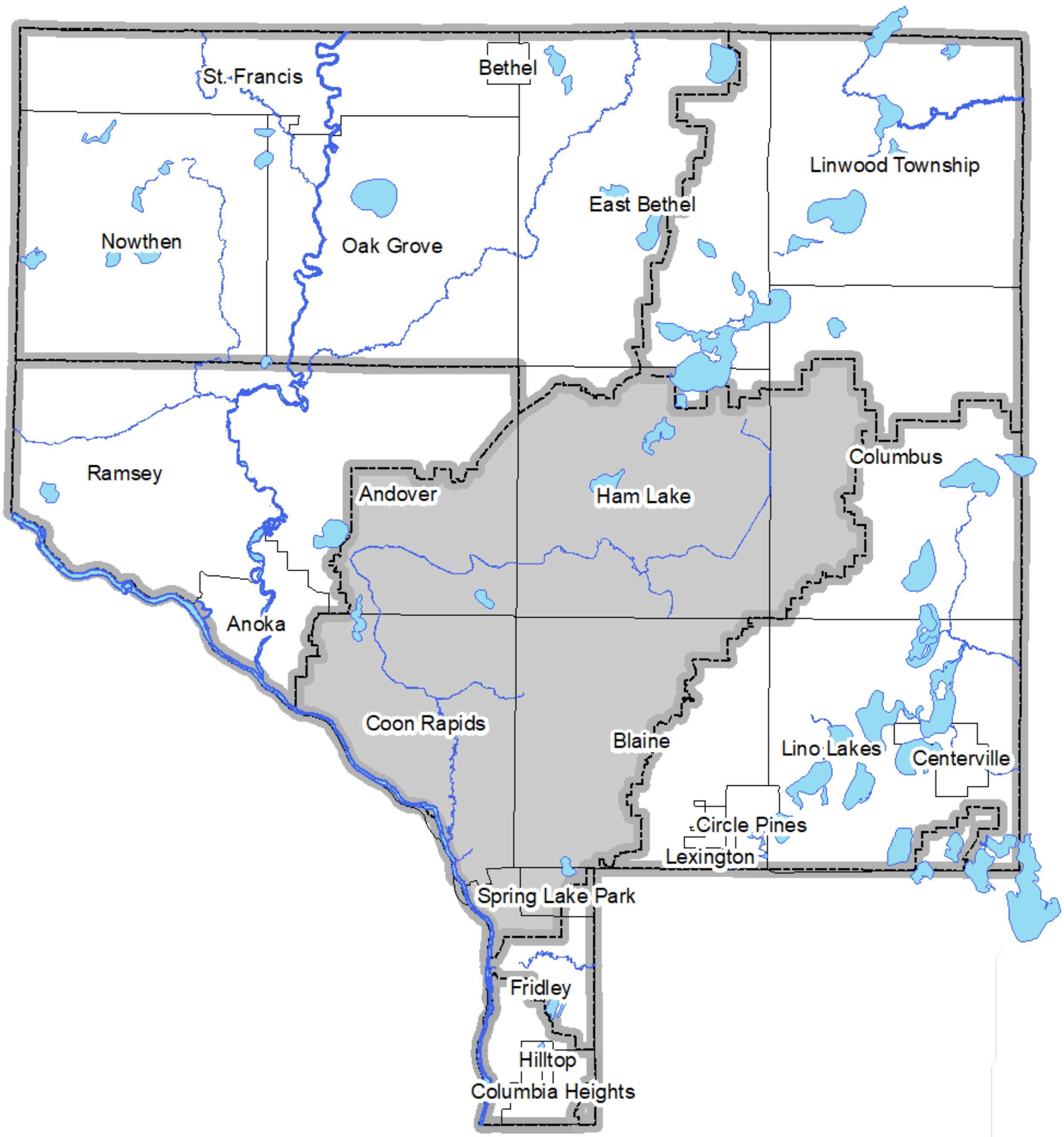
Excerpt from the 2021 Water Almanac

Chapter 6: Coon Creek Watershed



Prepared by the Anoka Conservation District

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SUMMARY OF FINDINGS

Description: This is a brief summary of new findings and notable results from 2021. Detailed analyses for all individual sites can be found within this report.

Precipitation:

- Volunteer data and online resources showed a below average precipitation year. Anoka County was in a state of drought beginning in June, with most of the growing season spent in a severe drought condition.

Lake Levels:

- In 2021, lake levels started near or below average and declined throughout the season. The rebound often seen in the fall was not observed. Lake levels were lower than they have been over the last decade on most lakes.

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.
- A rating curve was developed for Coon Creek at Aberdeen. This new site is just upstream of the Coon Creek at Hwy 65, and has safer access to the creek.

Stream Water Quality:

- In general, elevated total phosphorus (TP) concentrations, especially during storms, are an issue throughout the watershed and Anoka County as a whole.
- Sand Creek had a significant improving trend for TP at baseflow. Recent work in this portion of the subwatershed includes construction of a new stormwater pond, many rain garden installations, as well as a large channel restoration and re-meander project that stabilized eroding banks and provides additional habitat.
- New monitoring sites were established in the upper subwatersheds of Coon Creek in 2021. Unfortunately, given drought conditions and extremely low flows, conditions were not amenable to collecting useable data in most cases.
- High *E. coli* levels persist throughout the watershed.

Wetland Hydrology:

- Many reference wetland sites experienced low levels, which resulted in water levels dropping below the measureable depth of equipment at some sites for a portion of the growing season.

RECOMMENDATIONS

- **Update older 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. Starting in 2021, all grab samples are now paired with discrete discharge measurements. Rating curves should be developed or redeveloped for Pleasure Creek at 86th Ave., Ditch 58 at Andover Blvd, and Coon Creek at 131st.

- **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 2021, six new water quality sites were established and most will be sampled again in 2022. This will aid in understanding the water quality decline of Coon Creek as it flows through the upper portion of its watershed. Ditch 60 and Ditch 39 tributaries to sand creek should be priority monitoring locations to evaluate phosphorus loading in the Sand Creek Subwatershed.

- **Continue monitoring chlorides regularly.** Samples collected in 2019 offered a valuable update to chloride measurements 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. Starting in 2021, annual chloride monitoring was initiated at the four major stream outlet sites.

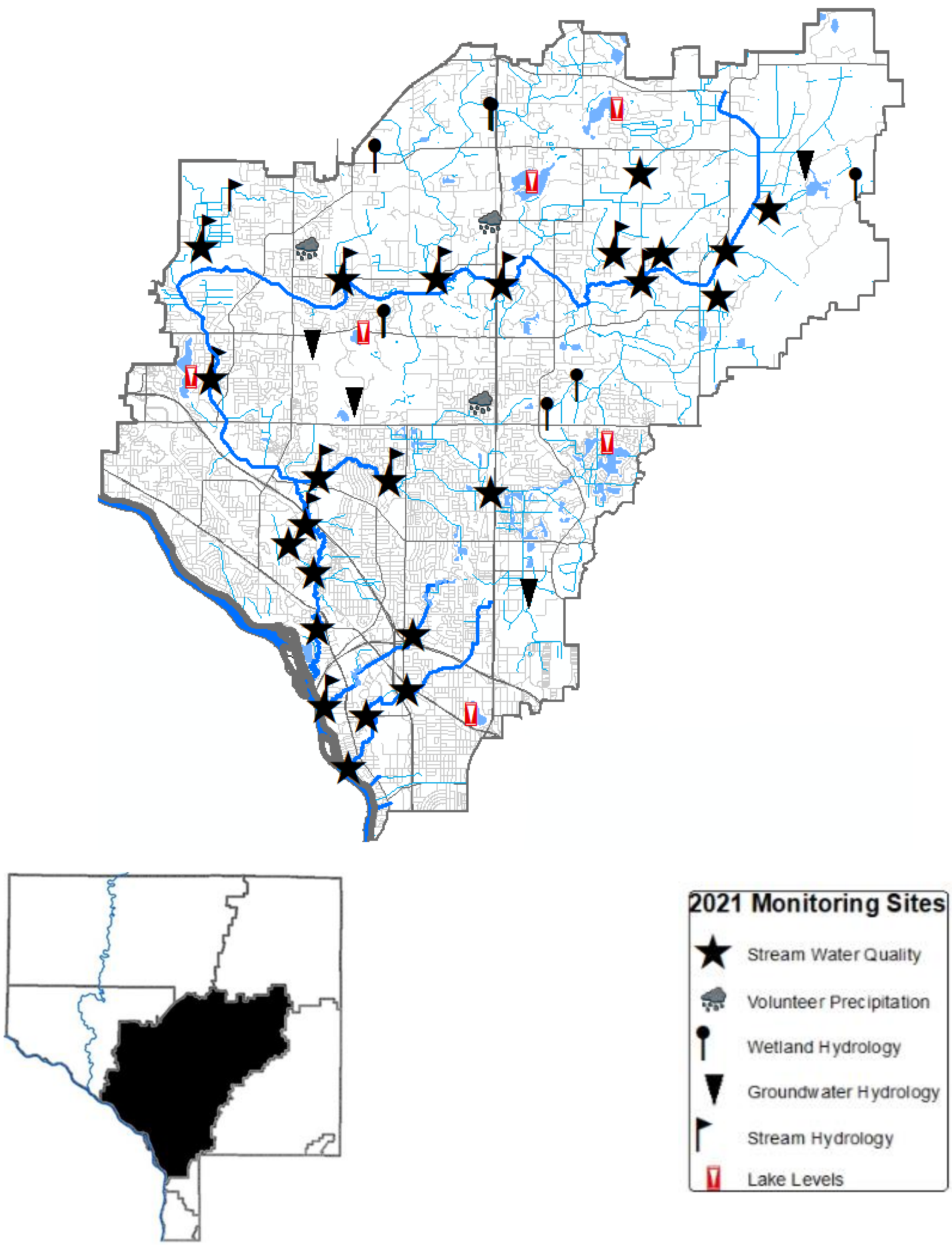
- **Investigate phosphorus loading to Springbrook Creek**. During baseflow, total phosphorus concentrations decrease moving downstream in Springbrook Creek. During storms however, concentrations at the downstream site, 79th Way, increase greatly and often exceed state standards. Investigation into potential 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.

- **Reevaluate existing reference wetland sites** to determine any changes to wetland boundaries and document any changes to vegetation and soil profiles. This data assists wetland regulatory personnel as well as consultants with 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. These upper reaches of the watershed are 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.

Map: 2021 Water Monitoring Locations – Coon Creek Watershed District



COON CREEK WATERSHED LAKE LEVELS MONITORING

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:

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

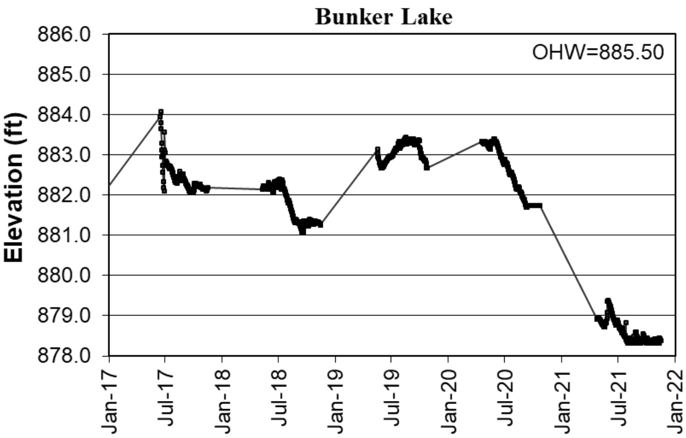
Results: In 2021, lake levels were measured by volunteers 73 times at Ham Lake, 30 times at Lake Netta, 32 times at Crooked Lake, and 10 times at Sunrise Lake. Unfortunately, the volunteer at Laddie Lake recorded no readings in 2021. Water levels at Bunker Lake were monitored May through November using an electronic datalogger which reported the daily average of six readings each day.

Lake gauges were installed by ACD, surveyed by the MN DNR, and read by volunteers. In 2021, lake levels started near or below average and declined throughout the season. The rebound often seen in the fall was not observed. 2021 was the 11th driest year on record, and Anoka County was in a state of drought beginning in June, with most of the growing season spent in a severe drought condition.

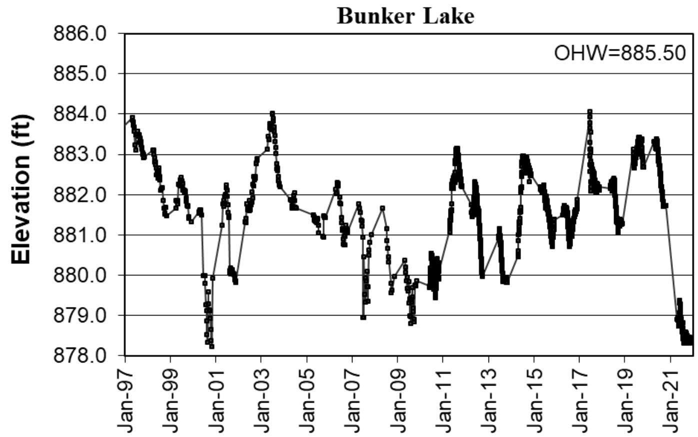
Lower average water levels were recorded on all lakes when compared to long-term averages. Bunker Lake's average was 3.92 feet lower than the 2020 average; it also reached its lowest level since 2000. Crooked lake was 1.07 feet lower on average in 2021, and reached its lowest level since 2009. Ham Lake declined steadily throughout 2021 and averaged 1.1 feet lower than 2020. Lake Netta also declined steadily and reached its lowest level since 2009, and averaged 1.66 feet lower in 2021. Only four years of data are recorded for Sunrise Lake and 2021 had the lowest water level recorded at 889.06 feet.

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.

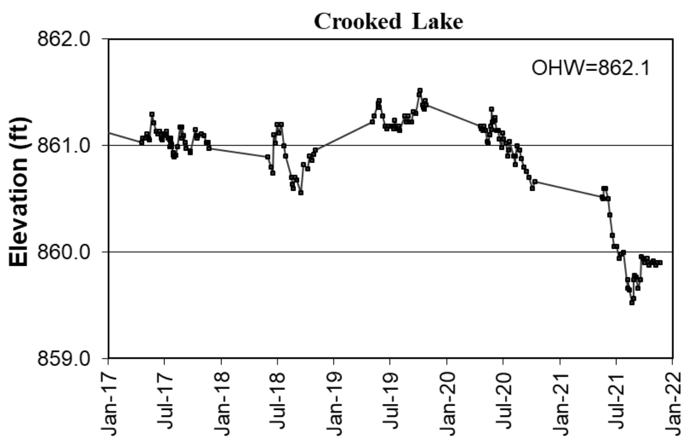
Bunker Lake Levels – last 5 years



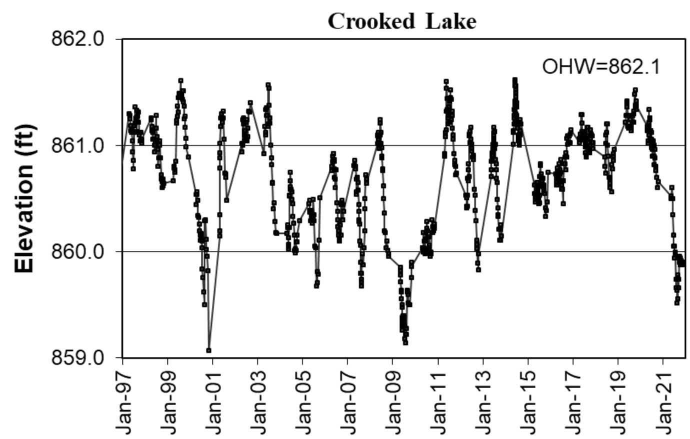
Bunker Lake Levels – last 25 years



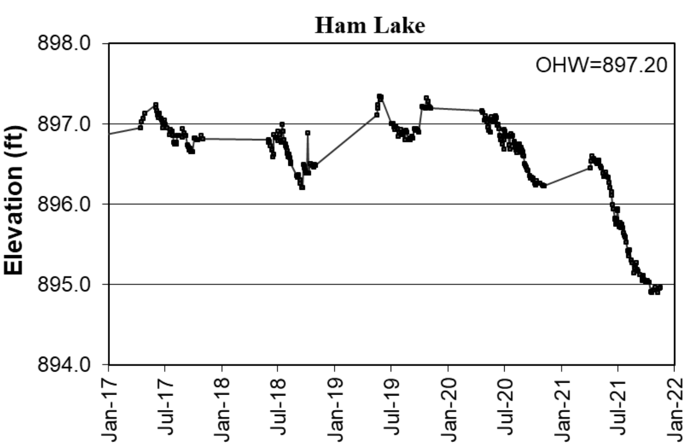
Crooked Lake Levels – last 5 years



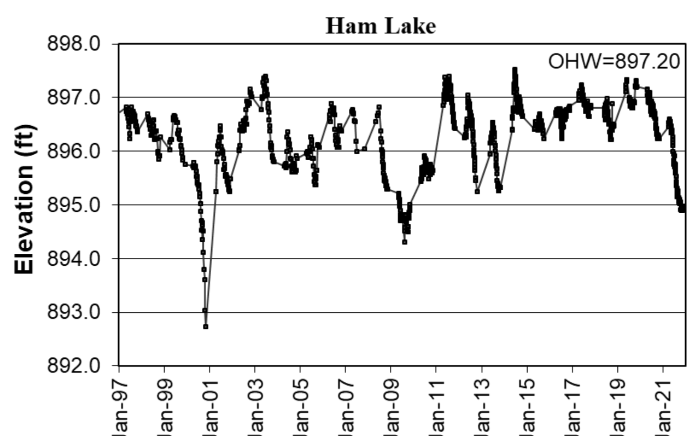
Crooked Lake Levels – last 25 years



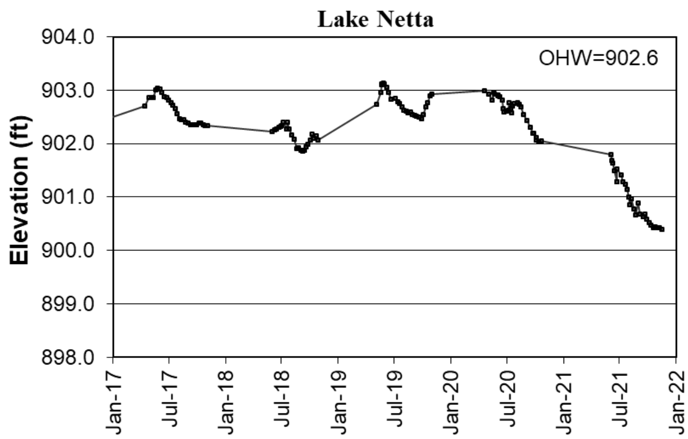
Ham Lake Levels – last 5 years



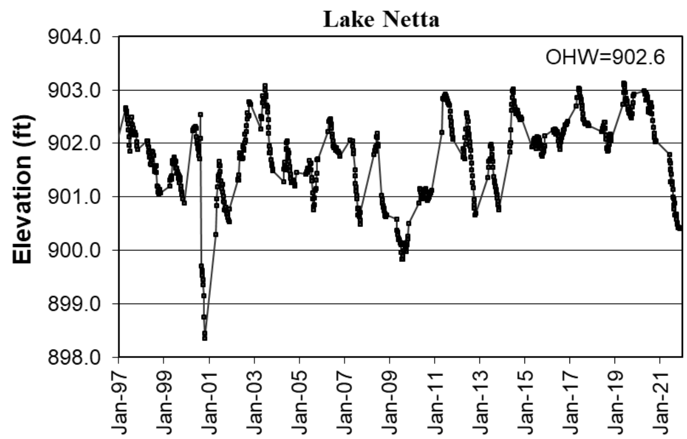
Ham Lake Levels – last 25 year



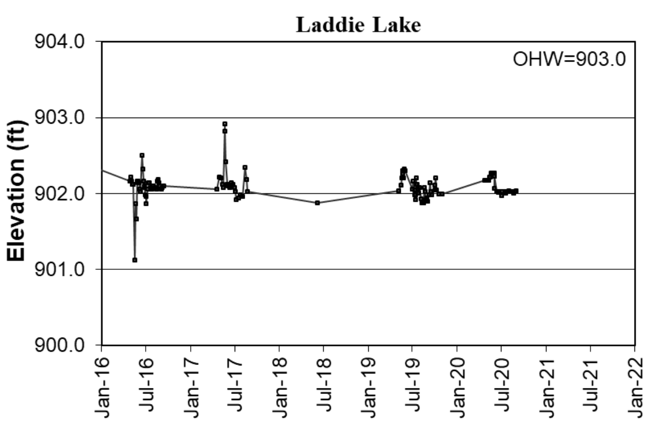
Lake Netta Levels – last 5 years



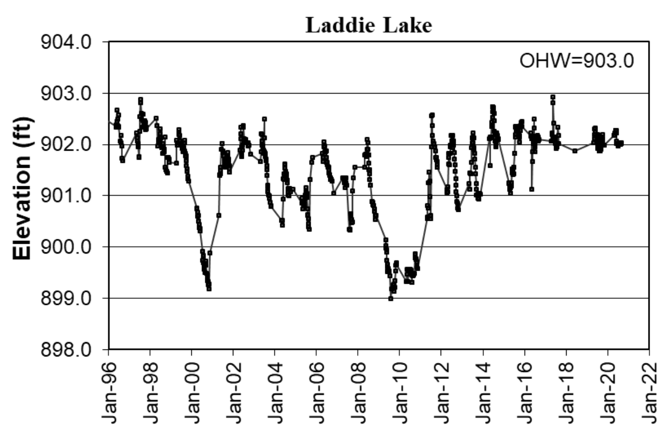
Lake Netta Levels – last 25 years



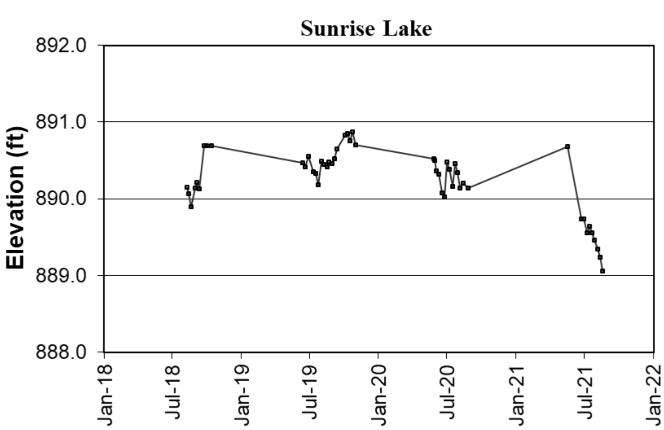
Lake Laddie Level – last 5 years of available data



Lake Laddie Level – last 25 years of available data



Sunrise Lake – all available data



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

Lake	Year	Average	Min	Max
Bunker	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
	2021	878.60	878.31	879.38

Lake	Year	Average	Min	Max
Crooked	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
	2021	859.97	859.52	860.60

Lake	Year	Average	Min	Max
Ham	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
	2021	895.70	894.90	896.60

Lake	Year	Average	Min	Max
Netta	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
	2021	900.94	900.40	901.79

Lake	Year	Average	Min	Max
Laddie	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
	2021	Incomplete Data		

Lake	Year	Average	Min	Max
Sunrise	2018	890.30	889.90	890.69
	2019	890.54	890.18	890.87
	2020	890.29	890.02	890.52
	2021	889.60	889.06	890.68

WETLAND HYDROLOGY

Description: Continuous groundwater level monitoring at a wetland boundary. Countywide, 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 wetland 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)

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

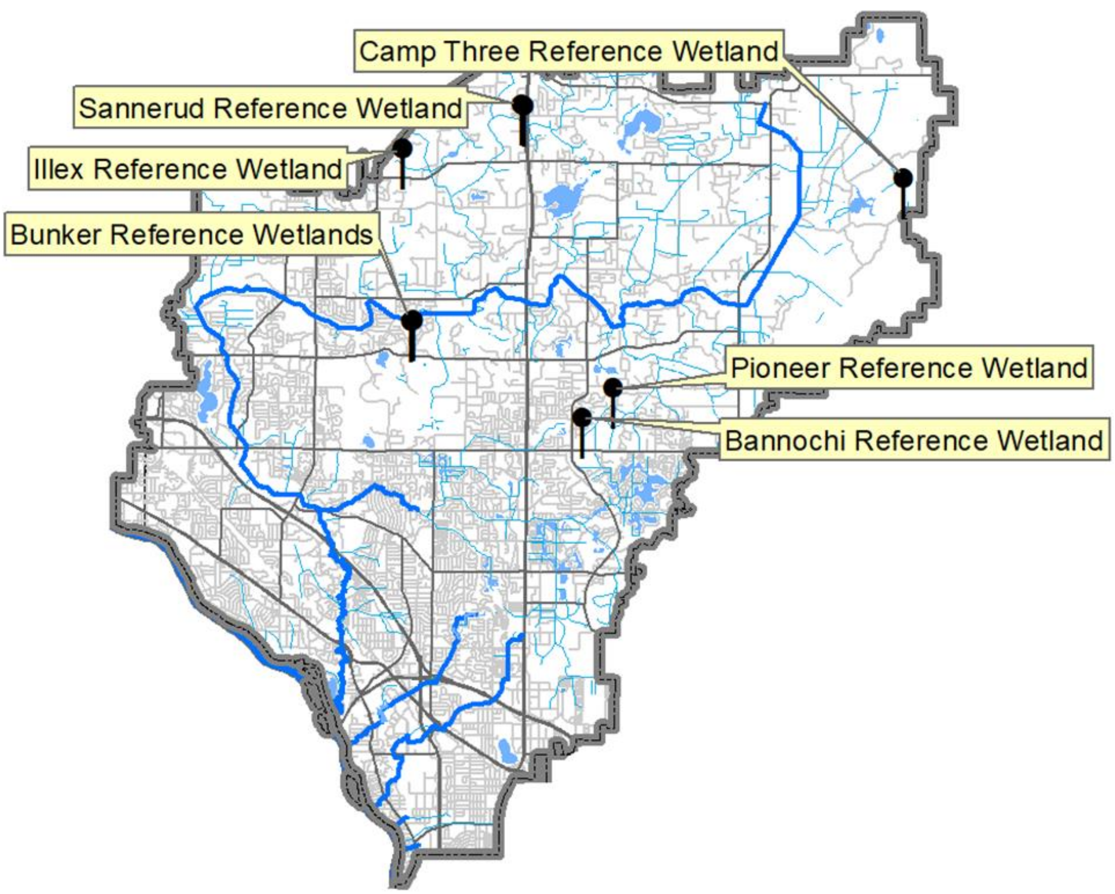
Ilex Wetland, City Park at Ilex St and 159th Ave, Andover (Middle and Edge)

Pioneer Park Wetland, Pioneer Park of Main St, Blaine

Sannerud Wetland, W side of Hwy 65 at 165th Ave, Ham Lake (Middle and Edge)

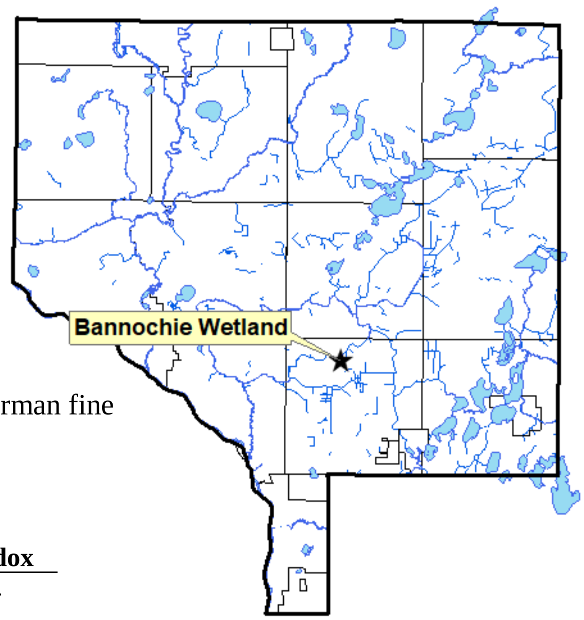
Results: See the following pages.

Coon Creek Watershed 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

Surrounding Soils: Rifle and some Zimmerman fine sand

Soils at Well Location:

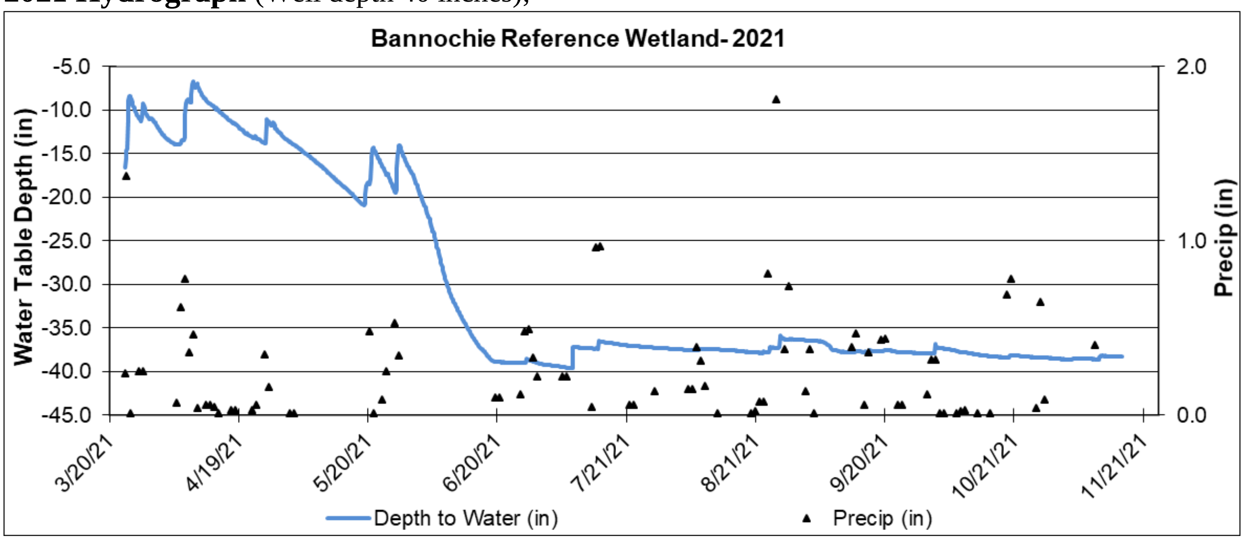
Horizon	Depth	Color	Texture	Redox
Oe1	0-6	10yr 2/1	Organic	-
Oe2	6-40	10yr 2/1-7.5yr2.5/1	Organic	-

Vegetation at Well Location:

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

Notes: This well is not at the wetland boundary, but rather within the basin. Intense residential construction has occurred nearby in recent years, including construction dewatering. In 2021, Anoka County was in a drought starting in June, and water levels were low most of the year.

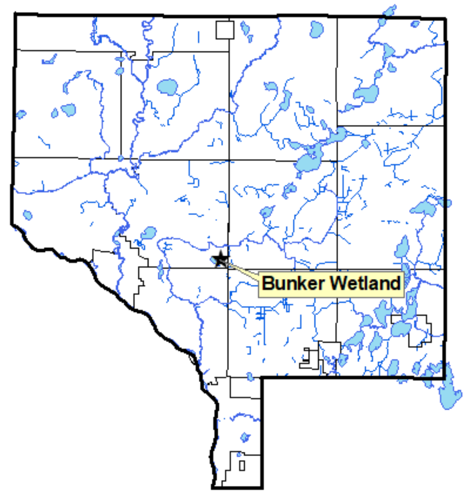
2021 Hydrograph (Well depth 40 inches),



BUNKER REFERENCE WETLAND –EDGE

Bunker Hills Regional Park, Andover

Site Information



Monitored Since:	1996-2005 at wetland edge. In 2006 re-delineated wetland moved well to new wetland edge (down gradient)
Wetland Type:	2
Wetland Size:	~1.0 acre
Isolated Basin:	Yes
Connected to a Ditch:	No
Surrounding Soils:	Zimmerman fine sand

Soils at Well Location:

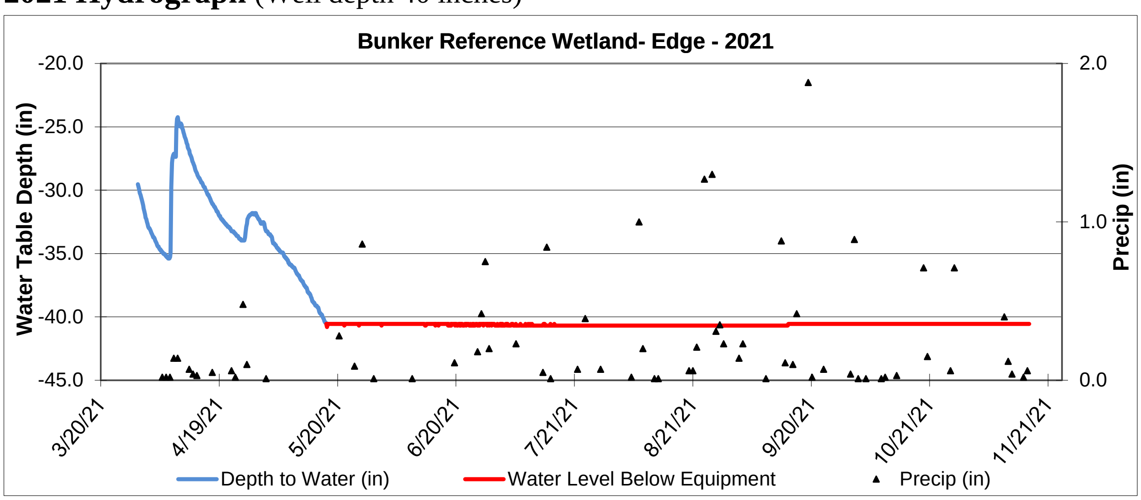
Horizon	Depth	Color	Texture	Redox
AC1	0-3	7.5yr3/1	Sandy Loam	50% 7.5yr 4/6
AC2	3-20	10yr2/1-5/1	Sandy Loam	-
2Ab1	20-31	N2/0	Mucky Sandy Loam	-
2Oa	31-39	N2/0	Organic	-
2Oe	39-44	7.5yr 3/3	Organic	-

Vegetation at Well Location:

Scientific	Common	% Coverage
Phalaris arundinacea	Reed Canary Grass	100
Populus tremuloides(T)	Quaking Aspen	30

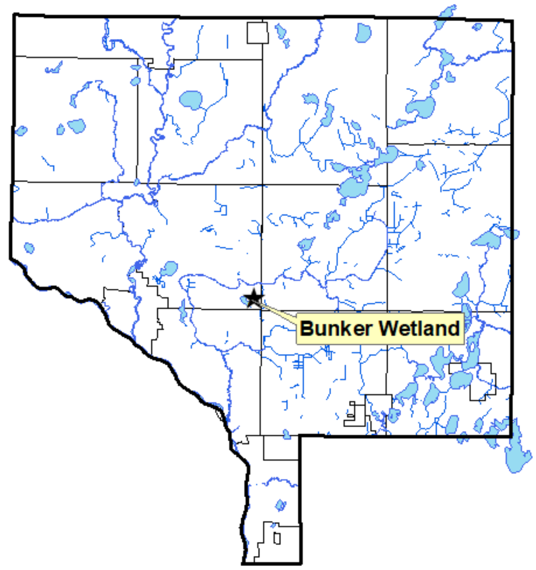
Notes: This well is located at the wetland boundary. In 2000-2005 the water table was >40 inches below the surface throughout most or all of the growing season. This prompted us to re-delineate the wetland and move the well down gradient to the new wetland edge at the end of 2005. In 2021, Anoka County was in a drought starting in June, and water levels became too low for the equipment to detect.

2021 Hydrograph (Well depth 40 inches)



BUNKER REFERENCE WETLAND – MIDDLE

Bunker Hills Regional Park, Andover



Site Information

Monitored Since: 2006

Wetland Type: 2

Wetland Size: ~1.0 acres

Isolated Basin: Yes

Connected to a Ditch: No

Surrounding Soils: Zimmerman fine sand

Soils at Well Location:

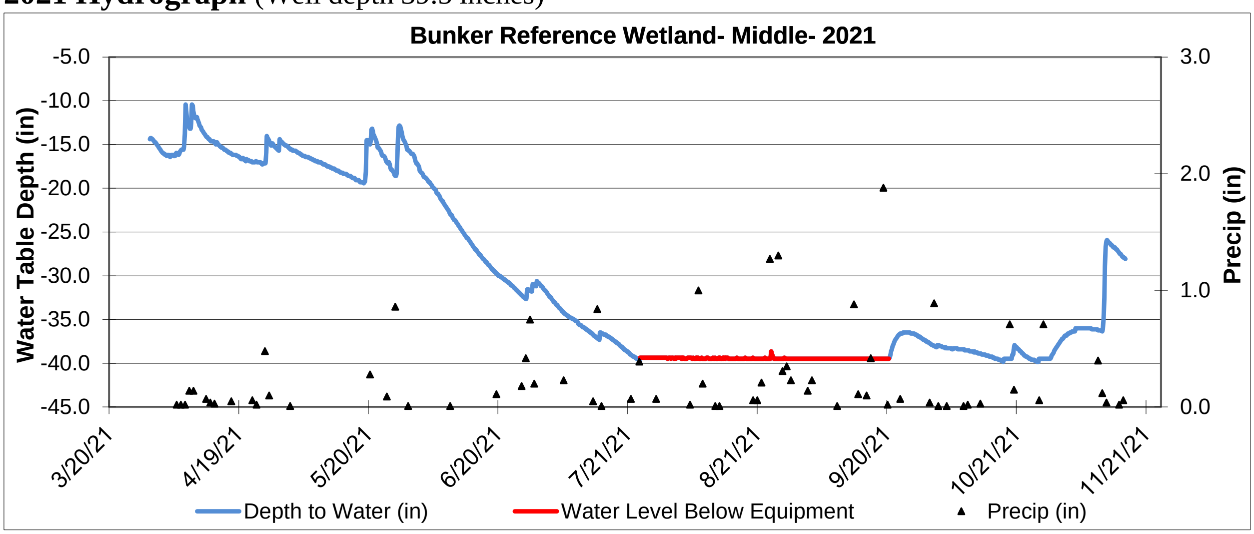
Horizon	Depth	Color	Texture	Redox
Oa	0-22	N2/0	Organic	-
Oe1	22-41	10yr2/1	Organic	-
Oe2	41-48	7.5yr3/4	Organic	-

Vegetation at Well Location:

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

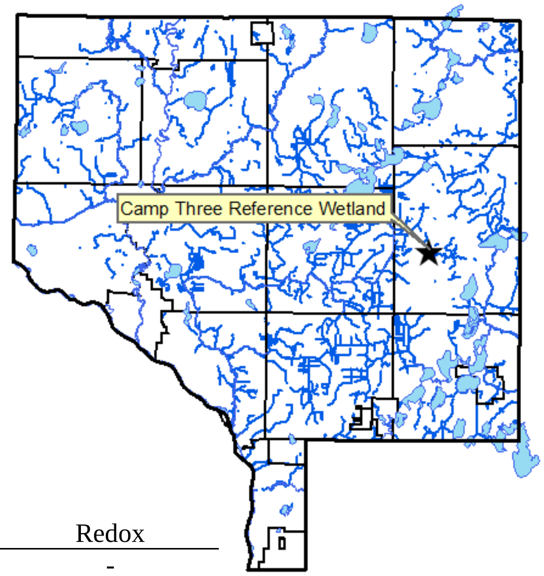
Notes: This well at the middle of the wetland and was installed at the end of 2005 and first monitored in 2006. In 2021, Anoka County was in a drought starting in June, and water levels became too low for the equipment to detect.

2021 Hydrograph (Well depth 39.5 inches)



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
Surrounding Soils:	Markey Muck, Zimmerman fine sand

Soils at Well Location:

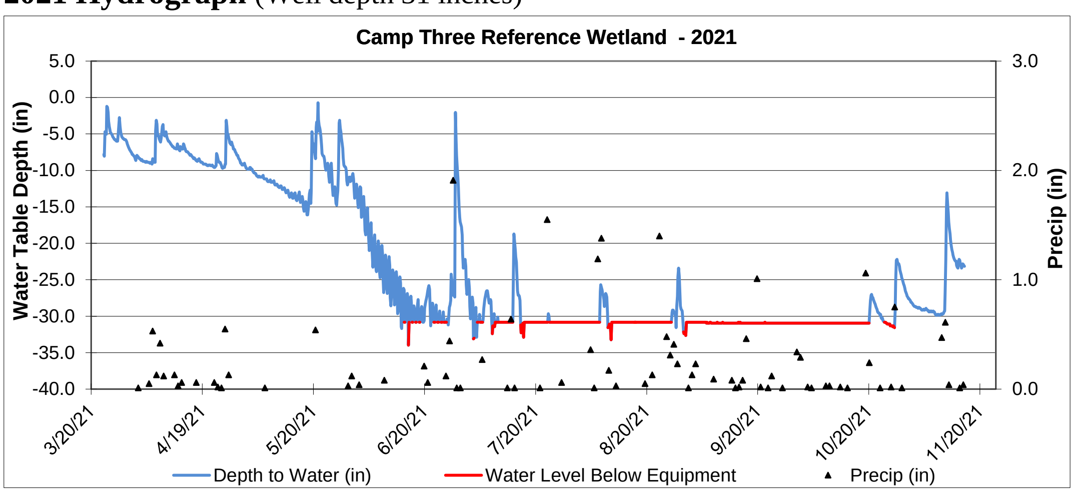
Horizon	Depth	Color	Texture	Redox
A	0-4	N2/0	Mucky Fine Sandy Loam	-
A2	4-13	10yr 3/1	Fine Sandy Loam	20% 5yr 5/6
Bg1	13-21	10yr 5/1	Fine Sandy Loam	2% 10yr 5/6
Bg2	21-39	10yr 5/1	Fine Sandy Loam	5% yr 5/6
Bg3	39-55	10yr 5/1	Very Fine Sandy Loam	10% 10yr 5/6

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

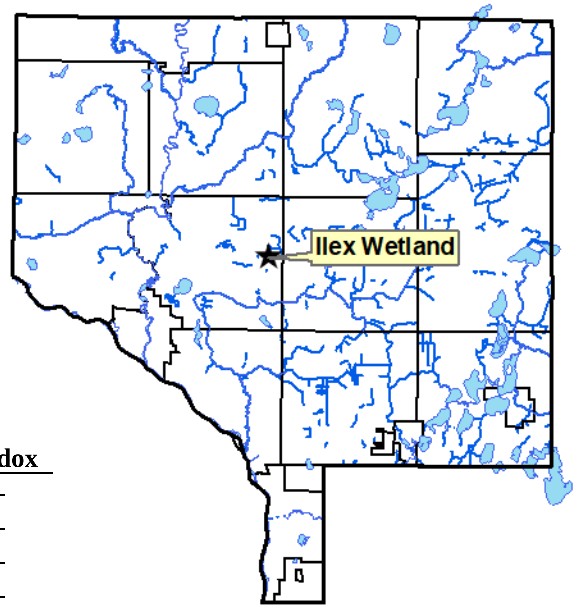
Notes: This well is located at the wetland boundary. Water levels fluctuate constantly throughout the year. Water control structures in the Carlos Avery Wildlife Management Area may effect water levels at this site. In 2021, Anoka County was in a drought starting in June, and water levels became too low for the equipment to detect.

2021 Hydrograph (Well depth 31 inches)



ILEX REFERENCE WETLAND – EDGE

City Park at Ilex St and 159th Ave, Andover



Site Information

Monitored Since:	1996
Wetland Type:	2
Wetland Size:	~9.6 acres
Isolated Basin:	Yes
Connected to a Ditch:	No
Surrounding Soils:	Loamy wet sand and Zimmerman fine sand

Soils at Well Location:

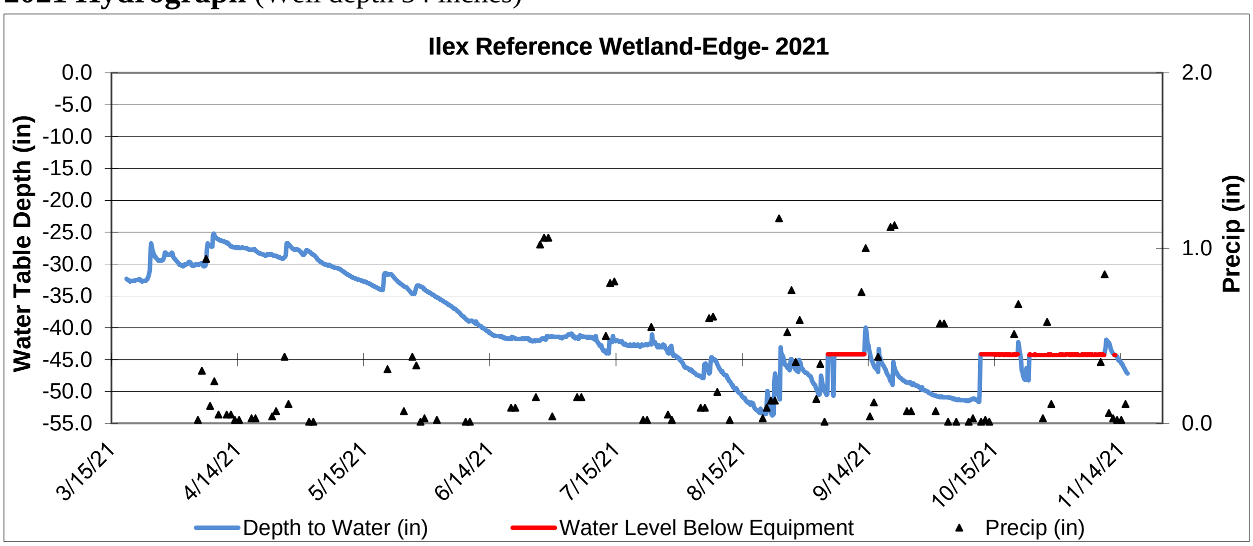
Horizon	Depth	Color	Texture	Redox
A	0-10	10yr2/1	Fine Sandy Loam	-
Bg	10-14	10yr4/2	Fine Sandy Loam	-
2Ab	14-21	N2/0	Sandy Loam	-
2Bg1	21-30	10yr4/2	Fine Sandy Loam	-
2Bg2	30-45	10yr5/2	Fine Sand	-

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

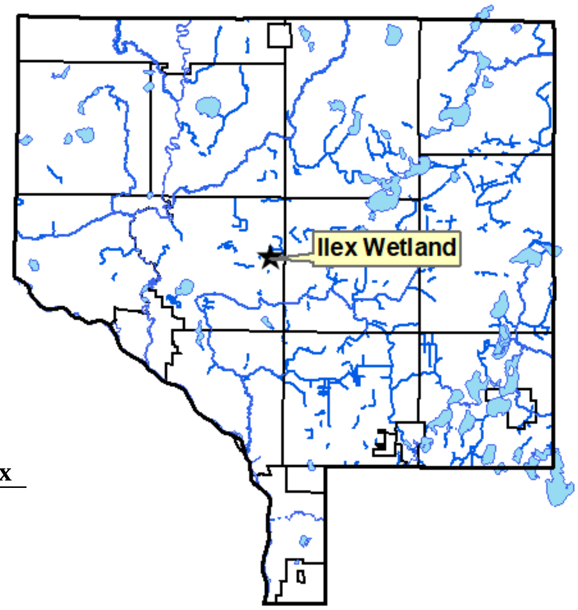
Notes: This well is located at the wetland boundary. In 2000-2005 the water table was only once within 15 inches of the surface and seldom within the 40 inch well depth. This prompted us to re-delineate the wetland and move the well down gradient to the new wetland edge at the beginning of 2006.

2021 Hydrograph (Well depth 54 inches)



ILEX REFERENCE WETLAND – MIDDLE

City Park at Ilex St and 159th Ave, Andover



Site Information

Monitored Since: 2006

Wetland Type: 2

Wetland Size: ~9.6 acres

Isolated Basin: Yes

Connected to a Ditch: No

Surround Soils: Loamy wet sand and Zimmerman fine sand

Soils at Well Location:

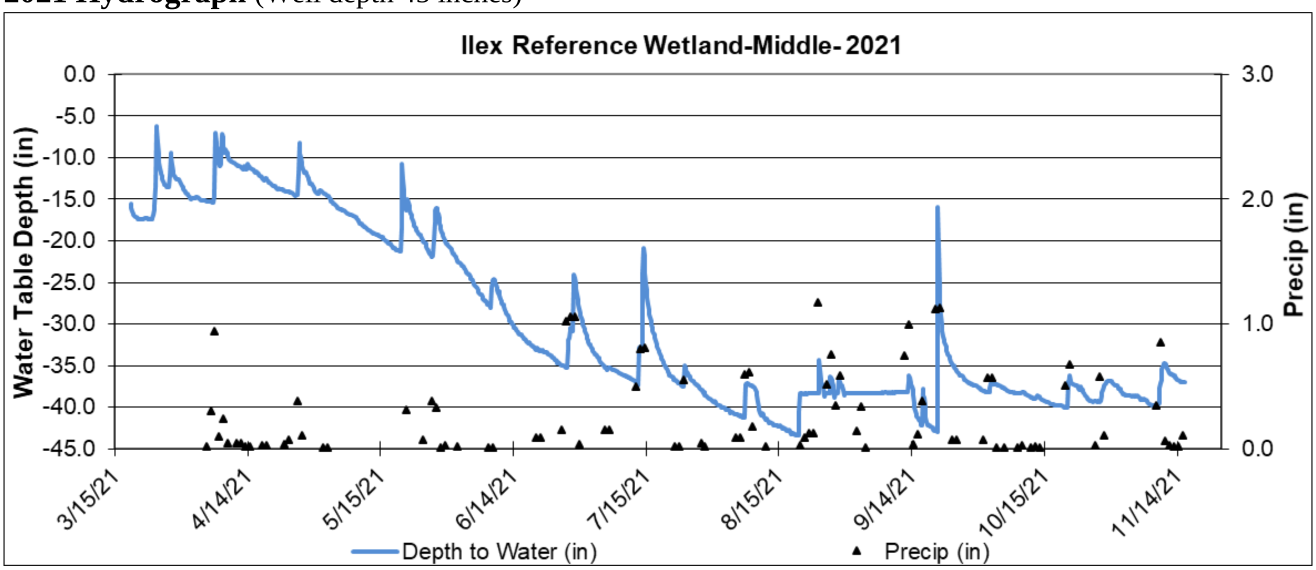
Horizon	Depth	Color	Texture	Redox
Oa	0-9	N2/0	Organic	-
Bg1	9-19	10yr4/2	Fine Sandy Loam	-
Bg2	19-45	10yr5/2	Fine Sand	-

Vegetation at Well Location:

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

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

2021 Hydrograph (Well depth 45 inches)



PIONEER PARK REFERENCE WETLAND

Pioneer Park N Side of Main St E of Radisson Rd, 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, and nearby ditches.
Surround Soils:	Rifle and loamy wet sand

Soils at Well Location:

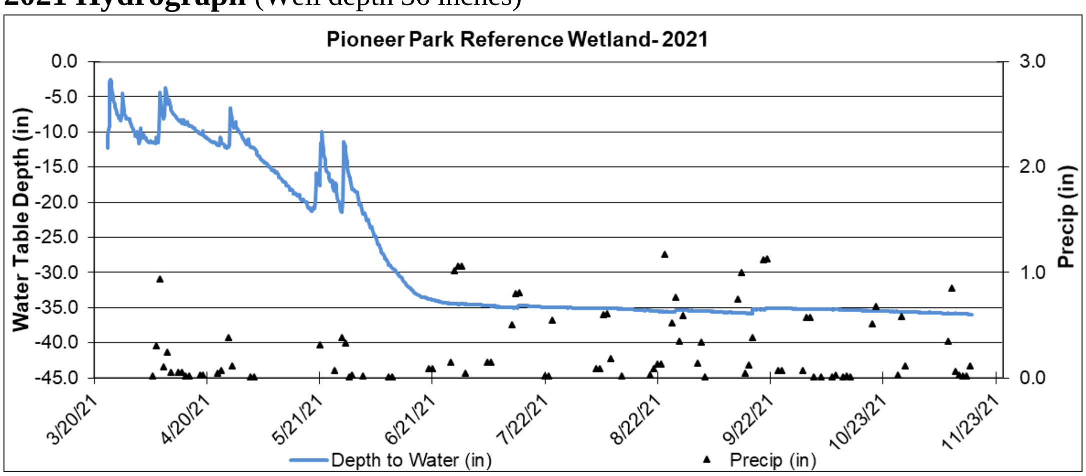
Horizon	Depth	Color	Texture	Redox
Oa1	0-4	10yr 2/1	Sapric	-
Oa2	4-8	N 2/0	Sapric	-
AB	8-12	10yr 3/1	Mucky Sandy Loam	-
Bw	12-27	2.5y 5/3	Loamy Sand	-
Bg	27-40	2.5y 5/2	Loamy Sand	-

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

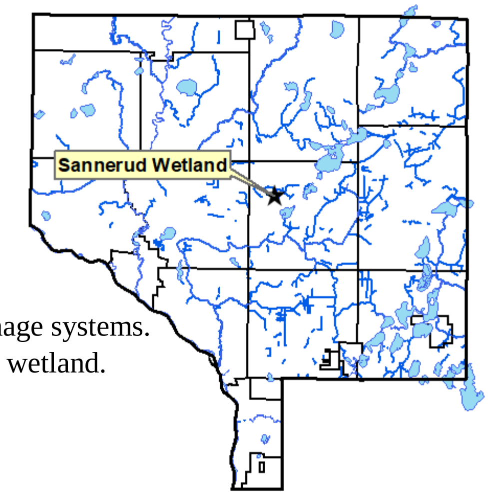
Notes: This well is located within the wetland, not at the edge. In 2021, Anoka County was in a drought starting in June, and water levels were low most of the year.

