the highest. No sample approached the acute state standard of 860 mg/L. Chlorides were not sampled for in 2020.

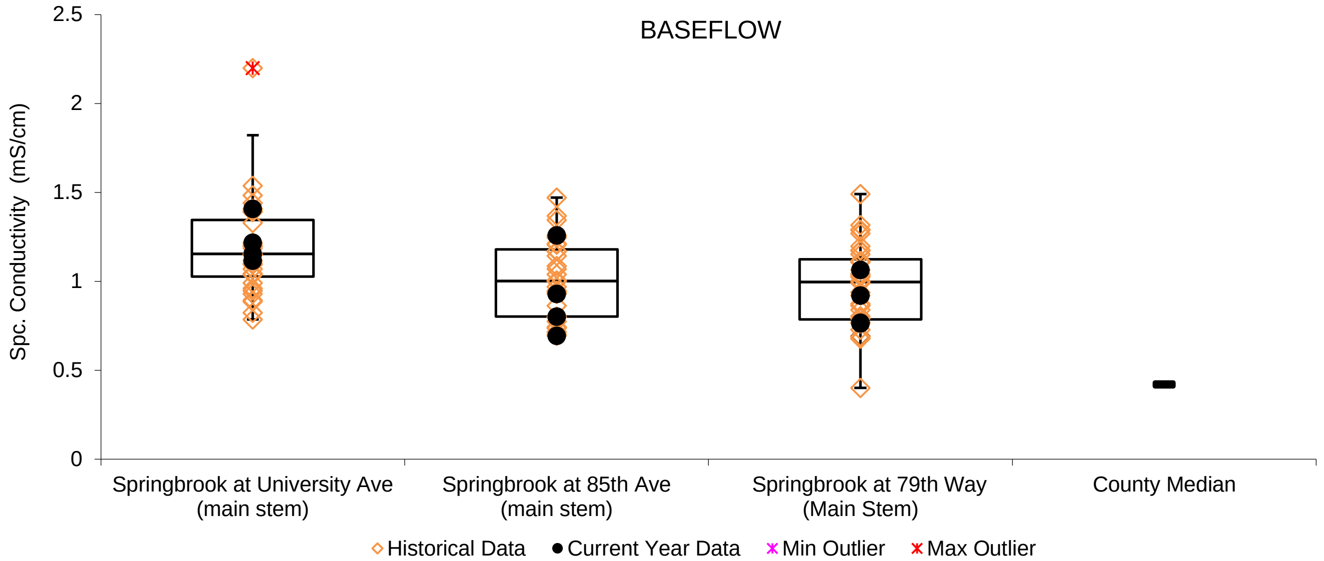
Springbrook Creek's high dissolved pollutants are lower during storm flows, suggesting that the local shallow groundwater is a pollutant source during baseflow conditions. Road deicing salts are often a contributor when similar conditions are found elsewhere in the region, but interestingly actual chloride concentrations did not show the same decline during storms that overall specific conductance did. Regardless, chlorides in the shallow groundwater that feeds baseflow in Springbrook Creek appear to be a problem, causing higher concentrations in this creek than others in the watershed. Greater road densities and a long history of road salting contribute to high chlorides. Chlorides are persistent in the environment and not effectively broken down by stormwater treatment or time. They migrate into the shallow groundwater that feeds the stream during baseflow. Still, during storm flows Springbrook also carries high concentrations of dissolved pollutants, suggested that runoff from impervious surfaces directly to the stream is also problematic.

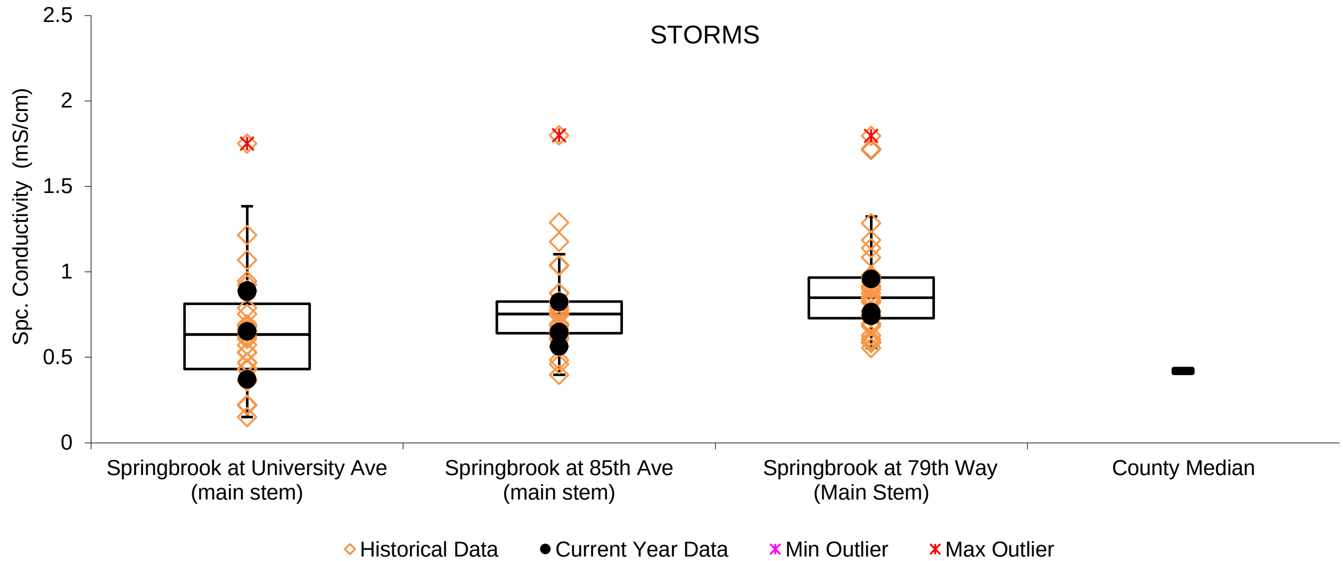
Dissolved pollutants are especially difficult to manage once in the environment. They are not removed by stormwater settling ponds. Infiltration practices can provide some treatment through biological processes in the soil, but also risk contaminating groundwater. The first approach to dissolved pollutant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

Average and median specific conductance in Springbrook Creek. Data is from 79th Way for specific conductance and chlorides all years through 2020.

	Average Specific Conductance (mS/cm)	Median Specific Conductance (mS/cm)	State Standard	N (Spc. Cond)
Baseflow	0.970	0.996	Specific conductance – none	36
Storms	0.910	0.849		36
All	0.940	0.905		72
Occasions > State Standard				

Specific conductance at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





Total Phosphorus

Springbrook Creek often exceeds the state water quality standard of 100 µg/L during storm events. During baseflow conditions, TP levels only exceeded the standard twice for all samples at all sites in 2020, both at the furthest upstream site (University Ave.). Post-storm TP concentrations are much higher in Springbrook Creek, and exceed 100 µg/L most of the time. The average of all post-storm TP samples collected at the 79th Way site is 132 µg/L.

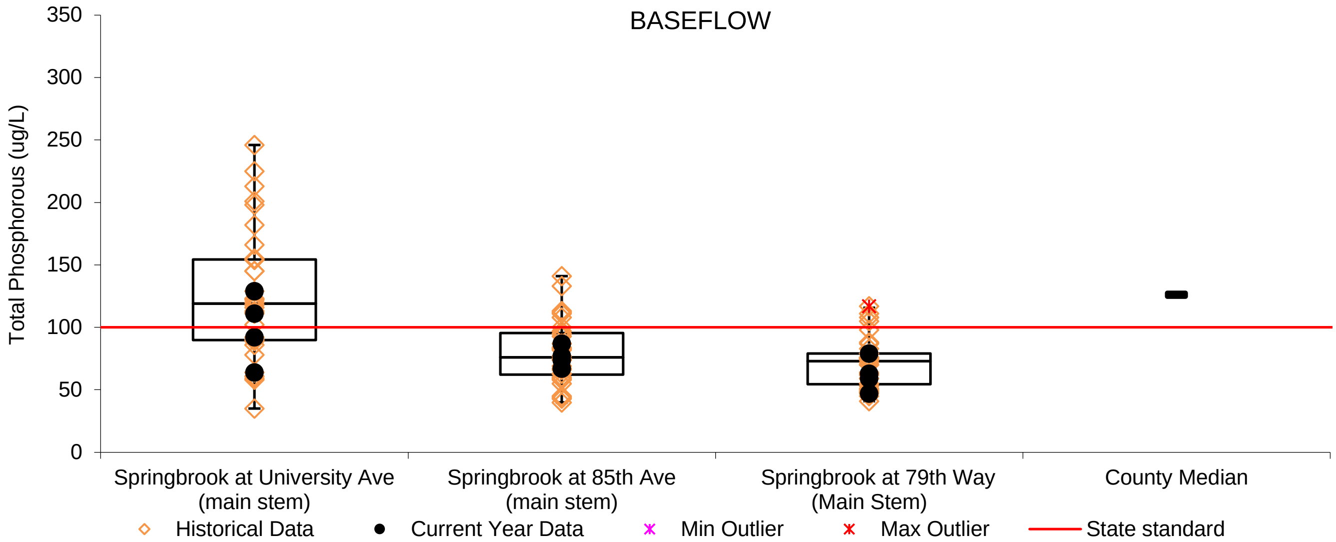
It is interesting to note that there is an apparent decrease in TP levels moving from upstream to downstream during baseflow conditions. Long-term median concentrations at the three sites are 119, 76.0, and 73.0 µg/L respectively. This suggests that active water quality projects and best management practices are effectively removing phosphorus from the Springbrook Creek system throughout the watershed. One likely source of treatment is the large wetland complex located in the Springbrook Nature Center, although a decrease also occurs between the two sites upstream of the complex. Overall, the system is doing a decent job of maintaining total phosphorus concentrations and helping keep TP levels below the state standard during baseflow at the site near its outlet.

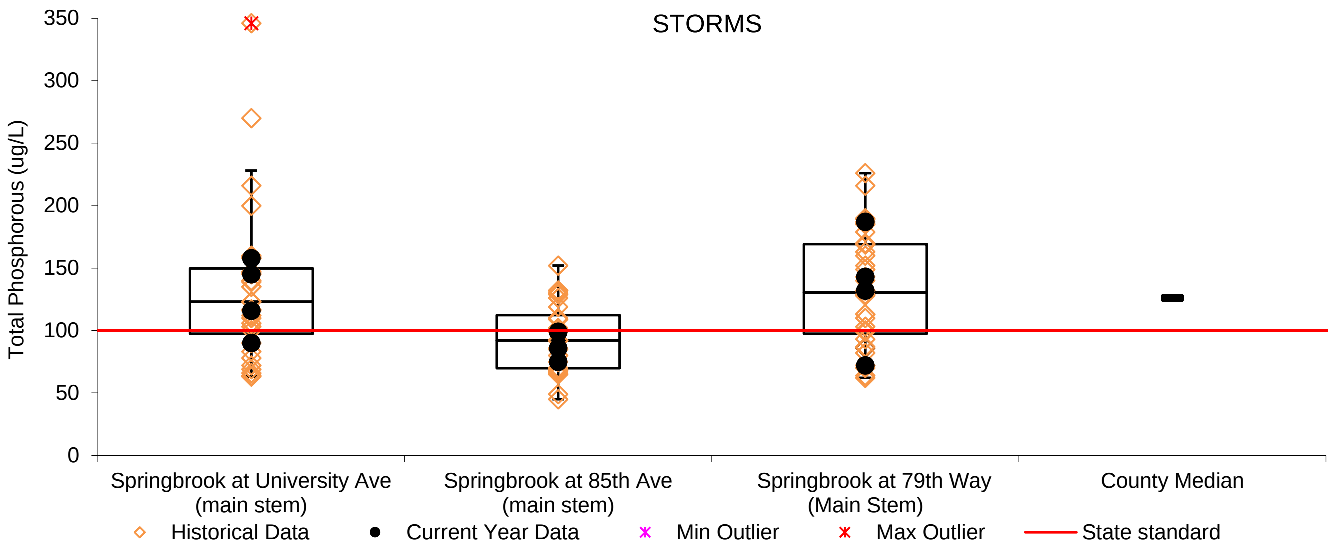
Following storm events there is a slight decrease in TP moving upstream to downstream from University Ave. to 85th, but concentrations rebound at 79th Way and are much higher than those collected at baseflow. It appears that the Springbrook Nature Center wetland complex and other stormwater treatment practices in the area are undersized or overwhelmed by the volume of water and pollutant loading from the watershed during larger storm events and/or phosphorus-rich runoff is entering the system downstream of the Springbrook Nature Center. Adding additional capacity for treatment is advised, but the limited available space in this urban setting presents a challenge. Gaining a better understanding of whether the increase in total phosphorus being flushed through this complex during storms is predominantly dissolved or particulate phosphorus would better inform any water management decisions including the planning of any additional retrofits to the system. Following storm events, phosphorus concentrations at the 79th Way site exceed state standards 66% of the time.

Average and median total phosphorus in Springbrook Creek. Data is from 79th Way for all years through 2020.