2021 Hydrograph (Well depth 36 inches)



SANNERUD REFERENCE WETLAND – EDGE

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



Site Information

Monitored Since: 2005

Wetland Type: 2

Wetland Size: ~18.6 acres

Isolated Basin: Yes

Connected to a Ditch: Is adjacent to Hwy 65 and its drainage systems. Small remnant of a ditch visible in wetland.

Surrounding Soils: Zimmerman and Lino

Soils at Well Location:

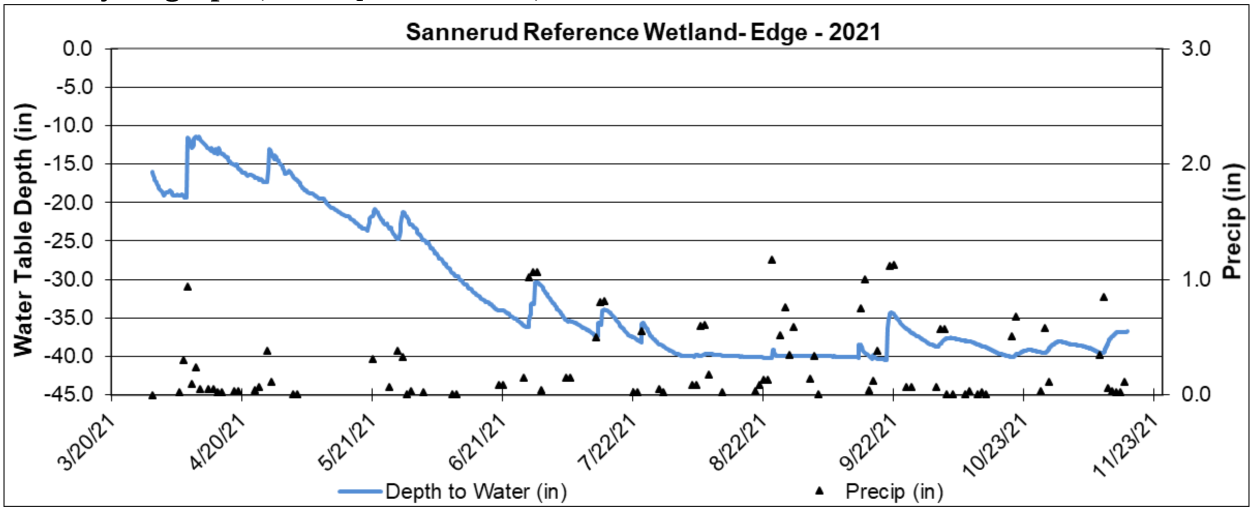
Horizon	Depth	Color	Texture	Redox
Oa	0-8	N2/0	Sapric	-
Bg1	8-21	10yr 4/1	Sandy Loam	-
Bg2	21-40	10yr 4/2	Sandy Loam	-

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

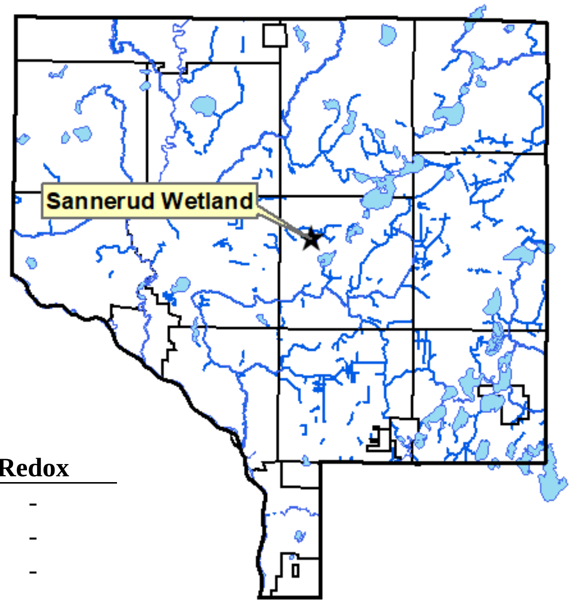
Notes: This is one of two monitoring wells on this wetland. This one is located at the wetland's edge. In 2021, Anoka County was in a drought starting in June, and water levels were low most of the year.

2021 Hydrograph (Well depth 40.5 inches)



Sannerud Reference Wetland – Middle

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



Site Information

Monitored Since: 2005

Wetland Type: 2

Wetland Size: ~18.6 acres

Isolated Basin: Yes

Surrounding Soils: Zimmerman and Lino

Soils at Well Location:

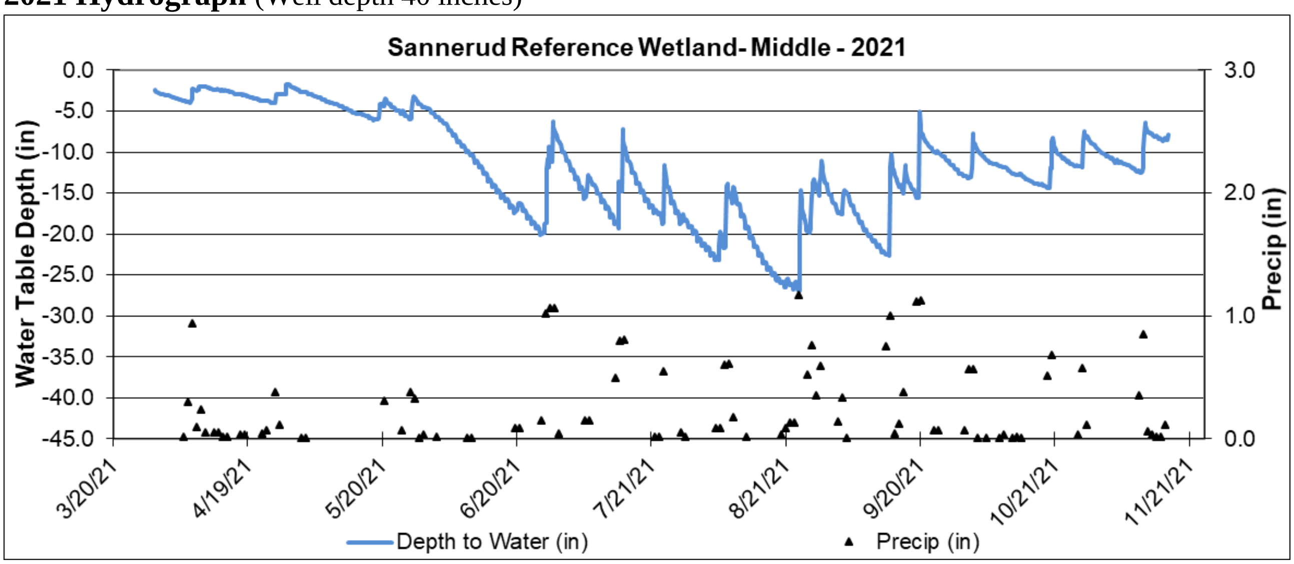
Horizon	Depth	Color	Texture	Redox
Oe	0-3	7.5yr 3/1	Organic	-
Oe2	18-Mar	10yr 2/1	Organic	-
Oa	18-48	10yr 2/1	Organic	-

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

Notes: This is one of two monitoring wells in this wetland. This one is near the center of the wetland.

2021 Hydrograph (Well depth 40 inches)



Reference Wetland Analysis

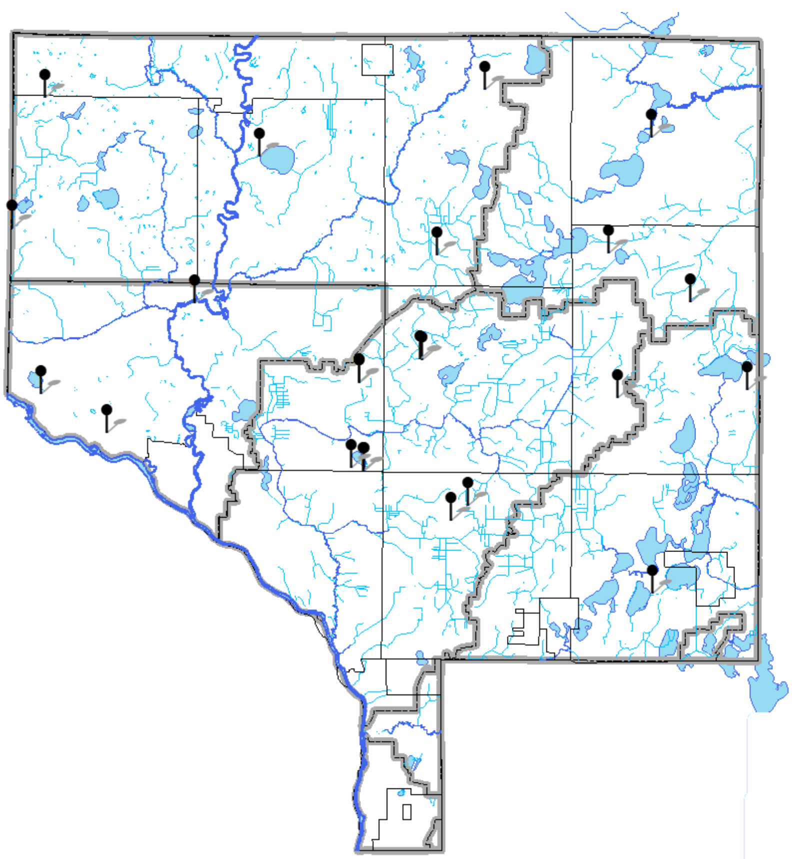
Description: This section includes analyses of wetland hydrology data for 19 reference wetlands collected from 22 monitoring wells. Shallow groundwater levels at the edges or middle of these wetlands are recorded every four hours. Many have been monitored since 1996. These analyses summarize the enormous multi-year multi-wetland dataset. A database summarizing all of the data is now available online through the ACD website (https://maps.barr.com/Anoka/Home/Chart/). 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.

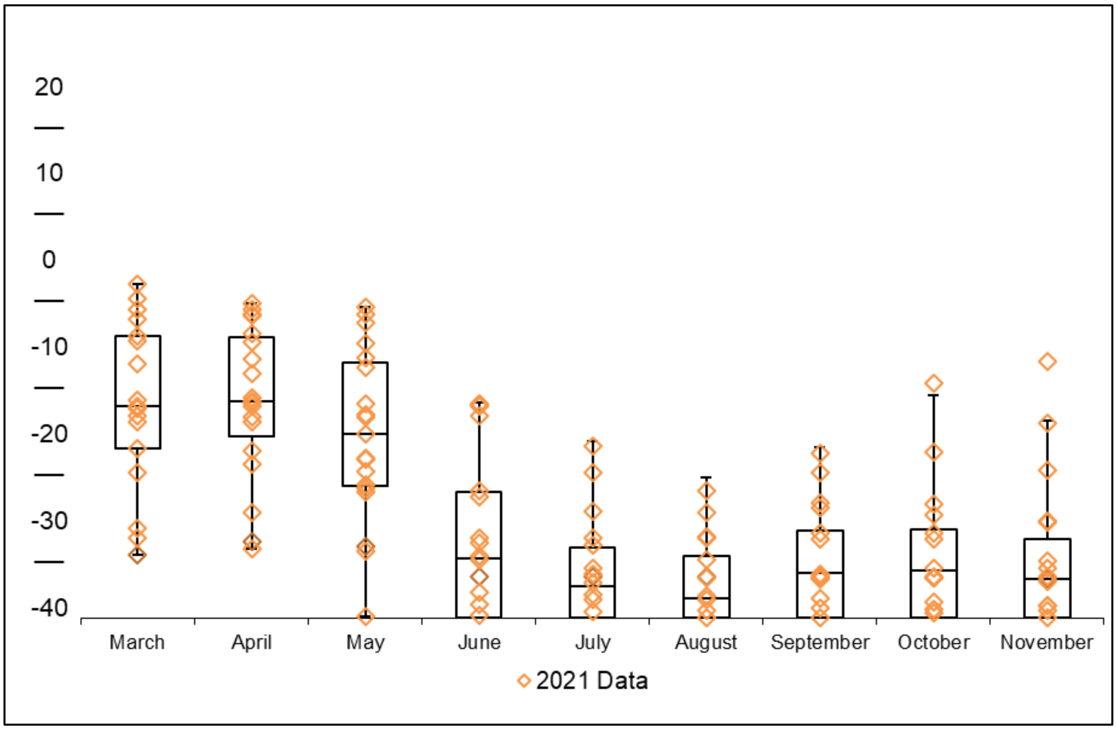
Locations: 19 reference wetland hydrology monitoring sites in Anoka County.

Results: On the following page, there is a summary of data for the most recent year alone, as well as across all years with available data.

Reference Wetland Hydrology Monitoring Sites – Anoka County



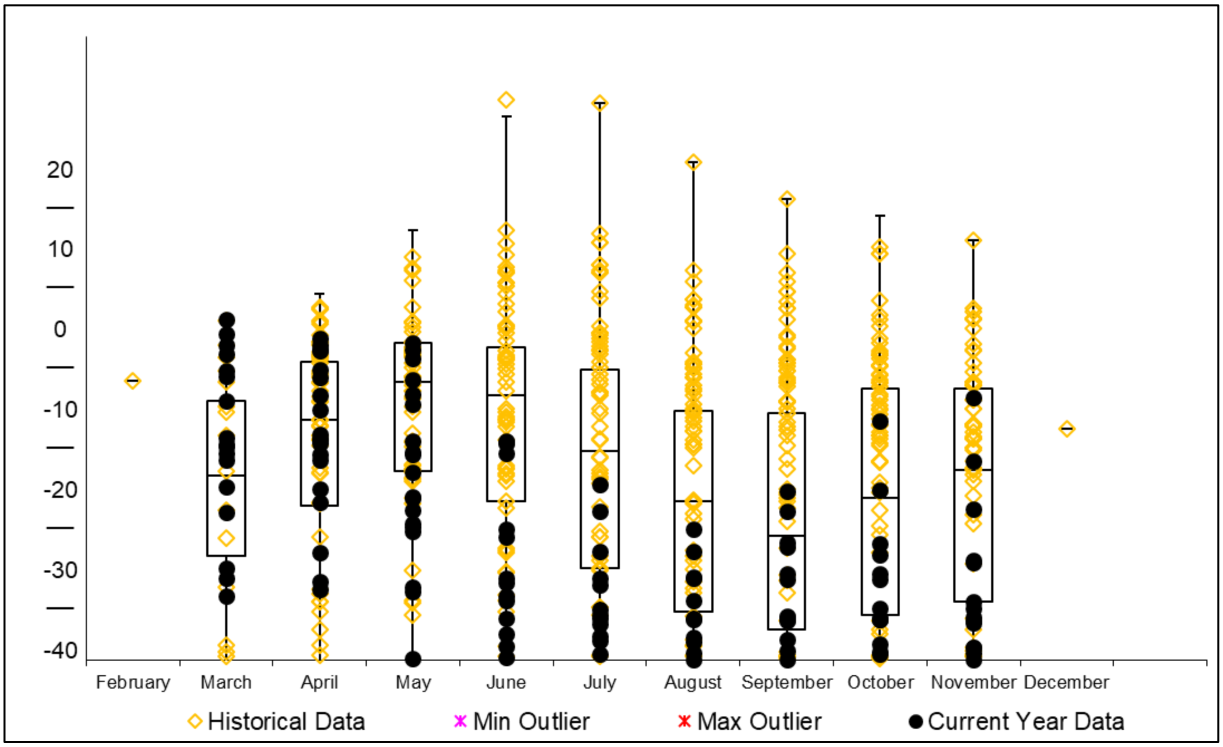
2021 Reference Wetland Water Levels Summary: Each marker represents the median depth to the water table at the edge of one reference wetland for a given month in 2021. The quantile boxes show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines). Maximum well depths were 40 to 45 inches, so a reading greater than -40 inches likely indicates water below the well at an unknown depth.



Quantiles

Month	Min	10%	25%	Median	75%	90%	Max
3	-32.8	-30.156	-20.6	-15.72	-7.6	-4.08	-1.7
4	-32.0	-28.6	-19.2	-15.1	-7.8	-5.0	-3.8
5	-39.8	-31.9	-24.9	-18.8	-10.7	-5.9	-4.3
6	-41.8	-41.2	-40.1	-33.2	-25.7	-15.6	-15.4
7	-42.5	-41.9	-41.0	-37.3	-32.9	-26.8	-20.3
8	-47.4	-43.2	-41.5	-39.1	-34.3	-30.0	-25.3
9	-47.1	-41.5	-40.7	-35.5	-30.6	-26.1	-21.0
10	-44.3	-41.6	-40.9	-35.4	-30.6	-25.7	-13.1
11	-44.3	-41.8	-40.3	-35.8	-31.2	-22.0	-10.5

1996 – 2021 Reference Wetland Water Levels Summary: Each dot represents the median depth to the water table at the edge of one reference wetland for a month between 1996 and 2021. The quantile boxes show the median (median line), 25th and 75th percentile (ends of box), and 10th and 90th percentile (floating horizontal lines). Maximum well depths were 40 to 45 inches, so a reading greater than -40 inches likely indicates water below the well at an unknown depth.



Quantiles

Month	Min	10%	25%	Median	75%	90%	Max
2	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
3	-41.6	-39.1	-28.3	-19.3	-10.8	-6.4	-1.9
4	-41.6	-37.9	-26.6	-14.2	-7.6	-3.7	1.2
5	-41.4	-33.9	-23.1	-10.6	-5.7	-3.2	3.8
6	-50.5	-37.6	-27.4	-15.5	-6.6	-3.2	3.8
7	-67.9	-40.0	-35.6	-24.9	-12.3	-6.3	4.3
8	-50.3	-41.1	-38.1	-31.4	-15.8	-7.9	0.3
9	-48.8	-40.9	-38.8	-31.8	-17.1	-7.0	5.3
10	-45.0	-40.8	-38.0	-28.5	-11.9	-5.4	6.4
11	-46.9	-41.1	-39.4	-24.1	-12.1	-6.2	7.2
12	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0	-14.0

Discussion:

The purpose of reference wetland data is to help 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 and developers 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. 2021 reference wetland data reflect the drought conditions seen throughout Anoka County for most of the growing season.

STREAM HYDROLOGY AND WATER QUALITY MONITORING

Description: Water chemistry grab sampling, discrete discharge measurements, and continuous stage monitoring

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

Locations: Throughout the watershed

Methods: See below

STREAM MONITORING METHODS

Stream Hydrology

Continuous stage data is recorded using water level logging equipment deployed in the stream for the duration of the open water season at select monitoring sites. These readings are converted to elevations 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.

Starting in 2021, discrete manual discharge measurements were also collected in conjunction with water chemistry grab samples. These discharge measurements allow for continual refinement of rating curves and aid in pollutant loading estimates.

Water Chemistry Grab Sampling

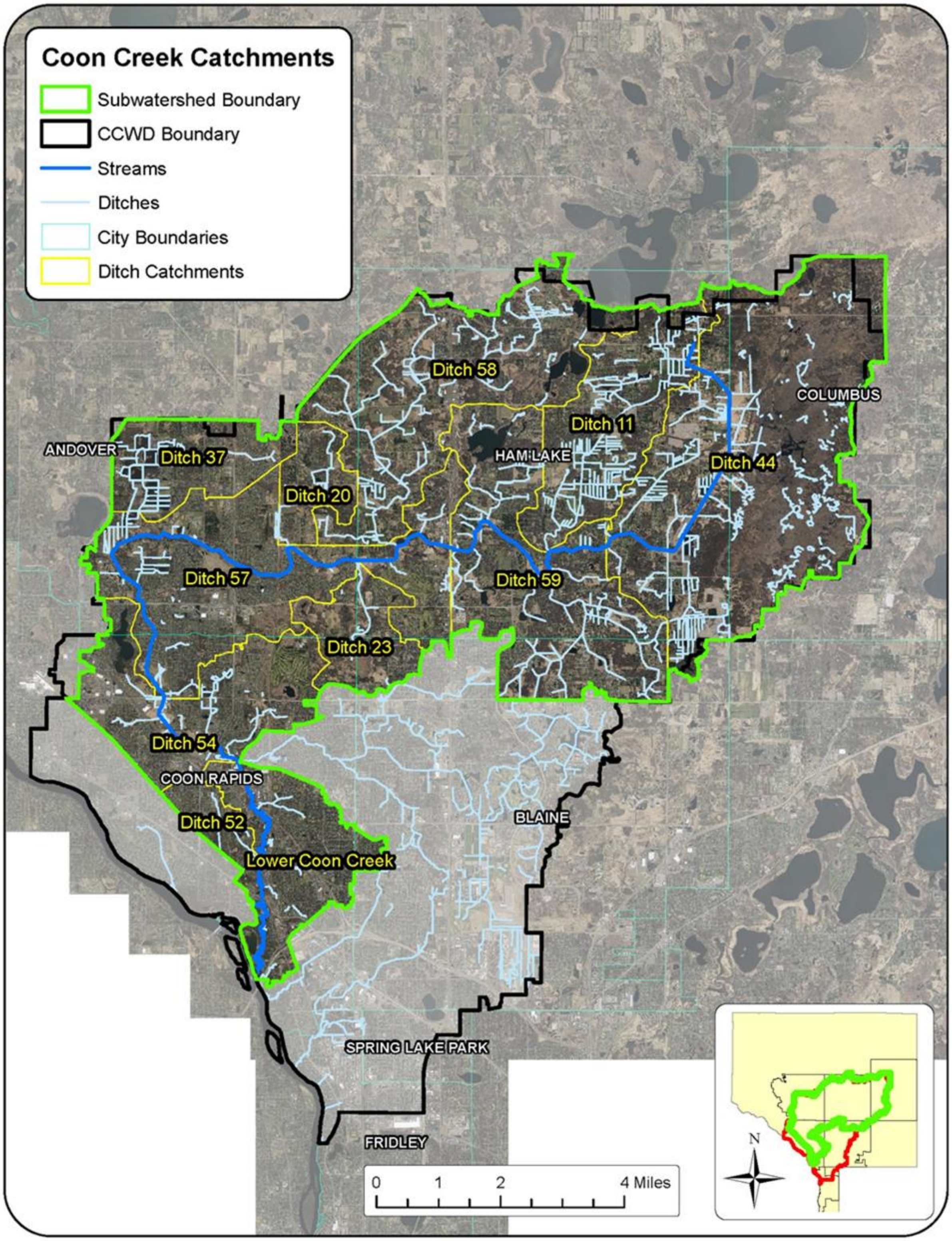
Grab samples are collected from streams during both storm and baseflow conditions throughout the open water season and sent to a certified laboratory for analysis. Parameters analyzed by the lab include total phosphorus (TP), total suspended solids (TSS), E.coli bacteria, and periodically chlorides and orthophosphorus. Prior to 2021, four samples were collected during storm events and four samples during baseflow for a total of eight annual samples. Starting in 2021, a new sampling scheme was employed to instead collect six routine samples on a pre-determined monthly schedule (May-Oct) to be representative of conditions over time regardless of flow condition. Additionally, four samples targeting storm flows were collected for a total of ten annual samples at each site. Storms are generally defined as one-inch or more of rainfall in 24 hours sufficient to produce runoff. In some years, smaller storms were sampled because of a lack of larger storms. Physical and chemical water parameters are also measured with portable meters during each sampling event. Parameters measured include pH, specific conductance, turbidity, temperature, salinity, dissolved oxygen (DO), and seechi. Water level (stage) is also recorded at each site 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. New in 2021, stream monitoring data collection activities were split between ACD and CCWD staff; methodologies were consistent and QA/QC was performed by both organizations.

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 TRIBUTARIES



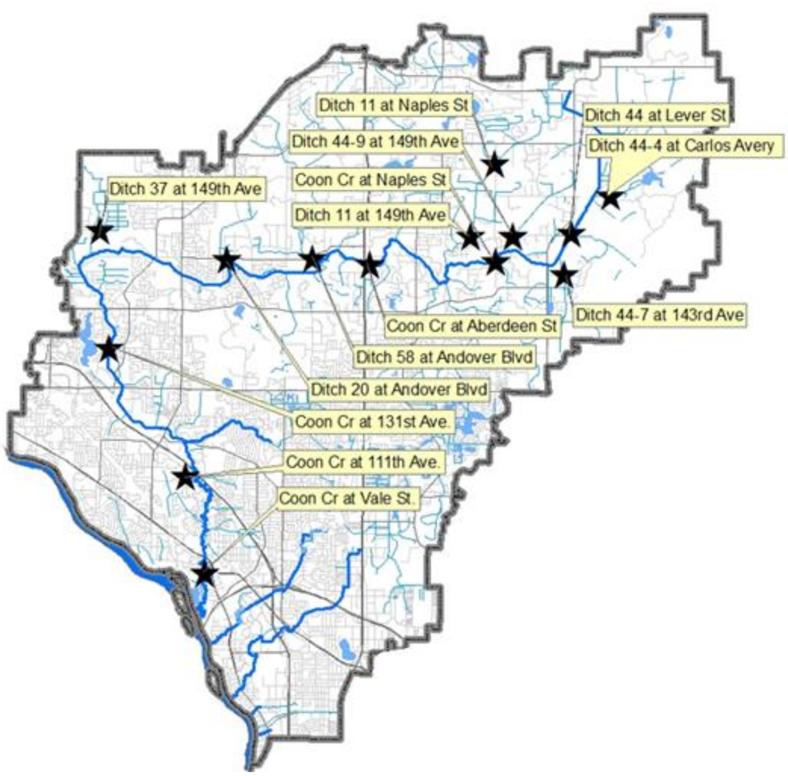
Coon Creek Main Stem and Tributary Ditches Monitoring Sites		
Site Name/ SiteID	**Years Monitored**	**2021 Data Collected**
Ditch 44-4 at Carlos Avery (tributary)	2021	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Ditch 44 at Lever St (tributary)	2021	Water Chemistry Grab Samples, Flow Measurements
Ditch 44-7 at 143rd Ave (tributary)	2021	Water Chemistry Grab Samples, Flow Measurements
Coon Cr at Lexington Blvd S007-539	2013-2016	
Ditch 44-9 at 149th Ave	2021	Water Chemistry Grab Samples, Flow Measurements
Coon Cr at Naples St S007-057	2012-2021	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Ditch 11 at Naples St (tributary)	2021	Water Chemistry Grab Samples, Flow Measurements
Ditch 11 at 149st Ave (tributary) S007-541	2013-2017, 2020-2021	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Coon Cr at Aberdeen St	2021	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Coon Cr at Hwy 65 S005-259	2018-2020	
Ditch 58 at Andover Blvd (tributary) S005-830	2001-2018, 2020-2021	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Coon Cr at Prairie Rd. S007-540	2013, 2017, 2018, 2020	
Ditch 20 at Andover Blvd) (tributary) S016-392	2020-2021	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Ditch 37 at 149th (tributary)	2021	Water Chemistry Grab Samples, Continuous Stage, Flow Measurements
Coon Cr at 131st Ave S005-257	2010-2021	Water Chemistry Grab Samples
Coon Cr at Lions Park (Hanson Blvd) S004-171	2007-2017	
Coon Creek at 111th S007-559	2018-2021	Water Chemistry Grab Samples, Continuous Stage
Ditch 52 at Robinson (tributary) S015-117	2018, 2021	
Woodcrest Creek at Creekside Estates S016-393	2020	
Coon Cr at Vale St S003-993	2005-2021	Water Chemistry Grab Samples

Background

Coon Creek and its tributaries 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 out letting to the creek itself.

The rural ditch systems that drain agricultural and residential lands to Coon Creek 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 and fish communities. Coon Creek also exceeds state standards for Total Suspended Solids (TSS) and Total Phosphorus (TP), two pollutants that have been identified as primary stressors to the local invertebrate and fish communities.

2021 Coon Creek Stream Water Quality Monitoring Sites



Results and Discussion

Coon Creek is listed as impaired for aquatic recreation (*E. coli*) and aquatic life- (macroinvertebrates, fish), with TP and TSS identified as the primary stressors along with poor habitat and altered hydrology. TP levels throughout the watershed often exceed state water quality standards, as do TSS levels during storms. Coon Creek's water quality declines significantly upstream to downstream, though this decline is most pronounced in the upper portions of the watershed. A number of factors compromise water quality in Coon Creek, but the data suggests that efforts by the CCWD to improve stormwater treatment are helping improve water quality where this work is occurring. 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 preventing further decline of water quality. There is no significant change in TP 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.

Phosphorus concentration data indicate that ditch systems in the upper portions of the watershed are degrading Coon Creek water quality to levels that will prevent it from achieving state water quality standards downstream. A statistically 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 draining rural and agricultural areas join Coon Creek throughout this portion of the watershed. These ditches are not all monitored, but those that are have poor water quality. The primary source of *E. coli* bacteria in Coon Creek as identified by the TMDL, is livestock (cattle and horses), which are more prevalent in the upper reaches of the watershed and are often present adjacent to the creek itself. Domestic pets are the next largest source of *E. coli*, and another likely source. Throughout the watershed waterfowl also congregate throughout much of the drainage area and in the creek itself. Shifting water quality improvement efforts to the upstream reaches of the Coon Creek watershed may be the most productive way to improve water quality for the entire 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. Median specific conductance increases gradually from upstream (0.437 mS/cm) to downstream (0.760 mS/cm) during baseflow conditions through all monitoring years. Median specific conductance (all years) following storm events shows a smaller difference between upstream and downstream measurements, ranging from 0.410 to 0.529 mS/cm. The median specific conductance in Coon Creek at Vale St. is higher during both baseflow conditions and post storm events 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.

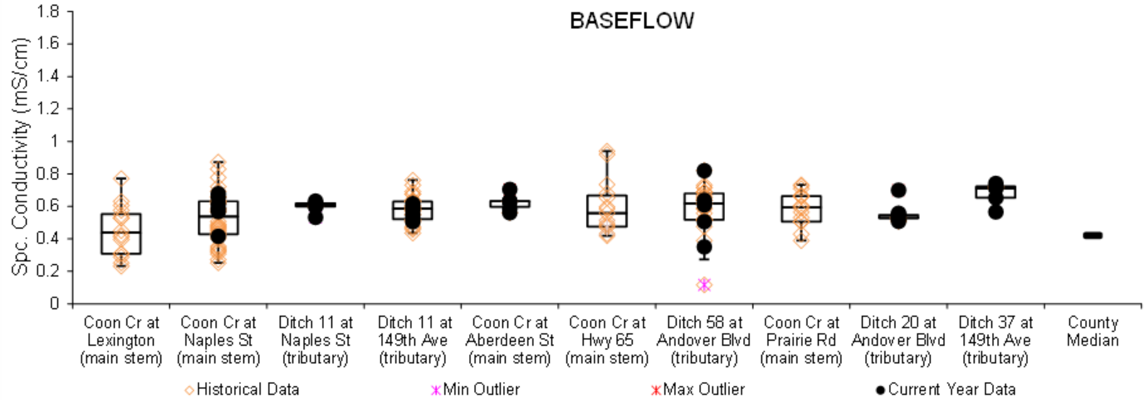
Storms help dilute some of the pollutant load, making the increase from upstream to downstream smaller. However, upstream median values during all conditions are still above average in Coon Creek compared to other Anoka County streams. Prevention measures to reduce specific conductance (such as reduced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

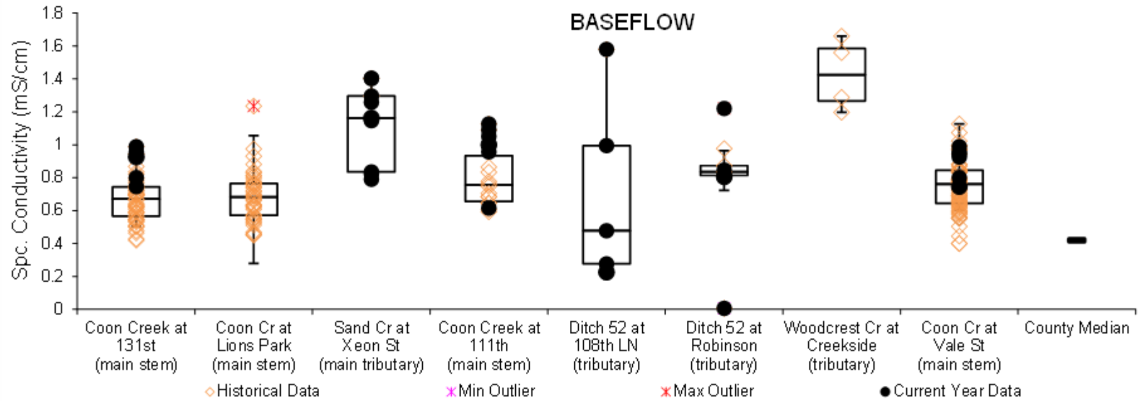
Chloride sampling has not occurred enough in Coon Creek for statistical analysis, but a general look at past data shows an increase in chloride moving downstream through Coon Creek. As the creek progresses through its watershed, urban development increases. This is likely contributing to chloride loading through road salting and industrial inputs. Although the concentrations of chlorides increase dramatically moving downstream, they have not approached state standard concentrations (230 mg/L chronic and 860 mg/L acute). In 2021, chloride sampling was conducted at the Vale St outlet monitoring site. Chloride concentrations averaged 69.77 mg/L during storm flow and 96.56 mg/L during baseflow conditions. These 2021 levels were higher than chloride averages recorded in 2019 but still well below the state standards.

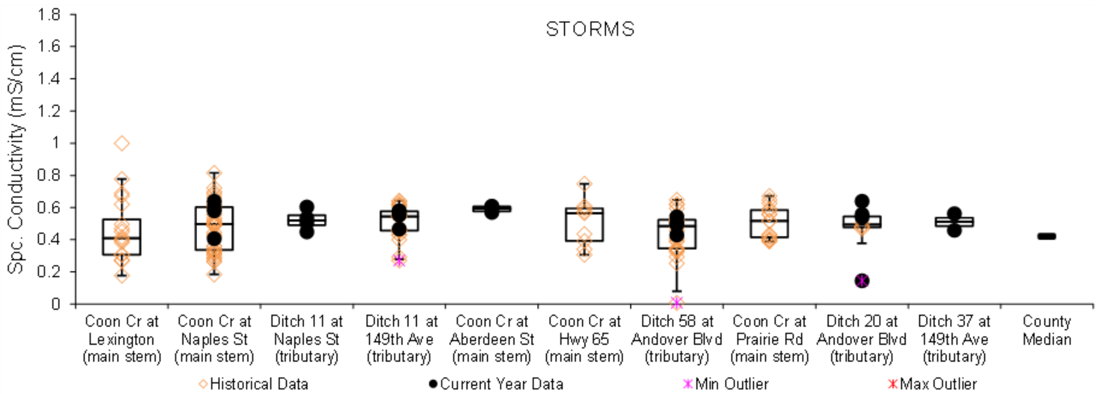
Median specific conductance in Coon Creek. Data is from Vale St for all years through 2021.

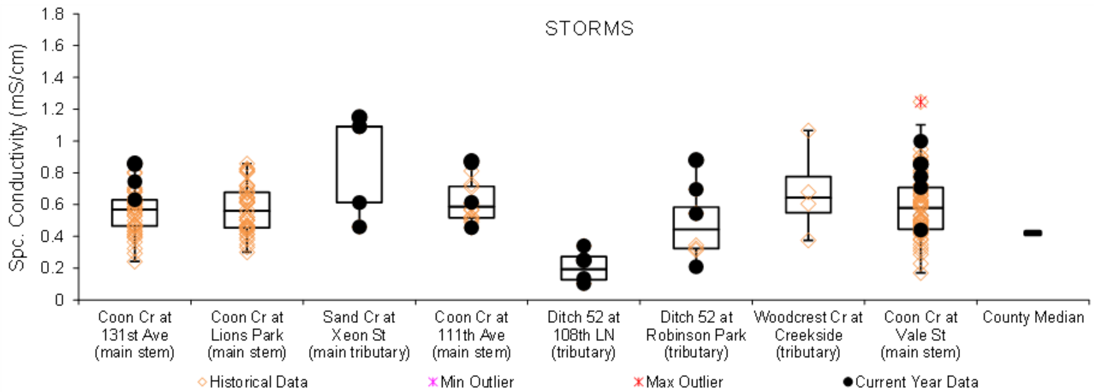
	Specific conductance (mS/cm)	State Standard	N
Baseflow	0.760	Specific conductance – none	69
Storms	0.579		69
All	0.663		138
Occasions > state standard			0

Specific Conductance at Coon Creek Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (end of box), and 10th and 90th percentile (floating outer lines) of all data collected at these sites.









TOTAL PHOSPHORUS

The state water quality standard for total phosphorus (TP) for streams in this region is 100 µg/L. Coon Creek may eventually be designated as impaired for eutrophication because it often exceeds this standard, especially during storms. Coon Creek has a TMDL in place for TP, even without the impaired designation for this pollutant, because it is identified as a primary stressor to Coon Creek's aquatic life impairments. 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 outlet monitoring site at Vale St under both flow conditions. There is also a significant increase from the headwaters to the approximate mid-point of the watershed (Naples St. to 131st Ave.) during baseflow conditions only. In both flow conditions, no additional significant increase is present from 131st Ave to the downstream monitoring site at Vale St.

In the upper portions of the watershed, the monitoring sites along main stem Coon Creek at Lexington Ave and Naples St generally contain baseflow and storm event concentrations below the state standard. The four monitored ditch systems that join with Coon Creek downstream of these sites (Ditch 11, Ditch 58, Ditch 20, Ditch 37) generally have higher phosphorus concentrations than main stem Coon Creek. Ditch 11 typically contains high concentrations in all conditions contributing to the degradation of Coon Creek water quality downstream. The median concentration of TP samples collected in Ditch 11 at 149th Avenue from 2013-2017, 2020 and 2021 was 118 µg/L for baseflow events and 228.5 µg/L for storm events, which are both higher than the state standard of 100 µg/L. Similarly, at Ditch 58, the median concentration of TP was 75 µg/L during baseflow and 144 µg/L during storm events. Ditch 20 at Andover Blvd was also higher than the State standard during both baseflow (103 µg/L) and storm events (160.5 µg/L). Ditch 37 at 149th Ave, first monitored in 2021, drastically exceeded the state standard during both baseflow (322.2 µg/L) and storm flow conditions (294.40 µg/L). Based on these findings, it is likely that other unmonitored ditch systems in this region are contributing to TP loads in similar ways. Altogether, ANOVA results show significant increases in average baseflow and nearly significant increase in average stormflow TP concentrations between Naples St (headwaters) and 131st Ave ($p= <0.01$ & $p= 0.058$, respectively), likely caused by inputs from several tributary ditch systems.

There is no significant difference in median baseflow or storm flow TP concentrations between 131st Ave and Vale St (located in the middle and lower portions of the watershed). Baseflow concentrations at 131st Ave average 109 µg/L at 131st Ave. and 94 µg/L at Vale St. Average storm flow concentrations were 187 µg/L and 200.5 µg/L, respectively. These results indicate there is no further increase in TP in Coon Creek downstream of 131st Ave. Additionally, no significant increase was observed for baseflow or post-storm TP concentrations at Vale St. from 2005-2021, although storm flow conditions have marginally improved during this period of record ($p=.30$. The Coon Creek Watershed District has invested a large amount of money and effort into stormwater treatment practices and stream improvement projects in this portion of the watershed, which collectively indicate quantifiable impacts towards reduced phosphorus concentrations in the creek during storm events. However, the concentrations in these lower watershed reaches often still exceed state standards in part due to high phosphorus in upper parts of the watershed.

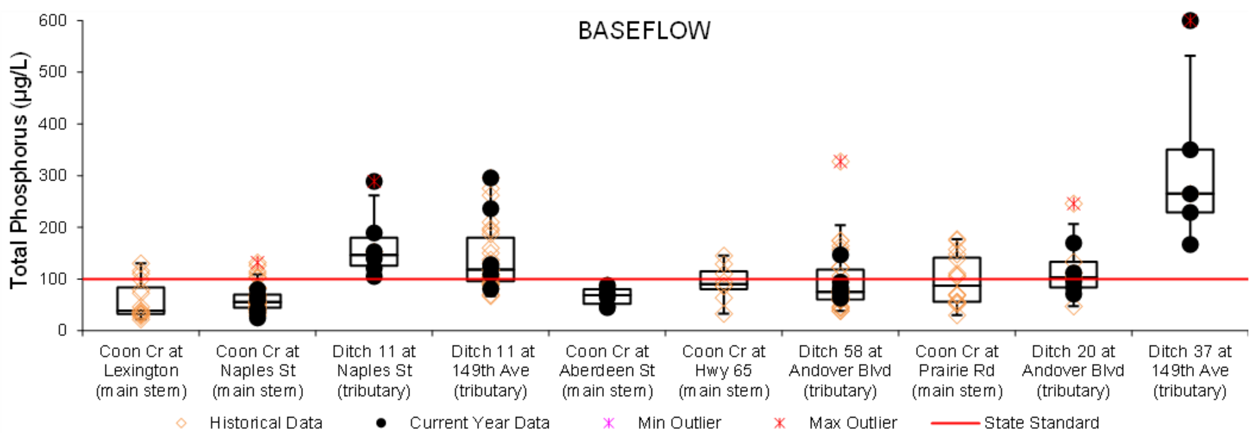
Supplemental Ortho Phosphorus (OP) samples were collected in 2021 at the outlet of Coon Creek. The average Ortho Phosphorus concentration during baseflow was 38% (range=22%-54%) of the average Total Phosphorus concentration. During storms, the average OP concentration was 15% (range=13%-36%) of the average TP concentration. This indicates that the majority of phosphorus in Coon Creek is particle bound reaffirming the need for further bank stabilization in the upper portion of the watershed. The MN Stormwater Manual reports the national average Ortho Phosphorus concentration as a percentage of Total Phosphorus to be 26% indicating Coon Creek is in the normal range.

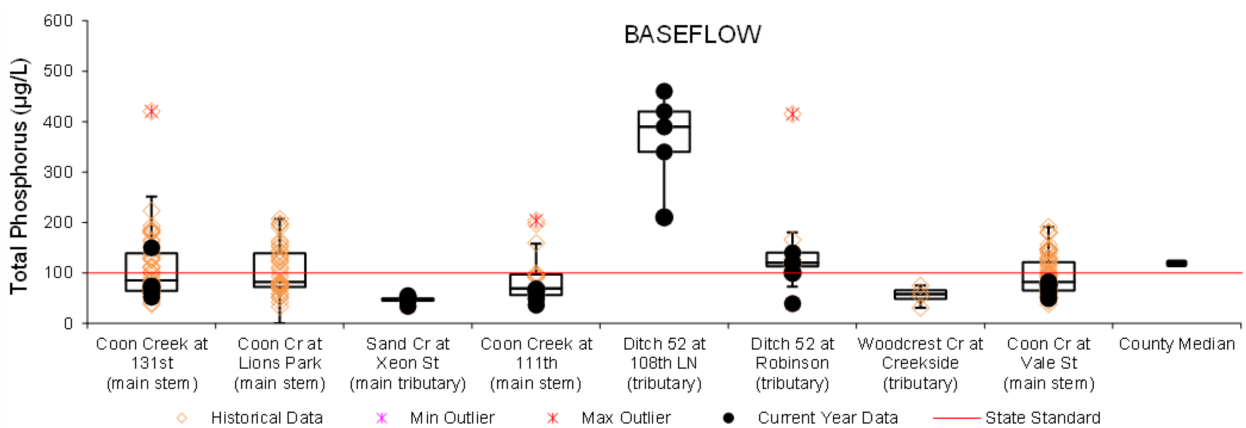
The Coon Creek TMDL, approved in 2016, delegates acceptable loads of pollutants in Coon Creek on a load duration curve (LDC) instead of a fixed daily or annual load in pounds. The LDC for Coon Creek is graphed on a plot with flow-weighted daily loads for phosphorus samples collected at Vale Street from 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 nearly 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 the Coon Creek watershed. This work will likely require implementation of in-field and edge-of-field best management practices where agricultural land uses remain. 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 before travelling through the entire system.

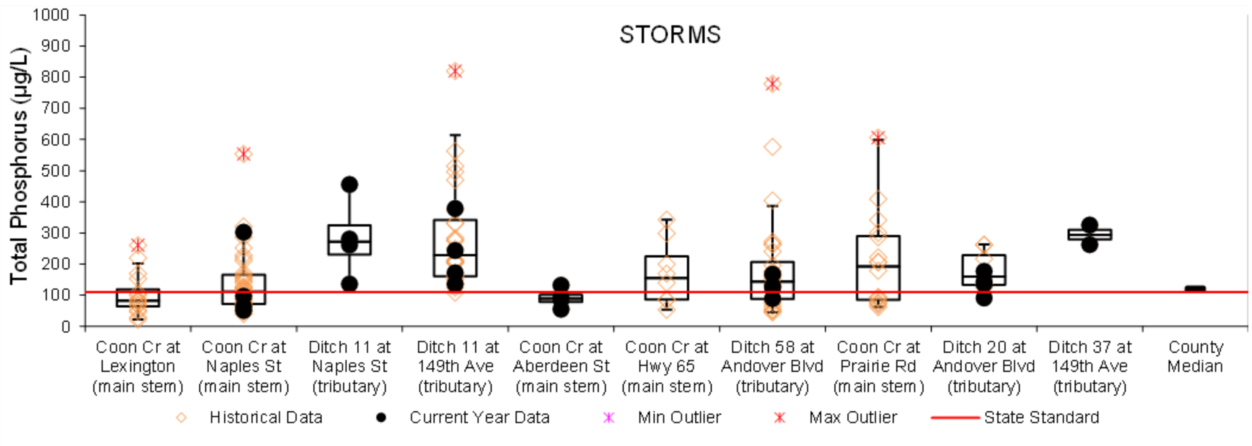
Average and median total phosphorus in Coon Creek Data is from Vale St for all years through 2021.

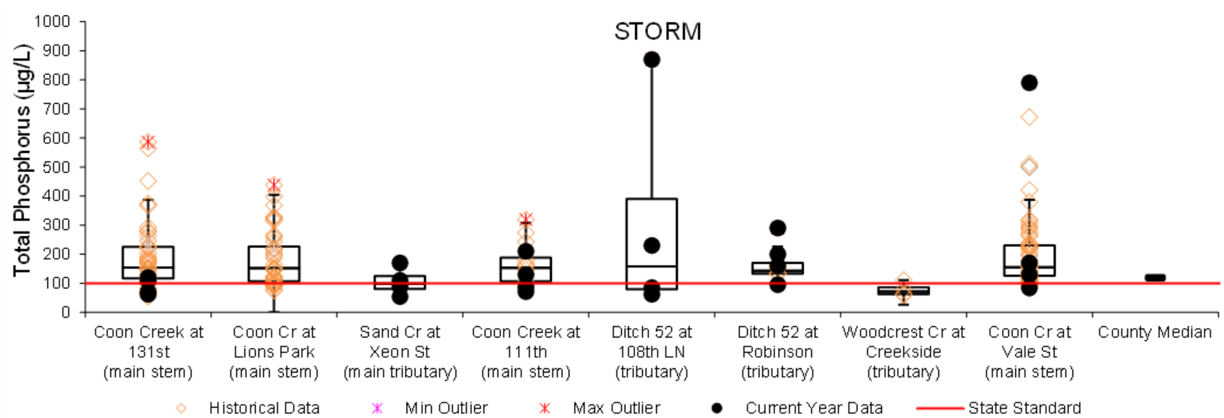
	Average Total Phosphorus (µg/L)	Median Total Phosphorus (µg/L)	State Standard	N
Baseflow	93.81	82.00	100 µg/L	69
Storms	200.51	154.50		68
All	146.77	122.0		137
Occasions>state standard				22 (baseflow) 32% 61 (storm) 90%

Total Phosphorus at Coon Creek Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (median line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.



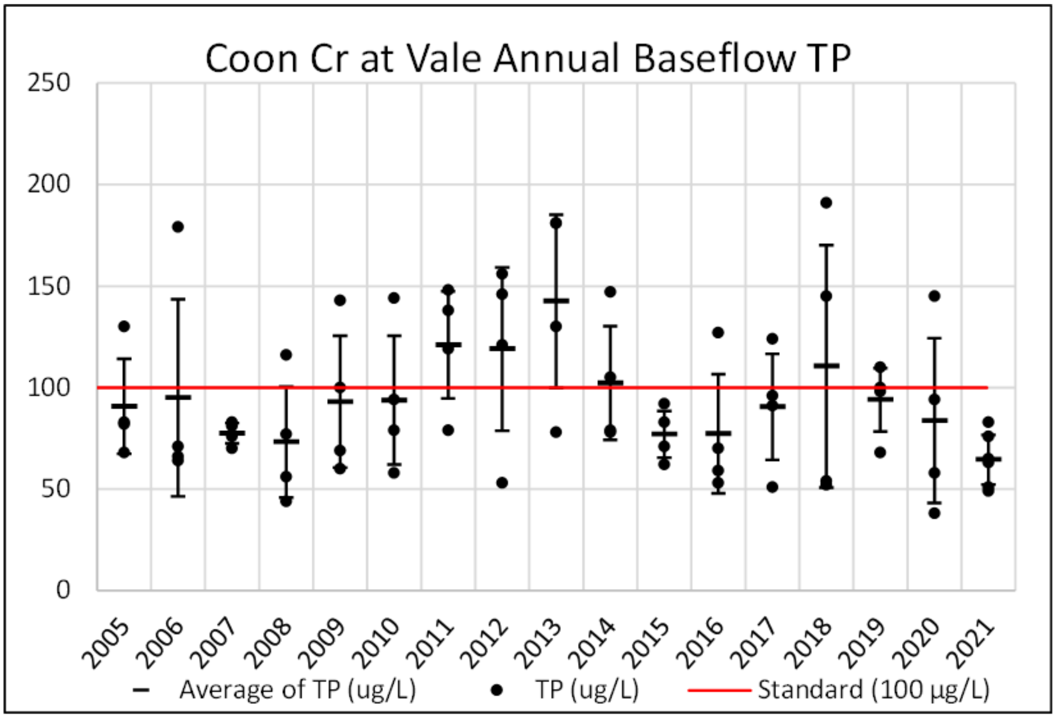


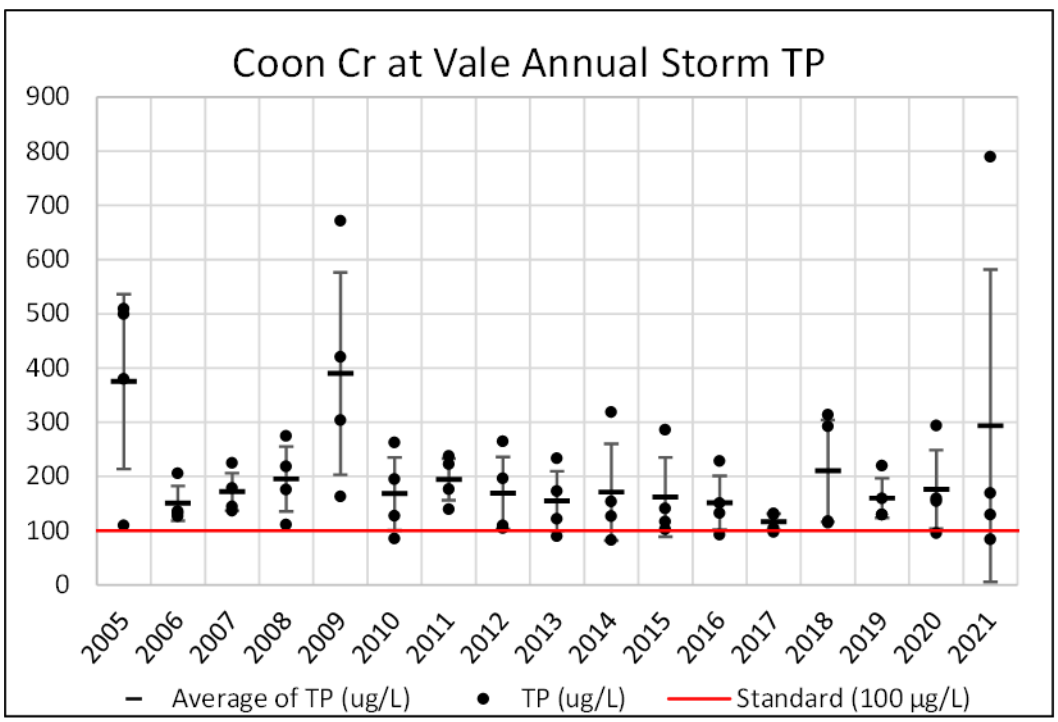

STORMS
Total Phosphorus (µg/L)
1000
900
800
700
600
500
400
300
200
100
0
Coon Cr at Lexington (main stem)
Coon Cr at Naples St (main stem)
Ditch 11 at Naples St (tributary)
Ditch 11 at 149th Ave (tributary)
Coon Cr at Aberdeen St (main stem)
Coon Cr at Hwy 65 (main stem)
Ditch 58 at Andover Blvd (tributary)
Coon Cr at Prairie Rd (main stem)
Ditch 20 at Andover Blvd (tributary)
Ditch 37 at 149th Ave (tributary)
County Median
Historical Data
Current Year Data
Min Outlier
Max Outlier
State Standard


STORM
Total Phosphorus (µg/L)
1000
900
800
700
600
500
400
300
200
100
0
Coon Creek at 131st (main stem)
Coon Cr at Lions Park (main stem)
Sand Cr at Xeon St (main tributary)
Coon Creek at 111th (main stem)
Ditch 52 at 108th LN (tributary)
Ditch 52 at Robinson (tributary)
Woodcrest Cr at Creekside (tributary)
Coon Cr at Vale St (main stem)
County Median
Historical Data
Min Outlier
Max Outlier
Current Year Data
State Standard

Coon Creek at Vale St. - Annual average TP concentration change - ANOVA regression 2005-21

Parameters	**Significant Change in Annual x̄ (2005-2021)**	**p-value**	**Standard Error of Means**
Total Phosphorus – Baseflow	None	0.68	20.40
Total Phosphorus – Storm	None	0.30	77.40





ANOVA Matrix for Baseflow Total Phosphorus

	Coon Creek at Naples St. (2012-2021) 42 Samples Total	Coon Creek at 131st Ave. (2010-2021) 50 Samples Total	Coon Creek at Vale St. (2005-2021) 69 Samples Total
Coon Creek at Naples St.		Significant Increase Naples $\bar{X}$= 62.46µg/L 131st $\bar{X}$= 108.96 µg/L p= < 0.01	Significant Increase Naples $\bar{X}$= 62.46µg/L Vale $\bar{X}$= 93.81 µg/L p= < 0.01
Coon Creek at 131st Ave.			No Sig. Change 131st $\bar{X}$= 108.96 µg/L Vale $\bar{X}$= 93.81 µg/L p= 0.116
Coon Creek at Vale St.			