	Average Total Phosphorus (µg/L)	Median Total Phosphorus (µg/L)	State Standard	N
Baseflow	71.19	73.0	100	36
Storms	131.97	130.5		36
All	101.58	86.5		72
Occasions > state standard				4 (11%) Baseflow 24 (66%) storm

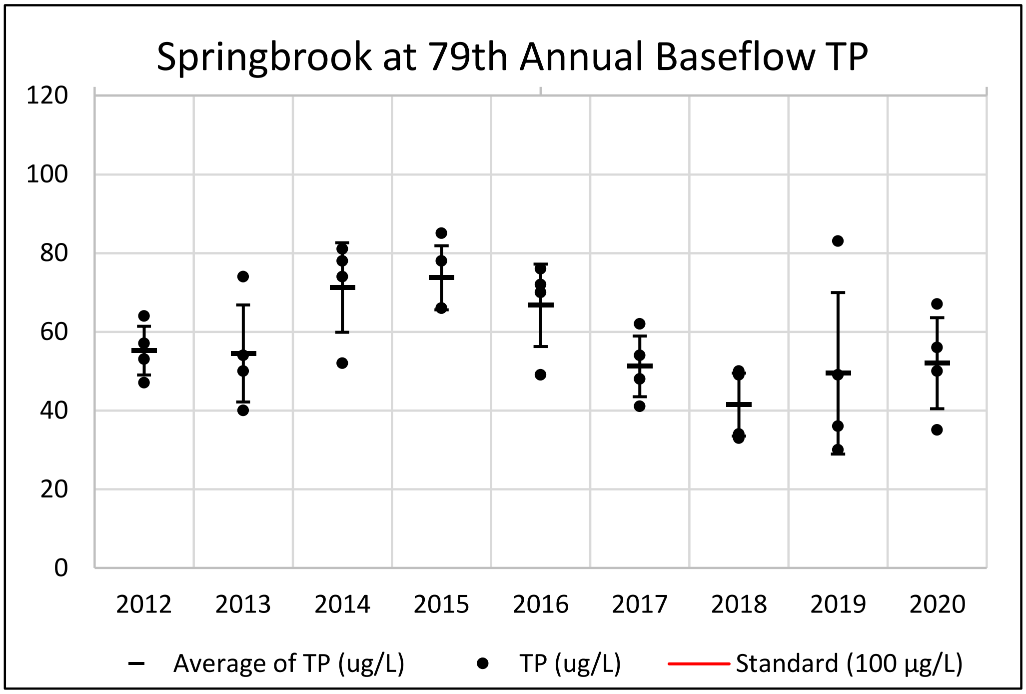
Total phosphorus at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

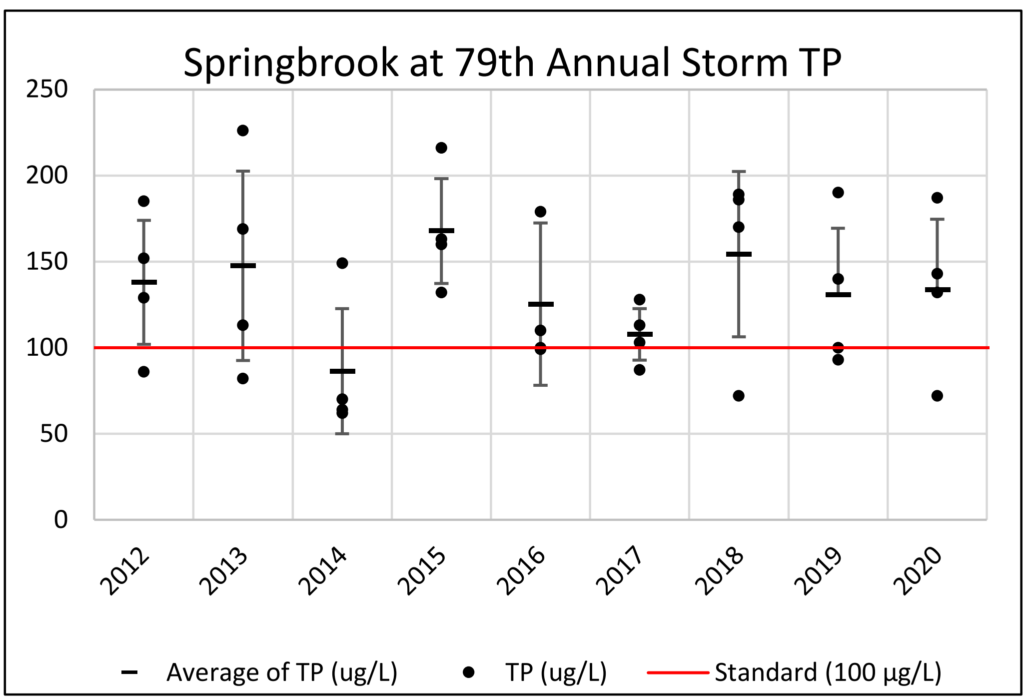




Parameter	Significant Change in Annual $\bar{X}$ (2012-2020)	p=	Standard Error of Means
Total Phosphorus - Baseflow	None	0.22	10.38
Total Phosphorus - Storm	None	0.98	26.12

Springbrook at 79th - Annual average ANOVA regression TP 2012-2020





Total Suspended Solids and Turbidity

TSS and turbidity in Springbrook Creek are generally low during baseflow conditions and elevated following storms. This is most apparent at the 79th Way site. During baseflow conditions TSS concentrations are low at all sites and remain low following storm events at the two upstream sites. Interestingly, there is a large increase in post-storm TSS concentrations between 85th Ave. and 79th Way. The area between the two sites contains a large wetland complex located at the Springbrook Nature Center. These wetlands are potentially being filled in with sediment that is re-suspended and flushed through during storm events or could be coming from bank and bed erosion downstream of the Springbrook Nature Center. After storms, TSS concentrations at 79th way exceed the 30 mg/L state standard 25% of the time.

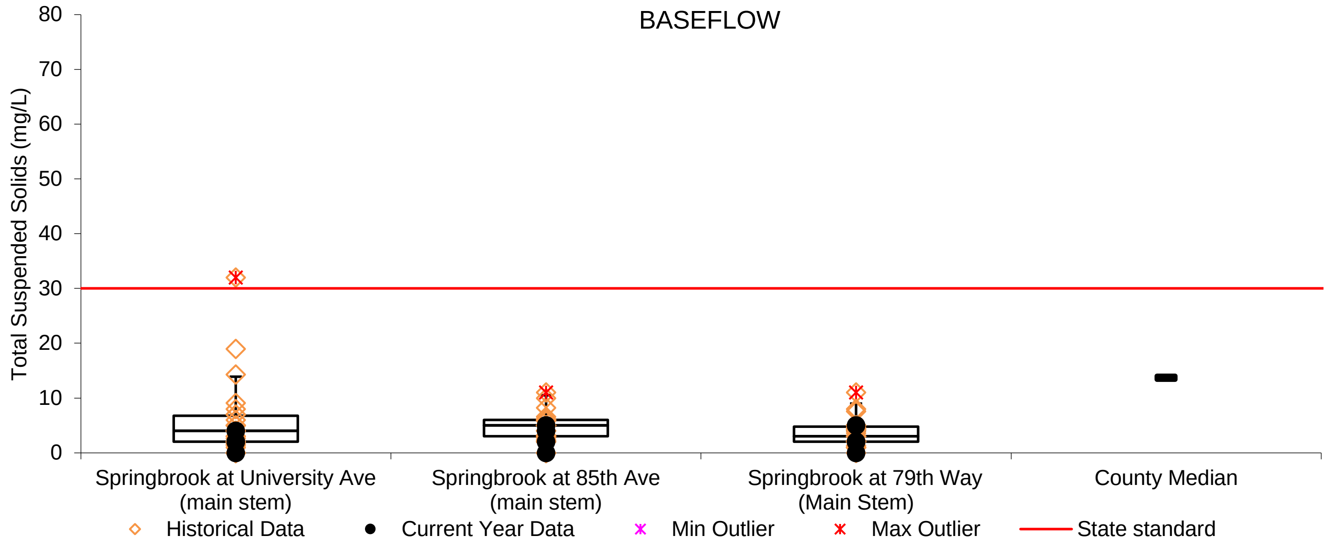
Based on long-term average concentrations, TSS does not increase moving upstream to downstream during baseflow but does during storm flow. The long-term (all years) medians for TSS concentrations post-storms are 3.0, 7.0, and 18.0 mg/L, moving upstream to downstream. The largest likely contributor of TSS to Springbrook Creek is solids transported by stormwater conveyances from impervious surfaces.

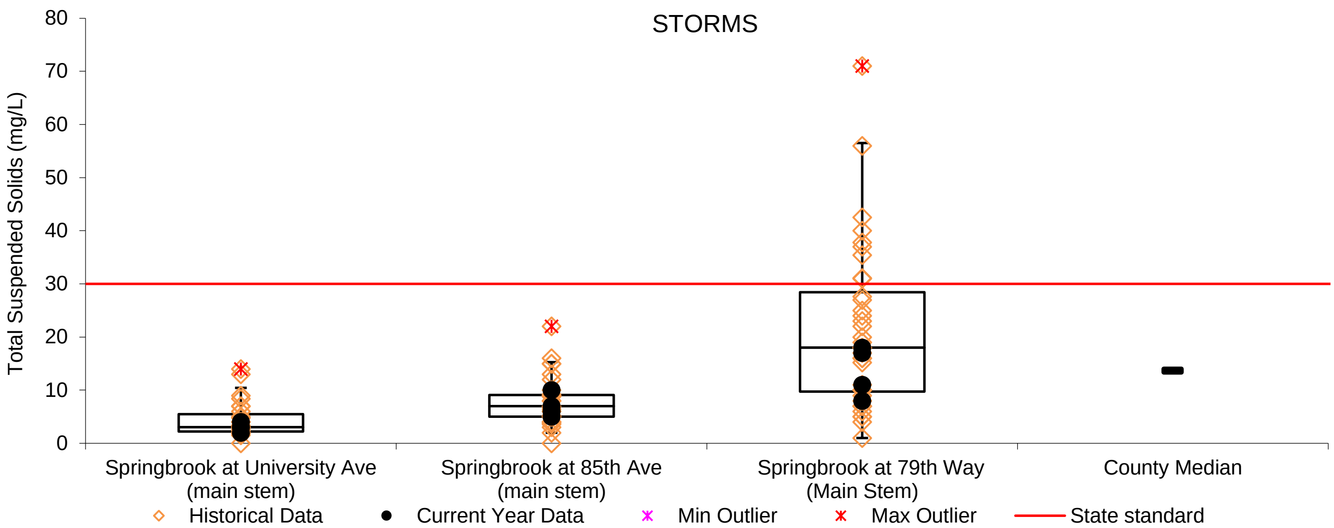
During baseflow conditions, turbidity is similarly low, only exceeding 5.0 NTU on five occasions at 79th Way since 2012. Turbidity does increase during storm flows and follows the same trend of increasing downstream. The long-term median turbidity (all years) post-storms at each site is 4.7, 9.0, and 15.3 NTU respectively from upstream to downstream. This indicates the same source of pollutant loading from downstream stormwater as TSS.

Average and median total suspended solids in Springbrook Creek. Data is from 79th Way for all years through 2020.

	Average Total Suspended Solids (mg/L)	Median Total Suspended Solids (mg/L)	State Standard	N
Baseflow	3.49	3	30 mg/L TSS	36
Storms	21.18	18.00		36
All	12.46	5.0		72
Occasions > state TSS standard				0 baseflow 9 (25%) storm

Total suspended solids at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

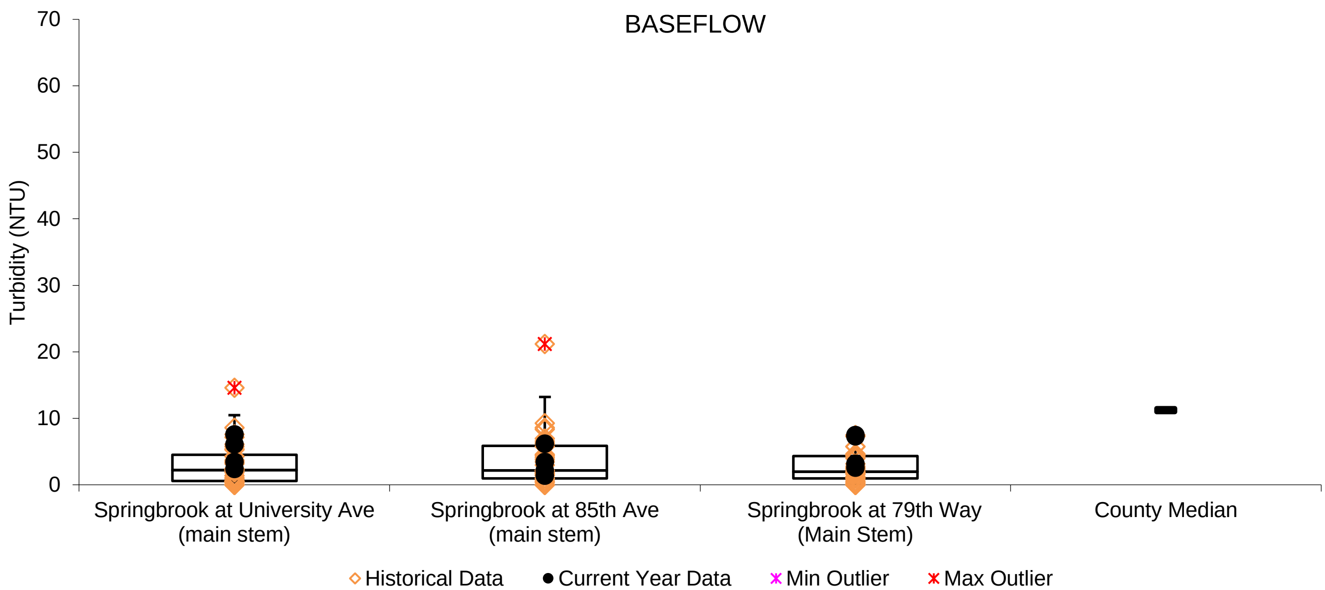


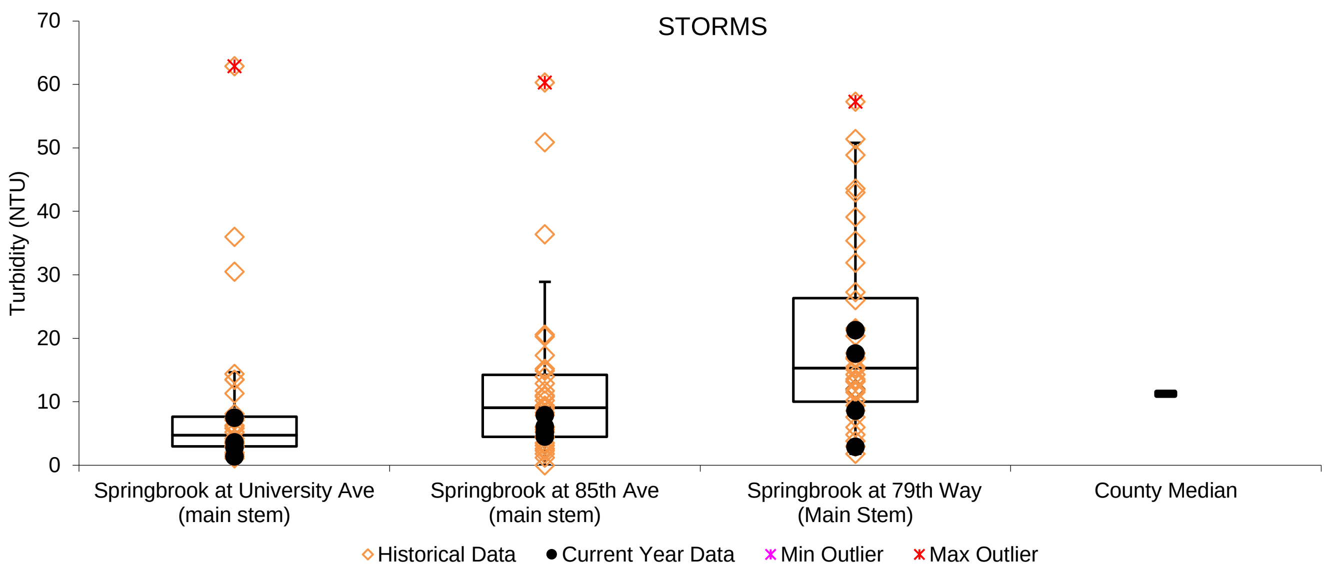


Average and median turbidity in Springbrook Creek. Data is from 79th Way for all years through 2020.

	Average Turbidity (NTU)	Median Turbidity (NTU)	State Standard	N
Baseflow	2.60	2.0	n/a	36
Storms	19.85	15.30		36
All	11.23	5.30		72

Turbidity at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





pH

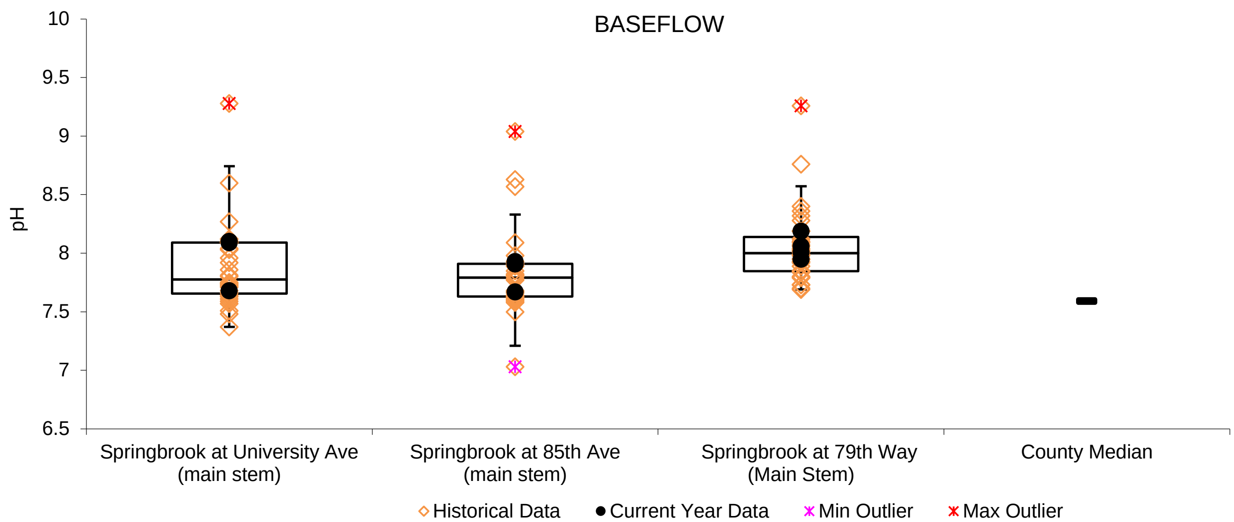
Springbrook Creek generally maintains healthy pH levels within the state water quality standard range of 6.5-8.5. Only a couple of rare outlier readings exceeding 8.5 have occurred.

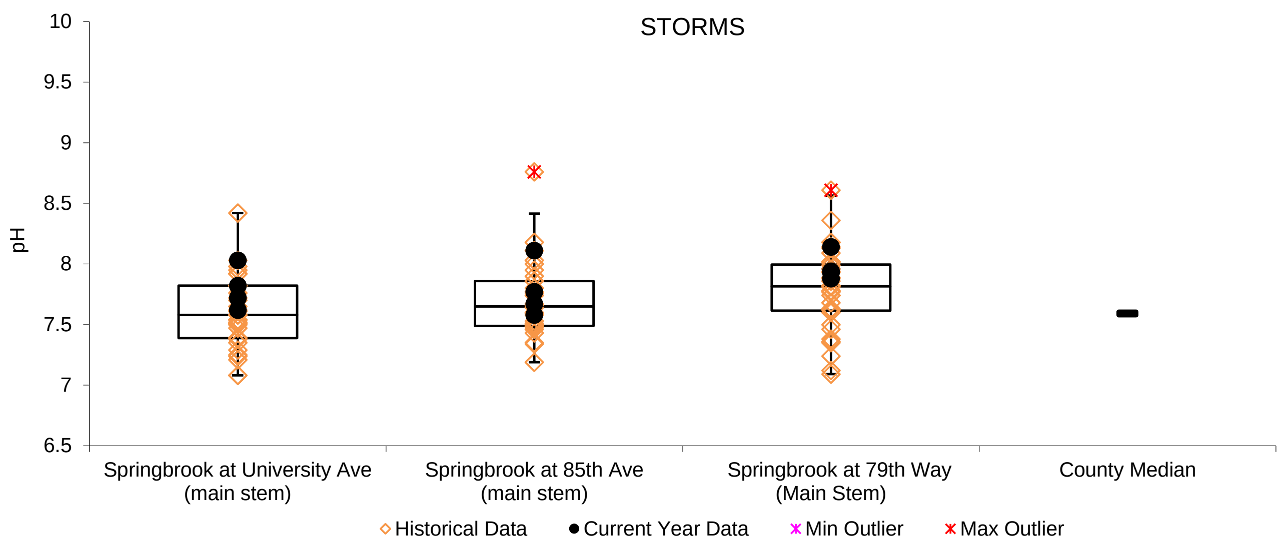
Average and median pH in Springbrook Creek. Data is from 79th Way for all years through 2020.

	Average pH	Median pH	State Standard	N
Baseflow	8.05	8.00	6.5-8.5	36
Storms	7.79	7.81		36
All	7.92	7.93		72
Occasions outside state standard				3*

*****one result questionable*

pH at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





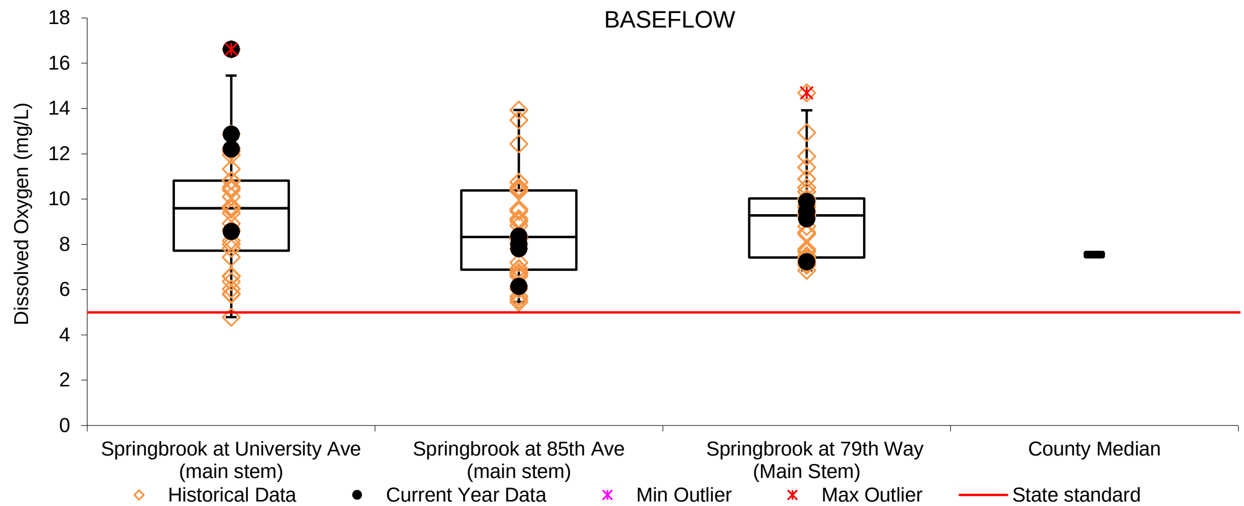
Dissolved Oxygen

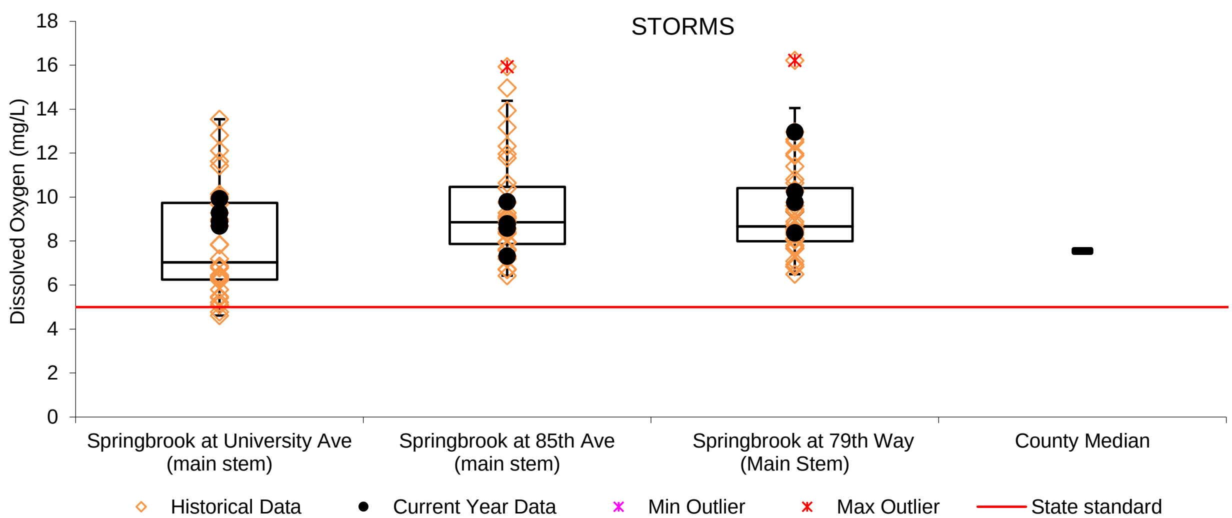
Dissolved Oxygen levels in Springbrook Creek are generally high. There have been a few instances at the furthest upstream site (University Ave.) in which DO has been below or near the state standard of 5.0 mg/L.

Median dissolved oxygen in Springbrook Creek. Data is from 79th Way for all years through 2020.

	Average Dissolved Oxygen (mg/L)	Median Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	9.18	9.28	5 mg/L daily minimum	34
Storms	9.35	8.66		36
All	9.27	9.01		70
Occasions <5 mg/L				0

Dissolved Oxygen at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).





E. coli

The chronic state water quality standard for *E. coli* in streams is based on a calculated geometric mean of not less than five samples in any given calendar month. This mean should not exceed 126 MPN. An additional acute standard of not more than 10% of all samples in a given month should not exceed 1260 MPN is also listed. Because we monitor streams throughout the year, only collecting eight samples total, we do not have sufficient numbers of samples for any given calendar month to calculate geometric means or percentage-based exceedances comparable to these standards

E. coli concentrations during baseflow conditions are usually near the chronic standard of 126 MPN at all of the Springbrook sites. Out of the 96 baseflow samples collected since 2013, *E. coli* has only once exceeded the acute standard of 1260 MPN (Springbrook at University Ave.). Interestingly, during baseflow conditions, median *E. coli* concentrations since 2013 decrease between University Ave. (144.0 MPN) and 85th Ave. (68.5). It seems that the ponds and wetlands located between the two sites are providing some level of treatment during baseflow conditions. However, *E. coli* concentrations tend to rebound again between the 85th Ave and 79th Way sites (132.5 MPN). We saw the opposite trend in 2020 during baseflow conditions with an increase in *E. coli* concentrations between University Ave and 85th Ave and then a slight decrease from 85th Ave to the 79th Way site.

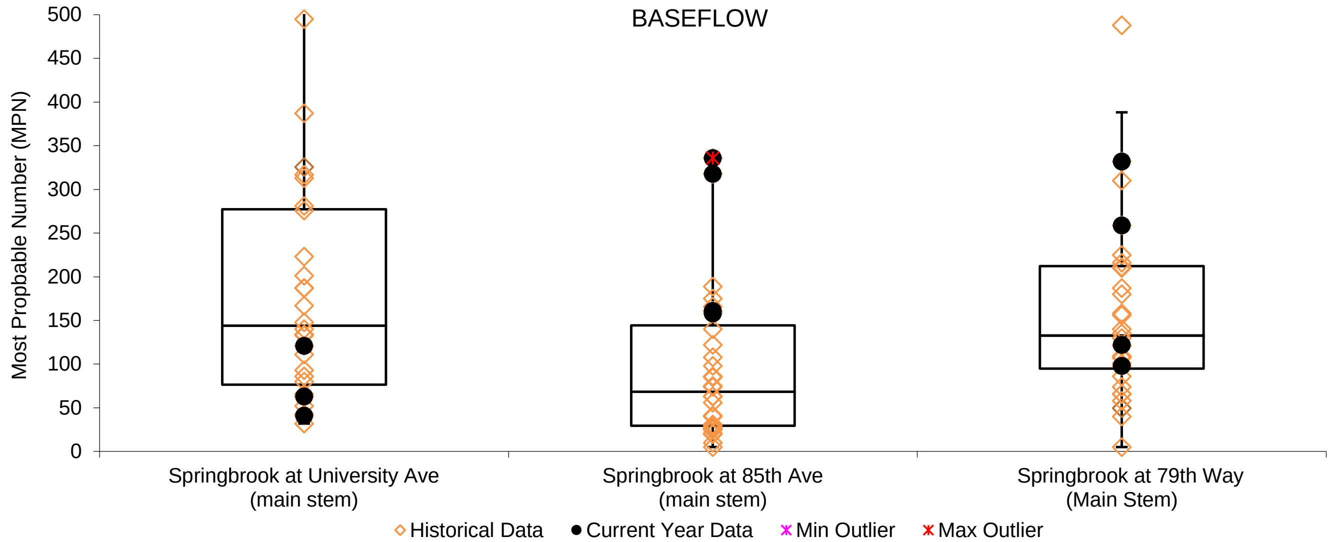
After storm events, *E. coli* tends to be significantly higher (note the difference in scale on the charts below), but the same pattern remains between the sites with the middle site (85th Ave) having lower levels than the upstream site (University Ave). In 2020, *E. coli* concentrations at all of the sites were observed at similar levels following storm events. Median *E. coli* concentrations following storms for all years from upstream to downstream are 1,145, 620, and 866.4 MPN, respectively. These levels are all quite high, and 91% of post-storm samples collected at 79th Way have exceeded 126 MPN and nearly half of the samples collected at 79th way during following storms have exceeded the acute standard of 1260 MPN.