ANOVA Matrix for Storm Total Phosphorus

	Coon Creek at Naples St. (2012-2021) 40 Samples Total	Coon Creek at 131st Ave. (2010-2021) 48 Samples Total	Coon Creek at Vale St. (2005-2021) 68 Samples Total
Coon Creek at Naples St.		No Sig. Change (close to being Significant) Naples $\bar{X}$=141.2 µg/L 131st $\bar{X}$= 187.04 µg/L p= 0.058	Significant Increase Naples $\bar{X}$= 141.2 µg/L Vale $\bar{X}$= 200.51 µg/L p= <0.05
Coon Creek at 131st Ave.			No Sig. Change 131st $\bar{X}$= 187.04 µg/L Vale $\bar{X}$= 200.51 µg/L p= 0.57
Coon Creek at Vale St.			

TOTAL SUSPENDED SOLIDS

Similar to TP, Coon Creek has a TMDL for TSS because it is identified as a stressor for aquatic macroinvertebrates and fish in the creek, not because the creek is directly impaired for TSS. TSS concentrations in Coon Creek follow a similar pattern to TP concentrations, but are generally below (meet) 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 during storm events in its middle and lower reaches.

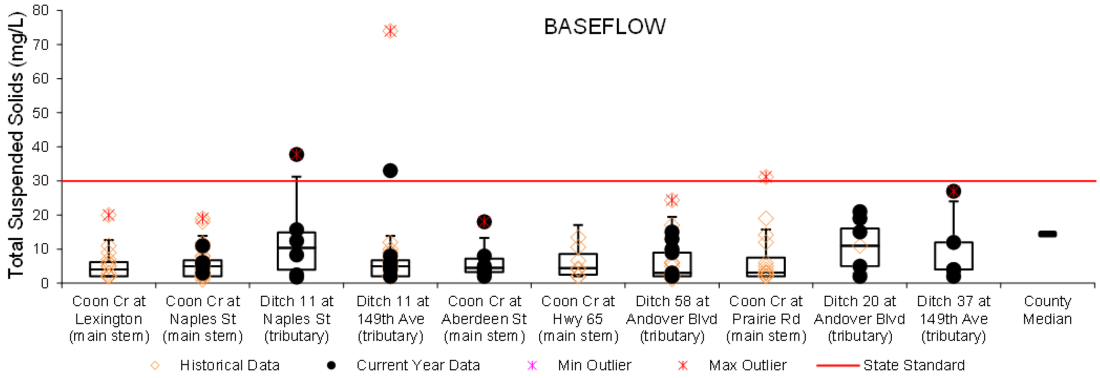
ANOVA analyses at three sites moving upstream to downstream (Coon Creek at Naples St, 131st Ave, and Vale St.) show a significant increase in TSS concentrations from the upstream portions of the watershed to the approximate mid-point of the watershed (Naples St. to 131st Ave.) during both baseflow and stormflow conditions. During stormflow conditions there is also a significant difference present from 131st Ave to the downstream monitoring site at Vale St, indicating that increases in TSS in Coon Creek is occurring in both the upper and lower portions of the watershed. There is also no significant change in TSS at Vale St from 2005 through 2021. 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.

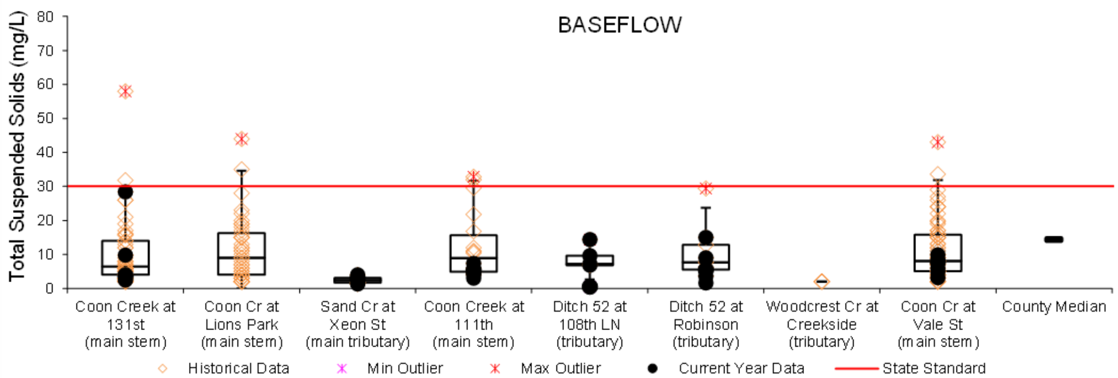
While TSS concentrations and daily flow-weighted loads generally conform to state standards in Coon Creek at Vale Street, it should be noted that significant increases in concentrations moving from upstream to downstream sites occur and should be a high priority for management of Coon Creek's water quality. In the TMDL report, it is estimated that 63% of all TSS loading to Coon Creek is due to streambank erosion. 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. Efforts to reduce TSS loading in these upper reaches will improve water quality downstream of the implemented projects. Additionally, as the northern portion of the watershed develops, it is important to continue enforcing stringent stormwater regulations and compliance with construction site best practices.

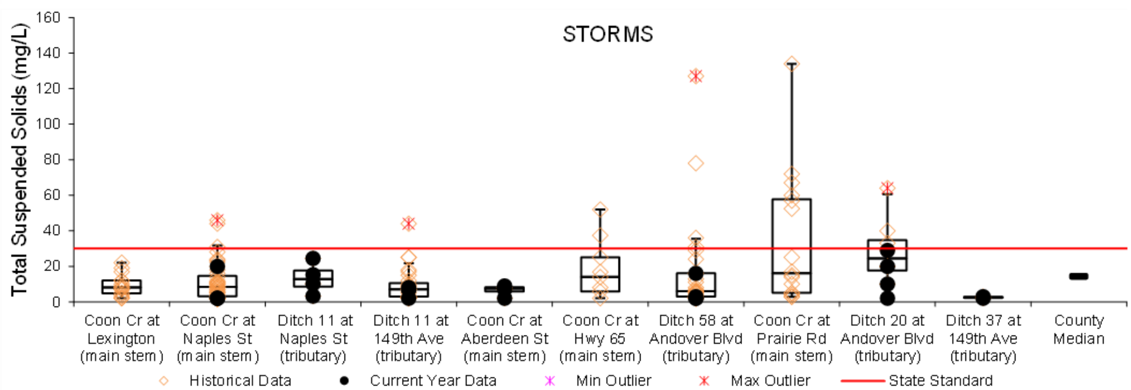
Average and median total suspended solids in Coon Creek Data is from Vale St for all years through 2021.

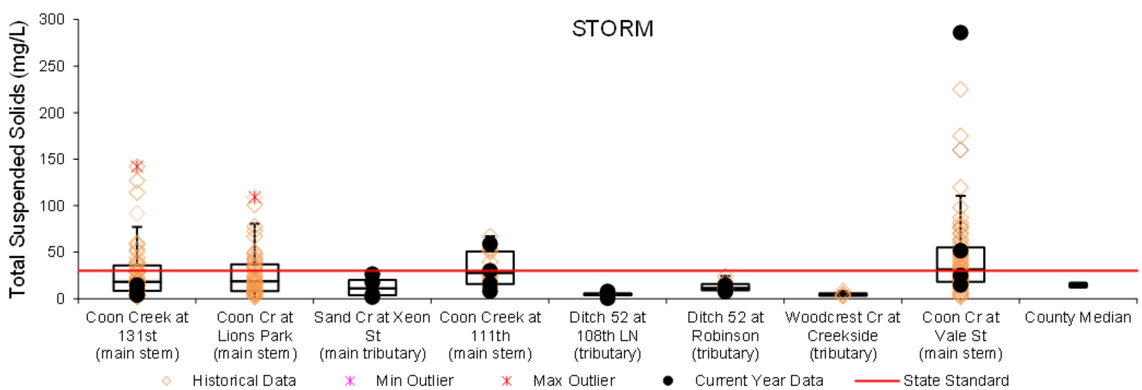
	Average TSS (mg/L)	Median TSS (mg/L)	State Standard	N
Baseflow	11.19	8.1	30 mg/L	70
Storms	50.34	31.0		68
All	30.48	16.0		138
Occasions > state TSS standard				2 (baseflow) 26% 34 (storm) 50%

Total Suspended Solids at Coon Creek Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) of all data collected at these sites.



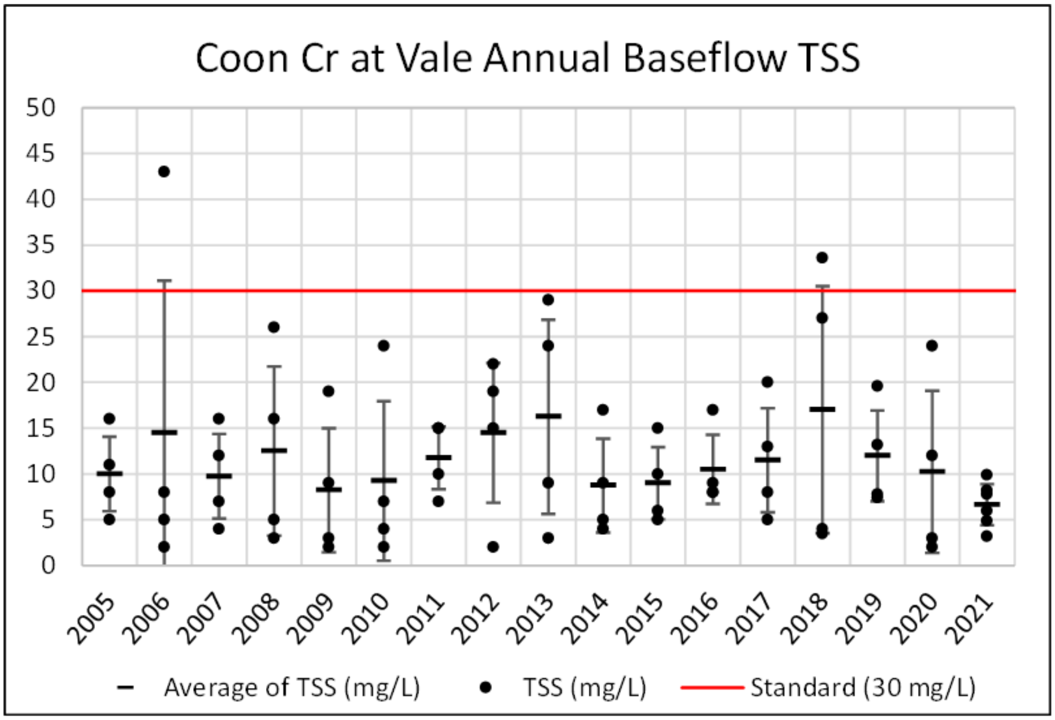


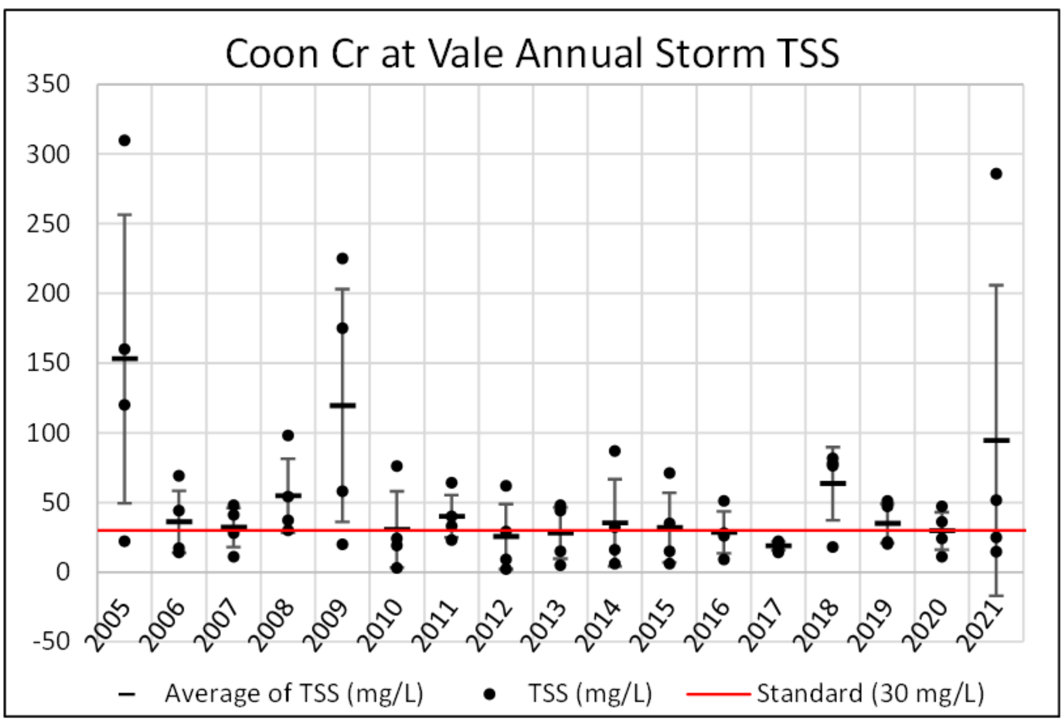




Coon Creek at Vale St. - Annual average ANOVA regression TSS 2005-2021

Parameters	Significant Change in Annual x̄ (2005-2021)	p-value	Standard Error of Means
Total Suspended Solids – Baseflow	None	0.80	2.96
Total Suspended Solids – Storm	None	0.26	36.94





ANOVA Matrix for Baseflow Total Suspended Solids

	Coon Creek at Naples St. (2012-2021) 42 Samples Total	Coon Creek at 131st Ave. (2010-2021) 52 Samples Total	Coon Creek at Vale St. (2005-2021) 70 Samples Total
Coon Creek at Naples St.		Significant Increase Naples $\bar{X}$= 5.54 mg/L 131st $\bar{X}$= 10.37 mg/L p= < 0.01	Significant Increase Naples $\bar{X}$= 5.54 mg/L Vale $\bar{X}$= 11.18 mg/L p= < 0.01
Coon Creek at 131st Ave.			No Sig. Change 131st $\bar{X}$= 10.37 mg/L Vale $\bar{X}$= 11.18 mg/L p= 0.63
Coon Creek at Vale St.			

ANOVA Matrix for Storm Total Suspended Solids

	Coon Creek at Naples St. (2012-2021) 40 Samples Total	Coon Creek at 131st Ave. (2010-2020) 48 Samples Total	Coon Creek at Vale St. (2005-2021) 68 Samples Total
Coon Creek at Naples St.		Significant Increase Naples $\bar{X}$= 11.44mg/L 131st $\bar{X}$= 28.31 mg/L p= < 0.01	Significant Increase Naples $\bar{X}$= 11.44mg/L Vale $\bar{X}$= 50.34 mg/L p= <0.001
Coon Creek at 131st Ave.			Significant Increase 131st $\bar{X}$= 28.31 mg/L Vale $\bar{X}$= 50.34 mg/L p= <0.05
Coon Creek at Vale St.			

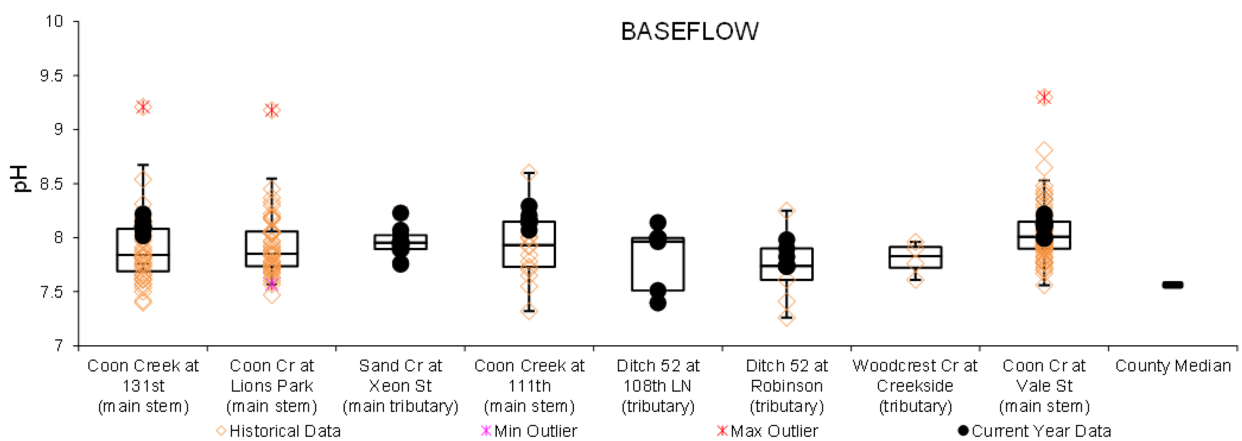
pH

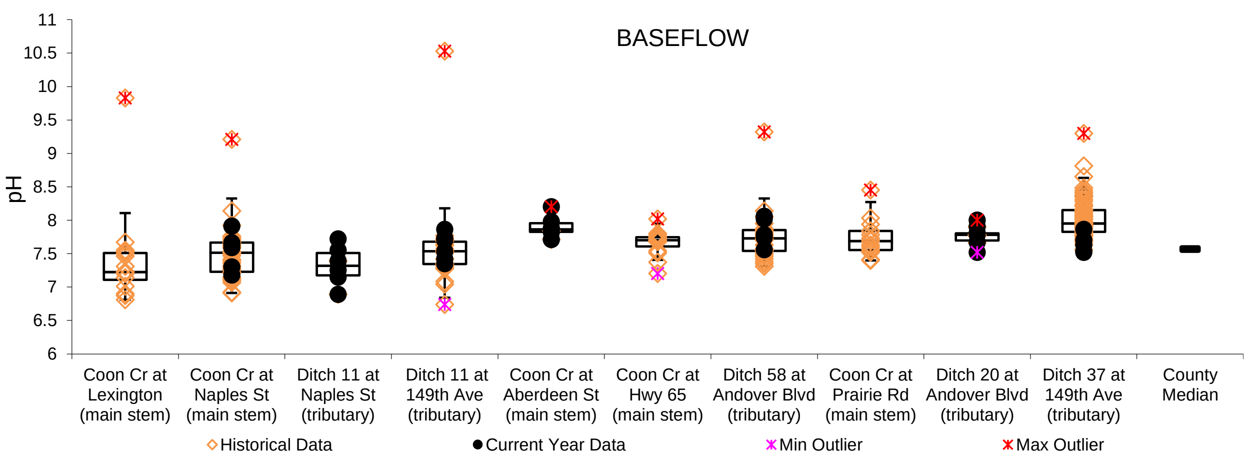
pH levels in Coon Creek are normally within the state standard range of 6.5-8.5. Typically, pH is lower during storm events because rainfall is more acidic. Exceedances of state standards have occurred, but they are rare and are not currently a concern.

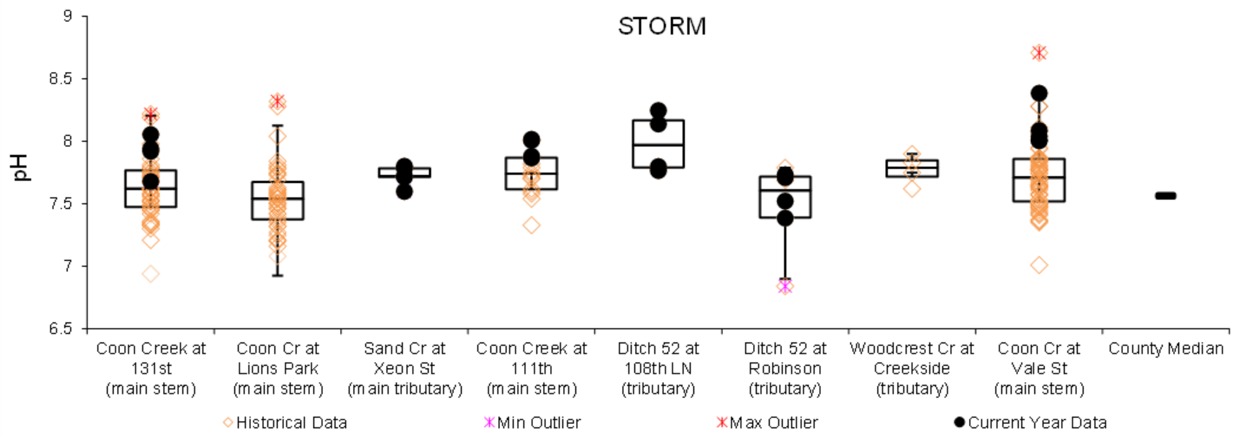
Average and median pH in Coon Creek Data is from Vale St for all years through 2021.

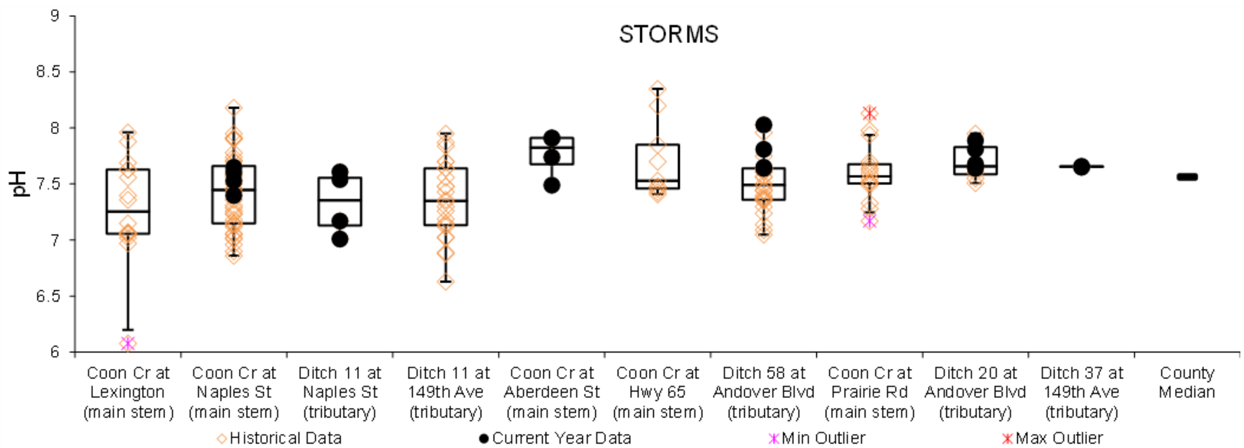
	Average pH	Median pH	State Standard	N
Baseflow	8.05	8.00	6.5-8.5	72
Storms	7.70	7.68		65
All	7.9	7.89		137
Occasions outside state standard				3 (baseflow) 4% 1 (storm) 1%

pH at Coon Creek Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).






STORM
pH
9
8.5
8
7.5
7
6.5
Coon Creek at 131st (main stem)
Coon Cr at Lions Park (main stem)
Sand Cr at Xeon St (main tributary)
Coon Creek at 111th (main stem)
Ditch 52 at 108th LN (tributary)
Ditch 52 at Robinson (tributary)
Woodcrest Cr at Creekside (tributary)
Coon Cr at Vale St (main stem)
County Median
Historical Data
Min Outlier
Max Outlier
Current Year Data


STORMS
pH
9
8.5
8
7.5
7
6.5
6
Coon Cr at Lexington (main stem)
Coon Cr at Naples St (main stem)
Ditch 11 at Naples St (tributary)
Ditch 11 at 149th Ave (tributary)
Coon Cr at Aberdeen St (main stem)
Coon Cr at Hwy 65 (main stem)
Ditch 58 at Andover Blvd (tributary)
Coon Cr at Prairie Rd (main stem)
Ditch 20 at Andover Blvd (tributary)
Ditch 37 at 149th Ave (tributary)
County Median
Historical Data
Current Year Data
Min Outlier
Max Outlier

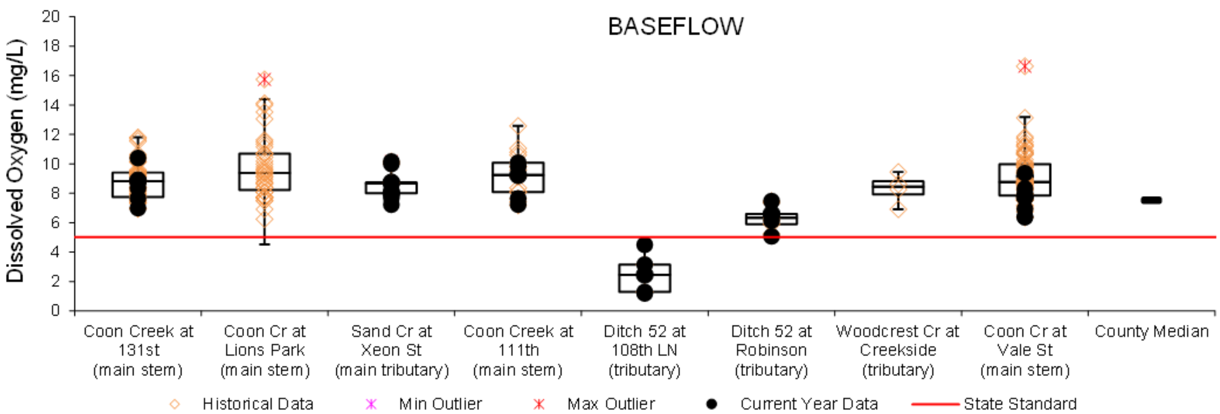
Dissolved Oxygen

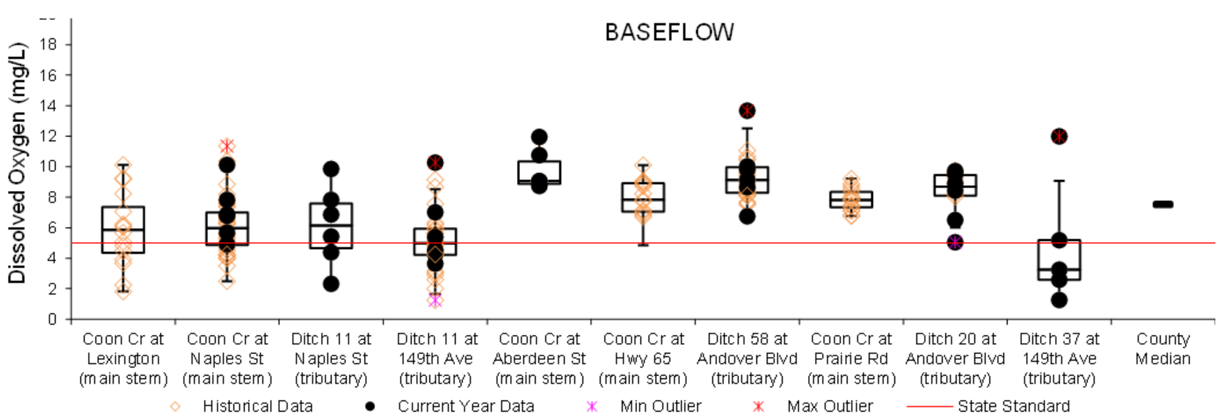
Low dissolved oxygen (DO) levels are generally not an issue in Coon Creek, especially in its downstream reaches, but they are identified as a stressor to aquatic life in the headwaters. In past years, low DO readings all occurred in the upstream reaches of the main stem and in Ditch 11. Higher DO levels are present in the larger and more natural channel found further downstream than the levels observed in the small ditched channels upstream. In 2021, DO levels below the state standard of 5 mg/L were recorded in Ditch 11, Ditch 37, and Ditch 52. DO levels may have been influenced by drought conditions in 2021. Low DO levels in these systems may be contributing to the high TP loadings observed at these sites by creating conditions amenable to internal loading in wetlands, ponds, or stagnant reaches; this warrants further investigation.

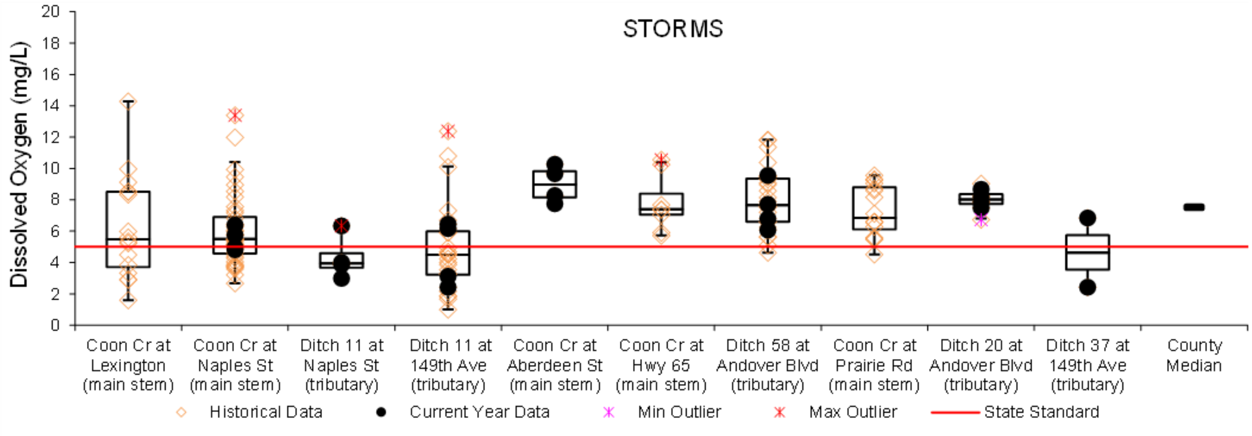
Average and median dissolved oxygen in Coon Creek Data is from Vale St for all years through 2021.

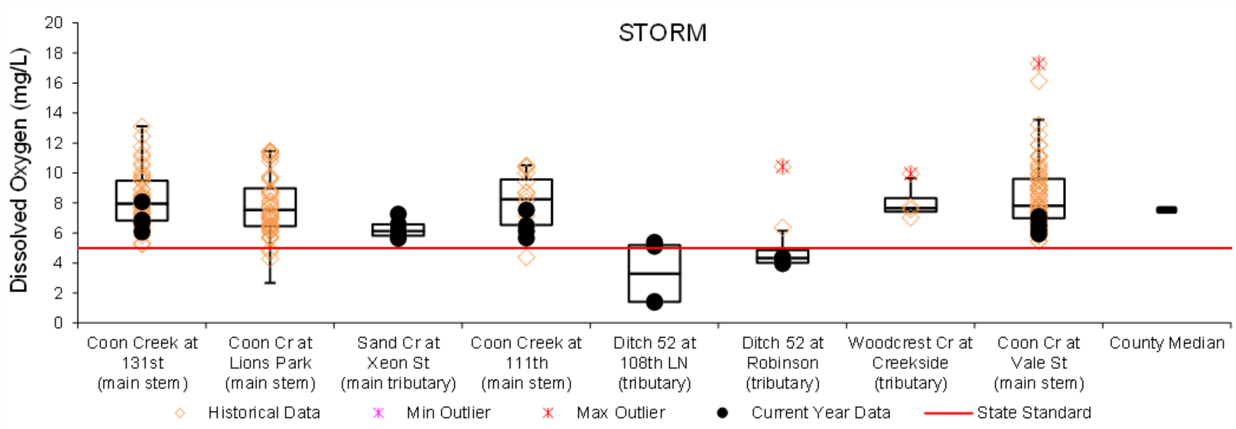
	Average Dissolved Oxygen (mg/L)	Median Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	9.10	8.75	5 mg/L daily minimum	67
Storms	8.50	7.81		67
All	8.80	8.57		134
Occasions <5 mg/L				0

Dissolved oxygen at Coon Creek Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) of all data collected at these sites.






STORMS
Dissolved Oxygen (mg/L)
Coon Cr at Lexington (main stem)
Coon Cr at Naples St (main stem)
Ditch 11 at Naples St (tributary)
Ditch 11 at 149th Ave (tributary)
Coon Cr at Aberdeen St (main stem)
Coon Cr at Hwy 65 (main stem)
Ditch 58 at Andover Blvd (tributary)
Coon Cr at Prairie Rd (main stem)
Ditch 20 at Andover Blvd (tributary)
Ditch 37 at 149th Ave (tributary)
County Median
Historical Data
Current Year Data
Min Outlier
Max Outlier
State Standard


STORM
Dissolved Oxygen (mg/L)
Coon Creek at 131st (main stem)
Coon Cr at Lions Park (main stem)
Sand Cr at Xeon St (main tributary)
Coon Creek at 111th (main stem)
Ditch 52 at 108th LN (tributary)
Ditch 52 at Robinson (tributary)
Woodcrest Cr at Creekside (tributary)
Coon Cr at Vale St (main stem)
County Median
Historical Data
Min Outlier
Max Outlier
Current Year Data
State Standard

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 (Most Probable Number) 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 ten 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 77 MPN at Naples St. to 169 MPN at Vale St during baseflow conditions. Sampling frequency requirements were not met for comparison to the chronic state water quality standard benchmark of 126 MPN in the upper watershed.

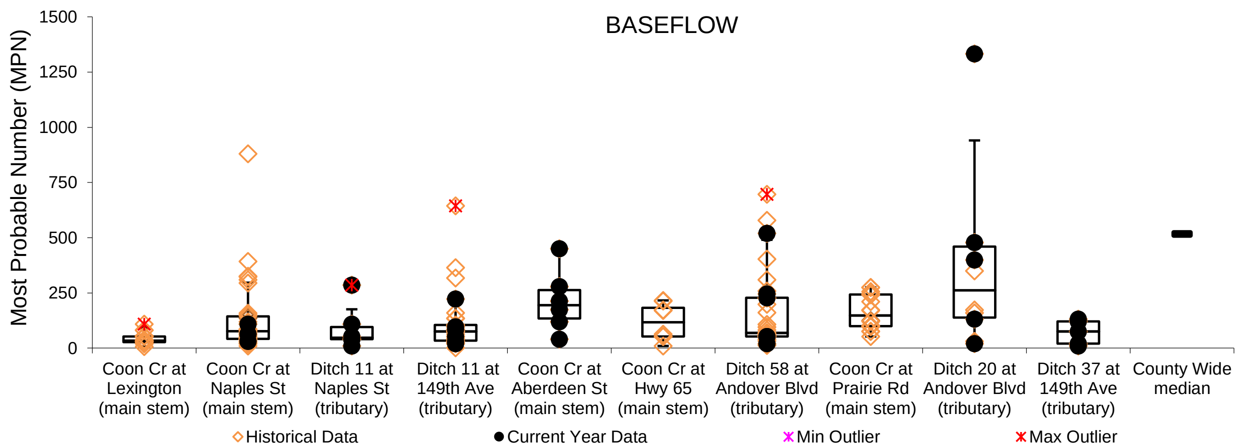
During baseflow conditions, all sites downstream of Naples St exceeded 126 MPN on at least one occasion in 2021, with most sites exceeding the standard three to four times. *E. coli* concentrations were higher than previous years monitored. Median *E. coli* for all years suggest that concentrations exceeded 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 1050 MPN at Vale St. In 2021, all but five 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 2021 exceeded 1,260 MPN on 25 occasions (48.1% of samples).

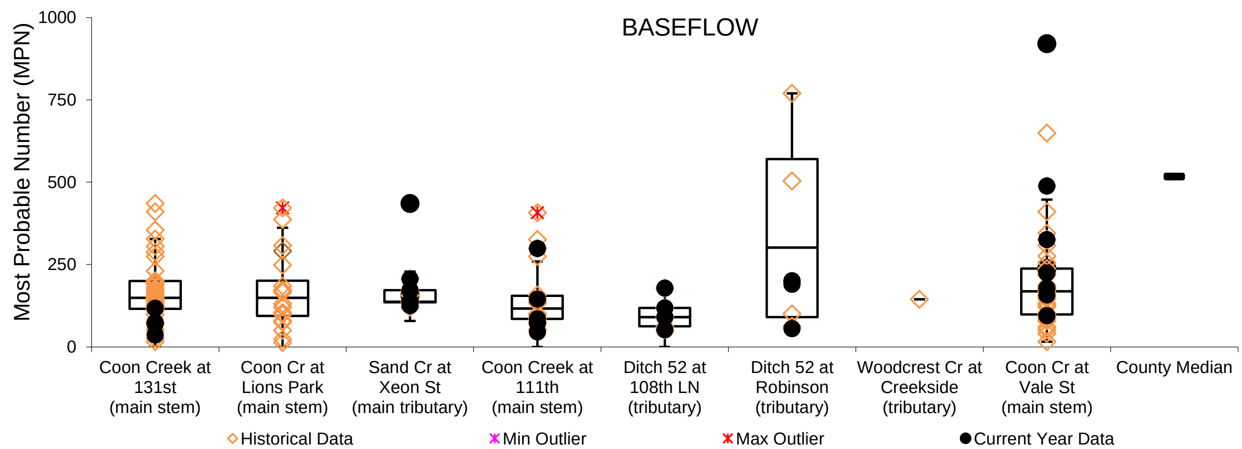
Coon Creek is listed as impaired for aquatic recreation due to *E. coli*. The *E. coli* LDC in the Coon Creek TMDL (Page 51, Figure 20) shows that the creek often exceeds acceptable loads during all flow levels. *E. coli* sources can be harder to pinpoint than sources of other pollutant loading because concentrations fluctuate wildly up or down without additional input because this pollutant is 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*.

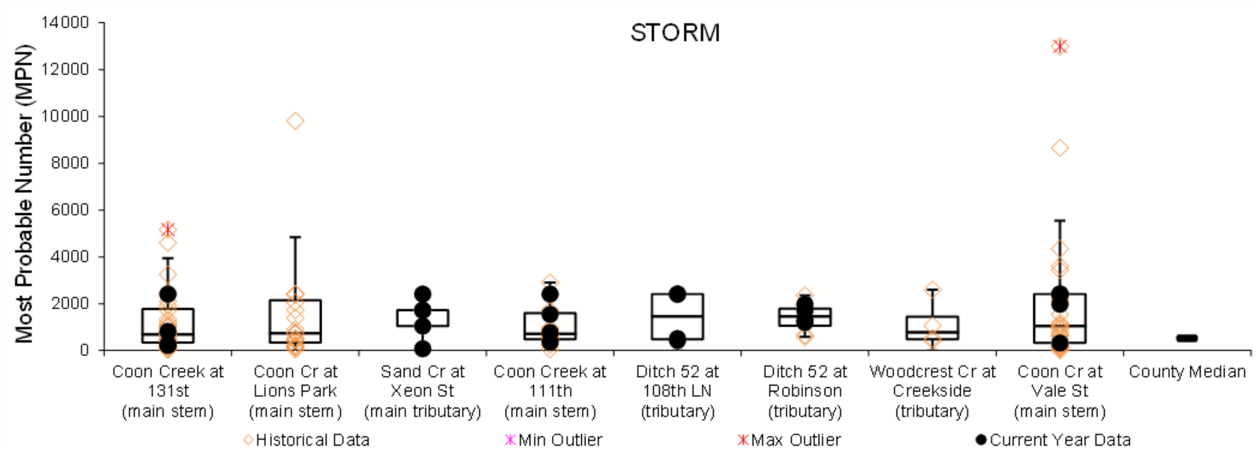
Average, Geomean and median *E. coli* in Coon Creek Data is from Vale St. 2013-2021.

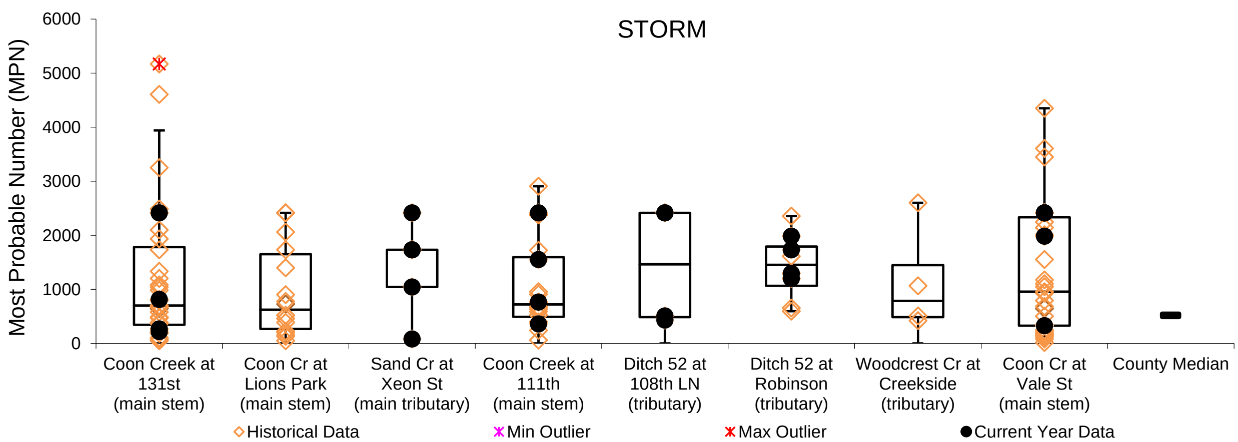
	Average *E. coli* (MPN)	Geomean *E. coli* (MPN)	Median *E. coli* (MPN)	State Standard	N
Baseflow	175.37	154.97	169.0	Monthly Geometric Mean >126 Monthly 10% average >1260	41
Storms	1,835.89	866.89	1050.00		37
All	978.74	351.08	252.0		78
Occasions >126 MPN					27 baseflow (66%), 34 storm (92%)
Occasions >1260 MPN					0 baseflow, 16 storm (43%)

***E. coli* at Coon Creek** Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites. Extremely high outliers were excluded from box-plot graphs.



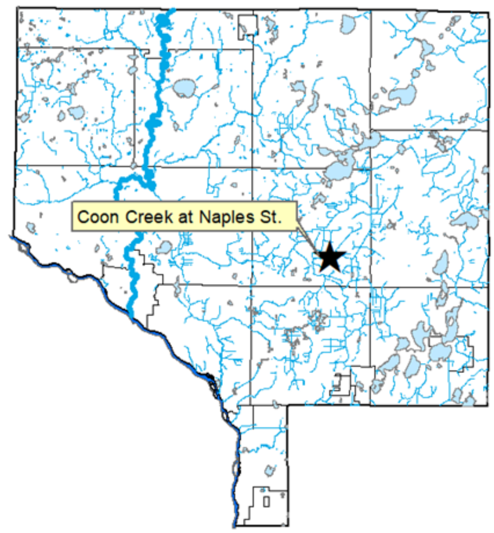



STORM
Most Probable Number (MPN)
14000
12000
10000
8000
6000
4000
2000
0
Coon Creek at 131st (main stem)
Coon Cr at Lions Park (main stem)
Sand Cr at Xeon St (main tributary)
Coon Creek at 111th (main stem)
Ditch 52 at 108th LN (tributary)
Ditch 52 at Robinson (tributary)
Woodcrest Cr at Creekside (tributary)
Coon Cr at Vale St (main stem)
County Median
Historical Data
Min Outlier
Max Outlier
Current Year Data


STORM
Most Probable Number (MPN)
6000
5000
4000
3000
2000
1000
0
Coon Creek at 131st (main stem)
Coon Cr at Lions Park (main stem)
Sand Cr at Xeon St (main tributary)
Coon Creek at 111th (main stem)
Ditch 52 at 108th LN (tributary)
Ditch 52 at Robinson (tributary)
Woodcrest Cr at Creekside (tributary)
Coon Cr at Vale St (main stem)
County Median
Historical Data
Min Outlier
Max Outlier
Current Year Data

STREAM HYDROLOGY – COON CREEK

COON CREEK AT NAPLES ST, HAM LAKE



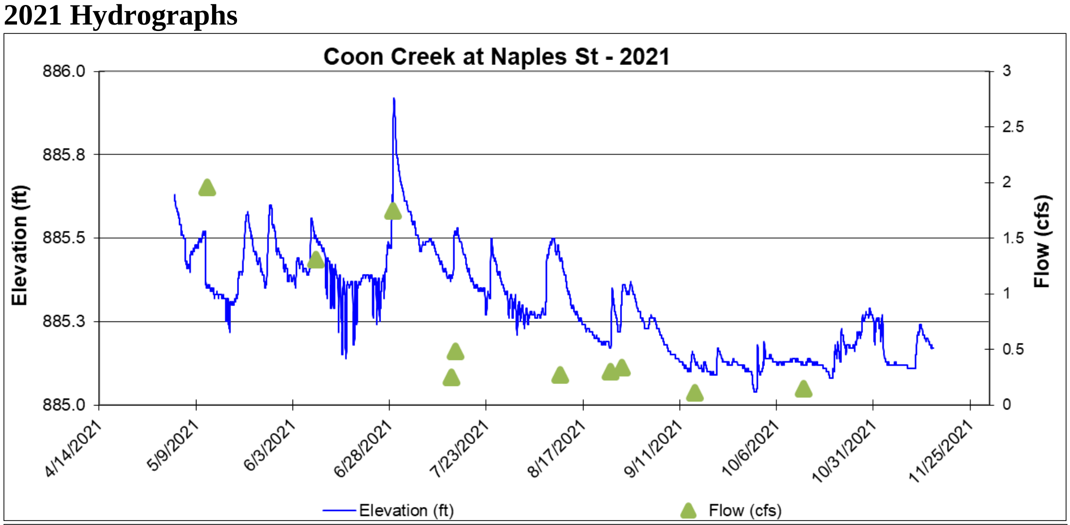
Notes

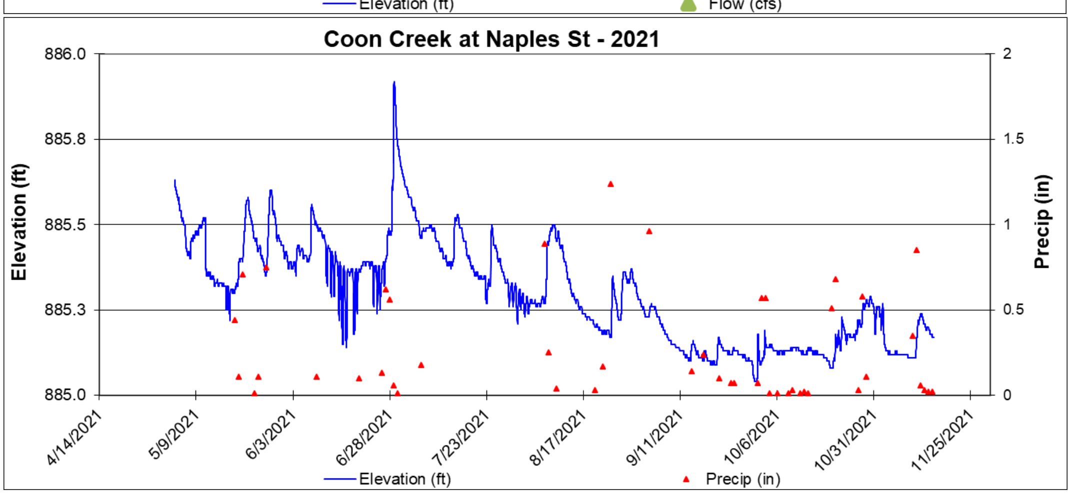
Stage at this site was slow to respond to rain events and fluctuated less than previous years. Throughout the monitoring season, the baseflow stage elevation at this site steadily decreased.

During the 2021 season, the creek at Naples St. only fluctuated 0.88 ft. between its minimum and maximum-recorded stage. This was the smallest range of stage fluctuation on record. The 2021 recorded range was 1.74 ft. less than the average range for this site. This was likely due to the drought conditions seen through most of the monitoring season. During a 1.24-inch storm on August 24, stage only rose 0.18 ft. in an eight-hour span.

A rating curve was first established for this site in 2013 and was redeveloped in 2020.

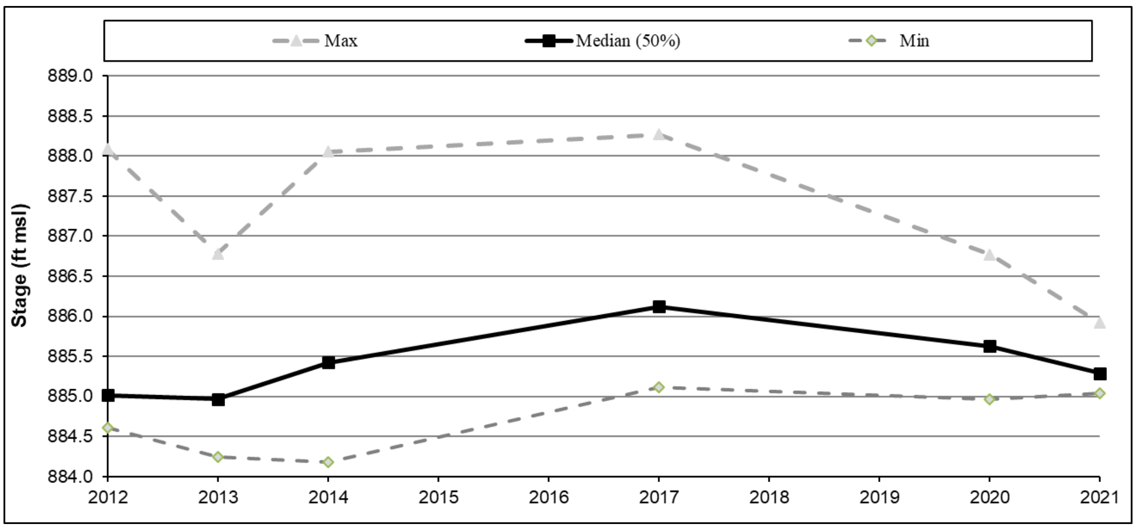
2021 Hydrographs



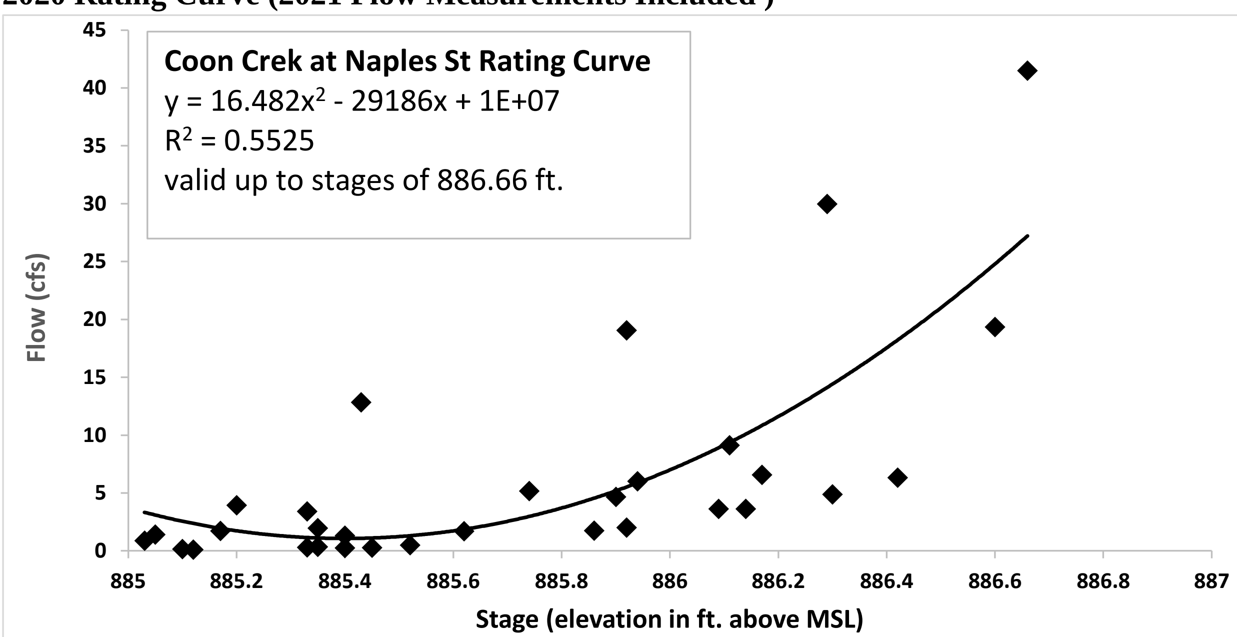


Summary of All Monitoring Years

Percentiles	2012	2013	2014	2017	2020	2021
Min	884.61	884.24	884.18	885.11	884.96	885.04
2.5%	884.71	884.41	884.69	885.26	884.99	885.10
10.0%	884.81	884.46	884.88	885.65	885.04	885.12
25.0%	884.89	884.55	885.06	885.78	885.36	885.15
Median (50%)	885.01	884.97	885.42	886.12	885.63	885.29
75.0%	885.49	885.42	886.38	886.42	885.92	885.41
90.0%	885.89	885.84	887.76	886.92	886.23	885.49
97.5%	887.78	886.22	888.01	888.09	886.66	885.59
Max	888.09	886.78	888.06	888.27	886.77	885.92

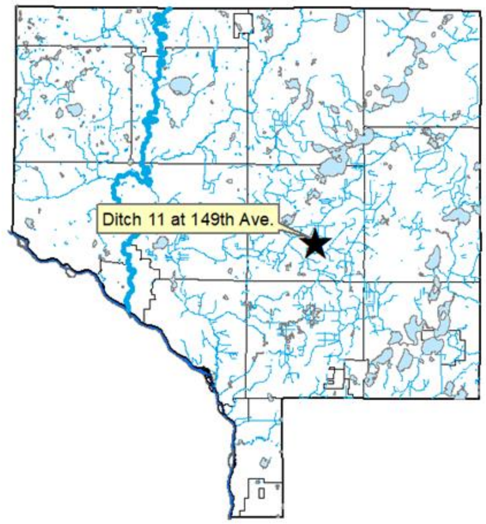


2020 Rating Curve (2021 Flow Measurements Included)



DITCH 11 AT 149TH AVE, HAM LAKE

Notes



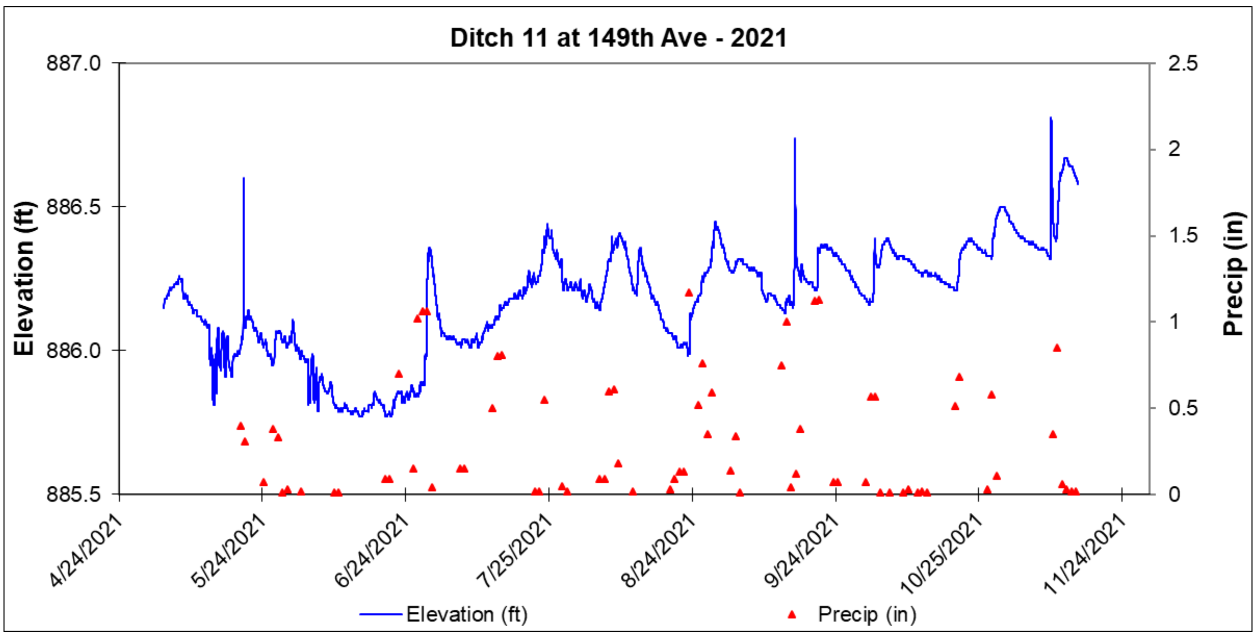
Stage at this site is flashy in response to storms, reacting quickly to rainfall events. This was the second year stage was monitored at this site.