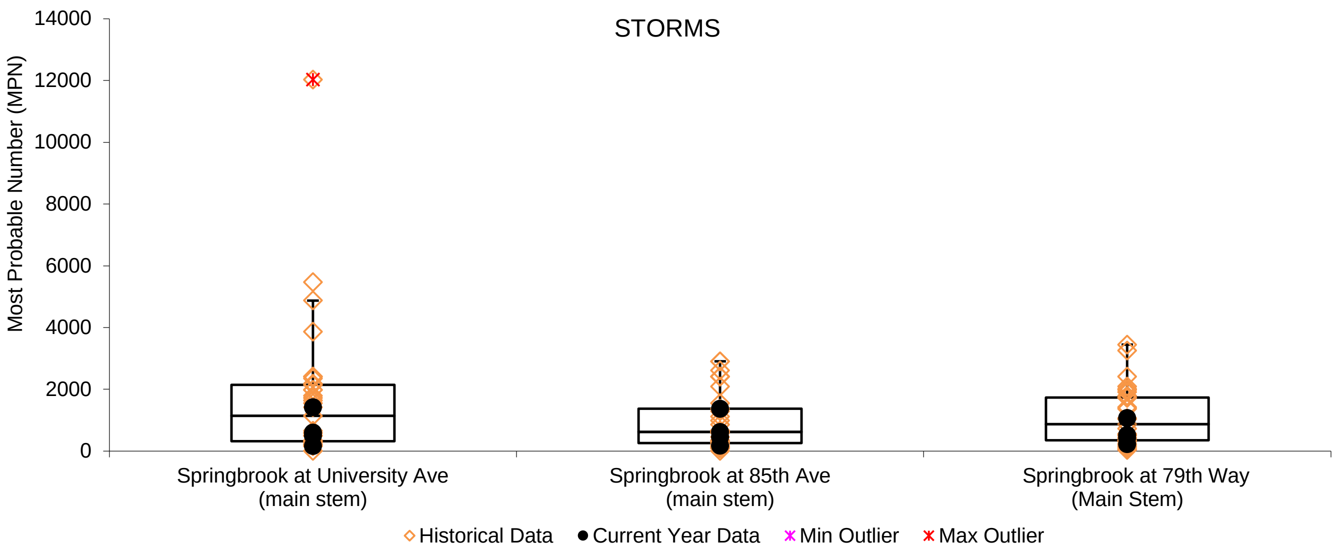
The *E. coli* LDC from the Coon Creek TMDL shows that *E. coli* exceeds acceptable levels often and at all flows.

Average and median *E. coli* in Springbrook Creek. Data is from 79th Way for all years through 2020

	Average *E. coli* (MPN)	**Median *E. coli* (MPN)**	**Geometric Mean**	**State Standard**	**N**
Baseflow	180.16	132.5	130.30	Monthly Geometric Mean >126 Monthly 10% average >1260	32
Storms	1,079.07	866.40	672.31		33
All	636.50	233.0	300.10		65
Occasions >126 MPN **Occasions >1260 MPN**					17 (53%) baseflow, 30 (91%) storm 0 baseflow, 12 (36%) storm

***E. coli* at Springbrook.** Orange diamonds are historical data from previous years and black circles are 2020 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



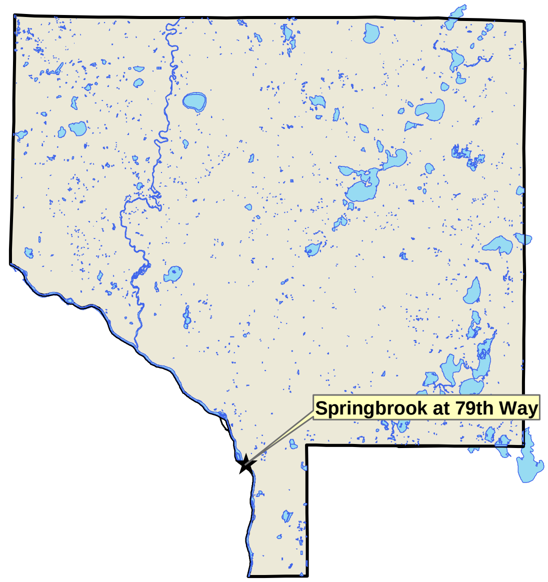


SPRINGBROOK

at 79th Way, Fridley

Notes:

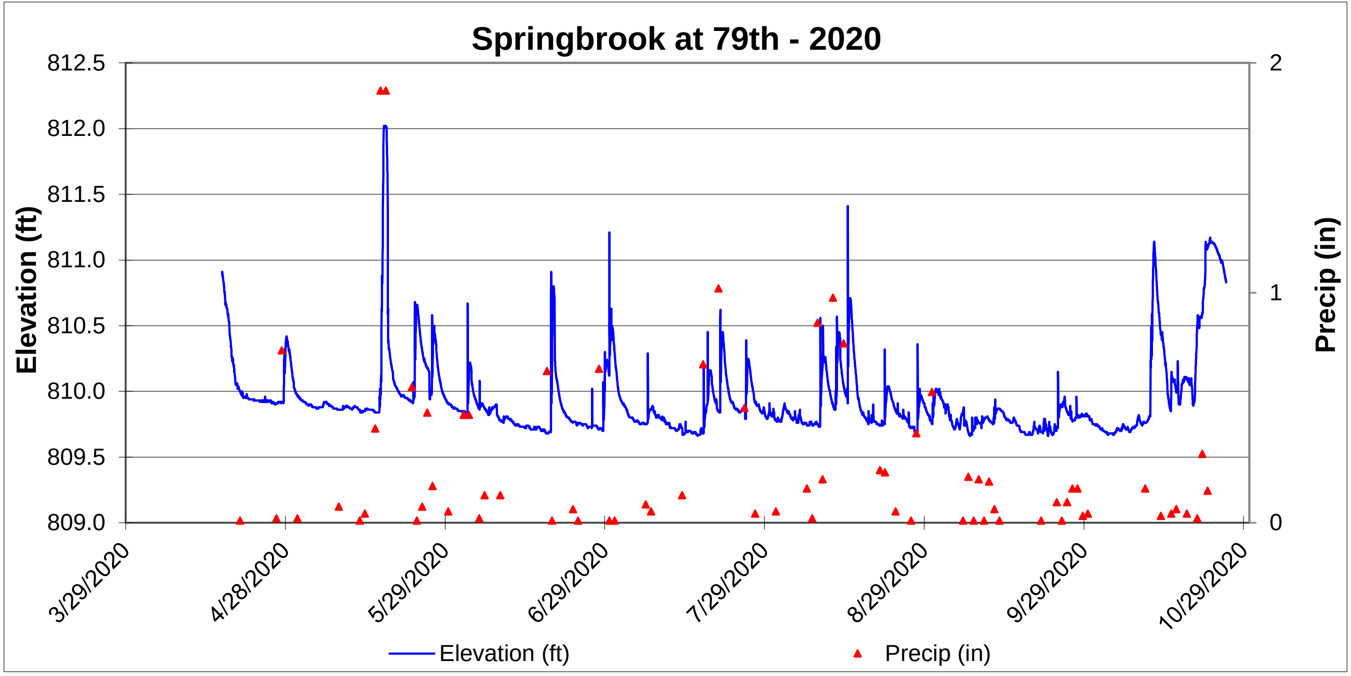
The creek is usually flashy at this site, with water levels rising quickly during rainfall and receding quickly thereafter, despite a likely dampening effect of the Springbrook Nature Center wetland complex just upstream. Logging intervals were shortened from one-hour intervals to 30-minute intervals, to better capture the full range of storm surges.



Throughout the 2020 season, Springbrook Creek at the 79th Way site only fluctuated 2.36 ft. between its highest and lowest measured elevations. This was the smallest fluctuation on record, and 1.28 ft. less than the fluctuation observed in 2019. The maximum elevation recorded was also the lowest on record since stage was first monitored in 2012. Precipitation in 2020 was infrequent and less intense then previous years, with the lowest annual precipitation totals recorded since 2012.

Based on a rating curve developed in 2018, estimated discharge ranged from 0.22 cfs to 28.05 cfs in 2020, with a 50th percentile discharge of 1.80 cfs. The 2018 rating curve is displayed below.

2020 Hydrograph

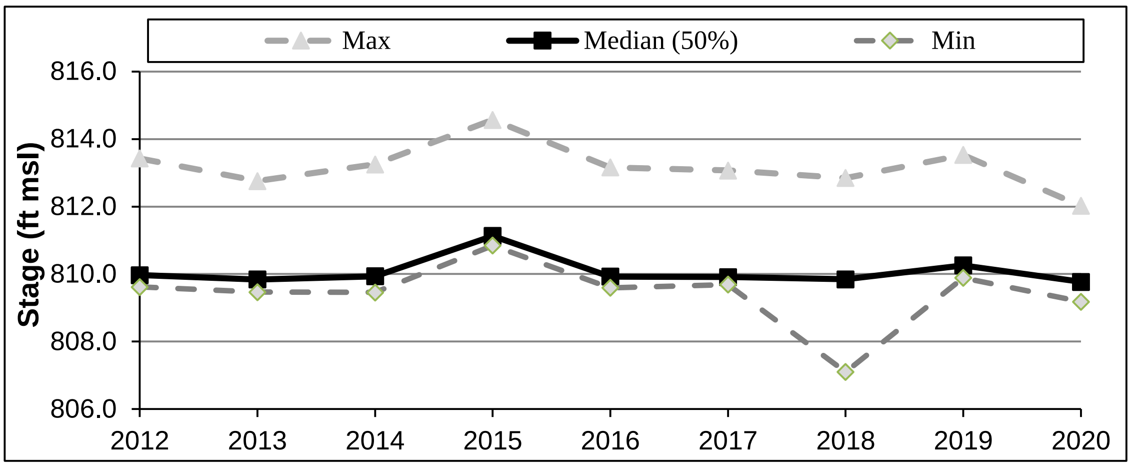


SPRINGBROOK

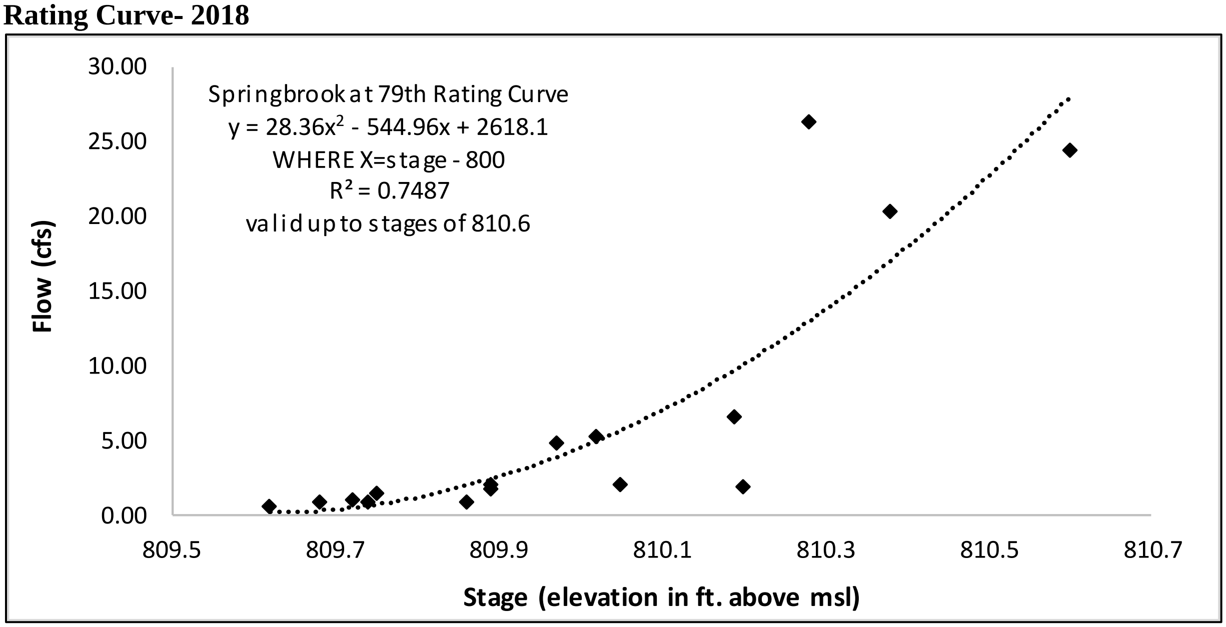
at 79th Way, Fridley

Summary of All Monitored Years

Percentiles	2012	2013	2014	2015	2016	2017	2018	2019	2020
Min	809.62	809.47	809.46	810.85	809.59	809.6883	807.10	809.89	809.18
2.5%	809.65	809.54	809.63	810.91	809.67	809.7217	809.56	809.94	809.18
10.0%	809.69	809.60	809.66	810.96	809.74	809.78	809.59	809.99	809.18
25.0%	809.76	809.67	809.72	811.04	809.79	809.83	809.71	810.05	809.18
Median (50%)	809.97	809.84	809.93	811.13	809.93	809.9133	809.85	810.26	809.77
75.0%	810.29	810.08	811.62	811.30	810.13	810.0967	810.01	811.14	809.91
90.0%	811.24	810.71	812.99	811.73	810.50	810.41	810.27	812.04	810.15
97.5%	812.87	812.17	813.18	812.63	811.28	811.5063	810.65	813.10	810.78
Max	813.43	812.76	813.25	814.57	813.16	813.0717	812.85	813.53	812.02



Rating Curve- 2018



WETLAND HYDROLOGY

Description: Continuous groundwater level monitoring at a wetland boundary. Countywide, the ACD maintains a network of 23 wetland hydrology monitoring stations.