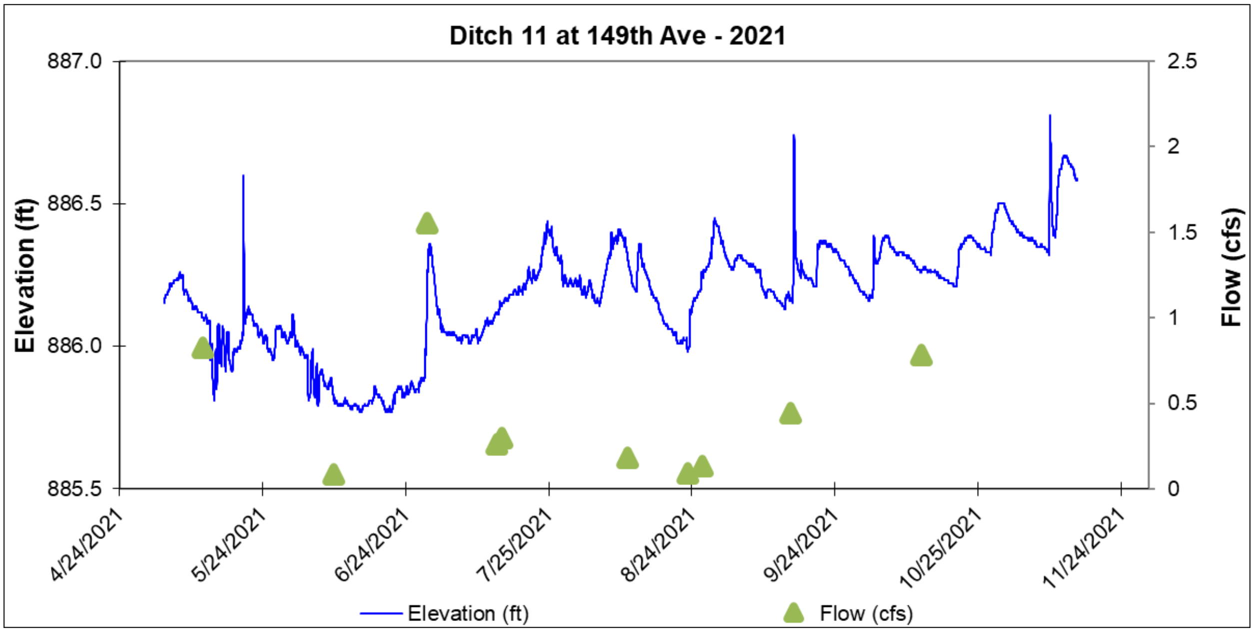
During the 2021 season, the ditch at the 149th Ave site fluctuated 1.04 ft. between its minimum and maximum-recorded stage. This is over a foot lower than the recorded range in 2020. During a 1.17-inch storm on August 23, stage rose 0.14 ft. in 11 hours.

This site had higher than anticipated water levels in 2021that continued to rise despite drought conditions. The cause is unclear, but likely related to active water level management in the ditch system by local agricultural producers for irrigation purposes.

A rating curve was established for this site in 2020 and is displayed below. Additional flow measurements were collected during each water quality monitoring visit.

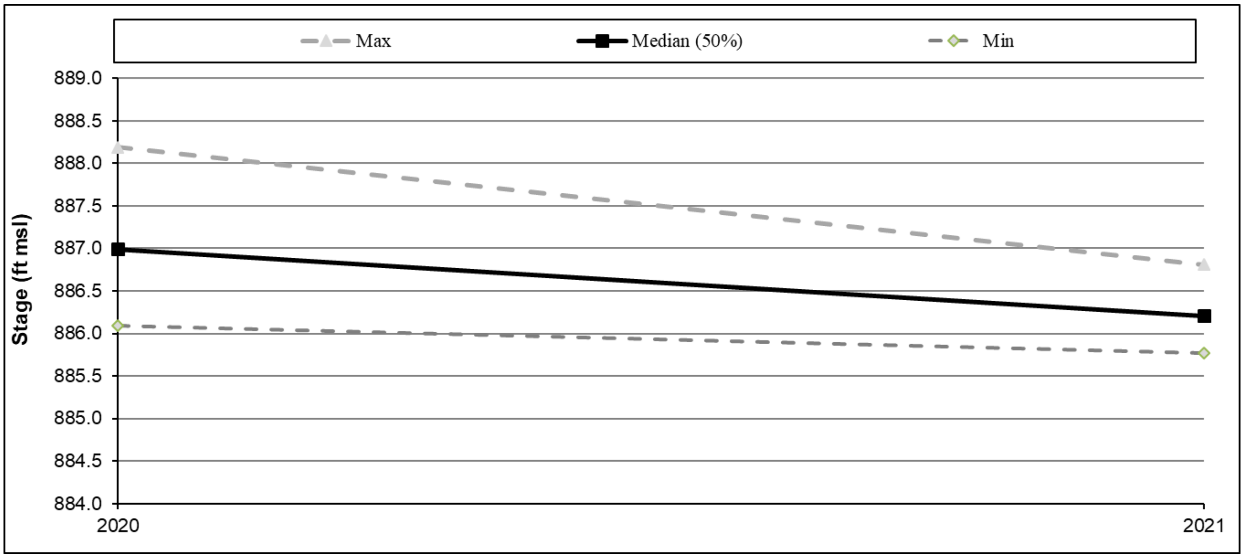
2021 Hydrographs





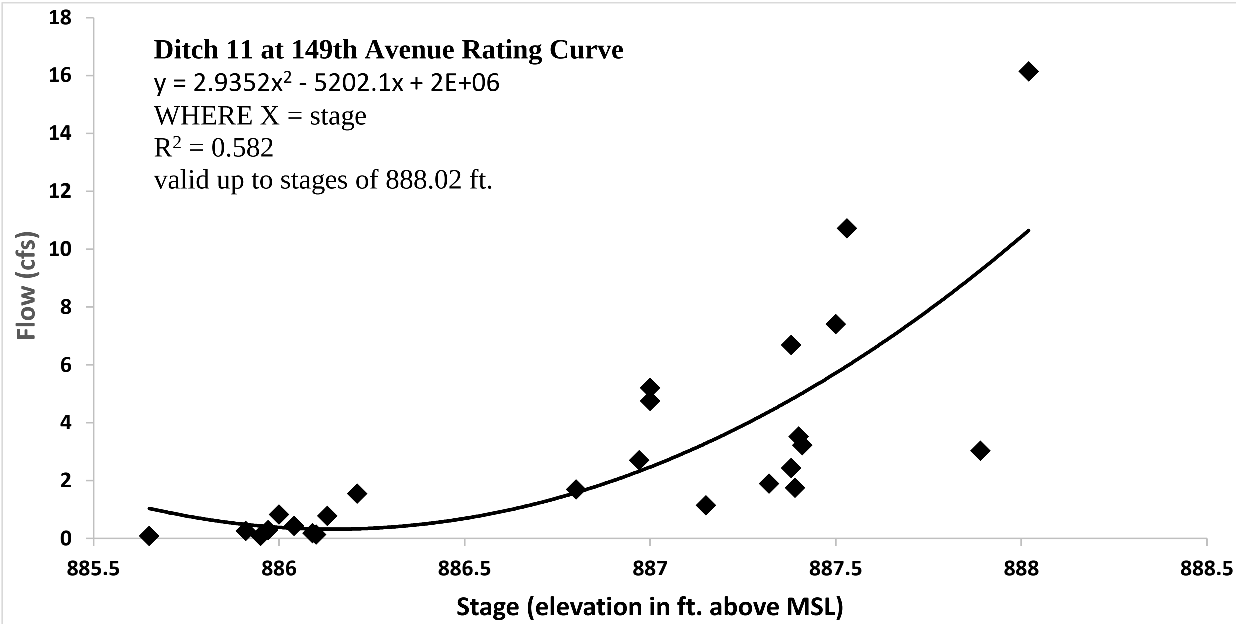
Summary of All Monitoring Years

Percentiles	2020	2021
Min	886.09	885.77
2.5%	886.36	886.05
10.0%	886.66	885.86
25.0%	886.79	886.05
Median (50%)	886.99	886.21
75.0%	887.09	886.32
90.0%	887.33	886.38
97.5%	887.75	886.5
Max	888.19	886.81



2020 Rating Curve (2021 Flow Measurements Included)

Note: this rating curve is impacted by water level management activities for agricultural irrigation



Coon Creek at Aberdeen St, Ham Lake

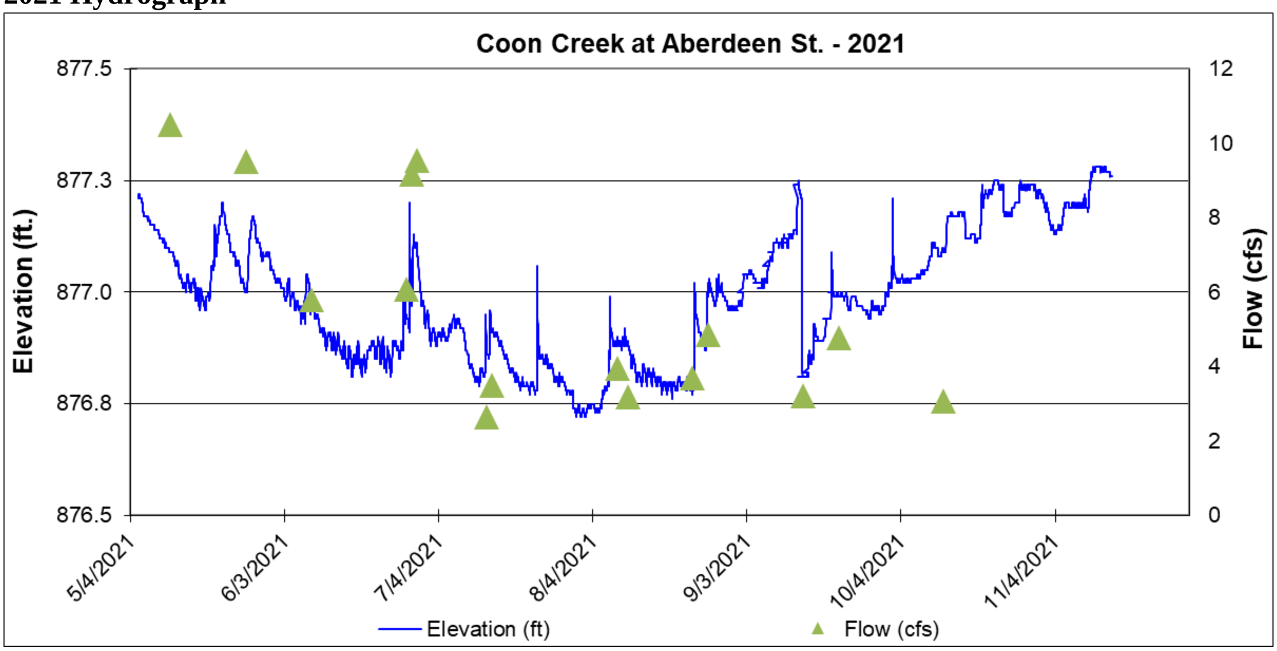
Notes

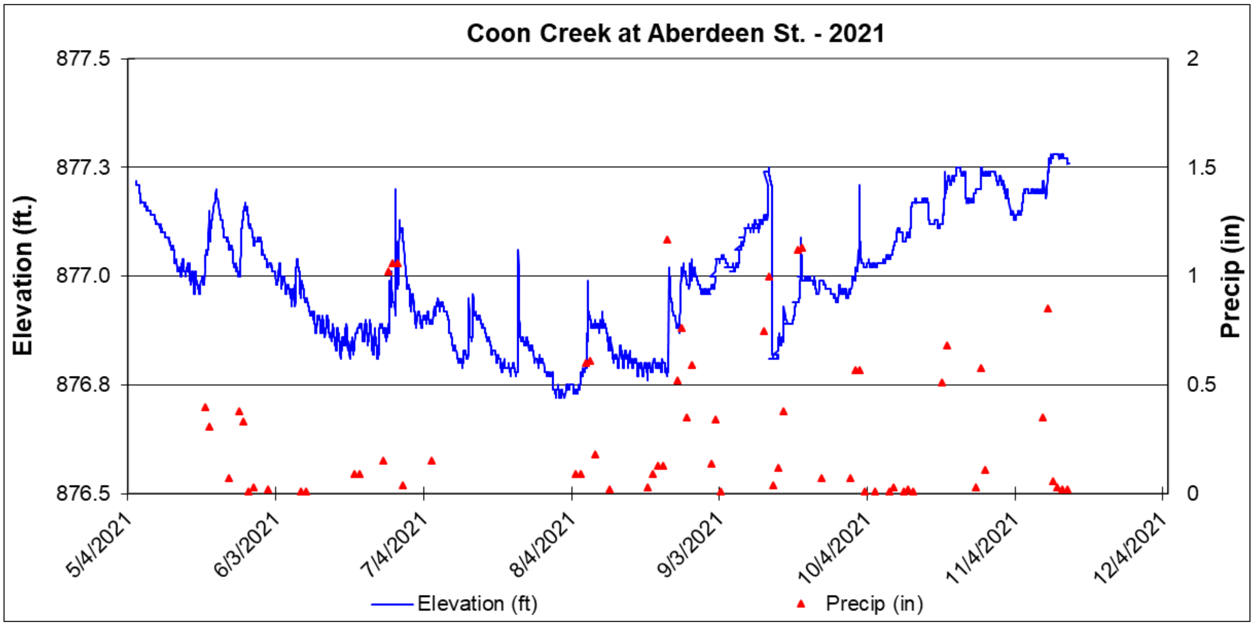
2021 is the first year of monitoring stage at Aberdeen St which is a newly constructed stream crossing. This location is located just upstream from the previous monitoring location at Highway 65, and provides safer access to Coon Creek. During the season, the creek fluctuated by only 0.56 feet between its minimum and maximum recorded elevations. Following a 1.17-inch rainfall, stage rose 0.23ft in an 11-hour span.

This site had higher than anticipated water levels in 2021 that continued to rise despite drought conditions. It was determined there was a buildup of debris under the Hwy 65 bridge immediately downstream that caused water to dam. CCWD staff cleared the obstruction in September of 2021, but no further damming was observed to explain the continued increase in water levels.

More monitoring should be done at this site to examine how stage fluctuates through the season. A rating curve was developed in 2021 and is displayed below.

2021 Hydrograph

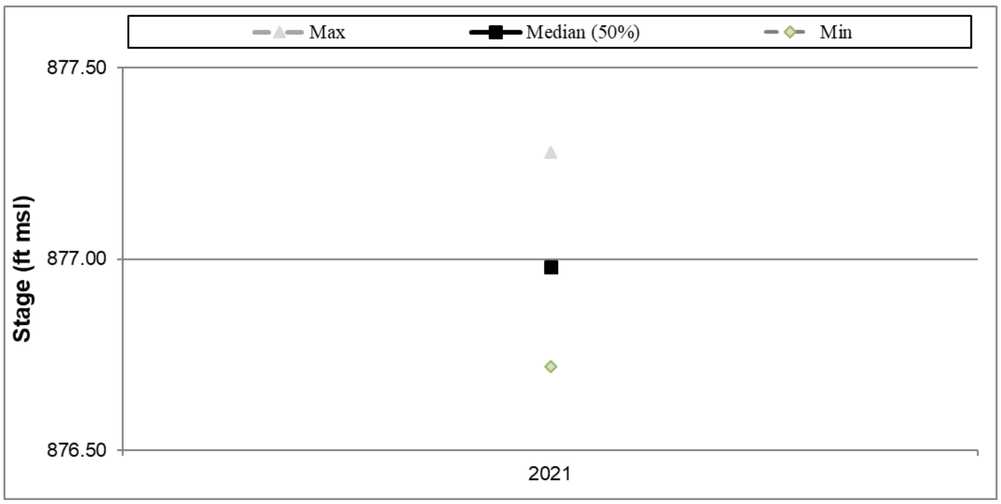




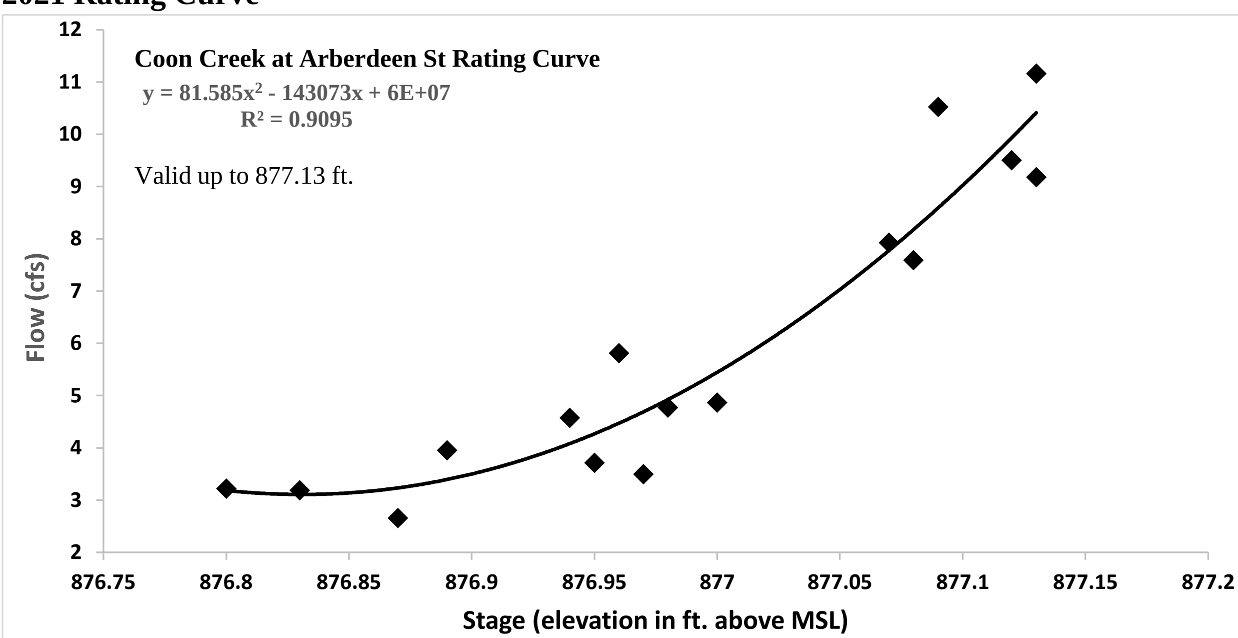
Coon Creek at Aberdeen St. - 2021
877.5
877.3
877.0
876.8
876.5
Elevation (ft.)
2
1.5
1
0.5
0
Precip (in)
5/4/2021
6/3/2021
7/4/2021
8/4/2021
9/3/2021
10/4/2021
11/4/2021
12/4/2021
Elevation (ft)
Precip (in)

Summary of All Monitoring Years

Percentiles	2021
Min	876.72
2.5%	876.75
10.0%	876.80
25.0%	876.87
Median (50%)	876.98
75.0%	877.11
90.0%	877.19
97.5%	877.25
Max	877.28

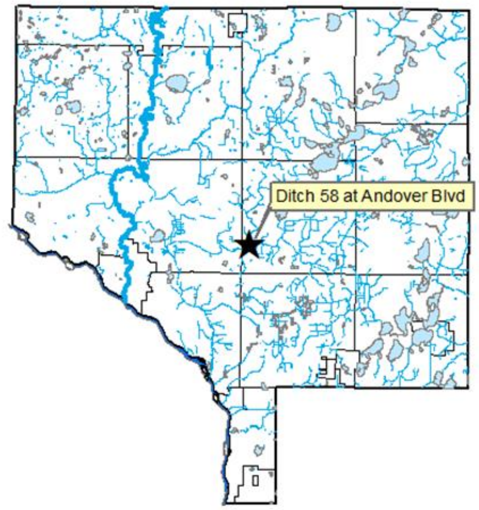


2021 Rating Curve



DITCH 58 AT ANDOVER BLVD, HAM LAKE

Notes



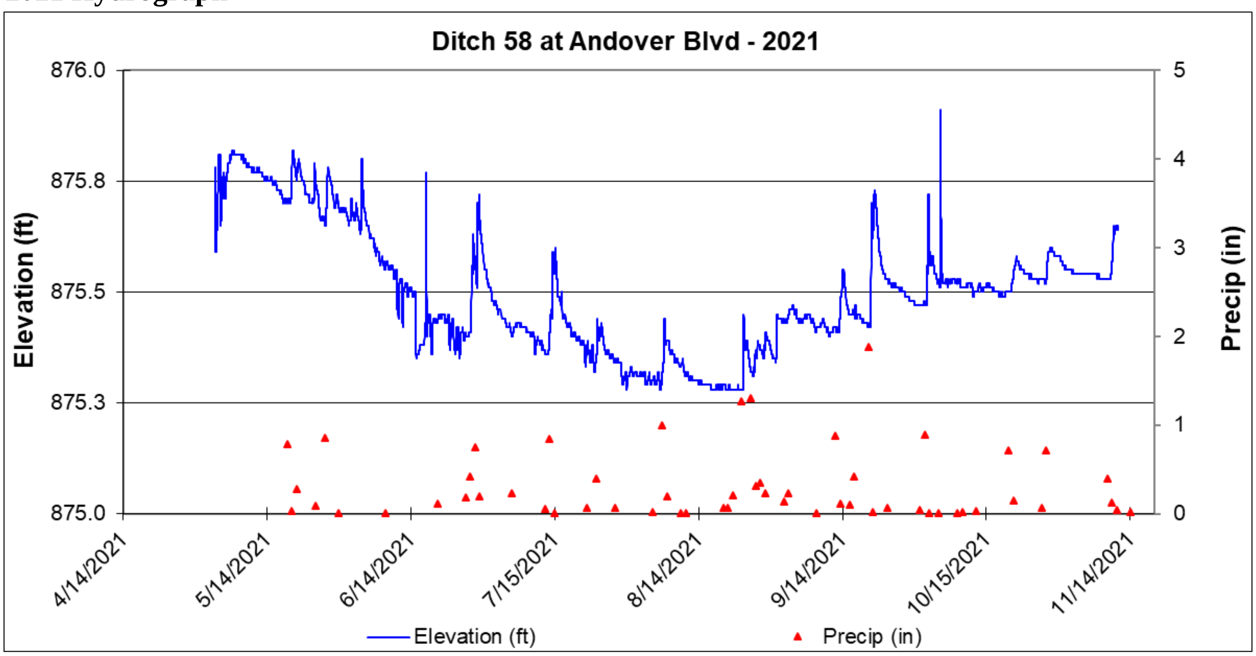
The monitoring site Ditch 58 at Andover Blvd has been monitored since 2001. This site only fluctuated 0.63 feet between its minimum and maximum-recorded stage. This was lower than the 2.53 ft. average fluctuation for this site.

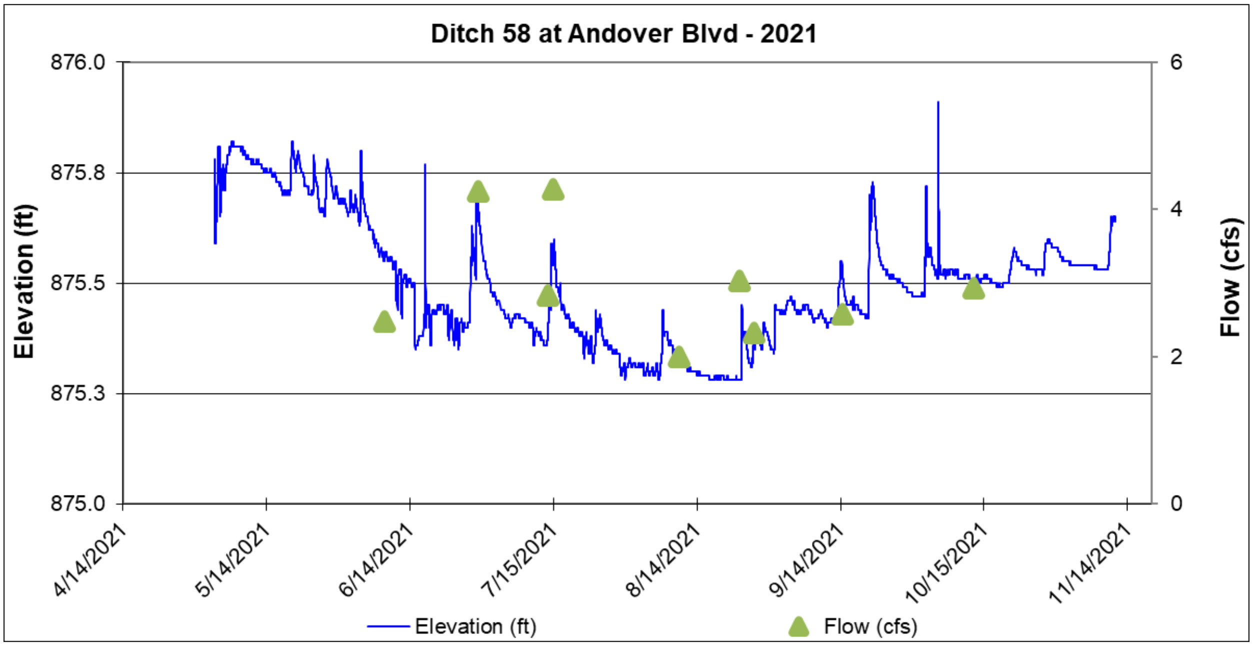
In 2021 Anoka County was in drought since June, with most of the growing season spent in a severe drought condition. Rainfall was infrequent and storms were less intense. Baseflow elevation at this site steadily decreased throughout the spring and summer but rebounded in the fall.

The level logger at this site took readings in 15-minute intervals. Stage was quick to react to storm events. During a 1.88-inch rainfall event on September 20th the stream rose 0.28 feet over a six-hour period.

In 2021, flow measurements were also taken during every stream water quality monitoring visit. A rating curve has not yet been developed for this site.

2021 Hydrograph

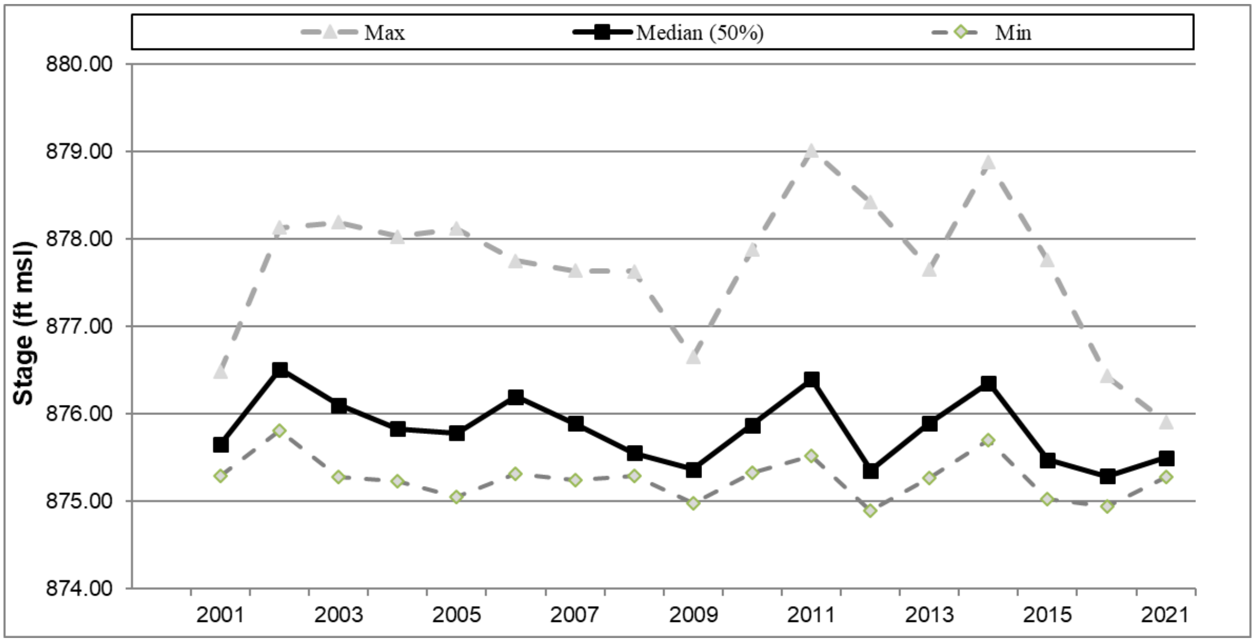




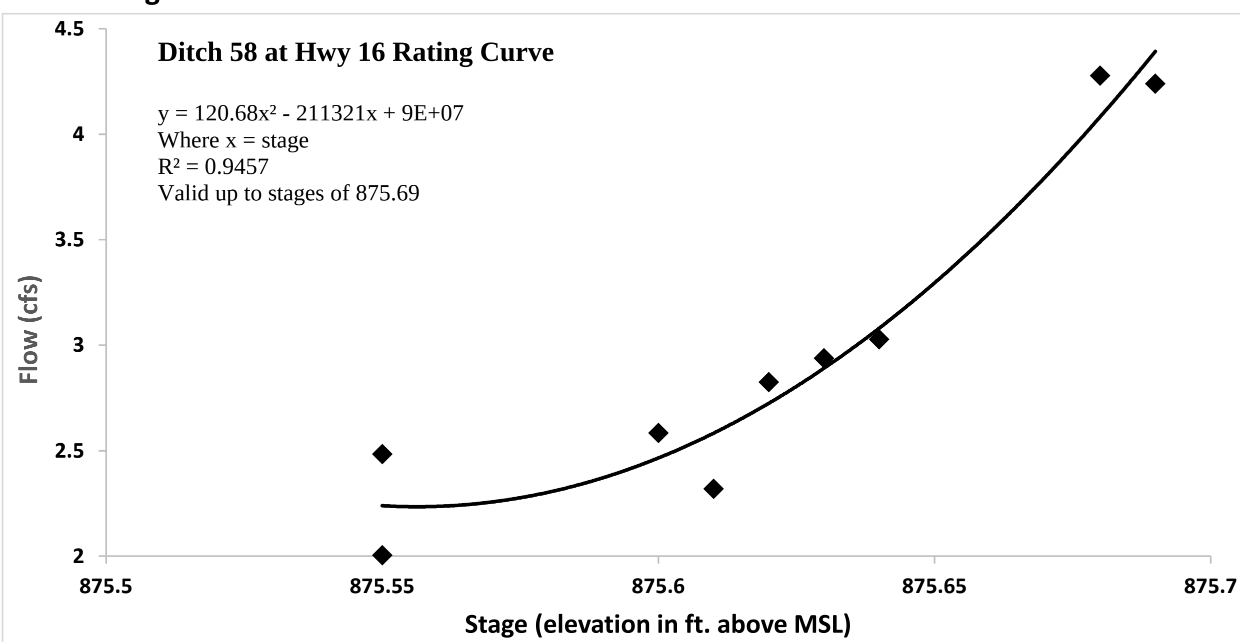
Summary of All Monitoring Years

Percentiles	2001	2002	2003	2004	2005	2006	2007	2008	2009
Min	875.29	875.81	875.28	875.23	875.05	875.31	875.24	875.29	874.98
2.5%	875.35	876.18	875.57	875.63	875.54	875.91	875.29	875.33	875.01
10.0%	875.48	876.33	875.64	875.51	875.37	875.66	875.37	875.36	875.16
25.0%	875.58	876.41	875.74	875.63	875.54	875.91	875.49	875.39	875.29
Median (50%)	875.65	876.51	876.10	875.83	875.78	876.20	875.89	875.56	875.37
75.0%	875.77	876.73	876.59	876.05	876.04	876.35	876.16	876.06	875.46
90.0%	876.23	877.42	877.01	876.45	876.22	876.47	876.40	876.28	875.54
97.5%	876.30	878.13	878.16	877.04	876.98	876.89	876.90	876.61	875.79
Max	876.48	878.13	878.19	878.03	878.12	877.75	877.64	877.63	876.65

Percentiles	2010	2011	2012	2013	2014	2015	2020	2021
Min	875.33	875.52	874.90	875.27	875.70	875.03	874.94	875.28
2.5%	875.39	875.62	875.02	875.52	876.07	875.19	874.99	875.28
10.0%	875.48	875.65	875.06	875.57	876.10	875.28	875.04	875.32
25.0%	875.58	875.79	875.12	875.64	876.16	875.36	875.12	875.40
Median (50%)	875.88	876.40	875.36	875.90	876.35	875.48	875.29	875.50
75.0%	876.25	876.92	875.51	876.24	877.05	875.63	875.51	875.57
90.0%	876.49	877.67	875.79	876.48	878.30	875.92	875.67	875.72
97.5%	877.13	878.55	877.02	877.00	878.80	876.77	875.88	875.79
Max	877.88	879.02	878.42	877.65	878.88	877.76	876.43	875.91



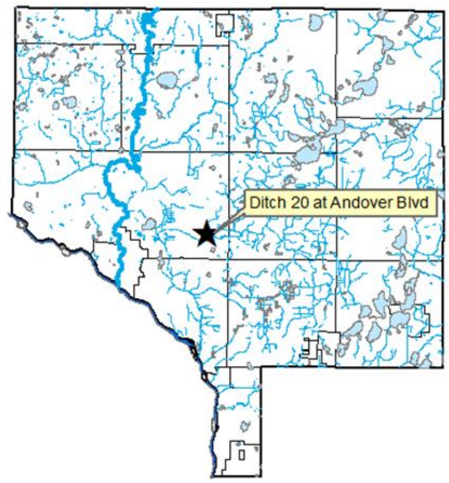
2021 Rating Curve



Ditch 20 at Andover Blvd, Andover

Notes

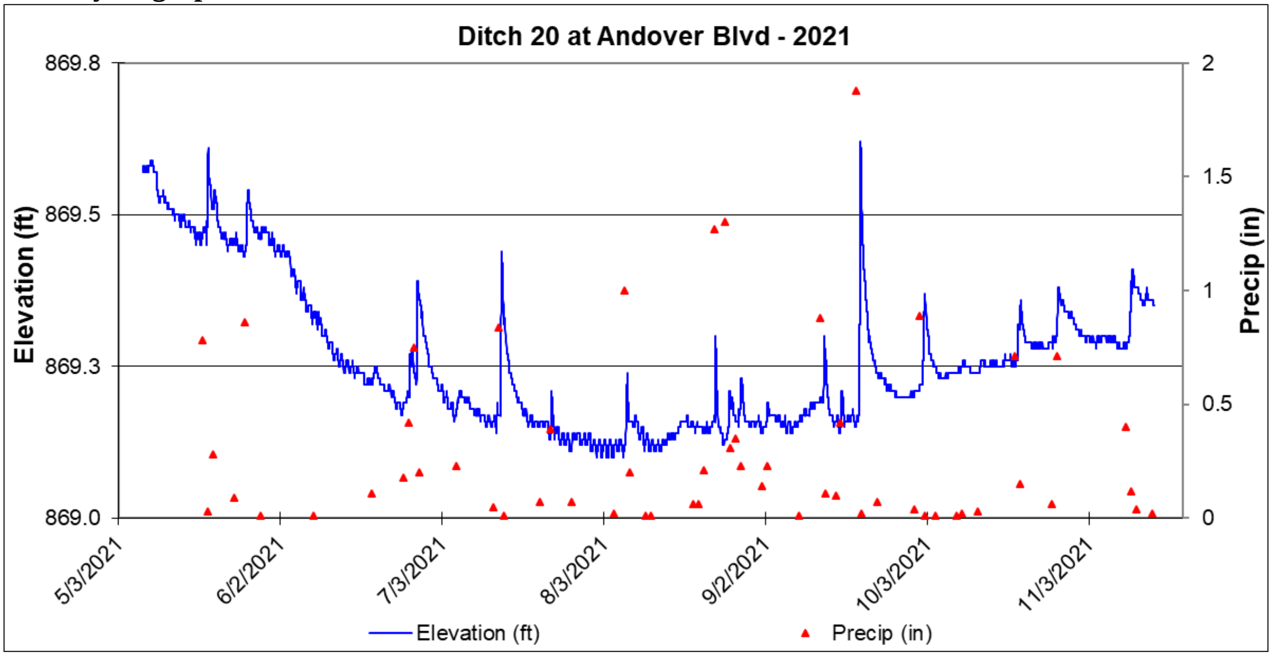
2021 was the second year stage was recorded at Ditch 20 at Andover Blvd. During the 2021 season, the stage only fluctuated 0.52 feet between its minimum and maximum recoded stage, which was 1.09 feet below the 2020 fluctuation.

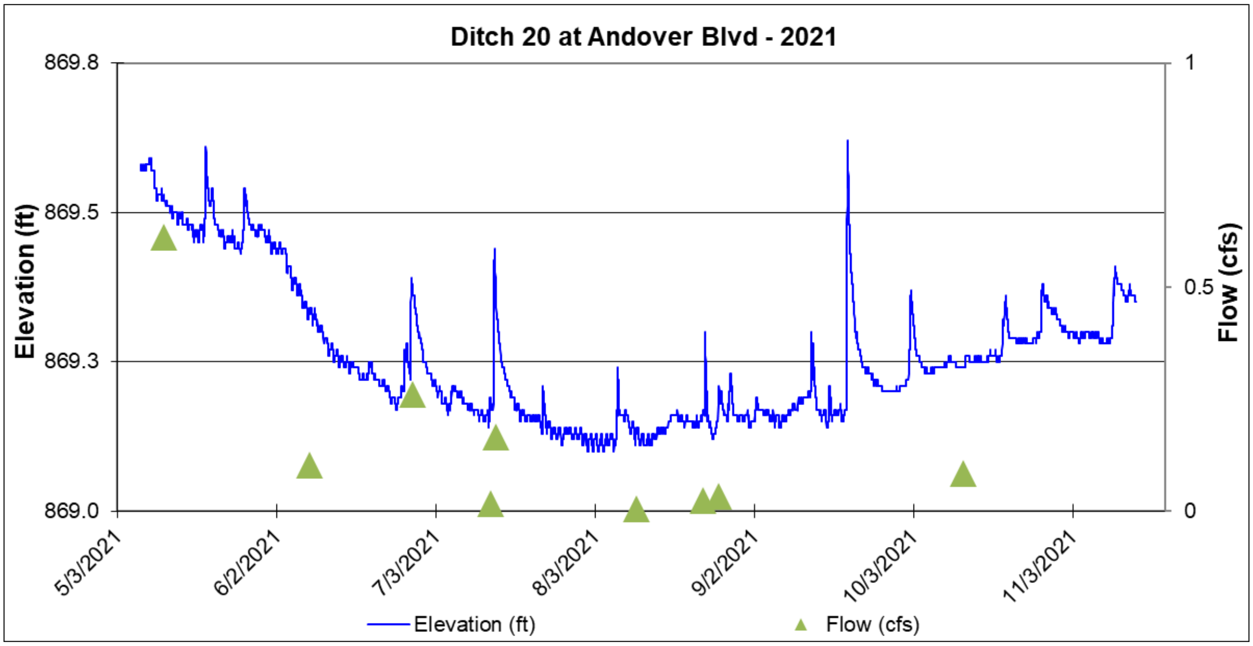


In 2021, Anoka County was in drought starting in June, with most of the growing season spent in a severe drought condition. Rainfall was infrequent and storms were less intense. During the season, this site experienced very low flow, which decreased throughout the spring and summer but rebounded slightly in the fall.

A rating curve was developed for this site in 2020 and is displayed below. In 2021, additional flow measurements were collected during each water quality monitoring visit.

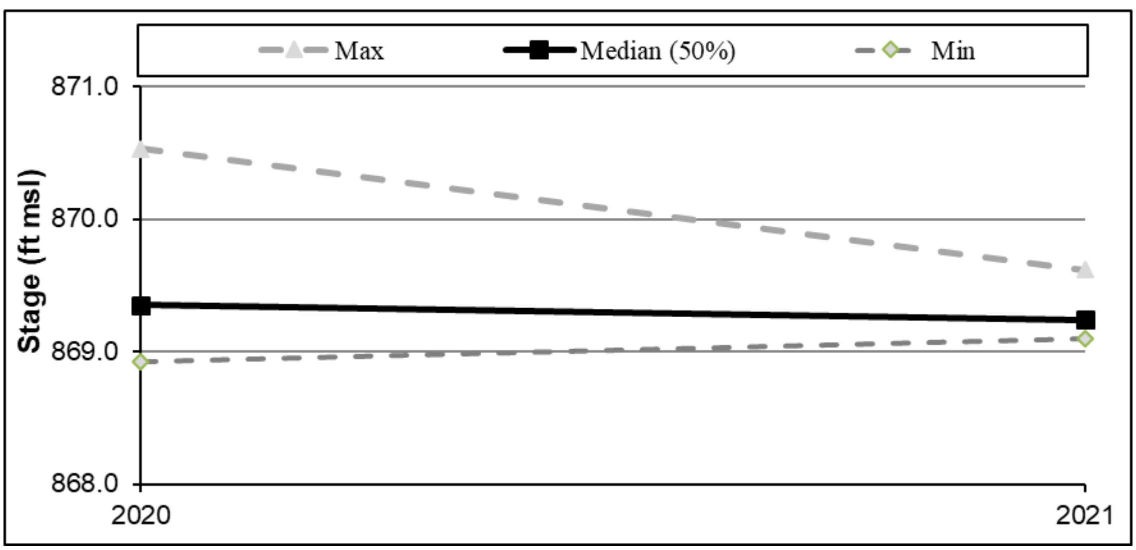
2021 Hydrographs



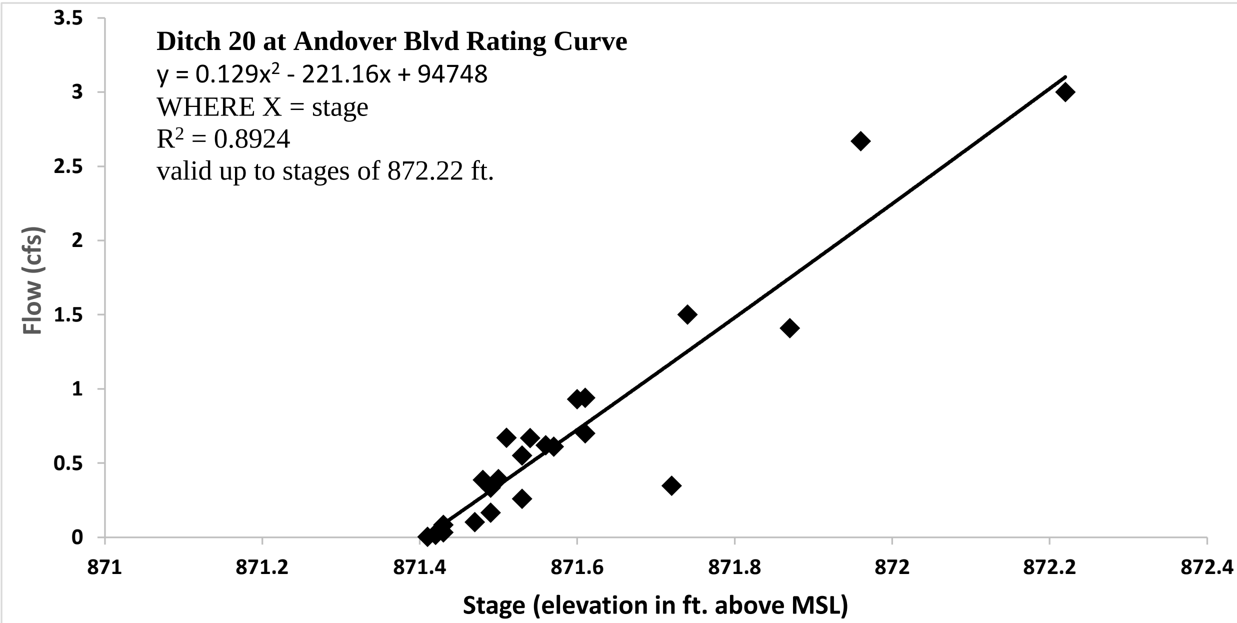


Summary of All Monitoring Years

Percentiles	2020	2021
Min	868.92	869.10
2.5%	868.98	869.12
10.0%	869.12	869.14
25.0%	869.22	869.16
Median (50%)	869.35	869.24
75.0%	869.7	869.31
90.0%	869.99	869.46
97.5%	870.03	869.53
Max	870.53	869.62



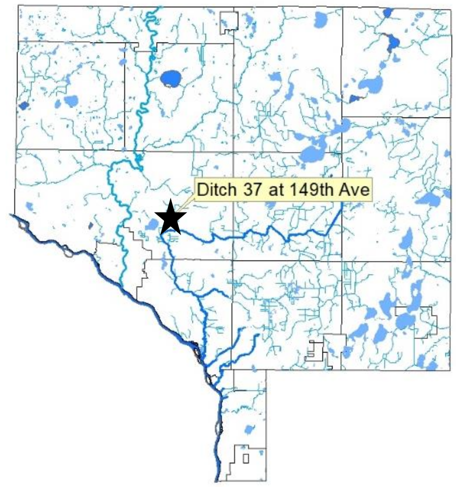
2020 Rating Curve (2021 flow measurements included)



Ditch 37 at 149th Ave

Notes

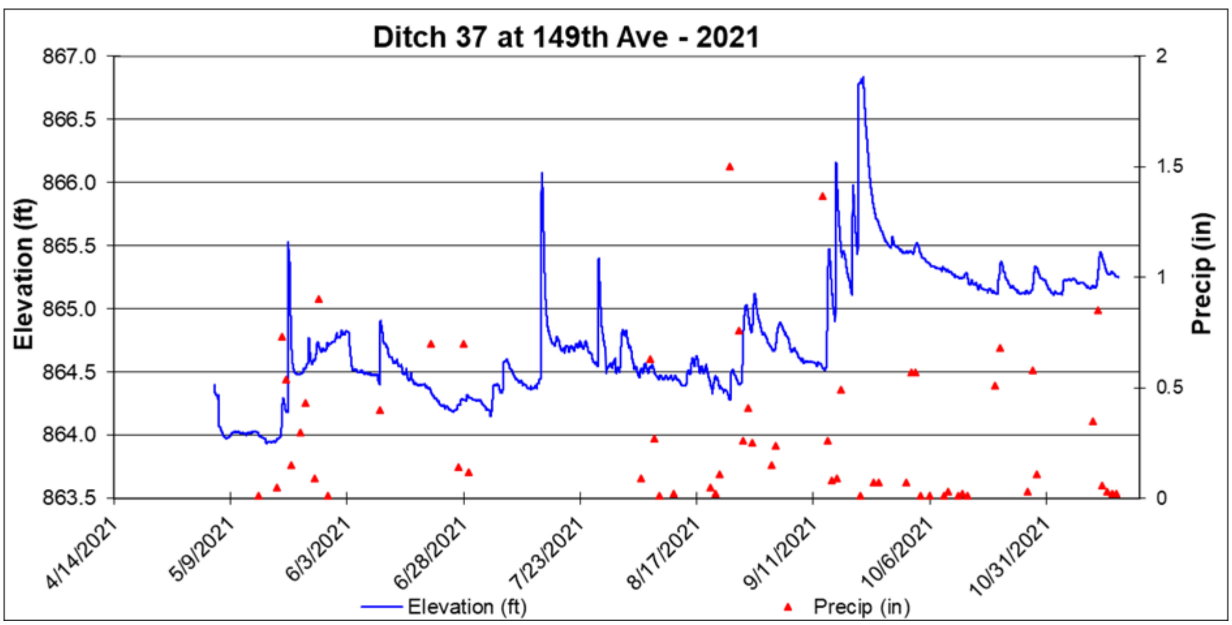
2021 was the first year stage was monitored at this site. This site is located on a private access road on a sod farm. During the 2021 season, Ditch 37 at 149th Ave fluctuated 2.91 feet between its minimum and maximum-recorded stage.

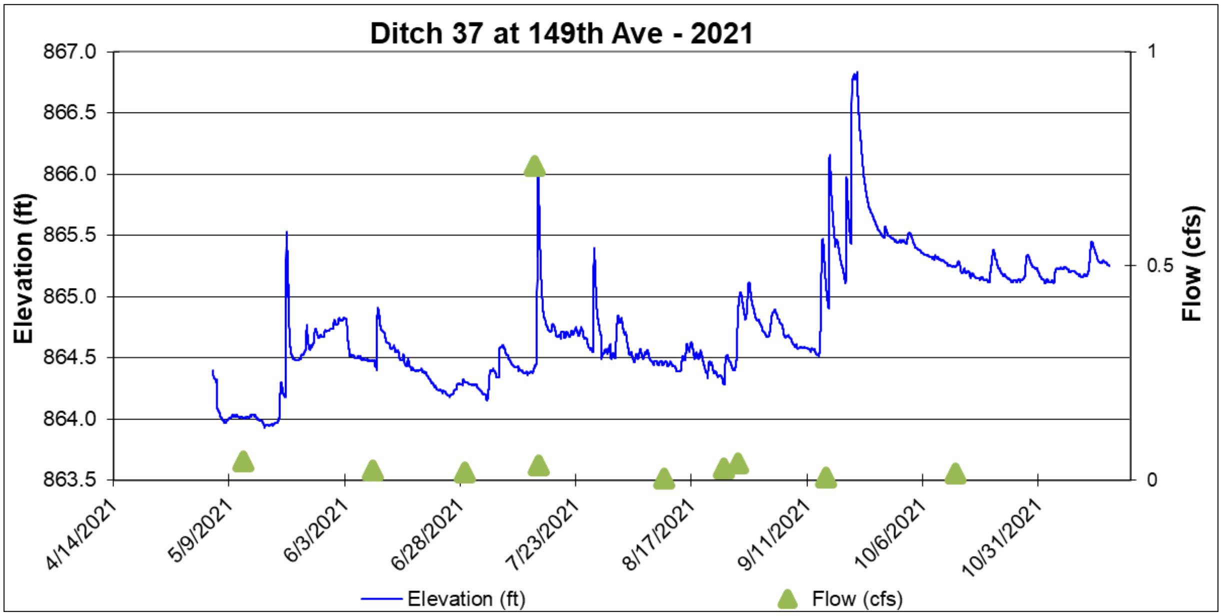


Although Anoka County was in a drought condition since June 2021, this site increased in elevation throughout the season. During a 1.63-inch storm event, the stage rose 0.96 feet in the span of eight hours. There were several increases in stage that did not correspond to any rainfall event. This can likely be explained by active water level management of the ditch system for agricultural irrigation; there is a stop log weir structure near the confluence of Ditch 37 and Coon Creek.

2021 Hydrographs

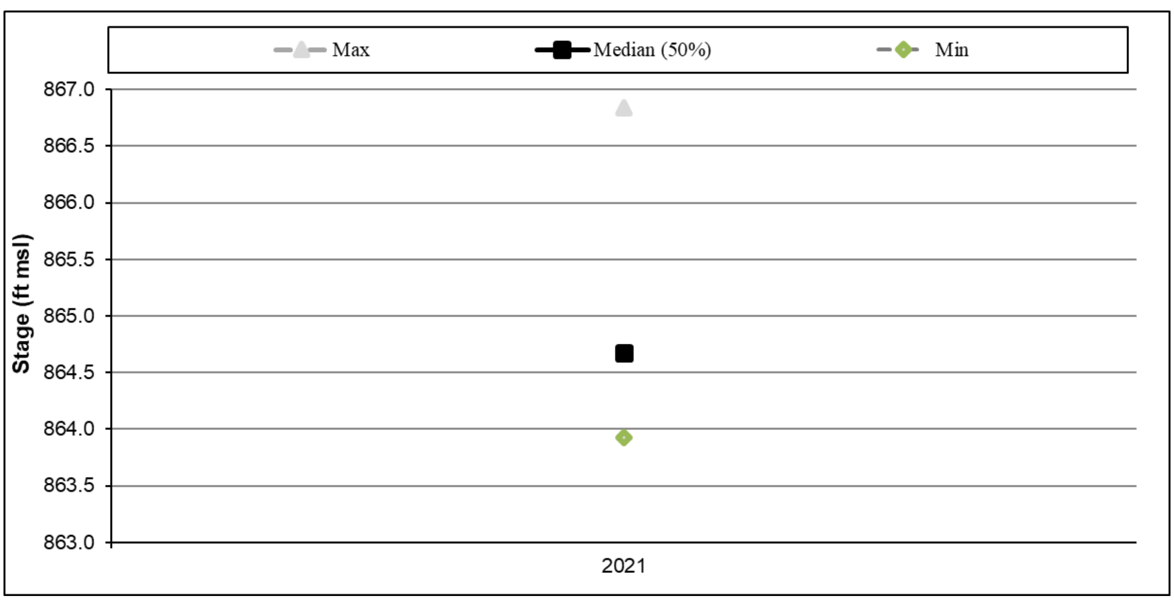
Note: there is active water level management of Ditch 37 for agricultural irrigation. Discharge measurements were recorded upstream at the Raven St site.





Summary of All Monitoring Years

Percentiles	2021
Min	863.93
2.5%	863.98
10.0%	864.23
25.0%	864.44
Median (50%)	864.67
75.0%	865.18
90.0%	865.39
97.5%	865.78
Max	866.84



DITCH 37 AT RAVEN ST

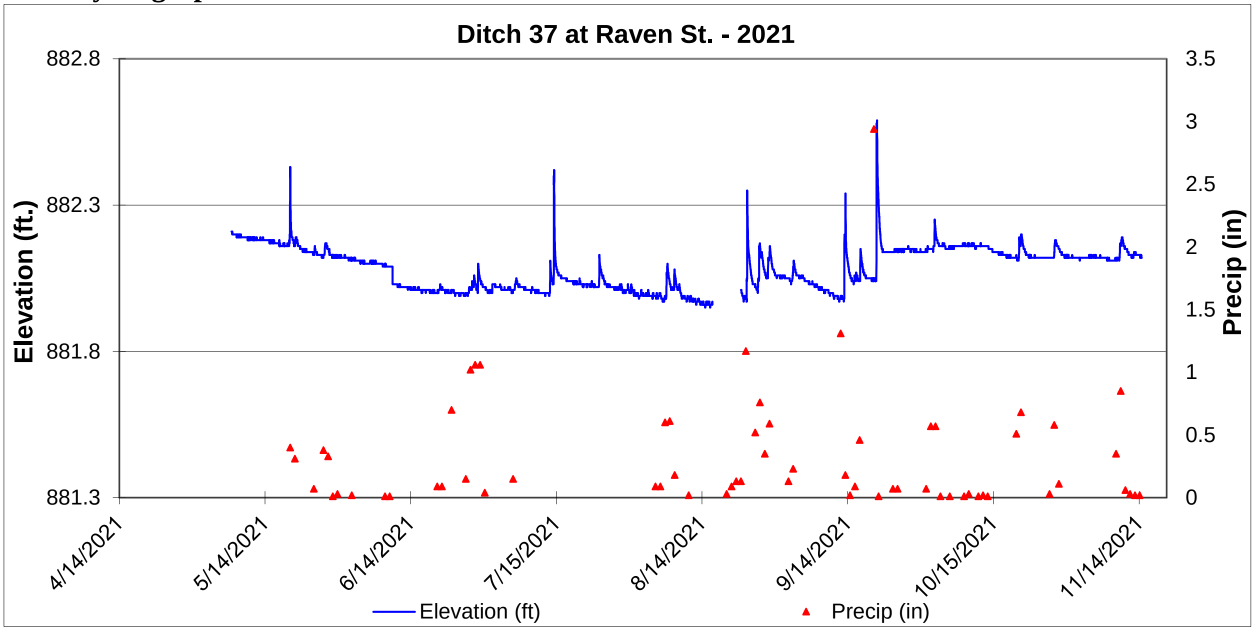
Notes

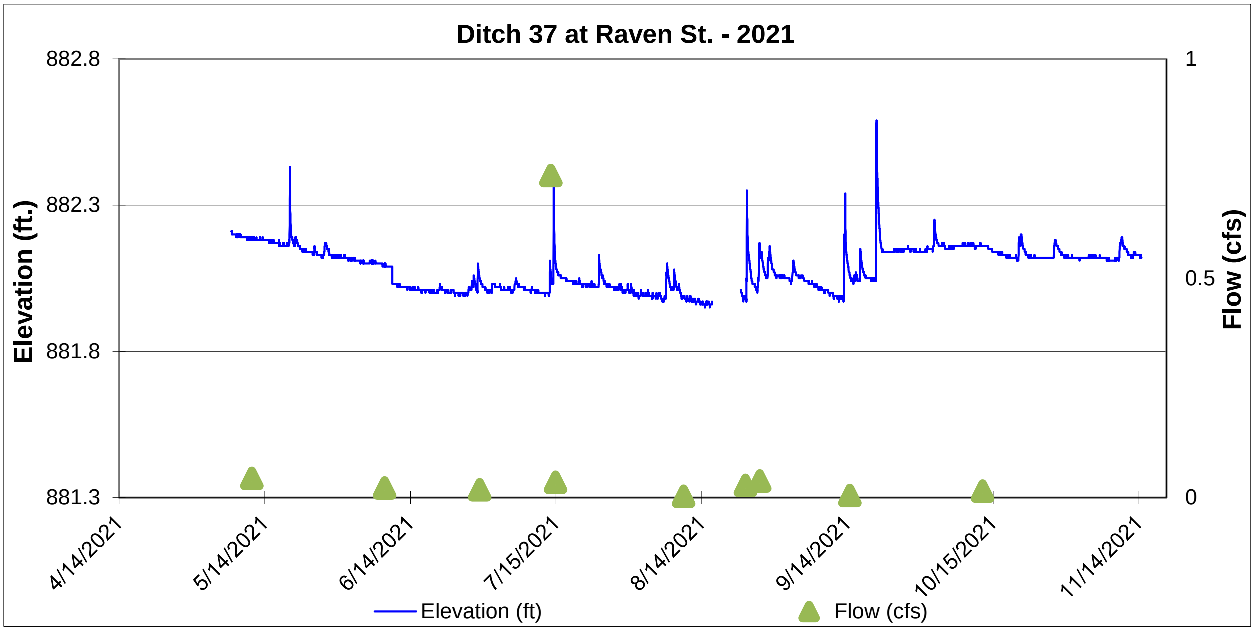
2021 was the first year stage was monitored at this site. This site is located upstream from Ditch 37 at 149th Ave. During the 2021 season, Ditch 37 at Raven St fluctuated 1.14 feet between its minimum and maximum-recorded stage.

Stage at this site was flashy in response to storms, with stage rising quickly after rainfall and receding quickly back to baseflow. During a 2.94 rainfall event the stage increased by 0.55 feet in about three hours.

In 2021, flow measurements were taken during each water quality monitoring visit. A rating curve has not yet been developed for this site.

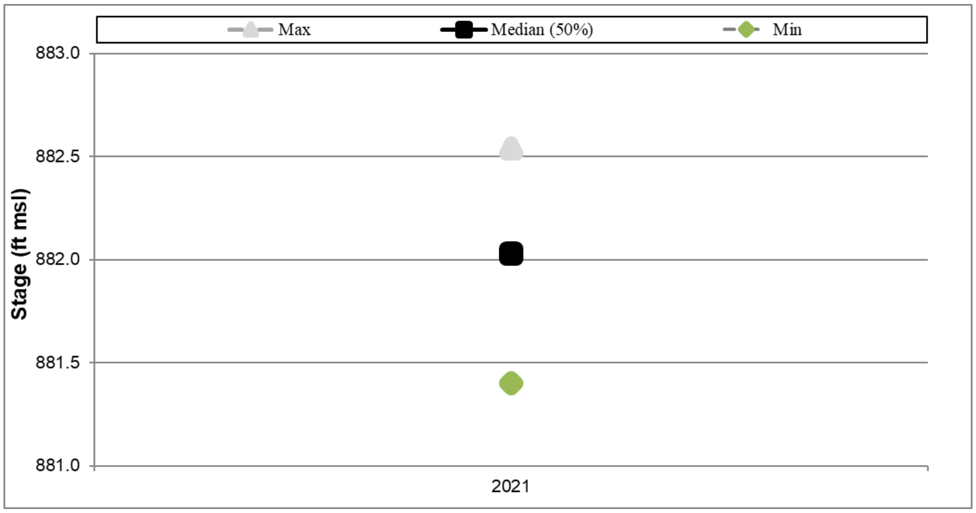
2021 Hydrographs





Summary of All Monitoring Years

Percentiles	2021
Min	881.40
2.5%	881.92
10.0%	881.94
25.0%	881.96
Median (50%)	882.03
75.0%	882.09
90.0%	882.11
97.5%	882.14
Max	882.54



COON CREEK AT 131ST AVE

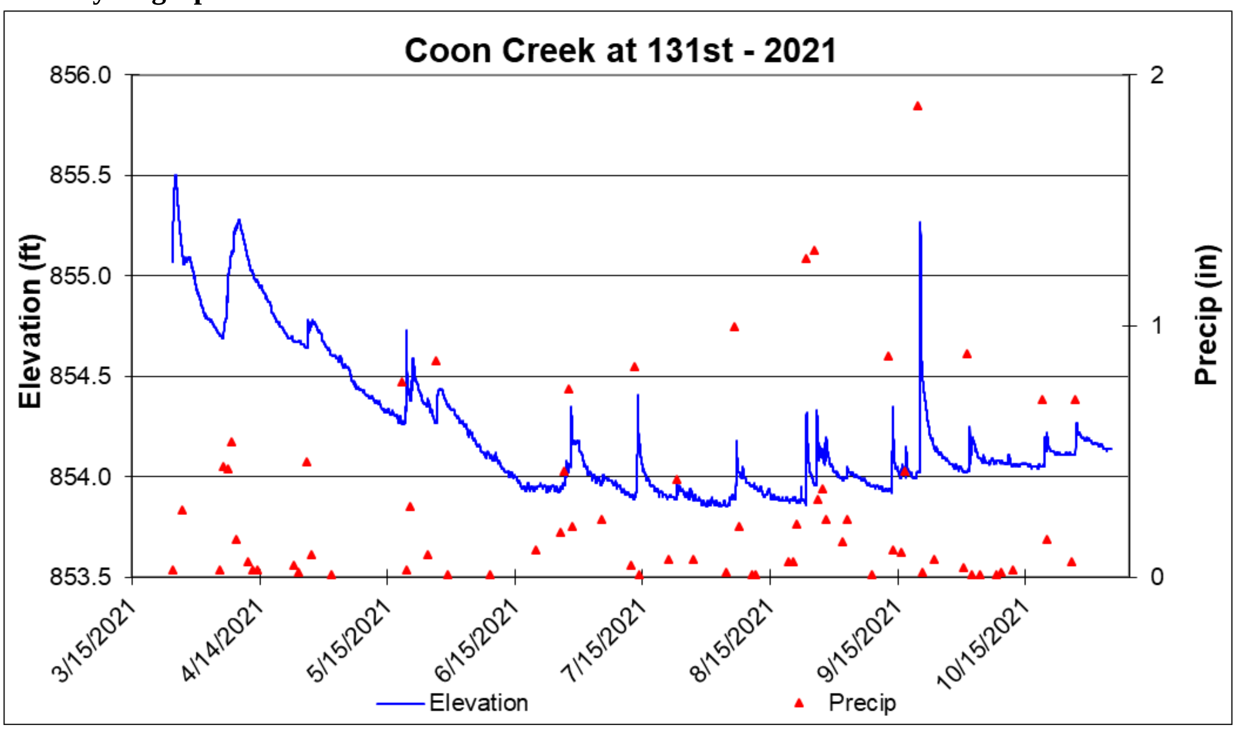
Notes

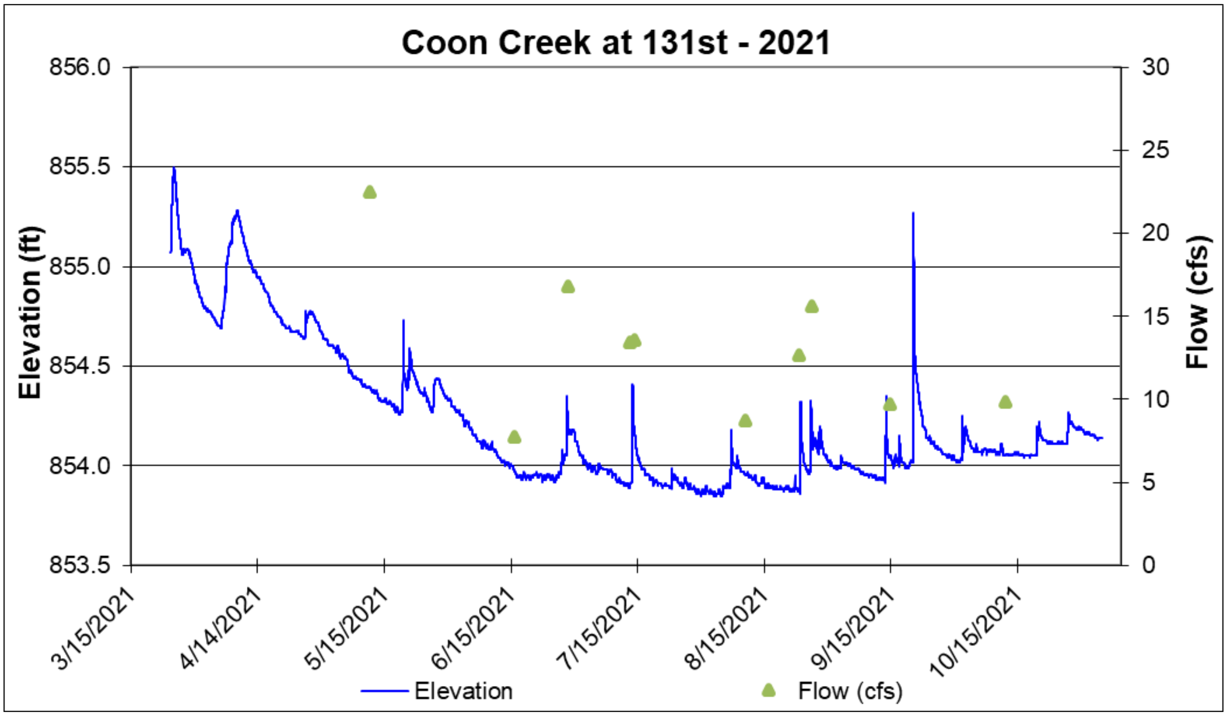
Throughout the 2021 season, water levels steadily decreased, with a slight increase in the fall. The water level at this site fluctuated 1.65 ft. between its maximum and minimum recorded stage. This was the lowest fluctuation in water level ever recorded. This fluctuation is 0.64 ft. lower than the average fluctuation for this site. This was likely due to the drought conditions seen through most of the monitoring season.

During a September rain event of 1.88 inches, the creek rose 1.08 ft. over the course of 3.5 hours at this site. There were several other occasions throughout the 2021 season where the creek responded in a similar fashion.

In 2021, flow measurements were taken during each water quality monitoring visit. A rating curve has not yet been developed for this site.

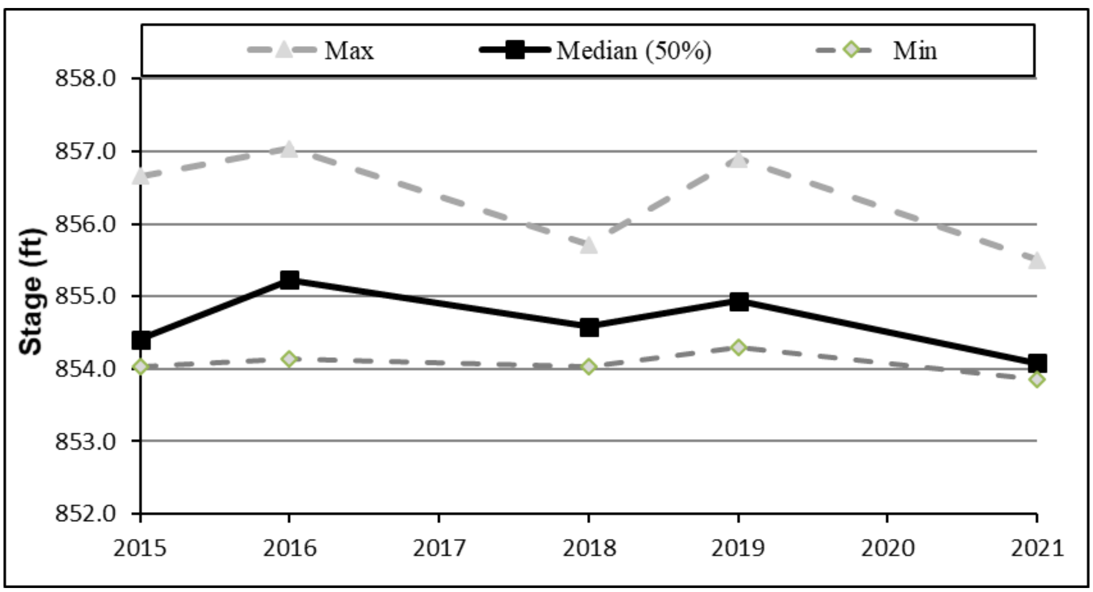
2021 Hydrographs





Summary of All Monitoring Years

Percentiles	2015	2016	2018	2019	2021
Min	854.03	854.14	854.04	854.29	853.85
2.5%	854.09	854.32	854.08	854.33	853.87
10.0%	854.16	854.45	854.13	854.43	853.90
25.0%	854.27	854.71	854.32	854.57	853.97
Median (50%)	854.41	855.23	854.58	854.94	854.08
75.0%	854.68	855.65	854.76	855.58	854.38
90.0%	855.03	855.88	855.02	856.09	854.77
97.5%	855.79	856.19	855.40	856.57	855.12
Max	856.66	857.04	855.71	856.90	855.50



Coon Creek at 111th Ave

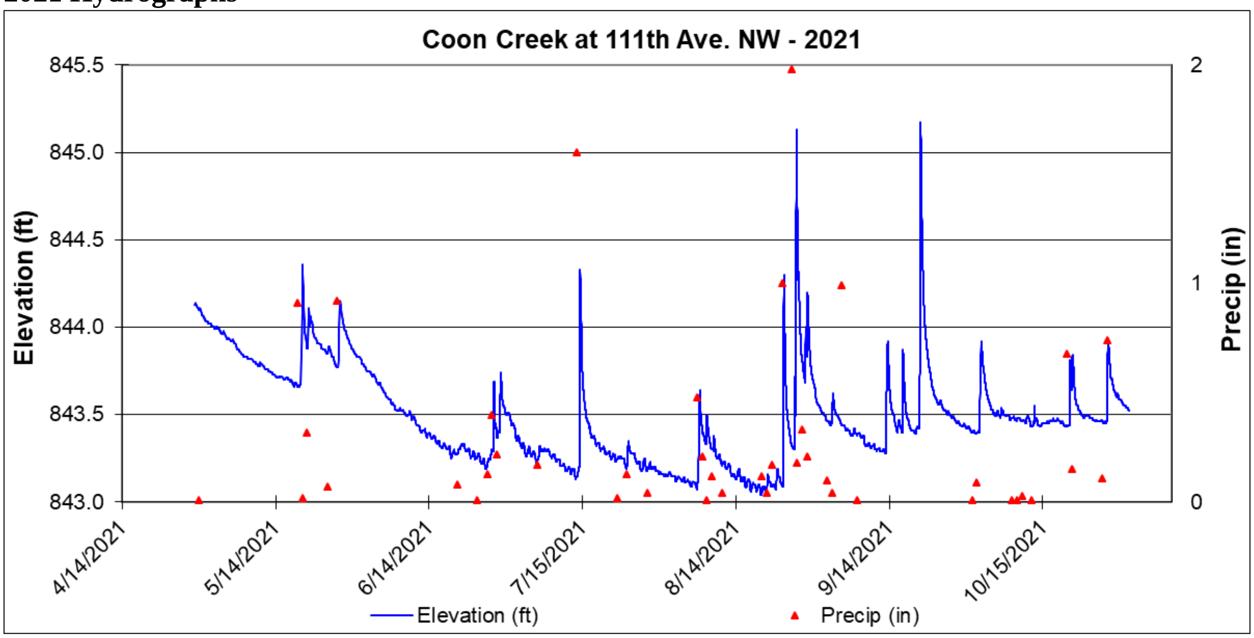
Notes

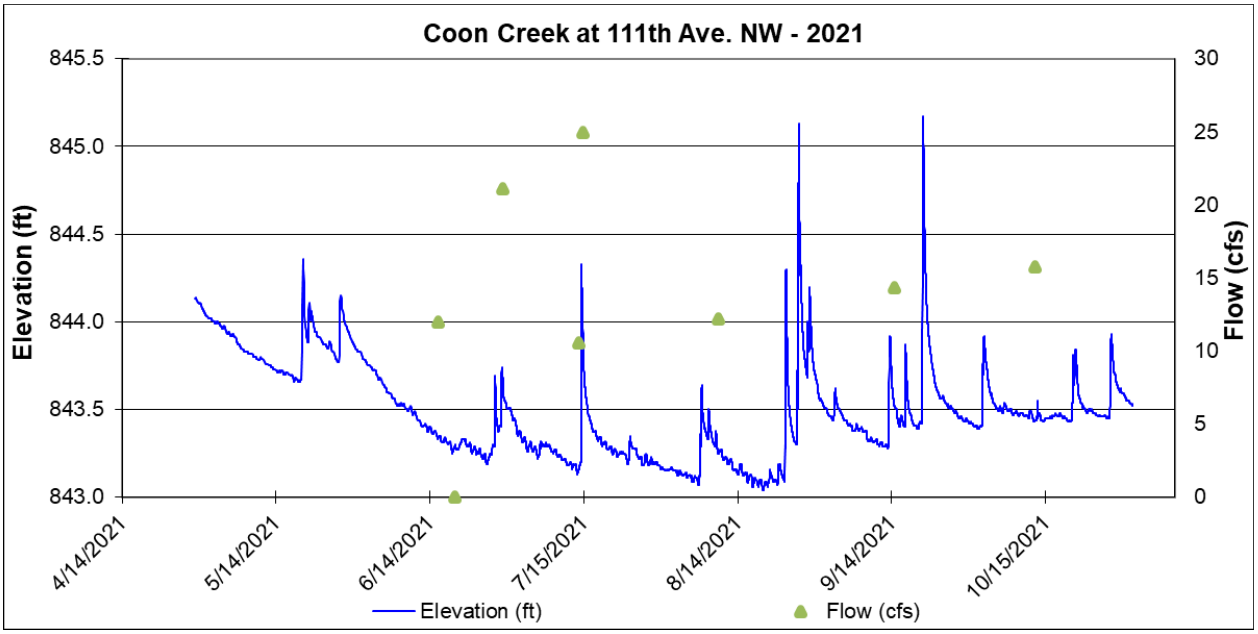
Stage at this site was flashy in response to storms, with stage rising quickly after rainfall but receding slowly back to baseflow.

During the 2021 season, the creek at the 111th Ave site only fluctuated 2.13 ft. between its minimum and maximum-recorded stage. This was the smallest range of stage fluctuation recorded at this site, likely due to drought conditions for most of the 2021 growing season. During a 1.98-inch storm on August 26, stage rose 1.49 ft. in a seven-hour span.

In 2021, flow measurements were taken during each water quality monitoring visit. A rating curve was developed for this site in 2018 and is displayed below.

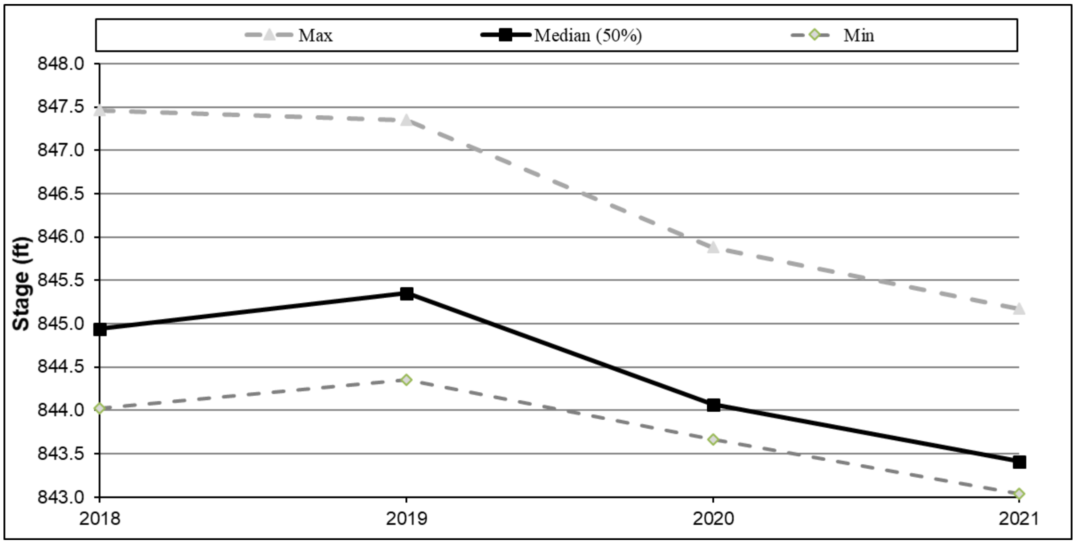
2021 Hydrographs



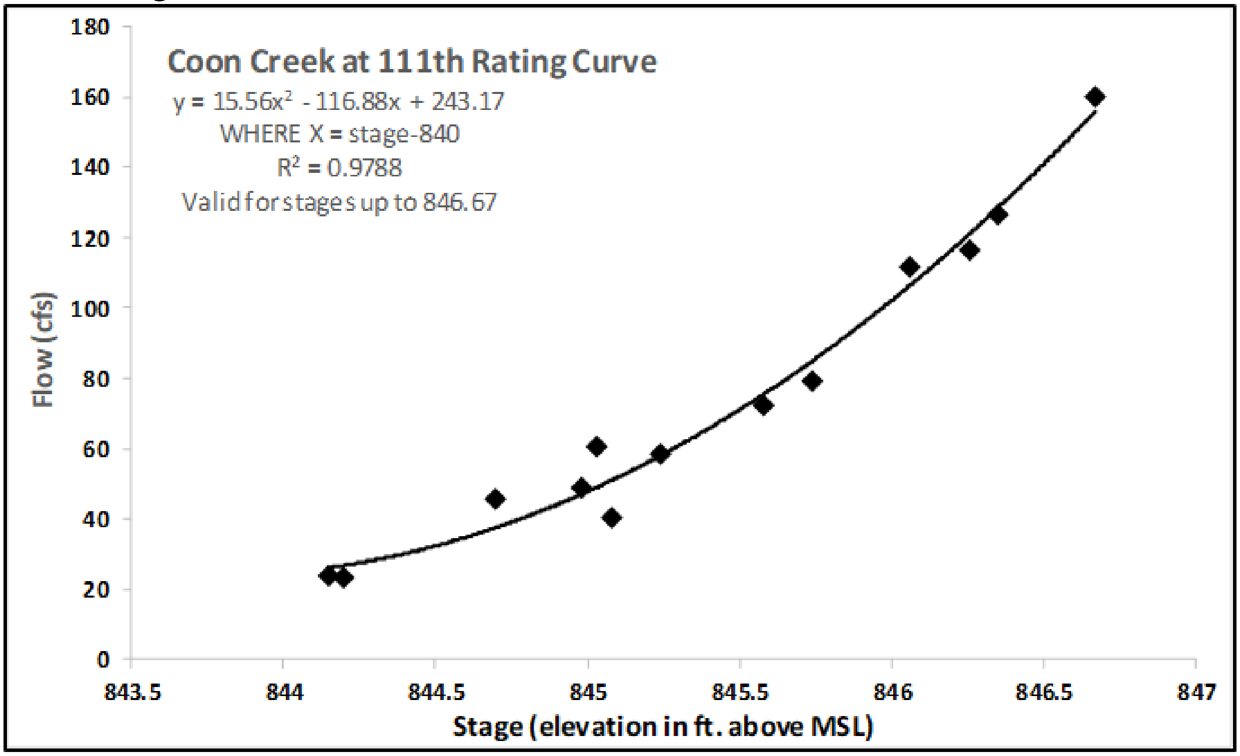


Summary of All Monitoring Years

Percentiles	2018	2019	2020	2021
Min	844.02	844.35	843.67	843.04
2.5%	844.08	844.48	843.71	843.09
10.0%	844.24	844.58	843.76	843.15
25.0%	844.50	844.81	843.85	843.25
Median (50%)	844.94	845.35	844.07	843.41
75.0%	845.51	846.09	844.55	843.50
90.0%	845.88	846.75	844.93	843.70
97.5%	846.45	847.20	845.39	843.99
Max	847.46	847.35	845.88	845.17



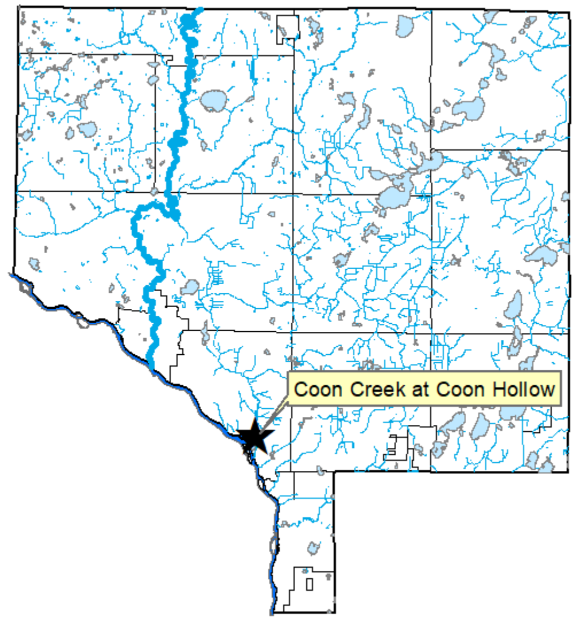
2018 Rating Curve



COON CREEK

at Coon Creek Hollow, Vale Street, Coon Rapids

Notes

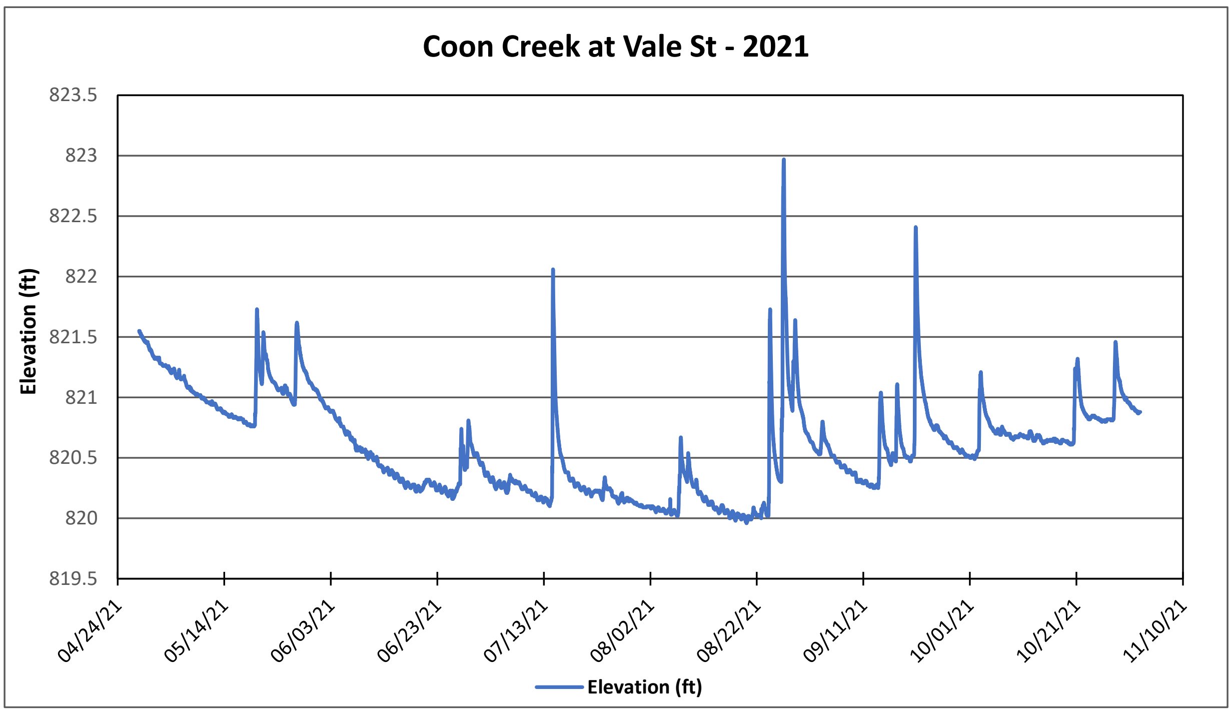


In 2021, water levels at Vale St. fluctuated 3.01 ft. Coon Creek hit the lowest water level at this site since stage was first monitored back in 2005. The maximum stage was also the lowest on record. Stage remained lower than average throughout the year in 2021, with sustained periods with no rainfall.

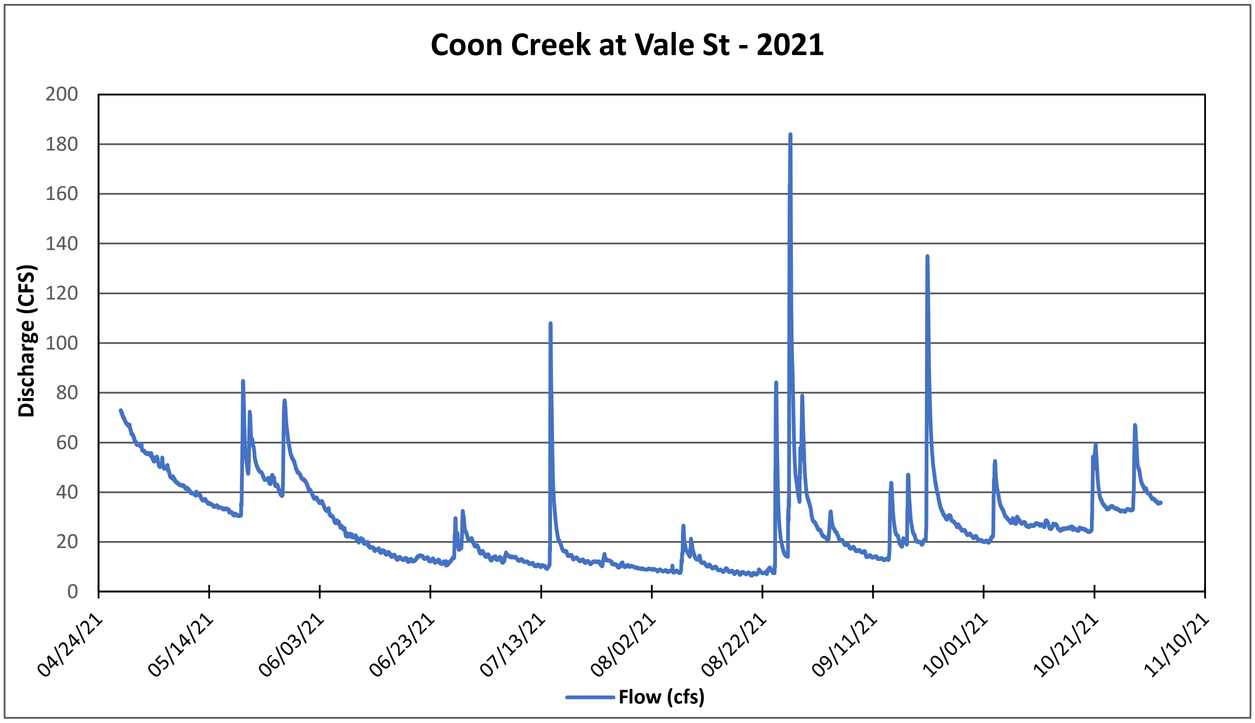
Coon Creek has flashy responses to rain events, water levels rise quickly in response to precipitation, but return to baseflow conditions slowly. The quick, intense response to rainfall is likely due to a large amount of stormwater infrastructure input from the urbanized portions of the lower watershed.

During a rain event on July 14, the creek rose 1.68 ft. in three hours. Similarly, a storm of on August 16 caused stage in the creek to rise 1.86 ft. in slightly over three hours.
This site is monitored in partnership with the United States Geological Survey (USGS). Continuous level data is measured in 15-minute increments and transformed into continuous discharge data using a rating curved developed and maintained by USGS. Real-time and archival stage and discharge data is located here: https://waterdata.usgs.gov/monitoring-location/05288490/#parameterCode=00060&period=P365D

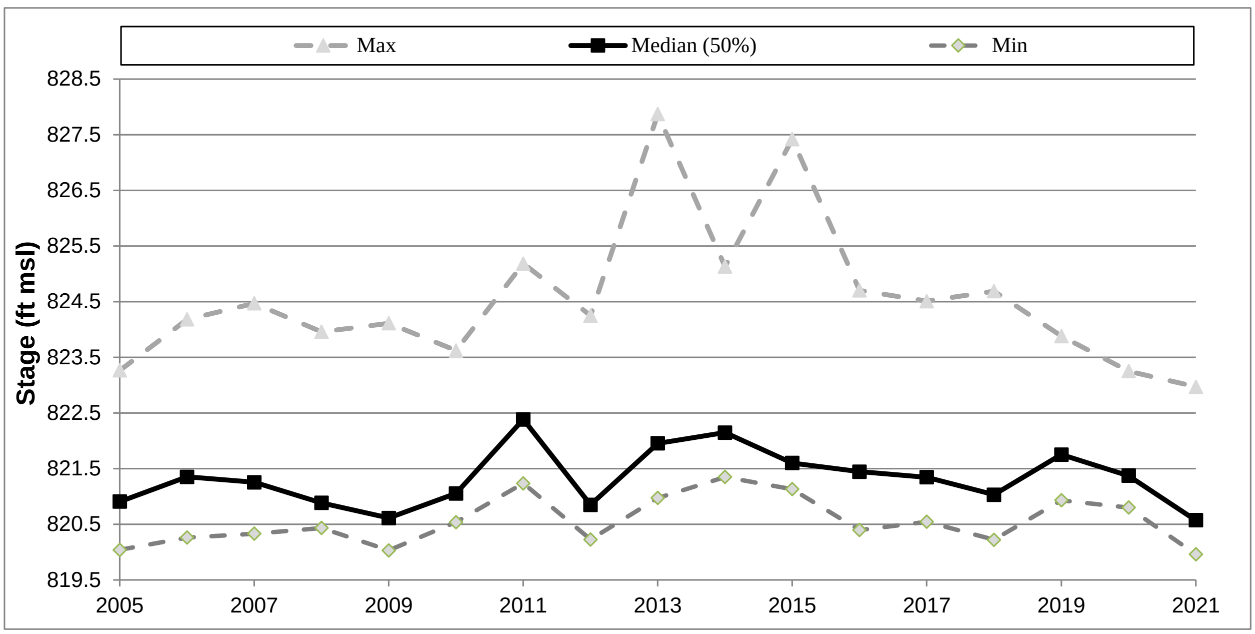
2021 Hydrograph



2021 DISCHARGE



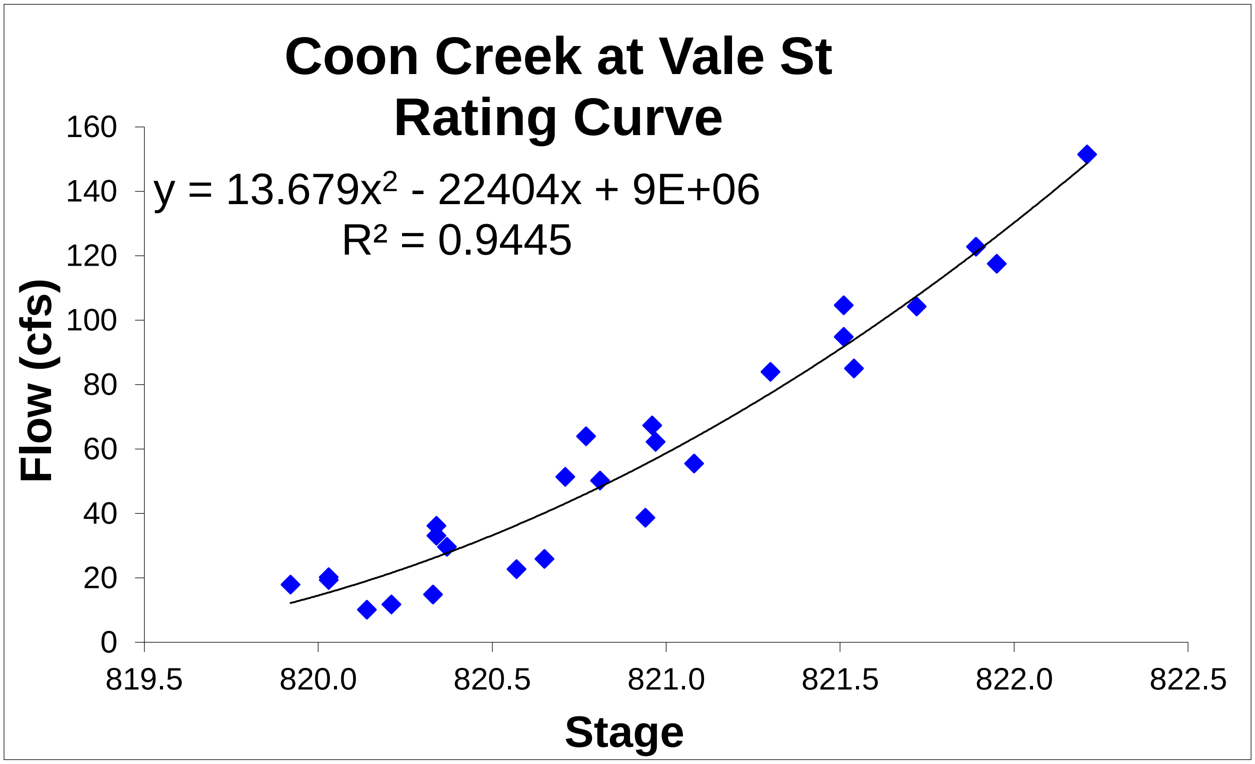
SUMMARY OF ALL MONITORED YEARS



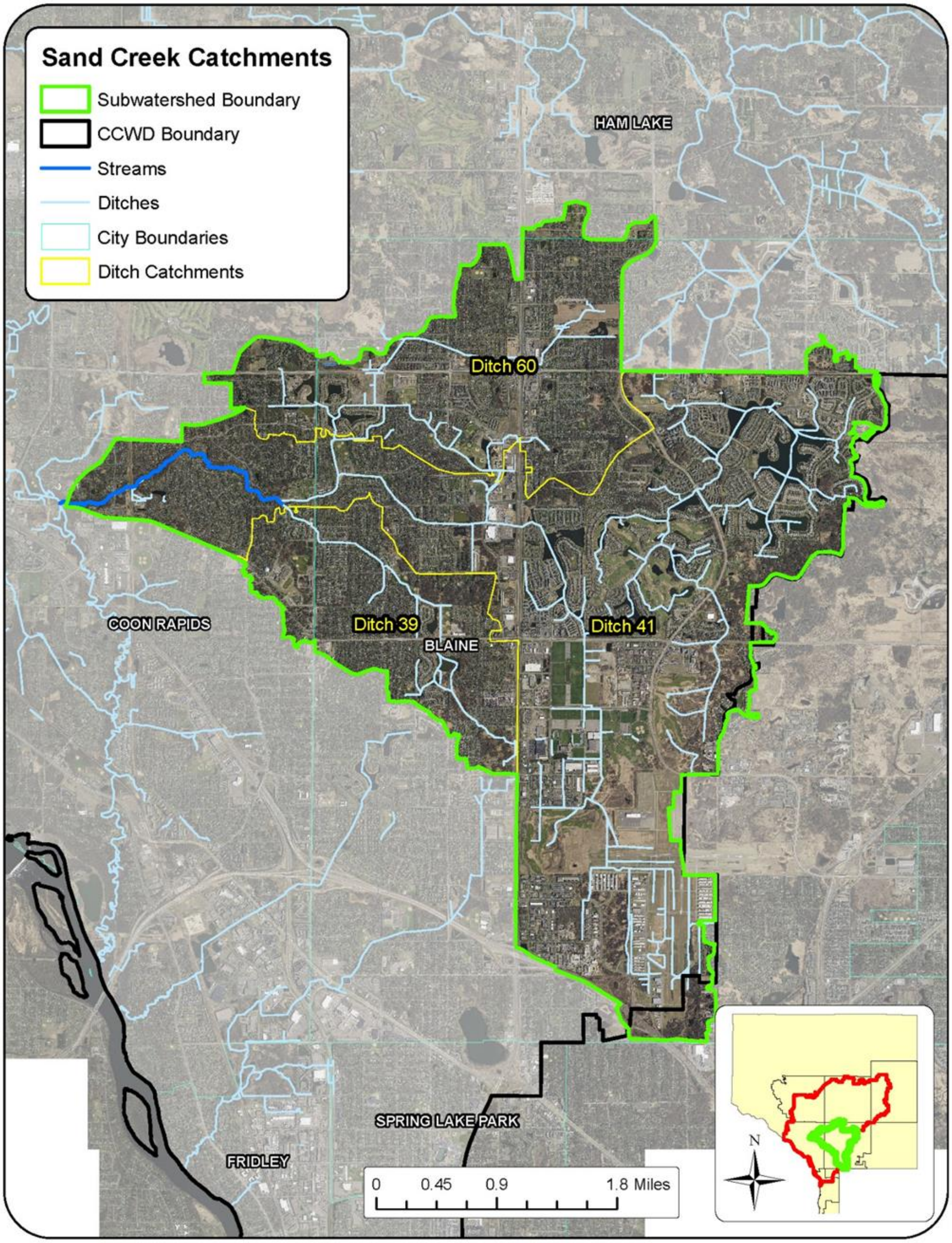
Percentiles	2005	2006	2007	2008	2009	2010	2011	2012
Min	820.04	820.26	820.33	820.43	820.03	820.54	821.23	820.22
2.5%	820.06	820.42	820.40	820.52	820.12	820.64	821.27	820.28
10.0%	820.19	820.53	820.53	820.57	820.20	820.73	821.31	820.33
25.0%	820.57	820.78	820.73	820.63	820.35	820.85	821.83	820.45
Median (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	2021
Min	820.97	821.35	821.13	820.39	820.54	820.22	820.93	820.37	819.96
2.5%	820.99	821.47	821.19	820.58	820.70	820.28	821.05	820.44	820.03
10.0%	821.00	821.51	821.31	820.78	820.84	820.40	821.16	820.54	820.12
25.0%	821.20	821.67	821.41	820.99	821.08	820.60	821.37	820.65	820.27
Median (50%)	821.95	822.15	821.60	821.44	821.34	821.03	821.75	820.94	820.57
75.0%	827.87	823.33	821.92	821.91	821.72	822.21	822.49	821.27	820.87
90.0%	827.87	824.38	822.30	822.24	822.25	822.56	823.19	821.66	821.16
97.5%	827.87	824.87	823.08	822.76	823.84	823.33	823.52	822.00	821.46
Max	827.87	825.13	827.42	824.70	824.51	824.69	823.88	822.82	822.97

2010 Rating Curve (2021 flow measurements included)



WATER QUALITY MONITORING – SAND CREEK



Sand Creek System Monitoring Sites		
Site Name/ SiteID	**Years Monitored**	**2021 Data Collected**
Ditch 41 at Radisson Rd, Blaine S006-421	2010-2017	
Ditch 41 at Highway 65, Blaine S005-639	2009-2021	Water Chemistry Grab Samples, discrete discharge measurements
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	2010-2021	Water Chemistry Grab Samples, Continuous Stage, discrete discharge measurements
Sand Cr at Xeon Street, Coon Rapids S004-619	2007-2021	Water Chemistry Grab Samples, Continuous Stage, discrete discharge measurements

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. Ditch 41 is the primary ditch system comprising the Sand Creek subwatershed, which drains 6,658 acres of suburban residential, commercial, and retail areas throughout western Blaine. The upstream portions of this system (upstream of Highway 65) is comprised of a complex network of ditch tributaries and man-made ponds and lakes serving as stormwater treatment practices and aesthetic landscape features. The northern portion of this network is comprised primarily of the Lakes of the 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 Twin Cities golf course ponds, and finally through the network of ponds in the Club West Development.

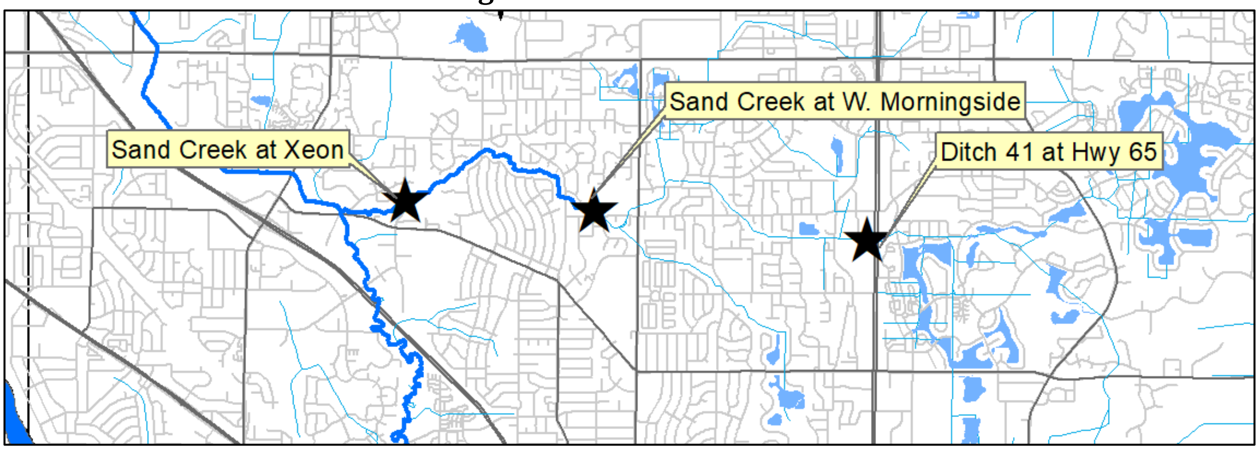
The upstream, most southern portion of the Ditch 41 system drains primarily commercial areas of the eastern Highway 65 corridor, including large shopping centers, athletic complexes, schools, and small businesses. It also drains a significant portion of the Anoka County Airport in Blaine. These drainageways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

A few 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 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 at Coon Creek at Lions 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 of 0.4 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) may take into consideration that the creek is part of a public ditch system and, therefore, has lower aquatic life expectations.

2021 Sand Creek Water Monitoring Sites



Results and Discussion

Sand Creek's water quality generally meets state standards for most parameters other than *E. coli*. It is listed as impaired for aquatic recreation due to *E. coli* and for aquatic life due to invertebrate biota and has a deferred aquatic life impairment for fish. Load duration curves and pollutant reduction targets for total phosphorus and TSS were developed in the Coon Creek TMDL due to their status as stressors to aquatic life. Pollutant loading into the Sand Creek system appears to vary throughout the watershed for each parameter.

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 while moving downstream from Morningside Memorial Gardens to Xeon St. In fact, baseflow TP concentrations have significantly declined over time at the Xeon St outlet monitoring site although there is no significant trend for stormflow TP. However, post-storm TSS increases significantly between Morningside memorial Gardens and Xeon St. The TMDL attributes only 13% of TSS loading in Sand Creek to bank erosion, but this factor may be underestimated in the lower portion of the Creek between Morningside and Xeon St based on ditch inspection results and collected data. A 2018-2021 stream restoration project along Sand Creek between Olive St and Xeon Blvd will help stabilize banks in these lower reaches and dissipate erosive energy during high flow events, during which the creek periodically exceeds state TSS standards.

E. coli loading occurs 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.

Because pollutant loading is not consistent throughout the watershed, no single management strategy or project will simultaneously maximize reductions for all targeted pollutants. Targeted projects that reduce phosphorus loading from stormwater should occur in the upper portions of the tributary ditch subwatersheds, namely Ditch 60 and Ditch 39. Targeted projects that reduce TSS loading should occur in the lower reaches of the stream channel, potentially through further stabilization of eroding banks and additional re-meandering or rate control projects. *E coli* bacteria reduction likely cannot be accomplished at any single location, but rather through deploying educational resources and offering dog-waste disposal resources to users of the Sand Creek Trail system. Dog waste stations were installed along the trail system in fall 2021.

Specific Conductance and Chlorides

Sand Creek's dissolved pollutant levels as measured by specific conductance and are higher than levels found in Coon Creek, which Sand Creek drains into. The long-term median of specific conductance under all conditions in Sand Creek at Xeon St is 0.769 mS/cm compared to the median for all Coon Creek monitoring sites upstream of this confluence (median of all specific conductance data from Lions Coon Creek Park and upstream sites) which has a longer-term median of 0.566 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 were the primary source of dissolved pollutants in the creek, one indicator would be higher conductance during storm events. Specific conductance monitored at Xeon Street during baseflow conditions had median levels 10% 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 and conditions monitored, Sand Creek's median specific conductance is approximately 30% higher than Coon Creek (0.811 vs 0.566 mS/cm) before this junction.