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

Locations: Bannochie Wetland, SW of Main St and Radisson Rd, Blaine

Bunker Wetland, Bunker Hills Regional Park, Andover
(middle and edge of Bunker Wetland are monitored)

Camp Three Wetland, Carlos Avery WMA on Camp Three Road, Columbus Township

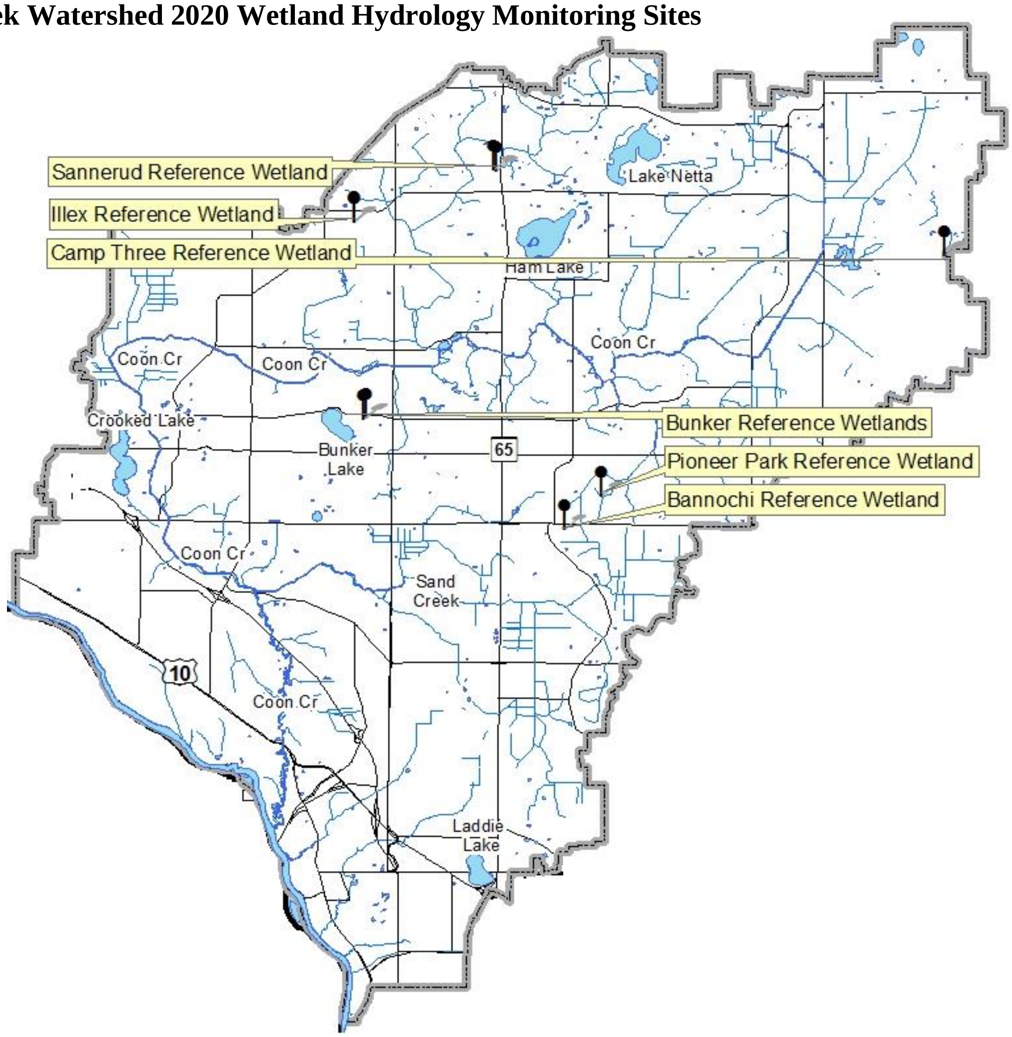
Ilex Wetland, City Park at Ilex St and 159th Ave, Andover
(middle and edge of Ilex Wetland are monitored)

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

Sannerud Wetland, W side of Hwy 65 at 165th Ave, Ham Lake
(middle and edge of Sannerud Wetland are monitored)

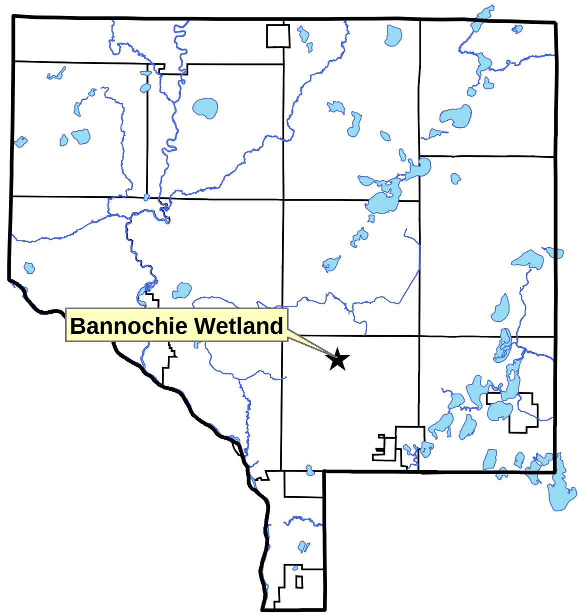
Results: See the following pages.

Coon Creek Watershed 2020 Wetland Hydrology Monitoring Sites



BANNOCHIE REFERENCE WETLAND

SE quadrant of Radisson Rd and Hwy 14, Blaine



Site Information

Monitored Since: 1997

Wetland Type: 2

Wetland Size: ~21.5 acres

Isolated Basin? No

Connected to a Ditch? Yes, on edges, but not the interior of wetland

Soils at Well Location:

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

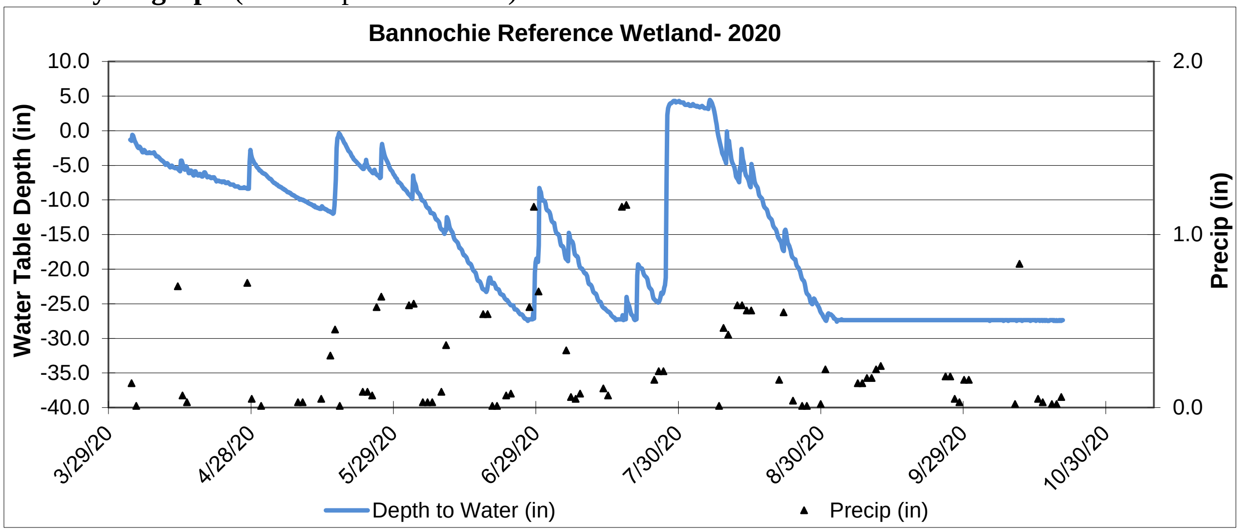
Surrounding Soils: Rifle and some Zimmerman fine sand

Vegetation at Well Location:

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

Other Notes: This well is not at the wetland boundary, but rather is within the basin. Intense residential construction has occurred nearby in recent years, including construction dewatering. Annual precipitation was below average in 2020 and resulted in equipment bottoming out. Equipment infrastructure will be adjusted in 2021 to reach deeper depths.

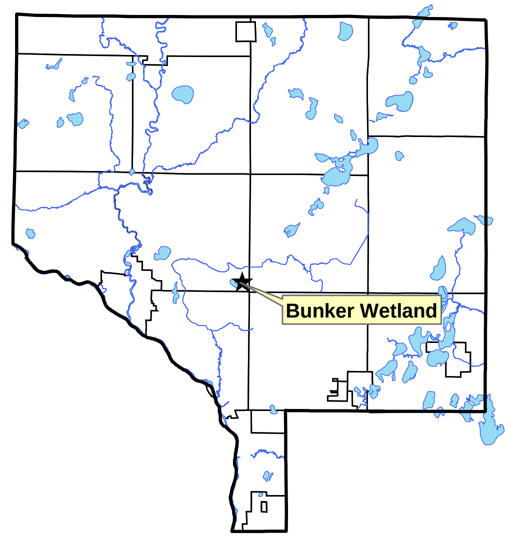
2020 Hydrograph (Well Depth -27 inches)



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	-

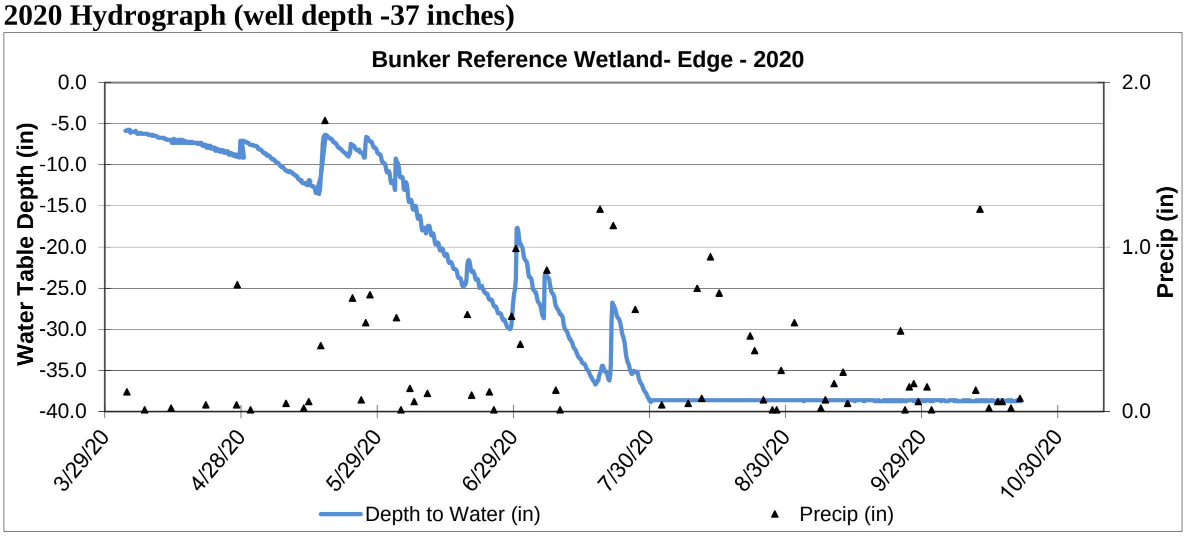
Surrounding Soils: Zimmerman fine sand

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 in. 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. Annual precipitation was below average in 2020 resulting in water levels being below the equipment late in the season.

2020 Hydrograph (well depth -37 inches)

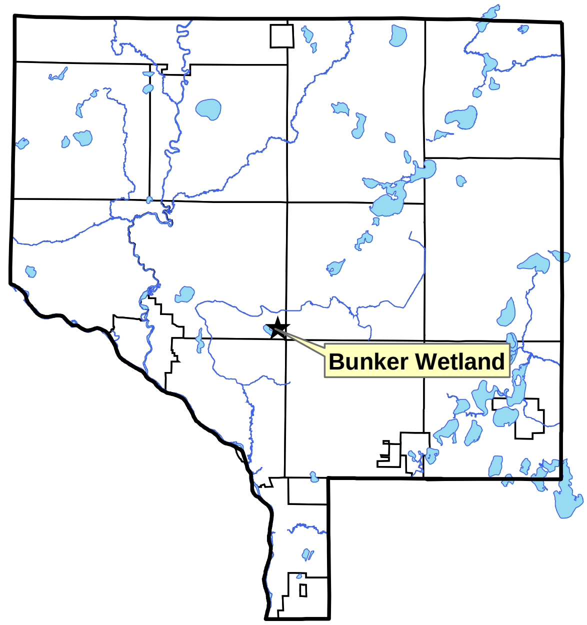


Wetland Hydrology Monitoring

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	-

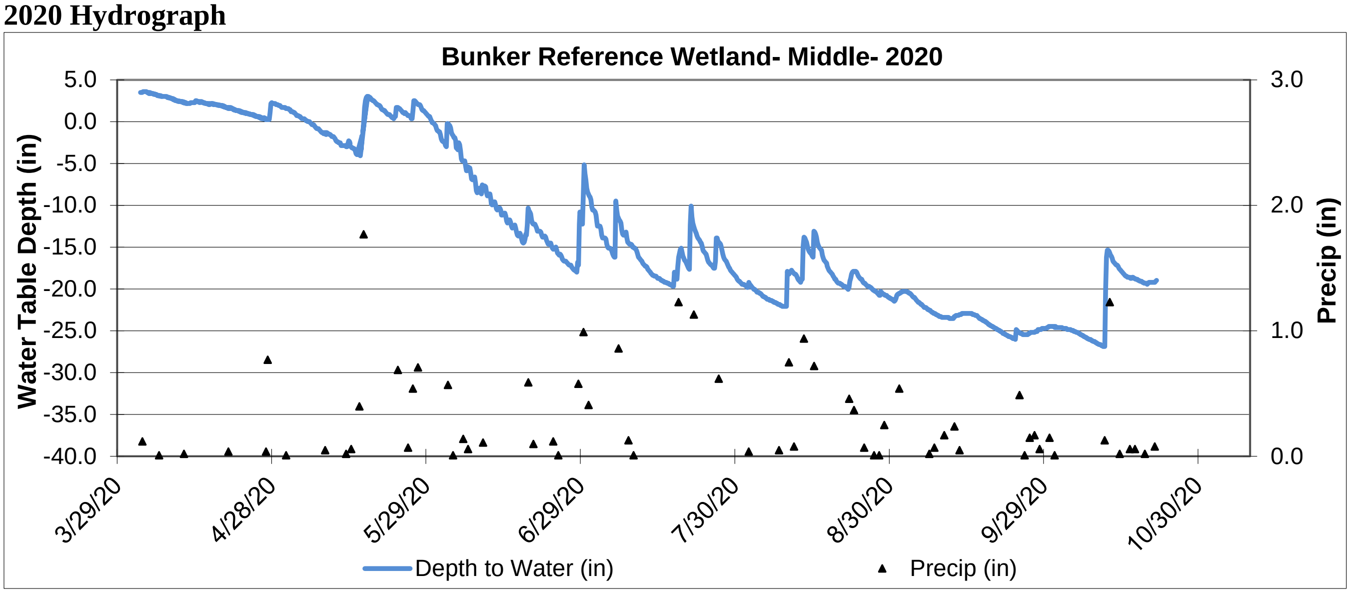
Surrounding Soils: Zimmerman fine sand

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.