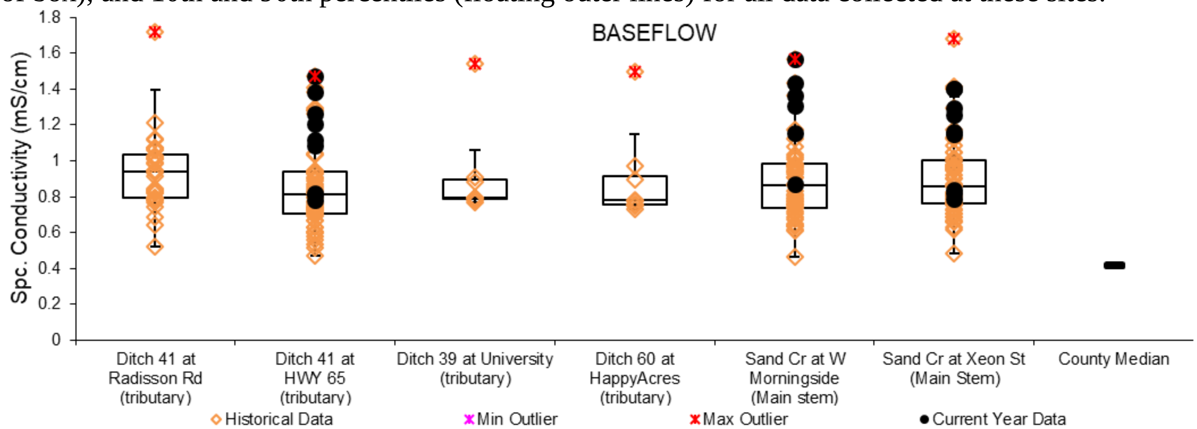
Chloride salts are a primary driver of conductance levels in urban streams. Median chloride concentrations are also higher in Sand Creek than in Coon Creek. Chloride samples were collected in 2019 in each of Sand Creek's individual contributing ditch systems as well as the creek itself. Concentrations 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.

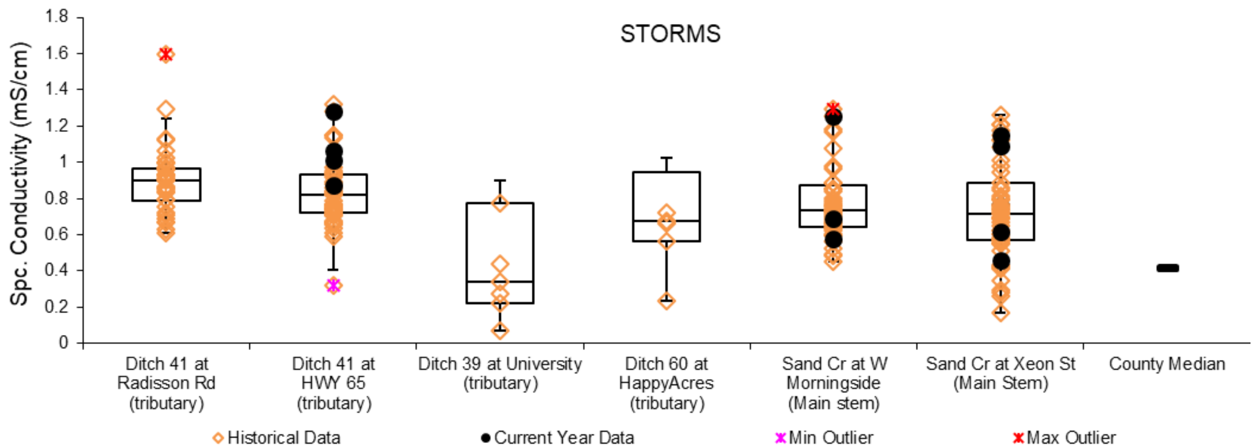
Eight years of chloride sample collection have occurred at the downstream site at Xeon St, 2007-2012, 2019, and 2021. While this is not a large enough record to assess trends over time, looking at annual averages for these samples offers insight into any potential changes in the system. These averages are generally lower than the baseflow averages for the same year, except for in 2019 which was the highest average on record for either condition over any monitored year. Chloride concentrations in 2021 were once again higher during baseflow conditions (128.33 mg/L) than during storm flow (88.2 mg/L) Chloride concentrations for all years monitored during all conditions averaged 78.1 mg/L. No individual samples on record have approached the 230 mg/L chronic state standard for chlorides during the growing-season.

Average and median specific conductance in Sand Creek Data is from Xeon St for specific conductance and all years through 2021

	Average Specific conductance (mS/cm)	Median Specific conductance (mS/cm)	State Standard	N (Sp Cond.)
Baseflow	0.909	0.857	Specific conductance – none	65
Storms	0.734	0.716		61
All	0.824	0.792		126
Occasions > state standard				0

Specific conductance at Sand Creek Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.





TOTAL PHOSPHORUS

Similar to Coon Creek, Sand Creek is not listed as impaired for eutrophication directly, but it does have an approved TMDL for TP as a result of the aquatic life impairment. Grab samples show 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 57.5 µg/L during baseflow and 89 µg/L during storm events. However, Sand Creek at Xeon St samples during storm events averaged 105.6 µg/L, slightly higher than the state standard of 100 µg/L. Since 2007, post-storm samples collected at Xeon St. have exceeded the state standard 36% 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. Ditch 39 and Ditch 60 were only monitored in 2009 and 2019, so very limited information is 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 2021 readings at the Memorial Gardens site remained below 100 µg/L during baseflow but were at or above 100 µg/L during storm events; this is an increase from 2020. 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. There is a significant decrease in baseflow TP over time from 2007-2021 at the Xeon St outlet monitoring site. 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 a large channel restoration and re-meander project that stabilized eroding banks and provide additional habitat for aquatic biota.

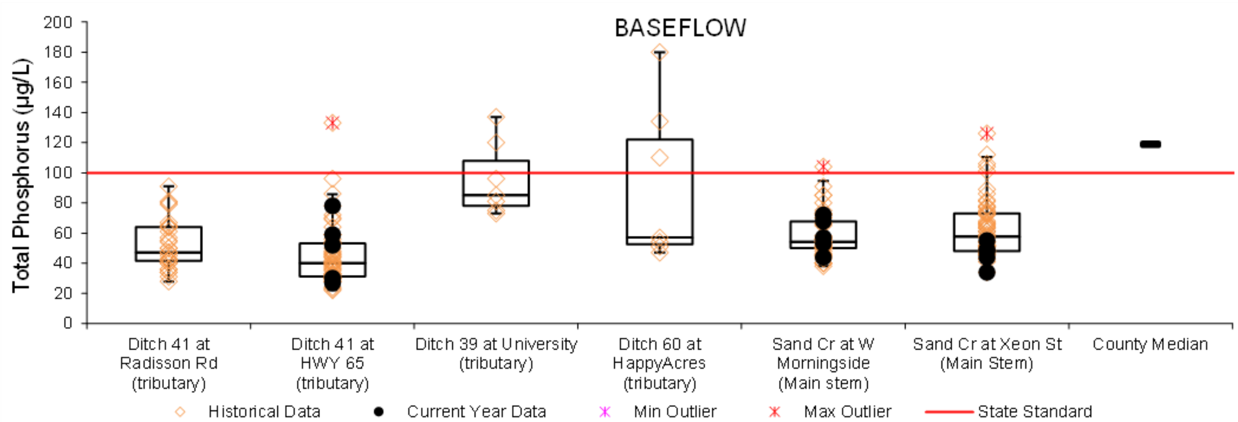
Supplemental Ortho Phosphorus (OP) samples were collected in 2021 at the outlet of Sand Creek. The average OP concentration during baseflow was 36% (range=20%-58%) of the average Total Phosphorus (TP) concentration. During storms, the average OP concentration was 39% (range=20%-65%) of the average TP concentration. Compared to mainstem Coon Creek, OP loading during storms appears to be elevated indicating extra sources of OP in the system. Additional OP samples will be collected at the Ditch41 at Highway 65 site in 2022, which is upstream of where Ditch 60 and Ditch 39 enter Sand Creek. The MN Stormwater Manual reports the national average Ortho Phosphorus concentration as a percentage of Total Phosphorus to be 26% indicating Sand Creek is slightly higher than the national average.

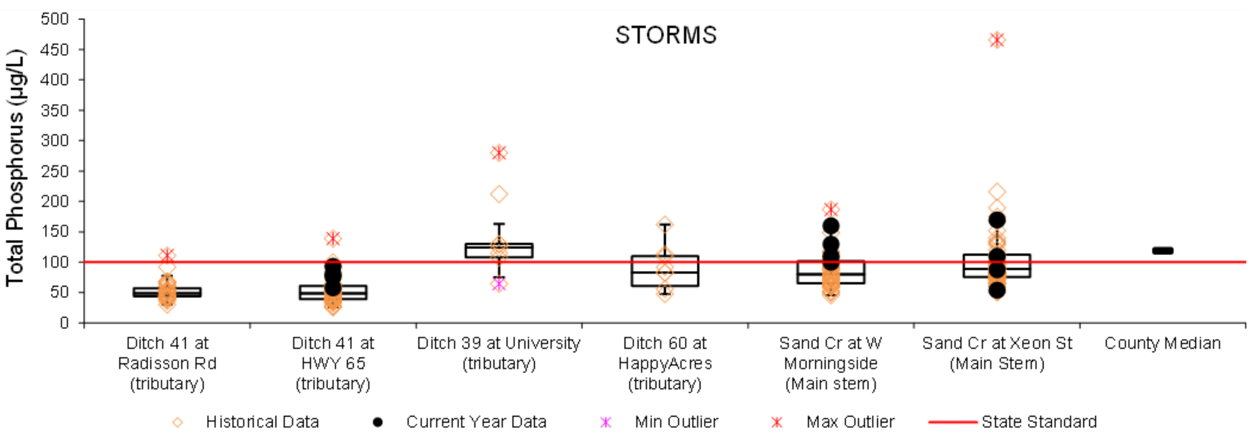
The Coon Creek TMDL, approved in 2016, also delegates acceptable levels of pollutants in Sand Creek using a load duration curve (LDC) approach. The LDC for Sand Creek is graphed on a plot with flow-weighted daily loads for phosphorus samples collected at Xeon Street (Page 48, Figure 17). This plot shows 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 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 2021.

	Mean Total Phosphorus (µg/L)	Median Total Phosphorus (µg/L)	State Standard	N
Baseflow	62.52	57.50	100	62
Storms	105.56	89.00		59
All	83.50	74.0		121
Occasions > state standard				21 (35%) storm 5 (8%) baseflow

Total phosphorus at Sand Creek Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.

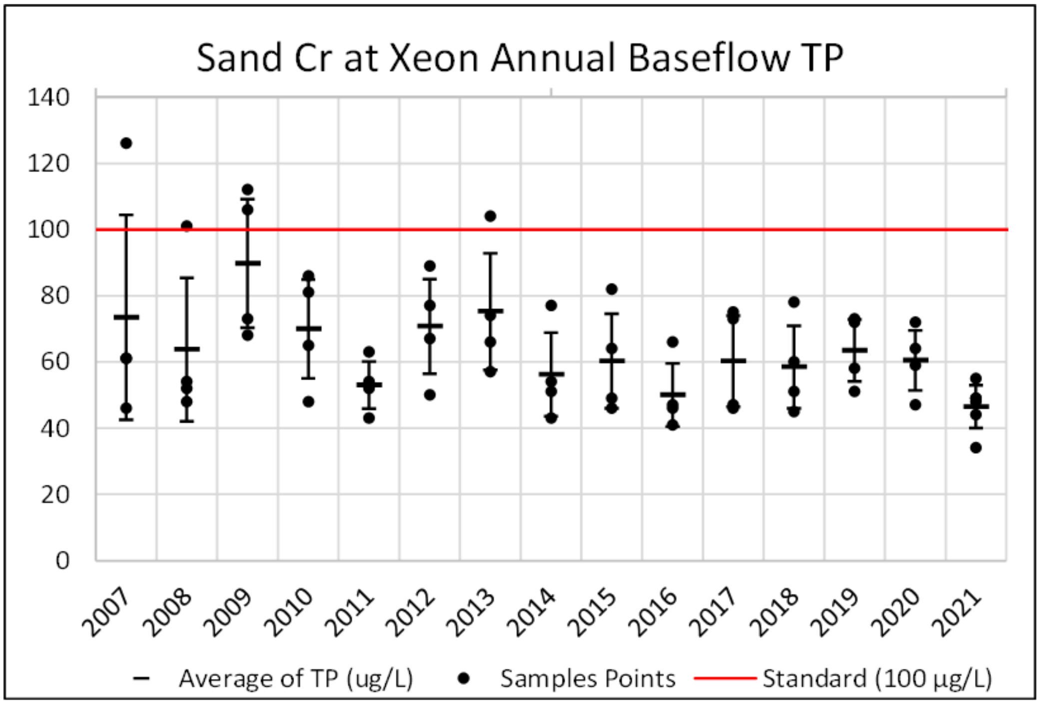


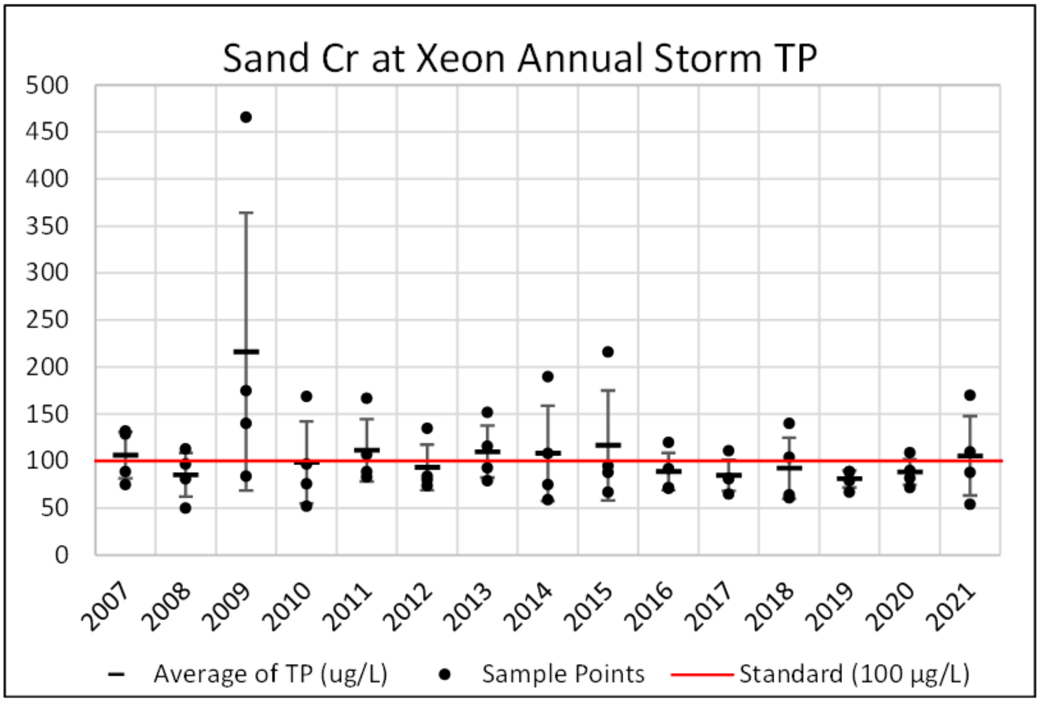


Total Phosphorus Trend Analysis

Parameter	**Significant Change in Annual $\bar{x}$ (2007-2021)**	**P=**	**Standard Error of Means**
Total Phosphorus – Baseflow	Yes, improving trend	0.016	9.11
Total Phosphorus – Storm	No	0.16	31.27

Sand Creek at Xeon St. – Annual average ANOVA regression TP 2007-20





ANOVA Matrix for Baseflow Total Phosphorus

	Sand Cr at West Morningside Memorial Gardens (WMMG) (2010-2021) - 50 Samples	Sand Cr at Xeon St. (2007-2021) – 62 Samples
Sand Cr at Morningside Memorial Gardens		No Sig. Change WMMG $\overline{X}$= 58.28 µg/L Xeon $\overline{X}$= 62.51 µg/L p= 0.19
Sand Cr at Xeon St.		

ANOVA Matrix for Storm Total Phosphorus

	Sand Cr at West Morningside Memorial Gardens (WMMG) (2010-2021) – 47 Samples	Sand Cr at Xeon St. (2007-2021) – 59 Samples
Sand Cr at Morningside Memorial Gardens		No Sig. Change (close Significant Increase) WMMG $\overline{X}$= 87.06 µg/L Xeon $\overline{X}$= 105.56 µg/L p= 0.055
Sand Cr at Xeon St.		

TOTAL SUSPENDED SOLIDS

Total Suspended Solids (TSS) concentrations are generally low in Sand Creek, although storm flow concentrations are elevated in the downstream portions of the creek and appear not to follow the same loading pattern as TP 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 10.4 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 threshold 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 8% 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.

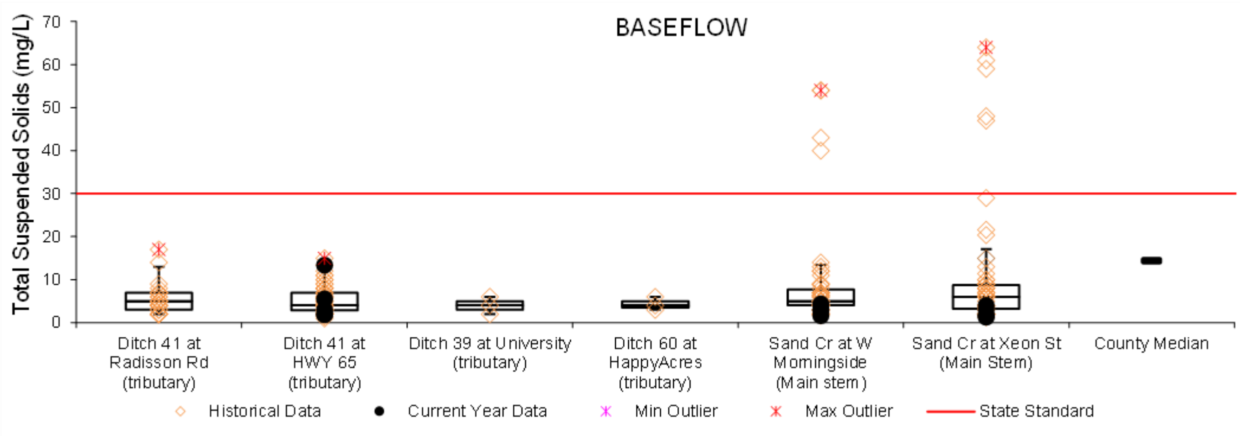
The approved Coon Creek TMDL contains a Load Duration Curve for TSS in Sand Creek at the Xeon St monitoring station (Page 43, Figure 14). The results graphed on this curve show only a couple of exceedances for TSS, only at high to very high flows. TSS loading in Sand Creek appears to be occurring in the main channel after the confluence of the three ditches, and primarily during larger storm events that cause high flows. This is in contrast to total phosphorus loading, which appears to be highest from the Ditch 39 and Ditch 60 tributaries. 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.

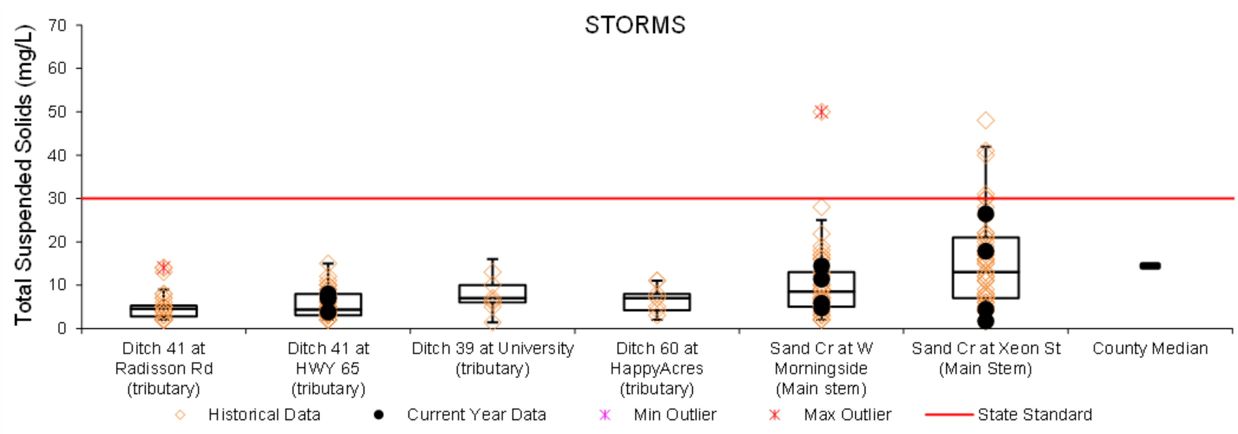
Additionally, while the Coon Creek TMDL identified bank erosion as a major contributor of TSS to Coon Creek (63%), it is considered only a minor factor in Sand Creek accounting for just 13% of the total TSS load. If this is the case, there may be some large source(s) of TSS washing into Sand Creek in the lower portion of the watershed during storm events. This additional TSS does not seem to be 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 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 the water before it enters 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 2021

	Average Total Suspended Solids (mg/L)	Median Total Suspended Solids (mg/L)	State Standard	N
Baseflow	10.36	6.0	30 mg/L TSS	62
Storms	16.7	13.0		60
All	13.49	8.0		122
Occasions > state TSS standard				5 (8%) storm 5 (8%) baseflow

Total suspended solids at Sand Creek Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.

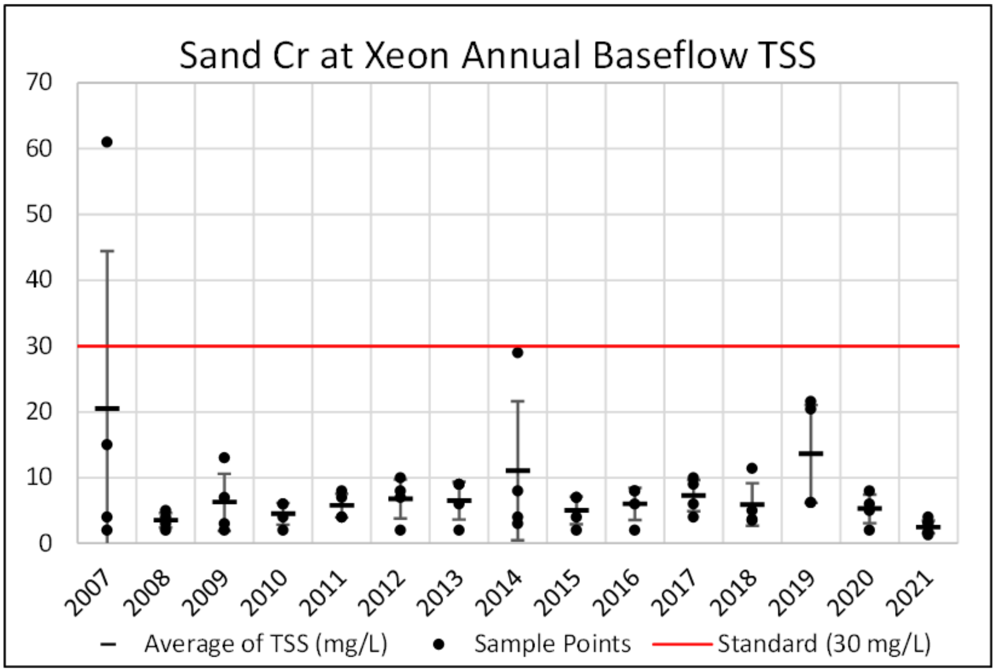


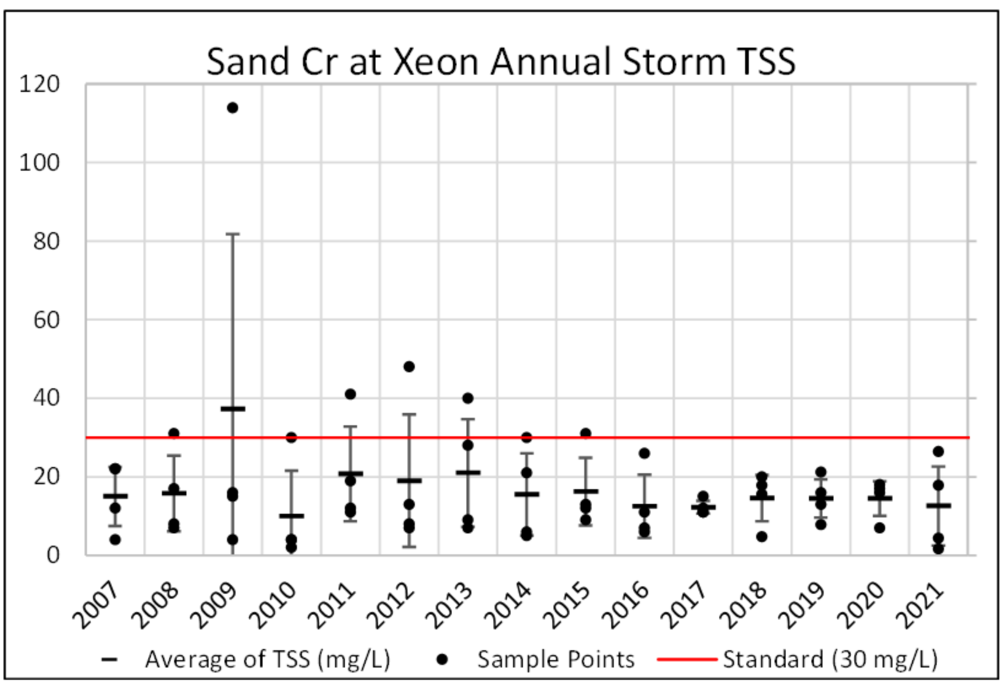


Total Suspended Solids Trend Analysis

Parameter	**Significant Change in Annual $\bar{x}$ (2005-2021)**	**P=**	**Standard Error of Means**
Total Suspended Solids – Baseflow	None	0.36	4.57
Total Suspended Solids – Storm	None	0.13	6.11

Sand Creek at Xeon St. – Annual Average ANOVA regression TSS 2007-2021





ANOVA Matrix for Baseflow Total Suspended Solids

	Sand Cr at West Morningside Memorial Gardens (2010-2021) - 50 Samples	Sand Cr at Xeon St. (2007-2021) – 62 Samples
Sand Cr at Morningside Memorial Gardens		No Sig. Change WMMG $\bar{X}$= 9.03 mg/L Xeon $\bar{X}$= 10.37 mg/L p= 0.60
Sand Cr at Xeon St.		

ANOVA Matrix for Storm Total Suspended Solids

	Sand Cr at West Morningside Memorial Gardens (2010-2021) - 48 Samples	Sand Cr at Xeon St. (2007-2021) – 60 Samples
Sand Cr at Morningside Memorial Gardens		Significant Increase WMMG $\bar{X}$= 10.17 mg/L Xeon $\bar{X}$= 16.70 mg/L p= <0.05
Sand Cr at Xeon St.		

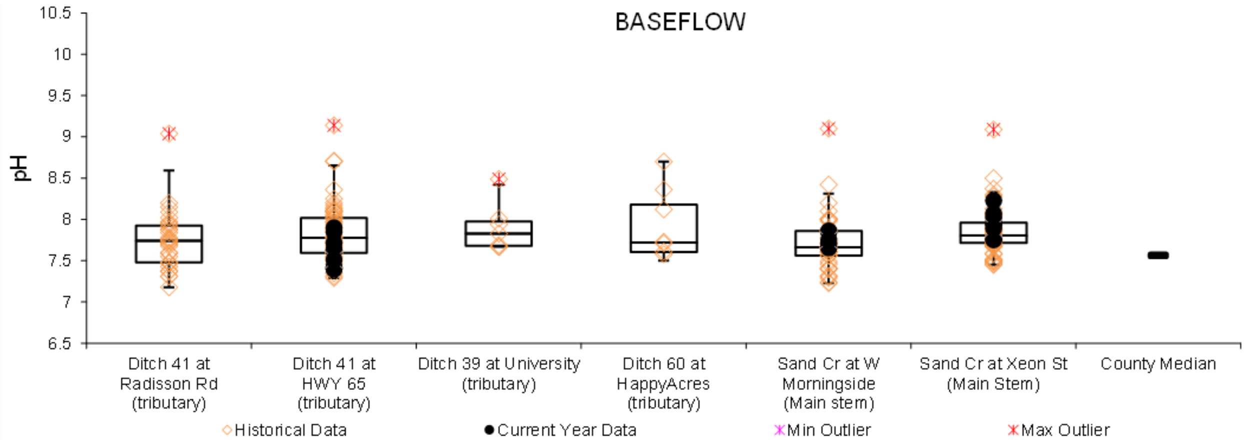
PH

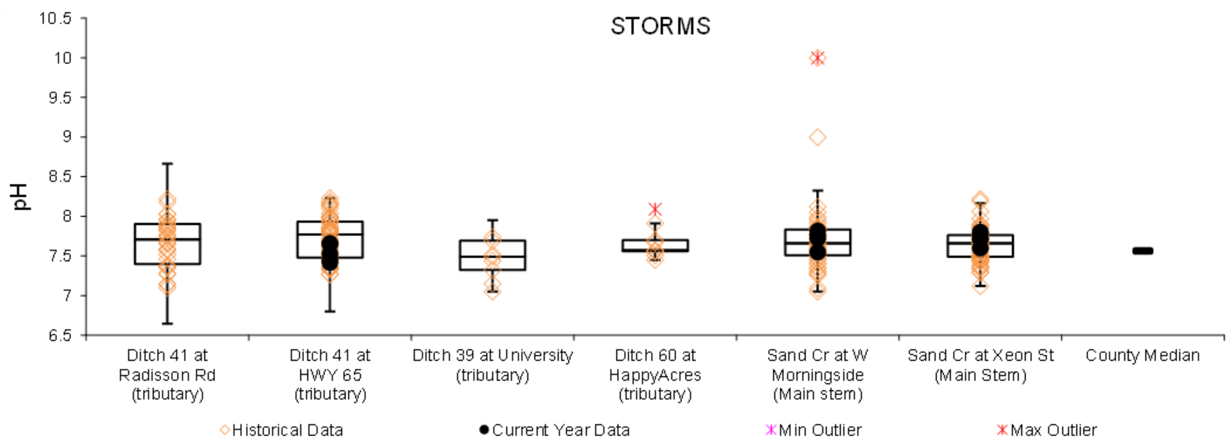
Sand Creek pH remained within the acceptable range in 2021. Historically, individual outliers have caused a couple high readings in excess of 9.0. These may be due to a poor calibration of the sampling equipment. The median for all conditions at Xeon is 7.74. The state standard for pH is for the parameter 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 2021.

	Average pH	Median pH	State Standard	N
Baseflow	7.86	7.80	6.5-8.5	64
Storms	7.81	7.66		61
All	7.83	7.74		125
Occasions outside state standard				1 baseflow (1%) 2 storm (3%)

pH at Sand Creek Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.





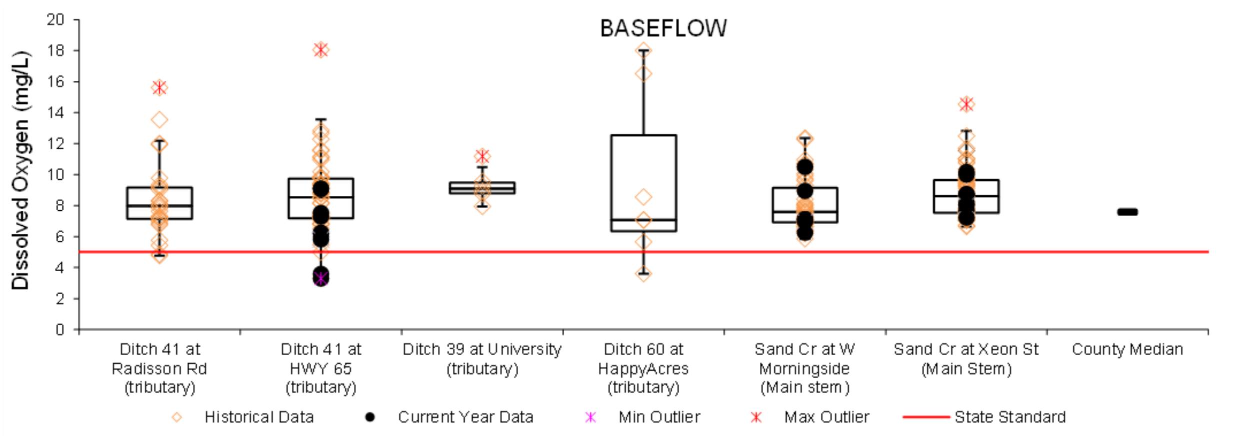
Dissolved Oxygen

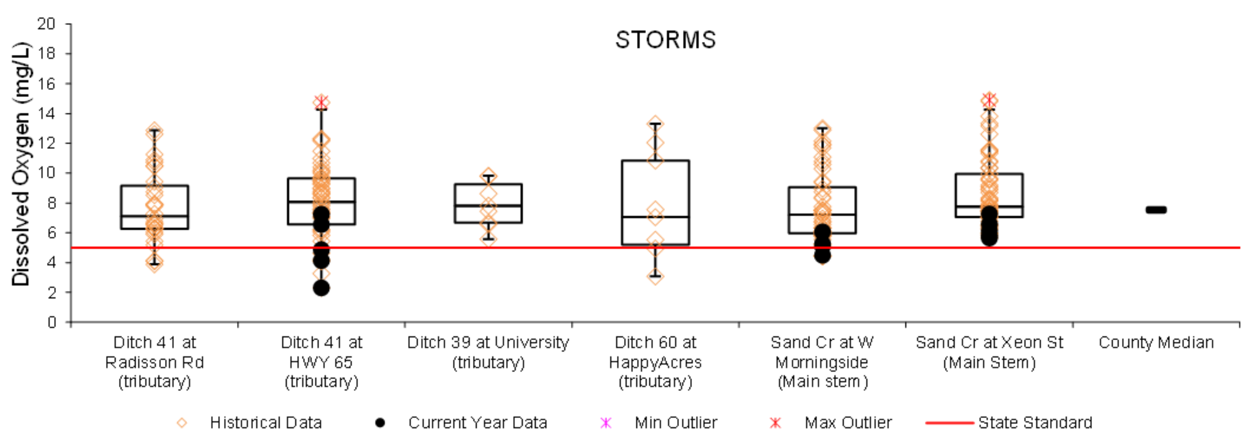
Dissolved oxygen is within a healthy range in the lower reaches of Sand Creek, and has never been recorded below 5 mg/L at Xeon St. However, DO dropped below 5 mg/L on 22 of 295 (7.5%) sampling occasions across all monitored years at other upstream sites. Overall, there are no significant management 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 certain conditions.

Average and median dissolved oxygen in Sand Creek. Data is from Xeon St for all years through 2021.

	Average Dissolved Oxygen (mg/L)	Median Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	8.80	8.61	5 mg/L daily minimum	61
Storms	8.68	7.75		61
All	8.74	8.15		122
Occasions <5 mg/L				0 at Xeon St., 22 at other sites

Dissolved Oxygen at Sand Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating lines) for all data collected at these sites.





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 ten 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.

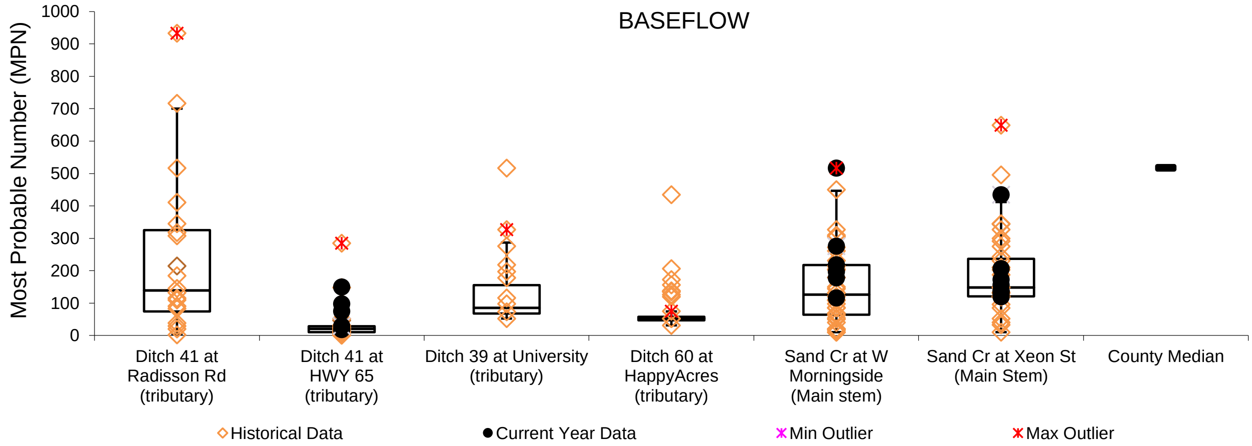
It appears that Ditch 41 is contributing high levels of *E. coli* during both baseflow and storms at the furthest upstream monitoring site at Radisson Road during past monitoring years (this site was not monitored in 2021), followed by a consistently sharp decline at the monitoring site at Highway 65. Again, in 2021, 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 low levels of *E. coli* while Ditch 39 saw higher levels, especially after storm events.

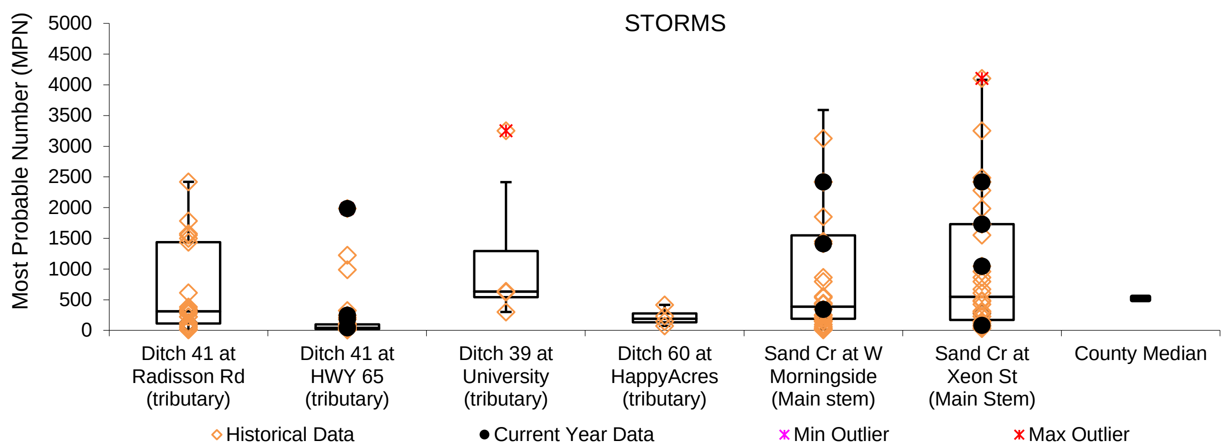
The Coon Creek TMDL offers more insight into *E. coli* loading into Sand Creek. The Load Duration Curve plot (Page 51, Figure 21) shows exceedances of acceptable flow-weighted loads of *E. coli* in most samples and across all flow ranges at Xeon St. The TMDL lists domestic pets as the primary source 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. Dog waste disposal stations were installed along the Sand Creek trail corridor in fall of 2021.

Average, Geomean and median *E. coli* in Sand Creek. Data is from Xeon St. for all years through 2021.

	Average *E. coli* (MPN)	**Geomean *E. coli* (MPN)**	**Median *E. coli* (MPN)**	**State Standard**	**N**
Baseflow	286.47	169.84	150.00	Monthly Geometric Mean >126	41
Storms	1,852.711	632.16	670.0		37
All	1,029.43	317.02	229.5		78
Occasions >126 MPN				Monthly 10% average >1260	28 (68%) baseflow, 30 (81%) storm
Occasions >1260 MPN					2 (5%) baseflow, 14 (38%) storm

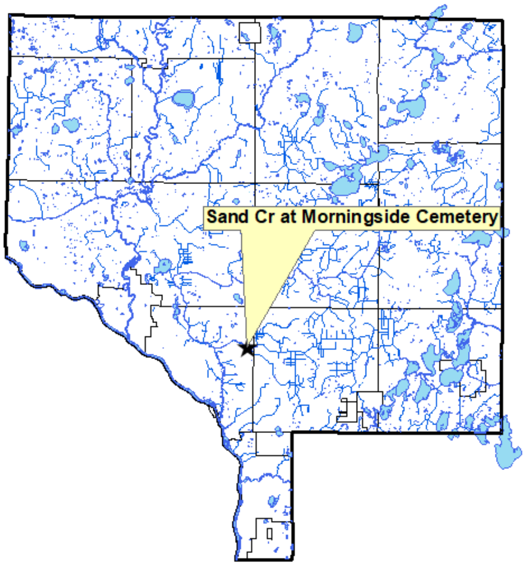
***E. coli* at Sand Creek.** Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating lines) for all data collected at these sites. Abnormally high outliers are not included in box-plots.





STREAM HYDROLOGY – SAND CREEK
SAND CREEK AT MORNINGSIDE MEMORIAL GARDENS, COON RAPIDS

Notes

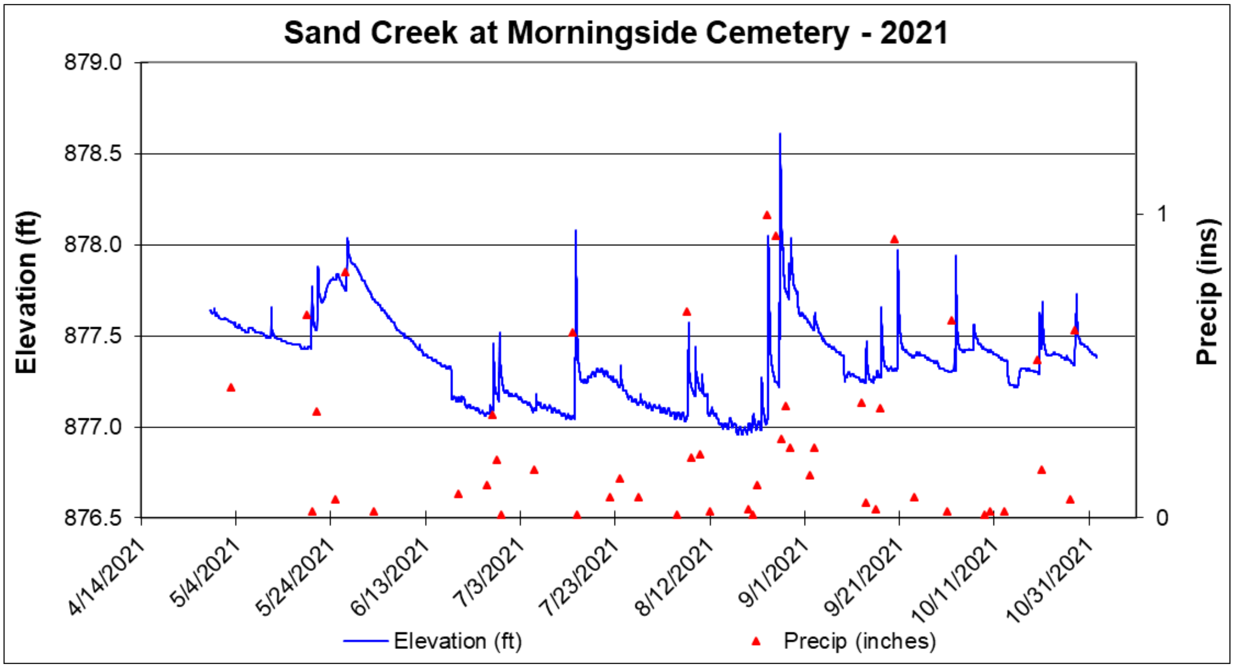


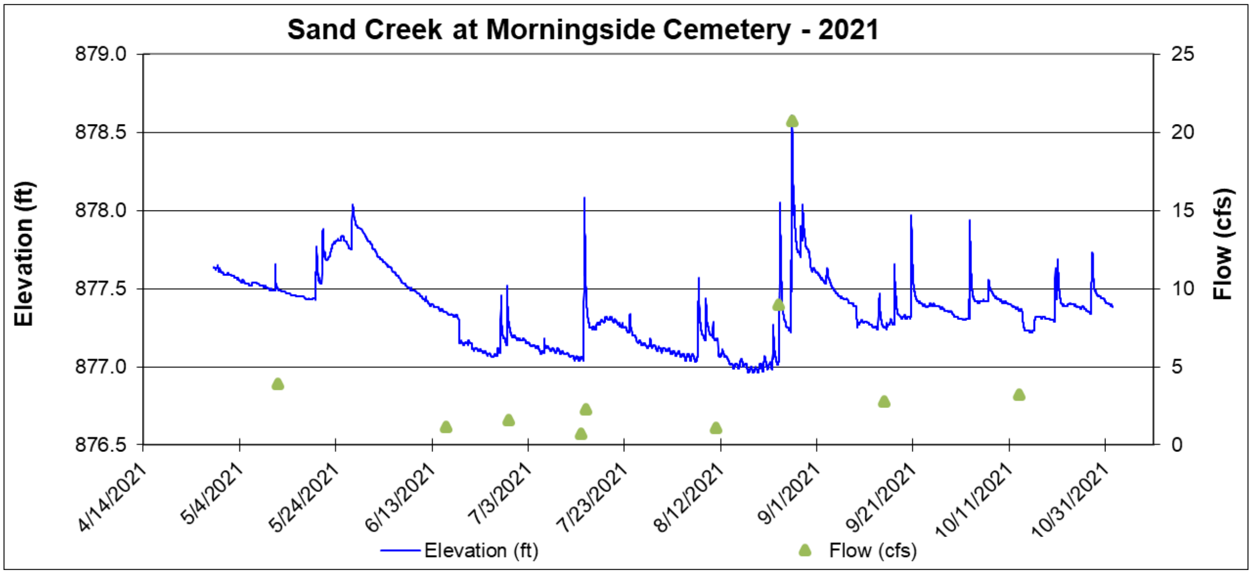
Water levels at the Sand Creek at Morningside site fluctuated 1.65 ft. throughout the 2021 season, the second smallest range since the site began being monitored back in 2010. The lowest average water level was recorded, likely due to the drought Anoka County was experiencing in 2021.

The creek is very narrow as it flows through this site causing water levels to be very flashy in response to rain events. During a 2.52-inch rain event in late August the creek rose 1.39 ft. in 7 hours. The second lowest water level was recorded in 2021. The maximum level in 2021 was almost a half a foot lower than the next lowest maximum recorded in 2013.

A rating curve was established for this site in 2019 and is displayed below.

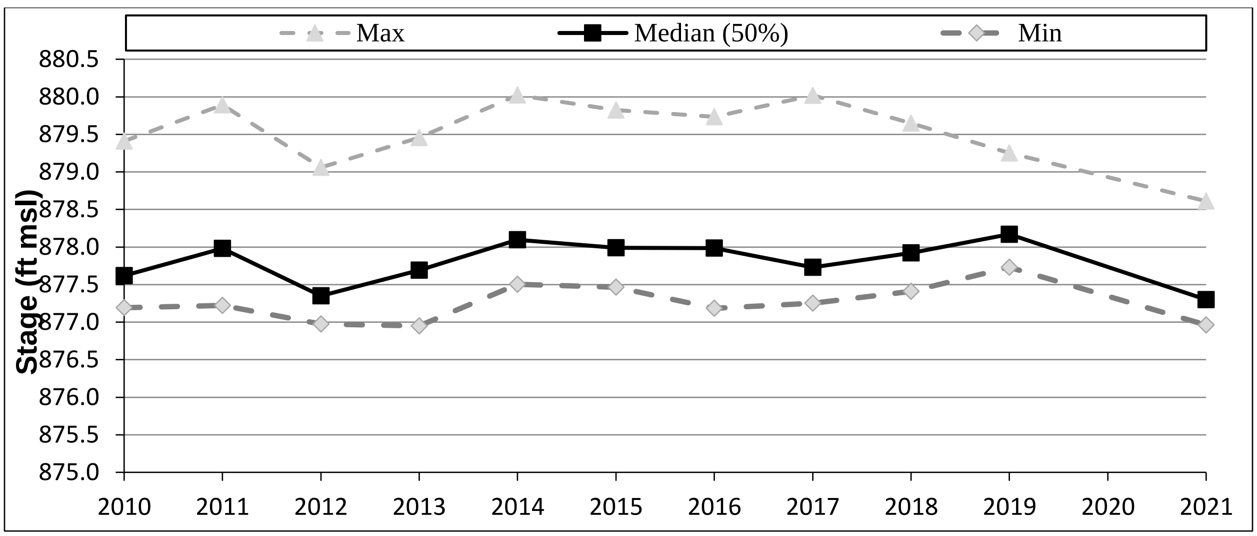
2021 Hydrograph



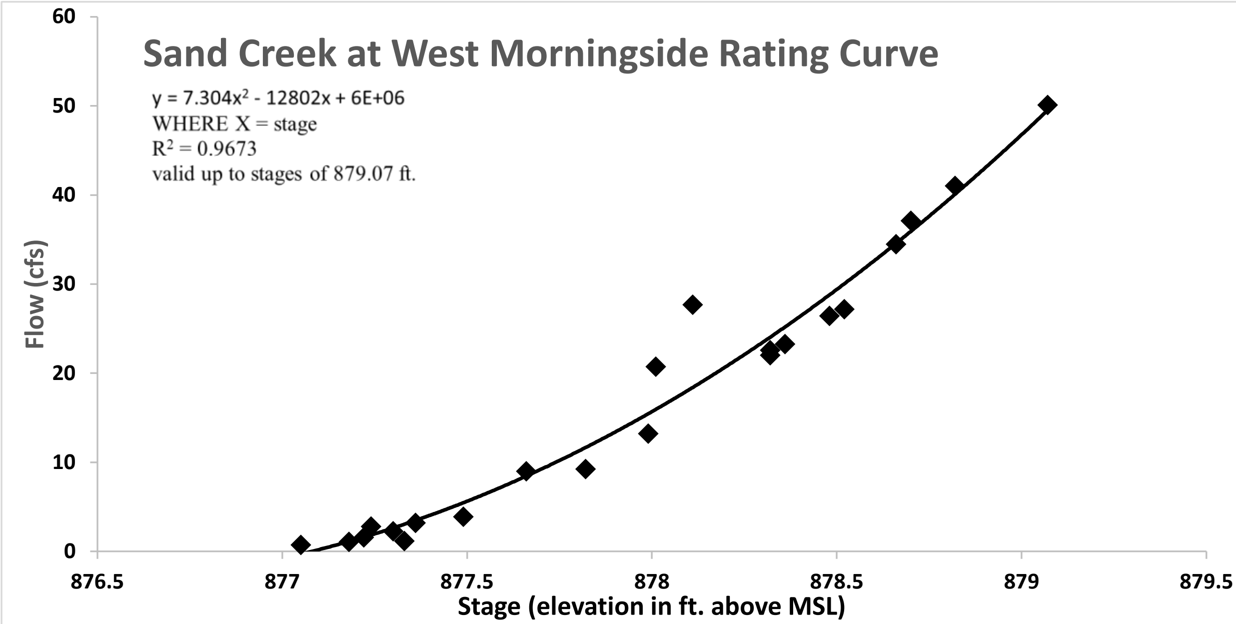


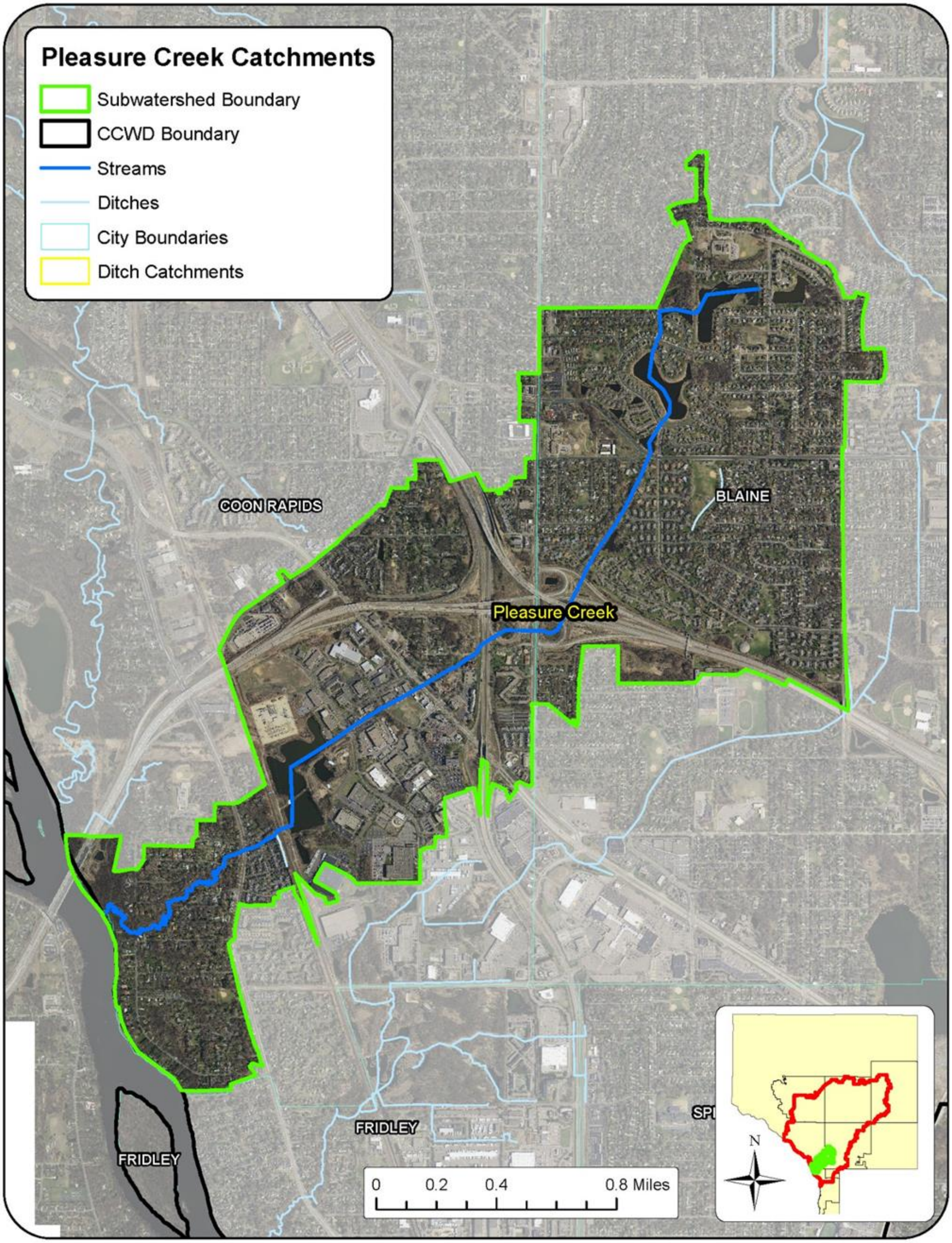
Summary of All Monitored Years

Percentiles	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021
Min	877.19	877.22	876.98	876.95	877.51	877.46	877.18	877.25	877.41	877.73	876.96
2.5%	877.27	877.28	877.00	877.18	877.56	877.52	877.49	877.34	877.49	877.81	877.00
10.0%	877.36	877.36	877.03	877.28	877.62	877.66	877.58	877.41	877.68	877.91	877.06
25.0%	877.45	877.72	877.15	877.38	877.81	877.80	877.70	877.53	877.80	878.00	877.13
Median (50%)	877.62	877.98	877.35	877.69	878.10	877.99	877.98	877.73	877.92	878.17	877.30
75.0%	877.79	878.22	877.65	877.93	878.43	878.19	878.26	877.96	878.10	878.38	877.42
90.0%	877.95	878.55	877.94	878.42	878.72	878.39	878.54	878.27	878.34	878.60	877.56
97.5%	878.26	878.86	878.38	878.75	879.16	878.70	878.93	878.80	878.60	878.79	877.81
Max	879.41	879.89	879.06	879.46	880.02	879.82	879.73	880.02	879.65	879.25	878.61



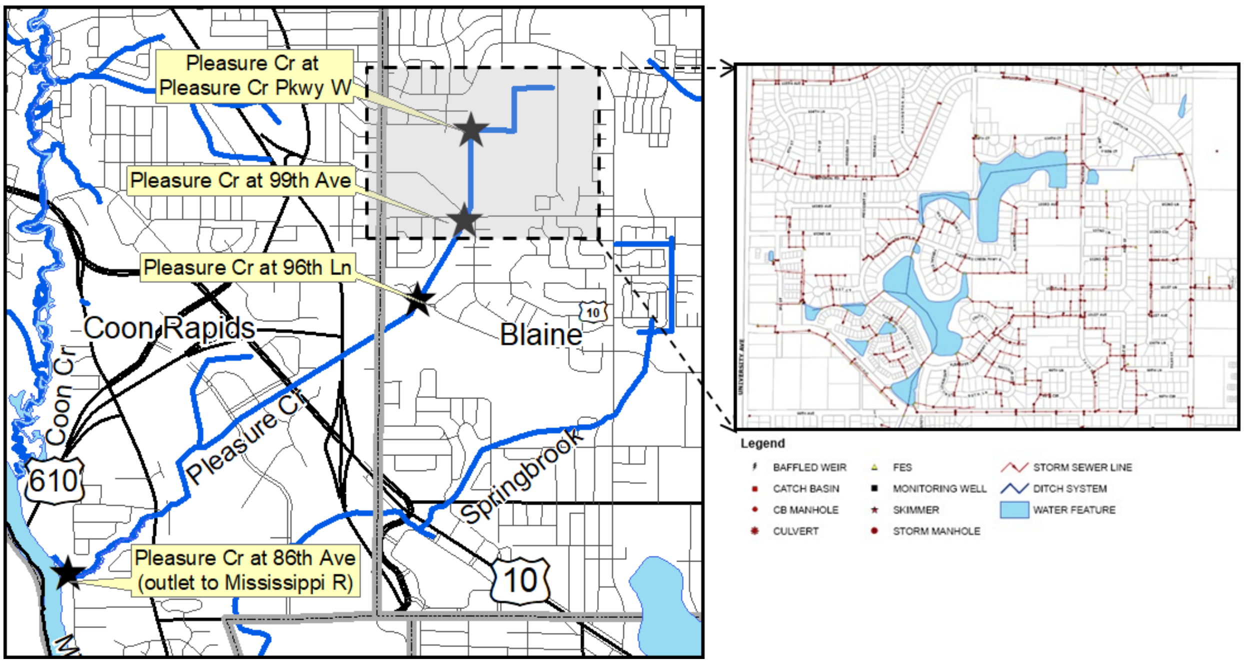
2019 Rating Curve (2021 flow measurements included)




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

Pleasure Creek (Ditch 17) Monitoring Sites		
Site Name/ SiteID	**Years Monitored**	**2021 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, 2018-2021	Water Chemistry Grab Samples, Discrete discharge measurements
Pleasure Creek at 86th Avenue S003-995	2006-2021	Water Chemistry Grab Samples, Continuous Stage, Discrete discharge measurements

Pleasure Creek Monitoring Sites



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.