2020 Hydrograph

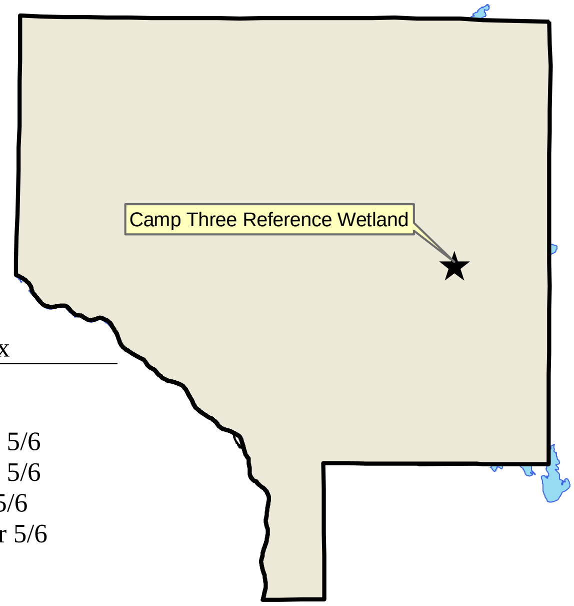


Wetland Hydrology Monitoring

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

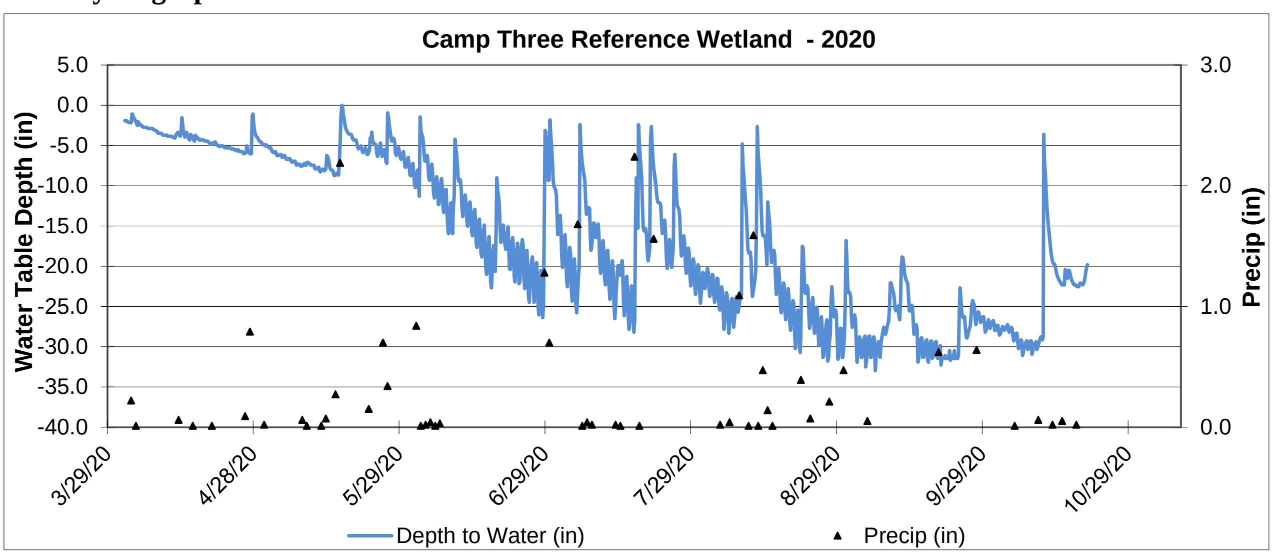
Surrounding Soils: Zimmerman Fine Sand

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. Water levels bounce constantly throughout the year. Water control structures in the Carlos Avery Wildlife Management Area may effect water levels at this site.

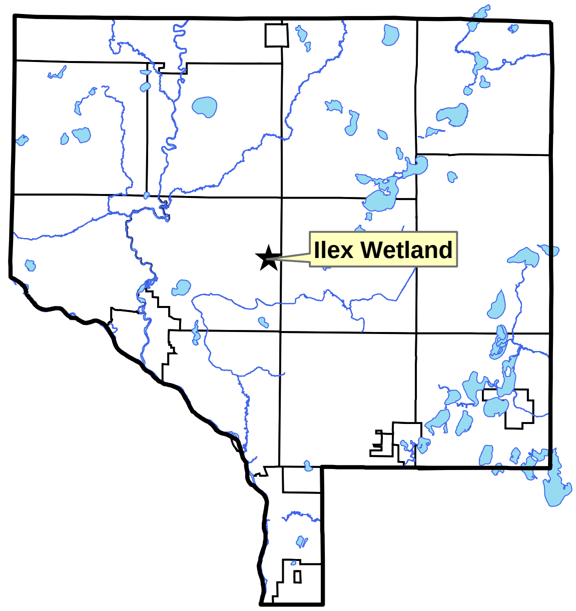
2020 Hydrograph



Wetland Hydrology Monitoring

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	-

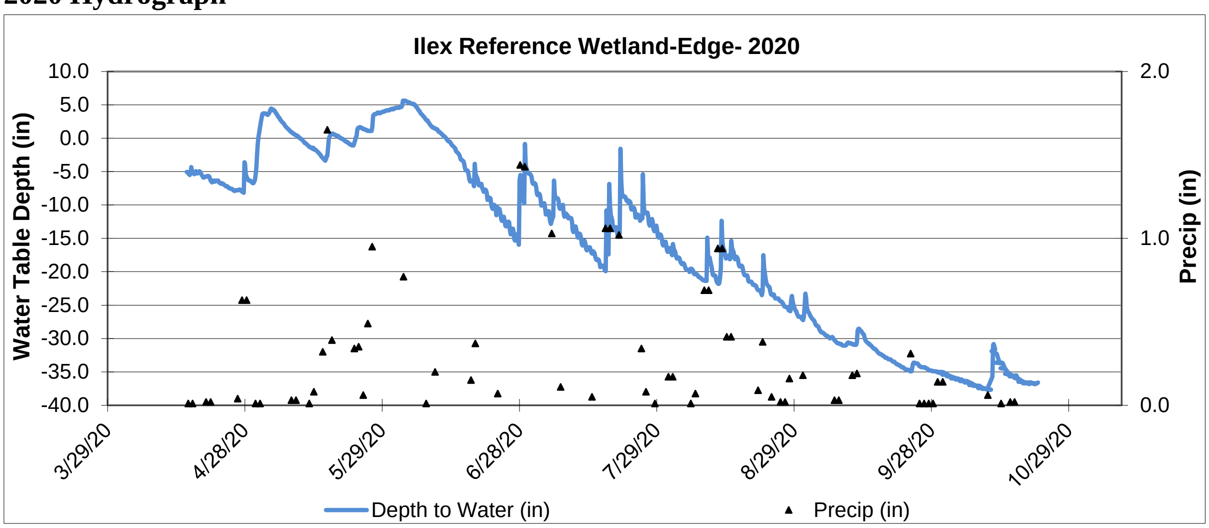
Surrounding Soils: Loamy wet sand and Zimmerman fine sand

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.

2020 Hydrograph



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

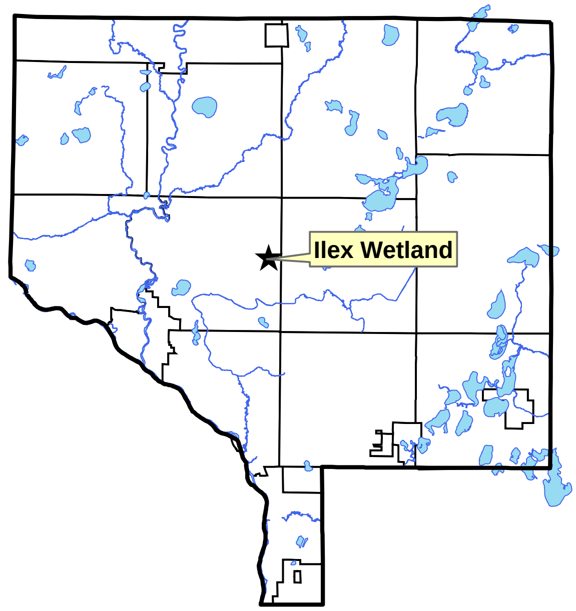
Isolated Basin? Yes

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

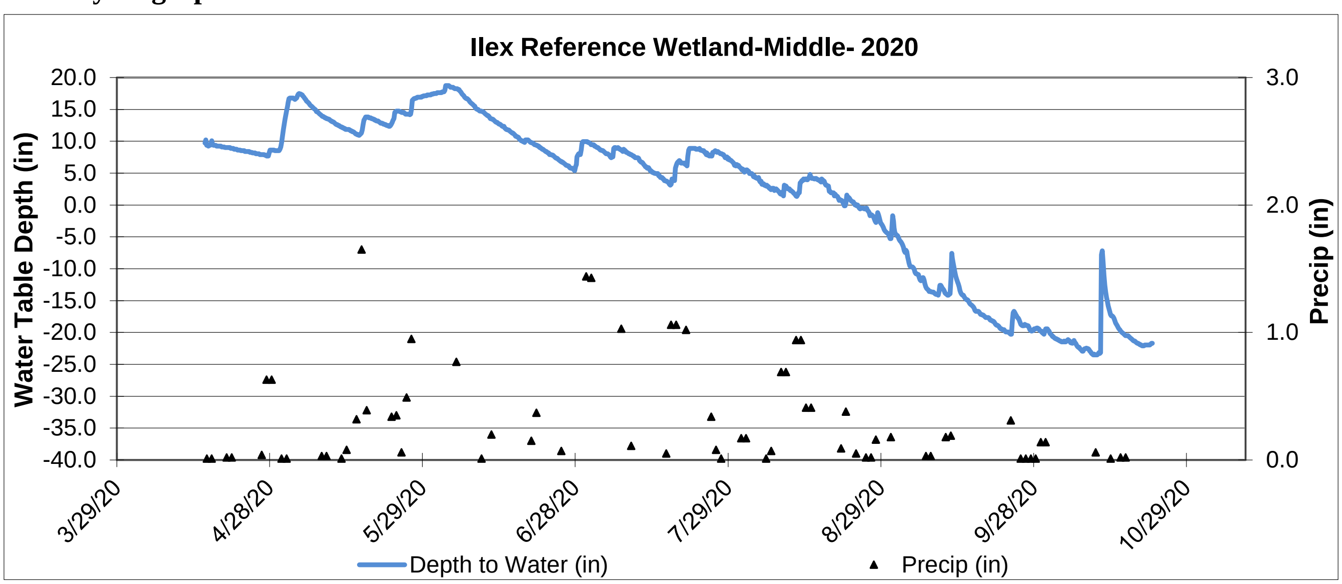


Vegetation at Well Location:

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.

2020 Hydrograph

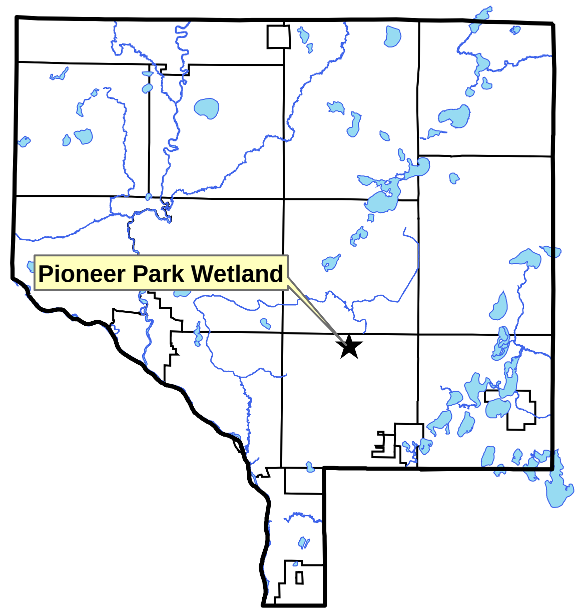


Wetland Hydrology Monitoring

PIONEER PARK REFERENCE WETLAND

Pioneer Park N Side of Main St. E of Radisson Road, Blaine

Site Information



Monitored Since:	2005
Wetland Type:	2
Wetland Size:	Undetermined. Part of a large wetland complex.
Isolated Basin?	No
Connected to a Ditch?	Not directly.Wetland complex has small drainage ways, culverts, & nearby ditches.

Soils at Well Location:

Horizon	Depth	Color	Texture	Redox
Oa1	0-4	10yr 2/1	Sapric	-
Oa2	4-8	N 2/0	Sapric	-
AB	8-12	10yr 3/1	Mucky Sandy Loam	-
Bw	12-27	2.5y 5/3	Loamy Sand	-
Bg	27-40	2.5y 5/2	Loamy Sand	-

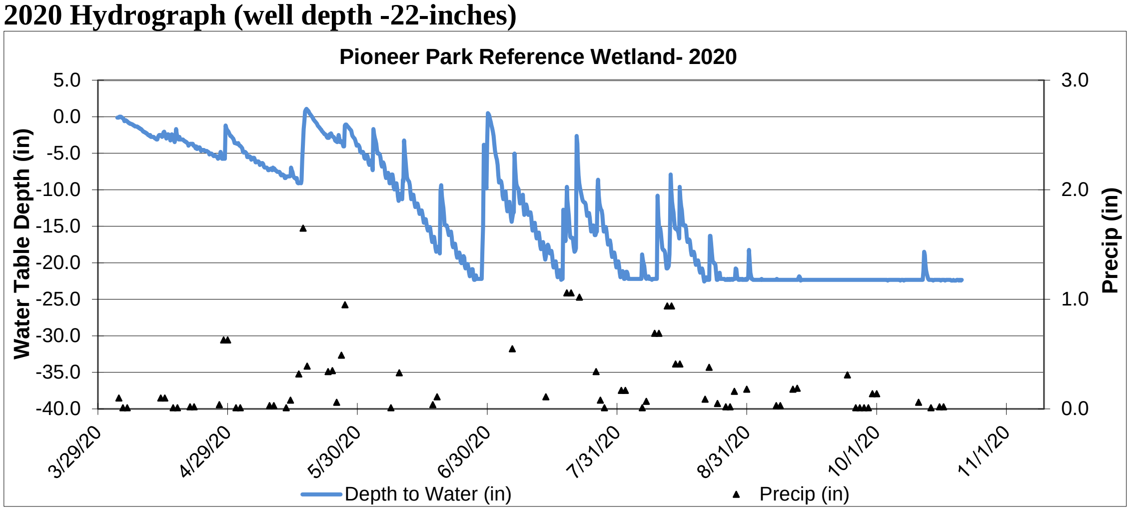
Surrounding Soils: Rifle and loamy wet sand.

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Carex lacustris	Lake Sedge	20
Fraxinus pennsylvanica (T)	Green Ash	30
Rhamnus frangula (S)	Glossy Buckthorn	20
Ulmus americana (T)	American Elm	20
Populus tremuloides (S)	Quaking Aspen	20
Urtica dioica	Stinging Nettle	10

Other Notes: This well is located within the wetland, not at the edge. Low precipitation totals led to equipment bottoming out for the first time in 2020. This was not noticed before because water levels were always higher when OTT's began being used in 2016. Infrastructure will be adjusted in 2021 to reach deeper depths.

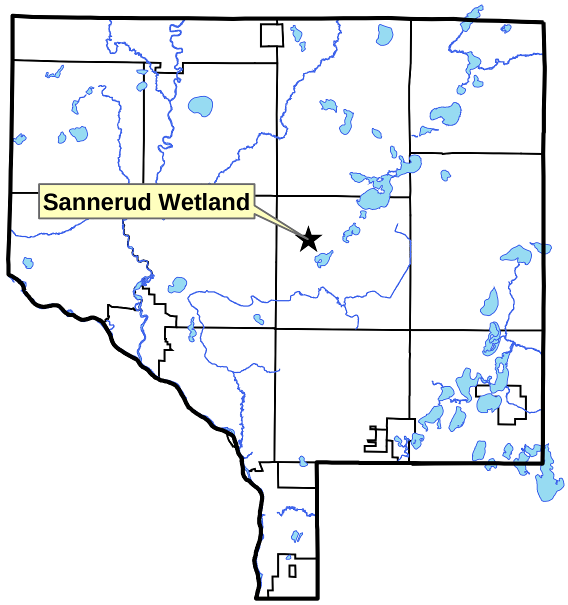
2020 Hydrograph (well depth -22-inches)



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	-

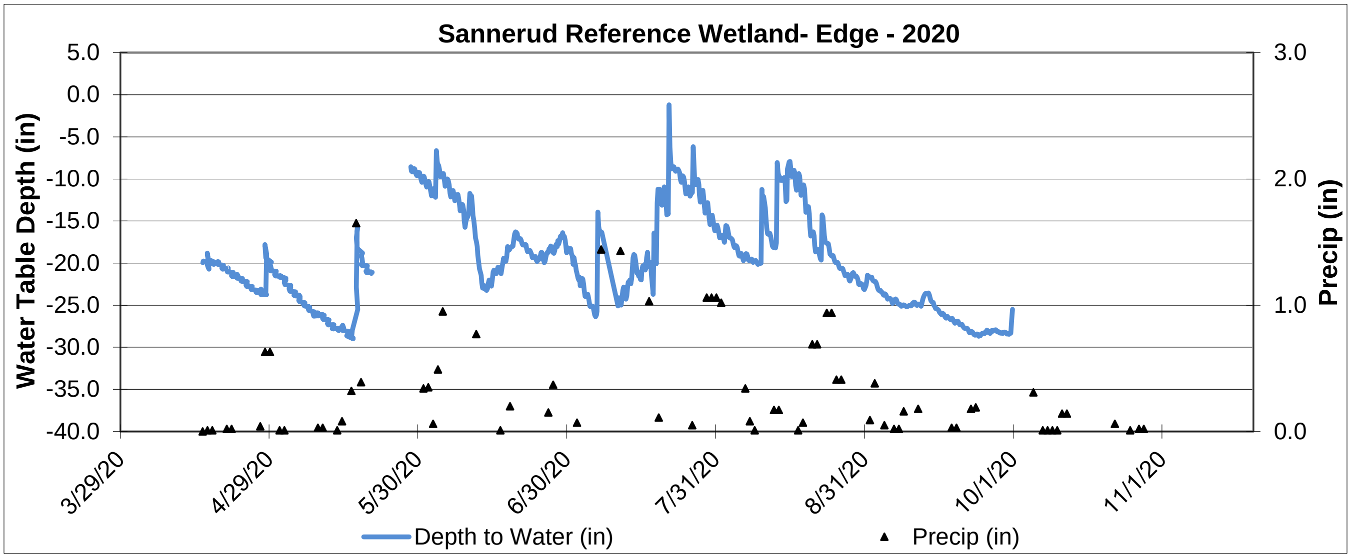
Surrounding Soils: Zimmerman and Lino.

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. Equipment was malfunctioning throughout the season and will be replaced in 2021.

2020 Hydrograph (data gap in late May due to logger malfunction)



SANNERUD REFERENCE WETLAND - MIDDLE

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

Site Information

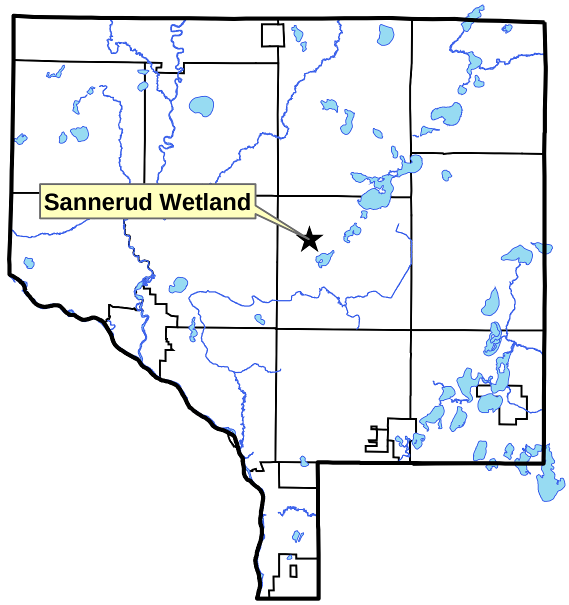
Monitored Since: 2005

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	-

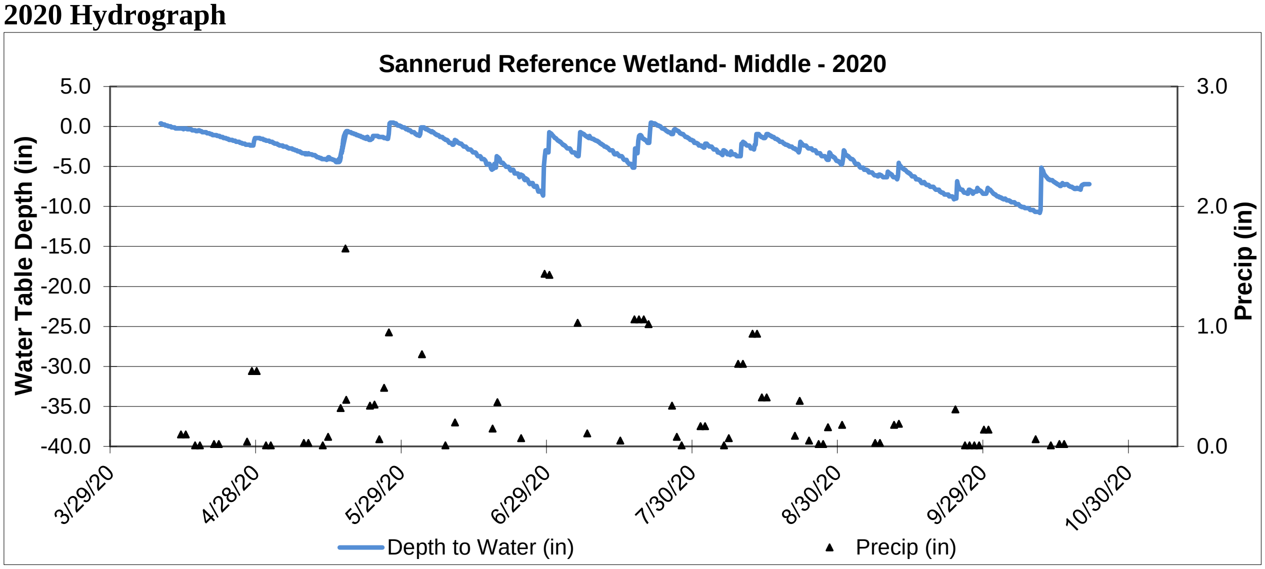
Surrounding Soils: Zimmerman and Lino.

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.

2020 Hydrograph



Reference Wetland Analyses

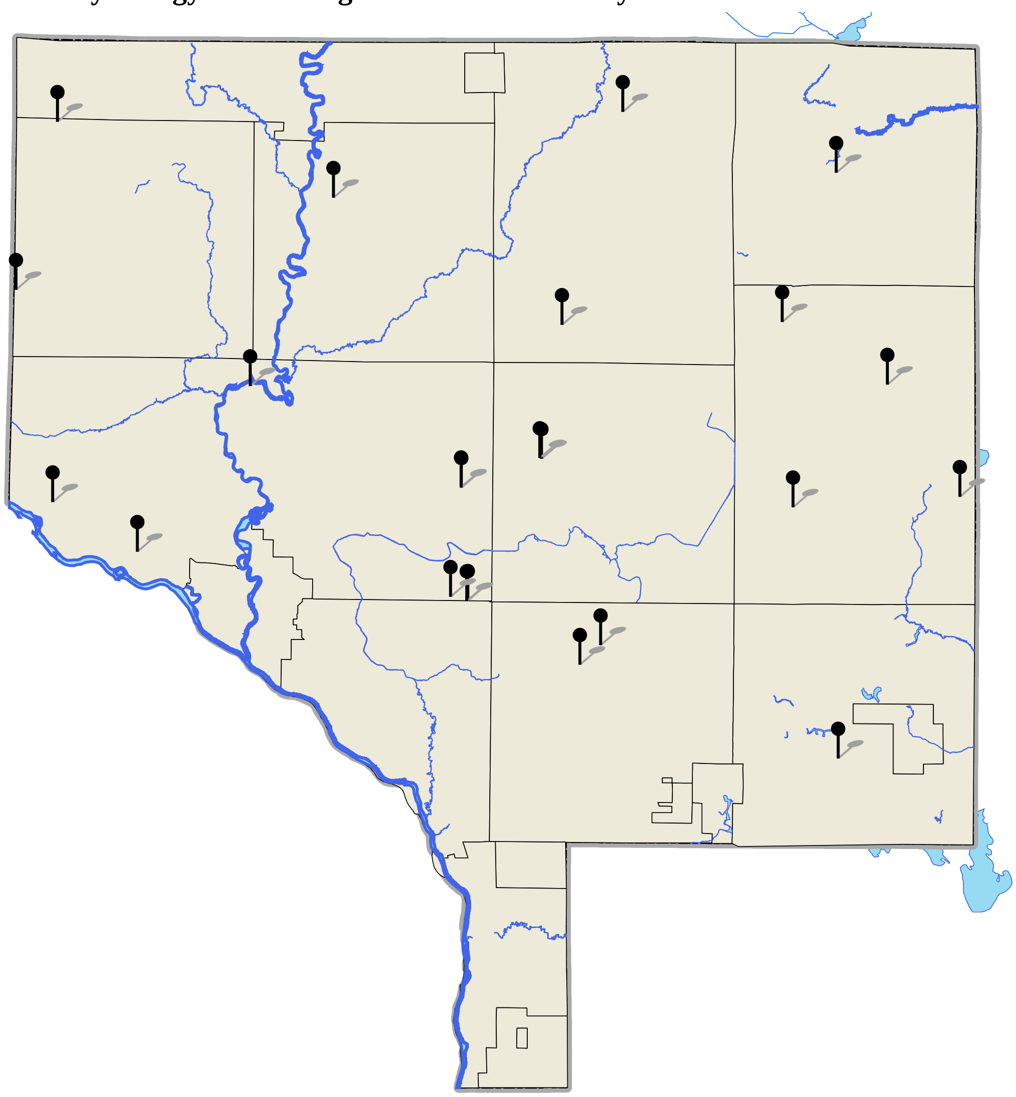
Description: This section includes analyses of wetland hydrology data of 19 reference wetland wells collected at 19 locations. Shallow groundwater levels at the edge of these wetlands are recorded every four hours. Many have been monitored since 1996. These analyses summarize this enormous multi-year, multi-wetland dataset. A database summarizing all of the data is now available online through the ACD website. 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 hydrological conditions in monitored 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.

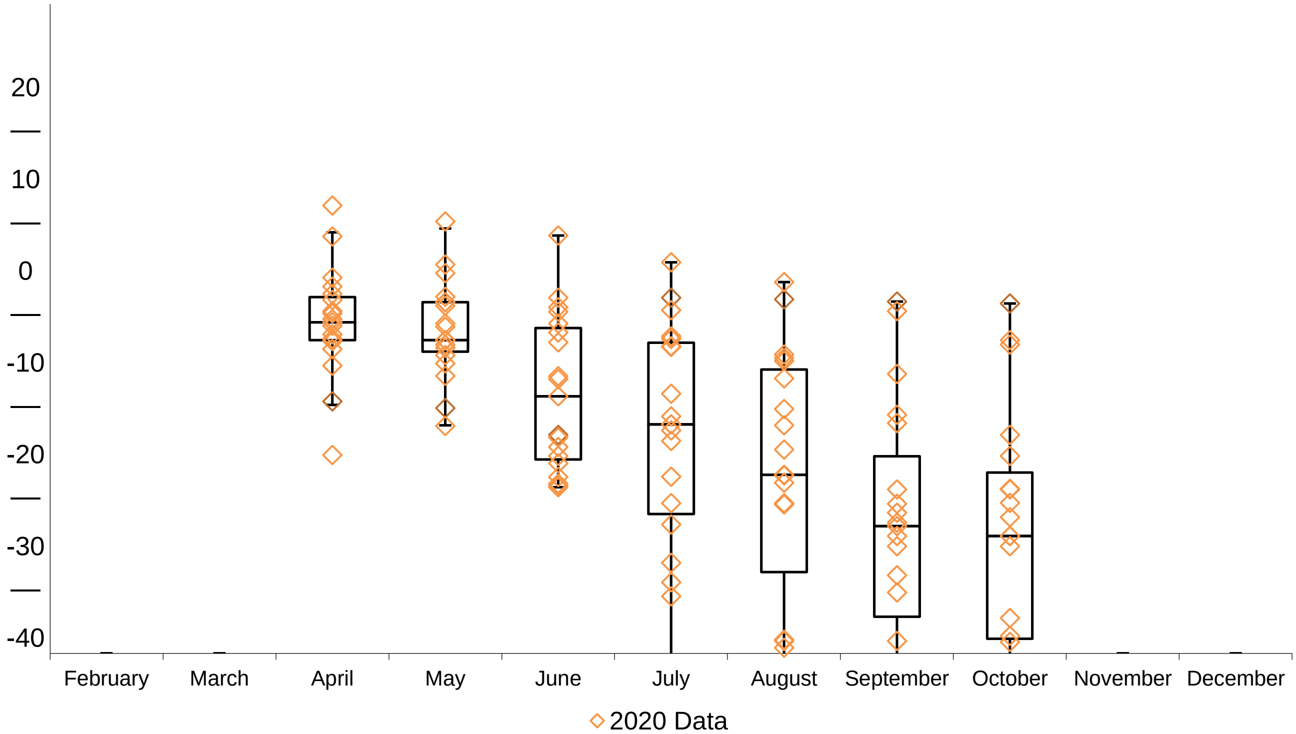
Locations: 19 reference wetland hydrology monitoring sites in Anoka County.