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 74% of the time at baseflow and 86% 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 and 2021, 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 five of ten samples in 2021, four of these occurred during baseflow conditions. Chlorides averaged 233.3 mg/L. over all ten samples collected. This was an increase from the 2019 average of 185.5 mg/L. Pleasure Creek has not exceeded the acute standard of 860 mg/L in any sample during the growing season. Pleasure Creek is at high risk for a chloride impairment. 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 Pleasure Creek and the Mississippi River..

SPECIFIC CONDUCTANCE AND CHLORIDES

Specific conductance in Pleasure Creek is high. The long-term median for specific conductance during baseflow conditions at the 86th Av. site is 1.120 mS/cm. By comparison, the median for all Anoka County streams is 0.420 mS/cm. Similarly, the long-term median for specific conductance post-storm in Pleasure Creek at 86th Ave is 1.170 mS/cm. 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 86th Ave, which fluctuates to a far greater degree.

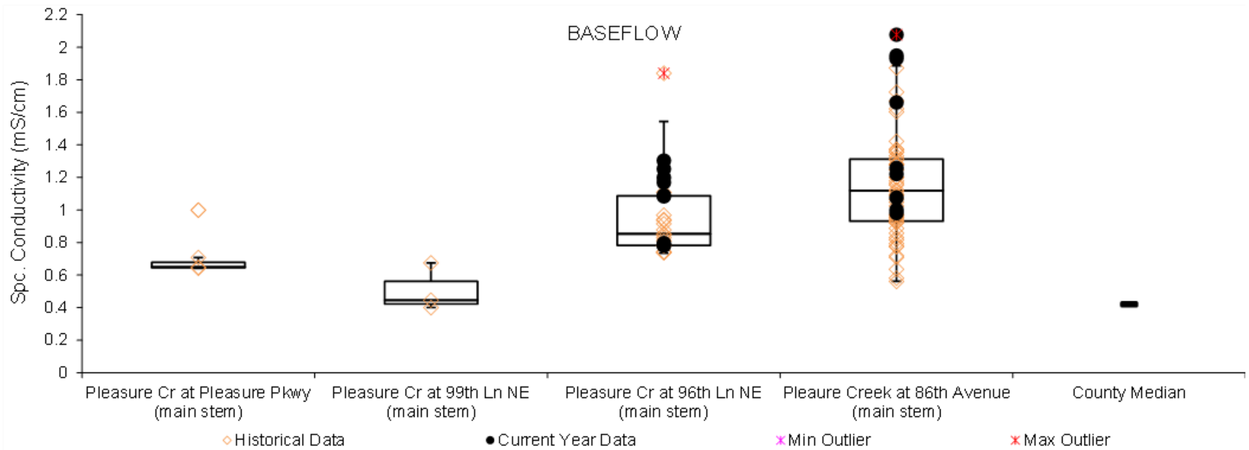
Specific conductance is slightly higher during baseflow conditions, except at 99th lane. Road deicing salt infiltration to the shallow water table that feeds stream base flows is an often-suspected source of pollutants. This is probably occurring at Pleasure Creek, based on high baseflow specific conductance. However, high specific conductance observed post-storms, indicates that stormwater runoff 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.

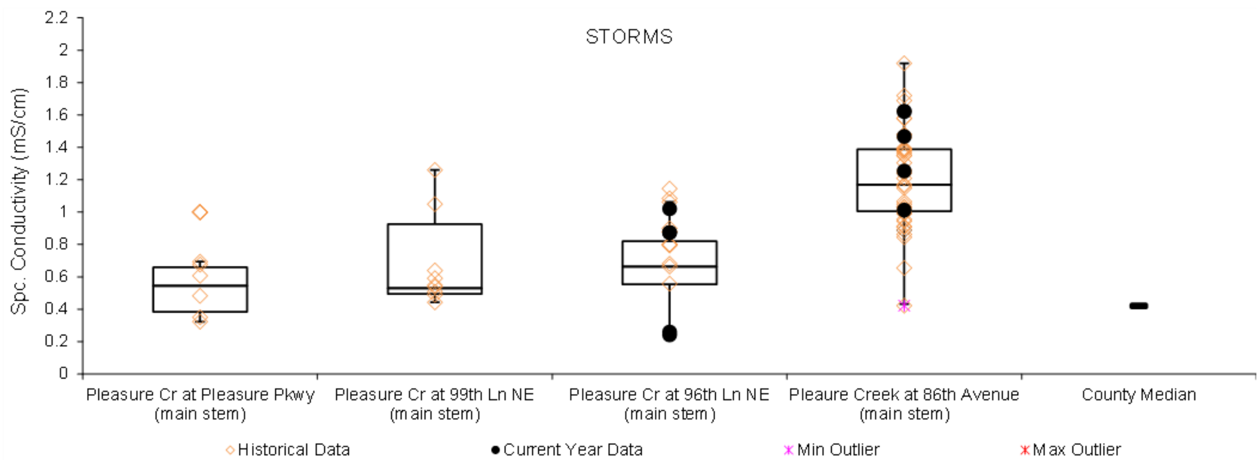
Dissolved pollutants are especially difficult to manage once in the environment. They are not readily removed by stormwater settling ponds. Infiltration practices can provide some treatment through biological processes in the soil, but also risk contaminating groundwater. The first approach to dissolved 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 2021.

	Average specific conductance (mS/cm)	Median specific conductance (mS/cm)	State Standard	N
Baseflow	1.155	1.120	Specific conductance – none	62
Storms	1.208	1.170		51
All	1.179	1.159		113

Specific conductance at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.





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 73.0 µg/L compared to the overall countywide median of 118.8 µg/L. Pleasure Creek, however, has exceeded the state standard of 100 µg/L during 28% of storm samples taken at the 86th Ave outlet monitoring site. The TP concentration at 96th lane also exceeded 100 µg/L on 10 occasions since 2018, five during baseflow and five post-storms. 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 the outlet-monitoring site, 86th Ave ($p < 0.05$). It is possible that one or more ponds in the headwaters are loading phosphorus to the system under certain conditions.

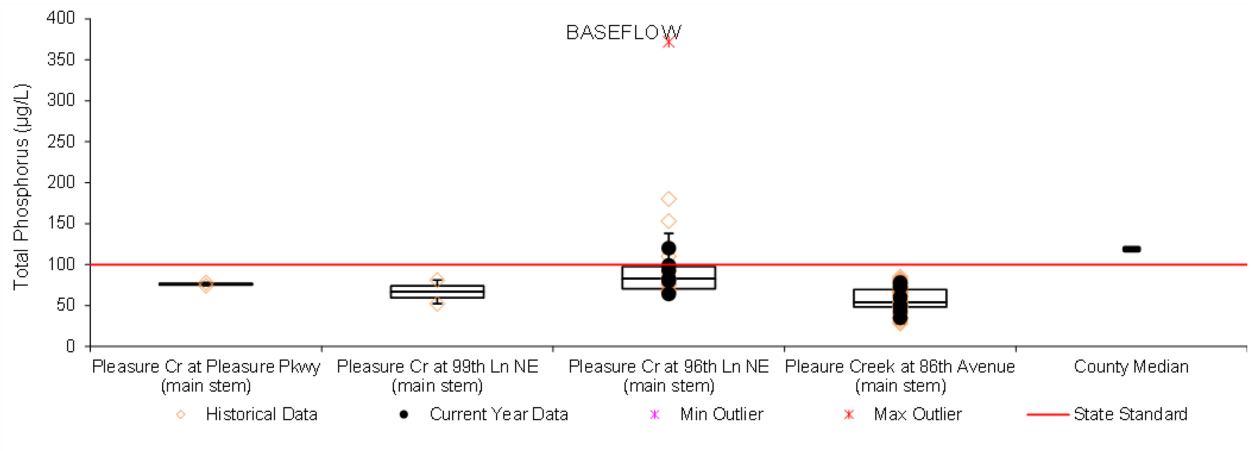
Supplemental Ortho Phosphorus (OP) samples were collected in 2021 at the outlet of Pleasure Creek. The average OP concentration during baseflow was 14% (range=2%-31%) of the average Total Phosphorus (TP) concentration. During storms, the average OP concentration was 23% (range=1%-33%) of the average TP concentration. This indicates that the stormwater ponds upstream of East River Rd are likely performing as designed. The MN Stormwater Manual reports the national average Ortho Phosphorus concentration as a percentage of Total Phosphorus to be 26% indicating Pleasure Creek is slightly below the national average.

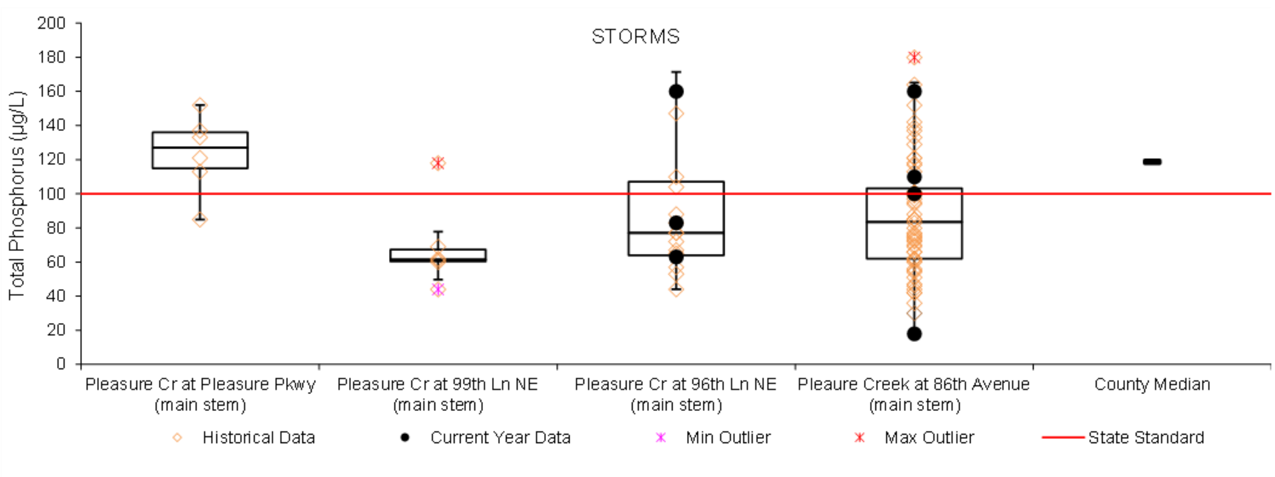
The Pleasure Creek LDC for TP in the Coon Creek TMDL (Page 48, Figure 18) shows that Pleasure Creek does not often exceed acceptable TP loads, and generally only does so at very high flows. This indicates that stormwater infrastructure in this creek's watershed is effectively treating stormwater for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

Median TP in Pleasure Creek. Data is from the 86th Avenue site and all years through 2021.

	Average Total Phosphorus (µg/L)	**Median Total Phosphorus (µg/L)**	**State Standard**	**N**
Baseflow	56.75	54.0	100	54
Storms	87.23	83.5		60
All	72.80	67.0		114
Occasions > state standard				0 baseflow 17 (28%) storms

Total phosphorus at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.





ANOVA Matrix for Baseflow Total Phosphorus

	Pleasure Creek at 96th Lane (2008-2021) - 22 Samples	Pleasure Creek at 86th Ave (2001-2021) - 54 Samples
Pleasure Creek at 96th Lane		Significant Decrease 96th Ln X= 102.82 µg/L 86th Ave X= 56.76 µg/L p= <0.0001
Pleasure Creek at 86th Ave		

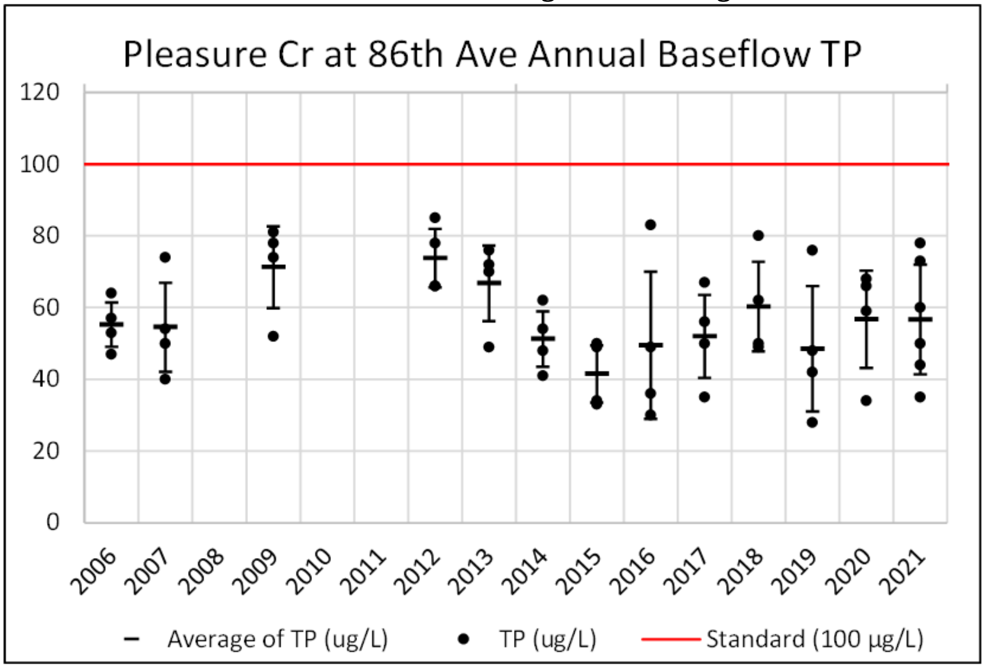
ANOVA Matrix for Storm Total Phosphorus

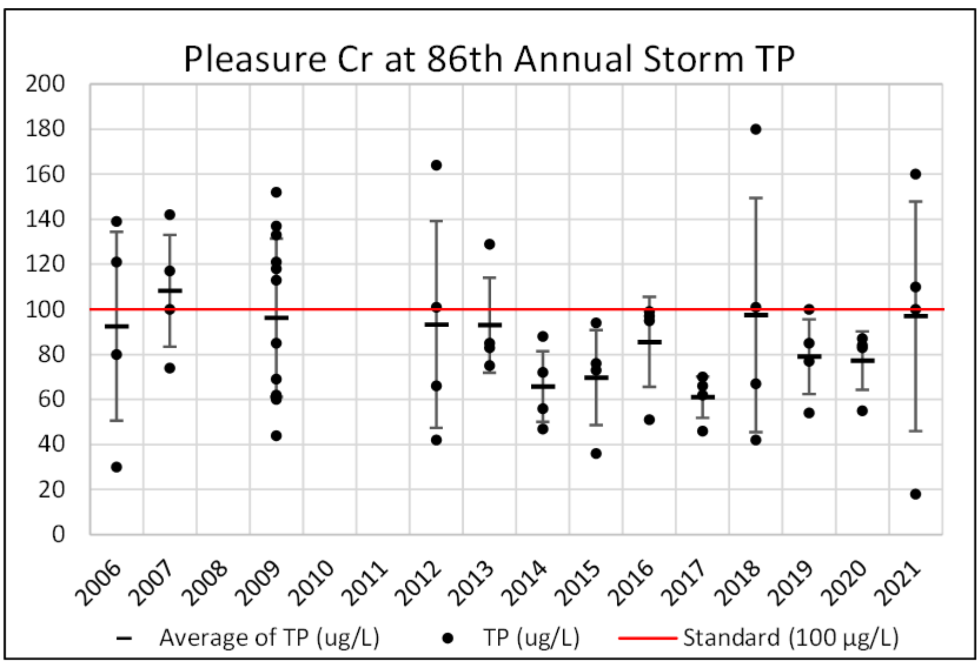
	Pleasure Creek at 96th Lane (2008-2021) - 19 Samples	Pleasure Creek at 86th Ave (2001-2021) - 60 Samples
Pleasure Creek at 96th Lane		No Sig. Change 96th Ln X= 110.89 µg/L 86th Ave X= 87.23 µg/L p= 0.16
Pleasure Creek at 86th Ave		

Trend Analysis

Parameter	Significant Change in Annual $\overline{X}$ (2006-2021)	p=	Standard Error of Means
Total Phosphorus - Baseflow	None	0.32	9.21
Total Phosphorus - Storm	None	0.16	13.54

Pleasure Creek at 86th Ave - Annual average ANOVA regression TP 2006-2021





TOTAL SUSPENDED SOLIDS

TSS is generally low during baseflow conditions. However, during storm events, TSS (all years) has exceeded the state standard of 30 mg/L 37% of the time. Three samples collected in 2021 exceeded the state standard concentration, all during storm sampling. 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 site and 86th Ave site downstream. This indicates 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 TSS, and 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 way to improve 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 2021.

	Average Total Suspended Solids (mg/L)	**Median Total Suspended Solids (mg/L)**	**State Standard**	**N**
Baseflow	8.38	6.0	30 mg/L TSS	54
Storms	28.00	20.5		60
All	18.71	10.8		114
Occasions > state TSS standard				0 baseflow 22 (37%) storm

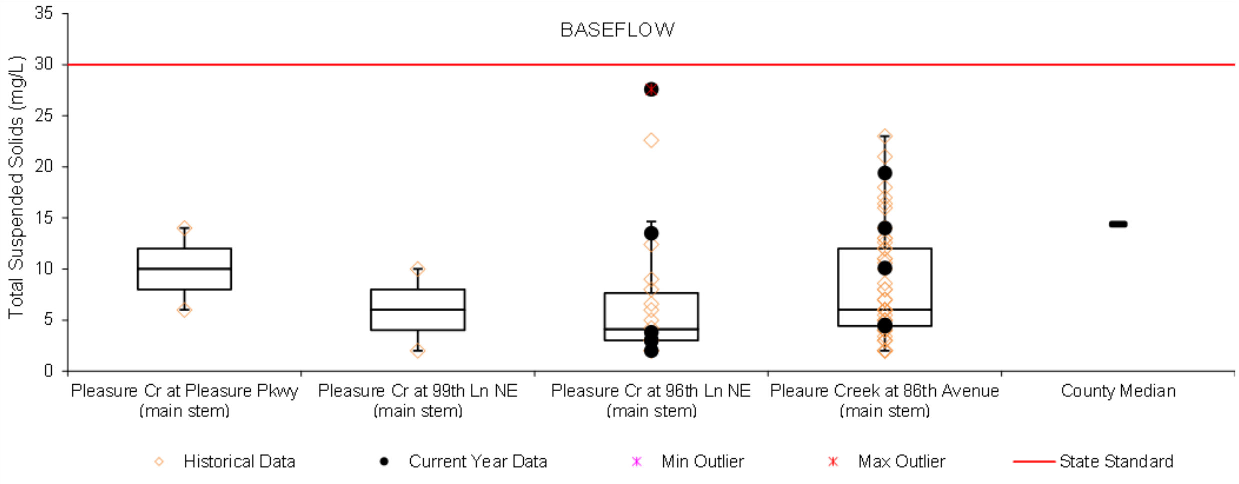
ANOVA Matrix for Baseflow TSS

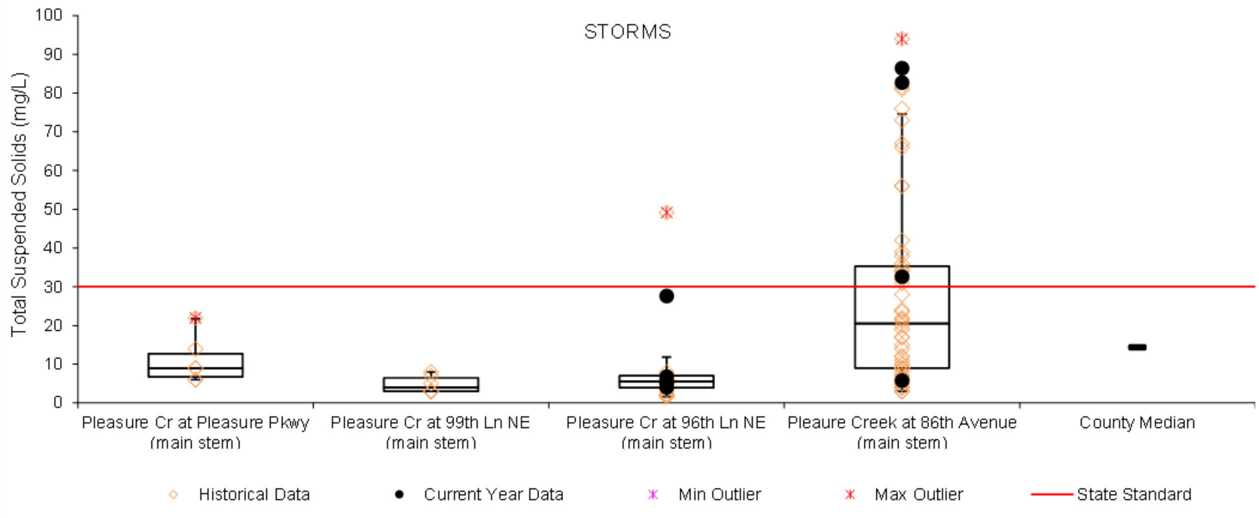
	Pleasure Creek at 96th Lane (2008-2021) - 22 Samples	Pleasure Creek at 86th Ave (2001-2021) - 54 Samples
Pleasure Creek at 96th Lane		No Sig. Change 96th Ln X= 6.89 mg/L 86th Ave X= 8.37 mg/L p= 0.31
Pleasure Creek at 86th Ave		

ANOVA Matrix for Storm TSS

	Pleasure Creek at 96th Lane (2008-2021) - 20 Samples	Pleasure Creek at 86th Ave (2001-2021) - 60 Samples
Pleasure Creek at 96th Lane		Significant Increase 96th Ln X= 10.15 mg/L 86th Ave X= 28.00 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 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.

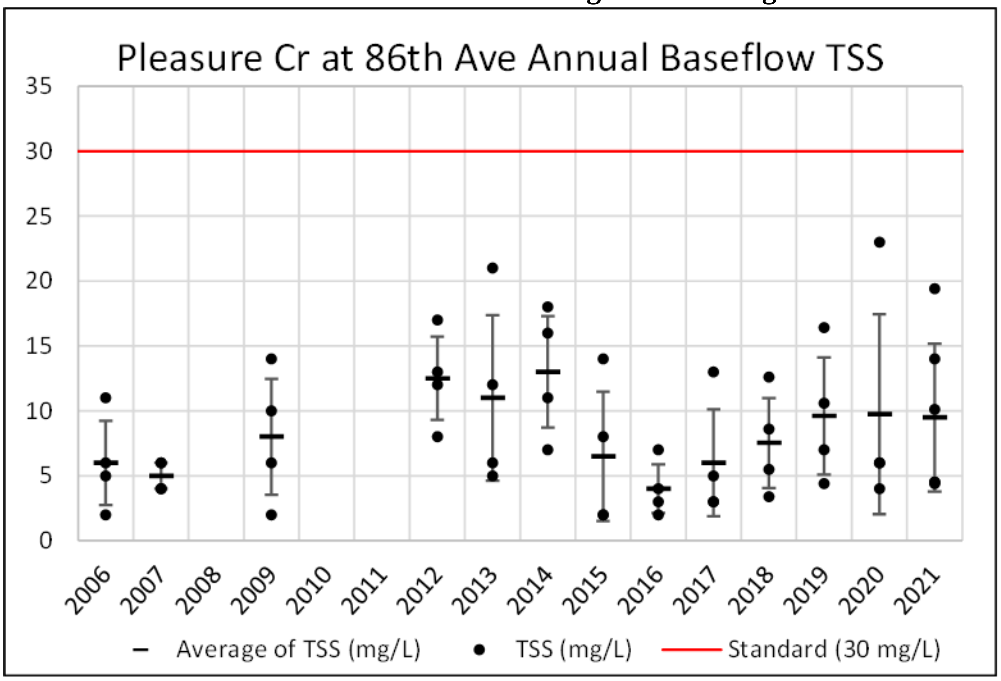


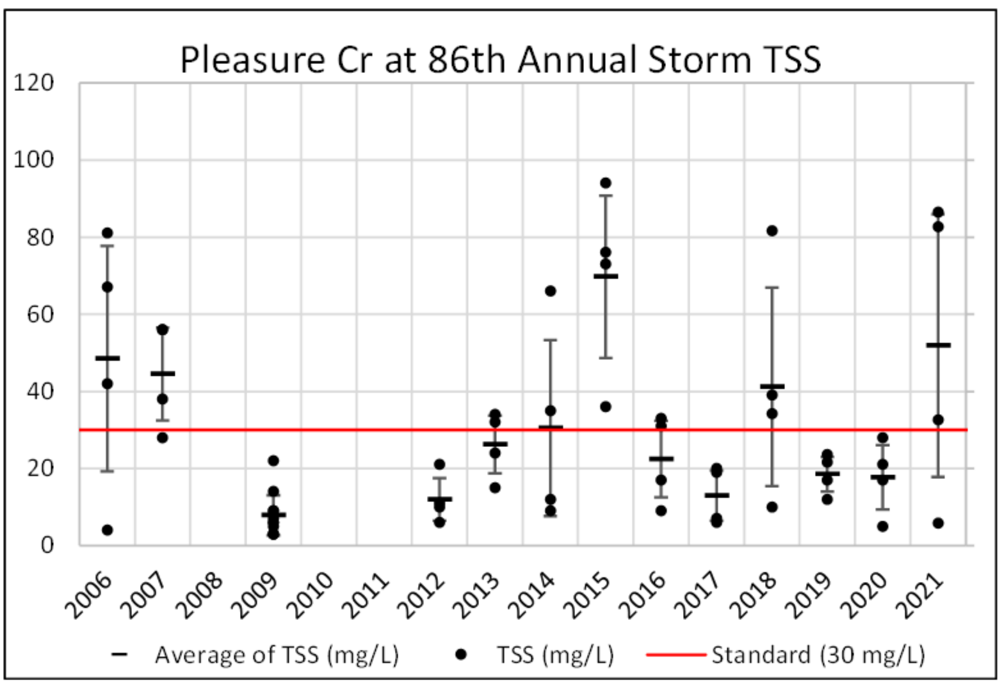


Trend Analysis

Parameter	Significant Change in Annual $\overline{X}$ (2006-2021)	p=	Standard Error of Means
Total Suspended Solids - Baseflow	None	0.48	2.88
Total Suspended Solids - Storm	None	0.84	19.44

Pleasure Creek at 86th Avenue - Annual average ANOVA regression TSS 2006-2021





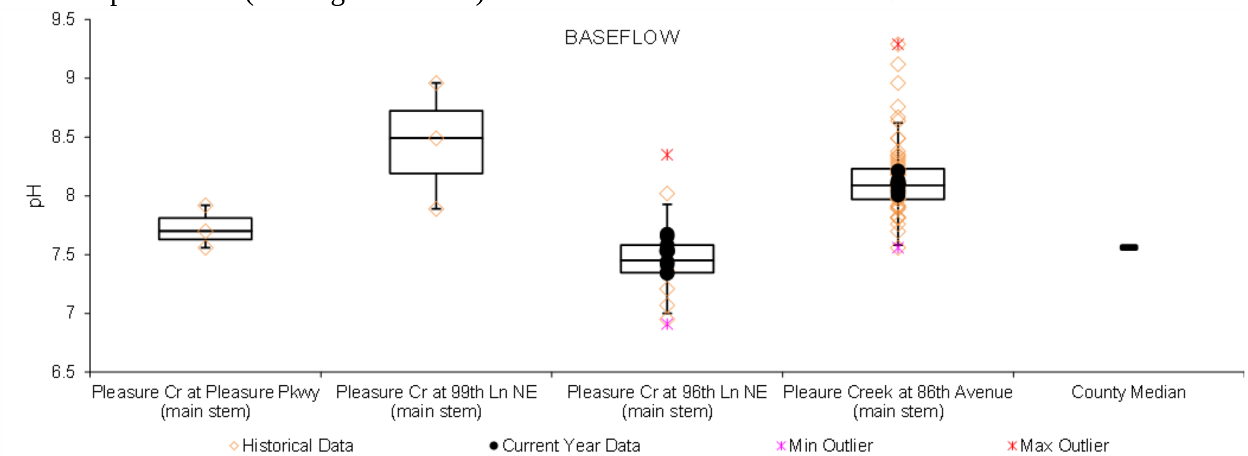
pH

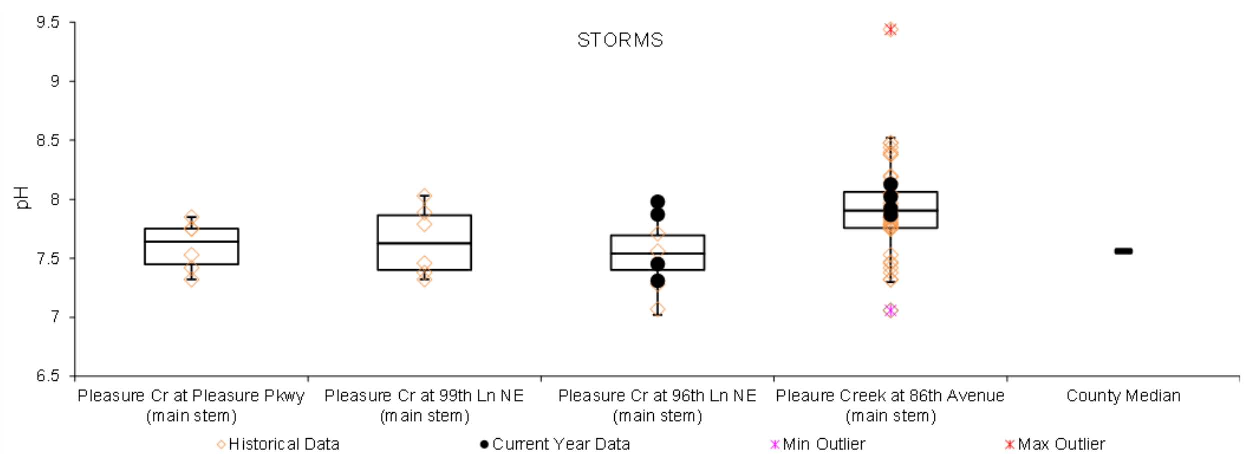
Pleasure Creek pH levels have generally remained within the state water quality standard range of 6.5-8.5, but median and average values are at the higher end of that range and higher than the long-term median for all Anoka County streams (7.56). Eight exceedances of the healthy range have occurred in all samples collected since 2007 at 86th Ave. Seven of these twelve 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 2021.

	Average pH	Median pH	State Standard	N
Baseflow	8.14	8.09	6.5-8.5	69
Storms	7.93	7.90		60
All	8.04	8.03		129
Occasions outside state standard				7 (10%) baseflow 1 (2%) storm

pH at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.





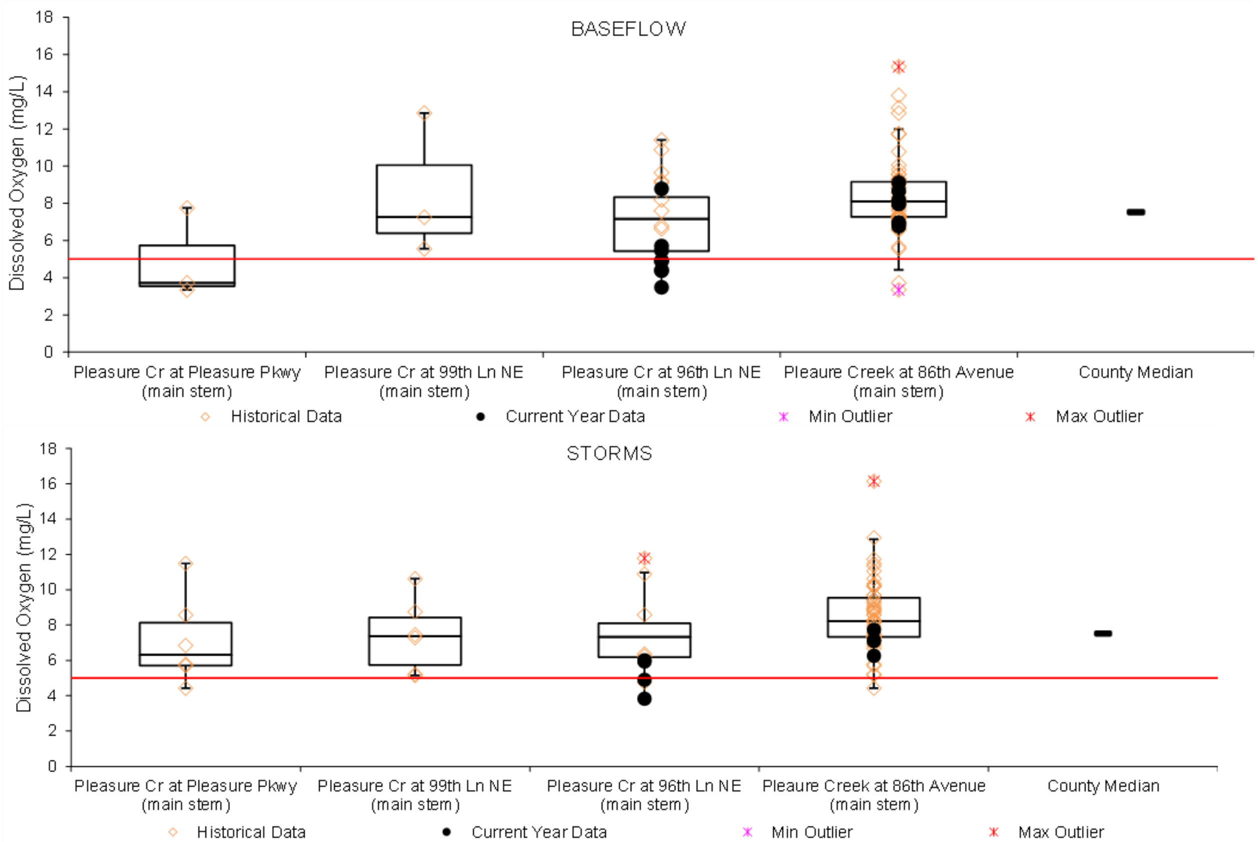
DISSOLVED OXYGEN

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 126 samples collected since 2002 at 86th Ave. DO levels below 5 mg/L were however commonly observed at the 96th Ln site further upstream. Low DO in the upstream reaches of Pleasure Creek may cause internal loading of TP which could explain the occurrence of high TP levels during baseflow in this area.

Average and Median dissolved oxygen in Pleasure Creek. Data is from the 86th Avenue site and all years through 2021.

	Average Dissolved Oxygen (mg/L)	Median Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	8.43	8.12	5 mg/L daily minimum	64
Storms	8.54	8.22		62
All	8.48	8.16		126
Occasions <5 mg/L				2 (3%) baseflow 1 (2%) storm

Dissolved Oxygen at Pleasure Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.



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 ten 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

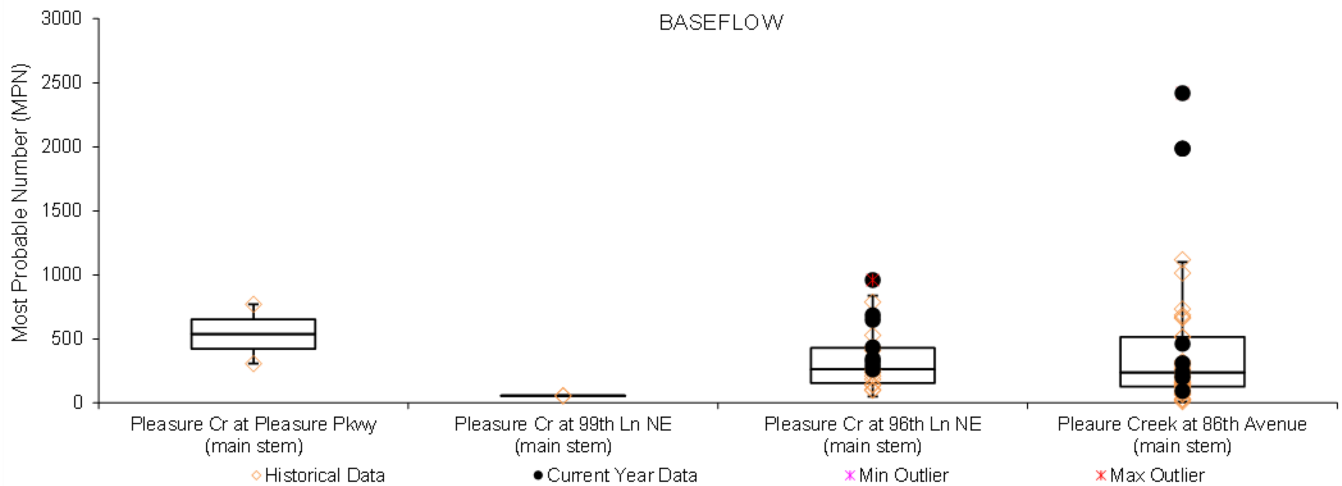
Pleasure Creek is listed as impaired for aquatic recreation due to excessive *E. coli*, and the Coon Creek TMDL contains a Load Duration Curve for this parameter (Page 52, Figure 22). The LDC chart shows exceedances of acceptable levels for the majority of samples collected. High *E. coli* still persists 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.

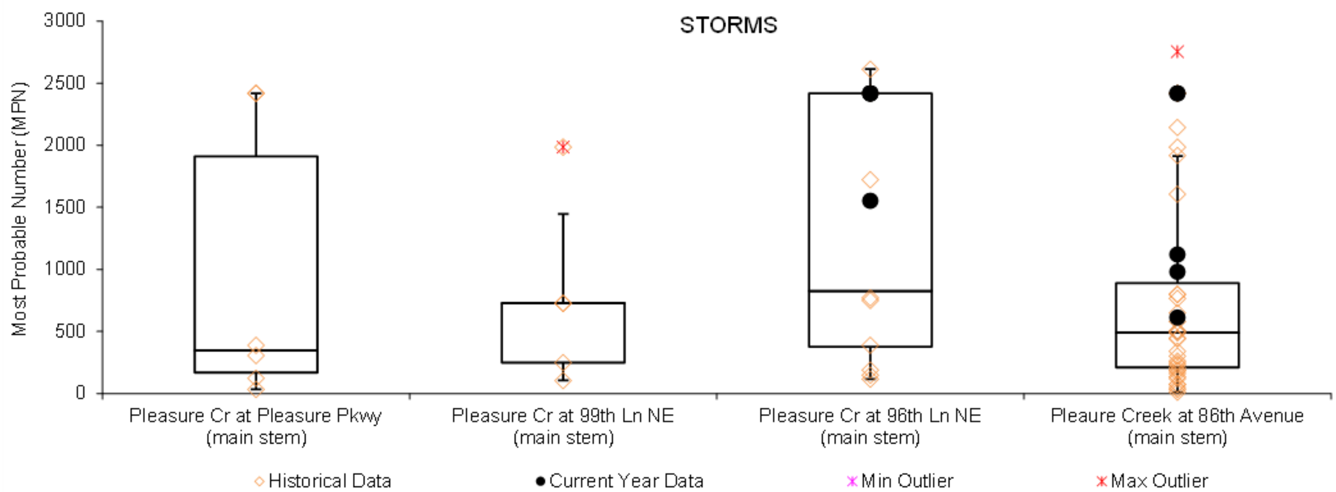
While current sampling frequency does not allow calculations based on state standards, *E. coli* measurements collected in 2021 are still informative. In 2021, 13 of the 14 samples collected during all conditions at 86th Ave exceeded the chronic standard of 126 MPN. Two of these samples exceeded the acute standard of 1260 MPN, both during storm sampling. *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 2021.

	Average *E. coli* (MPN)	**Median *E. coli* (MPN)**	**Geometric Mean**	**State Standard**	**N**
Baseflow	434.04	236.60	197.34	Monthly Geometric Mean >126	47
Storms	781.00	488.0	422.83		43
All	599.81	311.00	312.28		90
Occasions >126 MPN				Monthly 10% average >1260	35 (74%) baseflow, 37 (86%) storm
Occasions >1260 MPN					3 (6%) baseflow, 9 (21%) storm

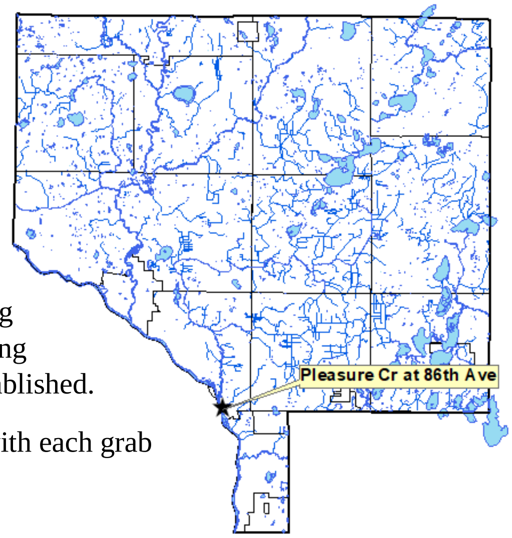
***E. coli* at Pleasure Creek.** Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.





Stream Hydrology – Pleasure Creek
Pleasure Creek at 86th Ave

Notes

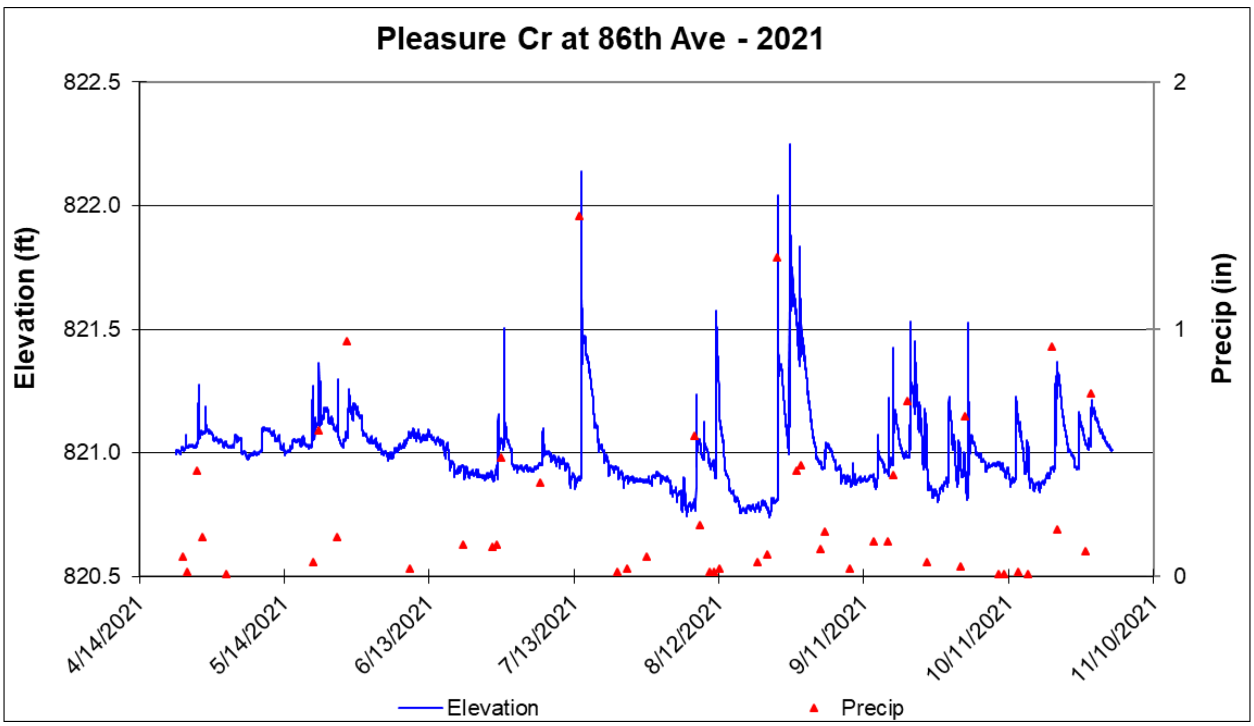


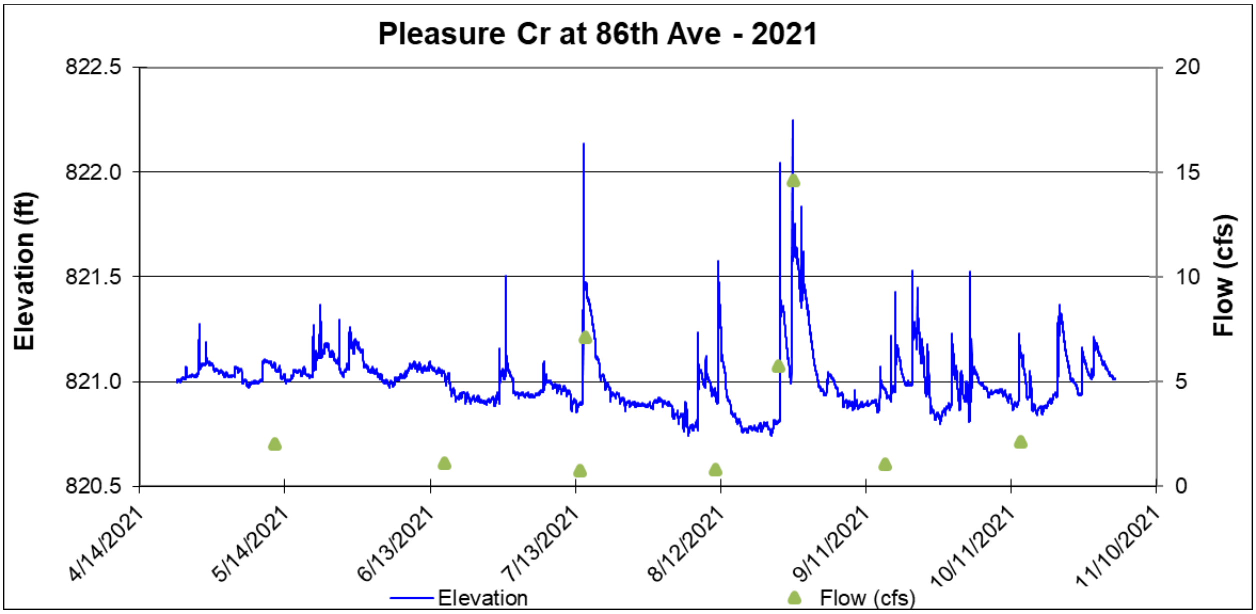
Pleasure Creek at 86th fluctuated 1.51 feet throughout 2021. Stage reading frequency was 15-minute intervals in order to capture the majority of storm surge fluctuations. The site is flashy, with a 1.46-inch storm on July 14 causing an increase of 1.23 feet in only a two-hour span.

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.

In 2021, discrete manual discharge measurements were taken with each grab sample.