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



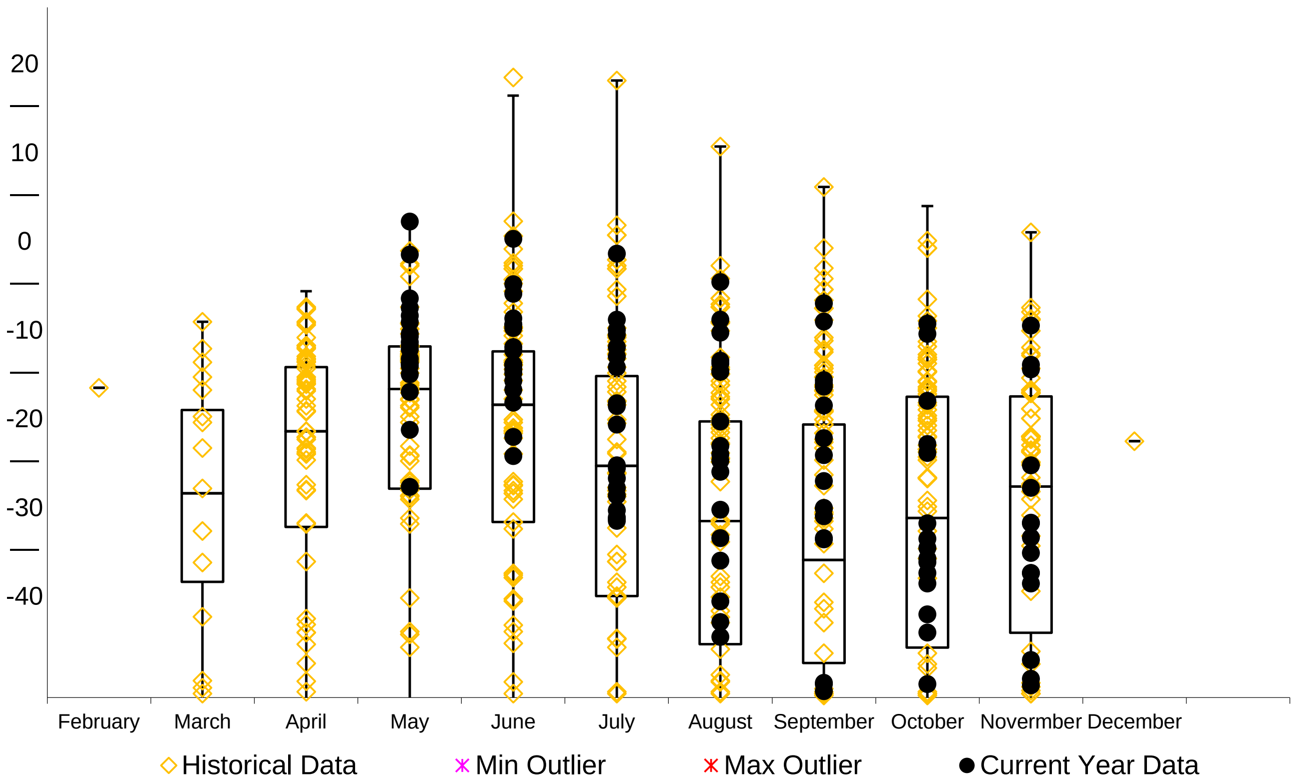
2020 Reference Wetland Water Levels Summary: Each marker represents the median depth to the water table at the edge of one reference wetland for a given month in 2020. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines). Maximum well depths were 40 to 45 in, so a reading < -40 in. likely indicates water was below the well at an unknown depth.



Quantiles

Month	Min	10%	25%	Median	75%	90%	Max
5	-18.6	-9.8	-6.2	-4.3	-1.6	1.4	8.3
6	-15.5	-10.8	-7.5	-6.2	-2.2	1.2	6.5
7	-22.1	-21.8	-19.1	-12.3	-4.9	-2.5	5.0
8	-41.0	-32.6	-25.0	-15.3	-6.5	-2.7	2.2
9	-42.8	-39.6	-31.2	-20.8	-9.4	-6.6	0.0
10	-43.0	-40.9	-36.0	-26.3	-18.8	-8.5	-2.1
11	-43.0	-41.5	-38.4	-27.4	-20.5	-6.6	-2.3

1996-2020 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 2018. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines).



Quantiles

Month	Min	10%	25%	Median	75%	90%	Max
2	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
3	-41.6	-39.1	-28.3	-19.3	-10.8	-6.4	-1.9
4	-41.6	-33.5	-22.7	-13.0	-6.5	-2.7	1.2
5	-41.6	-30.1	-18.8	-8.7	-4.4	-1.0	8.3
6	-50.5	-34.5	-22.2	-10.3	-4.9	0.4	22.9
7	-67.9	-39.1	-29.7	-16.5	-7.4	-2.5	22.6
8	-50.3	-39.8	-34.6	-22.1	-12.0	-4.9	15.9
9	-48.8	-40.4	-36.5	-26.1	-12.3	-5.6	11.8
10	-45.0	-40.1	-35.0	-21.8	-9.5	-4.1	9.8
11	-46.9	-40.0	-33.5	-18.6	-9.5	-4.9	7.2
12	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0

Maximum well depths were 40 to 45 in., so a reading < -40 in. likely indicates water was below the well at an unknown depth.

Discussion:

The purpose of reference wetland data is to help ensure 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, excavating, 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. 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 dispute, 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 documented 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.

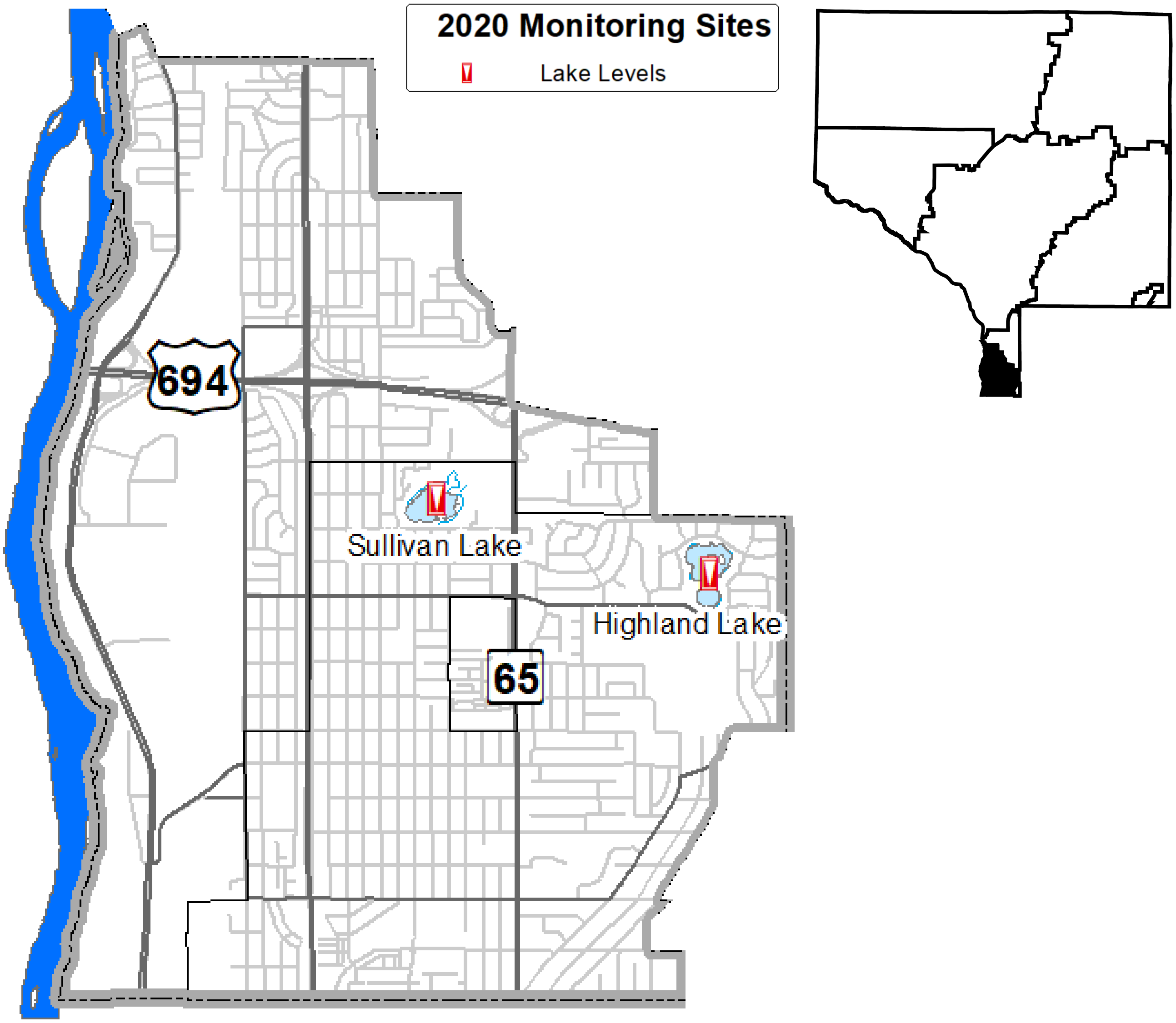
This approach can be refined by examining data from only the year of interest and only certain wetland types. This removes much of the variation that is due to climatic variation among years and due to wetland type. Substantial variation in water levels will no doubt remain among wetlands even after 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 23 reference wetland wells (except during winter), and the raw water level data are available through the Anoka Conservation District monitoring database.

Chapter 7: Mississippi Watershed

Prepared by the Anoka Conservation District

Chapter 7: Mississippi Watershed Management Organization



Lake Levels

Partners: MWMO, ACD, MN DNR, City of Columbia Heights, volunteers

Description: Weekly water level monitoring in lakes. These data, as well as all additional historical data are available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

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

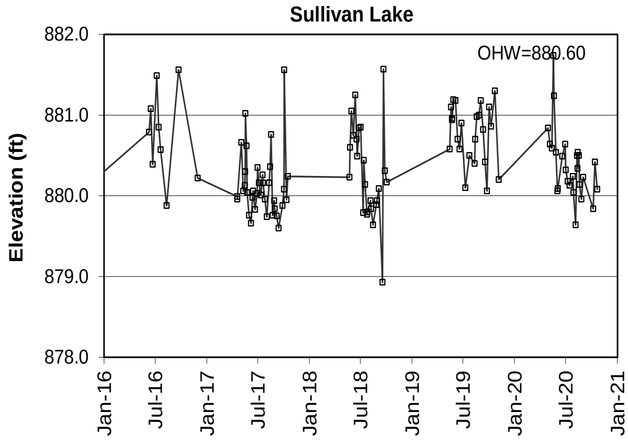
Locations: Sullivan/Sandy Lake, Highland Lake

Results: Lake levels were measured 25 times at Highland Lake and 26 times at Sullivan/Sandy, April through October of 2020. Sullivan Lake water levels typically fluctuate rapidly, routinely bouncing by half a foot in response to single rainfall events due to the volume of stormwater directed to the lake and its small basin size. In 2020, Sullivan levels fluctuated more than in previous years, 2.1 feet in total, and reached the highest elevation documented since 2002 (881.74). This elevation was recorded in May following a 2.93-inch rain event that ended the night before the reading was taken.

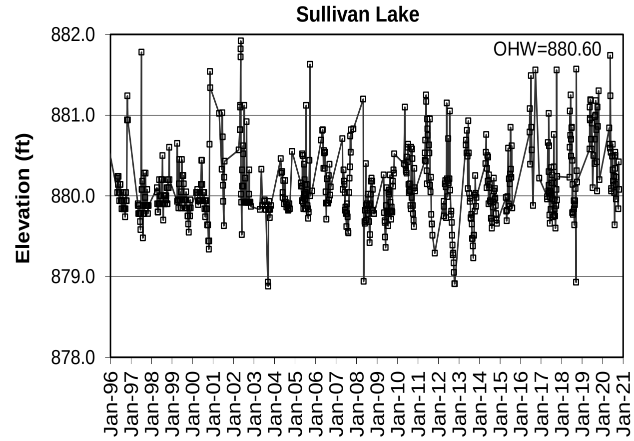
2020 water levels on Highland Lake were similar to previous years on average, and fluctuated only 0.38 feet throughout the season. Both of these lakes have controlled outlet structures which help prevent flooding.

Raw lake level data for all sites and all years can be downloaded from the Minnesota DNR website using the "LakeFinder" tool. Ordinary High Water Levels (OHW), the elevation below which a DNR permit is needed to perform work, are listed for each lake on the graph below.

Sullivan/Sandy Lake Levels last 5 years

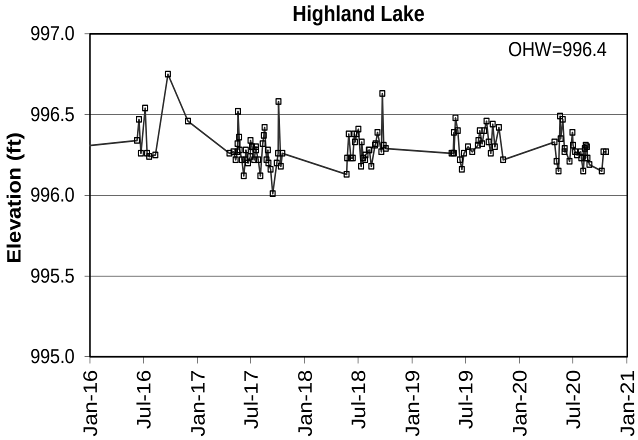


Sullivan/Sandy Lake Levels last 25 years

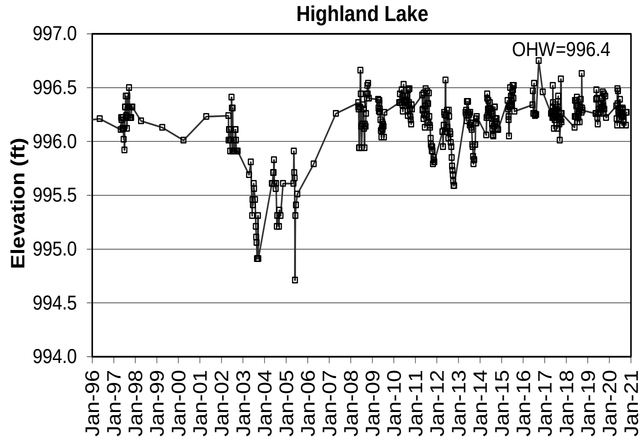


Year	Average	Min	Max
2016	880.76	879.88	881.56
2017	880.13	879.6	881.56
2018	880.29	878.93	881.57
2019	880.77	880.06	881.3
2020	880.38	879.64	881.74
5-year	880.39	878.93	881.74

Highland Lake Levels last 5 years



Highland Lake Levels last 25 years



Year	Average	Min	Max
2016	996.40	996.24	996.75
2017	996.27	996.01	996.58
2018	996.30	996.13	996.63
2019	996.32	996.16	996.48
2020	996.3	996.15	996.49
5-year	996.31	996.01	996.75

Recommendations

- **Continue to monitor water quality and water levels** on Highland and Sullivan Lakes.
- **Implement practices identified in the Highland and Sullivan SRA report** to benefit the water quality of these two lakes. Both lakes have very poor water quality, are impaired for nutrients and recreation, and both have popular parks adjacent to them that many visitors and occupants of the area frequent. These lakes could provide an even larger benefit to the community with improved water quality.
- **Continue work to improve the ecological health of Clearwater, Hardwood, and Rice Creeks.** Clearwater Creek is designated as impaired for aquatic life based on fish and invertebrate IBIs. Hardwood Creek is impaired based on invertebrate data and low dissolved oxygen. Rice Creek is impaired for both fish and invertebrate IBIs downstream of Baldwin Lake in Anoka County. The invertebrate data for Anoka County RCWD streams continues to indicate a depleted invertebrate community.
- **Continue efforts to reduce road salt use.** Chlorides are pervasive throughout shallow aquifers and the streams that feed them. Conductivity readings are increasing throughout the County, and it is likely that stream chloride concentrations are following suit.