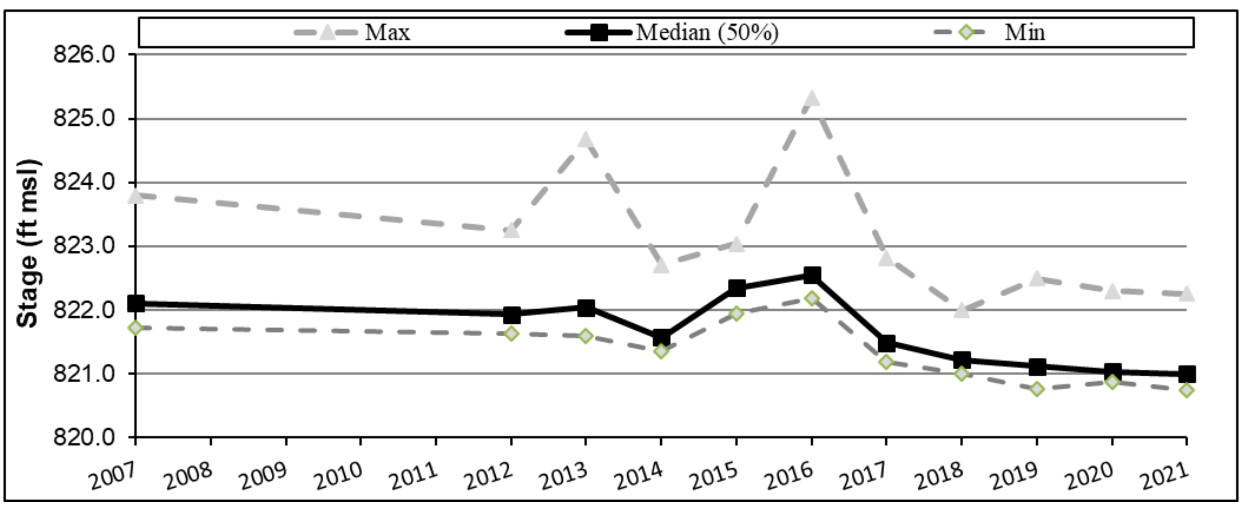
2021 Hydrograph

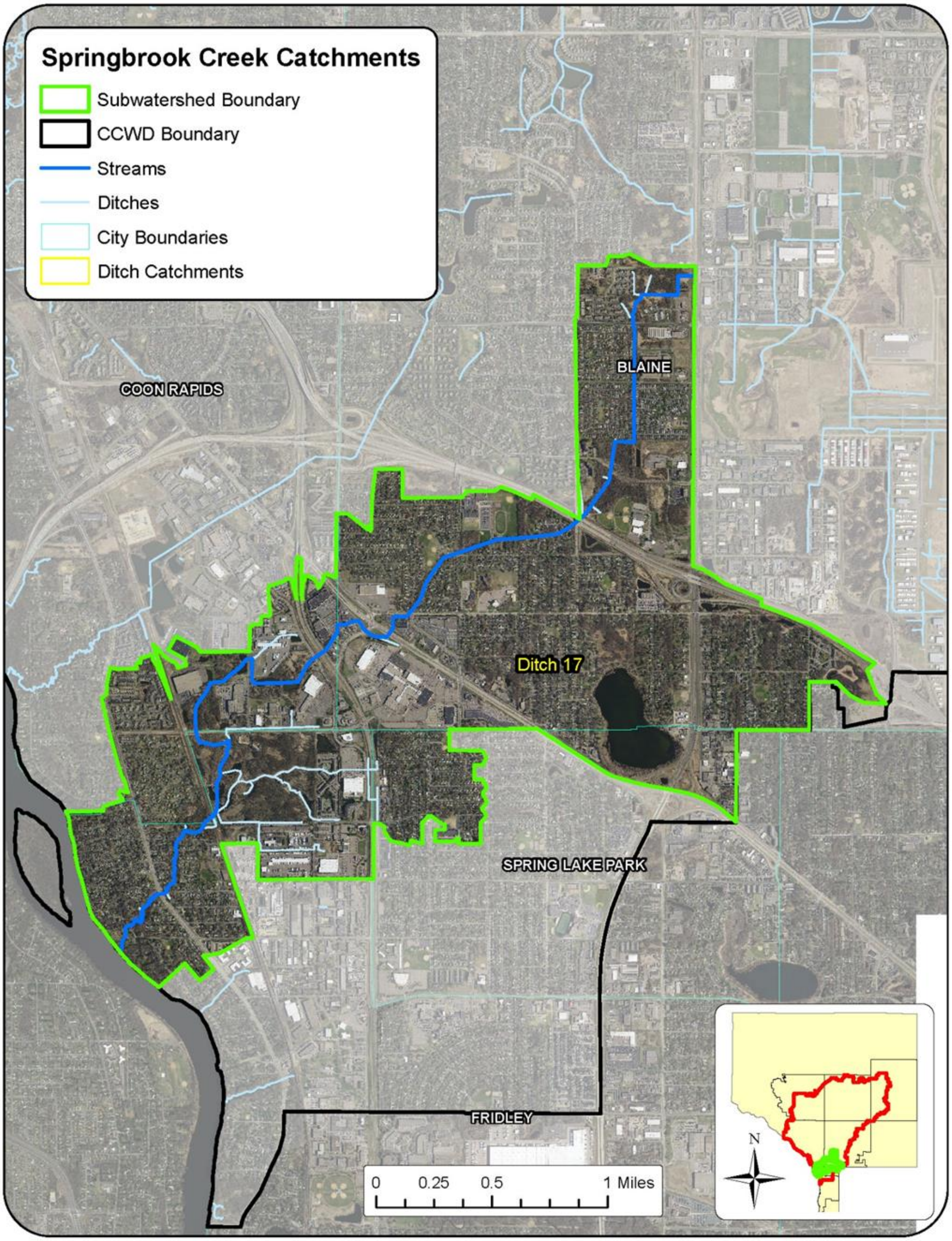




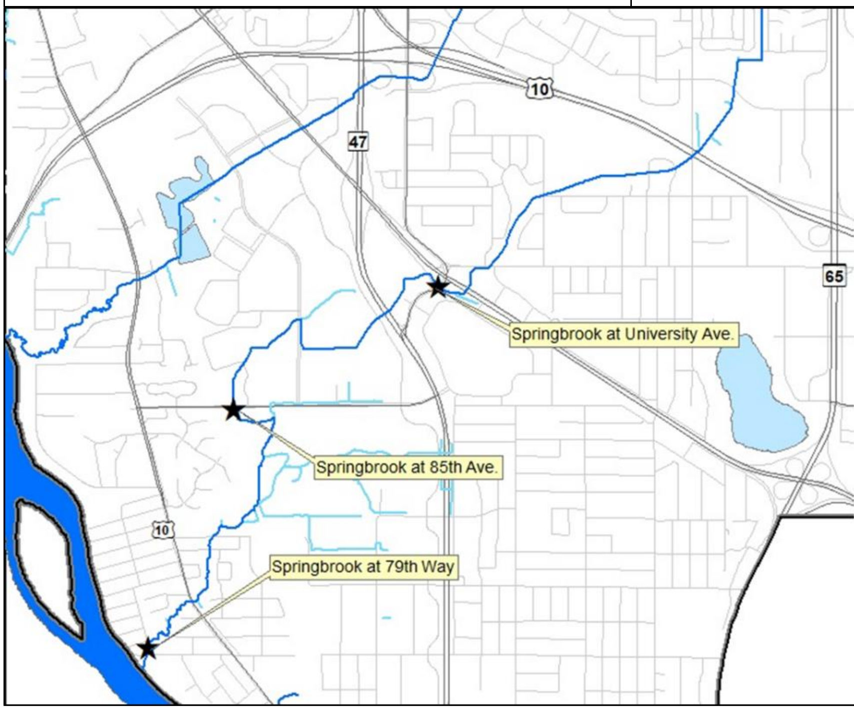
Summary of All Monitored Years

Percentiles	2007	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Min	821.73	821.63	821.60	821.34	821.95	822.17	821.18	820.99	820.75	820.87	820.74
2.5%	821.77	821.69	821.63	821.38	821.98	822.20	821.26	821.01	820.91	820.89	820.78
10.0%	821.84	821.77	821.73	821.42	822.02	822.27	821.31	821.06	820.97	820.93	820.86
25.0%	821.95	821.80	821.78	821.45	822.26	822.46	821.40	821.13	821.03	820.98	820.91
Median (50%)	822.10	821.93	822.04	821.57	822.34	822.54	821.48	821.21	821.11	821.03	820.99
75.0%	822.32	822.04	824.67	821.82	822.46	822.61	821.59	821.29	821.20	821.18	821.06
90.0%	822.49	822.19	824.67	821.98	822.56	822.70	821.69	821.43	821.27	821.27	821.14
97.5%	822.63	822.33	824.67	822.19	822.61	822.81	821.82	821.52	821.69	821.43	821.37
Max	823.79	823.25	824.67	822.70	823.04	825.33	822.81	821.99	822.49	822.30	822.25




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

Springbrook Creek (Ditch 17) Monitoring Sites		
Site Name/ SiteID	**Years Monitored**	**2021 Data Collected**
Springbrook at University, Blaine S007-542	2013-2021	Water Chemistry Grab Samples
Springbrook at 85th Avenue, Fridley S007-543	2013-2020	
Springbrook at 79th Way, Fridley S006-140	2012-2021	Water Chemistry Grab Samples



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 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 above, and the CCWD has installed water quality improvement projects.

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, altered hydrology, and poor habitat identified as the main stressors). 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 is 102 µg/L, which exceeds the state standard of 100 µg/L. The average concentration for storm samples collected at this site is 135 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 if assessed.

E. coli levels are high in Springbrook Creek. The chronic standard concentration of 126 MPN is exceeded over 60% of the time at baseflow and 92% 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 at CCWD stream outlet monitoring sites in 2019 and 2021, with Springbrook Creek having higher concentrations than other streams in the watershed. The chronic state standard for chlorides is 230 mg/L. Springbrook Creek near its outlet at 79th Way did not exceed that concentration in any growing-season grab samples before 2021.In 2021 chloride concentrations at this site averaged 176.75 mg/L and exceeded the state standard on four occasions during baseflow conditions. Chloride levels of samples taken during storm flow conditions averaged below the state standard (176.66 mg/L) but this was an increase from 2019 levels (155.5 mg/L). Chloride concentrations averaged 176.85 mg/L over all years and conditions. 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.

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 0.920 mS/cm. By contrast, the median for Coon Creek at Vale St. is 0.663 mS/cm. Median specific conductance at 79th Way (all years) is lower during storm events (0.852 mS/cm) compared to baseflow conditions (1.031 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 in 2021.

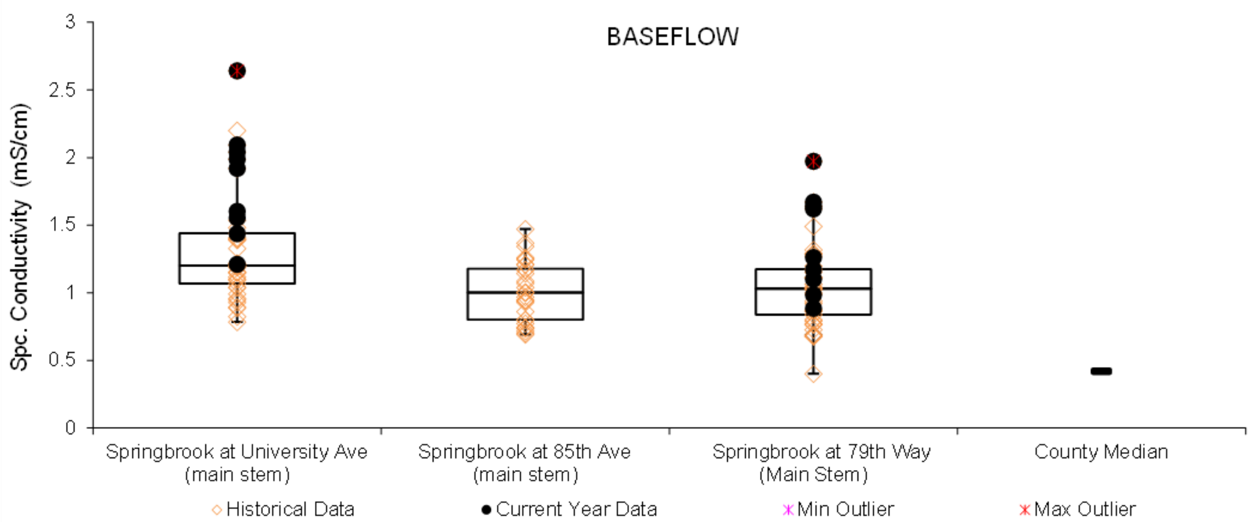
Springbrook Creek's high dissolved pollutants are lower during storm flows, suggesting that the local shallow groundwater is a pollutant source during baseflow conditions. Road deicing salts are often a contributor when similar conditions are found elsewhere in the region, but interestingly, actual chloride 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.

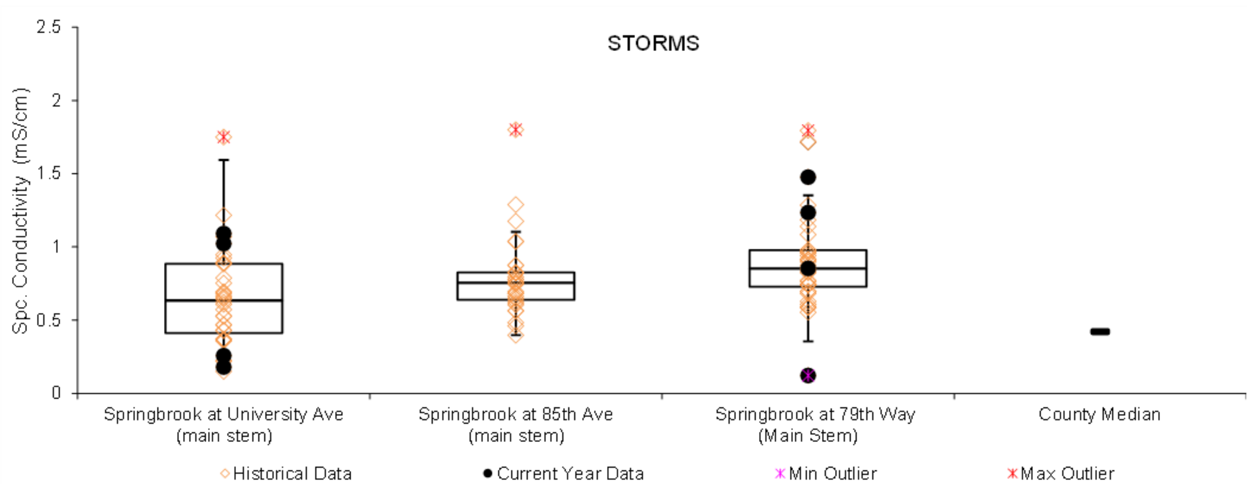
Dissolved pollutants are especially difficult to manage once in the environment. They are not removed by stormwater settling ponds. Infiltration practices can provide some treatment through biological processes in the soil, but also risk contaminating groundwater. The first approach to dissolved pollutant 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 2021.

	Average Specific Conductance (mS/cm)	Median Specific Conductance (mS/cm)	State Standard	N
Baseflow	1.050	1.031	Specific conductance – none	45
Storms	0.911	0.852		40
All	0.985	0.920		85
Occasions > State Standard				

Specific conductance at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.





TOTAL PHOSPHORUS

Springbrook Creek often exceeds the state water quality standard of 100 µg/L during storm events. During baseflow conditions, TP levels exceeded the state standard eight times for all samples and sites in 2021. 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 135 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 baseflow for the three sites are 86.8, 62.3, and 53.5 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.

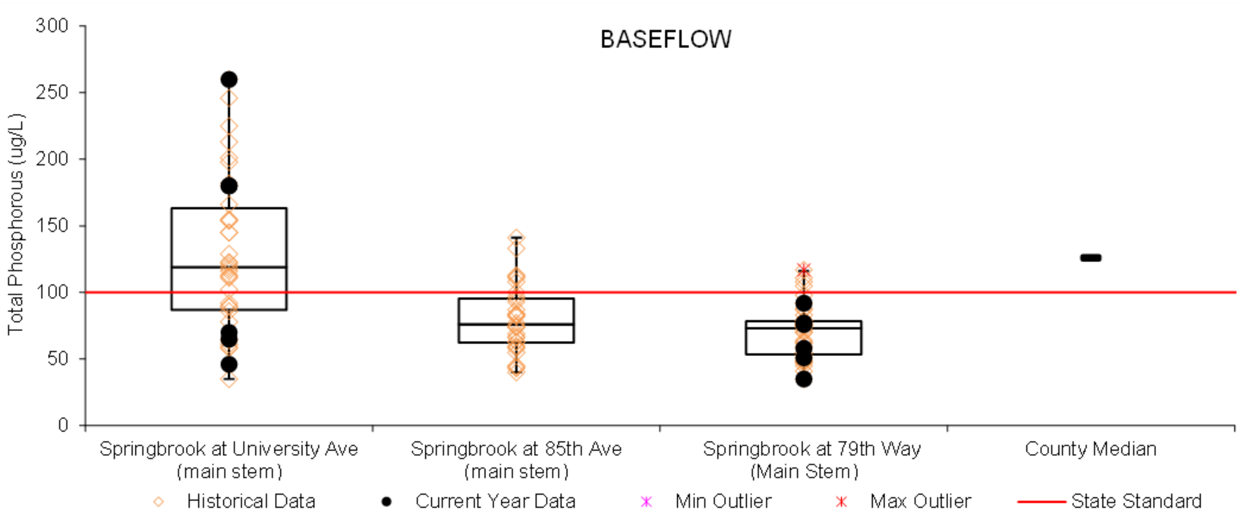
Following storm events there is a slight decrease in TP moving upstream to downstream from University Ave. to 85th, but concentrations increase at 79th Way and are much higher than those collected at baseflow. It appears that the Springbrook Nature Center wetland complex and other stormwater treatment practices in the area are undersized or overwhelmed by the volume of water and pollutant loading from the subwatershed during larger storm events and/or phosphorus-rich runoff is entering the system downstream of the Springbrook Nature Center. It is also possible that one or more basins is leaching phosphorus via internal loading and flushing. Adding additional capacity for treatment is advised, but the limited available space in this urban setting presents a challenge. Following storm events, phosphorus concentrations at the 79th Way site exceed state standards 67% of the time.

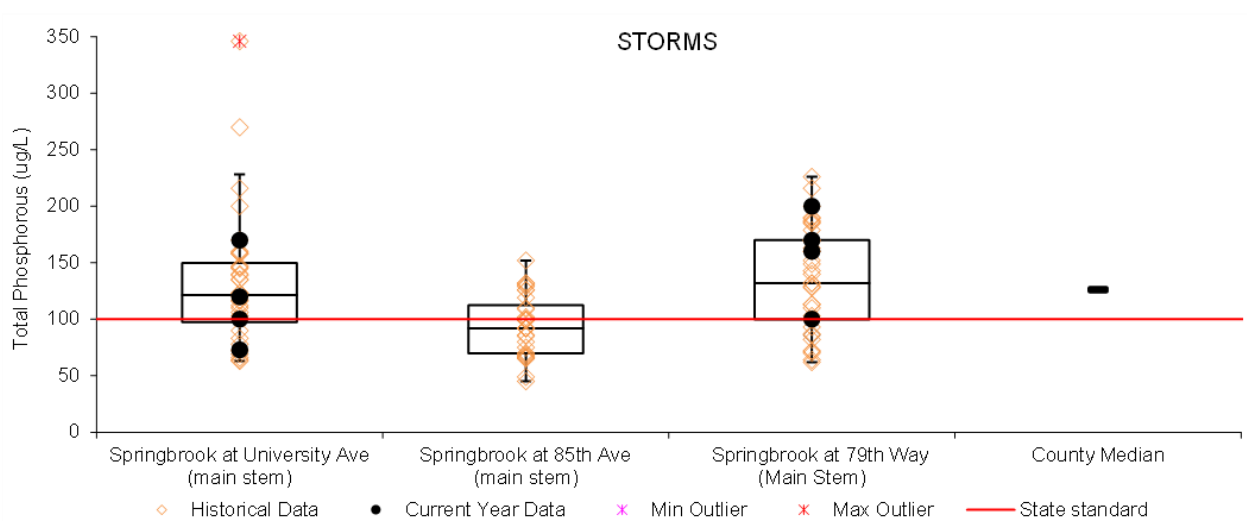
Supplemental Ortho Phosphorus (OP) samples were collected in 2021 at the outlet of Springbrook Creek. The average OP concentration during baseflow was 66% (range=16-83%) of the average Total Phosphorus (TP) concentration. During storms, the average OP concentration was 53% (range=14%-119%) of the average TP concentration. These were the highest average OP concentration percentages of the four outlet sites sampled in 2021 for baseflow and storms. Samples for OP and TP have also been collected at the outlet of Springbrook Nature Center from 2019-2021 (n=16) revealing an average OP concentration of TP to be only 20%, indicating the OP issue may be between Springbrook Nature Center and the outlet of Springbrook Creek. In 2022, additional OP sampling will take place upstream and downstream of Springbrook Nature Center. The MN Stormwater Manual reports the national average Ortho Phosphorus concentration as a percentage of Total Phosphorus to be 26% indicating Springbrook Creek is considerably higher than the national average.

Average and median total phosphorus in Springbrook Creek. Data is from 79th Way for all years through 2021.

	Average Total Phosphorus (µg/L)	Median Total Phosphorus (µg/L)	State Standard	N
Baseflow	70.28	73.0	100	42
Storms	134.52	132.00		40
All	101.62	86.5		82
Occasions > state standard				4 (9%) baseflow 27 (67%) storm

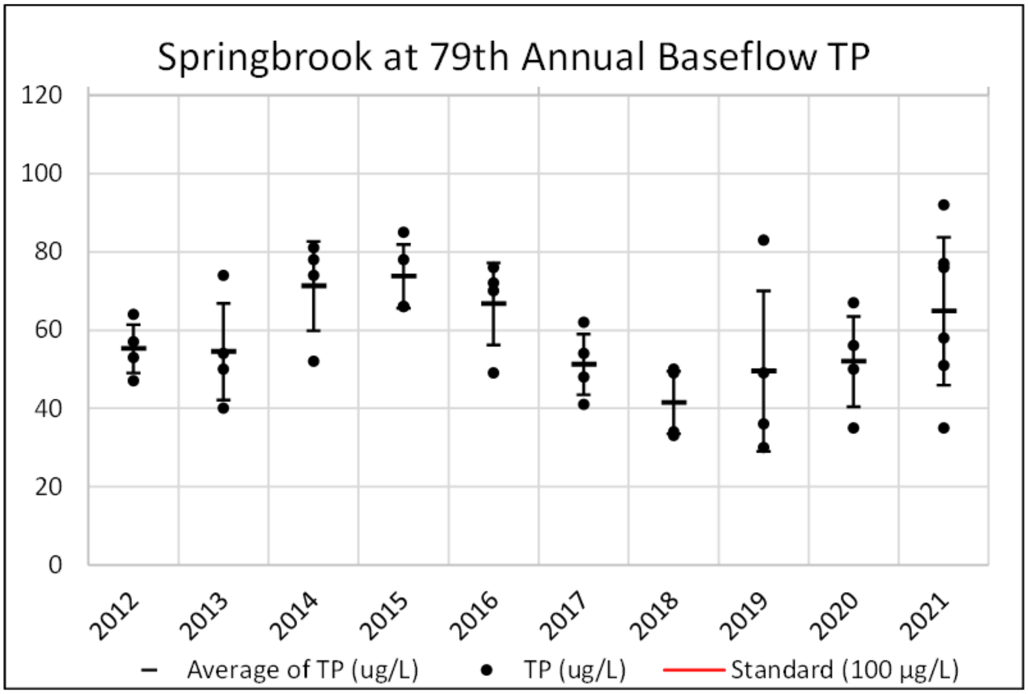
Total phosphorus at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these site

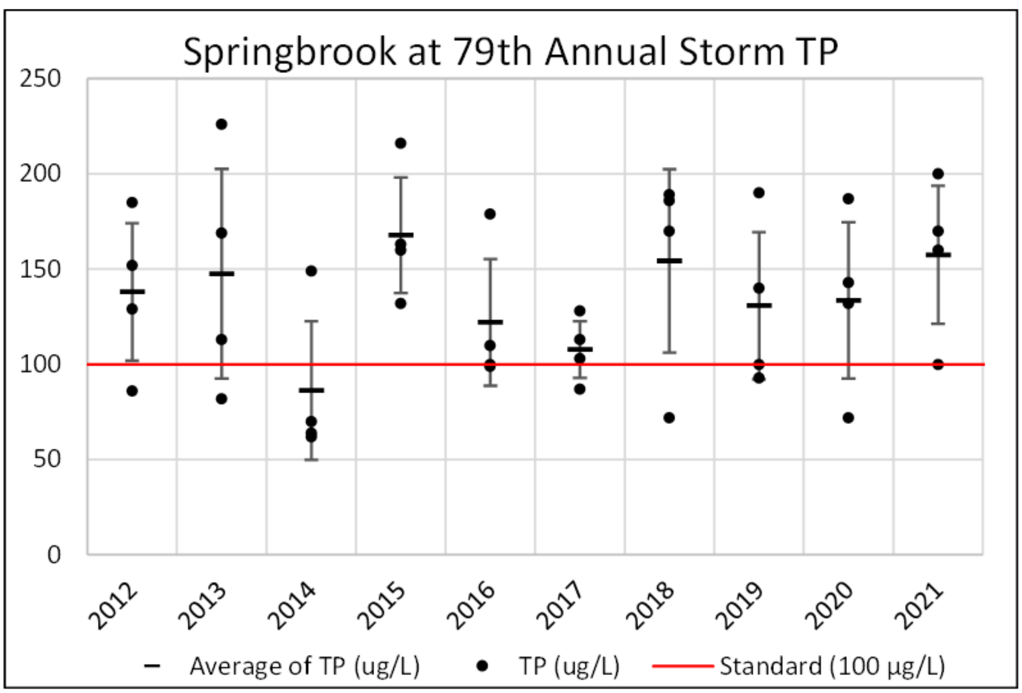




Parameter	Significant Change in Annual $\bar{X}$ (2012-2021)	p=	Standard Error of Means
Total Phosphorus - Baseflow	None	0.47	10.76
Total Phosphorus - Storm	None	0.35	24.45

Springbrook at 79th - Annual average ANOVA regression TP 2012-2021





TOTAL SUSPENDED SOLIDS

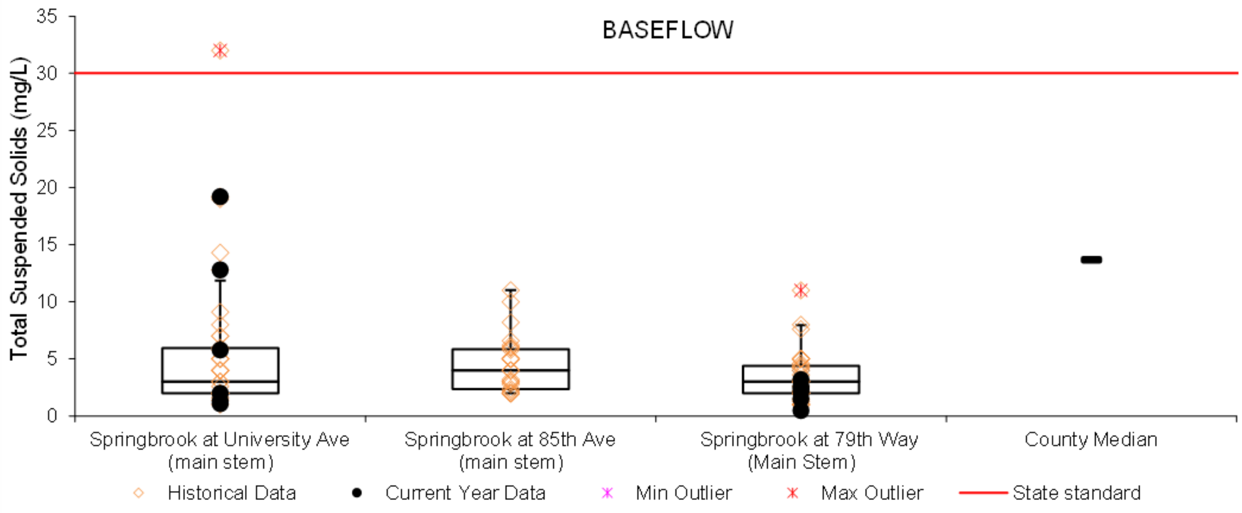
TSS in Springbrook Creek is generally low during baseflow conditions and elevated following storms. During baseflow conditions TSS concentrations are low at all sites and remain low following storm events at the two upstream sites. Interestingly, there is a large increase in post-storm TSS concentrations between 85th Ave and 79th Way. The area between the two sites contains a large wetland complex located at the Springbrook Nature Center. This wetland complex is potentially being filled in with sediment that is re-suspended and flushed through the system during storm events or could be coming from undertreated stormwater runoff or 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.

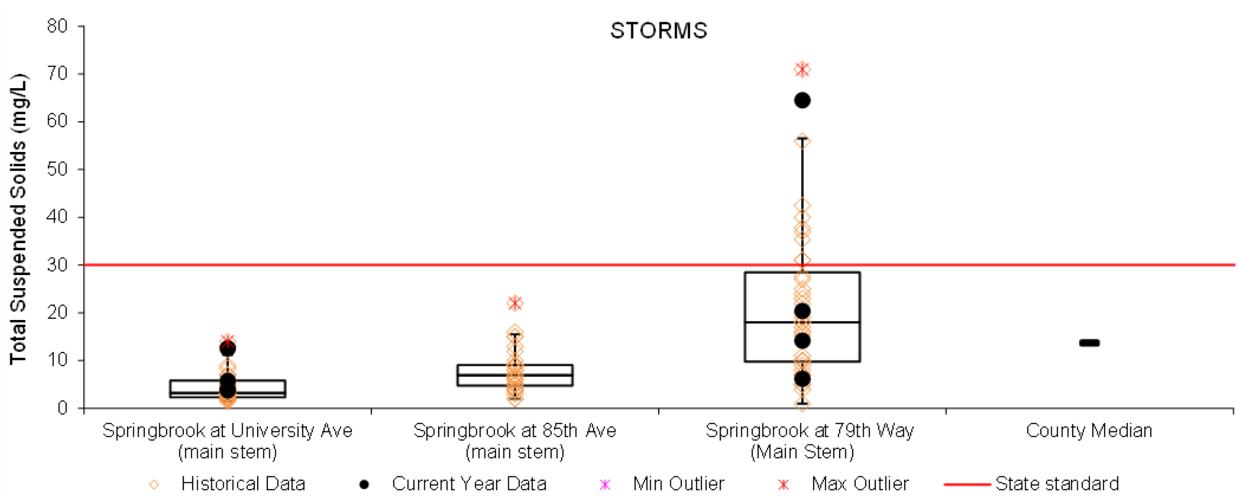
Based on long-term average concentrations, TSS does not increase moving upstream to downstream during baseflow but does during storm flow. The long-term (all years) medians for TSS concentrations post-storms are 3.2, 6.9, and 18.0 mg/L, moving upstream to downstream. The largest likely contributor of TSS to Springbrook Creek is solids transported by stormwater conveyances from impervious surfaces. There are no significant trends in long-term TSS concentrations at the outlet monitoring site from 2012 to 2021.

Average and median total suspended solids in Springbrook Creek. Data is from 79th Way for all years through 2021.

	Average Total Suspended Solids (mg/L)	Median Total Suspended Solids (mg/L)	State Standard	N
Baseflow	3.25	3.00	30 mg/L TSS	42
Storms	21.70	18.00		40
All	12.25	5.0		82
Occasions > state TSS standard				0 baseflow 10 (25%) storm

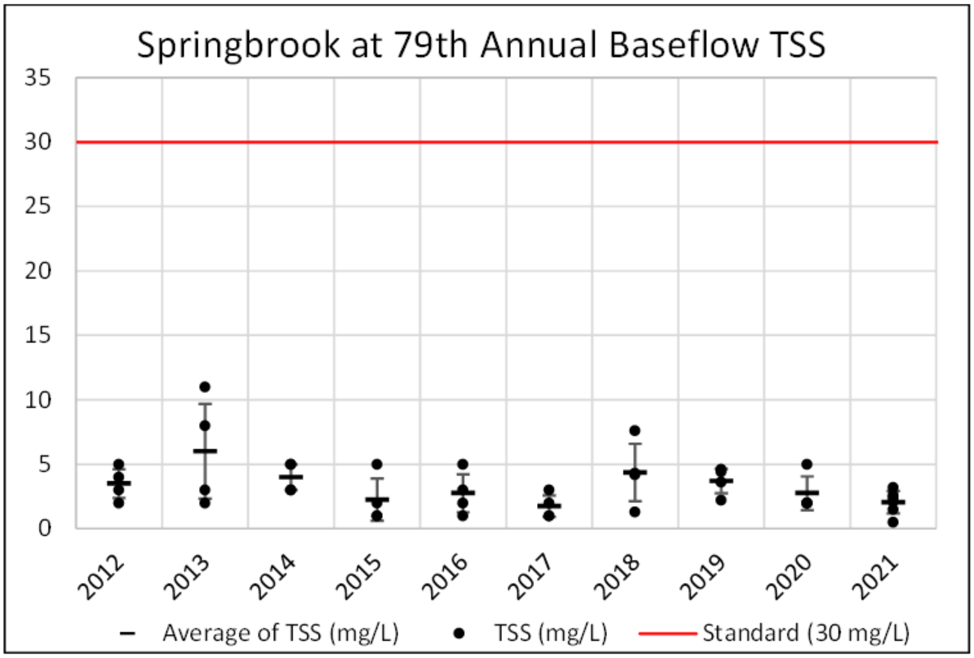
Total suspended solids at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.

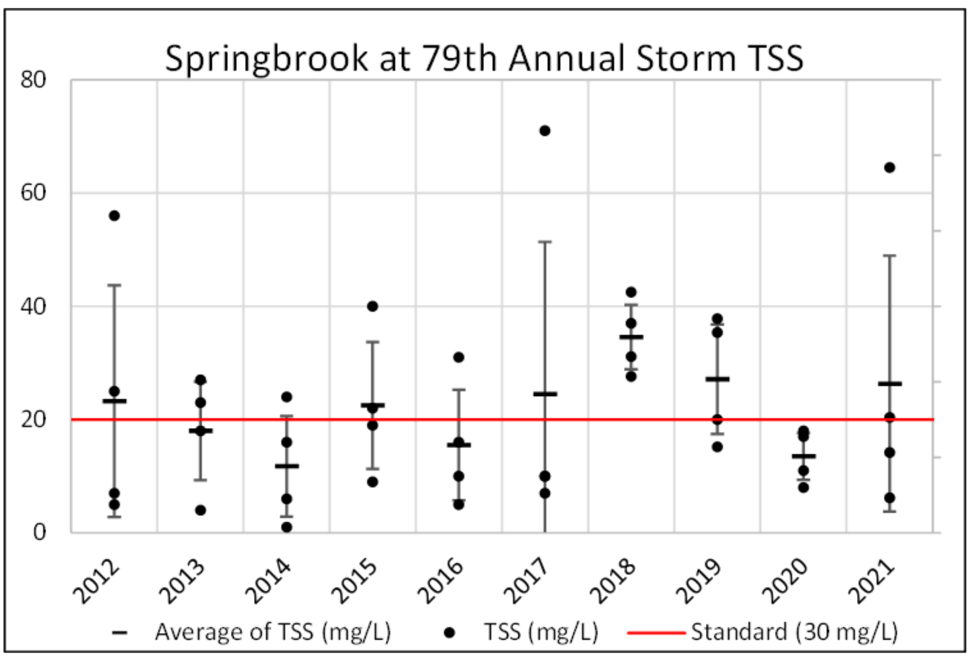




Parameter	Significant Change in Annual $\bar{X}$ (2012-2021)	p=	Standard Error of Means
TSS - Baseflow	None	0.80	3.42
TSS - Storm	None	0.44	17.88

Springbrook at 79th - Annual average ANOVA regression TSS 2012-2021





pH

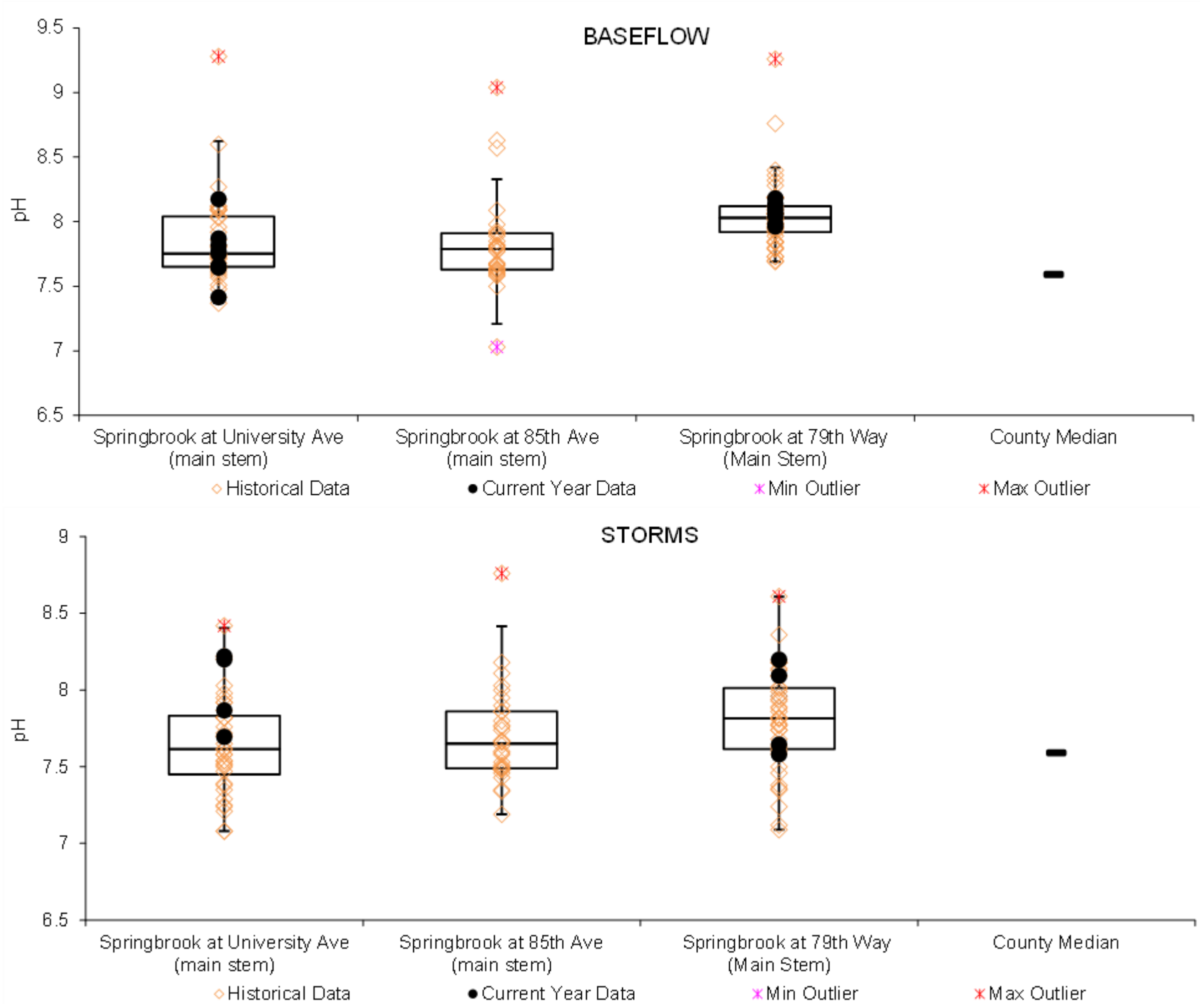
Springbrook Creek generally maintains healthy pH levels within the state water quality standard range of 6.5-8.5. Only a couple of rare outlier readings exceeding 8.5 have occurred.

Average and median pH in Springbrook Creek. Data is from 79th Way for all years through 2021.

	Average pH	Median pH	State Standard	N
Baseflow	8.05	8.03	6.5-8.5	45
Storms	7.80	7.81		40
All	7.93	7.95		85
Occasions outside state standard				*****2 (4%) Baseflow 1 (2%) Storm

**one result questionable*

pH at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.



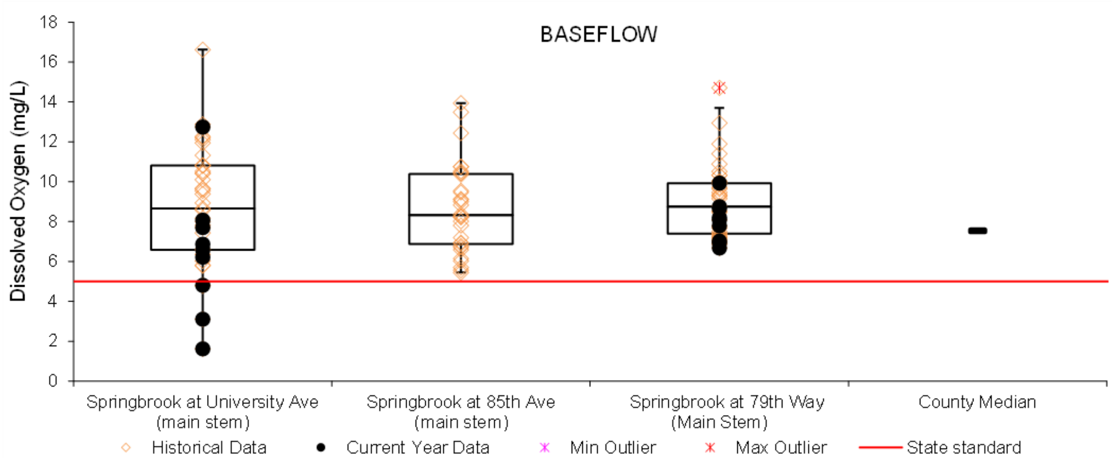
Dissolved Oxygen

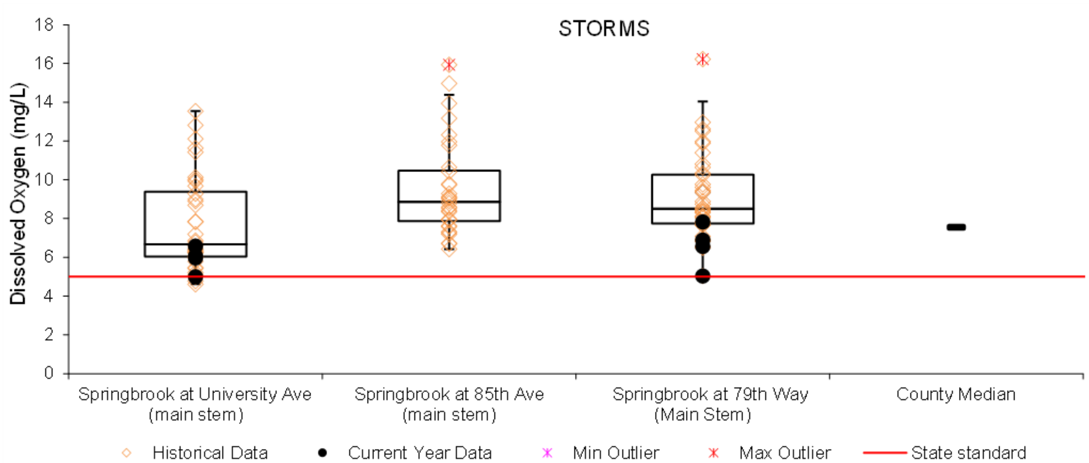
Dissolved Oxygen levels in Springbrook Creek are generally high. There have been a few instances at the furthest upstream site (University Ave.) in which DO has been below or near the state standard of 5.0 mg/L. It is worth noting that CCWD collections supplemental DO measurements at the outlet of the Springbrook Nature Center as part of their BMP performance monitoring program; here, DO concentrations routinely fall below the 5 mg/L standard and have been observed below 1 mg/L. Low DO levels in the reservoirs at the Springbrook Nature Center could lead to internal TP loading and release.

Median dissolved oxygen in Springbrook Creek. Data is from 79th Way for all years through 2021.

	Average Dissolved Oxygen (mg/L)	Median Dissolved Oxygen (mg/L)	State Standard	N
Baseflow	8.94	8.75	5 mg/L daily minimum	43
Storms	9.08	8.5		40
All	9.00	8.57		83
Occasions <5 mg/L				0

Dissolved Oxygen at Springbrook Creek. Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites.





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 ten 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

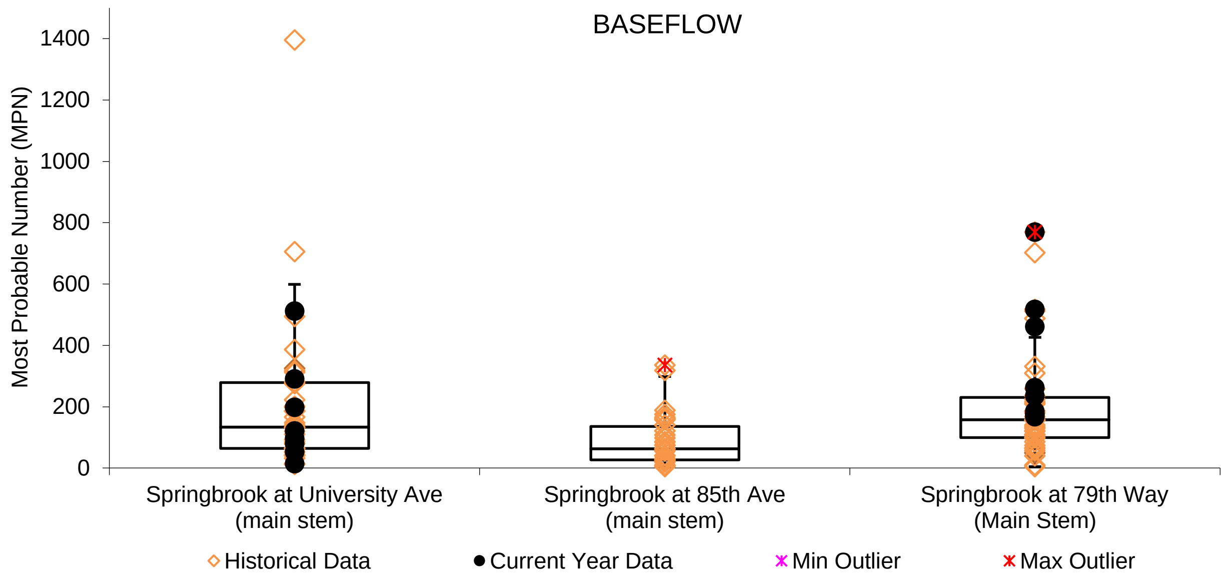
E. coli concentrations during baseflow conditions are usually near the chronic standard of 126 MPN at all of the Springbrook sites. Out of the 120-baseflow samples collected since 2013, *E. coli* has only twice exceeded the acute standard of 1260 MPN (Springbrook at University Ave.). Interestingly, during baseflow conditions, median *E. coli* concentrations since 2013 decrease between University Ave. (134 MPN) and 85th Ave (63 MPN). 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 (158 MPN).

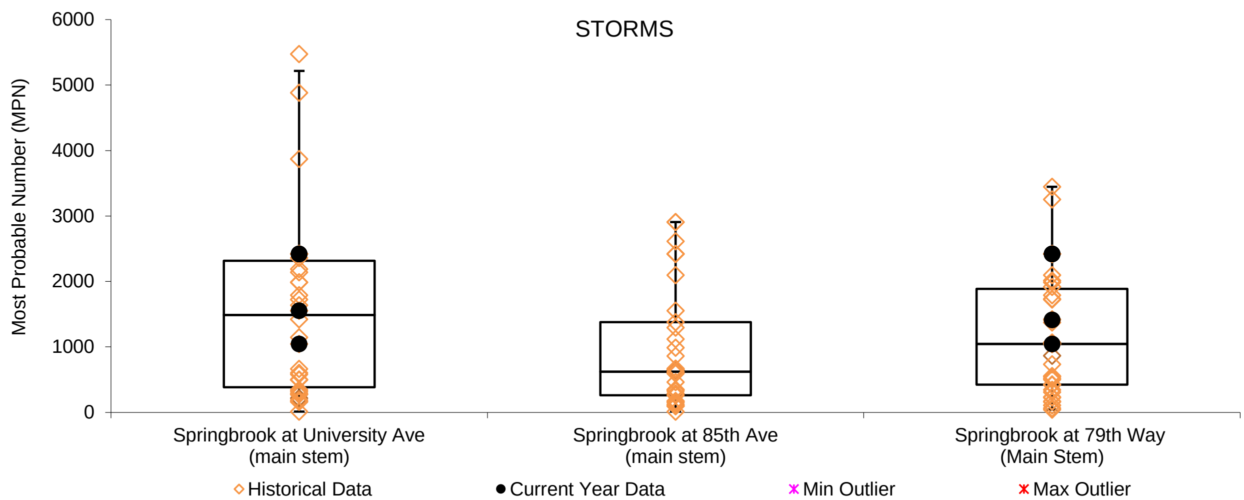
After storm events, *E. coli* tends to be significantly higher (note the difference in scale on the charts below), but the same pattern remains between the sites with the middle site (85th Ave) having lower levels than the upstream site (University Ave). In 2021, Median *E. coli* concentrations following storms for all years from upstream to downstream were 1,487, 620, and 1046 MPN, respectively. These levels are all quite high. Post-storm samples collected at 79th Way have exceeded 126 MPN 92% of the time and nearly half (42%) of the samples have exceeded the acute standard of 1260 MPN.

Average and median *E. coli* in Springbrook Creek. Data is from 79th Way for all years through 2021.

	Average *E. coli* (MPN)	**Median *E. coli* (MPN)**	**Geometric Mean**	**State Standard**	**N**
Baseflow	203.06	158.00	135.09	Monthly Geometric Mean >126 Monthly 10% average >1260	43
Storms	1,192.84	1,046.00	767.40		38
All	667.40	259.00	305.55		65
Occasions >126 MPN					26 (60%) baseflow, 35 (92%) storm
Occasions >1260 MPN					0 baseflow, 16 (42%) storm

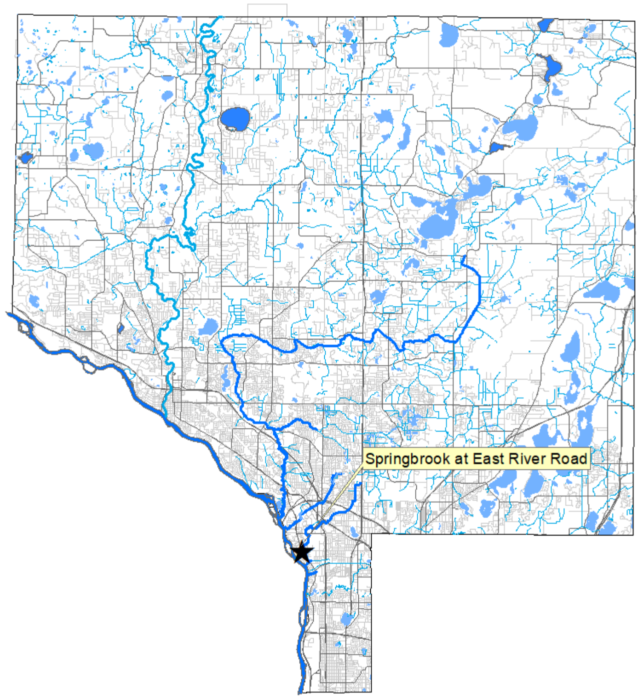
***E. coli* at Springbrook.** Orange diamonds are historical data from previous years and black circles are 2021 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines) for all data collected at these sites. Extremely high outliers were not included in the box-plots





STREAM HYDROLOGY – SPRINGBROOK CREEK
SPRINGBROOK AT EAST RIVER RD

Notes

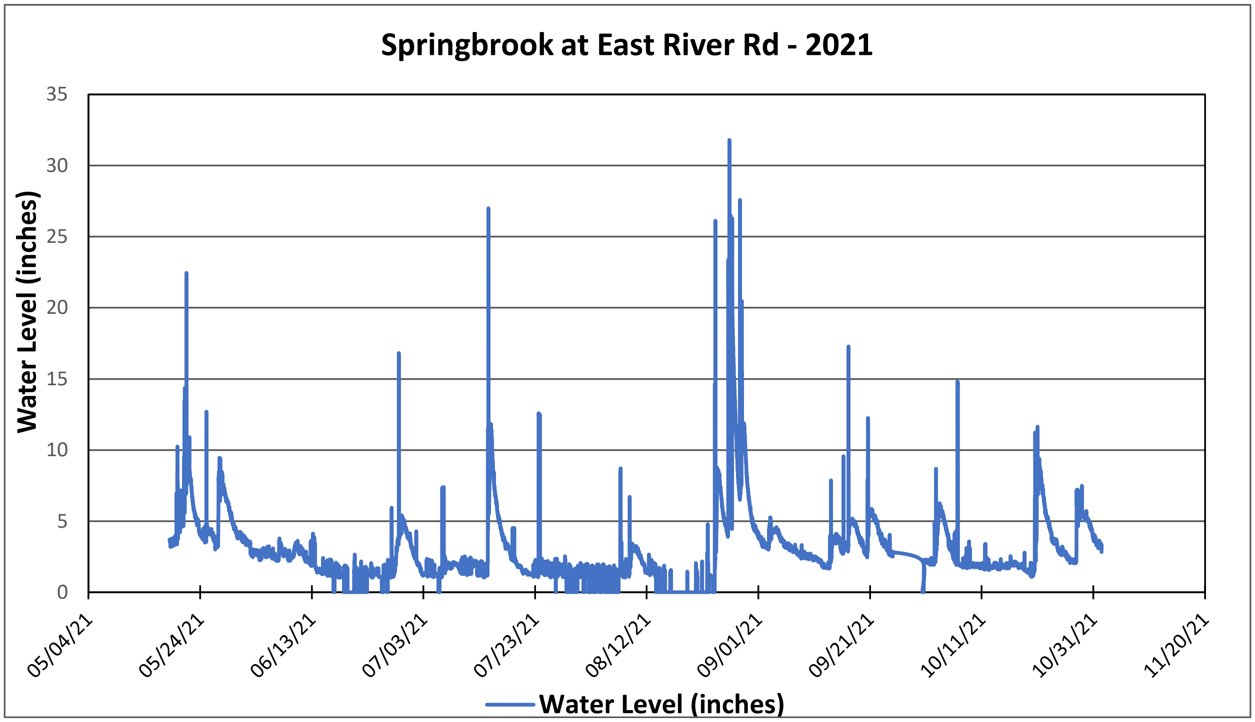


Springbrook Creek at East River Road fluctuated 2.65 feet throughout 2021. Stage reading frequency was 15-minute intervals in order to capture the majority of storm surge fluctuations. The site is extremely flashy, with a storm event on July 14 causing an increase of 1.63 feet in only a 15-minute span. Another rain event on September 17 caused stage to rise 1.17 feet just a half hour.

Water elevation at this site is unknown and is displayed in inches. This hydrograph represents stage fluctuation throughout the year.

Continuous stage and flow measurements were monitored at this site for the first time in 2021. Hydrology monitoring for the Springbrook Creek outlet was moved from the existing 79th Way site to this site given conditions suitable for deployment of an area-velocity sensor (Pulsar Mantaray) within the culvert and to avoid backwater impacts of the Mississippi River. Because there are few stormwater inputs between East River Rd and 79th Way, grab samples for pollutants will continue to be sampled at 79th Way and paired with discharge measurements at East River Road.

2021 Hydrograph



2021 Discharge